Environmental Investigation Plan
John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

October 19, 2018

REVISION LOG

Revision	Description	Date
0	Issued for TDEC Review	November 3, 2016
1	Addresses June 22, 2017 TDEC General EIP Rev0 Comments and Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC EIP Rev1 Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Public Comments, TDEC EIP Rev2 Review Comments, Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

TITLE AND APPROVAL PAGE

Title of Plan: Environmental Investigation Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Tennessee Valley Authority

Effective Date: October 19, 2018 Revision 3

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LIST OF APPENDICES

Abbreviations

BTV	Background Threshold Value
CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
CCR Rule	Environmental Protection Agency Final CCR Rule
CFR	Code of Federal Regulations
CLS	Central Laboratory Service
CPT	Cone Penetration Test
CYRP	Coal Yard Runoff Pond
DMP	Data Management Plan
DMR	Discharge Monitoring Report
DPT	Direct Push Technology
EAR	Environmental Assessment Report
ESC	Environmental Science Corporation
EIP	Environmental Investigation Plan
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GPS	Global Positioning System
HDPE	High-Density Polyethylene
HERT	High Energy Reduction Technology
JSF	John Sevier Fossil Plant
KMP	Knowledge Management Portal
MCL	Maximum Contaminant Level
NPDES	National Pollutant Discharge Elimination System
PWP	Process Water Pond
PLM	Polarized Light Microscopy
QA	Quality Assurance
QAPP	Quality Assurance Project Plan

QC	Quality Control
RFAI	Reservoir Fish Assemblage Index
Rev	Revision
SAP	Sampling and Analysis Plan
SPT	Standard Penetration Test
Study Area	Dry Fly Ash Stack (Dry Stack), Ash Disposal Area J, Bottom Ash Pond (Ash Pond), and Highway 70 Borrow Area
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner's Order OGC015-0177
TA	TestAmerica
TI	Technical Instruction
TVA	Tennessee Valley Authority
WET	Whole Effluent Toxicity

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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF EIP Revision (Rev) 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log. This JSF EIP Rev 3 addresses TDEC's EIP Rev 2 review comments provided to TVA on March 27, 2018.

1.1 PURPOSE

The purpose of this EIP is to comply with Section VII.A.d. of the TDEC Order, which requires TVA, upon receiving requests for 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 schedule set forth in this EIP correspond to each individual task in TDEC's information request letter for JSF dated August 3, 2016. The Environmental Assessment Report (EAR), to be submitted at a later date following completion of the environmental investigation identified in the EIP, will provide "an analysis of the extent of soil, surface water, and groundwater 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 FOR JSF

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 for to be addressed at each Investigation Conference.
- On May 20, 2016, TVA provided TDEC with an Investigation Conference Data Transmittal for JSF. This transmittal included electronic and hard copies of supporting information files (and a file directory). TVA held the Investigation Conference at JSF on June 8 and 9, 2016. The Investigation Conference included a site reconnaissance and presentation that addressed the questions provided by TDEC on September 22, 2015.

- On August 3, 2016, TDEC provided an Investigation Conference Response Letter. 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 EIP was established as November 3, 2016.
- On November 3, 2016, TVA submitted Rev 0 of the EIP to TDEC.
- On June 22, 2017, TDEC provided a follow-up letter that documented conference dates and EIP delivery dates. The letter also provided comments regarding information TVA should include in each EIP. The deadline for the submittal of the revised JSF EIP Rev 1 was set for December 15, 2017.
- On December 15, 2017, TVA submitted Rev 1 of the EIP to TDEC.
- On March 27, 2018 TDEC provided review comments on the EIP Rev1.
- On May 25, 2018, TVA submitted Rev 2 of the EIP to TDEC.
- On September 24, 2018 TDEC and TVA reviewed proposed changes to the EIP Rev 2 on a conference call.

1.3 EIP IMPLEMENTATION (INVESTIGATION)

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

- TVA addressed TDEC's questions and comments from the August 3, 2016 and June 22, 2017 letters and submitted the JSF EIP Rev 1 and its implementation schedule to TDEC on December 15, 2017.
- TDEC provided TVA a list of comments on the JSF EIP Rev 1 on March 27, 2018.
- TVA addressed TDEC's JSF EIP Rev1 comments and submitted a JSF EIP Rev 2 on May 25, 2018.
- TVA will address additional revisions to TDEC as they become available and will repeat the process until TDEC approves the EIP and schedule.
- In a letter dated September 28, 2015 from TDEC to the Southern Alliance for Clean Energy, TDEC added an opportunity for public involvement. TDEC committed to host a meeting with interested parties to discuss the proposed EIP before the public comment period stated in the Order.
- TVA will provide public notice of the EIP published in a manner specified by TDEC and allow a minimum of 30 days for public comment.
- TVA will provide responses to public comments to TDEC within 30 days after the end of the public comment period.
- 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.

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 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 conducted numerous studies at JSF and has programs underway for the Environmental Protection Agency (EPA) Final CCR Rule (CCR Rule), TDEC permitting requirements, Federal permitting and program commitments, Capital Projects, normal site operations, inspections, and maintenance that can help address TDEC's information requests. TVA will describe how, to the extent possible, data from work already completed, ongoing, or planned will be used to meet the objectives of the information requests.

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
   - 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 brief 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 U. TVA will work with TDEC and revise the EIP until a final version is approved.

As stated in the Investigation Conference Response Letter, this EIP will address the:

- Dry Fly Ash Stack (Dry Stack)
- Ash Disposal Area J
- Bottom Ash Pond (Ash Pond)
- Highway 70 Borrow Area

These areas are shown on Figure 1 (Appendix C) and will collectively be referred to as the "Study Area" with responses included in Sections 3 and 4.

Section 3, TDEC Site-Specific Environmental Investigation Requests, addresses 13 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 and 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 August 3, 2016 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 National Environmental Policy Act reviews.

2.3 QUALITY ASSURANCE PROJECT PLAN

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

The QAPP describes the QA implementation for the investigation and identifies the obligations of the various entities responsible for generating environmental data. The 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 QAPP establishes an overall environmental QA framework for the investigation and provides quantitative 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 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 QAPP appendices present requirements and quantitative objectives for analytical data for each investigation. Analytical data intended for use under the JSF 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 E) 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

Several datasets will be acquired and generated during the environmental investigations related to the TDEC Order. An EarthSoft EQuIS™ database will provide analytical data control, consistency, reliability, reproducibility and a framework for validating analytical data throughout the life of the TDEC Order. The EQuIS database is the database for analytical chemistry and field parameter data. To support the wide-array of non-analytical data management needs related to the TDEC Order, a SharePoint-based knowledge management portal (KMP) for data access and document management has been developed. The KMP will integrate the EQuIS database, geographic information system database for geospatial data, and various other datasets of historical and EIP generated deliverables. The KMP will thus serve as the central access point for the TDEC Order data including EIPs, the environmental investigation data, and other data necessary for the EAR and Corrective Action/Risk Assessment (CARA) Plan.

3.0 TDEC SITE-SPECIFIC ENVIRONMENTAL INVESTIGATION REQUESTS

TDEC requested that TVA provide responses to the following information requests presented below following 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 TDEC SITE-SPECIFIC ENVIRONMENTAL INVESTIGATION REQUESTS

3.1.1 TDEC Site-Specific Information Request No. 1

Cadmium (Cd) results from the analysis of groundwater monitoring samples exceeded the Cd MCL from October 2007 till April 2011. As a part of the Environmental Investigation Plan, TVA shall analyze all samples for the constituents as described in Attachment A.

Upon completion of sampling, TVA shall submit the results of sample analyses in the Environmental Assessment Report. The EAR for the TVA JSF site shall include all groundwater monitoring sampling locations and the results from all groundwater samples collected. The EAR shall identify sampling locations where analysis of groundwater monitoring samples indicated the level of constituents' results exceeded either the Maximum Contaminant Level (MCL) as defined in the TN Public Drinking Water regulations or background levels in local groundwater. TVA shall include in the EAR the history of Cd sampling at the JSF site, the groundwater sampling data for Cd and report if monitoring well sampling was discontinued after 2011 and if so why.

<u>**TVA Response**</u>

TVA reviewed concentrations of cadmium from previous sampling activities and evaluated if and where concentrations exceeded the MCL. Previous evaluation of the exceedances observed between 2007 and 2011 indicated that they were the result of a laboratory interference after switching to a different laboratory and analytical method in 2007.

The laboratory interference was reported to be due to the presence of elevated levels of molybdenum oxide. This interference was investigated by increasing the flow of oxygen into the laboratory instrument used for the analysis. In 2011, a cadmium comparative analysis was conducted with and without the addition of oxygen for the samples analyzed by the laboratory utilized in 2011 (Environmental Science Corporation (ESC)) and was compared with results from two other laboratories (TestAmerica (TA) in Nashville, Tennessee and TVA's Central Laboratory Service (CLS) in Chattanooga, Tennessee)). The QA/QC correction appeared to influence the sample result, bringing the results from ESC closer to what was reported by the comparison laboratories, but concentrations were higher than the comparison laboratories and historical results for JSF.

Additional cadmium analysis was conducted by ESC with and without the QA/QC correction in 2012. The results indicated that the corrected sample results were in line with the results from the comparison laboratories (TA and CLS) included in the 2011 comparative analysis. Additional details of this procedure are included in Appendix E of the TVA Groundwater Assessment Monitoring Report – April 2011 and TVA Groundwater Assessment Monitoring Report - October 2012. Copies of these reports are included in Appendix F. Sampling has continued since 2011 with no cadmium concentrations greater than the MCL.

Historical analytical groundwater data are summarized in tables included in Appendix G as discussed in Section 3.1.2.

TVA is currently conducting groundwater monitoring at JSF for other programs that include the parameters listed in this information request. For this information request, TDEC is requesting analysis of samples for the constituents as described in the General Information Requests, which includes constituents listed in Appendices III and IV of 40 Code of Federal Regulations (CFR) Part 257. 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 naturally-occurring levels. 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.

Monitoring locations and analytical results collected during the environmental investigation will be provided in the EAR. The analytical results will be compared to MCLs, Tennessee Public Drinking Water values and background concentrations.

3.1.2 TDEC Site-Specific Information Request No. 2

Groundwater monitoring parameters are being reported in two different tables in the information provided by TVA for the JSF site:

a. Table 2 = Primary Constituents

b. Table 3 = Other Permit Required Constituents

In the EAR for the JSF Site, please include all groundwater monitoring results in one Excel workbook by sampling location and sampling date. The workbook should include the sampling dates and whether constituents exceed Drinking Water MCLs or background levels for constituents without MCLs. - Reference Groundwater Monitoring Report – November 2015.

TVA Response

A table including historical groundwater monitoring results was provided as part of the John Sevier Fossil Plant Investigation Conference transmittal on May 20, 2016. This information, compared to MCLs, is also provided in Appendix G in tabular form. This data has been collected for a variety of reasons since approximately the 1980's. TVA may use these historical data for qualitative purposes but will use such data only after evaluating it in accordance with the QAPP. Supporting information used to validate historical data will be included in the EAR. In addition, a figure showing existing and closed monitoring wells is included as Figure 2 (Appendix C).

The EAR will include a combined table with the existing analytical test results for each constituent listed by location and date, including a comparison to applicable MCLs or background levels for constituents without MCLs. Data collected as part of future sampling events and used as part of evaluations included in the EAR will be compiled in a similar format.

3.1.3 TDEC Site-Specific Information Request No. 3

TVA shall install a minimum of one up gradient and three down gradient monitoring wells at each of the four disposal units at the JSF site. The wells should be located and constructed to provide representative groundwater samples from the upper most aquifer. A description of the drilling method, well logging, well construction and well development shall be provided in the EIP. TVA shall provide a schedule for the placement construction and development of additional borings/groundwater monitoring wells.

TVA Response

TVA has other investigative activities underway at JSF for TDEC Solid Waste Management permit requirements and the CCR Rule (EPA 2015a) that included the installation of monitoring wells and collection of groundwater levels and samples for the Dry Fly Ash Stack and the Bottom Ash Pond. The information provided by programs that include these monitoring well networks will be used to respond to TDEC's Information Requests related to the identification of background and downgradient groundwater monitoring locations for these CCR units. TVA will incorporate pertinent data from these investigations that meet the QA/QC requirements of the QAPP into the identification of proposed monitoring well locations.

As part of TVA's ongoing investigations at JSF, two new potential background monitoring wells (JSF-101 and JSF-102) were installed in the saturated overburden. These wells were installed in cross-gradient locations east of the CCR units because the saturated overburden is thin or absent near the western and southern boundaries of the plant.

Monitoring well JSF-102 is in a similar geological setting as the Dry Fly Ash Stack well network and monitoring well JSF-101 is located in a similar geological setting as the Bottom Ash Pond well network.

In addition, three other monitoring wells (JSF-103, JSF-104 and JSF-105) were installed in the saturated overburden at locations to supplement the existing monitoring well networks for the Bottom Ash Pond. Monitoring well JSF-103 was installed in what was expected to be a downgradient location from the Bottom Ash Pond and was placed to provide a sampling location between the CCR unit and the Polly Branch. Monitoring well JSF-104 was installed in a potential downgradient location from the Bottom Ash Pond and was placed to provide a sampling location between the CCR unit and potential drinking water wells. Monitoring well JSF-105 was installed to replace well 10-37 to provide a sampling location in the overburden because well 10-37 was screened in the weathered shale. Proposed and existing well locations are shown on Figure 3 (Appendix C).

TVA is in the process of obtaining and reviewing data to determine if these wells may be suitable for use in groundwater monitoring networks. TVA will continue to collect groundwater samples from these existing monitoring wells and review the analytical results as a part of TDEC Solid Waste Management permit requirements. If TVA determines that the existing or new wells installed as part of recent investigations are suitable, then TVA will propose them to TDEC for concurrence that they are appropriate background and downgradient 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.

In addition to the investigations discussed above, TVA plans to install eight monitoring wells at preliminarily identified locations in the saturated silty sand and gravel layer above bedrock within 150 meters of the boundary of the CCR units as part of this investigation. At JSF, the overburden consists of alluvial deposits of silt and clay underlain by a silty sand and gravel layer. Based on previous investigation activities conducted at JSF for the Dry Fly Ash Stack and the Bottom Ash Pond, groundwater may be present in the silty sand and gravel layer. However, this layer may be thin or absent near the western and southern boundaries of the plant. As a result, groundwater may not be present in the overburden south or west of the JSF plant and installation of useful monitoring wells in the overburden may not be possible.

If bedrock monitoring wells are required, then the data collected as part of the initial investigation phase will be reviewed to identify alternative monitoring well 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.

One background well (JSF-106) and three downgradient wells (JSF-107, JSF-108 and JSF-109) are proposed near the Ash Disposal Area J, and one background well (JSF-110) and three downgradient wells (JSF-111, JSF-112 and JSF-113) are proposed near the Highway 70 Borrow Area. Figure 3 (Appendix C) shows the locations of the proposed wells.

The proposed background monitoring well location (JSF-106) for Ash Disposal Area J was selected in an up gradient location based on current groundwater elevation data showing groundwater flow to the north/northwest. The three downgradient locations (JSF-107, JSF-108 and JSF-109) were selected to provide downgradient sampling locations based on groundwater flow to the north/northwest and lithologic information regarding the presence of the silty sand and gravel layer. The historical boring logs indicate that the silty sand and gravel layer is absent in the central portion of the northern boundary of Ash Disposal Area J. The location of monitoring well JSF-109 was also selected to provide a sampling point between the unit and the creek located west of the unit.

The proposed background monitoring well location (JSF-110) for the Highway 70 Borrow Area was selected in an up gradient location based on current groundwater elevation data showing groundwater flow to the north/northwest. The three downgradient well locations (JSF-111, JSF-112 and JSF-113) were selected to provide downgradient sampling locations based on groundwater flow to the north/northwest.

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

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 collect groundwater levels and samples from the alluvial deposits. Groundwater samples will be analyzed for the CCR Parameters discussed in Section 3.1.1. Sampling procedures and parameters are provided in the Groundwater Investigation SAP provided in Appendix H. TVA will provide a summary of sampling results from the wells in the EAR.

The selection of background monitoring wells proposed in this EIP will be finalized after monitoring bi-monthly for one year (six sampling events) to evaluate if the wells are appropriate background wells. TVA will provide this evaluation to TDEC for input and concurrence prior to finalizing the monitoring well networks for each CCR unit.

3.1.4 TDEC Site-Specific Information Request No. 4

Page 113 of the multisite order presentation references active facilities and that TVA is in the process of determining the uppermost aquifer at the JSF Site. Ongoing work as well as additional work to determine the uppermost aquifer at the JSF site shall be included in the JSF Site EIP. TVA shall provide a groundwater potentiometric surface map for the Highway 70 borrow area and Ash Disposal Area J as a part of the JSF site EAR.

TVA Response

This information request is similar to Information Request No. 3. The response to this request is included in Section 3.1.3.

3.1.5 TDEC Site-Specific Information Request No. 5

The JSF Site EIP shall describe how TVA will determine if the piezometric surface and the potentiometric surface are hydraulically connected. TVA shall include in the JSF Site EAR the results of this investigation including if there are differences between the groundwater piezometric surface and potentiometric surface and explain if the piezometric surface and potentiometric surface are distinctly different from the uppermost aquifer at this site.

TVA Response

This information request encompasses ongoing work and future work proposed in the responses to the information requested in Sections 3.1.3 and 3.1.4. The hydrogeological characterization discussed in those sections will include groundwater contour maps and a characterization of groundwater flow conditions.

The results of the evaluation described above will be provided in the EAR.

3.1.6 TDEC Site-Specific Information Request No. 6

TVA shall identify the processes it plans to use to estimate the amount of CCR material that is below the highest recorded groundwater potentiometric surface at the JSF Site.

TVA Response

TVA will use the information obtained in the above responses (Sections 3.1.3, 3.1.4, and 3.1.5) to characterize the hydrogeology at JSF. Groundwater level measurements will be collected from existing and new monitoring wells and observation wells for a 1-year monitoring period. These water levels will be combined with data collected from other investigative activities to develop maps that illustrate the level of saturation below the CCR units. The maps will be provided in the EAR.

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 Study Area 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-Specific Information Request No. 7

TVA shall provide a copy of the seismic hazard study performed by AMEC Geomatrix, Inc. referenced on page 94 of the multisite order presentation with the JSF Site EIP. TVA shall explain in the JSF Site EAR how the horizontal seismic coefficient of 0.115g was determined. The data and formulae used to make this determination shall also be included.

TVA Response

TVA provided TDEC a letter that documents the 2012 seismic analyses of the JSF Bottom Ash Pond (Stantec 2012d) with the Investigation Conference Data Transmittal. The analyses were performed to support EPA assessment of the JSF CCR units. As noted in the letter, a ground motion level corresponding to a return period of 2,500 years was used to select horizontal seismic coefficients. For purposes of the referenced simplified analysis, the pseudostatic seismic coefficient was set equal to the peak ground acceleration of 0.115 g for a 2,500-year return period. This acceleration value was selected from Table 18 of the region-specific seismic hazard study performed by AMEC Geomatrix, Inc. (2011). This peak ground acceleration is representative for rock at the ground surface, where the rock has a shear wave velocity of approximately 9,000 feet per second.

The Stantec (2012d) seismic analysis, which is the subject of this information request, is being taken into consideration, and will be supplemented by more recent data and updated analyses as discussed in the response to D.6 (Section 4.4.6) and in the Stability SAP (Appendix J). The newer information (used in conjunction with historical information) can account for current site conditions. Newer analyses (performed in the context of the historical analyses) can account for updates to the state of practice and provide an improved understanding of expected performance.

3.1.8 TDEC Site-Specific Information Request No. 8

Stantec recommended further work at the TVA JSF site in the "February 8, 2010 Report of Geotechnical Exploration". TVA shall explain whether it took the actions recommended, the data generated from that work and the results from implementing the recommendations when it submits the JSF Site EAR.

TVA Response

The Report of Geotechnical Exploration (Stantec 2010) recommended additional work for the Dry Fly Ash Stack and Ash Disposal Area J. There were four primary recommendations: (1) Perform appropriate geotechnical evaluation with future build-out or closure of the Dry Fly Ash Stack; (2) Improve stability of the river bank along the north slope of the Dry Fly Ash Stack below elevation 1,110 feet (via underdrain installation and partial slope regrading); (3) Construct river bank stabilization features to protect Ash Disposal Area J; and (4) Periodically evaluate the stability of the dike slopes below the

Dry Fly Ash Stack through an instrumentation plan. The four recommendations have been addressed as follows:

a. Item No. 1 was addressed by Stantec (2013a) with geotechnical evaluations performed as part of the Dry Fly Ash Stack closure. The evaluation included static stability analyses of four cross sections with the closure geometry.

b. Item Nos. 2, 3, and 4 were subsequently evaluated by URS (2010a and 2010b), which reevaluated the static stability analyses performed by Stantec (2010). URS (2010b) concurred with the Stantec (2010) recommendation (Item No. 2) to install a toe drain system in order to "control water levels in the vicinity of the perimeter dike" and "enhance long term embankment stability." The toe drain was subsequently designed and installed by Stantec (2012b). The toe drain was installed in a clay dike, along the interior of the Lower Road at the Dry Fly Ash Stack. The drain system includes a series of pumps and force mains that discharge at a riprap-line ditch north of the Coal Yard Runoff Pond (drawing series 10W511). During the JSF EIP Preview Meeting on November 14, 2017, TDEC requested that TVA provide as-built drawings of the toe drain and review whether the river level has gone above the toe drain. Record drawings of the toe drain system will be provided to TDEC under separate cover.

   River levels are recorded from a river gauge downstream of the detention dam (see Figure 3 – Appendix C). Levels are currently recorded via a radar ranging sensor at five-minute intervals. The sensor (installed at a known elevation) measures signal travel time and relates this to water surface elevation.

   As part of the proposed hydrogeological investigation, TVA will review information and data to develop a more comprehensive understanding of the toe drain system. Accordingly, a review and discussion of the toe drain system, river elevations, leachate generation records, and rainfall data will be provided in the EAR.

c. URS (2010a) also concluded that toe scour protection should be installed along the north dike of Ash Disposal Area J (Item No. 3). The scour protection consisted of a series of riprap and crushed stone berms and buttresses, as documented in TVA Drawing series 10W801. The scour protection project was completed in March 2017.

d. URS (2010b) concurred with the proposed recommendation by Stantec (2010) to periodically evaluate the lower slopes (i.e., below elevation 1,110 feet) through an instrumentation program (Item No. 4). Monitoring instruments were initially installed in 2010 by Stantec. Additional instruments were installed during subsequent field activities by URS (2010b) and Stantec (2012c, 2013b, 2016c). As part of TVA's instrumentation monitoring program, slope stability is routinely reviewed using data from the instruments installed in the Dry Fly Ash Stack.

3.1.9 TDEC Site-Specific Information Request No. 9

The TVA shall provide, in the JSF site EIP, a description of the process it plans to use to determine if dike construction at the TVA JSF site is susceptible to failure. While TVA may have historic data for dike construction, TVA shall perform proposed additional on-site activities to definitively determine dike construction materials and the location and relative amount of the different materials in the dikes. The JSF Site EAR shall contain this information as well as data that confirm CCR materials used to raise the dikes and a determination if the use of CCR materials contributed to the North Dike Failure in 1973. TVA shall describe the repairs made to the North Dike Failure after the 1973 repair and if any additional repair work is anticipated.

TVA Response

Introduction

TVA understands the information request is to comprehend the stability of perimeter dike systems for the CCR units. Emphasis is placed on the possible presence of CCR in the existing dikes, and whether factors that contributed to the 1973 North Dike failure may still be present.

TVA will use existing data to respond to the information request. Sufficient data exists to characterize the dike materials, construction methods, and material locations without additional field work. The adequacy of existing data to support this response is presented below. The response includes a description of dike construction for each unit, an explanation of the 1973 North Dike failure and subsequent repair, and a review of the existing perimeter dike stability.

Due to the lengthy discussion necessary to address this information request, the full response describing the dike evaluation of each unit is provided in Appendix K, Evaluation of Existing Geotechnical Data. The conclusion of the response is as follows:

JSF Study Area Dike Evaluation

The review of available design and construction documents, inspection reports, and subsurface exploration reports demonstrates that portions of the raised perimeter dike of the Dry Fly Ash Stack were constructed using compacted fly ash. In contrast, for Ash Disposal Area J and the Bottom Ash Pond, design and construction records and borings demonstrate that the perimeter dikes consist of clay, and do not include CCR. Given the emphasis of this information request regarding dike stability as it relates to the presence of CCR in the dikes, only the Dry Fly Ash Stack is discussed in the remainder of this response.

Refer to the Stability SAP (Appendix J) and related information requests that explain how TVA will use existing and proposed analyses to demonstrate perimeter slope stability of each CCR unit.

1973 North Dike Failure Evaluation

Based on the data presented in Section 4.0 of Appendix K, the following conclusions can be made:

- The footprint of the Dry Fly Ash Stack was originally constructed and operated as a surface impoundment for sluiced ash disposal. Design and construction records and borings demonstrate that the starter perimeter dike consisted of clay, while portions of the raised perimeter dike originally included some CCR.
- For the Ash Disposal Area J and the Bottom Ash Pond, design and construction records and borings demonstrate that the perimeter dikes consist of clay, and do not include CCR.
- In 1973, a slope failure occurred along a segment of the raised, north perimeter dike of the present-day Dry Fly Ash Stack. An evaluation of the failure indicated that several factors contributed to the failure, including overly steep outslopes, use of poorly compacted ash in the raised dike, saturated outslopes (due to elevated river levels), and elevated operating pool levels.
- The slope failure was repaired by flattening the perimeter dike outslopes, reconstructing the raised dike using compacted clay fill, and installing scour protection along the starter dike outslope. Operational improvements were also made by lowering the operating pool and ultimately discontinuing sluicing and converting the unit to a Dry Fly Ash Stack.
- More recently, additional perimeter improvements have been made to the Dry Fly Ash Stack, including flattening of perimeter outslopes and improving subsurface drainage. The final closure of the unit also improves stability by reducing infiltration, leading to long-term reductions in pore water pressures.
- Borings confirm that portions of the raised perimeter dike consist of compacted fly ash, although it is beneath a clay veneer placed as part of the 2002-2004 slope flattening project. The presence of the CCR is accounted for in recent slope stability modeling of the closed conditions, and adequate factors of safety have been achieved. Similarly, proposed slope stability analyses (refer to the Stability SAP – Appendix J) to be performed as part of the TDEC Order Investigation will also account for the CCR.
- As part of TVA's instrumentation monitoring program, piezometers and slope inclinometers are routinely monitored to provide information regarding dike condition/performance and slope stability.

- Based on the above information, adequate data is available to assess the stability of the perimeter dikes of the CCR units in the JSF study area. No additional field work is necessary to address this information request, and no additional modifications or repairs are anticipated at this time. The presence of CCR in the raised perimeter dike of the Dry Fly Ash Stack has been adequately characterized and is accounted for in slope stability analyses.

3.1.10 TDEC Site-Specific Information Request No. 10

TVA shall propose the method(s) it will implement to better define the physical characteristics of the clay layer identified below the compacted ash. This includes (1) compaction if any, (2) the occurrence of rock or debris in the clay that would reduce permeability and (3) the depth and location of the clay layers referenced on page 111 of the TVA JSF Fossil Plant multisite order presentation.

TVA Response

TVA reviewed available construction records, operations manuals, and reports of subsurface explorations to evaluate the spatial extents of the clay material, and potential explanations for its presence within the compacted fly ash fill in the Dry Fly Ash Stack. Based on the findings, presented below, it was determined that sufficient data exists for the evaluation; no additional field work is anticipated for this request.

Borings JS-36A, JS-52, JS-71, JS-74, and JS-75 each encountered a single depth interval of clay within the compacted fly ash fill. Borings JS-38, JS-39, JS-46, and JS-50 each encountered two separate depth intervals of clay within the compacted fly ash fill. Many more borings did not encounter clay within the compacted fly ash fill. See Figure 4 (Appendix C) for the boring layout. These clay intervals range from 0.6 to 12.9 feet thick, with an average thickness of 3 feet. The clay intervals were encountered between approximate elevations 1,071 feet and 1,142 feet. Based on the horizontal and vertical distribution of these clay materials (as well as borings without such clay), continuous layer(s) do not appear to be present.

The cross section (Section B) referenced in this information request, shown on page 111 of the Investigation Conference presentation, modeled a clay layer in the compacted fly ash fill based on results from borings JS-50 and JS-52 (Stantec 2010). In a subsequent subsurface exploration (Stantec 2013b), boring JS-73 was performed between JS-50 and JS-52, approximately on the same cross section. No clay was encountered in the compacted fly ash fill in JS-73, providing an example of the discontinuous nature of this material. Given the additional boring data now available, a refined slope stability analysis of the Dry Fly Ash Stack would not model continuous clay layers within the compacted fly ash fill.

The discontinuous clay encountered within the compacted fly ash fill is likely remnants of intermediate (i.e., temporary) cover installed during phased stacking and interim closure operations. The Operations Manual (TVA 2013a) specifies intermediate cover requirements for the Dry Fly Ash Stack Area:

> "Planned phases of the stack that have not yet reached final fill grades and will not receive ash for extended periods as determined by the phased development of the site will be managed to reduce infiltration by use of 6-12 inches of compacted soil."

In preparing for the final cover, the manual states that where possible, intermediate cover soil should be stripped for later re-use; however, it is likely that isolated, discontinuous pockets of soil were left in place in the stack.

Due to the limited occurrence and discontinuous nature of the encountered clay material within the compacted fly ash fill, it does not have a significant effect on slope stability of the unit and going forward, will not be modeled as a separate layer or zone. With respect to phreatic levels within the compacted fly ash, a review of historical and recent piezometer data does not indicate elevated phreatic levels that might suggest continuous clay layer(s) that influence seepage within the fill. Given the lack of influence this clay material has on the performance of the Dry Fly Ash Stack, the existing characterization of this material is adequate to address this information request.

3.1.11 TDEC Site-Specific Information Request No. 11

TVA shall provide the date of the drawing set with the 10W204-combined file name.

TVA Response

Rev 0 drawings 10W204-1, 10W204-5, and 10W204-6 are not dated. Rev 1 Drawings 10W204-2, 10W204-3, 10W204-4, 10W204-7, 10W204-8, and 10W204-9 are dated August 2008. These drawings will be provided in the EAR.

3.1.12 TDEC Site-Specific Information Request No. 12

TVA shall provide data for the location and depth of borings 33B, 34B, 33A and 33B presented on drawing 10W507-09. The borings shall be mapped with their location relative to the liner system present in the "Bathtub Area" (Drawing 10W507-02). TVA shall provide geotechnical data and stability calculations that transect and include the liner system of the ammoniated ash fill area and also provide cross section E-E' indicated on drawing 10W502-1.

TVA Response

Figure 5 (Appendix C) shows the approximate limits of the Phase I and II liner system installed in the historical "Bathtub Area" in the Dry Fly Ash Stack, as well as borings performed within the footprint of this liner system. The chronology of the borings relative to the installation of the liner is important to answering this information request.

Ten borings are located (in plan view) within the footprint of the liner system. Key events in the chronology are as follows:

1. Boring PZ-8 was performed in 1998.

2. Borings JS-33A, JS-33B, JS-34A, and JS-34B were performed in March and April 2009 (Stantec 2010).

3. The top of hole (i.e., ground surface) elevations of borings JS-33A, JS-33B, JS-34A, and JS-34B are above the liner elevation and the bottom of hole elevations are below the liner elevation, yet these holes did not penetrate the liner. This is because at the time of drilling, ash was stacked above the proposed subgrade for liner installation and the liner had not yet been installed. Refer to Section C of approved permit drawing 10W204-7.

4. As part of the preparation and regrading for the liner installation, the height of the ash stack was lowered approximately 40 feet to reach the liner subgrade. Borings JS-33A, JS-33B, JS-34A, and JS-34B were drilled in March and April 2009, during the ash removal process, at an intermediate elevation above the liner subgrade. After the borings were performed, ash removal was completed, the area was regraded, and the liner was installed.

5. The liner system was installed between May and October 2009. Thus, the five borings listed above did not penetrate the Phase I and Phase II liner.

6. Stantec (2013b) performed five additional borings in the area (Figure 5 – Appendix C) after the Phase I and II liner system was installed. Borings JS-76, JS-77, JS-78, JS-79, and JS-80 were performed using vacuum excavation. The borings were terminated above the liner, at the top of the high-density polyethylene (HDPE) underdrain pipe.

The boring logs and available geotechnical data for the Stantec (2010, 2013b) explorations are included in the reports provided as part of the Investigation Conference Data Transmittal to TDEC.

Cross Section E-E’ (Figure 6 – Appendix C) transects the Phase II liner footprint. In the Basis of Design Report for the Dry Fly Ash Stack Closure (Stantec 2013a), slope stability was analyzed on this section for the closed condition, and acceptable factors of safety were achieved. TVA will provide Stantec (2013a) in the EAR. Refer to Section 4.4.6 for additional information on existing and proposed slope stability analyses.

3.1.13 TDEC Site-Specific Information Request No. 13

As a part of the JSF Site EAR, TVA shall provide geotechnical data and stability calculations for the critical sections of the final geometry should the Bottom Ash Stacking plan be implemented as planned.

TVA Response

Closure of the Bottom Ash Pond CCR Unit is complete and the Construction Certification Report is dated October 6, 2017 (Stantec 2017). The preliminary plans for closure were submitted to TDEC on July 15, 2015. The Basis of Design Report (Stantec 2016a) contains supporting geotechnical data and slope stability analyses for the closed condition.

Within the framework and processes of TVA's National Pollutant Discharge Elimination System (NPDES) permit for this unit, the required documentation for the closure design and construction will be provided to TDEC.

During the JSF EIP Preview Meeting on November 14, 2017, TDEC requested that TVA provide information regarding how the western portion of the Bottom Ash Pond footprint was restored after ash was removed. TDEC also requested that TVA provide observations regarding initial pond construction (including dike and clay foundation thicknesses) that were made during the closure process. As outlined in the closure design documents (Stantec 2016a), ash was removed from the western portion of the Bottom Ash Pond and relocated to the eastern portion. Based on historical boring logs, the uppermost foundation soil in the western portion was residual clay/silt (Figure 18 – Appendix C). After ash removal, the remaining subgrade material was observed to consist of residual clay/silt, weathered shale, or shale (areas of thin soil may have been over-excavated). Borrow soil was excavated from the perimeter dikes and placed as structural fill in the western portion to achieve final grades and promote positive drainage. Sod was then installed over the fill. Refer to historical boring data for additional detail on dike and foundation soil types and thicknesses.

4.0 TDEC GENERAL INFORMATION REQUESTS

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

TVA shall provide 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 III Detection Monitoring and Appendix IV Assessment Monitoring found on page 21500 of the Friday, April 17, 2015 Federal Register (Appendices III and IV 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 JSF to evaluate the background levels of constituents of concern, previously defined as CCR Parameters.

TVA has prepared a Background Soil SAP (Appendix L) to characterize background soils on TVA property in the vicinity of the TVA JSF 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 (Appendix L) establishes the procedures necessary to conduct investigation activities associated with the sampling and analysis of background soils. Figure 7 (Appendix C) depicts the locations of twelve proposed background soil sampling locations, selected for collecting background soil data.

Figure 8 (Appendix C) 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 as well as potential impacts from the 1973 North Dike failure 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 groundwater flow from JSF 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.

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 L).

In addition to the soil data that will be collected from the twelve proposed sampling locations, TVA will review the background soil data previously collected during the 2015 installation of background monitoring wells JSF-101 and JSF-102. During installation of proposed background groundwater monitoring wells JSF-106 and JSF-110 soil samples will be collected through the screened interval of each well.

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 un-impacted site-specific reference areas and represent an upper threshold of background concentration(s) expected to exist naturally in the environment.

The choice of BTV (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 M), and an evaluation of CCR Parameters from pore water samples and CCR material samples.

The CCR Material Characteristics SAP (Appendix M) will help determine the leachability of CCR constituents from material in the closed CCR units. The approach will include the collection and analysis of both pore water and CCR material from the Dry Fly Ash Stack, Ash Disposal Area J, Bottom Ash Pond, and Highway 70 Borrow Area. If existing instrumentation continues to trend downward and shows a CCR unit to be dry (e.g., Bottom Ash Pond), the proposed temporary wells in that unit will not be completed, and that unit will be removed from the Study Area of the CCR Material Characteristics SAP.

Twelve temporary wells will be installed at locations proposed in Figures 9, 10, and 11 (Appendix C), then filtered and unfiltered pore water samples will be collected from the phreatic zone at the base of the unit, or the base of the ammoniated ash liner, 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.

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 (Appendix M) will provide procedures necessary to conduct the sampling of pore water and CCR material in the CCR unit, 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 N)
- Collect CCR material samples during installation of the temporary wells
- Collect pore water samples from the completed temporary wells
- Conduct laboratory testing and analysis of samples

Sample collection methods, sample transport, and analytical methodology shall be addressed in the CCR Material Characteristics SAP (Appendix M) and the QAPP (Appendix D). Laboratory qualifications shall be addressed in the 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. Existing CCR leachability data will be reviewed and evaluated if available for the CCR units. Results, conclusions, and recommendations will be provided in the EAR.

TVA will review existing CCR leachability data available for the CCR units. The information will be evaluated and addressed in the EAR, along with the new leachability data.

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

Cherokee Dam was completed downstream of JSF in December 1941. TVA began constructing CCR units at JSF in 1952, and CCR unit operations began in 1957. The *Geologic Map of East Tennessee, Greenville* (Rodgers 1953) is provided as Figure 12 (Appendix C) with the approximate boundary of the CCR units added for clarity.

The 1940 USGS Topographic Maps of the Burem and McCloud Quadrangles (Figure 13 – Appendix C) and TVA Drawings 10N410, 10W286-1, and 10W293-1 provide pre-construction topography.

TVA will review these maps during the Investigation and discuss surface water features and the flow direction of streams before JSF 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 Dry Fly Ash Stack, Ash Disposal Area J, and Ash Pond. TVA will also use this information to estimate the pre-construction surface elevations at the location of these CCR units. TVA will report this information in the EAR. It should be noted the Highway 70 Borrow Area was not operated as a CCR surface impoundment.

- **Pre-construction Topographic Maps:** TVA will use maps referenced in Section 4.1.3 which show pre-construction topography to estimate the original surface elevations at the location of the CCR units.

- **Construction Drawings:** Record drawing 10N410 depicts the construction of the original Ash Disposal Area (Dry Fly Ash Stack). The 10W286 Drawing Series depicts the construction of Ash Disposal Area J. Record drawings (10W293 Series) depict the construction of the Ash Pond. TVA provided these drawings to TDEC in the Investigation Conference Data Transmittal.

- **Geotechnical Reports:** Geotechnical reports summarized in the Evaluation of Existing Geotechnical Data (Appendix K) provide information including dike configurations and material classifications.

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.

In addition, the Exploratory Drilling SAP (Appendix N) includes groups of closely spaced Cone Penetration Test (CPT) soundings to evaluate possible pre-construction stream channels that cross the perimeters of the Dry Fly Ash Stack (Figure 11) and Bottom Ash Pond (Figure 10).

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.

TVA Response

TVA prepared a Material Quantity SAP, provided as Appendix O, 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. The objectives and approach for the Material Quantity SAP are summarized below.

Proposed TDEC Order Borings

TVA proposes CPT soundings, temporary wells, and groundwater monitoring wells at locations shown on Figures 3, 9, 10, and 11 (Appendix C) to supplement existing data and answer various information requests including those regarding CCR material quantity, groundwater elevations, saturation levels, and subsurface conditions.

As described in the Hydrogeological Investigation SAP (Appendix I), TVA plans to install new monitoring wells to characterize groundwater flow at JSF. Details regarding the proposed CPT soundings and temporary wells are provided in the Exploratory Drilling SAP (Appendix N).

Three Dimensional Models

Three-dimensional models of the Dry Fly Ash Stack, Ash Disposal Area J, Bottom Ash Pond, and Highway 70 Borrow Area will be developed to depict subsurface conditions from ground surface to bedrock. The models will be developed using the data summarized below which includes data from the proposed exploratory borings and wells discussed above, existing piezometers and wells, as well as other relevant data collected during the Investigation.

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

2. Recent aerial surveys, as-built closure surveys and borings shown on Figures 9 through 11 and Figures 14-16 (Appendix C) will be used to model the upper CCR surface.

3. Pre-construction topographic information from the McCloud and Burem Quadrangles dated 1940, TVA Drawings 10N410 "Ash Disposal Area," 10W293 "Ash Disposal Area No. 2 Plan," 10N295 "Fly Ash Disposal Area G-Plan" and 10W286-1 "Fly Ash Disposal Area J, and data from borings that penetrated the CCR surface shown on Figures 9 through 11 and Figures 14-16 (Appendix C) will be used to model the lower CCR surface at the Dry Fly Ash Stack, Bottom Ash Pond, Highway 70 Borrow Area, and Ash Disposal Area J.

4. Data from borings shown on Figures 4, 9 through 11, 17, and 18 (Appendix C) will be used to model the foundation soils underlying each site.

5. Data from borings that encountered top of bedrock shown on Figures 9 through 11 and 19 through 21 (Appendix C) will be used to model the top of bedrock surface.

6. Estimated piezometric levels of saturation discussed in Section 3.1.3 will be incorporated into the models.

7. Groundwater levels estimated as part of the hydrogeological investigation described in the Hydrogeological Investigation SAP (Appendix I) will be incorporated into the models.

8. TVA surveyed slopes, embankments, and benches to develop stability cross-sections. TVA will use this topographic data with the most recent aerial survey data to model the geometry of the dikes and benches.

The three-dimensional models 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 models of the facilities. The models, supporting documentation, drawings and a summary of the estimated CCR will be provided in the EAR.

Drawings

After the three-dimensional models are finalized, they will be used to produce drawings of the Dry Fly Ash Stack, Bottom Ash Pond, Highway 70 Borrow Area, and Ash Disposal Area J 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

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
- Volume of CCR below the highest recorded groundwater surface

The combined total volume of CCR for all study area units at JSF will also be estimated. These volumetric estimates will be calculated using two methods to validate the model and results.

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.

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

This request for a water balance analysis for active surface impoundments is not applicable at JSF. The last coal-fired units at JSF were retired in 2014 and are currently not in use.

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 groundwater (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 groundwater is used as a source of domestic water supply within a ½ mile radius of the TVA site, the EIP shall include an offsite groundwater and surface water sampling plan as a part of the EIP.

4.2.1 TDEC Water Use Survey Request No. 1

TVA Response

TVA's Water Use Survey SAP (Appendix P) includes details to complete a water use survey for the JSF property. TVA previously conducted a survey of domestic water supplies within one-mile of the boundary of the JSF property in 2015. The survey will be updated to explore whether new domestic water supplies have been installed since the time of the previous survey.

TVA will update previous studies by reviewing existing documentation and the state database to identify existing water supply wells and springs within 1/2 mile of the boundary of the JSF property, including water well inventory records on file with TDEC for Hawkins County. TVA will also review water supply information on file for the City of Rogersville to identify water service hookup locations in the search area. TVA owned property will not be included in the water use survey. The updated information will be provided in the EAR.

TVA will develop a field verification plan to demonstrate the procedure for conducting a water use survey for off-site water supply wells and springs used for domestic or business purposes. The plan will include a field verification map with the location of identified water supply wells and springs, homes, and businesses within 1/2 mile of the boundary of the JSF Study Area, and will consist of the following steps:

- Conduct a door-to-door survey to identify registered and unregistered water supply wells and springs and their construction metrics, based on the homes and businesses located on the field verification map.
- Obtain permission (in writing) from the property owner to access their property.
- Physically verify water supply wells and springs.
- Obtain permission (in writing) from the property owner to sample the water well(s) or springs, from the wellhead or closest tap, [Note: samples will not be collected without the well owner's approval].
- Take a global positioning system (GPS) reading of the verified water well(s) and of springs (e.g., pumps) for map updates.
- Update and prepare the field verification map and survey report after completion of the survey for inclusion in the EAR submittal to TDEC.

Property access and water well and spring sampling permission forms have been developed by TVA for use during field verifications. Details of sampling methods and analytical parameters are included in the Water Use Survey SAP (Appendix P).

In the event that TVA is unable to gain permission to enter a property for field verification of private water wells and springs, TDEC has offered assistance in field verifying the locations, well construction information, withdrawal rates, and collecting samples. Property access and water well sampling permission forms have been developed by TVA for use during field verifications.

TVA and TDEC will discuss the construction, depth, and location of private water-supply wells identified during the survey and evaluate the method of sampling. Details of sampling methods and analytical parameters are included in the Water Use Survey SAP (Appendix P).

If sampling reveals CCR constituents present above MCLs within the ½ mile initial survey boundary, TVA will promptly report the information to TDEC and confirmatory sampling will be performed.
A final report and associated map showing the verified location(s) of water supply well(s) and springs with associated sampling locations (if sampling is required) 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 groundwater sampling. The constituents for Groundwater Detection Monitoring are listed in Table Appendix 3 of the EPA CCR regulations and the constituents for Groundwater Assessment Monitoring are listed in Table Appendix 4 of the EPA CCR regulations. TDEC is requiring TVA to include a description of the groundwater monitoring plan it will implement at each TVA site.

All groundwater samples collected as a part of the Groundwater Monitoring Plan shall be analyzed for the CCR constituents listed in Tables 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 groundwater 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 groundwater monitoring wells and springs.

TVA shall include all groundwater monitoring construction information, location and historical groundwater monitoring data in each TVA site's EAR.

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 newly 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 G in tabular form. This data has been collected for a variety of reasons since approximately the 1980's.

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 as Figure 2 (Appendix C).

In addition to the analytical data, the construction and location of newly installed and closed groundwater monitoring wells and information will be researched, collected, reviewed and compiled into a report to be provided in the EAR.

An unnamed spring was observed approximately 200 feet west of MW-2 (Figure 2 – Appendix C) (TVA 2009). The spring was observed to have standing water and occasional flow between February 2007 and May 2007 with no water between June 2007 and October 2007. The spring was observed to have standing water on April 29, 2016 and was dry on June 29, 2016. Based on available information, the spring is located approximately 2,000 feet from the CCR units in an upgradient location and appears to be an ephemeral, wet-weather feature associated with an ephemeral stream. As a result, collection of water samples is not proposed.

No perennial springs have been observed at the site. If additional springs are observed, TVA's inspection program will identify and document the new springs around the CCR units. The newly identified springs will be added to the groundwater monitoring plan in the monitoring network, as described in Section 4.3.5.

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

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

TVA Response

This TDEC General EIP Guideline request is similar to Information Request No. 3. Proposed background locations are discussed in Section 3.1.3.

The selection of background monitoring wells will be finalized after evaluation of preliminary data from the proposed background locations to determine if the wells are appropriate background wells and receiving input from TDEC on the proposed locations.

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

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

TVA Response

This TDEC General EIP Guideline request is similar to the information requested in Sections 3.1.3 and 3.1.4. Refer to these sections 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 groundwater 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 3.1.3 and 4.3.2. Refer to those sections and the Hydrogeological Investigation SAP (Appendix I) 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 groundwater monitoring plan for sampling all wells and springs included in the monitoring network. This should include the methods TVA shall use to collect groundwater samples, the analytical methods to be used for groundwater 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 and shipping and transportation requirements. Additional information regarding laboratories to be used for analysis of the samples is provided in the QAPP (Appendix D).

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 groundwater surface elevation under the landfill(s), surface impoundment(s) and/or non-registered site(s). If additional data is needed to provide groundwater 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 groundwater surface in the ash disposal areas such that (1) the CCR material between the original ground surface and the top of the current groundwater table is defined and (2) CCR material between the current groundwater 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 groundwater surface and from CCR material that is below the projected groundwater 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 estimated amount of CCR material below the groundwater surface is similar to the information requested in Sections 3.1.3, 3.1.4, 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 pore water sampling is related to work being conducted as part of the ongoing investigation activities. Refer to Section 4.1.2 for information related to this request. Pore water sampling will be conducted in accordance with the CCR Material Characteristics SAP (Appendix M), developed to characterize the leachability of CCR material in the units, and addressed in greater detail in Section 4.1.2.

Pore water sampling will be completed as part of the ongoing investigation activities and the results, conclusions and recommendations will be addressed in the EAR. If, based on the results of the ongoing work, data gaps are identified to meet the objectives of the TDEC Order, then TVA will propose additional investigations to address the data gaps and submit plans to TDEC for review.

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

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

TVA Response

As discussed in Section 3.1.3, the initial phase of the environmental investigation is to characterize the site by assessing current subsurface conditions at JSF. 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 TVA's TI for Monitoring Well and Piezometer Installation and Development (TVA 2017). New monitoring wells will be monitored every other month 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., TVA 1952, Stantec 2012c), 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 JSF site. The response will discuss how the geologic lithology influences the construction and performance of the different units.

Available information, at the time of this report, indicates that the CCR units at JSF are underlain by the Sevier Shale, which is predominantly shale. Therefore, the Sevier Shale is not subject to extensive karstic solutioning and karst features are not likely to be present in this formation (TVA 1952). No known sinkholes or karst features have been identified at JSF in the historical construction reports, drawings, inspections, or geotechnical explorations. Further, natural seeps have not been identified at JSF.

An unnamed spring was observed approximately 200 feet west of MW-2 (Figure 2 – Appendix C) (TVA 2009). The spring was observed to have standing water and occasional flow between February 2007 and May 2007 with no water between June 2007 and October 2007. The spring was observed to have standing water on April 29, 2016 and was dry on June 29, 2016. Based on available information, the spring is located approximately 2,000 feet from the CCR units in an upgradient location and appears to be an ephemeral, wet-weather feature associated with an ephemeral stream. No perennial springs have been observed at the site.

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 groundwater flow.

TVA Response

The information required for this response is similar to that for 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 JSF will be provided based on existing literature. Observations regarding fractures and bedding planes identified in rock cores collected during previous investigations (TVA 1952) 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 JSF, including the proximity of faults below the CCR units and the degree of infilling of fractures and bedding plans. 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 groundwater monitoring well construction data. TVA shall describe the methods (surface geophysics; installation of borings/groundwater 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

TVA prepared a Material Quantity SAP, provided as Appendix O, to describe the methods TVA will use during the Investigation to answer TDEC's information requests regarding CCR material quantity and subsurface conditions. The scope of the Material Quantity SAP includes modeling subsurface conditions from final grade to bedrock. The Material Quantity SAP describes how existing and new top of bedrock data will be incorporated into three-dimensional models of the units to develop top of bedrock contours. Requirements related to information and logging procedures for new borings are addressed in the Exploratory Drilling SAP (Appendix N).

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

TVA constructed the Original Ash Disposal Area as a surface impoundment, subdivided into nine cells (Areas A through I) with interior dikes. The approximate footprint of this Original Ash Disposal Area and the subdivided cells is shown on Figure 1 (Appendix C). The majority of this footprint was transitioned gradually from a surface impoundment to a landfill beginning in about 1979. In 1998, the Dry Fly Ash Stack was formally permitted by TDEC as Class II Landfill No. IDL 37-0097. However, portions of the Original Ash Disposal Areas G, H, and I are outside of the Dry Fly Ash Stack footprint (Figure 1 - Appendix C). The portions inside and outside of the permitted Dry Fly Ash Stack are discussed in more detail below. At this time, no additional field work at the Dry Fly Ash Stack is anticipated to answer the above request.

Original Ash Disposal Areas Inside Dry Fly Ash Stack Footprint

TVA will describe how the Dry Fly Ash Stack was converted from a surface impoundment to a dry stacking facility in the EAR. TVA will use the following data to describe structural changes to this unit.

- **Record Drawings:** Record drawings (Stantec 2016d) for the Dry Fly Ash Stack closure show its final configuration.

- **Construction Drawings:** Drawing 10N410 shows the original perimeter dike that formed the Original Ash Disposal Area. Drawing 10N290 for the Area E Dike Repair provides plan and cross section views of the Original Ash Disposal Area. Drawings 10N295-10N298 show construction of Area G.

- **Geotechnical Reports:** Stantec (2010) summarized the construction history of the Dry Fly Ash Stack. This report also includes stability sections which depict the original and modified configurations of the unit.

TVA will also evaluate historical geotechnical data to characterize the uppermost foundation soils (type and location) present beneath the CCR and perimeter dike systems (Figure 4 - Appendix C). The foundation soils will be incorporated into the three-dimensional model outlined in Section 4.1.5.

Original Ash Disposal Areas Outside Dry Fly Ash Stack Footprint

The West Stilling Pond was constructed in the west end of Area G in 1985. Area G was split with a divider dike, and the portion west of the divider dike was excavated to original ground (i.e., CCR was removed) during construction (TVA 1986). The West Stilling Pond was converted to a stormwater pond as part of the Dry Fly Ash Stack closure (Stantec 2016d).

The two Chemical Treatment Ponds and the Intermediate Stilling Pond were constructed in portions of Area H outside of the Dry Fly Ash Stack footprint. The Chemical Treatment Ponds (Copper and Iron Cleaning Ponds) were constructed in the southeast corner of Area H in 1980. To construct the ponds, the interiors were excavated, and perimeter dikes were constructed. Some foundation stripping was performed prior to dike construction; however, ash was encountered beneath the dikes in two of four borings performed during subsequent subsurface explorations (Stantec 2014). In 2015, the Chemical Treatment Ponds were closed by dewatering, stabilizing the sediment, then filling and capping the ponds (Stantec 2015). The Intermediate Stilling Pond was constructed adjacent to the Chemical Treatment Ponds; original construction was prior to 1995 and modifications were performed prior to 1999. The modifications included excavating and lining the bottom three feet of the existing pond with compacted, low hydraulic conductivity soil (drawing 10H291-10). The Intermediate Stilling Pond was converted into a stormwater pond as part of the Dry Fly Ash Stack closure. Historical documents and existing borings will be used to estimate CCR quantity beneath these ponds, per the Material Quantity SAP (Appendix O).

The southern part of Area I is outside the Dry Fly Ash Stack footprint. However, CCR from this portion of Area I was removed when constructing a drainage channel for the adjacent South Perimeter Roadway (URS 2011). The excavated CCR was placed in the Dry Fly Ash Stack (drawing 10W418-04). The excavation was backfilled with soil prior to drainage channel construction.

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

This information request applies only to the Dry Fly Ash Stack at JSF, which was transitioned gradually from a surface impoundment to a landfill beginning in about 1979. In 1998, the Dry Fly Ash Stack was formally permitted by TDEC as Class II Landfill No. IDL 37-0097. TVA will analyze existing information including historical inspection reports, drawing 10W292, and the stability sections from Stantec (2010) to describe the as-built interface between stacked and sluiced ash in the Dry Fly Ash Stack. An analysis of this interface will be included in the EAR.

Discussion will be added to the EAR regarding how the findings of the historical geotechnical borings compares to the interface geometry shown on the referenced documents. As long as the boring locations and elevations are documented, and the boring logs have sufficient detail to distinguish the interface, then the age of the borings does not impact their value.

Based on the above information, the interface can be characterized with a reasonable degree of confidence. The EAR will also provide explanation that a more accurate delineation of the stacked/sluiced ash interface is not critical to the slope stability analysis of the unit. The stability is not controlled by the exact elevation of the interface. The available information locates the interface to a sufficient degree of accuracy such that no additional borings are necessary.

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 J), 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 K (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 Multisite 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 for each unit is described below. Where proposed below, the stability evaluation analysis methodology and acceptance criteria are in the Stability SAP (Appendix J). 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 Ash Disposal Area J and the Highway 70 Borrow Area to answer this information request. Refer to the Exploratory Drilling SAP (Appendix N) for more information.

Dry Fly Ash Stack: Existing analyses are available for the Dry Fly Ash Stack, from the following sources:

- Stantec (2013a): Static stability analyses (i.e., global stability of the closed stack and veneer stability of the final cap) for the closure geometry (final phase of closure approved by TDEC in April 2016)
- Stantec (2010): Static stability analyses of existing conditions, incorporating results of additional geotechnical exploration
- URS (2010b): Additional static stability analysis of existing conditions, supplemental to Stantec (2010)
- Law (1997): Pseudostatic seismic stability analyses for permitted geometry as part of its application for a Class II Solid Waste Landfill Permit. TDEC approved and issued the permit (IDL 37-0097) in 1998. It should be noted that the geometry of the closed unit is within the permitted geometry and therefore the analysis is still valid.

The existing static stability analyses performed for closure (Stantec 2013a) will support the stability assessment of the Dry Fly Ash Stack. No additional static stability analyses are anticipated. Updated seismic stability (global and veneer) and new liquefaction triggering analyses will be performed for the final closed geometry in accordance with the Stability SAP (Appendix J). A summary of these analyses will be included in the EAR.

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

- Stantec (2016a): Static stability analyses (global and veneer), to support the Basis of Design Report for ongoing Ash Pond closure
- Stantec (2012d): Pseudostatic seismic stability analysis, to support EPA's assessment of TVA's CCR disposal facilities

Preliminary plans for the Bottom Ash Pond closure were submitted to TDEC on July 15, 2015. Updated static global stability analyses were developed as part of the closure design (Stantec 2016a) and fulfill a portion of this data request for the Bottom Ash Pond. The expected schedule to provide the static stability analyses for the closed-in-place condition will be linked to the submittal of closure design documents to TDEC. Updated seismic (global and veneer) stability and new liquefaction triggering analyses will be performed for the final closed geometry in accordance with the Stability SAP (Appendix J). A summary of these analyses will be included in the EAR.

Ash Disposal Area J: Existing analyses are available for Ash Disposal Area J, from the following sources:

- TVA (1985): Static stability analysis, to support change in dike configuration
- Stantec (2010): Static stability analyses of existing closed conditions, incorporating results of additional geotechnical exploration
- URS (2010a): Additional static and pseudostatic stability analysis of existing closed conditions, supplemental to Stantec (2010)

TDEC approved the closure of Ash Disposal Area J in 1997. The closure plan (included in the Investigation Conference Transmittal) did not include stability analyses (Tribble & Richardson, Inc. and Law Engineering, Inc. 1993).

The existing static stability analyses performed by Stantec (2010) and URS (2010a) did not include geometry changes from a recent scour protection project. Therefore, new static (global and veneer) and seismic (global and veneer) stability analyses and liquefaction triggering analyses for the closed (with scour protection) conditions will be performed in accordance with the Stability SAP (Appendix J).

A summary of these analyses will be included in the EAR. Existing data is available to support the evaluation and will be supplemented with new CPT soundings as proposed in the Exploratory Drilling SAP (Appendix N).

Highway 70 Borrow Area:

TDEC approved the closure of the Highway 70 Borrow Area in 1997. The closure plan (included in the Investigation Conference Transmittal) did not include stability analyses or liquefaction triggering analyses (Tribble & Richardson, Inc. and Law Engineering, Inc. 1995). New static (global and veneer) and seismic (global and veneer) stability analyses and liquefaction triggering analyses will be performed in accordance with the Stability SAP (Appendix J). A summary of these analyses will be included in the EAR.

Some existing data is available to support the evaluation and will be supplemented with new CPT soundings as proposed in the Exploratory Drilling SAP (Appendix N).

Stability cross section geometry will be developed based on TVA record drawings, historical explorations, and the proposed new CPT soundings.

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

Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area: The units are not permitted CCR landfills, and do not have a drainage layer within the units; therefore, this information request does not apply to these units. The ongoing closure of the Bottom Ash Pond does not include drainage layers within or below CCR in the final configuration.

However, to evaluate phreatic levels within these units, the Exploratory Drilling SAP (Appendix N) includes temporary wells as shown on Figures 9 through 11 (Appendix C).

Dry Fly Ash Stack: The Dry Fly Ash Stack was permitted as a solid waste facility under TDEC Class II Landfill Permit No. IDL 37-0097. The Operations Manual (TVA 2013a) describes the leachate management system installed in portions of the Dry Fly Ash Stack:

> "TVA installed in 2001-2002 an extraction and collection system which will collect and reroute all significant visible seeps and generally lower the phreatic surface in the vicinity of the Bathtub area. The design features of the collection system are shown on TVA drawings 17W445-1 through 17W445-4. In 2010-2011, TVA installed an additional seepage collection system along the western two-thirds of the facility's north toe to supplement and improve the system installed in 2001-2002.
>
> The improvements consisted of seepage collection trench extension, three new pumps, and associated discharge lines that run from the pump stations up to and along the North Perimeter Road. These lines extend along the northeast corner of the facility and discharge into the Coal Yard Ponds.

> This system and related appurtenances are referred to as the Seepage Collection System herein. The design and construction of the additional seepage collection system is documented in TVA drawings 10W511-01 through 10W511-21."

In 2009, a geosynthetic liner system and leachate collection system was installed over the historical bathtub area as part of the plant's transition to High Energy Reduction Technology (HERT). The liner system was designed to separate the underlying, existing stacked ash from the new, ammoniated ash produced by the HERT equipment.

The liner system was placed in accordance with TVA drawings 10W204-1 through 10W204-11. Per the Dry Fly Ash Stack Operations Manual (TVA 2013a), the system consisted of:

- A liner consisting of a geotextile placed over the existing stacked ash, followed by a geomembrane, followed by a geonet drainage composite,
- A leachate pond lined with a geomembrane,
- A gravity leachate collection system constructed from HDPE pipe and manholes, draining to the leachate pond,
- A gravity line transporting the leachate from the leachate pond to the existing coal yard runoff pond

In 2015, the leachate pond was modified by filling with large aggregate and then capping with a geomembrane and soil cover. The modification continues to allow leachate flows but eliminates stormwater collection. Also in 2015, the Coal Yard Runoff Pond (CYRP) was closed by excavating all sediment (Stantec 2016b). A new Process Water Pond (PWP) was constructed within the footprint of the CYRP, and the Dry Fly Ash Stack leachate drain and toe drain were routed to the new PWP. Wastewaters discharging from the PWP are piped to NPDES Outfall 008 at the Holston River (Stantec 2016e).

Record drawings provided in the Investigation Conference transmittal detail changes made to the system, including the collection system installed for the "bathtub" area (drawing series 17W445 and 10W206), updates to the underdrain system (drawing series 10W511), and general modifications during liner installation (drawing series 10W204). These documents, plus the more recent Construction Certification Reports for the CYRP closure and PWP construction will be summarized in the EAR.

To evaluate phreatic levels within this unit, the Exploratory Drilling SAP (Appendix N) includes temporary wells as shown on Figure 11 (Appendix C).

With regard to slope stability, the key issue is whether or not representative (or conservative) pore water pressures within the unit are used in the stability analyses. The existing piezometers will aid in understanding this issue. The stability analyses prepared as part of closure (Stantec 2013a) consider the referenced liner and drainage systems.

The EAR will provide explanation that the drainage layer interfaces are not critical to the slope stability analysis of the unit.

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 Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow 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 JSF.

Regarding the Dry Fly Ash Stack, 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 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."

Throughout its service life, TVA has constructed and operated the Dry Fly Ash Stack in compliance with the state and/or federal regulatory frameworks in effect at the time.

In 1998, TDEC issued Class II landfill permit IDL 37-0097 governing construction and operation of the Dry Fly Ash Stack. Since 1998, TDEC has approved various permit modifications for the Dry Fly Ash Stack.

The Dry Fly Ash Stack is an inactive landfill, as defined by the CCR Rule. The CCR Rule became effective in 2015 and does not apply retroactively to the surface impoundment that was transitioned to a landfill in compliance with the 1998 TDEC permit.

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

TVA Response

Dry Fly Ash Stack: Recent geotechnical explorations in the Dry Fly Ash Stack have characterized the CCR materials present in this unit. Shear strengths were developed from field sampling and laboratory testing data in Stantec (2010) as provided in the Investigation Conference transmittal and in URS (2010b). Historical shear strength data is also available. Law (1999) (to be provided in the EAR) presents laboratory testing results and shear strength parameters for CCR materials in the Dry Fly Ash Stack. Additional explorations provide results of in-situ testing (i.e., standard penetration test (SPT), CPT, etc.), which were used to supplement the shear strength information for the CCR materials (Stantec 2012c, Stantec 2013b). The above data was used to develop CCR shear strength parameters for static stability analyses included in the closure plan (Stantec 2013a).

Bottom Ash Pond: Recent geotechnical explorations in the Bottom Ash Pond have characterized the CCR materials present in this unit. Shear strengths were developed from field sampling and laboratory testing data in Stantec (2010) as provided in the Investigation Conference transmittal. Additional explorations provide results of in-situ testing (i.e., SPT, CPT, etc.), which were used to supplement the shear strength information for the CCR materials (Stantec 2012a). The Bottom Ash Pond closure design included additional drilling and testing. Data from this exploration was used to develop CCR shear strength parameters for static stability analyses included in the closure plan (Stantec 2016a).

Ash Disposal Area J: Recent geotechnical explorations in Ash Disposal Area J have characterized the CCR materials present in this unit. Shear strengths were developed from field sampling and laboratory testing data in Stantec (2010) as provided in the Investigation Conference transmittal and in URS (2010a). Historical shear strength data is also available. TVA (1984) previously developed shear strength parameters for CCR material in Ash Disposal Area J. Additional field explorations are proposed to support material quantity estimates in the CCR but can also be used to supplement the existing shear strength information. Refer to the Exploratory Drilling SAP (Appendix N) for more information.

Highway 70 Borrow Area: Limited data is available for the Highway 70 Borrow Area. The closure plan for the Highway 70 Borrow Area includes the results of a field exploration and in-situ testing of the CCR material. This plan was included in the Investigation Conference transmittal. Additional explorations are proposed to obtain in-situ penetration resistance data in the CCR, which can be used to supplement the existing shear strength information. Refer to the Exploratory Drilling SAP (Appendix N) for more information.

General: Based on the amount and context of data available to support a response, additional field work is not anticipated at this time to answer this information request for the Dry Fly Ash Stack, Bottom Ash Pond, and Ash Disposal Area J. The EAR will present a summary of the existing data and a characterization of the CCR shear strength for these units.

Shear strengths for CCR material in the Highway 70 Borrow Area will be developed based on new subsurface data to be collected per the proposed Exploratory Drilling SAP (Appendix N). Results will be presented in the EAR as part of the proposed stability analyses (see Section 4.4.6 and Appendix J, Stability SAP).

4.4.10 D.10 TDEC Site Conditions Request No. 10

TVA shall provide the stability calculations for final permitted design elevations for Landfills that are defined by the Federal Regulations as overfills. If the stability calculations have not been completed, then TVA shall provide stability calculations 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 Response

As noted in Section 4.4.8, the Dry Fly Stack, Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area do not meet the definition of an overfill per the CCR Rule. Therefore, this information request does not apply to JSF.

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 Dry Fly Ash Stack, Bottom Ash Pond (after closure), Ash Disposal Area J, and the Highway 70 Borrow Area do not constitute dams, as defined by TVA Standard Programs and Processes manual on Dam Safety (TVA 2016). Likewise, the units do not constitute a dam under Federal Emergency Management Agency (FEMA) guidelines, which consider both dam height and impounding capacity (FEMA 2004). The above-listed units at JSF 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 Dry Fly Ash Stack and Bottom Ash Pond are included in TVA's Dam Safety Program (due to the nature of historic operations). TVA has applicable Standard Programs and Processes that govern the dam safety analysis (TVA 2012a). TVA's Dam Safety Governance and Oversight department provides TVA with procedural standards for managing dam safety activities, oversight, and support. Objectives of the program include:

- Establish and maintain a complete inventory of all TVA dams and impoundments
- 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). For example, this approach was used as part of the Division of Solid Waste Management permitting process for the Dry Fly Ash Stack.

While the JSF Study Area is not subject to the CCR Rule for active units, as noted in Section 4.4.8, 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 J). 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 JSF 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), closure documents for the Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area addressed many aspects of structural integrity listed in the CCR Rule CFR 257.73(d) such as settlement, erosion protection, vegetative cover, and spillway adequacy (Stantec (2013a, 2016a); Tribble & Richardson, Inc. and Law Engineering, Inc. (1993, 1995)).

A summary of the above-mentioned studies will be provided in the EAR.

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 J) 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 (i.e., closed) condition. Relevant information from Sections 4.4.1 and 4.4.2 will also be taken into consideration. This evaluation will be provided in the EAR.

Based on the amount and context of data available to support a response, no additional field work is anticipated in order to answer this information request.

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 groundwater 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 will continue to conduct a records search for additional sediment and surface water investigations of the Holston River and Polly Branch. TVA will provide a discussion of information discovered that identifies CCR deposition on the aforementioned streambeds along with the new data obtained from the proposed sediment study discussed in Section 4.5.2 and the proposed surface water study discussed in Section 4.5.5 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 characterize sediment chemistry, benthic macroinvertebrate (invertebrate) community composition, and benthic invertebrate bioaccumulation in surface streams on or adjacent to the site to determine if CCR material has migrated from the JSF site into surface streams.

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 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
7. Prepare the EAR

A two-phased approach is proposed in conducting the sediment characterization study, as provided in the Benthic SAP (Appendix Q). Phase 1 will include:

- Conduct three Vibracore borings at each of nine transects in the Holston River to six-foot depth or refusal, whichever comes first
- Conduct one Vibracore boring at seven points in the Polly Branch and three Vibracore borings at each of two transects in the Polly Branch 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 forty samples)
- Collect grab samples of remainder of each sediment core, segregated by strata 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 the CCR Parameters
- Hold the deeper sediment samples for potential future analyses in Phase 2 (if >20% ash)

Proposed sampling locations for Phase 1 of the Benthic SAP (Appendix Q) have been selected based on areas subject to past/potential CCR releases or ongoing operations downstream of the detention dam that have potential to impact adjacent surface waters including:

- Locations in the Holston River adjacent to the Dry Fly Ash Stack and Ash Disposal Area J
- Locations in the Holston River adjacent to the 1973 North Dike failure
- Locations in the Polly Branch adjacent to the Bottom Ash Pond

A map of proposed sediment sampling locations for Phase 1 is provided as Figure 22 (Appendix C), and a complete description of the sampling methods and protocols is provided in the Benthic SAP (Appendix Q).

Quantitative benthic invertebrate samples will be collected during Phase 1 and are included in the Benthic SAP (Appendix Q). The benthic invertebrate samples will be collected along transects at the locations depicted on Figure 23 (Appendix C). 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 Figure 24 (Appendix C). 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 (both depurated and non-depurated) 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

Phase 2 may also include collecting sediment samples upstream of the detention dam. 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

For related information refer to Section 4.5.1. If CCR material is identified from existing information or during future sampling events to exist in sediments, then the results will be used to prepare maps showing the distribution and depth of CCR material in the Holston River and Polly Branch adjacent to JSF. 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 groundwater 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

Existing available data was reviewed to determine if previous surface stream and seep sampling have been conducted in the vicinity of JSF. Several discharge monitoring reports (DMRs) for associated outfalls were identified during the review dating from February 2009 to May 2010. The DMRs include toxicity and water quality data for the outfall locations as compared to the limits allowable by NPDES Permit No. TN0005436. No other water quality data was identified during this review. The proposed Surface Stream SAP (Appendix R) as described in Section 4.5.5 will provide additional water quality data to help determine if movement of groundwater with dissolved CCR constituents into surface streams has occurred.

TVA will report the levels of CCR constituents in the surface water and provide supporting documentation in the EAR.

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

Seeps

Since there are no known active seeps at the site, no opportunity is afforded for the collection of seep samples. Should seeps be identified in the future, a Seep SAP will be developed. Upon implementation of the SAP, the seeps will be sampled and analyzed for the presence of CCR Parameters.

Information regarding historic seeps at JSF is summarized in Appendix S.

Surface Stream Characterization Study and Associated SAP

TDEC has requested a sampling plan to characterize surface streams on and/or adjacent to JSF for the CCR Parameters. TVA will obtain surface stream samples from the Holston River and Polly Branch. 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 R) is to characterize water quality on or adjacent to the JSF 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 nine sampling locations in the Holston River and an additional nine sampling locations in Polly Branch. No sampling is proposed upstream of the JSF detention dam due to the potential for contaminated sediments in the reservoir. Disturbance of these sediments could negatively impact aquatic life. 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 surface, mid-depth, and epibenthic samples. If water depth in Polly Branch is less than 0.5 meter, then collect one sample from midway between stream bed and water surface.
    - 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 Figure 25 (Appendix C). Sample locations are co-located with sediment sampling locations. 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 contamination. 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 Benthic SAP (Appendix Q). 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

The surface stream sampling locations are identified on a map in the Surface Stream SAP (Appendix R). Once the SAP has been implemented and analytical results have been obtained, a summary of the results will be placed on the map, along with the location of any public water intakes within 1 mile of the downstream side of the site.

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 Holston River to TDEC in the Investigation Conference (Slides 121-143) 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.

The results of previously conducted fish and benthic invertebrate studies were presented in the Biological Monitoring of the Holston River Near John Sevier Fossil and Combined Cycle/Combustion Turbine Plant Discharges, Summer and Autumn 2011 report dated June 2012 (TVA 2012b) and the Biological Monitoring of the Holston River Near John Sevier Fossil and Combined Cycle/Combustion Turbine Plant Discharges, Summer and Autumn 2012 report dated April 2013 (TVA 2013b). According to the June 2012 report (TVA 2012b), benthic invertebrate community samples were collected from transects located upstream and downstream of the detention dam in August and November 2011. The resulting benthic invertebrate data were evaluated using community characteristics/metrics and through statistical diversity comparisons. The June 2012 report indicated that comparisons between sampling sites were difficult due to differences in flow, depth, and substrate types (which were impacted by the presence of the detention dam), however it appeared that a healthy benthic community existed in the vicinity of the plant. According to the April 2013 report (TVA 2013b), benthic invertebrate community samples were again collected from transects located upstream and downstream of the detention dam in August and November 2012. The resulting benthic invertebrate data were evaluated using community characteristics/metrics and through statistical diversity comparisons. The data indicated that ecological health ratings were greater downstream than upstream and had improved downstream between 2011 and 2012.Benthic invertebrate sampling locations proposed in the Benthic SAP (Appendix Q) include transects at the locations referenced in the June 2012 report.

According to the 2012 and 2013 biological monitoring reports, fish community surveys were conducted above and below the detention dam using electrofishing and gill netting methods. Fish data from the survey were analyzed using traditional statistical methods due to the lack of ability to compare data collected above and below the dam or with other reservoirs in the region. The reports indicated that although comparisons between survey sites were difficult due to differences in flow, depth, and substrate types (which were impacted by the presence of the detention dam), the fish communities upstream and downstream of the detention dam were similar to their respective control sites. Fish sampling locations proposed in the Fish Tissue SAP (Appendix T) include transects similar to the locations referenced in the 2012 and 2013 reports.

Reservoir Fish Assemblage Index (RFAI) surveys were completed between 2001 and 2003 in the Holston River (within the Cherokee Reservoir). Scores for all sites sampled in 2003 rated Good and were equal to or better than the scores for the Cherokee Reservoir transition and forebay sites.

RFAI surveys in the Holston River were discontinued after the construction of the detention dam rendered comparison of upstream and downstream communities ineffective.

Per the plant's NPDES permit, whole effluent toxicity (WET) testing has been conducted annually since 1994. From May 1995 through July 2012, the WET results have been designated as "Pass" for Outfall 001. In 2012, Bottom Ash Pond discharges were re-routed through a new outfall structure to discharge to the Holston River through Outfall 006. Outfall 001 was then closed. From August 2013 through March 2016, the WET results have been designated as "Pass" for Outfall 006. 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 groundwater 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 T) has been prepared to help assess the potential impact of JSF site activities on fish and/or aquatic life in surface streams adjacent to the site, and to assist in providing an overall view of JSF 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 JSF. Four surface water reaches have been selected for the collection of fish and associated fish tissue (Figure 26 - Appendix C).

These four 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 JSF have higher concentrations of CCR-related constituents than fish from reference locations not adjacent to or downstream from JSF. The results from implementation of this SAP will be evaluated and addressed in the EAR.

Other biological studies TVA developed as part of the biological investigation include a benthic invertebrate sediment study developed to assess the status of the benthic community, and a bioaccumulation study on mayflies. The methodologies for these studies are included in the Benthic SAP (Appendix Q).

5.0 ENVIRONMENTAL ASSESSMENT REPORT

The EIP and EAR process is described in the 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 August 3, 2016, June 22, 2017 letters, EIP Rev 1 Comments dated March 27,2018, and discussion of EIP Rev 2 proposed changes on a September 24, 2018 conference call between TDEC and TVA.

TDEC will review the report to evaluate whether the tasks have been addressed in helping determine if 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 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

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APPENDIX A
SCHEDULE

ST612104-004 TDEC Order JSF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
	TDEC Order JSF Phase 2	835.0d	04-Sep-18 A	26-Jan-22
	Environmental Investigation	835.0d	04-Sep-18 A	26-Jan-22
	Task 1 - Planning & Procurement	229.0d	04-Sep-18 A	05-Sep-19
	Work Plans (301.1 to 301.6)	99.0d	09-Oct-18	04-Mar-19
	Work Plan 1 (Exploratory Drilling)	64.0d	09-Oct-18	10-Jan-19
STN-11015	Work Plan 1 (Exploratory Drilling)	64.0d	09-Oct-18	10-Jan-19
	Work Plan 2 (GW Investigation & Water Sampling)	38.0d	24-Oct-18	18-Dec-18
STN-11115	Work Plan 2 (GW Investigation & Water Sampling)	38.0d	24-Oct-18	18-Dec-18
	Work Plan 3 - TVA Sediment/Benthic/Surface Water	30.0d	18-Jan-19	04-Mar-19
STN-11415	Work Plan 3 - Sediment/Benthic/Surface Water	30.0d	18-Jan-19	04-Mar-19
	Permits (302)	199.0d	04-Sep-18 A	05-Sep-19
	Excavation Permit (Work Plan 1 & 2)	15.0d	28-Nov-18	18-Dec-18
STN-12115	Excavation Permit (Work Plan 1 & 2)	15.0d	28-Nov-18	18-Dec-18
	CEC Rev-Fish/Mayfly/Benthic/Sed/SW (39228)	0.0d	04-Sep-18 A	04-Sep-18 A
TVA-12415	CEC Rev - Fish/Mayfly/Benthic Inv/Sed/SW	0.0d	04-Sep-18 A	04-Sep-18 A
	CEC Review for Exlporatory Drilling	199.0d	21-Nov-18	05-Sep-19
TVA-12615	CEC Review for Exlporatory Drilling	199.0d	21-Nov-18	05-Sep-19
	CEC Rev for Background Soil (North)	125.0d	21-Nov-18	21-May-19
TVA-12715	CEC Review for Background Soil Sampling (North)	125.0d	21-Nov-18	21-May-19
	Task 2 - EIP Implementation	443.0d	19-Dec-18	22-Sep-20
	Task 2A - Background Soil Investigation (401)	333.0d	11-Jan-19	07-May-20
	Initial Background Soil Sampling (South)	187.0d	11-Jan-19	07-Oct-19
STN-21096	Preparation	26.0d	11-Jan-19	19-Feb-19
STN-21010	Fieldwork	10.0d	19-Feb-19	04-Mar-19
TVA-21020	Laboratory Analysis	35.0d	21-Feb-19	10-Apr-19
STN-21098	Validation & Reports	147.0d	12-Mar-19	07-Oct-19
	Background Soil Sampling (North)	168.0d	22-May-19	23-Jan-20
STN-21205	Preparation	7.0d	22-May-19	31-May-19
STN-21220	Fieldwork	10.0d	31-May-19	13-Jun-19
TVA-21230	Laboratory Analysis	35.0d	04-Jun-19	23-Jul-19
STN-21260	Validation & Reports	147.0d	21-Jun-19	23-Jan-20
	Supp/Follow-up BGS Sampling (South)	188.0d	08-Aug-19	07-May-20
STN-21196	Preparation	26.0d	08-Aug-19	13-Sep-19
STN-21100	Fieldwork	10.0d	16-Sep-19	27-Sep-19
TVA-21110	Laboratory Analysis	35.0d	18-Sep-19	06-Nov-19
STN-21198	Validation & Reports	147.0d	07-Oct-19	07-May-20

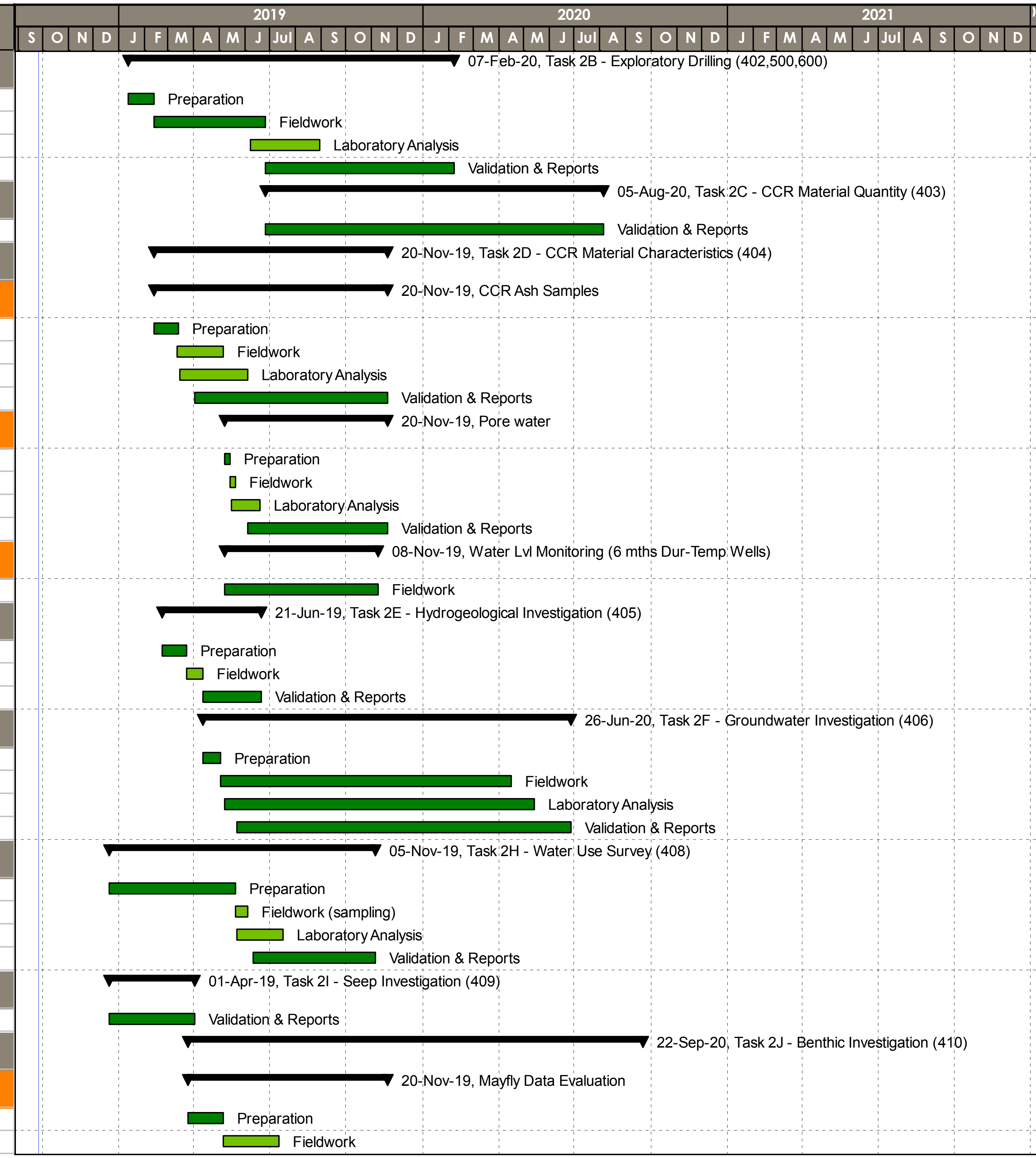
Remaining Level of Effort | Actual Work | Critical Remaining Work
Actual Level of Effort | Remaining Work | Milestone

Layout: Execution Schedule EIP (WBS) TDEC

Data Date:26-Sep-18
Print Date:18-Oct-18

ST612104-004 TDEC Order JSF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
Task 2B - Exploratory Drilling (402,500,600)		270.0d	11-Jan-19	07-Feb-20
STN-22096	Preparation	21.0d	11-Jan-19	11-Feb-19
STN-22097	Fieldwork	95.0d	11-Feb-19	25-Jun-19
STN-22040	Laboratory Analysis	60.0d	07-Jun-19	30-Aug-19
STN-22098	Validation & Reports	156.0d	25-Jun-19	07-Feb-20
Task 2C - CCR Material Quantity (403)		280.0d	26-Jun-19	05-Aug-20
STN-23098	Validation & Reports	280.0d	26-Jun-19	05-Aug-20
Task 2D - CCR Material Characteristics (404)		197.0d	11-Feb-19	20-Nov-19
CCR Ash Samples		197.0d	11-Feb-19	20-Nov-19
STN-24096	Preparation	21.0d	11-Feb-19	12-Mar-19
STN-24010	Fieldwork	40.0d	12-Mar-19	06-May-19
TVA-24020	Laboratory Analysis	58.0d	14-Mar-19	04-Jun-19
STN-24098	Validation & Reports	163.0d	01-Apr-19	20-Nov-19
Pore water		137.0d	07-May-19	20-Nov-19
STN-24094	Preparation	6.0d	07-May-19	14-May-19
STN-24110	Fieldwork	5.0d	14-May-19	20-May-19
TVA-24120	Laboratory Analysis	23.0d	16-May-19	18-Jun-19
STN-24099	Validation & Reports	118.0d	04-Jun-19	20-Nov-19
Water Lvl Monitoring (6 mths Dur-Temp Wells)		130.0d	07-May-19	08-Nov-19
STN-24097	Fieldwork	130.0d	07-May-19	08-Nov-19
Task 2E - Hydrogeological Investigation (405)		85.0d	22-Feb-19	21-Jun-19
STN-25096	Preparation	21.0d	22-Feb-19	22-Mar-19
STN-25010	Fieldwork	15.0d	22-Mar-19	11-Apr-19
STN-25098	Validation & Reports	50.0d	12-Apr-19	21-Jun-19
Task 2F - Groundwater Investigation (406)		305.0d	12-Apr-19	26-Jun-20
STN-26096	Preparation	16.0d	12-Apr-19	03-May-19
STN-26097	Fieldwork	240.0d	03-May-19	16-Apr-20
STN-26098	Laboratory Analysis	258.0d	07-May-19	14-May-20
STN-26099	Validation & Reports	276.0d	23-May-19	26-Jun-20
Task 2H - Water Use Survey (408)		222.0d	19-Dec-18	05-Nov-19
STN-28096	Preparation	105.0d	19-Dec-18	20-May-19
STN-28130	Fieldwork (sampling)	10.0d	21-May-19	04-Jun-19
TVA-28140	Laboratory Analysis	38.0d	23-May-19	17-Jul-19
STN-28098	Validation & Reports	103.0d	11-Jun-19	05-Nov-19
Task 2I - Seep Investigation (409)		70.0d	19-Dec-18	01-Apr-19
STN-29098	Validation & Reports	70.0d	19-Dec-18	01-Apr-19
Task 2J - Benthic Investigation (410)		379.0d	25-Mar-19	22-Sep-20
Mayfly Data Evaluation		168.0d	25-Mar-19	20-Nov-19
STN-29202	Preparation	31.0d	25-Mar-19	06-May-19
TVA-29210	Fieldwork	48.0d	06-May-19*	12-Jul-19



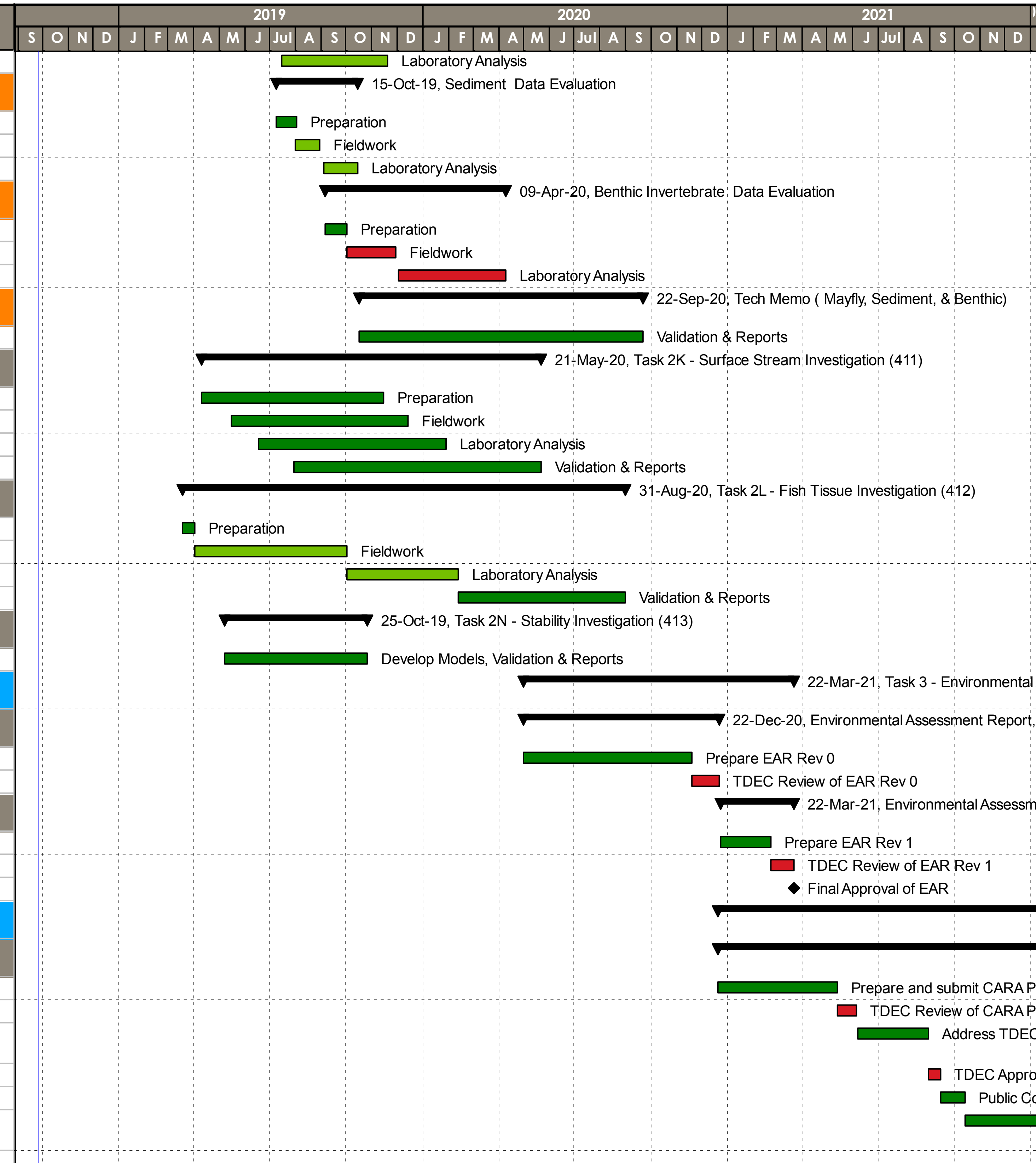
Remaining Level of Effort | Actual Work | Critical Remaining Work | Actual Level of Effort | Remaining Work | Milestone

Layout: Execution Schedule EIP (WBS) TDEC

Data Date: 26-Sep-18
Print Date: 18-Oct-18

ST612104-004 TDEC Order JSF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
TVA-29212	Laboratory Analysis	90.0d	15-Jul-19	20-Nov-19
Sediment Data Evaluation		70.0d	08-Jul-19	15-Oct-19
STN-29216	Preparation	19.0d	08-Jul-19	01-Aug-19
TVA-29221	Fieldwork	22.0d	01-Aug-19	30-Aug-19
TVA-29222	Laboratory Analysis	30.0d	03-Sep-19	15-Oct-19
Benthic Invertebrate Data Evaluation		149.0d	05-Sep-19	09-Apr-20
STN-29227	Preparation	19.0d	05-Sep-19	01-Oct-19
TVA-29228	Fieldwork	41.0d	01-Oct-19	29-Nov-19
TVA-29232	Laboratory Analysis	90.0d	02-Dec-19	09-Apr-20
Tech Memo (Mayfly, Sediment, & Benthic)		236.0d	16-Oct-19	22-Sep-20
STN-29A098	Validation & Reports	236.0d	16-Oct-19	22-Sep-20
Task 2K - Surface Stream Investigation (411)		282.0d	10-Apr-19	21-May-20
STN-29330	Preparation	153.0d	10-Apr-19	15-Nov-19
STN-29334	Fieldwork	147.0d	15-May-19	13-Dec-19
TVA-29342	Laboratory Analysis	155.0d	17-Jun-19	29-Jan-20
STN-29362	Validation & Reports	205.0d	30-Jul-19	21-May-20
Task 2L - Fish Tissue Investigation (412)		369.0d	18-Mar-19	31-Aug-20
STN-29509	Preparation	11.0d	18-Mar-19	01-Apr-19
TVA-29510	Fieldwork	129.0d	01-Apr-19	01-Oct-19
TVA-29520	Laboratory Analysis	90.0d	02-Oct-19	12-Feb-20
STN-29522	Validation & Reports	140.0d	13-Feb-20	31-Aug-20
Task 2N - Stability Investigation (413)		120.0d	07-May-19	25-Oct-19
STN-29798	Develop Models, Validation & Reports	120.0d	07-May-19	25-Oct-19
Task 3 - Environmental Assessment Report (EAR)		222.0d	01-May-20	22-Mar-21
Environmental Assessment Report, Rev 0		162.0d	01-May-20	22-Dec-20
STN-31096	Prepare EAR Rev 0	140.0d	01-May-20	19-Nov-20
STN-31150	TDEC Review of EAR Rev 0	22.0d	20-Nov-20	22-Dec-20
Environmental Assessment Report, Rev 1		60.0d	23-Dec-20	22-Mar-21
STN-32096	Prepare EAR Rev 1	40.0d	23-Dec-20	22-Feb-21
STN-32170	TDEC Review of EAR Rev 1	20.0d	23-Feb-21	22-Mar-21
STN-32180	Final Approval of EAR	0.0d		22-Mar-21
Task 10 - CARA		275.0d	21-Dec-20	26-Jan-22
Meetings & Deliverables		275.0d	21-Dec-20	26-Jan-22
STN-98254	Prepare and submit CARA Plan Rev 0 for TDEC Review	100.0d	21-Dec-20	13-May-21
TVA-98255	TDEC Review of CARA Plan Rev 0	15.0d	14-May-21	04-Jun-21
STN-98256	Address TDEC Comments on CARA Plan Rev 0, Prepare and submit Rev 1 to TDEC	60.0d	07-Jun-21	30-Aug-21
TVA-98295	TDEC Approval of CARA Plan Rev 1	10.0d	31-Aug-21	14-Sep-21
STN-98296	Public Comment Period	20.0d	15-Sep-21	13-Oct-21
STN-98298	Address Public Comments on CARA Plan Rev 1 and Prepare CARA Plan Rev 2 for TDEC	60.0d	14-Oct-21	11-Jan-22
TVA-98345	TDEC Final Approval of CARA Plan Rev 2	10.0d	12-Jan-22	26-Jan-22



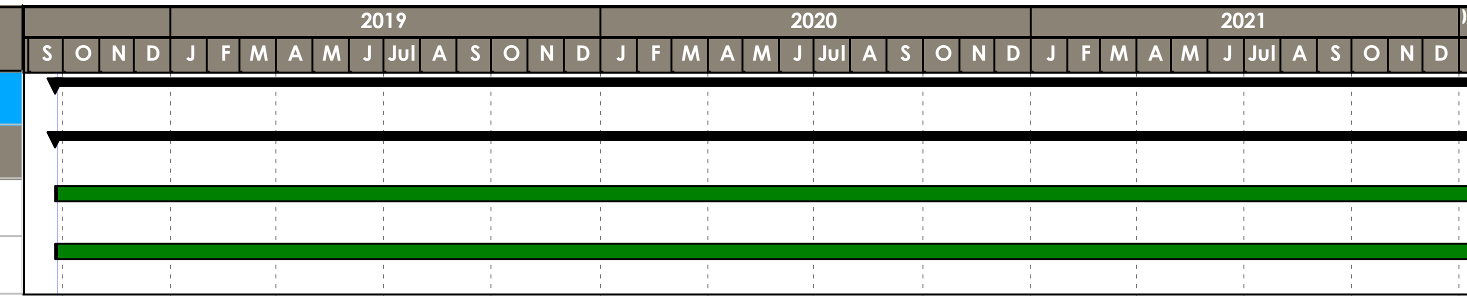
Remaining Level of Effort / Actual Level of Effort	Actual Work / Remaining Work	Critical Remaining Work / Milestone

Layout: Execution Schedule EIP (WBS) TDEC

Data Date:26-Sep-18
Print Date:18-Oct-18

ST612104-004 TDEC Order JSF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
Task 11 - Project Communic & Reporting (901)		835.0d	25-Sep-18 A	26-Jan-22
TDEC Updates		835.0d	25-Sep-18 A	26-Jan-22
TVA-96110	TDEC Monthly Progress Reports	835.0d	25-Sep-18 A	26-Jan-22
TVA-96120	TDEC Progress Update Meetings (Quarterly)	835.0d	25-Sep-18 A	26-Jan-22



Remaining Level of Effort
Actual Level of Effort
Actual Work
Remaining Work
Critical Remaining Work
Milestone

Layout: Execution Schedule EIP (WBS) TDEC

Data Date:26-Sep-18
Print Date:18-Oct-18

APPENDIX B
REGULATORY CORRESPONDENCE

A60 970131 001

CERTIFIED MAIL # 30,418
RETURN RECEIPT REQUESTED

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
JOHNSON CITY ENVIRONMENTAL FIELD OFFICE
2305 SILVERDALE ROAD
JOHNSON CITY, TENNESSEE 37601-2162
(423) 854-5400 FAX (423) 854-5401

~~Jamm~~
dwn
Re: hems

January 22, 1997

Mr. Bob Harris, Assistant Manager for Environmental Affairs
Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402-2801

Re: Approval of Final Closure Certification
TVA-John Sevier Fossil Plant-Borrow Area Ash Stack
NRS 37-104-0028

Dear Mr. Harris:

Following a site inspection of the above referenced non-registered site conducted on November 4, 1996, the Division of Solid Waste Management hereby approves the Borrow Area Ash Stack closure. The one year maintenance period as specified in the approved Closure/Post-Closure Plan begins from the date of your receipt of this letter.

Further, regulation number 1200-1-7-.04(8)(g)5. of the Rules Governing Solid Waste Disposal and Processing in the State of Tennessee states, 'If the dump is closed on-site, the owner/operator must ensure that, within 45 days of the dump closure and prior to sale or lease of property on which the dump is located, there is recorded a notation on the deed to the property or on some other instrument which is normally examined during title search that will in perpetuity notify any person conducting a title search, that the land has been used as a disposal facility.' Please provide the Division documentation of the notice to the Deed of the property when transacted.

RECEIVED
JAN 3 1997
Environmental Affairs

A60 970129 001

CERTIFIED MAIL # 30,417
RETURN RECEIPT REQUESTED

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
JOHNSON CITY ENVIRONMENTAL FIELD OFFICE
2305 SILVERDALE ROAD
JOHNSON CITY, TENNESSEE 37601-2162
(423) 854-5400 FAX (423) 854-5401

jwm
dwn
xc: harris

January 22, 1997

Mr. Bob Harris, Assistant Manager for Environmental Affairs
Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402-2801

Re: Approval of Final Closure Certification
TVA-John Sevier Fossil Plant-Ash Disposal Area Pond J
NRS 37-104-0062

Dear Mr. Harris:

Following a site inspection of the above referenced non-registered site conducted on November 4, 1996, the Division of Solid Waste Management hereby approves the Ash Disposal Area Pond J closure. The required post-closure care activities as specified in the approved Closure/Post-Closure Plan commences as of the date of receipt of this approval also.

Further, Regulation Number 1200-1-7-.04(8)(g)5. of the Rules Governing Solid Waste Disposal and Processing in the State of Tennessee states, 'If the dump is closed on-site, the owner/operator must ensure that, within 45 days of the dump closure and prior to sale or lease of the property on which the dump is located, there is recorded a notation on the deed to the property or on some other instrument which is normally examined during title search that will in perpetuity notify any person conducting a title search, that the land has been used as a disposal facility.' Please provide the Division documentation of the notice to the Deed of the property when transacted.

RECEIVED
97013000108
JAN 27 1997
Environmental Affairs

A60 070420 500

Amos

Env. Document Type: Solid Waste Correspondence

ENVIRONMENTAL ASSISTANCE CENTER
TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2305 SILVERDALE ROAD
JOHNSON CITY, TENNESSEE 37601-2162
(423) 854-5400 STATEWIDE 1-888-891-8332 FAX (423) 854-5401

April 9, 2007

Mr. Gordon G. Park
Manager of Environmental Affairs
Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402-2801

RE: Approval of Minor Modification Request for Change in Operational Plan
TVA John Sevier Fossil Plant Class II Disposal Facility, Reg. Number IDL 37-0097

Dear Mr. Park:

On March 30, 2007, the Division of Solid Waste Management (DSWM) received a minor permit modification request (JCFO file 37-31-3 PM 11) for changes to the operational plan at the John Sevier Fossil Plant-Dry Ash Stacking Facility (JSF) to allow a second operational area. This second disposal area is needed for upcoming testing of nitrogen oxide (NOx) reduction equipment at the plant will be used concurrently with the main operational disposal area.

After review of the submitted documents, the DSWM hereby approves the minor modification request. The revised operational manual pages and the engineering drawing should be incorporated into the facility's copy of the approved permit as appropriate and maintained at the JSF facility. Please provide this office with two additional originals.

If you have any questions concerning this communication, please contact this office at (423) 854-5400.

Sincerely,

xc: R.W. Sims, JSF 1A-RGT
EDM, WT CA-K

Chris M. Lamb

Chris M. Lamb, EPS
Division of Solid Waste Management

RECEIVED
APR 18 2007
ENVIRONMENTAL AFFAIRS

TVA

Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402-2801

August 28, 2008

Mr. Chris Lamb, Project Manager
Johnson City Environmental Assistance Center
Division of Solid Waste Management
Tennessee Department of Environment and Conservation
2305 Silverdale Road
Johnson City, Tennessee 37601

Dear Mr. Lamb:

TENNESSEE VALLEY AUTHORITY (TVA) - JOHN SEVIER FOSSIL PLANT (JSF) - DRY ASH STACKING FACILITY – IDL 37-0097 – REQUEST FOR MINOR PERMIT MODIFICATION AND REVISIONS TO THE OPERATIONS MANUAL

The two year test period for the nitrogen oxide (NOx) reduction equipment, termed High Energy Reduction Technology (HERT) is scheduled to end in November 2008. This equipment is being tested in a single JSF power generation unit during this time period and involves the introduction of ammonia to the flue gas stream which reacts with NOx emissions. TVA plans to install similar equipment on the remaining three JSF power generation units and perform startup testing by the end of December 2008. Full operation of the HERT equipment on all four steam generating units will be initiated by January 1, 2009.

In a meeting at your office on April 24, 2008, the Tennessee Department of Environment and Conservation (TDEC) indicated that due of the concentration of ammonia and its potential to adversely affect ground water, a barrier liner would need to be placed between the existing ash and any subsequently produced ammoniated ash once the test period has ended. TDEC further indicated that the installation of the barrier liner would be considered a minor permit change.

Consequently, TVA is requesting your review and approval of the attached modification to the Operations Manual and associated drawings in order to allow the continued disposal of the HERT treated coal combustion ash on a lined portion of the JSF Dry Fly Ash Stacking Facility. The installation of the liner system would be accomplished in two phases as indicated in the enclosed drawings.

A summary of the revisions to the Operations Manual follows:

1. Section I (Site Information), Subsection A - Contact information updated.
2. Section II - (Description of Solid Waste), Subsection A - Add description and schedule for the installation and testing of HERT equipment.
3. Section II - (Description of Solid Waste), Subsection B - Add expected marketing impact.
4. Section III - (Daily Operations), Subsection A, (8) and (9) - Update description of restrictions limiting the placement of HERT ash, and surveying the HERT test cell prior to covering the area.

5. Section IV - (Surface Water Management System) - Updates description of surface water treatment of area and removal of the 24-inch storm water runoff pipe during filling operation.
6. Section VI - (Leachate Control and Management System) - Add description of geocomposite liner and leachate collection systems.
7. Section XI - (Quality Assurance/Quality Control) - Add description of the quality assurance requirements for Phase I and II liners.
8. Appendix K - Adds Specifications for Geosynthetic Liner and Leachate Collection Components.
9. Appendix L - Adds Construction Quality Assurance Plan for Geosynthetic Liner Components.

In addition, there are a few minor housekeeping revisions related to typographical errors, table of contents, and changed conditions.

A summary of the revisions to the design and operational sequence drawings follows:

- Drawing Numbers 10H291-1 through 10H291-13 have not been revised and will continue to be a part of the permit documents.
- Drawing Numbers 10W204-1, -5, and -6 have not been revised, and will continue to be a part of the permit documents.
- Drawing Numbers 10W204-2 through -4, and -7 through -9 have been replaced.
- Drawing Numbers 10W204-10 through -12 have been added.

Three copies of the minor permit change request package are provided for your use.

I certify this information was prepared by a system designed to ensure qualified personnel properly gathered and evaluated the information submitted. The information submitted is to the best of my knowledge and belief true, accurate, and complete.

If you have further questions or need further clarification, please call John Dizer at (423) 751-7636 in Chattanooga.

Cynthia M. Anderson

Cynthia M. Anderson
Acting Manager
Water, Waste and Regulatory Programs
5D Lookout Place

Enclosures

STATE OF TENNESSEE
TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
JOHNSON CITY ENVIRONMENTAL FIELD OFFICE
2305 SILVERDALE ROAD
JOHNSON CITY, TENNESSEE 37601-2162
(423) 854-5400 STATEWIDE 1-888-891-8332 FAX (423) 854-5401

September 4, 2008

Ms. Cynthia M. Anderson, Acting Manager
Water, Waste and Regulatory Programs
Tennessee Valley Authority
5D Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

RE: Approval of Minor Modification Request- Liner/Leachate Collection System
TVA John Sevier Fossil Plant Class II Disposal Facility, Reg. Number IDL 37-0097

Dear Ms. Anderson:

On September 2, 2008, the Division of Solid Waste Management (DSWM) received a formal minor permit modification request (JCFO file 37-31-3 PM 15) for changes to the engineering plans and operations manual at the John Sevier Fossil Plant-Dry Ash Stacking Facility (JSF) to install a liner and leachate collection system (LLCS) in the east fill area. The LLCS is needed to protect ground water at the facility from the changes in the waste composition due to installation of additional pollution control devices at the plant.

After review of the submitted documents, the DSWM hereby approves the minor modification request. The revised operational manual pages and the engineering drawings should be incorporated into the facility's copy of the approved permit as appropriate and maintained at the JSF facility.

If you have any questions concerning this communication, please contact this office at (423) 854-5400.

Sincerely,

Chris M. Lamb, EPS
Division of Solid Waste Management

STATE OF TENNESSEE
TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
JOHNSON CITY ENVIRONMENTAL FIELD OFFICE
2305 SILVERDALE ROAD
JOHNSON CITY, TENNESSEE 37601-2162
(423) 854-5400 STATEWIDE 1-888-891-8332 FAX (423) 854-5401

March 4, 2013

Ms. Cynthia M. Anderson, Senior Manager
Water and Waste Compliance
Tennessee Valley Authority
1101 Market Street
BF4A-C
Chattanooga, Tennessee 37402-2801

RE: Approval of Revised C/PCP and Operations Manual
TVA John Sevier Fossil Plant Class II Disposal Facility, Reg. Number IDL 37-0097

Dear Ms. Anderson:

On February 19, 2013, the Division of Solid Waste Management (DSWM) received a revised operations manual (OP) and closure/post-closure plan (C/PCP) as a minor permit modification request (JCFO file 37-31-3 PM 33) at the John Sevier Fossil Plant-Dry Ash Stacking Facility (JSFP). The initial submittal was on June 25, 2012. A subsequent revised submittal was received on December 2012. An enhanced final cap system and improved storm water control system has been developed with relevant updates/revisions to the OP and the C/PCP. The redeveloped C/PCP was primarily needed as a result of the facility anticipating closure occurring prior to achieving permitted final grades and also deciding to utilize a different final closure barrier (FML vs. GCL).

After review of the submitted documents, the DSWM hereby approves the minor modification request. The revised OP and CPCP will replace the current documents in toto and must be maintained at the JSFP facility.

If you have any questions concerning this communication, please contact this office at (423) 854-5400.

Sincerely,

Christopher M. Lamb

Christopher M. Lamb
Division of Solid Waste Management

STATE OF TENNESSEE
TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
JOHNSON CITY ENVIRONMENTAL FIELD OFFICE
2305 SILVERDALE ROAD
JOHNSON CITY, TENNESSEE 37601-2162
(423) 854-5400 STATEWIDE 1-888-891-8332 FAX (423) 854-5401

October 3, 2014

Mr. Sam W. Hixon, Manager
Waste Permits, Compliance, and Monitoring
Tennessee Valley Authority
1101 Market Street, BF4A
Chattanooga, Tennessee 37402-2801

RE: Approval of Minor Modification, Decrease in Final Stack Height and Leachate Pond
TVA John Sevier Fossil Plant Class II Disposal Facility, Reg. Number IDL 37-0097

Dear Mr. Hixon:

On October 1, 2014, the Division of Solid Waste Management (DSWM) received a minor permit modification request (JCFO file 37-31-3 PM 38) for the John Sevier Fossil Plant-Dry Fly Ash Stacking Facility (JSFP). The minor permit modification is needed because the facility will not achieve the final permitted contours due to the fossil plant closing. More detailed final contour drawings will be redeveloped as a result and will follow the steps outlined in the facility's approved closure plan for 'partial closure'. Also, the facility requested a modification to the current leachate collection pond to allow it to be capped to limit infiltration and reduce long term maintenance. The pond will still function similarly, but will be filled with gravel and capped.

Please be advised that your request is hereby approved. The Stantec drawings submitted with your September 29, 2014, submittal are now considered part of the facility's permit as addenda to the approved closure plan. Prior to the implementation of closure, TVA will submit the revised closure plan documents to the DSWM for review.

Please let us know if you have any questions concerning this correspondence. We may be reached at (423) 854-5400.

If you have any questions concerning this communication, please contact this office at (423) 854-5400.

Sincerely,

Chris M. Lamb, EPS, Johnson City Field Office
Division of Solid Waste Management

Richard A. Whitson, P.E., Manager, Johnson City Field Office
Division of Solid Waste Management

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Solid Waste Management
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 14th Floor
Nashville, Tennessee 37243

October 24, 2014

Mr. Sam W. Hixson, Manager
Waste Permits, Compliance and Monitoring
Tennessee Valley Authority
1101 Market Street
Chattanooga TN 37402

RE: Approval of Closure Certification: Tennessee Valley Authority (TVA) John Sevier Fossil Plant-Dry Ash Stacking Facility Landfill-IDL 370000097 (Stage One Area-Approximately 13 Acres)

Dear Mr. Hixson:

On September 4, 2014, the Division of Solid Waste Management (DSWM), Johnson City Environmental Field Office, received closure certification from the above referenced facility. Based on a review of the certification document and upon a facility inspection conducted on July 16, 2014, verification of final closure for TVA John Sevier Fossil Plant Dry Ash Stacking Facility Landfill-Stage One Area, has been determined to be complete and approval is hereby granted.

Since TVA is a federal government entity, they are not required to post any financial assurance; however, the State of Tennessee does require TVA to maintain post closure procedures for the TVA John Sevier Fossil Plant Dry Ash Stacking Facility Landfill-Stage One Area.

Further, the thirty (30) year post closure care period for TVA John Sevier Fossil Plant Dry Ash Stacking Facility Landfill-Stage One Area will not begin until the entire site is closed. All post closure care activities outlined in Rule 0400-11-01-.04(8)(c) and all post closure care activities specified in the facility's approved Closure-Post Closure Plan must be followed as required.

Please contact Bassam Faleh at 615-532-0796 with questions concerning the closure certification.

Sincerely,

Patrick J. Flood

Patrick J. Flood, P.E.
Director

PJF/BHF/ljb

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Solid Waste Management
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 14th Floor
Nashville, Tennessee 37243

April 17, 2015

Mr. Sam W. Hixson, Manager
Waste Permits, Compliance and Monitoring
Tennessee Valley Authority
1101 Market Street
Chattanooga TN 37402

RE: Approval of Closure Certification: Tennessee Valley Authority (TVA) John Sevier Fossil Plant-Dry Ash Stacking Facility Landfill-IDL 370000097 (Stage Two Area-Approximately 38 Acres)

Dear Mr. Hixson:

On December 30, 2014, the Division of Solid Waste Management (DSWM), Johnson City Environmental Field Office, received closure certification from the above referenced facility. Based on a review of the certification document and upon a facility inspection conducted on April 7, 2015, verification of final closure for TVA John Sevier Fossil Plant Dry Ash Stacking Facility Landfill-Stage Two Area, has been determined to be complete and approval is hereby granted.

Since TVA is a federal government entity, they are not required to post any financial assurance; however, the State of Tennessee does require TVA to maintain post closure procedures for the TVA John Sevier Fossil Plant Dry Ash Stacking Facility Landfill-Stage Two Area.

Further, the thirty (30) year post closure care period for TVA John Sevier Fossil Plant Dry Ash Stacking Facility Landfill-Stage Two Area will not begin until the entire site is closed. All post closure care activities outlined in Rule 0400-11-01-.04(8)(c) and all post closure care activities specified in the facility's approved Closure-Post Closure Plan must be followed as required.

Please contact Bassam Faleh at 615-532-0796 with questions concerning the closure certification.

Sincerely,

Patrick J. Flood

Patrick J. Flood, P.E.
Director

PJF/BHF/ljb

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Solid Waste Management
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 14th Floor
Nashville, Tennessee 37243

April 15, 2016

Mr. Sam W. Hixson, Manager
Waste Permits, Compliance and Monitoring
Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402

RE: Approval of Closure Certification: Tennessee Valley Authority (TVA) John Sevier Fossil Plant-Dry Ash Stacking Facility Landfill-IDL 370000097-Stage Three, Phase III Area (Approximately 42 Acres)

Dear Mr. Hixson:

On March 9, 2016, the Division of Solid Waste Management (DSWM), Johnson City Environmental Field Office, received closure certification from the above referenced facility. Based on a review of the certification document and upon a facility inspection conducted on April 13, 2016, verification of final closure for TVA John Sevier Fossil Plant Dry Ash Stacking Facility Landfill- Stage Three, Phase III Area, has been determined to be complete and approval is hereby granted.

Since TVA is a federal government entity, they are not required to post any financial assurance; however, the State of Tennessee does require TVA to maintain post closure procedures for the TVA John Sevier Fossil Plant Dry Ash Stacking Facility Landfill- Stage Three, Phase III Area.

Further, the thirty (30) year post closure care period for TVA John Sevier Fossil Plant Dry Ash Stacking Facility Landfill- Stage Three, Phase III Area will not begin until the entire site is closed. All post closure care activities outlined in Rule 0400-11-01-.04(8)(c) and all post closure care activities specified in the facility's approved Closure-Post Closure Plan must be followed as required.

Please contact Bassam Faleh at 615-532-0796 with questions concerning the closure certification.

Sincerely,

Patrick J. Flood, P.E.
Director

PJF/BHF/ljb

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

August 3, 2016

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

RE: TVA John Sevier 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 June 8th and 9th 2016 regarding the TVA John Sevier Fossil Plant (JSF Site). 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 the JSF Site. Our staff easily understood the information presented and greatly appreciated the opportunity to ask questions and to discuss technical issues. The JSF Site has CCR disposal sites adjacent to the Holston River and Polly Branch Creek. The Coal Fired plant at the JSF site is no longer operating and demolition is in process.

Our staff members met following the June 8th and 9th 2016 JSF Site meeting to discuss what we learned about the site and we identified additional information needed from TVA to fully understand the site's 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 environmental investigation work and/or additional information needed at each TVA CCR site. TVA is required to submit this information in a proposed Environmental Investigation Plan (EIP).

TDEC identified information needed specifically for the JSF Site or information that TVA shall include in the Environmental Assessment Report (EAR) submitted once Environmental Investigation is complete. Please find the specific JSF Site comments below:

1. Cadmium (Cd) results from the analysis of ground water monitoring samples exceeded the Cd MCL from October 2007 till April 2011. As a part of the Environmental Investigation Plan, TVA shall analyze all samples for the constituents as described in Attachment A.

   Upon completion of sampling, TVA shall submit the results of sample analyses in the Environmental Assessment Report. The EAR for the TVA JSF site shall include all ground water monitoring sampling locations and the results from all ground water samples collected. The EAR shall identify sampling locations where analysis of ground water monitoring samples indicated the level of constituents' results exceeded either the Maximum Contaminant Level (MCL) as defined in the TN Public Drinking Water regulations or background levels in local ground water. TVA shall include in the EAR the history of Cd sampling at the JSF site, the ground water sampling data for Cd and report if monitoring well sampling was discontinued after 2011 and if so why.

2. Groundwater monitoring parameters are being reported in two different tables in the information provided by TVA for the JSF site:

   a. Table 2 = Primary Constituents
   b. Table 3 = Other Permit Required Constituents

   In the EAR for the JSF Site, please include all ground water monitoring results in one Excel workbook by sampling location and sampling date. The workbook should include the sampling dates and whether constituents exceed Drinking Water MCLs or background levels for constituents without MCLs. - Reference Groundwater Monitoring Report – November 2015.

3. TVA shall install a minimum of one up gradient and three down gradient monitoring wells at each of the four disposal units at the JSF site. The wells should be located and constructed to provide representative groundwater samples from the upper most aquifer. A description of the drilling method, well logging, well construction and well development shall be provided in the EIP. TVA shall provide a schedule for the placement construction and development of additional borings/groundwater monitoring wells.

4. Page 113 of the multisite order presentation references active facilities and that TVA is in the process of determining the uppermost aquifer at the JSF Site. Ongoing work as well as additional work to determine the uppermost aquifer at the JSF site shall be included in the JSF Site EIP. TVA shall provide a ground water potentiometric surface map for the Highway 70 borrow area and Ash Disposal area J as a part of the JSF site EAR.

5. The JSF Site EIP shall describe how TVA will determine if the piezometric surface and the potentiometric surface are hydraulically connected. TVA shall include in the JSF Site EAR the results of this investigation including if there are differences between the ground water piezometric surface and potentiometric surface and explain if the piezometric surface and potentiometric surface are distinctly different from the uppermost aquifer at this site.

6. TVA shall identify the processes it plans to use to estimate the amount of CCR material that is below the highest recorded ground water potentiometric surface at the JSF Site.

7. TVA shall provide a copy of the seismic hazard study performed by AMEC Geomatrix, Inc. referenced on page 94 of the multisite order presentation with the JSF Site EIP. TVA shall explain in the JSF Site EAR how the horizontal seismic coefficient of 0.115g was determined. The data and formulae used to make this determination shall also be included.

8. Stantec recommended further work at the TVA JSF site in the "February 8, 2010 Report of Geotechnical Exploration". TVA shall explain whether it took the actions recommended, the data generated from that work and the results from implementing the recommendations when it submits the JSF Site EAR,

9. The TVA shall provide, in the JSF site EIP, a description of the process it plans to use to determine if dike construction at the TVA JSF site is susceptible to failure. While TVA may have historic data for dike construction, TVA shall perform proposed additional on-site activities to definitively determine dike construction materials and the location and relative amount of the different materials in the dikes. The JSF Site EAR shall contain this information as well as data that confirm CCR materials used to raise the dikes and a determination if the use of CCR materials contributed to the North Dike Failure in 1973. TVA shall describe the repairs made to the North Dike Failure after the 1973 repair and if any additional repair work is anticipated.

10. TVA shall propose the method(s) it will implement to better define the physical characteristics of the clay layer identified below the compacted ash. This includes (1) compaction if any, (2) the occurrence of rock or debris in the clay that would reduce permeability and (3) the depth and location of the clay layers referenced on page 111 of the TVA JSF Fossil Plant multisite order presentation.

11. TVA shall provide the date of the drawing set with the 10W204-combined file name.

12. TVA shall provide data for the location and depth of borings 33B, 34B, 33A and 33B presented on drawing 10W507-09. The borings shall be mapped with their location relative to the liner system present in the "Bathtub Area" (Drawing 10W507-02). TVA shall provide geotechnical data and stability calculations that transect and include the liner system of the ammoniated ash fill area and also provide cross section E-E' indicated on drawing 10W502-1.

13. As a part of the JSF Site EAR, TVA shall provide geotechnical data and stability calculations for the critical sections of the final geometry should the Bottom Ash Stacking plan be implemented as planned.

Please find attached to this letter a guidance document which contains a general description of the items that shall be addressed in the Environmental Investigation Plan for each TVA Fossil (active and closed). In addition to the JSF Site specific information listed above.

TVA shall submit the proposed EIP for the TVA John Sevier site on or before close of business on November 3, 2016.

Attachment 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. TVA shall provide 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 III Detection Monitoring and Appendix IV Assessment Monitoring found on page 21500 of the Friday, April 17, 2015 Federal Register (Appendix III and IV 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 Table Appendix 3 of the EPA CCR regulations and the constituents for Ground Water Assessment Monitoring are listed in Table 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 Tables 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 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.

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 the stability calculations for final permitted design elevations for Landfills that are defined by the Federal Regulations as overfills. If the stability calculations have not been completed, then TVA shall provide stability calculations 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.;

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 Appendix 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 Appendix 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.

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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.

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.

<u>TVA Kingston (KIF Environmental Investigation Comments and Questions</u>

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.

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Robert J. Martineau, Jr.
Commissioner

Bill Haslam
Governor

March 27, 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 John Sevier Coal Fired Fossil Fuel Plant
Environmental Investigation Plan Revision 1 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.

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.

<u>John Sevier CCR site EIP Rev 1 Comments</u>

TVA submitted the EIP Rev 1 for TVA John Sevier Coal Fired Fossil Power Plant (TVA JSF) on December 15, 2017. TDEC has completed its review of EIP Rev 1 and is providing comments listed in the attached **Table 1 TVA John Sevier 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 **May 25, 2018**.

TDEC's goal is to work with TVA to ensure the environmental investigation of the TVA JSF 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:	Bryan Wells	Britton Dotson	James Clark
	Pat Flood	Chuck Head	Rob Burnette
	Tisha Calabrese Benton	Angela Adams	Joseph E. Sanders
	Shawn Rudder	Peter Lemiszki	

TVA John Sevier EIP Rev 1
Summary of Comments

Section Number	Section Title	Page	Paragraph	Line	Comment
General Comment	All	All	All	All	Present a site wide contour map depicting the top of bedrock surface elevation as encountered in borings, denote if the boring was drilled using direct push, hollow-stem auger methods or other.
General Comment	All	All	All	All	TVA will determine if buried bedrock valleys potentially associated with the pre-construction stream locations locally control flow in the overburden aquifer and if present if they are associated with highly fractured zones within the shale.
3.1.2	TDEC Site-Specific Information Request No. 2	9	2	8	Please provide well installation and well abandonment records for wells depicted on Figure 2.
3.1.2	TDEC Site-Specific Information Request No. 2	9	3	1	TVA will also include a table that documents the water quality parameters measured in the field at the time of sample collection and will provide field forms as an appendix. At a minimum the table will summarize pH, specific conductance, DO and turbidity.
3.1.3	TDEC Site-Specific Information Request No. 3	10	1	1	Did TVA will collect soil samples through the well screen interval at the locations of the newly installed potential background groundwater monitoring wells. If so, were they analyzed for CCR parameters?
3.1.3	TDEC Site-Specific Information Request No. 3	10	1-3	all	Please provide well installation and well abandonment records for wells mentioned in this section.

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Section Number	Section Title	Page	Paragraph	Line	Comment
3.1.3	TDEC Site-Specific Information Request No. 3	10	3	10	Sentence reads "*New and existing well locations are shown on Figure 3.*" This is potentially a typo and should actually reference Figure 2. Figure 3 depicts the locations of the proposed wells.
3.1.3	TDEC Site-Specific Information Request No. 3	11	1	1	This section states "*if bedrock wells are required…*" whereas in section 4.1.5 the statement is made that *"TVA plans to install new bedrock monitoring wells to characterize groundwater flow at JSF.*" and that they are described in Appendix H and Appendix N. Appendix H does not indicate that bedrock wells will be installed nor does the figure indicate where these bedrock wells will be located. Appendix N states "*In proposed borings with rock coring, the following suite of geophysical analyses will be performed to investigate groundwater conditions deeper in the bedrock.*" The figure does not indicate bedrock borings. Please clarify.
3.1.3	TDEC Site-Specific Request No. 3	20/906	last		TVA needs to provide more detail of what type of statistical analysis it will employ to determine background concentrations of constituents.
3.1.5	TDEC Site-Specific Request No. 5	20/906	1	1 & 2	TVA needs to clarify what they mean by "piezometeric surface" and "potentiometric surface" in relation to the Site hydrogeology, and incorporate into cross sections.
3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4		TVA needs to clarify how and how often the river elevations are recorded on the river gauge downstream of the detention dam.

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Section Number	Section Title	Page	Paragraph	Line	Comment
3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4		TVA needs to clarify how if the low point of the Lower Road dike is at an approximate elevation of 1,075 feet and all of the other available river elevation times were below elevation 1,072 feet, how was it documented that on a June 6, 2017 TDEC DSWM Post-Closure Inspection that the lower road was recently flooded due to river flooding and wood debris was observed in and across the lower road (water was still over portions of the lower road during my inspection with Chris Lamb(TDEC) and Tonya Bailey (TVA)).
3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4		TVA needs to clarify what the recorded river elevations were between June 4, 2017 through June 7, 2017.
3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4		In the past, TVA had thought the toe drain was hydraulically connected or related to the river water and most of the leachate being pumped was due to the river water. TVA needs to clarify or investigate the hydraulically connectivity of the river water and toe drain and if the leachate generation is related to the water elevation of the river, using the leachate generation records rain fall data and other retained records.
3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4		TVA needs to clarify what happens if the river elevation rose to an elevation equal to the man-holes, pump stations or top and/or bottom of the toe drain, if then the river water and toe drain would be then be hydraulically connected.
3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4	8	TVA needs to clarify their response to sub-part 3.1.8(b)(ii). If it is meant to explain that since the discharge point is not located at or near the constructed elevation of the top of the toe drain and that since the leachate is being pumped to higher elevation, that the toe drain and river water is not hydraulically connected, please clarify how it different from a normal toe drain.

Section Number	Section Title	Page	Paragraph	Line	Comment
3.1.8 & 4.0	TDEC Site-Specific Request No. 8 & Appendix I - Evaluation of Existing Geotechnical Data JSFP (Additional Discussion of Selected Information Requests)	22-23/906 & 629-631/906	4, Figure 4 and 5	8	TVA states in their response, in sub-part 3.1.8(b)(iii), that the toe drain was constructed in the clay dike laterally outside of the Stage 2 closure area. It also appears on the cross-sections in Appendix I - "Evaluation of Existing Geotechnical Data JSFP, Figure 4 and 5", to be very close to rip-rap otter edge. TVA needs to clarify if the river water and toe drain maybe hydraulically connectivity, if the river water rose to the elevation equal to or greater than the bottom elevation of the toe drain?
4.1.1	A.2 TDEC Site Information Request No. 1	23	1	1	In addition to the soil data that will be collected from the twelve proposed sampling locations, TVA will collect soil samples through the well screen interval at locations of proposed background groundwater monitoring wells.
4.1.1	A.2 TDEC Site Information Request No. 1	23	7	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	24	2	1	Sentence reads "*A CCR Material Characteristics SAP will be developed for the site because all CCR units are currently closed.* " Did TVA intend to state that this SAP will <u>not</u> be developed? Otherwise please attach a CCR Material Characteristics SAP.

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Section Number	Section Title	Page	Paragraph	Line	Comment
4.1.2	A.2 TDEC Site Information Request No. 2	24	2	1	Is TVA planning on conducting a leachability study or not? The line indicates there will be a plan developed, but the remaining paragraph indicates one will not be completed at the site.
4.1.2	A.2 TDEC Site Information Request No. 2	24	2	All	If TVA is not planning on conducting a leachability study, TVA shall demonstrate to TDEC that sufficient existing leachability data exists for each of the units. If TDEC determines that additional leachability data is required, TVA shall develop a Material Characteristics SAP for the JSF.
4.1.4	A.2 TDEC Site Information Request No. 2	25	2	6	Please provide information regarding the mitigation of the pre-construction stream channels indicated on the 1940 topographic map beneath the Dry Fly Ash Stack as well as the Bottom Ash Pond.
4.1.4	A.2 TDEC Site Information Request No. 2	25	2	6	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 Dry Fly Ash Stack and the Bottom Ash Pond.
4.1.4	A.2 TDEC Site Information Request No. 2	25	2	6	Additional information including mitigation technique is requested regarding the sinkhole (topographic depression) that appears beneath the southeastern edge of the Dry Fly Ash Stack.
4.1.5	A.5 TDEC Site Information Request No. 5	34/906			Additional piezometers need to be installed and monitored in the Ash Disposal Area J and the Dry Fly Ash Stack to meet to objectives of this request.

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Section Number	Section Title	Page	Paragraph	Line	Comment
4.1.5	A.5 TDEC Site Information Request No. 5	27	1	1	Sentence reads: "*Recent as-built closure surveys contour data from the most recent aerial and hydrographic surveys and borings shown on Figures 11 through 15 will be used to model the upper CCR surface.* " Is there some missing punctuation? The sentence is unclear.
4.1.5	A.5 TDEC Site Information Request No. 5	27	1	1	Since the units are closed, why would the upper surface need to be modeled? There should be closure profiles and as-built surface contours in the CQA closure documentation.
4.1.5	A.5 TDEC Site Information Request No. 5	27	9	1	The drawings produced from the 3-D models will need to also show the final elevations of the Dry Fly Ash Stack, Bottom Ash Pond, Highway 70 Borrow Area and Ash Disposal Area J.
4.3.1	C.1 TDEC Groundwater Monitoring and Mapping Request No. 1	30	5	3	Please provide well installation and well abandonment records for wells depicted on Figure 2.

Section Number	Section Title	Page	Paragraph	Line	Comment
4.4.1		34	3	2	Although the site is underlain by Sevier Shale, TVA needs to recognize that the formation is not a pure clastic shale and that it is a calcareous shale which potentially exhibits weak fissile planes that are calcite-filled microfractures which may act as potential planes of weakness and have an effect on the physical strength of the rock mass. TVA should not dismiss solution enhanced fractures as a potential pathway for groundwater migration. Preconstruction site topography and geologic mapping indicate features of a well developed drainage network including alluvial deposits, springs, and sinkholes.
4.5.4	E.4 TDEC Surface Water Impacts Request No. 4	52	1	1	TDEC understands that process water, landfill leachate and storm water are collected at various PWPs and discharged through the JSF NPDES permit at designated outfalls. TDEC needs to understand the level of CCR constituents in the wastewater discharged to the Holston River, specifically Outfall 008. Please attach as an appendix the NPDES outfall sampling information (including planned sampling events and frequency, a map showing the outfall locations and where each collects from) per outfall, a summary table of NPDES data specifically related to the CCR constituents at each outfall (including outfalls that may have been rerouted) and also at the intake point. Going forward TVA shall collect water samples for CCR analyses (to include all appendix III constituents) when it collects samples for NPDES monitoring or quarterly whichever produces the most representative picture of the river conditions.
4.4.7	D.7 TDEC Site Condition Request No. 7	50/906	NA	NA	Additional piezometers need to be installed and monitored in the Ash Disposal Area J and the Dry Fly Ash Stack to meet to objectives of this request.
Appendix C	Figure 13	NA	NA	NA	Unclear figure, does not seem to show anything.
Appendix C - Figures	Figure No. 2	112/906	NA	NA	Clarify if existing piezometers capable of monitoring post-closure the phreatic surfaces in the Dry Fly ash Stack and Ash Disposal Area J are present. Figure 2 indicates that all piezometers installed in these units have been closed. Provide a figure that provides the location of all existing piezometers.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix C - Figures	Figure No. 3	113/906	NA	NA	The proposed groundwater monitoring wells for Ash Pond Area J appear to be in the CCR unit area. Please clarify.
Appendix J - Stability SAP	All	NA	NA	NA	TVA should verify through this investigation that inactive CCR landfill and/or surface Impoundments on site are no longer impounding water.
Appendix J - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	655/906			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.
Appendix J - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	655/906	Phase 1		Explain the use of Newmark's analysis if FSpseudo > 1.0.
Appendix J - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	657/90	Phase 4		Work with TDEC to define acceptable performance will need to be established as part of the of Phase 1 Assessment.
Appendix J - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	658/90	Table 2		Work with TDEC to define acceptable criteria in Phase 1 of the Assessment. Reference comment above.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix J - Stability SAP	5.1.3 Basis for Load Cases and Acceptance Criteria	659/906	NA	NA	TVA embankment dam design guidance (TVA 2016) should be removed from the list of documents used to determine acceptable criteria.
Appendix J - Stability SAP	5.1.3.1 Static Loading	660/906	NA	NA	Flood loading should be considered for CCR units located in the flood plain.
Appendix J - Stability SAP	5.1.3.2.1 Pseudo static Stability	661/906	NA	NA	The Dry Fly Ash Stack (Closed Condition) incorporates a leachate collection system and designed liner systems (Phase I & II) intended to contain waste. TDEC's referenced guidance is to be considered to be applicable for the Dry Fly Ash Stack. The preamble of the Federal CCR rule requires the use of conservative design factors.
Appendix J, Stability SAP	All	All	All	All	Current static pore water elevation for all CCR units shall be provided in a table from borings or piezometers placed inside the units. The elevations mentioned above shall be used for stability calculations for existing conditions. TVA shall provide proposed static pore water elevations with stability calculations. This may require the installation of additional borings, piezometers, and groundwater monitoring wells within the CCR units.
Appendix K, 4.0	Sampling Locations	4	1	1	In addition to the soil data that will be collected from the twelve proposed sampling locations, TVA will collect soil samples through the well screen interval at locations of proposed background groundwater monitoring wells.
Appendix K, 5.2.1.2	Borehole Logging	7	1	8	Soil color will be determined using a Munsell soil color chart. Although not specifically called out and required by ASTM standard D2488 the Munsell color chart is the industry standard and will need to be followed.
Appendix K, 5.2.5	Preservation and Handling	10	1		TDEC will require an aliquot of each homogenized soil sample be tested using a field pH test kit with the results recorded in the daily field notes.

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Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix L, Leachability Data	All	All	All	All	There is no data available for Ash Disposal Area J or the Highway 70 Borrow Area. TVA shall propose a sampling plan for material characteristics for these areas that includes analysis of solids and pore water samples.
Appendix L, Leachability Data	All	All	All	All	There is no pore water data available for any of the CCR units. TVA shall propose a sampling plan for pore water characteristics at each CCR unit.
Appendix M, Material Quantity SAP	All	All	All	All	TVA shall propose locations for piezometers within the CCR units to determine current static pore water pressures. Current static pore water elevation for all CCR units shall be provided in a table from borings or piezometers placed inside the units.
Appendix M - Material Quality Sap	Attachment A -Figures	745/906	NA	NA	In reference to Figure 4 "Existing Instrumentation Ash Disposal Area J" TVA needs to install additional piezometers in the areas of maximum fill depth and in the northeast portion of the CCR unit.
Appendix M - Material Quality Sap	Attachment A -Figures	747/906	NA	NA	In reference to Figure 6 "Existing Instrumentation Dry Fly Ash Stack" TVA needs to install additional piezometers in the northeast portion of the CCR unit.

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Comment Number	Section Number	Section Title	Page	Para-graph	Line	JSF EIP Rev. 1 TDEC Comments	TVA Response to JSF EIP Rev. 1 TDEC Comments
1	General Comment	All	All	All	All	Present a site wide contour map depicting the top of bedrock surface elevation as encountered in borings, denote if the boring was drilled using direct push, hollow-stem auger methods or other.	Comment is acknowledged, and a top of bedrock surface map will be provided in the EAR that incorporates existing data and new top of bedrock information obtained during the EIP field investigations.
2	General Comment	All	All	All	All	TVA will determine if buried bedrock valleys potentially associated with the pre- construction stream locations locally control flow in the overburden aquifer and if present if they are associated with highly fractured zones within the shale.	There are many investigations that have been completed at the JSF plant that provide the depth to bedrock. The reported depths range from 0 to approximately 35 feet below ground surface. There are no known buried valleys at JSF. In addition, the EIP includes CPT borings targeted to investigate former stream channels.
3	3.1.2	TDEC Site-Specific Information Request No. 2	9	2	8	Please provide well installation and well abandonment records for wells depicted on Figure 2.	Comment is acknowledged, and a table has been provided in the EIP.
4	3.1.2	TDEC Site-Specific Information Request No. 2	9	3	1	TVA will also include a table that documents the water quality parameters measured in the field at the time of sample collection and will provide field forms as an appendix. At a minimum the table will summarize pH, specific conductance, DO and turbidity.	Comment is acknowledged, and a table will be provided in the EAR.
5	3.1.3	TDEC Site-Specific Information Request No. 3	10	1	1	Did TVA will collect soil samples through the well screen interval at the locations of the newly installed potential background groundwater monitoring wells. If so, were they analyzed for CCR parameters?	Soil samples were collected from the approximate screened intervals of potential background wells JSF-101 and JSF-102 and analyzed for applicable soil CCR Parameters with the exception of sulfate. TVA will review the background soil data previously collected during the 2015 installation of background monitoring wells JSF-101 and JSF-102. Additional soil samples will be collected from the screened intervals of JSF-101, JSF-102 and potential background monitoring wells JSF-106 and JSF-110 and analyzed for CCR Parameters.
6	3.1.3	TDEC Site-Specific Information Request No. 3	10	1-3	all	Please provide well installation and well abandonment records for wells mentioned in this section.	Comment is acknowledged, and a table has been provided in the EIP.

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Comment Number	Section Number	Section Title	Page	Para-graph	Line	JSF EIP Rev. 1 TDEC Comments	TVA Response to JSF EIP Rev. 1 TDEC Comments
7	3.1.3	TDEC Site-Specific Information Request No. 3	10	3	10	Sentence reads "*New and existing well locations are shown on Figure 3.* " This is potentially a typo and should actually reference Figure 2. Figure 3 depicts the locations of the proposed wells.	Comment is acknowledged, and the corresponding change has been made in the EIP text.
8	3.1.3	TDEC Site-Specific Information Request No. 3	11	1	1	This section states "*if bedrock wells are required…* " whereas in section 4.1.5 the statement is made that "*TVA plans to install new bedrock monitoring wells to characterize groundwater flow at JSF.* " and that they are described in Appendix H and Appendix N. Appendix H does not indicate that bedrock wells will be installed nor does the figure indicate where these bedrock wells will be located. Appendix N states "*In proposed borings with rock coring, the following suite of geophysical analyses will be performed to investigate groundwater conditions deeper in the bedrock.* " The figure does not indicate bedrock borings. Please clarify.	Bedrock wells are not proposed in the Hydrogeological Investigation SAP. Section 4.1.5 of the EIP has been corrected. Likewise, rock coring and/or downhole testing in rock are not proposed in the Exploratory Drilling SAP (see Section 4.0 of Appendix N) for JSF. Site-specific text in Section 4.0 will be clarified to exclude these activities. Standard methodology text in Section 5.3.1 will be clarified that this only applies if/when site-specific downhole testing is called for in Section 4.0.
9	3.1.3	TDEC Site-Specific Request No. 3	20/906	last		TVA needs to provide more detail of what type of statistical analysis it will employ to determine background concentrations of constituents.	There are multiple statistical methods available to calculate background concentrations. TVA proposes to utilize Background Threshold Values (BTVs) as the method to statistically evaluate and quantify site specific background concentrations for CCR parameters. BTVs are calculated using sampling data collected from un-impacted site-specific reference areas and represent an upper threshold of background concentration(s). The choice of BTV (Upper Confidence Limit, Upper Threshold Limit, Upper Prediction Limits) will be determined based on characteristics of the data (e.g. sample size, statistical distribution).
10	3.1.5	TDEC Site-Specific Request No. 5	20/906	1	1 & 2	TVA needs to clarify what they mean by "piezometeric surface" and "potentiometric surface" in relation to the Site hydrogeology, and incorporate into cross sections.	The terms piezometric surface and potentiometric surface can be used interchangeably for confined aquifers. They are an imaginary surface the represents the level that water will rise to within a well or piezometer that is installed in a confined aquifer. In response to TDEC's initial request, TVA used the term groundwater contour maps to avoid the confusion that can come with use of these terms. TVA will show water levels on cross-sections. Also, TVA believes that some of the confusion related to the response in the EIP is because the last paragraph in Section 3.1.5 was included in error and has since been removed.

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Comment Number	Section Number	Section Title	Page	Para-graph	Line	JSF EIP Rev. 1 TDEC Comments	TVA Response to JSF EIP Rev. 1 TDEC Comments
11	3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4		TVA needs to clarify how and how often the river elevations are recorded on the river gauge downstream of the detention dam.	The river gauge measures water surface elevations via a radar ranging sensor. The sensor (installed at a known elevation) measures signal travel time and relates this to water surface elevation. Data is currently collected on five-minute intervals. Text will be added to the EIP to address this comment.
12	3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4		TVA needs to clarify how if the low point of the Lower Road dike is at an approximate elevation of 1,075 feet and all of the other available river elevation times were below elevation 1,072 feet, how was it documented that on a June 6, 2017 TDEC DSWM Post-Closure Inspection that the lower road was recently flooded due to river flooding and wood debris was observed in and across the lower road (water was still over portions of the lower road during my inspection with Chris Lamb(TDEC) and Tonya Bailey (TVA)).	Comment is acknowledged. As part of the hydrogeological investigation, information and data will be reviewed to develop a more comprehensive understanding of the toe drain system. A review/discussion of the toe drain system, river elevations, leachate generation records, rainfall data, etc. will be provided in the EAR. Text in the EIP has been updated.
13	3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4		TVA needs to clarify what the recorded river elevations were between June 4, 2017 through June 7, 2017.	Comment is acknowledged. As part of the hydrogeological investigation, information and data will be reviewed to develop a more comprehensive understanding of the toe drain system. A review/discussion of the toe drain system, river elevations, leachate generation records, rainfall data, etc. will be provided in the EAR. Text in the EIP has been updated.
14	3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4		In the past, TVA had thought the toe drain was hydraulically connected or related to the river water and most of the leachate being pumped was due to the river water. TVA needs to clarify or investigate the hydraulically connectivity of the river water and toe drain and if the leachate generation is related to the water elevation of the river, using the leachate generation records rain fall data and other retained records.	Comment is acknowledged. As this area has not been fully investigated as part of a comprehensive site investigation like the EIP, part of the purpose of the proposed hydrogeological investigation is to review information and data to develop a more comprehensive understanding of the toe drain system. A review/discussion of the toe drain system, river elevations, leachate generation records, rainfall data, etc. will be provided in the EAR. Text in the EIP has been updated.
15	3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4		TVA needs to clarify what happens if the river elevation rose to an elevation equal to the man-holes, pump stations or top and/or bottom of the toe drain, if then the river water and toe drain would be then be hydraulically connected.	Comment is acknowledged. As part of the hydrogeological investigation, information and data will be reviewed to develop a more comprehensive understanding of the toe drain system. A review/discussion of the toe drain system, river elevations, leachate generation records, rainfall data, etc. will be provided in the EAR. Text in the EIP has been updated.
16	3.1.8	TDEC Site-Specific Request No. 8	22-23/906	4	8	TVA needs to clarify their response to sub-part 3.1.8(b)(ii). If it is meant to explain that since the discharge point is not located at or near the constructed elevation of the top of the toe drain and that since the leachate is being pumped to higher elevation, that the toe drain and river water is not hydraulically connected, please clarify how it different from a normal toe drain.	Comment is acknowledged. As part of the hydrogeological investigation, information and data will be reviewed to develop a more comprehensive understanding of the toe drain system. A review/discussion of the toe drain system, river elevations, leachate generation records, rainfall data, etc. will be provided in the EAR. Text in the EIP has been updated.

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Comment Number	Section Number	Section Title	Page	Para-graph	Line	JSF EIP Rev. 1 TDEC Comments	TVA Response to JSF EIP Rev. 1 TDEC Comments
17	3.1.8 & 4.0	TDEC Site-Specific Request No. 8 & Appendix I - Evaluation of Existing Geotechnical Data JSFP (Additional Discussion of Selected Information Requests)	22-23/906 & 629-631/906	4, Figure 4 and 5	8	TVA states in their response, in sub-part 3.1.8(b)(iii), that the toe drain was constructed in the clay dike laterally outside of the Stage 2 closure area. It also appears on the cross- sections in Appendix I - "Evaluation of Existing Geotechnical Data JSFP, Figure 4 and 5", to be very close to rip-rap otter edge. TVA needs to clarify if the river water and toe drain maybe hydraulically connectivity, if the river water rose to the elevation equal to or greater than the bottom elevation of the toe drain?	Comment is acknowledged. As part of the hydrogeological investigation, information and data will be reviewed to develop a more comprehensive understanding of the toe drain system. A review/discussion of the toe drain system, river elevations, leachate generation records, rainfall data, etc. will be provided in the EAR. Text in the EIP has been updated.
18	4.1.1	A.2 TDEC Site Information Request No. 1	23	1	1	In addition to the soil data that will be collected from the twelve proposed sampling locations, TVA will collect soil samples through the well screen interval at locations of proposed background groundwater monitoring wells.	In addition to the soil data that will be collected from the twelve proposed sampling locations, TVA will review the background soil data previously collected during the 2015 installation of background monitoring wells JSF-101 and JSF-102. Additional soil samples will be collected from the screened intervals of JSF-101, JSF-102 and potential background monitoring wells JSF-106 and JSF-110 and analyzed for CCR Parameters.
19	4.1.1	A.2 TDEC Site Information Request No. 1	23	7	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 initially proposed will be installed.
20	4.1.2	A.2 TDEC Site Information Request No. 2	24	2	1	Sentence reads "*A CCR Material Characteristics SAP will be developed for the site because all CCR units are currently closed.* " Did TVA intend to state that this SAP will <u>not</u> be developed? Otherwise please attach a CCR Material Characteristics SAP.	The CCR Material Characteristics SAP was originally "not" going to be developed due to all the CCR units being closed, and subject to groundwater monitoring during the post-closure care period. However, in response to Comment Nos. 49 and 50, that a CCR Material Characteristics SAP be developed if no data is available for Ash Disposal Area J and Highway 70 Borrow Area, and that a pore water SAP be developed if pore water data is not available for any of the units, a CCR Material Characteristics SAP will be developed, and the Study Area will consist of the following closed CCR units: Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area.
21	4.1.2	A.2 TDEC Site Information Request No. 2	24	2	1	Is TVA planning on conducting a leachability study or not? The line indicates there will be a plan developed, but the remaining paragraph indicates one will not be completed at the site.	See response to Comment No. 20.

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22	4.1.2	A.2 TDEC Site Information Request No. 2	24	2	All	If TVA is not planning on conducting a leachability study, TVA shall demonstrate to TDEC that sufficient existing leachability data exists for each of the units. If TDEC determines that additional leachability data is required, TVA shall develop a Material Characteristics SAP for the JSF.	See response to Comment No. 20.
23	4.1.4	A.2 TDEC Site Information Request No. 2	25	2	6	Please provide information regarding the mitigation of the pre-construction stream channels indicated on the 1940 topographic map beneath the Dry Fly Ash Stack as well as the Bottom Ash Pond.	TVA historic drawing 10W293-1 indicates that a ten-foot deep inspection trench was excavated in the low-lying area of the Bottom Ash Pond, and in any area where gravel was exposed, a cutoff trench was excavated through the pervious stratum and backfilled with compacted impervious earthfill. The geotechnical exploration outlined in the Exploratory Drilling SAP will include cone penetration tests at selected pre-construction stream channel locations to evaluate soils in these areas.
24	4.1.4	A.2 TDEC Site Information Request No. 2	25	2	6	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 Dry Fly Ash Stack and the Bottom Ash Pond.	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 Dry Fly Ash Stack and Bottom Ash Pond. This approach is consistent with other plants to evaluate the same issue.
25	4.1.4	A.2 TDEC Site Information Request No. 2	25	2	6	Additional information including mitigation technique is requested regarding the sinkhole (topographic depression) that appears beneath the southeastern edge of the Dry Fly Ash Stack.	TVA has not located documents that note the occurrence of sinkholes near the area beneath the southeastern edge of the Dry Fly Ash Stack. JSF is underlain by the Sevier shale, which has been described to only contain thin beds of limestone measuring only a few inches in thicknesses. The weathered zone at the bedrock surface is reported to be only a few feet. No sinkholes or karst have been reported or would be expected in this rock formation.
26	4.1.5	A.5 TDEC Site Information Request No. 5	34/90 6			Additional piezometers need to be installed and monitored in the Ash Disposal Area J and the Dry Fly Ash Stack to meet to objectives of this request.	The Exploratory Drilling SAP has been updated to add several temporary wells in the Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and the Highway 70 Borrow Area. The temporary wells allow for water level measurements. In the Dry Fly Ash Stack, temporary wells are planned within the lined portions (screened intervals above the liner) and elsewhere within the unit.
27	4.1.5	A.5 TDEC Site Information Request No. 5	27	1	1	Sentence reads: "*Recent as-built closure surveys contour data from the most recent aerial and hydrographic surveys and borings shown on Figures 11 through 15 will be used to model the upper CCR surface.* " Is there some missing punctuation? The sentence is unclear.	Comment is acknowledged, and the text has been revised to state "*Recent aerial surveys, as-built closure surveys and borings shown on Figures 11 through 15 will be used to model the upper CCR surface.*"
28	4.1.5	A.5 TDEC Site Information Request No. 5	27	1	1	Since the units are closed, why would the upper surface need to be modeled? There should be closure profiles and as-built surface contours in the CQA closure documentation.	The three-dimensional models will be developed to illustrate the full cross section of the CCR units including the top closure surface, top of CCR, bottom of CCR, and top of bedrock. Closure profiles and as-built surfaces will be incorporated into the models.

Comment Number	Section Number	Section Title	Page	Para-graph	Line	JSF EIP Rev. 1 TDEC Comments	TVA Response to JSF EIP Rev. 1 TDEC Comments
29	4.1.5	A.5 TDEC Site Information Request No. 5	27	9	1	The drawings produced from the 3-D models will need to also show the final elevations of the Dry Fly Ash Stack, Bottom Ash Pond, Highway 70 Borrow Area and Ash Disposal Area J.	The three-dimensional models will be developed to illustrate the full cross section of the CCR units including the top closure surface, top of CCR, bottom of CCR, and top of bedrock. Closure profiles and as-built surfaces will be incorporated into the models.
30	4.3.1	C.1 TDEC Groundwater Monitoring and Mapping Request No. 1	30	5	3	Please provide well installation and well abandonment records for wells depicted on Figure 2.	Comment is acknowledged, and a table has been provided in the EIP.
31	4.4.1		34	3	2	Although the site is underlain by Sevier Shale, TVA needs to recognize that the formation is not a pure clastic shale and that it is a calcareous shale which potentially exhibits weak fissile planes that are calcite-filled microfractures which may act as potential planes of weakness and have an effect on the physical strength of the rock mass. TVA should not dismiss solution enhanced fractures as a potential pathway for groundwater migration. Preconstruction site topography and geologic mapping indicate features of a well developed drainage network including alluvial deposits, springs, and sinkholes.	Rock cores from the site for borings conducted in 1986 make no mention of cavities or dissolution of limestone beds. The descriptions depict a thinly bedded shale with interbedded thin limestone beds. The thicknesses of the beds are less than one foot. The logs describe many calcite-filled fractures, some of which have been reported to provide strength to the fractured zones making them as strong as the surrounding rock. A report prepared by TVA in 2009 for a proposed landfill concluded the following: • Interbedded limestone layers are typically less than 0.3 foot in thickness and show no evidence of dissolution cavity development. • The proposed landfill site shows no evidence of sinkhole development and bedrock core samples indicated no limestone cavity development. • The potential for cavity development in the Sevier Shale is negligible due to the prevalence of thinly-bedded, shaley limestones. There is no evidence of karst, dissolution of limestone beds or sinkhole development at JSF and none is expected. An unnamed surface water feature termed a spring was observed approximately 200 feet west of MW-2. The spring was observed to have standing water and occasional flow between February 2007 and May 2007 with no water between June 2007 and October 2007. The spring was observed to have standing water on April 29, 2016 and was dry on June 29, 2016. Based on available information, the spring is located approximately 2,000 feet from the CCR units in an upgradient location and appears to be an ephemeral, wet-weather feature associated with an ephemeral stream. No perennial springs have been observed at the site. The available record for JSF does not include identification of sinkholes. TVA does not believe that they exist or existed at JSF. If a sinkhole is identified during implementation of the EIP, then TVA will notify TDEC and discuss the need for additional investigations.

Appendix B – Table 1

Summary of TDEC Comments & TVA Responses

May 25, 2018

Comment Number	Section Number	Section Title	Page	Para-graph	Line	JSF EIP Rev. 1 TDEC Comments	TVA Response to JSF EIP Rev. 1 TDEC Comments
32	4.5.4	E.4 TDEC Surface Water Impacts Request No. 4	52	1	1	TDEC understands that process water, landfill leachate and storm water are collected at various PWPs and discharged through the JSF NPDES permit at designated outfalls. TDEC needs to understand the level of CCR constituents in the wastewater discharged to the Holston River, specifically Outfall 008. Please attach as an appendix the NPDES outfall sampling information (including planned sampling events and frequency, a map showing the outfall locations and where each collects from) per outfall, a summary table of NPDES data specifically related to the CCR constituents at each outfall (including outfalls that may have been rerouted) and also at the intake point. Going forward TVA shall collect water samples for CCR analyses (to include all appendix III constituents) when it collects samples for NPDES monitoring or quarterly whichever produces the most representative picture of the river conditions.	TVA shall continue to collect, test and report outfall samples in accordance with the conditions of the NPDES permit. TVA has included NPDES outfall sampling information, as well as detailed constituent information provided in its NPDES permit applications. NPDES compliance data previously submitted to TDEC will be included in the revised EIP as an appendix. If after reviewing the existing data, TDEC desires additional surface water data as part of the investigation, TDEC and TVA can jointly determine a path forward.
33	4.4.7	D.7 TDEC Site Condition Request No. 7	50/90 6	NA	NA	Additional piezometers need to be installed and monitored in the Ash Disposal Area J and the Dry Fly Ash Stack to meet to objectives of this request.	The Exploratory Drilling SAP has been updated to add several temporary wells in the Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and the Highway 70 Borrow Area. The temporary wells allow for water level measurements. In the Dry Fly Ash Stack, temporary wells are planned within the lined portions (screened intervals above the liner) and elsewhere within the unit.
34	Appendix C	Figure 13	NA	NA	NA	Unclear figure, does not seem to show anything.	Comment is acknowledged, and the figure has been revised to show existing borings with CCR thickness data. The Exploratory Drilling SAP includes proposed borings and CPTs that will provide additional CCR thickness data to support the material quantity 3D model.
35	Appendix C - Figures	Figure No. 2	112/9 06	NA	NA	Clarify if existing piezometers capable of monitoring post-closure the phreatic surfaces in the Dry Fly ash Stack and Ash Disposal Area J are present. Figure 2 indicates that all piezometers installed in these units have been closed. Provide a figure that provides the location of all existing piezometers.	Figure 2 consists of existing and closed monitoring wells. The existing piezometers shown in Figures 4, 5, and 6 of Appendix M (Material Quantity SAP) will be used to monitor post-closure phreatic surfaces. In addition, new temporary wells will be installed in the Dry Fly Ash Stack and Ash Disposal Area J to provide additional phreatic data as outlined in the Exploratory Drilling SAP. The existing piezometers and new temporary wells will be adequate to monitor to post-closure phreatic surfaces.
36	Appendix C - Figures	Figure No. 3	113/9 06	NA	NA	The proposed groundwater monitoring wells for Ash Pond Area J appear to be in the CCR unit area. Please clarify.	The proposed monitoring wells are located along the perimeter earth-fill dikes beyond the CCR limits. The CCR unit boundaries shown on the figures outline the general area of each unit including CCR materials and perimeter earth-fill dikes, not the specific CCR limits.

Comment Number	Section Number	Section Title	Page	Para-graph	Line	JSF EIP Rev. 1 TDEC Comments	TVA Response to JSF EIP Rev. 1 TDEC Comments
37	Appendix J - Stability SAP	All	NA	NA	NA	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 JSF. 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.
38	Appendix J - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	655/906			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 will be added in Section 5.1.3.2.1 of the Stability SAP to explain the technical basis for this correlation.
39	Appendix J - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	655/906	Phase 1		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 site-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.
40	Appendix J - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	657/90	Phase 4		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 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.
41	Appendix J - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	658/90	Table 2		Work with TDEC to define acceptable criteria in Phase 1 of the Assessment. Reference comment above.	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.
42	Appendix J - Stability SAP	5.1.3 Basis for Load Cases and Acceptance Criteria	659/906	NA	NA	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. The text will be clarified to emphasize these similarities.

Appendix B – Table 1

Summary of TDEC Comments & TVA Responses

May 25, 2018

Comment Number	Section Number	Section Title	Page	Para-graph	Line	JSF EIP Rev. 1 TDEC Comments	TVA Response to JSF EIP Rev. 1 TDEC Comments
43	Appendix J - Stability SAP	5.1.3.1 Static Loading	660/906	NA	NA	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 JSF, this would include the Dry Fly Ash Stack and Ash Disposal Area J. 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 is not necessary.
44	Appendix J - Stability SAP	5.1.3.2.1 Pseudo static Stability	661/906	NA	NA	The Dry Fly Ash Stack (Closed Condition) incorporates a leachate collection system and designed liner systems (Phase I & II) intended to contain waste. TDEC's referenced guidance is to be considered to be applicable for the Dry Fly Ash Stack. The preamble of the Federal CCR rule requires the use of conservative design factors.	As noted in several sections of the Stability SAP, the tolerable displacement is subject to adjustment based on site-specific features and consequences of specific failure modes. The portions of the Dry Fly Ash Stack with leachate collection system and bottom liner are a good example of site-specific features that will require consideration when selecting an appropriate tolerable displacement. The TDEC guidance will be considered, and the justification for the selected tolerable displacement will be documented as part of the analyses in the EAR.
45	Appendix J, Stability SAP	All	All	All	All	Current static pore water elevation for all CCR units shall be provided in a table from borings or piezometers placed inside the units. The elevations mentioned above shall be used for stability calculations for existing conditions. TVA shall provide proposed static pore water elevations with stability calculations. This may require the installation of additional borings, piezometers, and groundwater monitoring wells within the CCR units.	Water levels from wells and piezometers, including those installed per the EIP, will be presented in 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.
46	Appendix K, 4.0	Sampling Locations	4	1	1	In addition to the soil data that will be collected from the twelve proposed sampling locations, TVA will collect soil samples through the well screen interval at locations of proposed background groundwater monitoring wells.	Comment is acknowledged, and the corresponding change has been made in the EIP.
47	Appendix K, 5.2.1.2	Borehole Logging	7	1	8	Soil color will be determined using a Munsell soil color chart. Although not specifically called out and required by ASTM standard D2488 the Munsell color chart is the industry standard and will need to be followed.	Comment is acknowledged, and the corresponding change has been made in the EIP.
48	Appendix K, 5.2.5	Preservation and Handling	10	1		TDEC will require an aliquot of each homogenized soil sample be tested using a field pH test kit with the results recorded in the daily field notes.	Comment is acknowledged, and the corresponding change has been made in the EIP.

Comment Number	Section Number	Section Title	Page	Para-graph	Line	JSF EIP Rev. 1 TDEC Comments	TVA Response to JSF EIP Rev. 1 TDEC Comments
49	Appendix L, Leachability Data	All	All	All	All	There is no data available for Ash Disposal Area J or the Highway 70 Borrow Area. TVA shall propose a sampling plan for material characteristics for these areas that includes analysis of solids and pore water samples.	EIP Section 4.1.2 will address the addition of a CCR Material Characteristics SAP with the Study Area consisting of the following closed CCR units: Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area. The SAP will address the collection of both pore water and CCR material samples.
50	Appendix L, Leachability Data	All	All	All	All	There is no pore water data available for any of the CCR units. TVA shall propose a sampling plan for pore water characteristics at each CCR unit.	EIP Section 4.1.2 will address the addition of a CCR Material Characteristics SAP with the Study Area consisting of the following closed CCR units: Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area. The SAP will address the collection of both pore water and CCR material samples.
51	Appendix M, Material Quantity SAP	All	All	All	All	TVA shall propose locations for piezometers within the CCR units to determine current static pore water pressures. Current static pore water elevation for all CCR units shall be provided in a table from borings or piezometers placed inside the units.	The Exploratory Drilling SAP has been updated to include temporary wells installations in each CCR unit.
52	Appendix M - Material Quality Sap	Attachment A -Figures	745/906	NA	NA	In reference to Figure 4 "Existing Instrumentation Ash Disposal Area J" TVA needs to install additional piezometers in the areas of maximum fill depth and in the northeast portion of the CCR unit.	The Exploratory Drilling SAP has been updated to include temporary wells installations in each CCR unit.
53	Appendix M - Material Quality Sap	Attachment A -Figures	747/906	NA	NA	In reference to Figure 6 "Existing Instrumentation Dry Fly Ash Stack" TVA needs to install additional piezometers in the northeast portion of the CCR unit.	The Exploratory Drilling SAP has been updated to include temporary wells installations in each CCR unit.

JSF Boring Location Revision Justification

Location ID	Issue Identified	Technical Objective	Changes
JSF-BG-01-Alt through JSF-BG-06-Alt	Alternate boring locations were added for BG-01 through BG-06 in the event that access is not granted from the TVA Lessor or NEPA approval is not able to be obtained timely for JSF-BG-01 through JSF-BG-06 on the north side of the river. A final determination of whether the original locations or alternate locations will be sampled shall be determined once access agreements and NEPA reviews are complete.	These alternate locations still accomplish the goals of the background soil sampling.	Preliminary alternate locations have been identified in the event they are needed.
JSF-BG-03	Initial location was within approximately 50 feet of a known wetland area.	Can still accomplish goal of collecting background soil samples.	Moved proposed boring location approximately 50 feet west to be about 100 feet outside of delineated wetland.
JSF-BG-07	The initial boring location was inaccessible.	Can still accomplish goal of collecting background soil samples.	Moved proposed boring location approximately 300 feet east-northeast of initial location.
JSF-BG-10	The initial boring location was inaccessible.	Can still accomplish goal of collecting background soil samples.	Moved proposed boring location approximately 800 feet west of initial location.
JSF-106	Initial location was too close to active railroad line.	Obtain background soil samples and install a permanent groundwater monitoring well.	Moved approximately 300 feet west-southwest to allow setup at sufficient distance from railroad line.
JSF-107	Initial location was on a steep slope, off the existing perimeter road of Ash Disposal Area J.	Install a permanent groundwater monitoring well.	Moved upslope (south) approximately 35 feet to allow setup on the existing access road.
JSF-108	Initial location was on a steep slope, off the existing perimeter road of Ash Disposal Area J.	Install a permanent groundwater monitoring well.	Moved upslope (south) approximately 35 feet to allow setup on the existing access road.
JSF-110	Initial location was within a densely wooded area.	Obtain background soil samples and install a permanent groundwater monitoring well.	Moved northwest approximately 75 feet into a more easily accessible open field.
JSF-111	Initial location was within a densely wooded low area.	Install a permanent groundwater monitoring well.	Moved north approximately 200 feet into a more easily accessible open area.

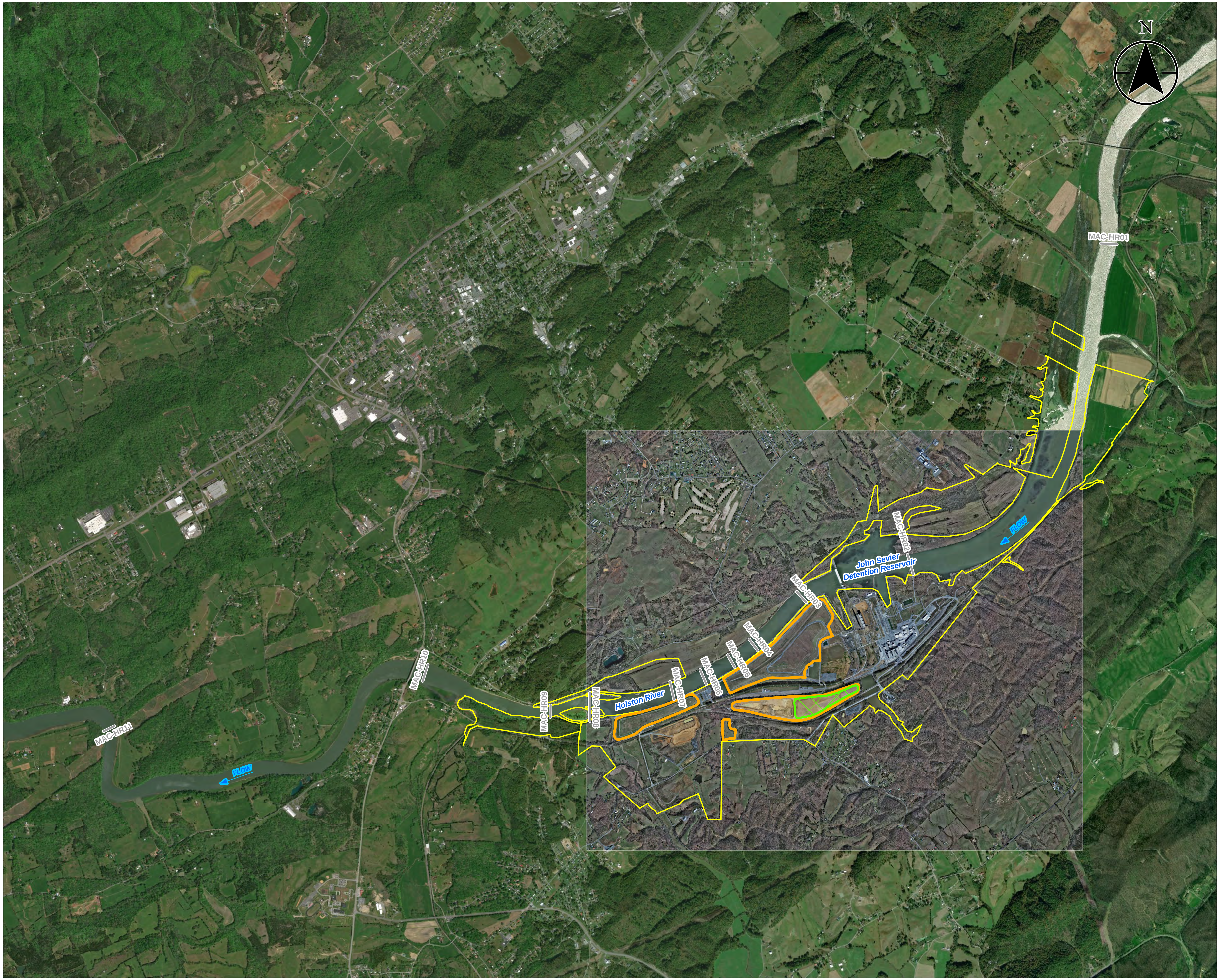

Figure No.
1

DRAFT

Title

Benthic Macroinvertebrates Sampling

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175566338
Prepared by LMB on 2018-07-25
Technical Review by RAA on 2018-07-25

0 1,500 3,000 4,500 6,000 Feet

1:18,000 (At original document size of 22x34)

Legend

- Benthic Transect
- Consolidated & Capped CCR Area (Approximate)
- CCR Unit Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08) and ESRI Basemaps (NAIP 2016)

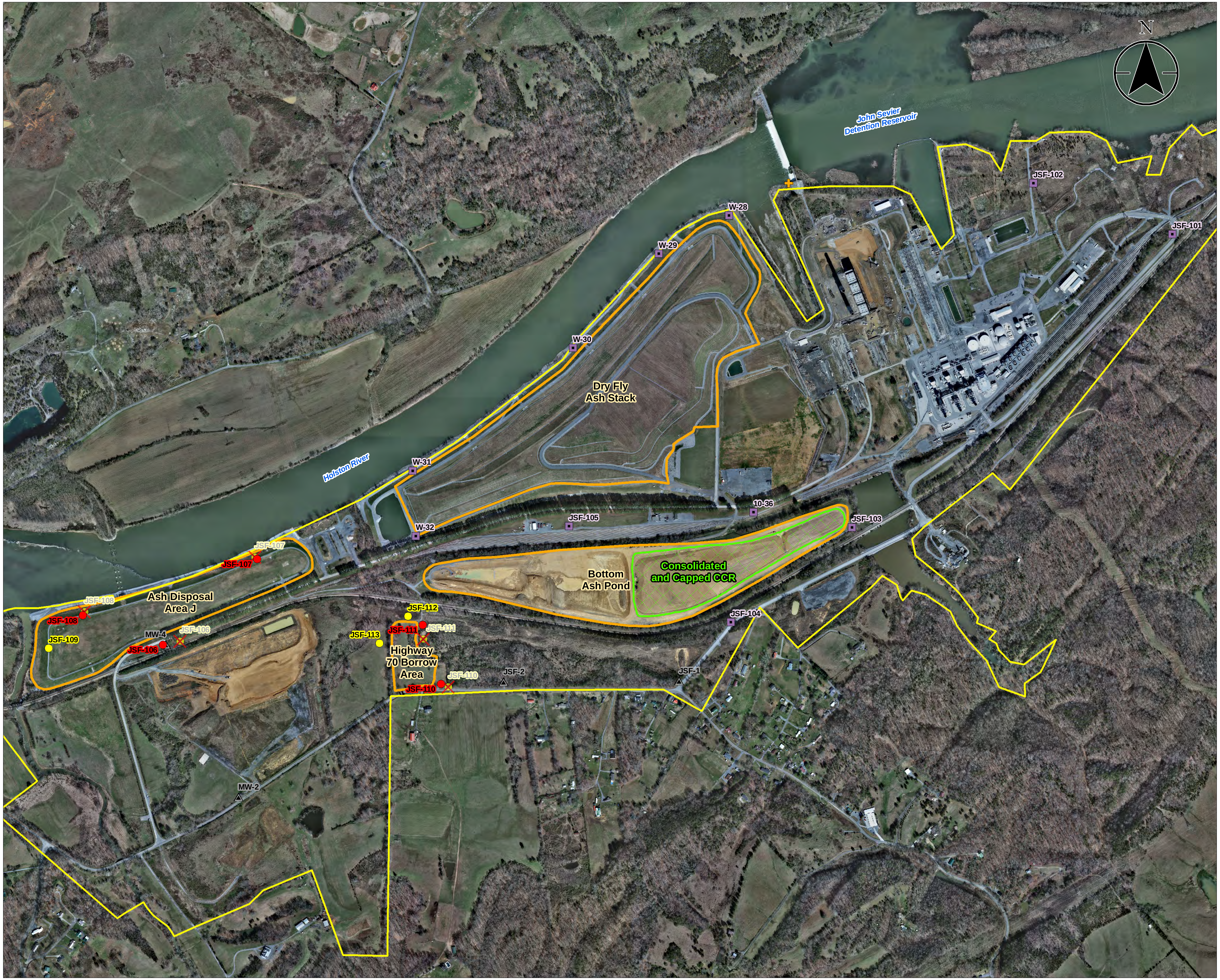

Figure No.
1

DRAFT

Title
John Sevier Fossil Plant
Proposed Groundwater Well Locations

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 450 900 1,350 1,800 Feet

1:5,400 (At original document size of 22x34)

Legend

- Proposed Groundwater Monitoring Well
- Alternate Proposed Groundwater Monitoring Well
- Original Proposed Groundwater Monitoring Well (Revised Location)
- River Gauge
- Existing Groundwater Monitoring Well
- Existing Observation Well
- TVA Property Boundary
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec

TVA

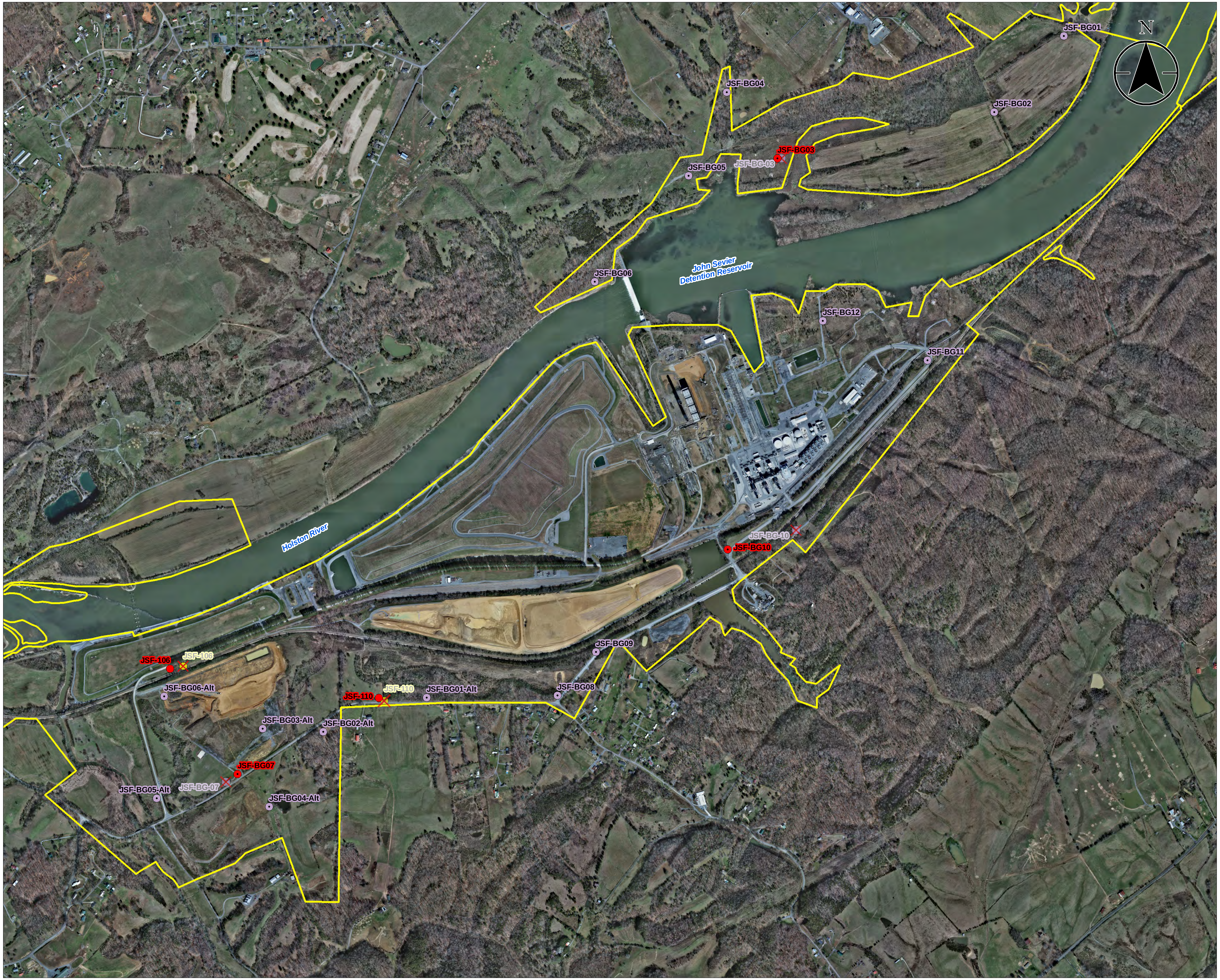

Figure No.
1

DRAFT

Title
Proposed Soil Sampling Locations

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 600 1,200 1,800 2,400 Feet
1:7,200 (At original document size of 22x34)

Legend

- Proposed Background Soil Sample Location
- Alternate Proposed Background Soil Sample Location
- Original Proposed Background Soil Sample Location (Revised Location)
- Alternate Proposed Groundwater Monitoring Well Location
- Original Proposed Groundwater Monitoring Well Location (Revised Location)
- TVA Property Boundary

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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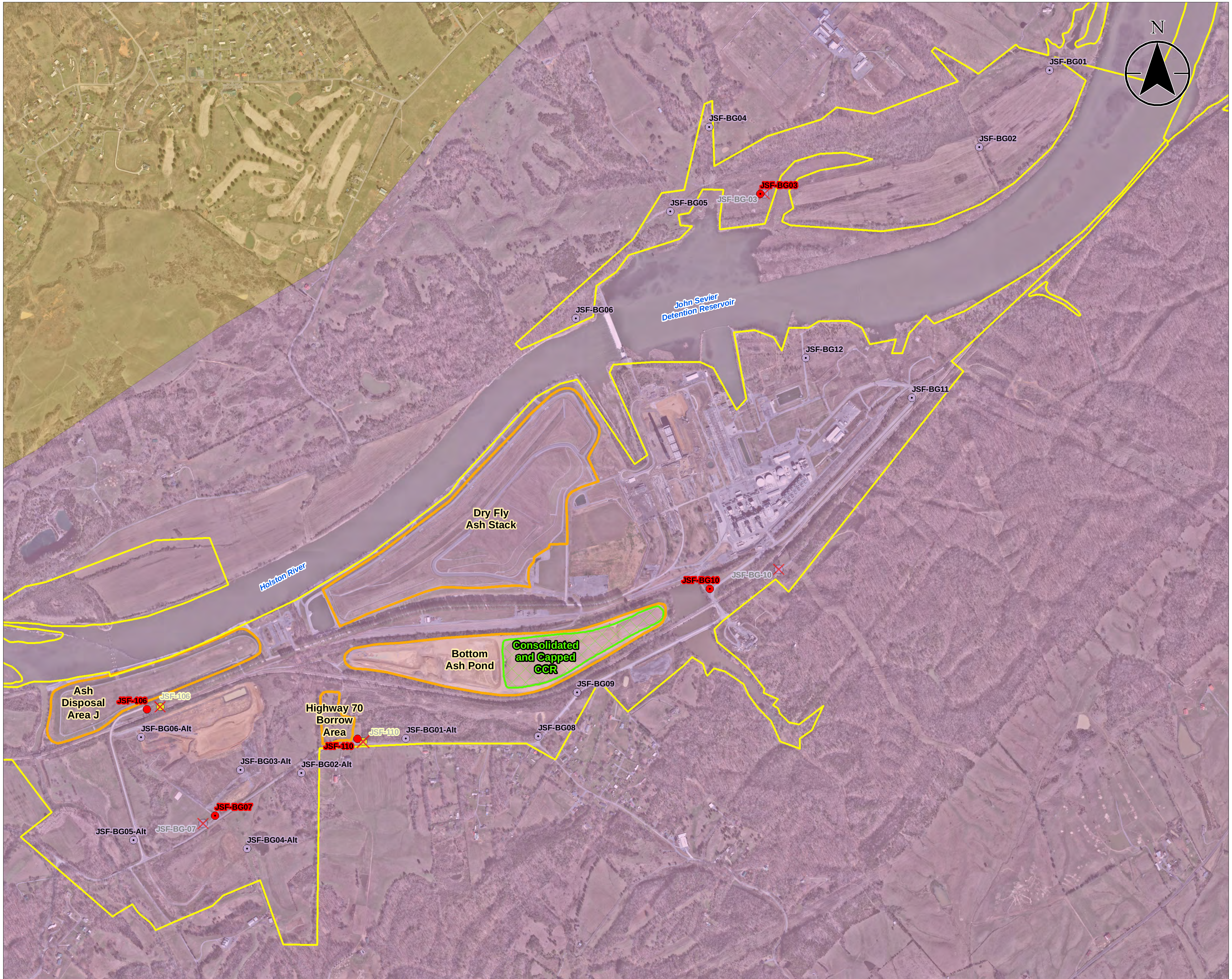

Figure No.
1

DRAFT

Title
Proposed Soil Sampling Locations - Geology

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 600 1,200 1,800 2,400 Feet
1:7,200 (At original document size of 22x34)

Legend

- Proposed Background Soil Sample Locations
- Alternate Proposed Background Soil Sample Location
- Original Proposed Background Soil Sample Location (Revised Location)
- Alternate Proposed Groundwater Monitoring Well Location
- Original Proposed Groundwater Monitoring Well Location (Revised Location)
- TVA Property Boundary
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- Newala Formation (On)
- Sevier Shale (Osv)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Soils Data provided by US Department of Agriculture

Stantec

TVA

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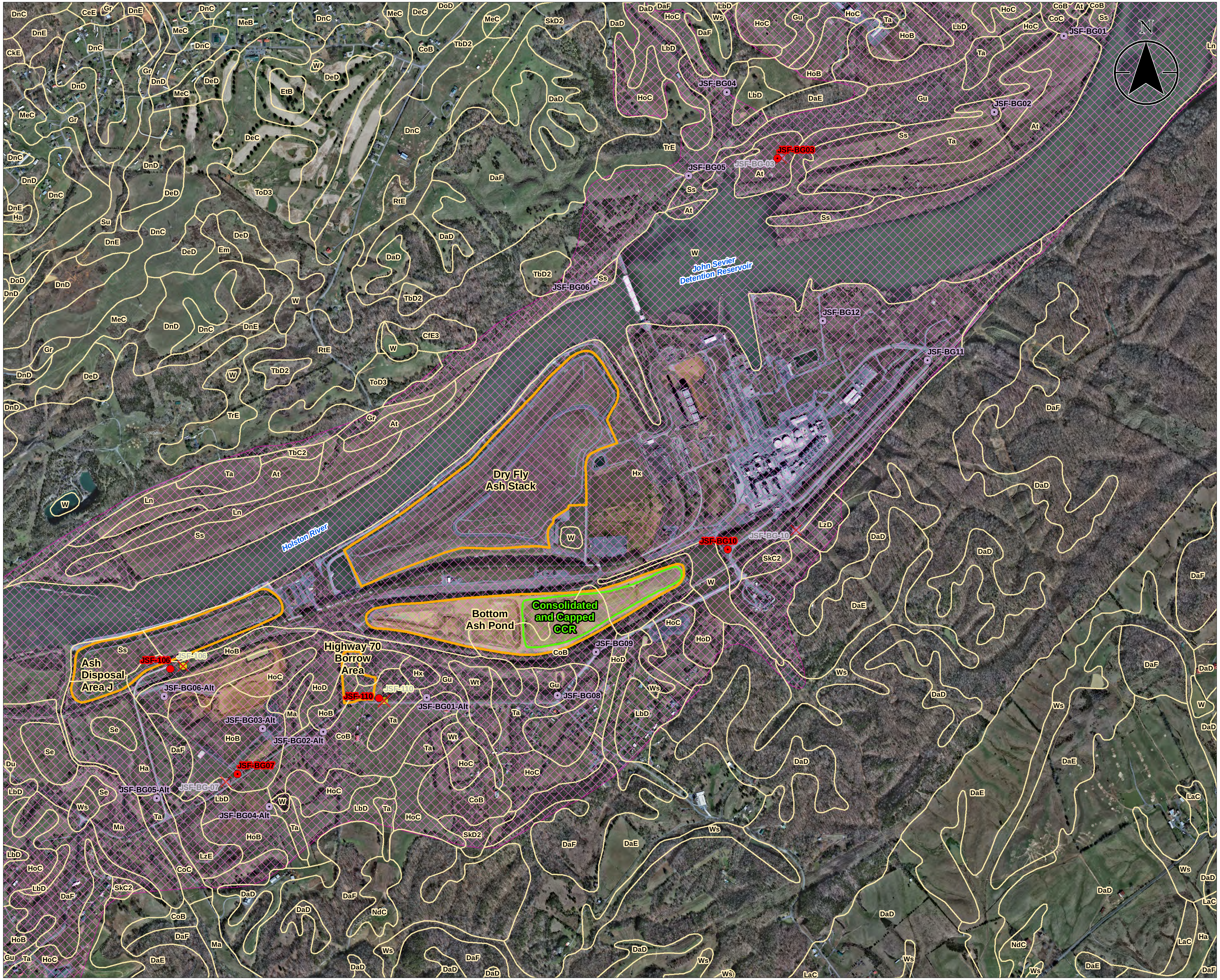

Figure No.
1

DRAFT

Title

Proposed Soil Sampling Locations

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 600 1,200 1,800 2,400 Feet

1:7,200 (At original document size of 22x34)

Legend

- Proposed Background Soil Sample Location
- Alternate Proposed Background Soil Sample Location
- Original Proposed Background Soil Sample Location (Revised Location)
- Alternate Proposed Groundwater Monitoring Well Location
- Original Proposed Groundwater Monitoring Well Location (Revised Location)
- Soil Map Unit
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- Soils Developed in Alluvial Deposits

Map Unit	Map Unit Name	Map Unit	Map Unit Name
HoC	Holston loam, 5 to 12 percent slopes	SkC2	Sequoia silt loam, 3 to 12 percent slopes, eroded
Ta	Taft silt loam	Ws	Whitesburg silt loam
MeB	Minvale silt loam, 2 to 5 percent slopes	Ss	Staser silt loam
DeD	Dewey silt loam, 15 to 25 percent slopes	ToD3	Talbott silty clay, 12 to 25 percent slopes, severely eroded
HoB	Holston loam, 2 to 5 percent slopes	CfE3	Claiborne soils, 15 to 35 percent slopes, severely eroded
DnE	Dunmore silt loam, 20 to 35 percent slopes	Du	Dunning silty clay loam
DaD	Dandridge shaly silty clay loam, 5 to 20 percent slopes	TbC2	Talbott silt loam, 5 to 12 percent slopes, eroded
LzD	Litz shaly silt loam, 8 to 20 percent slopes (sil)	Ma	Melvin silt loam
Ln	Lindside silt loam	DaF	Dandridge shaly silty clay loam, 35 to 60 percent slopes
DoD	Dunmore silty clay loam, 12 to 25 percent slopes	DeC	Dewey silt loam, 6 to 15 percent slopes
DnC	Dunmore silt loam, 5 to 12 percent slopes	LaC	Leadvale silt loam, 5 to 12 percent slopes
NdC	Needmore silt loam, 5 to 12 percent slopes	CoB	Cloudland loam, 2 to 5 percent slopes (monongahela)
W	Water	Hx	Holston-Urban land complex
DnD	Dunmore silt loam, 12 to 20 percent slopes	SkD2	Sequoia silt loam, 12 to 20 percent slopes, eroded
Se	Sequatchie loam	Ha	Hamblen silt loam
LbD	Leesburg gravelly loam, 10 to 20 percent slopes	DaE	Dandridge shaly silty clay loam, 20 to 35 percent slopes
MeC	Minvale silt loam, 5 to 12 percent slopes	RtE	Rock outcrop-Talbott complex, 10 to 40 percent slopes
TrE	Talbott-Rock outcrop complex, 20 to 50 percent slopes	CkE	Clarksville cherty silt loam, 20 to 40 percent slopes
Gr	Greendale silt loam, 0 to 6 percent slopes, occasionally flooded	CoC	Cloudland loam, 5 to 12 percent slopes (monongahela)
LzE	Litz shaly silt loam, 20 to 35 percent slopes (sil)	Wt	Whitwell loam
Gu	Guthrie silt loam	CeE	Claiborne silt loam, 25 to 40 percent slopes
TbD2	Talbott silt loam, 12 to 25 percent slopes, eroded	Su	Sullivan loam
HoD	Holston loam, 12 to 20 percent slopes	EtB	Etowah silt loam, 2 to 6 percent slopes
At	Altavista silt loam	Em	Emory silt loam, 0 to 4 percent slopes, occasionally flooded

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Soils Data provided by US Department of Agriculture

Stantec TVA

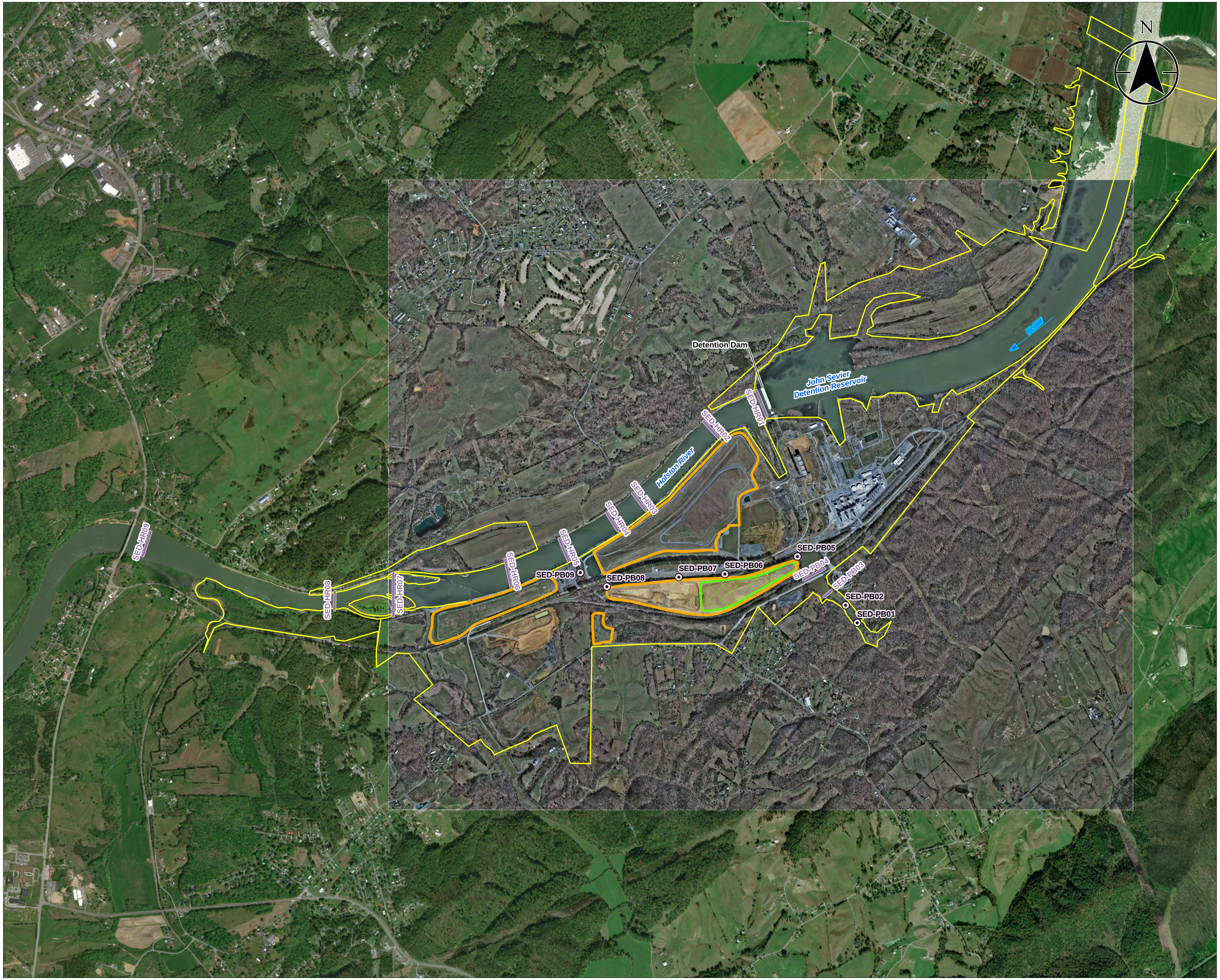

Figure No.
1

DRAFT

Title

Sediment Sampling

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by LMB on 2018-07-25
Technical Review by RAA on 2018-07-25

0 1,000 2,000 3,000 4,000 Feet

1:12,000 (At original document size of 22x34)

Legend

- Sediment Sampling Point
- Sediment Sampling Location
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08) and ESRI Basemaps (NAIP 2016)

Stantec

TVA

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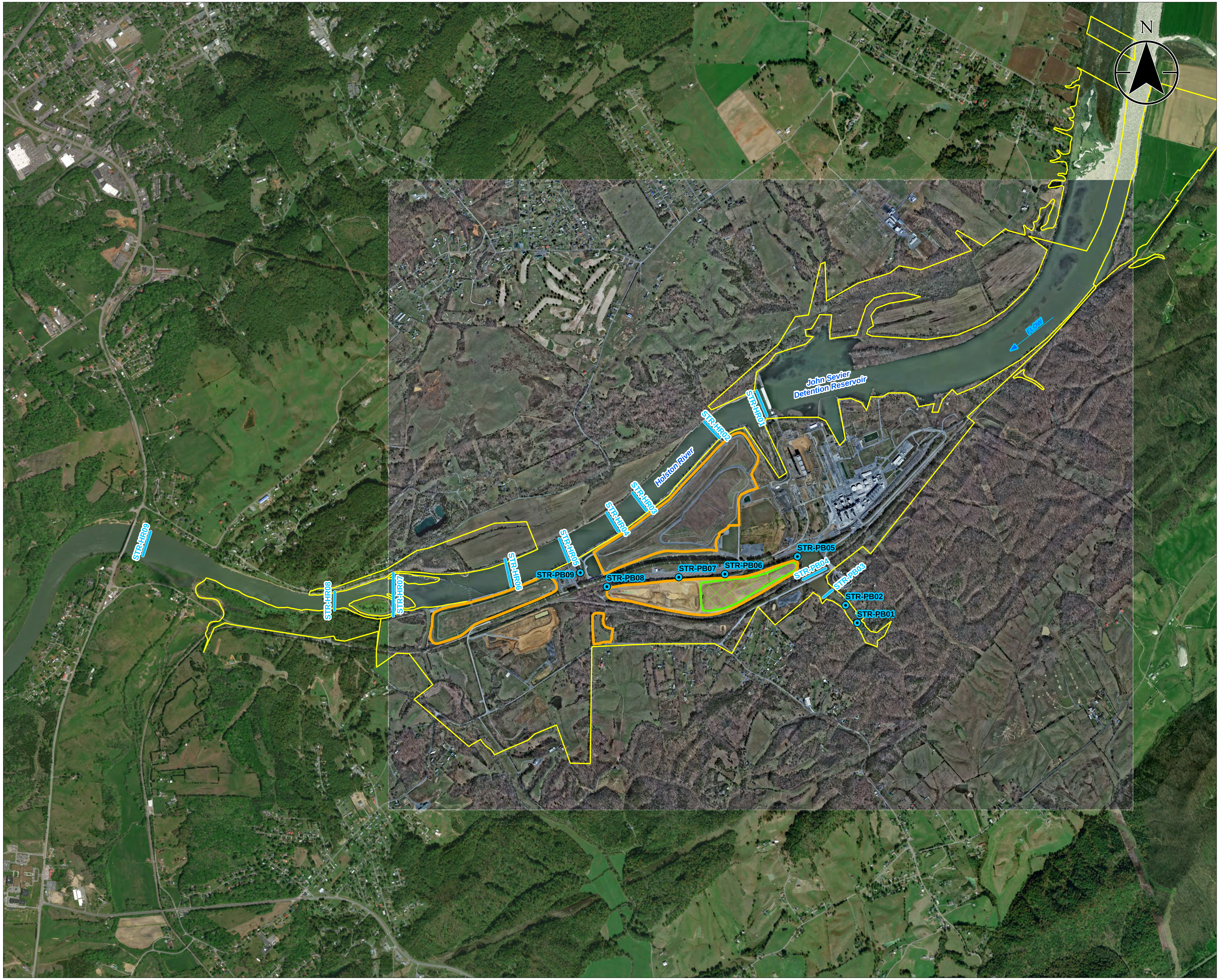

Figure No.
1

DRAFT

Title

Stream Sampling

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175566338
Prepared by TKR on 2018-07-25
Technical Review by RAA on 2018-07-25

0 1,000 2,000 3,000 4,000 Feet

1:12,000 (At original document size of 22x34)

Legend

- Stream Sampling Point
- Stream Sampling Transect
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08) and ESRI Basemaps (NAIP 2016)

U:\TVA-EIP\175566338\gis\mxds\JSF_Surface_Stream.mxd Revised: 2018-07-25 By: lblackman

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Master Log of Changes to JSF EIP
Surface Stream SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response	Proposed Update to JSF 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).	Neet to add.
2	ALF	October 3, 2017	59	Appendix C, Section 9.1.2	QAPP	23	4	9	Some of the requirements in the QAPP are written as should. The QAPP must be written as what will be done. If multiple coolers are needed, one COC Record should will accompany each cooler that contains the samples identified on the COC.	The word "will" will be replaced with "shall" where a TDEC regulation, rule or the Order is explicitly referenced. In all other uses, the word "will" can be interpreted by TDEC as having the same meaning as "shall" and reflect TVA's commitment to performing the specified task, action, activity, etc.	This change not currently incorporated in Surface Stream SAP.
3	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.	Incorporate similar change into CUF Surface Stream SAP.
4	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.	Need to add.
5	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.	Need to add.
6	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.	Need to add that Total Hardness will be calculated based on constituent results
7	BRF	May 22, 2018	2	All	All	All	All	All	Rev 1 Comment: TVA shall either collect water samples for CCR analyses when it collects samples for NPDES monitoring or collect and analyze water samples from the NPDES discharge point quarterly.	Rev 1 Response: TVA shall continue to collect, test and report outfall samples in accordance with the conditions of the NPDES permit. TVA has included NPDES outfall sampling information, as well as detailed constituent information provided in its NPDES permit applications. NPDES compliance data previously submitted to TDEC will be included in the revised EIP as an appendix. If after reviewing the existing data, TDEC desires additional surface water data as part of the investigation, TDEC and TVA can jointly determine a path forward.	No action required.
									Rev 2 Comment: TVA will confirm that samples collected will be analyzed for all CCR parameters.	Rev 2 Response: TVA will continue to comply with all terms and conditions of its TDEC NPDES permit. If additional surface water data is desired by TDEC as part of the investigation, TDEC and TVA can jointly determine a path forward.	No action required.
8	CUF	February 15, 2018	N/A	5.2	Surface Stream SAP	9-11	N/A	N/A	N/A	N/A	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.
9	CUF	September 12, 2018	N/A	5.2	Surface Stream SAP	NA	N/A	N/A	N/A	N/A	Add procedure for determining whether or not a thermocline exists.
10	?	?	TVA Comment	Table 7	Surface Stream SAP	NA	N/A	N/A	N/A	N/A	Add TDS & TSS to Table 7
11	JSF	May 25, 2018	NA	Figure 1	Stream Sampling	NA	Figure 1	N/A	NA	TVA NEPA process revealed a cultural concern - historical Native American fish ladder - so the STR-HR-6 sampling location was shifted upstream of the fish ladder location in order to not cause a disturbance of the ladder.	Update only needed on JSF

Master Log of Changes to JSF EIP
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 JSF EIP Rev 3 Final
1	JSF	July 2, 2018	NA	4	Sampling Locations	4	Table 1	2	NA	TVA NEPA process revealed a cultural concern - historical Native American fish ladder - so the HRA-1 sampling location was shifted downstream of the fish ladder location in order to not cause a disturbance of the ladder.	Update only needed on JSF
2	CUF	April 1, 2018	NA	5.2.3.3	Chain of Custody Forms	10	1	4	NA	Internal change to SAP	Yes
3	CUF	April 1, 2018	NA	5.2.4	Collection of Samples	12	10	5	NA	Internal change to SAP	Yes
4	JSF	September 28, 2018	NA	EIP 4.5.7	Surface Water Impacts Request No. 7	59, 60	2	4	NA	Added reference to additional historic biological monitoring d	Yes

Master Log of Changes to JSF EIP
Exploratory Drilling SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response	Proposed Update to JSF EIP Rev 3
1	CUF	September 13, 2018	n/a	5.2.7	Equipment Decontamination Procedures	14	First (new)	n/a	n/a	n/a	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	n/a	n/a	n/a	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 into the annular space of the drill tooling.

Master Log of Changes to JSF EIP
Stability SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response	Proposed Update to JSF EIP Rev 3
											No updates needed.

Master Log of Changes to JSF EIP
CCR Material Characteristics SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response	Proposed Update to JSF EIP Rev 3 Final
1	ALF	October 3, 2017	87	Appendix J, Section 5.2.2	Groundwater Investigation SAP, Well Purging				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).	Acknowledged; amend language in section 5.2.1.2.
2	All	May 7, 2018	NA	General Administrative	CCR Mat Char SAP				NA	NA	Correct error in document numbering in section 5.0 for TVA TI ENV-TI-05.80.01 .
3	All	May 7, 2018	NA	General Administrative	CCR Mat Char SAP				NA	NA	Correct error in document numbering in sections 5.0 and 5.2 for TVA TI ENV-TI-05.80.50.

Master Log of Changes to JSF EIP
Hydrogeological Investigation SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response	Proposed Update to JSF EIP Rev 3 Final
	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	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 into the annular space of the drill tooling.

Master Log of Changes to JSF EIP
Groundwater Investigation SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response	Proposed Update to JSF EIP Rev 3 Final
											No updates needed.

Master Log of Changes to JSF EIP
Benthic SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response	Proposed Update to JSF EIP Rev 3 Final
1	JSF	July 2, 2018	NA	Attachment A	Figures	NA	NA	NA	NA	TVA NEPA process revealed a cultural concern (historical Native American fish ladder). Sediment sampling transect SED-HR06 and benthic invertebrate transect MAC-HR07 were moved further upstream, and the HRA-1 mayfly sampling area was reduced in size to avoid causing a disturbance of the ladder.	Update only needed on JSF

Master Log of Changes to JSF EIP
Water Use Survey SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response	Proposed Update to JSF EIP Rev 3 Final
1	JSF	September 26, 2018	NA	4.2	Water Use Survey	30	entire section	NA	Resulted from multiple Public Comments related to sampling residential water supply wells.	Comment acknowledged, will include plan to sample usable water supply wells and water sources within 1/2-mile of the facility.	Include Water Use Survey SAP which details intended sampling procedures and protocol.

Master Log of Changes to JSF EIP
Quality Assurance Project Plan Revision 3

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response	Proposed Update to JSF EIP Rev 3 Final
1	JSF	NA	NA	2.2.4	Analytical Laboratories	6	Table 2-1	NA	NA	NA	Change PM for both TestAmerica Facilities as Gail Lage
2	JSF	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	JSF	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"
4	JSF	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)"
5	JSF	NA	NA	19.1	Precision	50	3	NA	NA	NA	Add language defining RER equation
6	JSF	NA	NA	All attachments	Various	Various	Various	NA	NA	NA	Update analyte lists for consistency with updates to SAPs.
7	JSF	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
8	JSF	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
9	JSF	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
10	JSF	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.
11	JSF	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
12	JSF	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

13	JSF	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
14	JSF	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
15	JSF	NA	NA	Attachment G	Investigation-Specific Quality Control Requirements – Surface Stream	G-2	Table G-1	NA	NA	NA	Remove thermal preservation required for radiological parameters
16	JSF	NA	NA	NA	Investigation-Specific Quality Control Requirements – Water Use Survey Sampling	NA	NA	NA	NA	NA	Water Use Survey is not applicable to JSF.
17	JSF	NA	NA	Attachment J	Investigation-Specific Quality Control Requirements – Benthic Sampling	J-2	Table J-1	NA	NA	NA	Update container type to 16-oz glass for radiological parameters for sediment
18	JSF	NA	NA	Attachment J	Investigation-Specific Quality Control Requirements – Benthic Sampling	J-2	Table J-1	NA	NA	NA	Remove thermal preservation required for radiological parameters
19	JSF	NA	NA	Attachment J	Investigation-Specific Quality Control Requirements – Benthic Sampling	J-3	Table J-2	NA	NA	NA	Update RLs to match current laboratory reporting limits
18	JSF	NA	NA	Attachment J	Investigation-Specific Quality Control Requirements – Benthic Sampling	J-3	Table J-2	NA	NA	NA	Removed note that biological samples will be reported on a dry-weight basis; tissue samples will be reported wet-weight.
18	JSF	NA	NA	Attachment I	Investigation-Specific Quality Control Requirements – Fish Tissue Sampling	I-3	Table I-2	NA	NA	NA	Removed note that biological samples will be reported on a dry-weight basis; tissue samples will be reported wet-weight.
20	JSF	NA	NA	Attachment K	Investigation-Specific Quality Control Requirements – Seep Sampling	K-2	Table K-1	NA	NA	NA	Seeps sampling not applicable to JSF
21	JSF	NA	NA	Attachment K	Investigation-Specific Quality Control Requirements – Seep Sampling	K-2	Table K-1	NA	NA	NA	Seeps sampling not applicable to JSF
22	JSF	NA	NA	Attachment K	Investigation-Specific Quality Control Requirements – Seep Sampling	K-3	Table K-2	NA	NA	NA	Seeps sampling not applicable to JSF
23	JSF	NA	NA	Attachment F	Investigation-Specific Quality Control Requirements – Groundwater	F-2	Table F-1	NA	NA	NA	Remove thermal preservation required for radiological parameters

24	JSF	NA	NA	Attachment E	Investigation-Specific Quality Control Requirements - Background Soil	E-2	Table E-1	NA	NA	NA	Added clarification for field pH analyses.
25	JSF	NA	NA	Attachment J	Investigation-Specific Quality Control Requirements - Sediment Sampling	All pages	All Tables	NA	NA	NA	Combined sediment and mayfly sampling requirements into Attachment J for consistency with SAP.
26	JSF	NA	NA	Attachment H	Investigation-Specific Quality Control Requirements - Water Use Survey	All pages	All Tables	NA	NA	NA	Added investigation-specific quality control requirements for Water Use Survey sampling.

APPENDIX C
FIGURES

Figure No.
1

Title
John Sevier Fossil Plant Site Map

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-09
Technical Review by RAA on 2017-11-09

0 450 900 1,350 1,800 Feet
1:5,400 (At original document size of 22x34)

Legend

- TVA Property Boundary
- Limit of Historical Ash Disposal Ponds (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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Figure No.
2

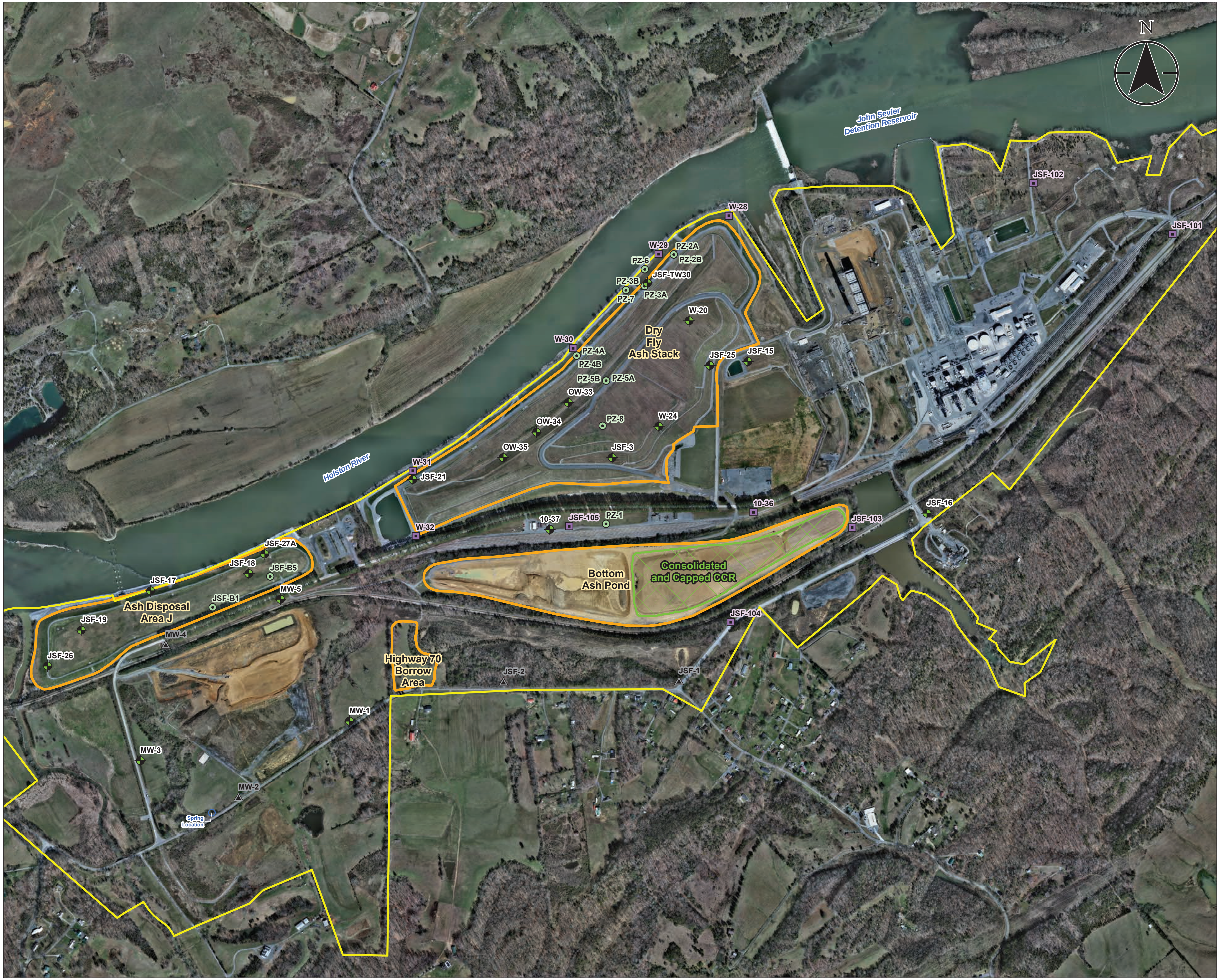
Title
John Sevier Fossil Plant Existing and Closed Wells

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-16
Technical Review by RAA on 2018-05-16

0 450 900 1,350 1,800 Feet
1:5,400 (At original document size of 22x34)



Legend

- Existing Groundwater Monitoring Well
- Closed Groundwater Monitoring Well
- Closed Piezometer
- Existing Observation Well
- Spring Location
- TVA Property Boundary
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec

TVA

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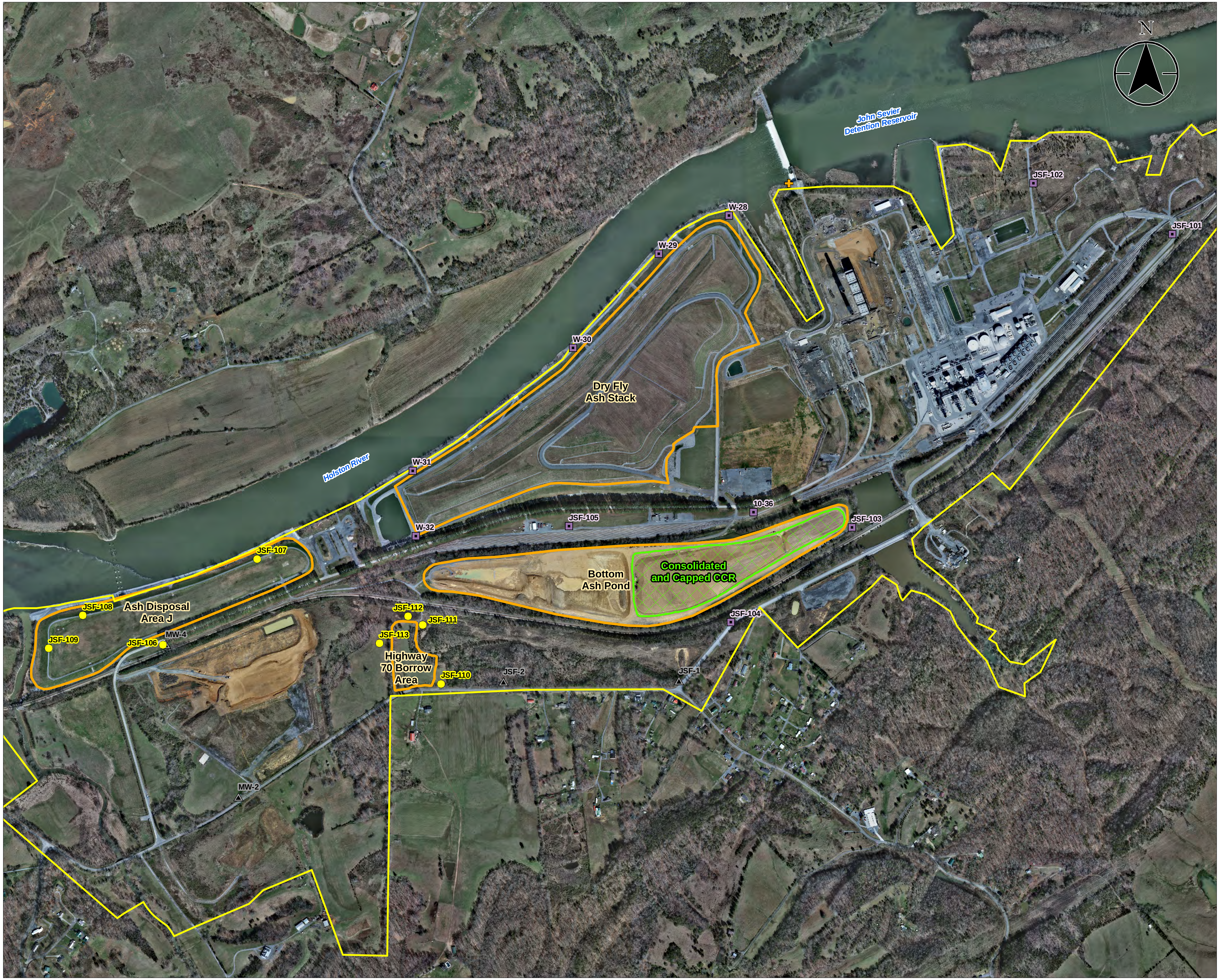

Figure No.
3

Title
John Sevier Fossil Plant
Proposed Groundwater Well Locations

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 450 900 1,350 1,800 Feet

1:5,400 (At original document size of 22x34)

Legend

- River Gauge
- Existing Groundwater Monitoring Well
- Existing Observation Well
- Proposed Groundwater Monitoring Well
- TVA Property Boundary
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec

TVA

Figure No.

4

Title

Uppermost Foundation Soil Data Dry Fly Ash Stack

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175566338

Prepared by TKR on 2017-11-21
Technical Review by RAA on 2017-11-21

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- Alluvial Clay/Silt
- Alluvial Gravel
- Alluvial Sand
- Residual Clay/Silt
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. The limits of the Historical Ash Disposal Ponds were approximated using drawing 10N295 and previous inspection reports per note 4 on drawing 10W507-01.

Stantec

TVA

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Figure No.
5

Title
Existing Borings in Historical Bathtub Area

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

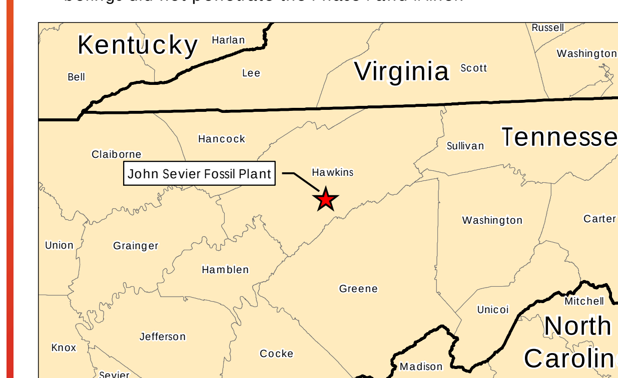
175566338
Prepared by TKR on 2017-11-09
Technical Review by RAA on 2017-11-09

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Existing Boring drilled before liner construction
- Existing Boring drilled after liner construction, but terminated above liner
- CCR Unit Area (Approximate)
- Limit of Phase I & II Liner (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Boring PZ-8 was performed in 1998. Borings JSF-33A, JSF-33B, JSF-34A, and JSF-34B were performed in March to April 2009. The Phase I and II liner was installed between May and October 2009 in the Bathtub Area. Thus, the borings did not penetrate the Phase I and II liner.
4. Borings JS-76, JS-77, JS-78, JS-79, and JS-80 were performed in 2013 using vacuum excavation. The borings were terminated at the top of the HDPE underdrain pipe installed above the Phase I and II liner. Thus, the borings did not penetrate the Phase I and II liner.



Stantec
TVA

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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
Dry Fly Ash Stack (Closed Condition)	C, E, F	C, E, F	C, E	Typ.[4]	C, E

[1] Pseudostatic, but related to a site-specific 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 was analyzed.
Blue cells are completed analyses. Yellow cells are proposed analyses.

Figure No.
6

Title
Completed and Proposed Stability Analyses Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-21
Technical Review by RAA on 2018-05-21

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

Stability Cross Section
CCR Unit Area (Approximate)
Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec
TVA

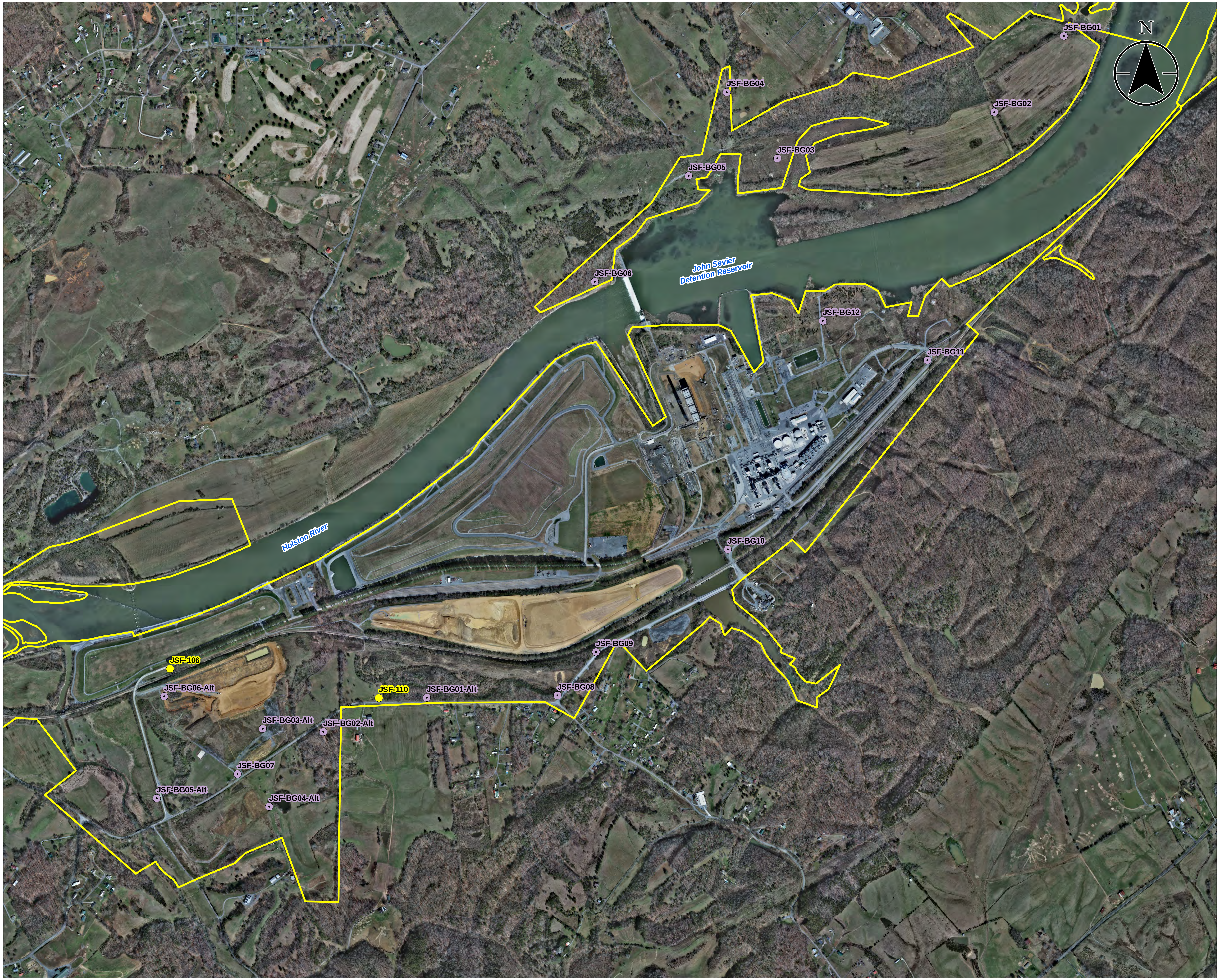

Figure No.

7

Title

Proposed Soil Sampling Locations

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 600 1,200 1,800 2,400 Feet

1:7,200 (At original document size of 22x34)

Legend

- Proposed Background Soil Sample Location
- Proposed Groundwater Monitoring Well
- TVA Property Boundary

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec

TVA

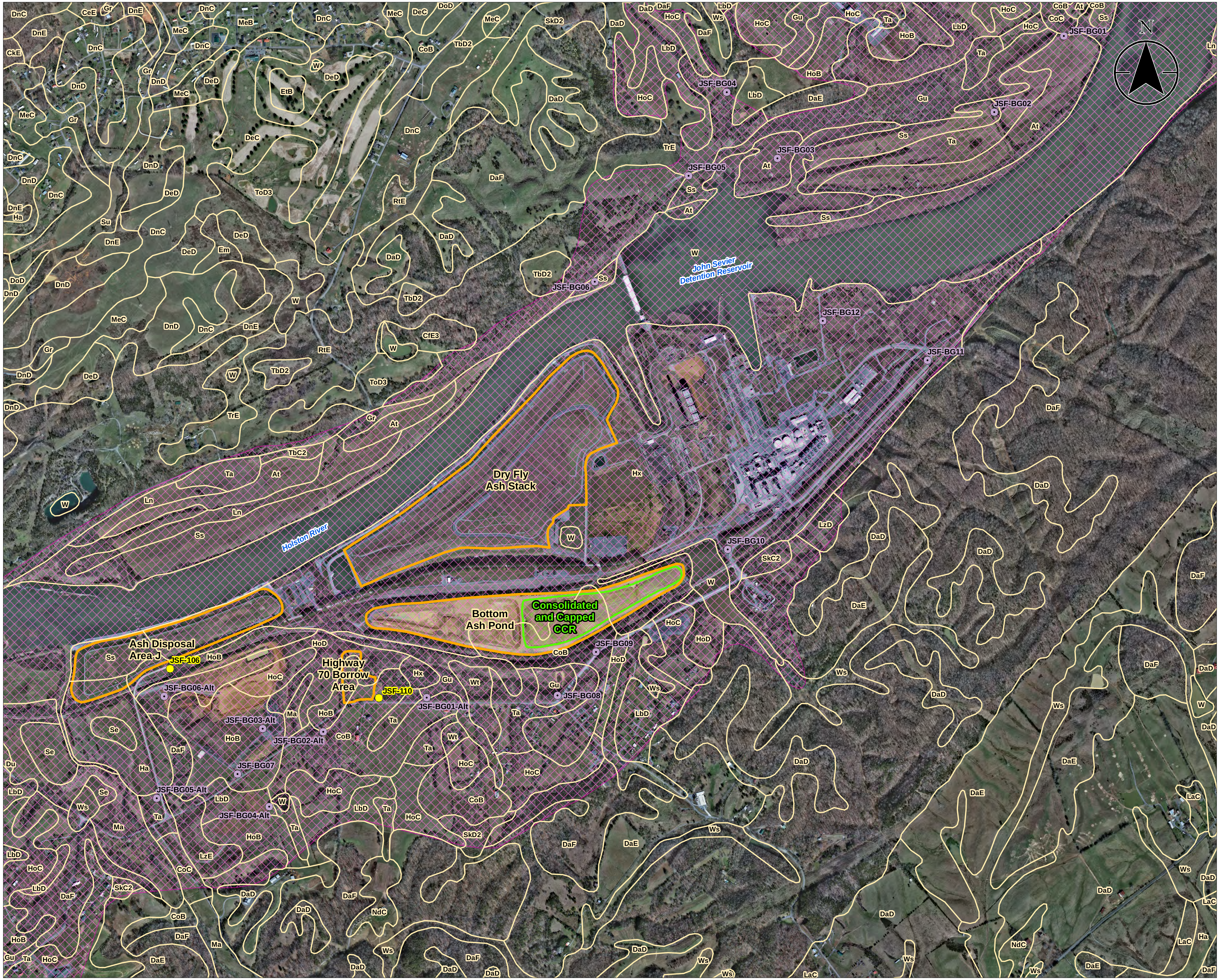

Figure No.
8

Title
Proposed Soil Sampling Locations

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 600 1,200 1,800 2,400 Feet
1:7,200 (At original document size of 22x34)

Legend

- Proposed Background Soil Sample Locations
- Proposed Groundwater Monitoring Well
- Soil Map Unit
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- Soils Developed in Alluvial Deposits

Map Unit	Map Unit Name	Map Unit	Map Unit Name
HoC	Holston loam, 5 to 12 percent slopes	SkC2	Sequoia silt loam, 3 to 12 percent slopes, eroded
Ta	Taft silt loam	Ws	Whitesburg silt loam
MeB	Minvale silt loam, 2 to 5 percent slopes	Ss	Staser silt loam
DeD	Dewey silt loam, 15 to 25 percent slopes	ToD3	Talbott silty clay, 12 to 25 percent slopes, severely eroded
HoB	Holston loam, 2 to 5 percent slopes	CfE3	Claiborne soils, 15 to 35 percent slopes, severely eroded
DnE	Dunmore silt loam, 20 to 35 percent slopes	Du	Dunning silty clay loam
DaD	Dandridge shaly silty clay loam, 5 to 20 percent slopes	TbC2	Talbott silt loam, 5 to 12 percent slopes, eroded
LzD	Litz shaly silt loam, 8 to 20 percent slopes (sil)	Ma	Melvin silt loam
Ln	Lindside silt loam	DaF	Dandridge shaly silty clay loam, 35 to 60 percent slopes
DoD	Dunmore silty clay loam, 12 to 25 percent slopes	DeC	Dewey silt loam, 6 to 15 percent slopes
DnC	Dunmore silt loam, 5 to 12 percent slopes	LaC	Leadvale silt loam, 5 to 12 percent slopes
NdC	Needmore silt loam, 5 to 12 percent slopes	CoB	Cloudland loam, 2 to 5 percent slopes (monongahela)
W	Water	Hx	Holston-Urban land complex
DnD	Dunmore silt loam, 12 to 20 percent slopes	SkD2	Sequoia silt loam, 12 to 20 percent slopes, eroded
Se	Sequatchie loam	Ha	Hamblen silt loam
LbD	Leesburg gravelly loam, 10 to 20 percent slopes	DaE	Dandridge shaly silty clay loam, 20 to 35 percent slopes
MeC	Minvale silt loam, 5 to 12 percent slopes	RtE	Rock outcrop-Talbott complex, 10 to 40 percent slopes
TrE	Talbott-Rock outcrop complex, 20 to 50 percent slopes	CkE	Clarksville cherty silt loam, 20 to 40 percent slopes
Gr	Greendale silt loam, 0 to 6 percent slopes, occasionally flooded	CoC	Cloudland loam, 5 to 12 percent slopes (monongahela)
LzE	Litz shaly silt loam, 20 to 35 percent slopes (sil)	Wt	Whitwell loam
Gu	Guthrie silt loam	CeE	Claiborne silt loam, 25 to 40 percent slopes
TbD2	Talbott silt loam, 12 to 25 percent slopes, eroded	Su	Sullivan loam
HoD	Holston loam, 12 to 20 percent slopes	EtB	Etowah silt loam, 2 to 6 percent slopes
At	Altavista silt loam	Em	Emory silt loam, 0 to 4 percent slopes, occasionally flooded

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Soils Data provided by US Department of Agriculture

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Figure No.
9

Title

Proposed Borings
Ash Disposal Area J

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-03
Technical Review by KRB on 2018-10-03

0 150 300 450 600 Feet

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

Legend

- Existing Piezometer Open Standpipe
- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- TVA Property Boundary (Approximate)
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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TVA

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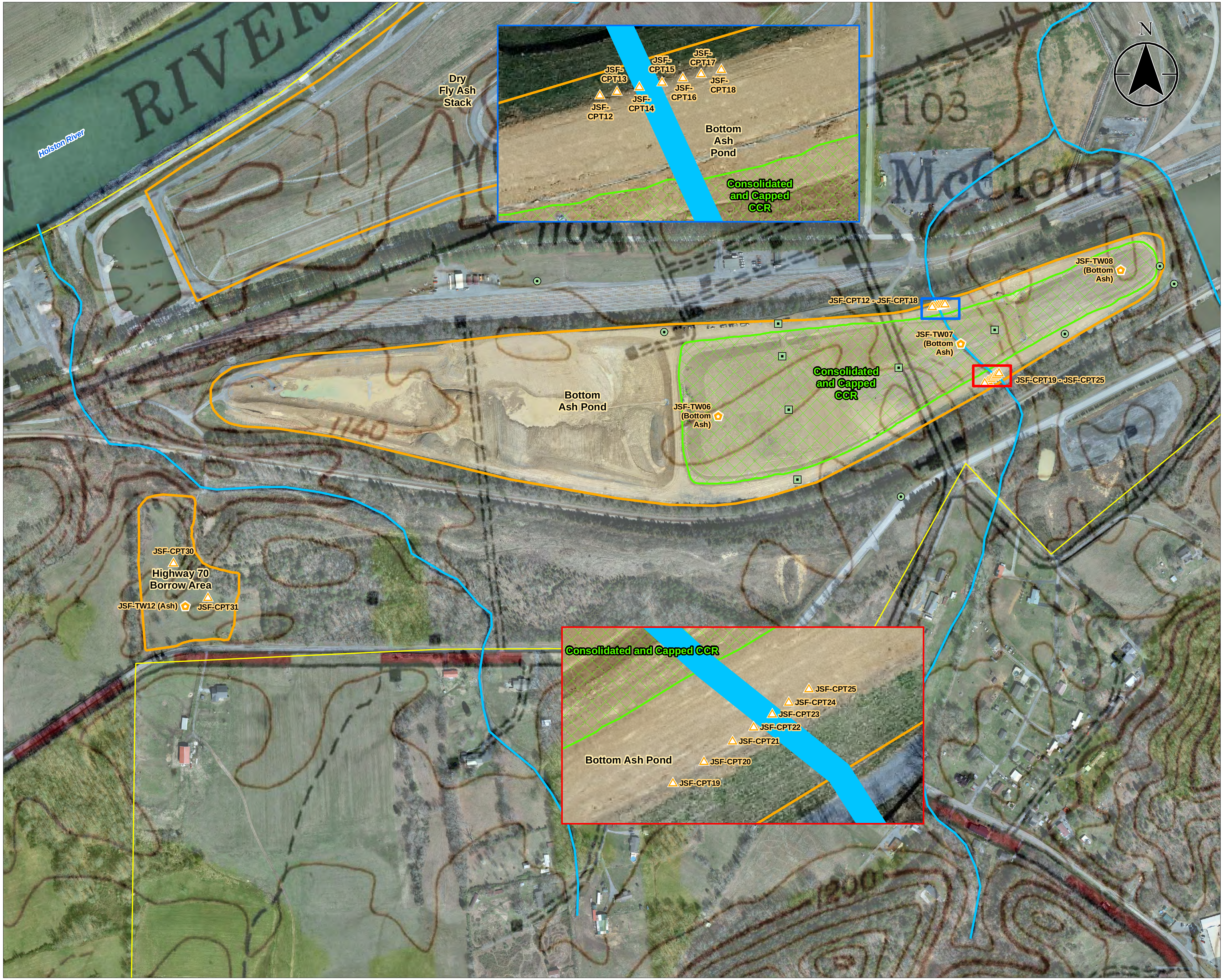

Figure No.
10

Title

Proposed Borings
Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- Existing Piezometer Open Standpipe
- Existing Piezometer Vibrating Wire
- Historical Stream Channel (approximate)
- TVA Property Boundary (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. The width of the pre-construction channel is unclear from historical mapping. CPTs will be advanced through the perimeter dike at 10-foot spacing near the approximate centerline of the pre-construction channel.
4. Topographic Map and Stream Alignment: USGS McCloud and Burem, Tennessee Quadrangles, 1940

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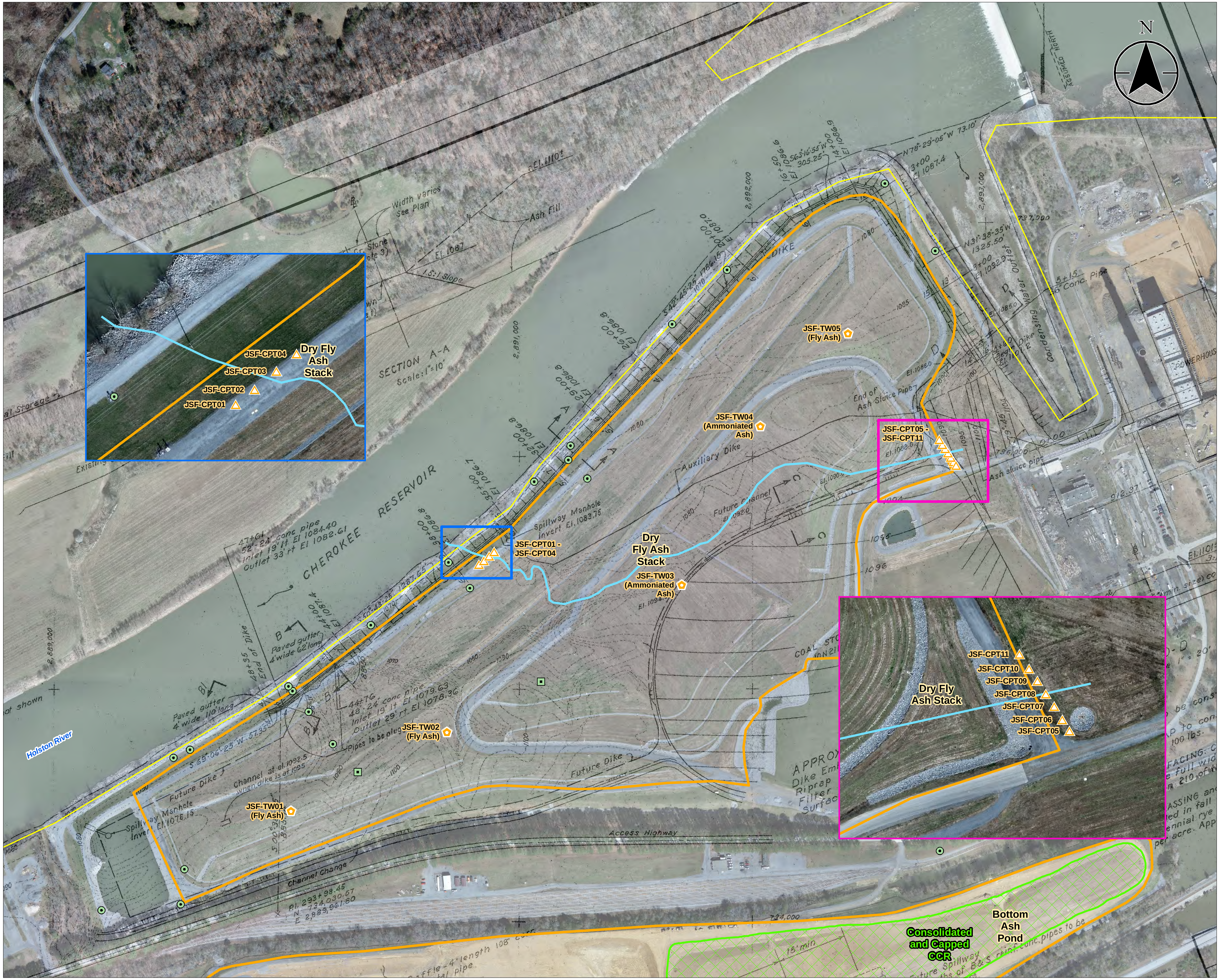

Figure No.
11

Title
Proposed Borings
Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- Existing Piezometer Open Standpipe
- Existing Piezometer Vibrating Wire
- Historical Stream Channel (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Based on historical mapping (TVA Dwg. 10N410), the pre-construction stream was approximately 40 feet wide. CPT borings will be advanced along the perimeter dike on 20-foot spacing within 60 feet of the historical stream centerline.
4. Fewer CPT borings are proposed at the historical stream channel on the northwest side of the DFAS than the southeast side because of the spatial coverage provided by existing borings.
5. Overlay and Stream Alignment: Historical TVA Drawing 10N410, 1958

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TVA

\\us1269-f01\shared_projects\TVA-EIP\175568225_JSF_Phase2\gis\mxd\JSF_Proposed_Borings_DryFly.mxd Revised: 2018-10-18 By: mbough

Figure No.
12

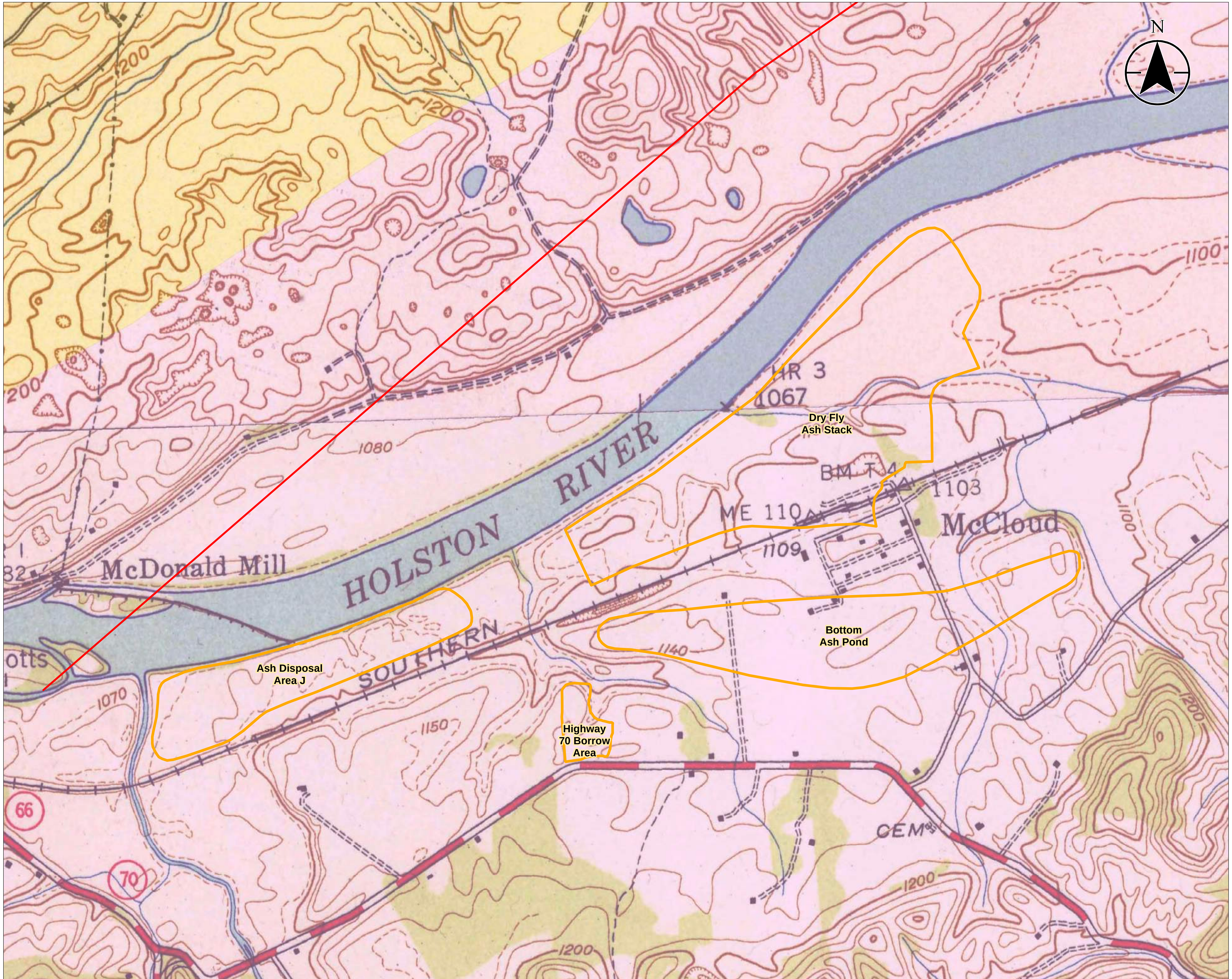
Title
John Sevier Fossil Plant Pre-Construction Geologic Map

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-12-11
Technical Review by RAA on 2017-12-11

0 400 800 1,200 1,600 Feet
1:4,800 (At original document size of 22x34)



Legend

- Fault
- CCR Unit Area (Approximate)
- Newala Formation (On)
- Sevier Shale (Osv)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Topographic Map: USGS McCloud and Burem, Tennessee Quadrangles, 1940
3. Formations and fault obtained from Geologic Map: Rodgers, 1953

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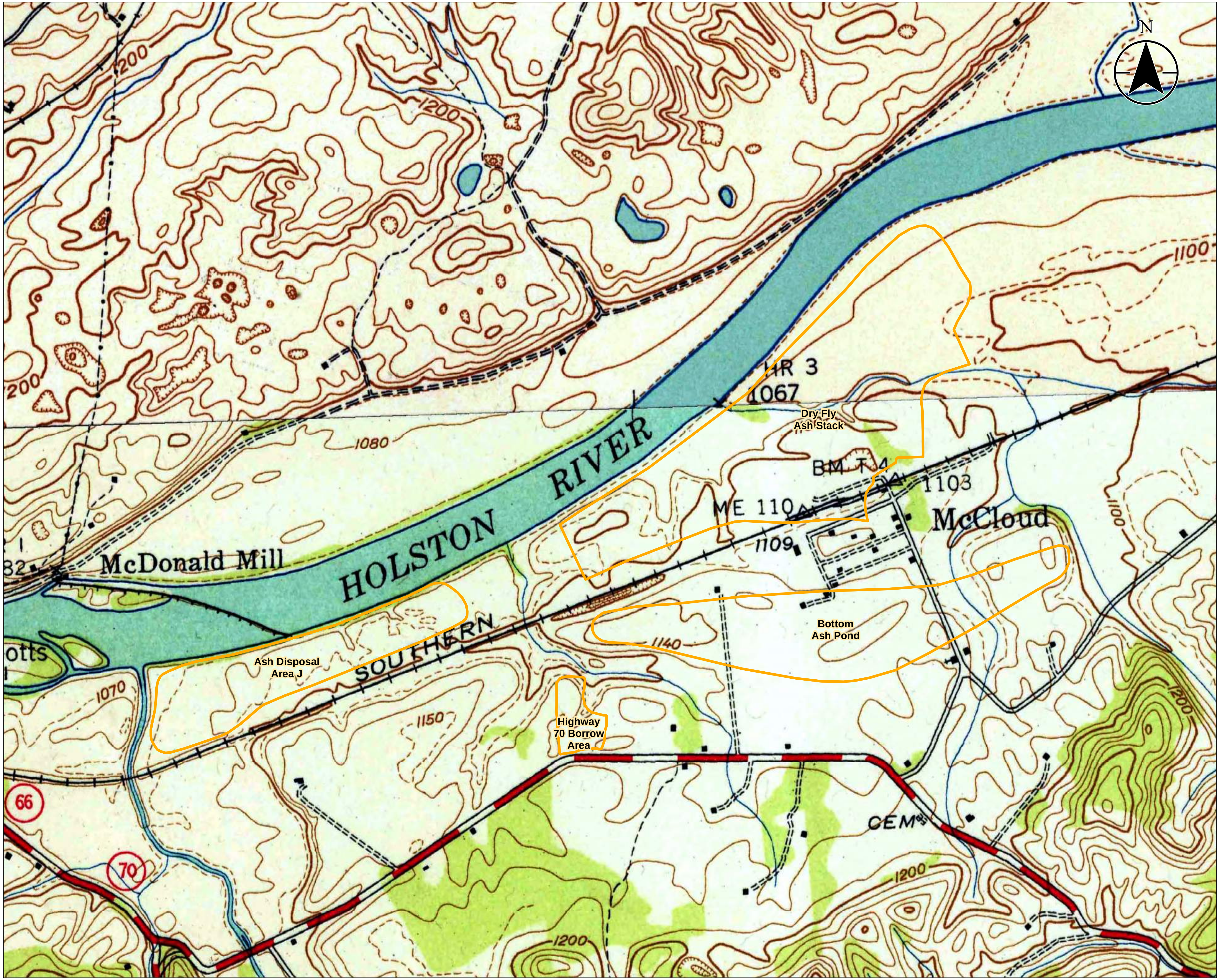

Figure No.
13

Title
John Sevier Fossil Plant
Pre-Construction Topographic Map

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-12-11
Technical Review by RAA on 2017-12-11

0 400 800 1,200 1,600
Feet
1:4,800 (At original document size of 22x34)

Legend

CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Topographic Map: USGS McCloud and Burem, Tennessee Quadrangles, 1940

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TVA

U:\TVA-EP\175566338\gis\mxds\JSF_Topographic.mxd Revised: 2017-12-11 By: mbough

Figure No.
14

Title
Existing CCR Thickness Boring Data
Ash Disposal Area J

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-17
Technical Review by RAA on 2018-05-17

0 200 400 600 800 Feet
1:1,800 (At original document size of 22x34)

Legend

- Boring with CCR Thickness Data
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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Figure No.
15

Title
Existing CCR Thickness Boring Data
Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-09
Technical Review by RAA on 2017-11-09

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Boring with CCR Thickness Data
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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TVA

U:\TVA-EIP\175566338\gis\mxds\JSF_CCR_BottomAsh.mxd Revised: 2017-11-09 By: mbough

Figure No.
16

Title
Existing CCR Thickness Boring Data Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-13
Technical Review by RAA on 2017-11-13

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Boring with CCR Thickness Data
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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TVA

Figure No.
17

Title

Uppermost Foundation Soil Data Ash Disposal Area J

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-17
Technical Review by RAA on 2018-05-17

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

Legend

- Alluvial Clay/Silt
- Alluvial Gravel
- Alluvial Sand
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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TVA

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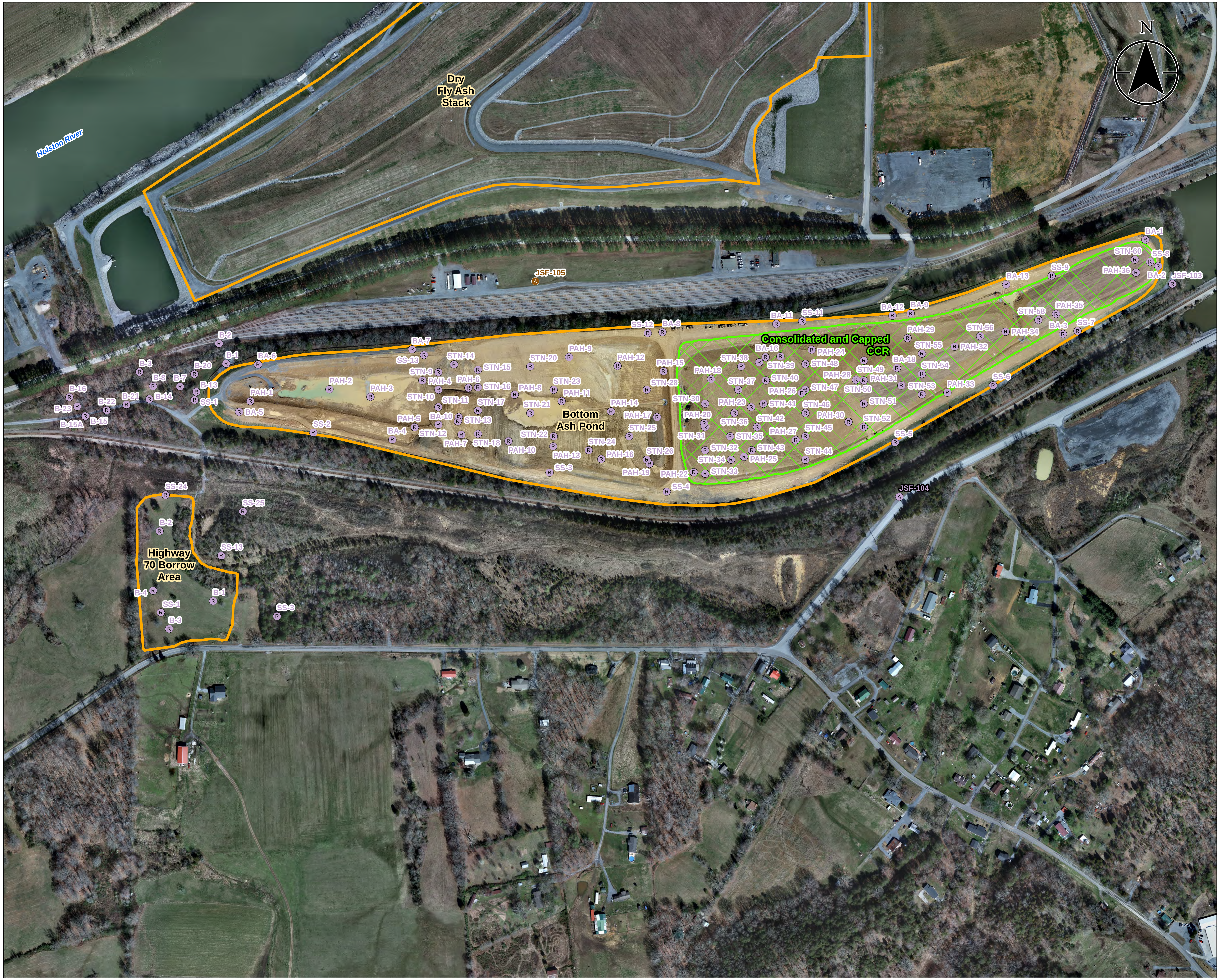

Figure No.
18

Title
Uppermost Foundation Soil Data Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-21
Technical Review by RAA on 2017-11-21

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- A Alluvial Clay/Silt
- A Alluvial Sand
- R Residual Clay/Silt
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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Figure No.
19

Title
Existing Top of Rock Elevation Boring Data Ash Disposal Area J

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-17
Technical Review by RAA on 2018-05-17

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

Legend

- Boring without Rock Core Data [ID, TOR Elevation]
- Fault Line
- CCR Unit Area (Approximate)
- Omb - Martinsburg Shale, including Reedsville Shale and Unnamed Limestone Unit
- On - Newala Formation, including Mascot Dolomite and Kingsport Formation
- Osv - Sevier Shale

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Geologic data downloaded from https://mrdata.usgs.gov/geology/state/state.php?state=TN

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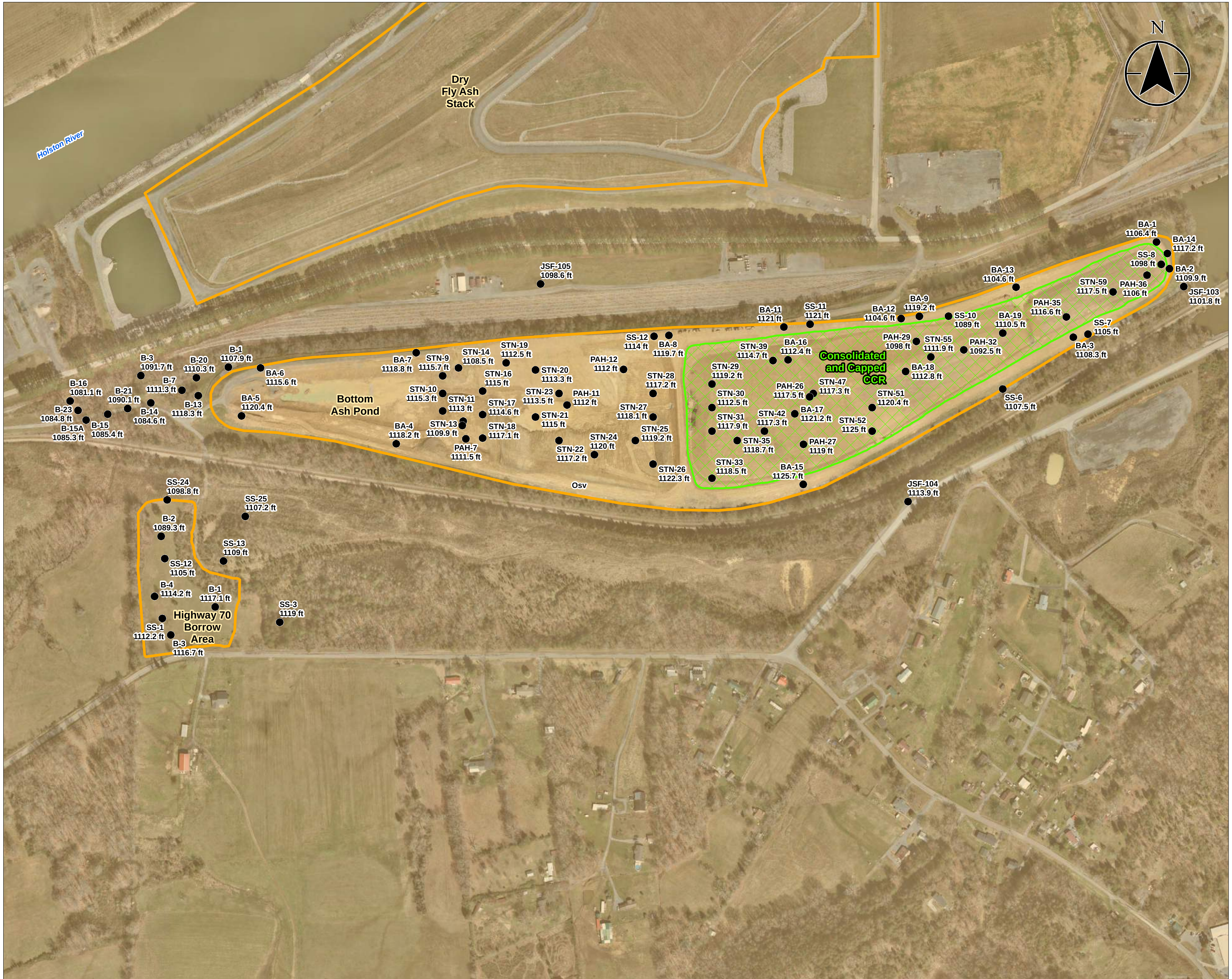

Figure No.
20

Title

Existing Top of Rock Elevation Boring Data Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-09
Technical Review by RAA on 2017-11-09

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Boring without Rock Core Data [ID, TOR Elevation]
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- Osv - Sevier Shale

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Geologic data downloaded from https://mrdata.usgs.gov/geology/state/state.php?state=TN

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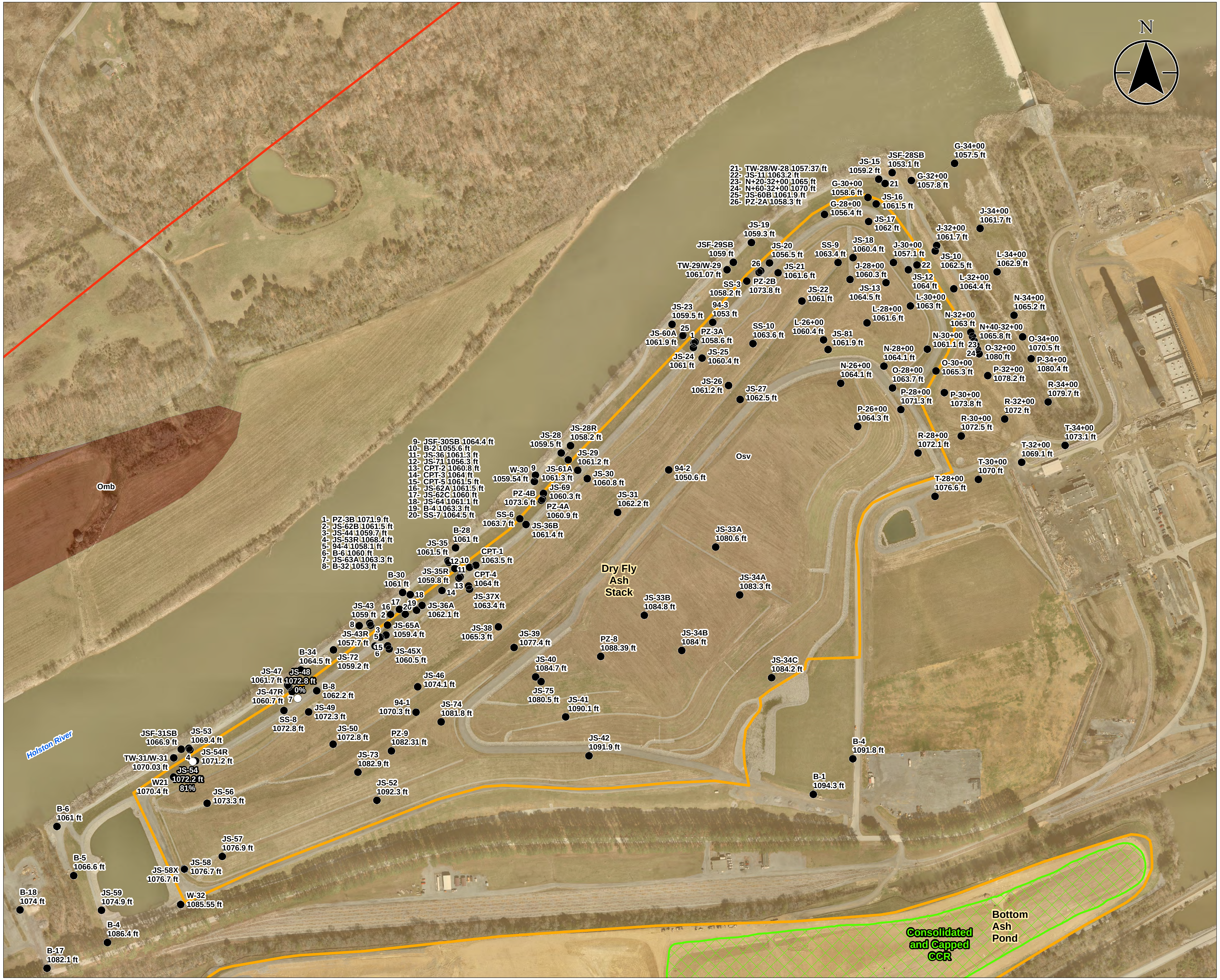

Figure No.
21

Title
Existing Top of Rock Elevation Boring Data Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-13
Technical Review by RAA on 2017-11-13

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- Boring without Rock Core Data [ID, TOR Elevation]
- Boring with Rock Core Data [ID, TOR Elevation, RQD]
- Fault Line
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- Omb - Martinsburg Shale, including Reedsville Shale and Unnamed Limestone Unit
- Osv - Sevier Shale

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Geologic data downloaded from https://mrdata.usgs.gov/geology/state/state.php?state=TN
4. RQD value corresponds to upper 20 feet of rock core.

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TVA

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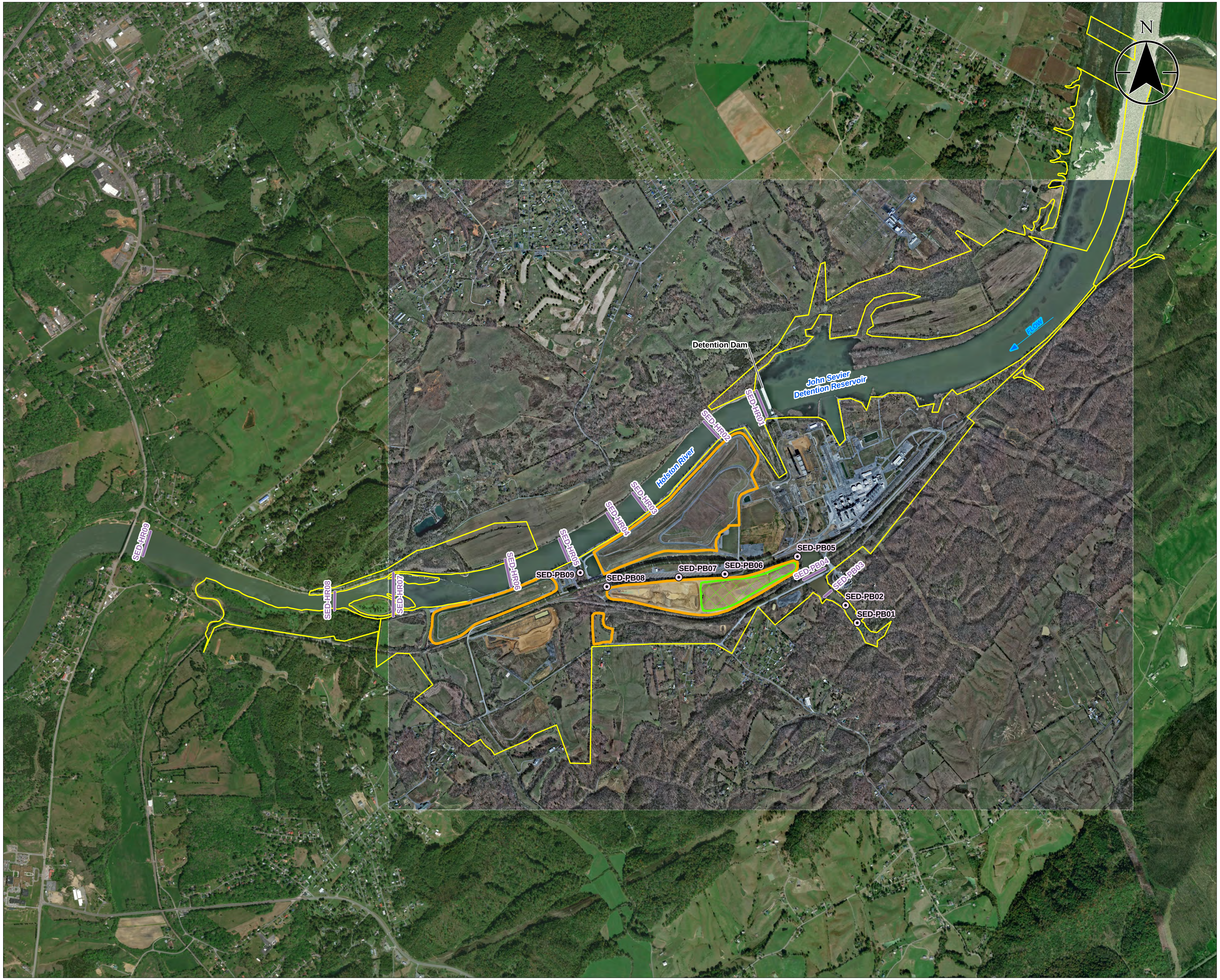

Figure No.
22

Title

Sediment Sampling

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by LMB on 2018-07-25
Technical Review by RAA on 2018-07-25

0 1,000 2,000 3,000 4,000 Feet

1:12,000 (At original document size of 22x34)

Legend

- Sediment Sampling Point
- Sediment Sampling Location
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08) and ESRI Basemaps (NAIP 2016)

Stantec

TVA

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Figure No.
23

Title

Benthic Macroinvertebrates Sampling

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

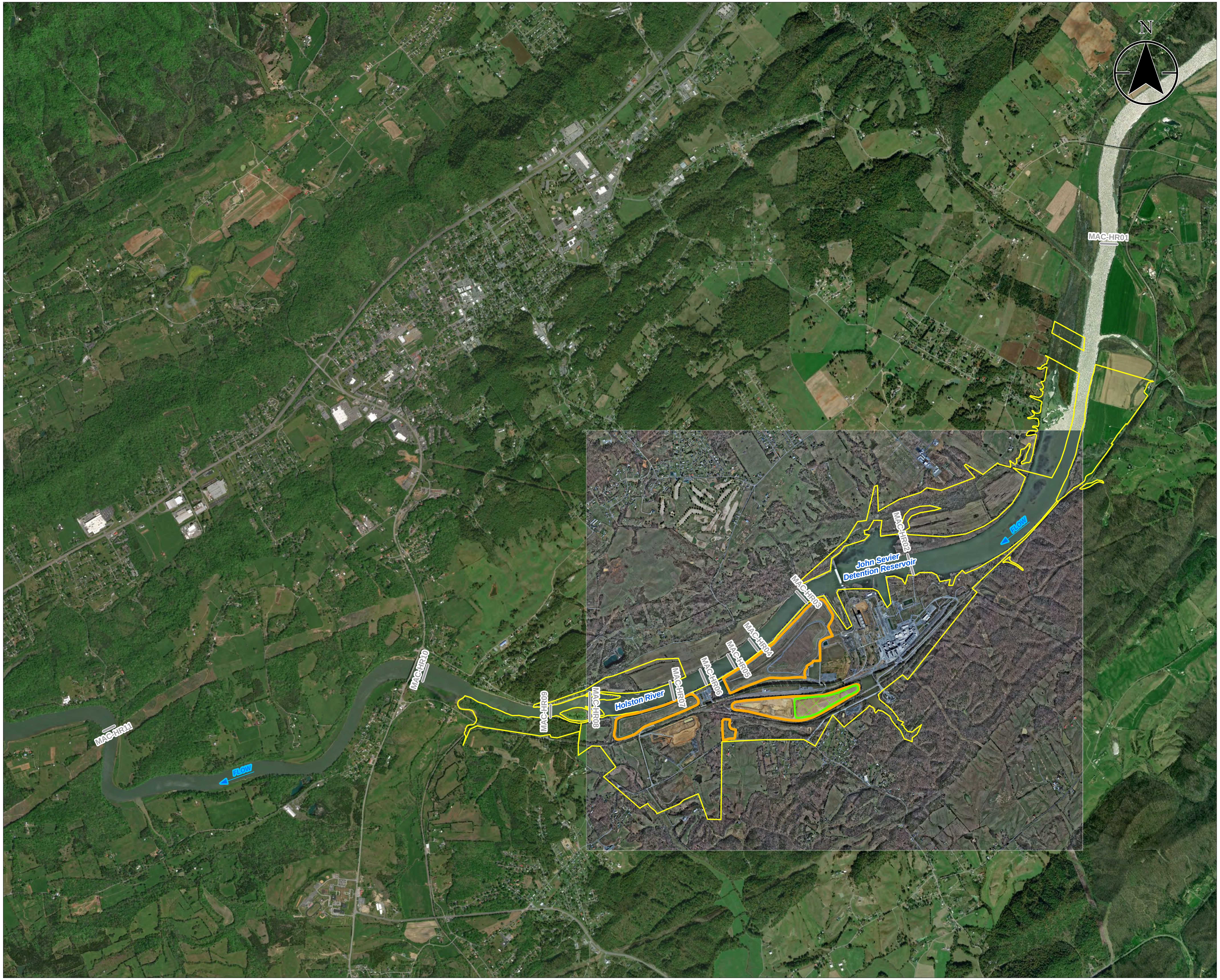
Project Location

Rogersville, Tennessee

175566338
Prepared by LMB on 2018-07-25
Technical Review by RAA on 2018-07-25

0 1,500 3,000 4,500 6,000 Feet

1:18,000 (At original document size of 22x34)



Legend

Benthic Transect

Consolidated & Capped CCR Area (Approximate)

CCR Unit Area (Approximate)

TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08) and ESRI Basemaps (NAIP 2016)

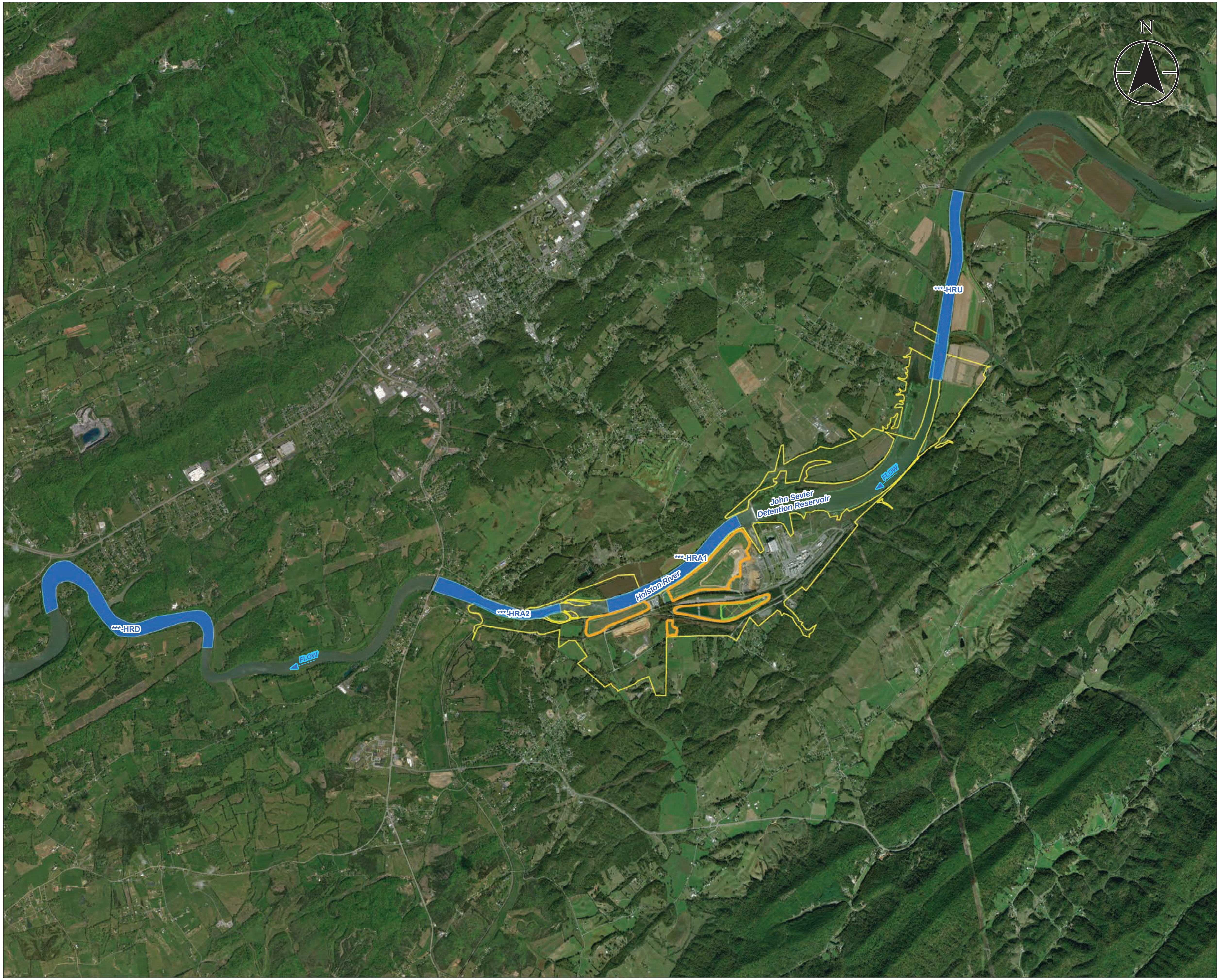


Figure No.
24

Title
Mayfly Sampling Adult Mayflies, Purated Mayfly Nymphs, & Non-Purated Mayfly Nymphs

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-16
Technical Review by RAA on 2018-05-16

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)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

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 Basemaps (NAIP 2016)

Stantec

TVA

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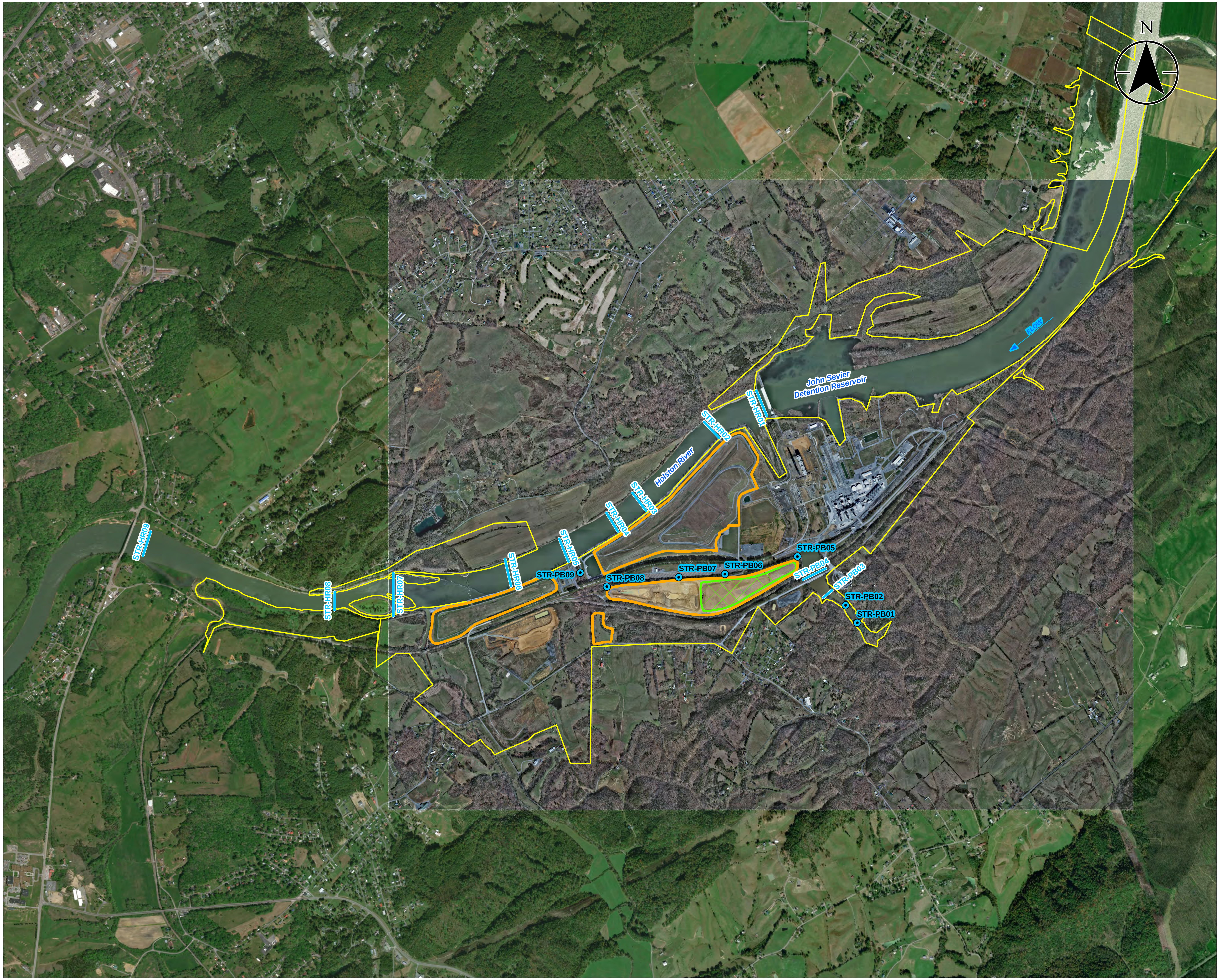

Figure No.
25

Title

Stream Sampling

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175566338
Prepared by TKR on 2018-07-25
Technical Review by RAA on 2018-07-25

0 1,000 2,000 3,000 4,000 Feet

1:12,000 (At original document size of 22x34)

Legend

- Stream Sampling Point
- Stream Sampling Transect
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08) and ESRI Basemaps (NAIP 2016)

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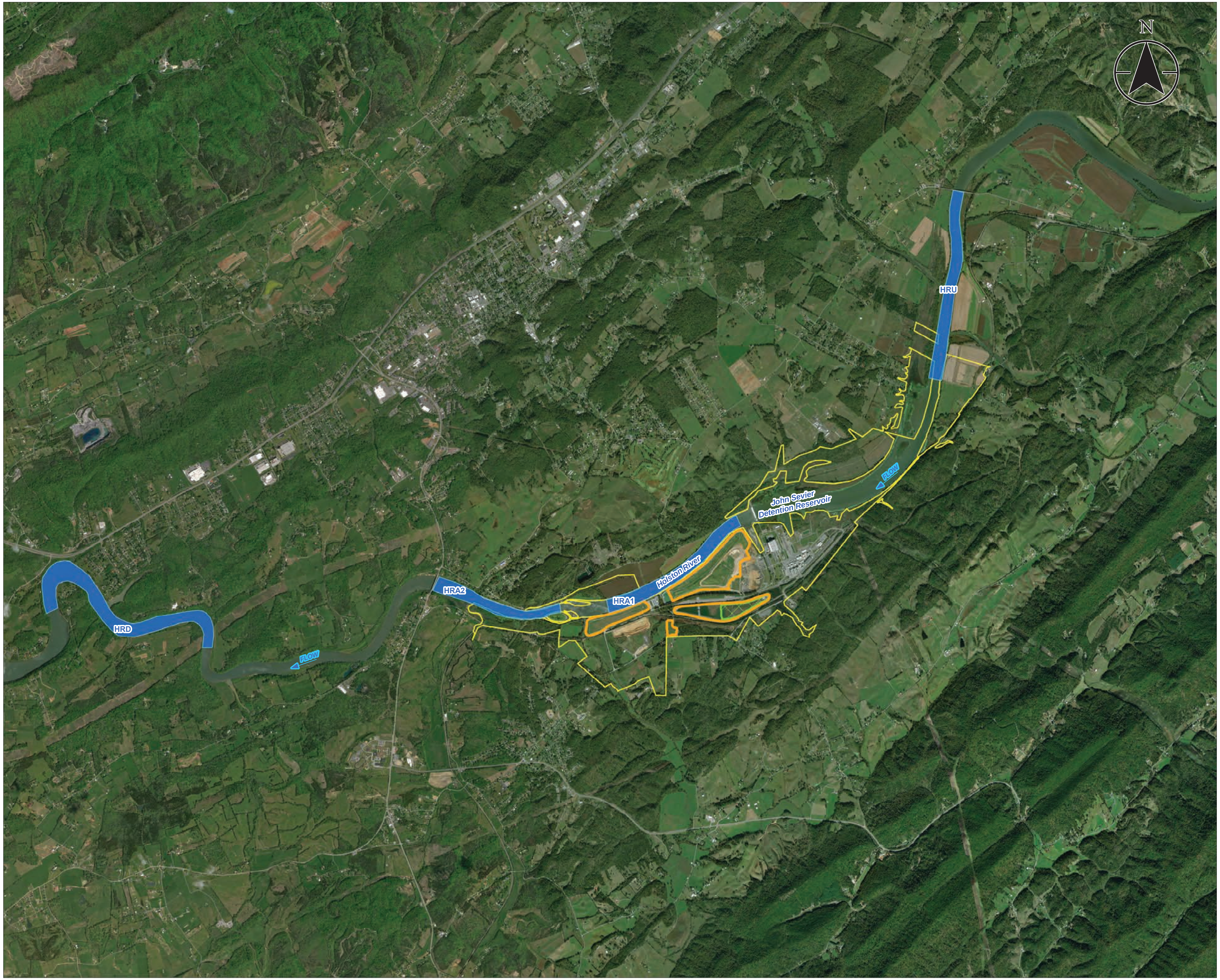

Figure No.
26

Title
Fish Sampling

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-16
Technical Review by RAA on 2018-05-16

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)
Consolidated & Capped CCR Area (Approximate)
TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by ESRI Basemaps (NAIP 2016)

Stantec TVA

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APPENDIX D
QUALITY ASSURANCE PROJECT PLAN

ENVIRONMENTAL® STANDARDS

Setting the Standards for Innovative Environmental Solutions

QUALITY ASSURANCE PROJECT PLAN

FOR THE TENNESSEE VALLEY AUTHORITY

JOHN SEVIER FOSSIL PLANT

ENVIRONMENTAL INVESTIGATION

Revision 2

October 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) John Sevier Fossil Plant (JSF) Environmental Investigation Quality Assurance Project Plan (JSF QAPP) is to confirm that the JSF 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 John Sevier Fossil Plant Environmental Investigation Plan*, *Revision 1* (JSF EIP, Revision 2; May 2018) and provides QA procedures and quality control (QC) measures to be applied to associated sampling and monitoring activities. This JSF QAPP will govern the quality aspects of the investigation-specific Sampling and Analysis Plans (SAPs).

This JSF QAPP describes the QA implementation for the JSF 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 JSF 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 JSF QAPP describes the generation and use of environmental data associated with the JSF EIP and is applicable to current sampling and monitoring programs associated with the project. Data generated under the JSF 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

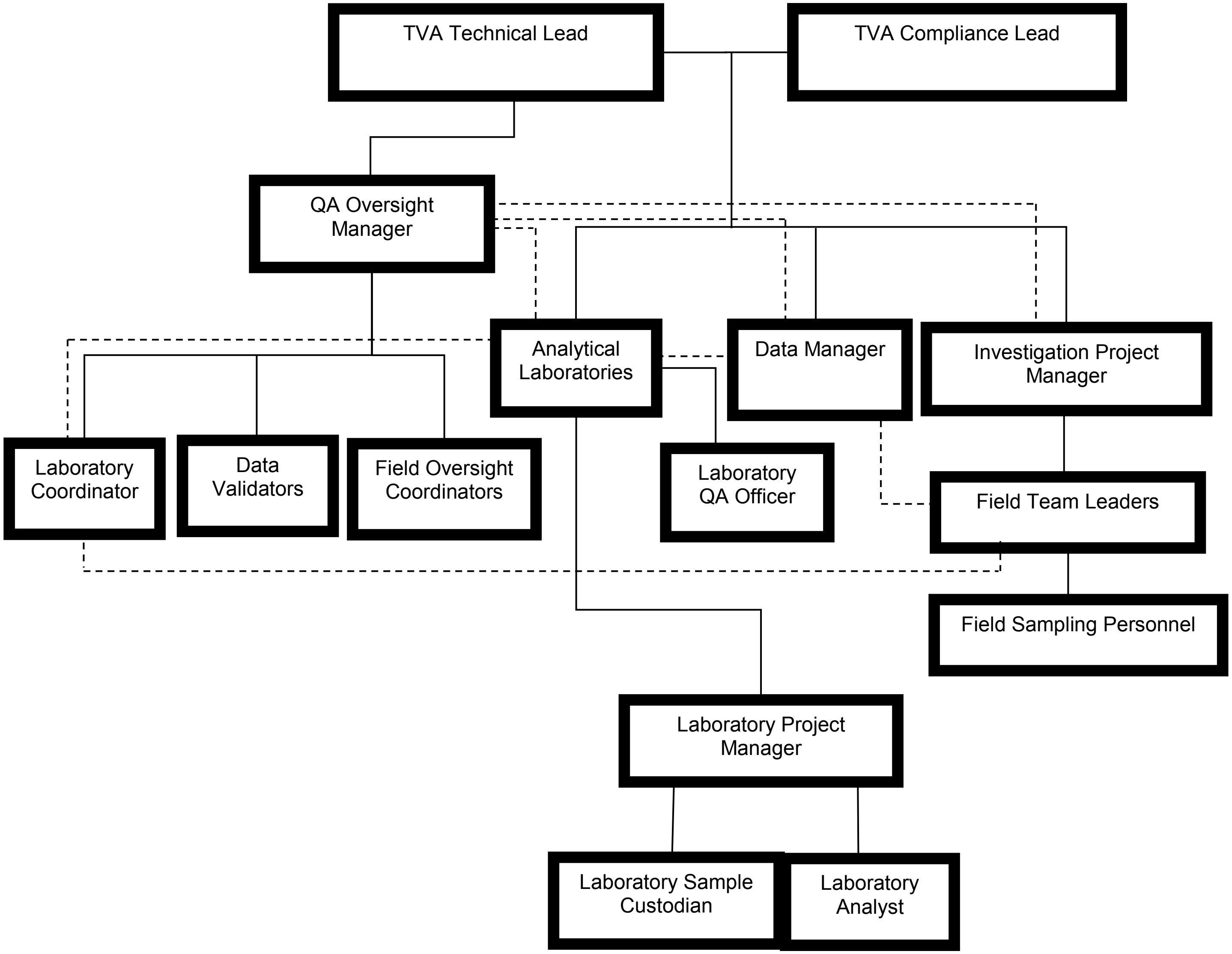
Successful implementation of a QA Program requires clear lines of reporting and authority, along with defined responsibilities for key individuals implementing and administrating the QA Program. This section describes the organizational structure, lines of authority, and responsibilities of key individuals accountable for the implementation and administration of the JSF 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 JSF 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 JSF EIP



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

2.2.1 TVA Compliance Lead

The TVA Compliance Lead is responsible for the coordination and direction of the JSF EIP. The TVA Compliance Lead is ultimately responsible for design and implementation of the Program. 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 EIP strategy.
- Reviewing and approving 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 JSF 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 JSF 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 JSF EIP strategy.
- Developing and reviewing JSF 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 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 JSF 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 JSF 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 JSF EIP are presented on Table 2-1.

Table 2-1. Analytical Laboratories for JSF 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]	
Arsenic Speciation		4955 Yarrow Street Arvada, CO 80002-4517[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)
Geotechnical Characteristics	Stantec Consulting Services Inc.	3052 Beaumont Centre Circle Lexington, KY 40513-1703	Ms. Ryan Jones (ryan.jones@stantec.com)
Biota Analyses	Pace Analytical Services, LLC	1241 Bellevue Street, Suite 9 Green Bay, WI 54302	Mr. Tod Noltemeyer (tod.noltemeyer@pacelabs.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 JSF 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 JSF 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 JSF 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 JSF 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 JSF 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 JSF 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 JSF 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™ 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 JSF EIP. The Data Manager is the main point-of-contact for data-related issues. The Data Manager is responsible for ensuring compliance with the JSF 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, the TDEC issued Commissioner’s Order No. OGC15-0177 (TDEC Order), to the 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 JSF on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management at JSF. On August 3, 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 November 3, 2016, TVA submitted JSF EIP Revision 0 to TDEC. This JSF EIP Revision 2 addresses TDEC’s EIP Revision 1 review comments provided to TVA on March 27, 2018.

The purpose of the JSF EIP is to characterize the hydrology and geology of the JSF, identify the extent of soil, surface water, and groundwater impact (if any) 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 JSF.

To support the JSF 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 JSF QAPP. The requirements of the JSF QAPP are applicable to project environmental personnel, support staff, consultants, and subcontractors.

3.1 Purpose and Scope

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

The scope of this document is to describe the QA requirements developed for the JSF EIP and provide the appropriate QA procedures and QC measures to be applied to the associated sampling and monitoring activities. The JSF 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 JSF 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 JSF 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 QAPP Distribution and Revision

The JSF 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 JSF 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 JSF QAPP will identify the JSF 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 Objective (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 JSF 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 program-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 Laboratory Director or her/his designee to conduct the various laboratory analyses described in the JSF 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 JSF QAPP and in the program-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 JSF 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 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

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:

- 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 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. 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.

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

Chemical analytical data will be provide 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 JSF 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 data (historical and investigatory) to be used as part of the JSF EIP. To maintain uniformity and consistency among analytical laboratories, the EDD format for the transfer of data associated with the JSF 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 JSF 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 JSF 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 JSF EIP. These samples will be subject to a variety of chemical, radiological, and physical analyses to support the objectives outlined in the JSF 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 JSF 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 JSF 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 SAP 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, 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 JSF 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 JSF 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 Team 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 Team 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 that are shipped to the laboratory frozen will be packed with blue ice or 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 JSF 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 JSF 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 JSF 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 JSF 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 program-specific SAPs and/or in the associated TVA TIs.

10.2 Laboratory Analysis

To support the objectives of the JSF EIP, the collected samples will be tested for the methods, constituents, and reporting limits presented in Attachments E through K of this JSF 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 JSF 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 JSF 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 samples where possible. Chemical analysis results for solid samples will be reported on a dry-weight basis unless specifically requested otherwise. 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 JSF EIP. Specific quantitative QA objectives for each investigation are presented in Attachments E through K of this JSF 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), 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 accuracy, precision, representativeness, comparability, and completeness, as discussed in Section 19.0. Specific qualitative criteria for the chemical analyses to be performed in association with the JSF EIP are presented in Attachments E through K of this JSF 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 precision and accuracy may be found in Section 19.0 of the JSF 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 JSF 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 and solid samples associated with the JSF 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; program-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	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 for analysis	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 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 from within the same core, whichever is more appropriate for the type of sample/sampling technique (surface or subsurface sediment sample). 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 perform 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 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 JSF 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 JSF 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 JSF 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 JSF 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 JSF EIP cannot be substantiated, the data may not be suitable the 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 will be 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 JSF 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 JSF QAPP includes systems and performance audits to ensure that established QA procedures are properly implemented.

The JSF 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 JSFQAPP 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 JSF

QAPP will identify the JSF 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 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 JSF 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 Department 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 should 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 JSF 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 and solid samples associated with the JSF 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 JSF QAPP, TIs, and/or program-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 JSF 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 JSF 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 JSF 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 team 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, to provide a "defense" in the event that field procedures are called into question, and to identify ways to reduce sampling costs. 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.

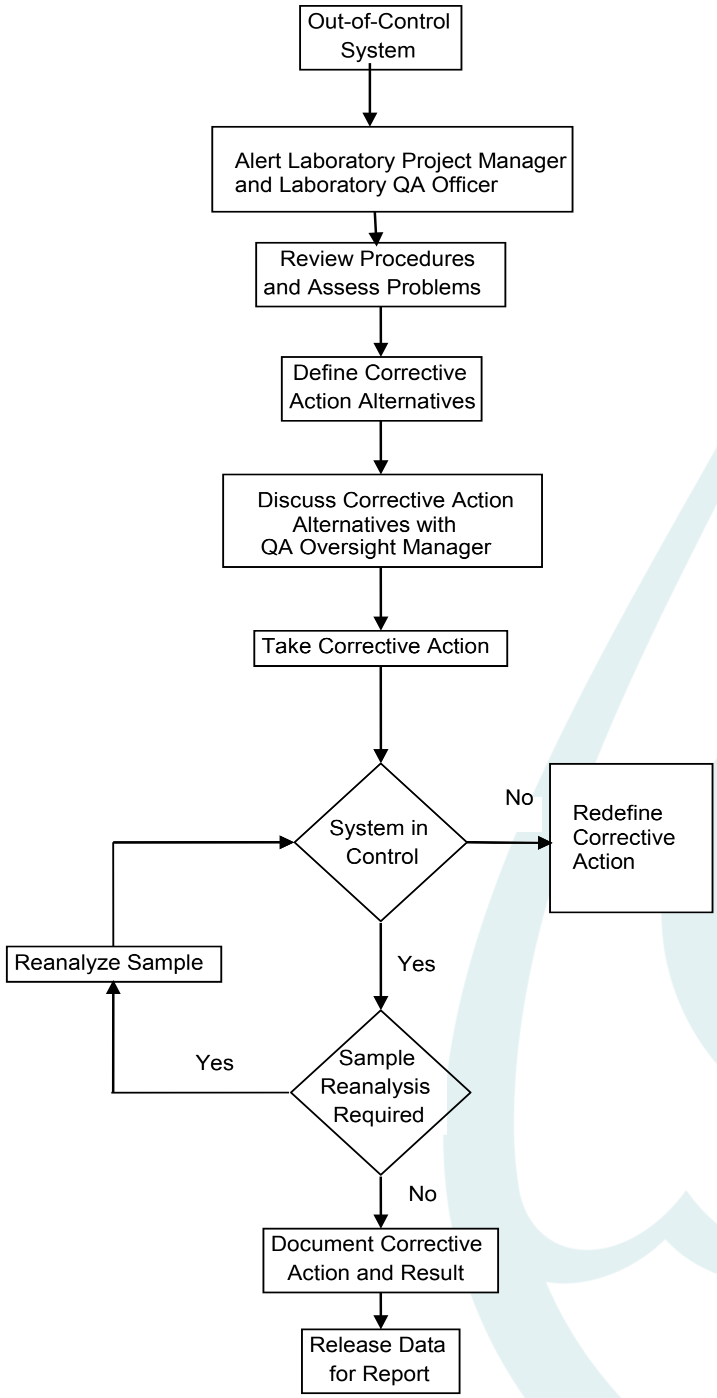
If the assessment reveals that the QC acceptance criteria are not met, the laboratory must immediately evaluate the analytical system and correct the problem. The Laboratory Analyst will notify the Laboratory Project Manager and Laboratory QA Officer of the problem and, if possible, will identify potential 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 pathway for 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 JSF 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 QA Oversight Consultant 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 Contract Laboratory Program (CLP) National Functional Guidelines (NFG) for Superfund Organic Methods Data Review (June 2008);
- 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 EI. 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 QA Oversight Consultant 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 program-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 JSF QAPP and program-specific SAPs. After completion of either Full or Limited data validation, a QA report will be prepared. The QA report will address JSF 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 appendix 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 JSF EIP are presented in Attachments E through K of this JSF 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 JSF 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 JSF 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 JSF 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 JSF 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. *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review,* EPA-540-R-08-01, June 2008.

US EPA. *Data Quality Objectives Process for Superfund, Interim Final Guidance,* EPA540-R-93-071, September 1993.

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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-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 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 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 Summaries: 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
Preparation Logs	A.2.8	X
Traceability Documents	A.2.9	X
Raw Data	A.2.7	F

<u>Notes:</u>
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 JSF 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**
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 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*
EMA-TI-05.80.40	*Surface Water Sampling*

ATTACHMENT C

EXAMPLE CHAIN OF CUSTODY RECORD

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:		Required Project Information:				Required Sampler Information:					
Lab Name:		Site ID #:				Sampler				TAT: Standard	Rush	Mark One
Address:	#N/A	Project #	#N/A			Sampling Company					
						Address:					
		Site Address	#N/A			City/State		Phone #:			
Lab PM:	#N/A	City	#N/A	State, Zip	#N/A	Reimbursement project?		Non-reimbursement	Mark one		
Phone/Fax:	#N/A	Site PM Name	#N/A			Send EDD to					
Lab PM email	#N/A	Phone/Fax:				CC Hardcopy report to					
Applicable Lab Quote #:		Site PM Email:				CC Hardcopy report to					

Filtered

Preserve

Analysis

ITEM #	SAMPLE ID Samples IDs MUST BE UNIQUE	SAMPLE LOCATION	Sample Depth: 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.
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			
							Y / N	Y / N	Y / N
							Y / N	Y / N	Y / N
							Y / N	Y / N	Y / N
							Y / N	Y / N	Y / N
						Temp in 0C	Samples on Ice?	Sample intact?	Trip Blank?

SHIPPING METHOD: (mark as appropriate)	SAMPLER NAME AND SIGNATURE	
UPS COURIER \ FEDEX	PRINT Name of SAMPLER:	
US MAIL	SIGNATURE of SAMPLER:	

ATTACHMENT D

SAMPLE NOMENCLATURE

Table A: TVA – TDEC Order Sample Naming Conventions – John Sevier Fossil Plant

Site (Plant) Name	Site Acronym	Sample Type (Matrix)	Matrix Sample Type Acronym	Location	Location ID	Depth Interval (If Applicable)	Quality Control/Quality Assurance Sample Type	QA/QC Sample Type Acronym	Date of Sample	Example
John Sevier Fossil Plant	JSF	Background Soil	BS	Soil Boring Number	SBXX	Feet/Feet	Equipment Rinsate Blank	EBXX	Year/Month/Day	JSF-BS-SBXX-6.0/8.0-20180510 JSF-BS-EBXX-20180510 JSF-BS-FBXX-20180510 JSF-BS-DUPXX-20180510
		Coal Combustion Residuals	CCR	Temporary Well Number	TWXX	Feet/Feet	Field Blank	FBXX	Year/Month/Day	JSF-CCR-TWXX-6.0/8.0-20180510 JSF-CCR-EBXX-20180510 JSF-CCR-FBXX-20180510 JSF-CCR-DUPXX-20180510
		Groundwater	GW	Monitoring Well Number	MWXX or Existing Name	Feet Below Top of Casing	Filter Blank	FLBXX	Year/Month/Day	JSF-GW-TN0001-35-20180510 JSF-GW-ALF210-35-20180510 JSF-GW-EBXX-20180510 JSF-GW-FBXX-20180510 JSF-GW-FLBXX-20180510 JSF-GW-DUPXX-20180510
		Pore Water	PW	Temporary Well Number	TWXX	Feet Below Top of Casing	Field Duplicate	DUPXX	Year/Month/Day	JSF-PW-TWXX-35-20180510 JSF-PW-EBXX-20180510 JSF-PW-FBXX-20180510 JSF-PW-FLBXX-20180510 JSF-PW-DUPXX-20180510
		Surface Stream **Not Stratified:**	STR	Water Body Acronym Spatial Location Number	HR = Holston River PB = Polly Branch	Not Stratified: Top = Water Surface Mid = Mid Column EpB = Epibenthic	Matrix Spike/Matrix Spike Duplicate *Note applicable sample on COC	MS/MSD	Year/Month/Day	JSF-STR-HRXX-Top-20180510 JSF-STR-HRXX-Mid-20180510 JSF-STR-HRXX-EpB-20180510 JSF-STR-PBXX-Top-20180510 JSF-STR-PBXX-Mid-20180510 JSF-STR-PBXX-EpB-20180510 JSF-STR-EBXX-20180510 JSF-STR-FBXX-20180510 JSF-STR-FLBXX-20180510 JSF-STR-DUPXX-20180510
		Surface Stream **Stratified:**	STR	Water Body Acronym Spatial Location Number	HR = Holston River PB = Polly Branch	Stratified: NS = Near Surface ME = Mid-Epilimnion MH = Mid-Hypolimnion NB = Near Bottom			Year/Month/Day	JSF-STR-HRXX-NS-20180510 JSF-STR-HRXX-ME-20180510 JSF-STR-HRXX-MH-20180510 JSF-STR-HRXX-NB-20180510 JSF-STR-PBXX-NS-20180510 JSF-STR-PBXX-ME-20180510 JSF-STR-PBXX-MH-20180510 JSF-STR-PBXX-NB-20180510 JSF-STR-EBXX-20180510 JSF-STR-FBXX-20180510 JSF-STR-FLBXX-20180510 JSF-STR-DUPXX-20180510
		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 Sample Naming Conventions – John Sevier Fossil Plant Fish and Mayfly Nomenclature

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	QA/QC Sample Type Acronym	Date of Sample	Example
John Sevier Fossil Plant	JSF	Adult Mayflies	MFA	NA	NA	HRU: Holston river Upstream Reach (Approximately HRRM 108.4 - 109.9)	NA	Field Duplicate	DUPXX	Year/Month/Day	JSF-MFA-HRU-20180510 JSF-MFA-DUPXX-20180510 JSF-MFA-EBXX-20180510
		Purated Mayfly Nymphs	MFP	NA	NA	HRA1: Holston River Adjacent Reach 1 (Approximately HRRM 105.2 - 106.4)	NA	Equipment Rinsate Blank	EBXX	Year/Month/Day	JSF-MFP-HRA1-20180510 JSF-MFP-DUPXX-20180510 JSF-MFP-EBXX-20180510
		Non-Purated Mayfly Nymphs	MFN	NA	NA	HRA2: Holston River Adjacent Reach 2 (Approximately HRRM 103.8 - 104.8)	NA			Year/Month/Day	JSF-MFN-HRA2-20180510 JSF-MFN-DUPXX-20180510 JSF-MFN-EBXX-20180510
		Fish	FH	Blue Gill	BG	HRD: Holston River Downstream Reach (Approximately HRRM 100.3 - 101.8)	F = Fillet tissue sample O = Ovary tissue sample L = Liver tissue sample			Year/Month/Day	JSF-FH-BG-HRD-F-20180510 JSF-FH-BG-HRD-O-20180510 JSF-FH-BG-HRD-L-20180510 JSF-FH-BG-F-DUPXX-20180510 JSF-FH-BG-F-EBXX-20180510
				Channel Catfish	CC		F = Fillet tissue sample O = Ovary tissue sample L = Liver tissue sample			Year/Month/Day	JSF-FH-CC-HRU-F-20180510 JSF-FH-CC-HRU-O-20180510 JSF-FH-CC-HRU-L-20180510 JSF-FH-CC-O-DUPXX-20180510 JSF-FH-CC-O-EBXX-20180510
				Largemouth Bass	LB		F = Fillet tissue sample O = Ovary tissue sample L = Liver tissue sample			Year/Month/Day	JSF-FH-LB-HRA1-F-20180510 JSF-FH-LB-HRA1-O-20180510 JSF-FH-LB-HRA1-L-20180510 JSF-FH-LB-L-DUPXX-20180510 JSF-FH-LB-L-EBXX-20180510
				Redear Sunfish	RS		F = Fillet tissue sample O = Ovary tissue sample L = Liver tissue sample			Year/Month/Day	JSF-FH-RS-HRA2-F-20180510 JSF-FH-RS-HRA2-O-20180510 JSF-FH-RS-HRA2-L-20180510 JSF-FH-RS-F-DUPXX-20180510 JSF-FH-RS-F-EBXX-20180510
				Shad	GS		WF = Whole Fish			Year/Month/Day	JSF-FH-GS-HRD-WF-20180510 JSF-FH-GS-WF-DUPXX-20180510 JSF-FH-GS-WF-EBXX-20180510

Table C: TVA – TDEC Order Sample Naming Conventions – John Sevier Fossil Plant Sediment and Benthic Sample Nomenclature

Site (Plant) Name	Site Acronym	Sample Type (Matrix)	Matrix Sample Type Acronym	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
John Sevier Fossil Plant	JSF	Macroinvertebrate	MAC	Water Body Acronym	HR = Holston River	HRXX	BENXX	Feet/Feet	NA	NA	Year/Month/Day	JSF-MAC-HRXX-BENXX-0.0/0.5-20180510
		Sediment	Sed	Water Body Acronym	HR = Holston River BP = Polly Branch	HRXX BPXX	CORXX	Feet/Feet	Equipment Rinsate Blank	EBXX	Year/Month/Day	JSF-SED-HRXX-CORXX-0.0/0.5-20180510 JSF-SED-PBXX-CORXX-0.0/0.5-20180510 JSF-SED-HRXX-EBXX-20180510 JSF-SED-PBXX-EBXX-20180510 JSF-SED-HRXX-DUPXX-20180510 JSF-SED-PBXX-DUPXX-20180510
									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	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	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

GROUNDWATER INVESTIGATION SAMPLING

Table F-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 F-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	10.00	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
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
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
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 F-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 Method 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 G

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

SURFACE STREAM SAMPLING

Table G-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 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	1000 mL (unfiltered)	Cool to < 6°C	7 days

Notes:

oz - ounce
g - grams
mL - milliliter
L - liter
HDPE - High Density Polyethylene
NA - Not applicable

Table G-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	1.00	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

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 G-3: Quantitative QA Objectives – Surface Water

Analyte/ Parameter Group	Method	Surrogate Compound Recoveries/ Chemical Yield (%)	Equipment Rinsate Blank, Field Blank, Filter 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 H

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

WATER USE SURVEY SAMPLING

Table H-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation	Holding Time
Water Supply Well	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 laboratory 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:

mL - milliliter
L - liter
HDPE - High Density Polyethylene
NA - Not applicable

Table H-2: Analytes, Methods, and Reporting Limits – Water Supply Well Samples

Parameter	CAS No.	Method	Reporting Limit	Units
Chloride	7647-14-5	EPA 300.0	1.00	mg/L
Fluoride	16984-48-8	EPA 300.0	0.10	mg/L
Sulfate	7757-82-6	EPA 300.0	1.00	mg/L
Total Dissolved Solids	TDS	SM2540C	10.0	mg/L
pH	pH	SW-846 9040C	0.05	pH units
Antimony (Total and Dissolved)	7440-36-0	EPA 200.8	2.00	μg/L
Arsenic (Total and Dissolved)	7440-38-2	EPA 200.8	1.00	μg/L
Barium (Total and Dissolved)	7440-39-3	EPA 200.8	10.0	μg/L
Beryllium (Total and Dissolved)	7440-41-7	EPA 200.8	1.00	μg/L
Boron (Total and Dissolved)	7440-42-8	EPA 200.8	80.0	μg/L
Cadmium (Total and Dissolved)	7440-43-9	EPA 200.8	1.00	μg/L
Calcium (Total and Dissolved)	7440-70-2	EPA 200.8	500	μg/L
Chromium (Total and Dissolved)	7440-47-3	EPA 200.8	2.00	μg/L
Cobalt (Total and Dissolved)	7440-48-4	EPA 200.8	0.50	μg/L
Copper (Total and Dissolved)	7440-50-8	EPA 200.8	2.00	μg/L
Lead (Total and Dissolved)	7439-92-1	EPA 200.8	1.00	μg/L
Lithium (Total and Dissolved)	7439-93-2	EPA 200.8	5.00	μg/L
Magnesium (Total and Dissolved)	7439-95-4	EPA 200.8	500	μg/L
Mercury (Total and Dissolved)	7487-94-7	EPA 245.1	0.200	μg/L
Molybdenum (Total and Dissolved)	7439-98-7	EPA 200.8	5.00	μg/L
Nickel (Total and Dissolved)	7440-02-0	EPA 200.8	10.0	μg/L
Potassium (Total and Dissolved)	7440-09-7	EPA 200.8	500	μg/L
Selenium (Total and Dissolved)	7782-49-2	EPA 200.8	5.00	μg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Silver (Total and Dissolved)	7440-22-4	EPA 200.8	1.00	µg/L
Sodium (Total and Dissolved)	7440-23-5	EPA 200.8	500	µg/L
Thallium (Total and Dissolved)	7440-28-0	EPA 200.8	1.00	µg/L
Vanadium (Total and Dissolved)	7440-62-2	EPA 200.8	1.00	µg/L
Zinc (Total and Dissolved)	7440-66-6	EPA 200.8	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
µg/L	-	micrograms per liter
mg/L	-	milligrams per liter
pCi/L	-	picoCuries per liter
CALC	-	Parameter determined by calculation.

Table H-3: Quantitative QA Objectives – Water Supply Well 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)	EPA 200.8	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Mercury (Total and Dissolved)	EPA 245.1	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)	EPA 300.0	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	-	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

FISH TISSUE SAMPLING

Table I-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 or 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 < -20°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 I-2: Analytes, Methods, and Reporting Limits – Fish Tissue Samples

Parameter	CAS No.	Method	Reporting Limit	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

Table I-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 J

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

BENTHIC SAMPLING

Table J-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 J-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 J-3: Analytes, Methods, and Reporting Limits – Benthic Invertebrates

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	7440-47-31	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

[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 J-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 J-5: Quantitative QA Objectives – Benthic Invertebrate 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 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
	Arsenic Speciation (arsenate and arsenite)	4-oz glass	5 g	Cool to < 6°C	28 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
	Arsenic Speciation (arsenate and arsenite)			Cool to < 6°C	28 days
	Anions (Chloride, Fluoride, and Sulfate)			Cool to < 6°C	28 days
	pH				NA*
Pore Water	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
	Arsenic Speciation (arsenate and arsenite)	250-mL HDPE	250 mL	Disodium EDTA, Acetic Acid 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

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation[1]	Holding Time
	Total Organic Carbon	2x 40-mL VOA Vial	40-mL	Cool to ≤ 6°C HCl to pH < 2	28 days
	pH (field measurement)	NA	NA	NA	15 minutes
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
	Arsenic Speciation (arsenate and arsenite)	250-mL HDPE	250 mL	Disodium EDTA, Acetic Acid 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	2x 40-mL VOA Vial	40-mL	Cool to ≤ 6°C HCl 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
Arsenate	As5	SW-846 6020A	0.0005	mg/kg
Arsenic	7440-38-2	SW-846 6020A	0.100	mg/kg
Arsenite	As3	SW-846 6020A	0.0005	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)	0.100	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 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	0.100	pH units
Antimony	7440-36-0	SW-846 6020A	2.00	µg/L
Arsenate	As5	SW-846 6020A	2.00	µg/L
Arsenic	7440-38-2	SW-846 6020A	1.00	µg/L
Arsenite	As3	SW-846 6020A	2.00	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	1.00	µg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Selenium	7782-49-2	SW-846 6020A	5.00	µg/L
Silver	7440-22-4	SW-846 6020A	1.00	µg/L
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
Arsenate	As5	SW-846 6020A	2.00	µg/L
Arsenic	7440-38-2	SW-846 6020A	1.00	µg/L
Arsenite	As3	SW-846 6020A	2.00	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

Parameter	CAS No.	Method	Reporting Limit	Units
Nickel	7440-02-0	SW-846 6020A	1.00	µg/L
Selenium	7782-49-2	SW-846 6020A	5.00	µg/L
Silver	7440-22-4	SW-846 6020A	1.00	µg/L
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-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
Arsenic Speciation	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
% Ash	RJ Lee SOP OPT-23.2	NA	NA	NA	NA	NA	±10%	RPD < 10%

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
Arsenic Speciation	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
Arsenic Speciation (Total and Dissolved)	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

APPENDIX E
DATA MANAGEMENT PLAN

ENVIRONMENTAL®
STANDARDS
Setting the Standards for Innovative Environmental Solutions

TENNESSEE VALLEY AUTHORITY

MULTI-SITE ORDER ENVIRONMENTAL INVESTIGATIONS

DATA MANAGEMENT PLAN

Revision 1

March 2018

Prepared by

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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.

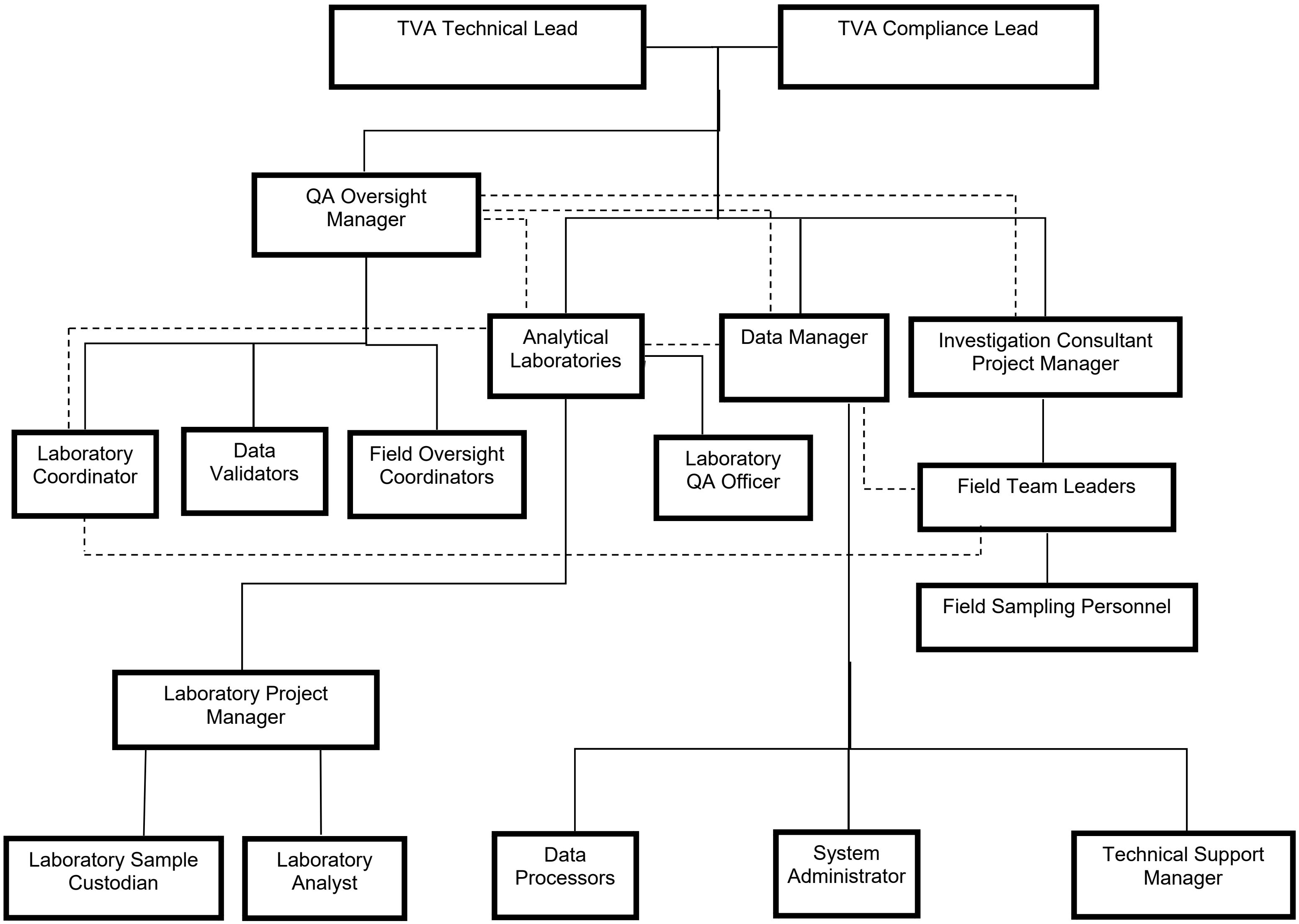
Users of the EQuIS Quality and Data Management System (EQDMS) primarily consist of technical and project staff that are assumed to have a general understanding of the environmental data and the EIs being conducted at each TVA facility. Some users are also required to have an advanced understanding of 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

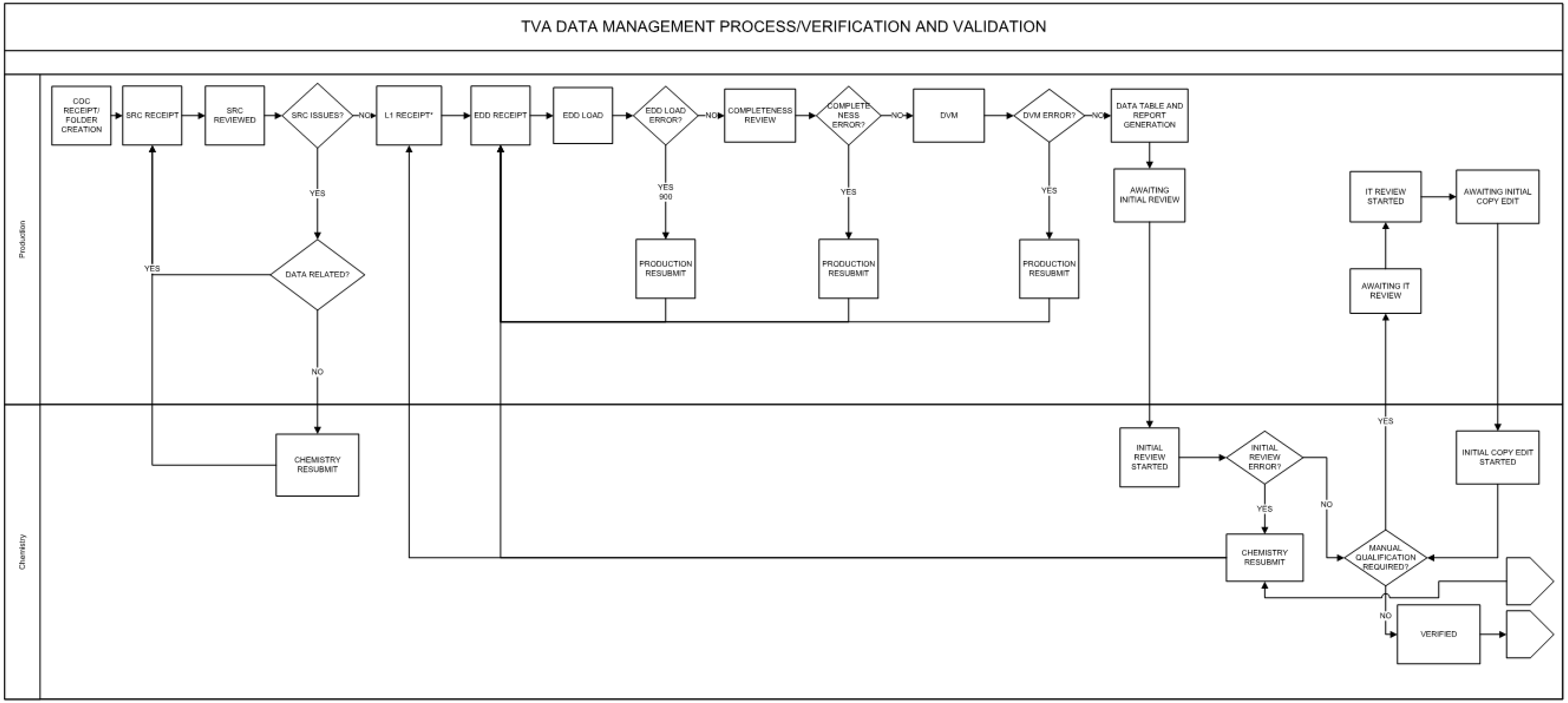
Automated full backups of the EQDMS are performed daily, and automated incremental backups of transactions are performed every 15 minutes to safeguard that any potential data loss is limited. An incremental daily backup is archived every night and retained for 30 days. A full weekly backup is archived 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
Production
Chemistry
COC RECEIPT/ FOLDER CREATION
SRC RECEIPT
SRC REVIEWED
SRC ISSUES?
NO
L1 RECEIPT*
EDD RECEIPT
EDD LOAD
EDD LOAD ERROR?
NO
COMPLETENESS REVIEW
COMPLETENESS ERROR?
NO
DVM
DVM ERROR?
NO
DATA TABLE AND REPORT GENERATION
YES
DATA RELATED?
YES
NO
CHEMISTRY RESUBMIT
YES 900
PRODUCTION RESUBMIT
YES
PRODUCTION RESUBMIT
YES
PRODUCTION RESUBMIT
AWAITING INITIAL REVIEW
IT REVIEW STARTED
AWAITING INITIAL COPY EDIT
AWAITING IT REVIEW
YES
INITIAL REVIEW STARTED
INITIAL REVIEW ERROR?
YES
NO
CHEMISTRY RESUBMIT
MANUAL QUALIFICATION REQUIRED?
INITIAL COPY EDIT STARTED
NO
VERIFIED

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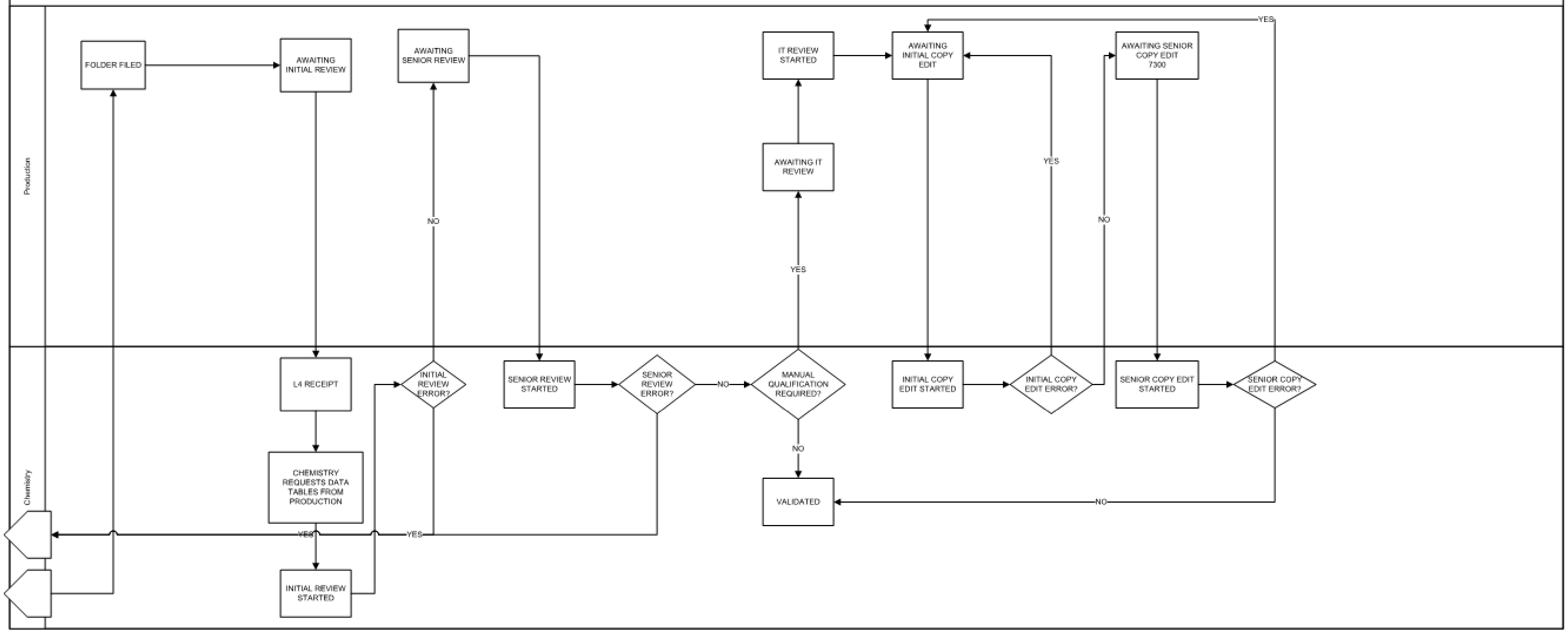
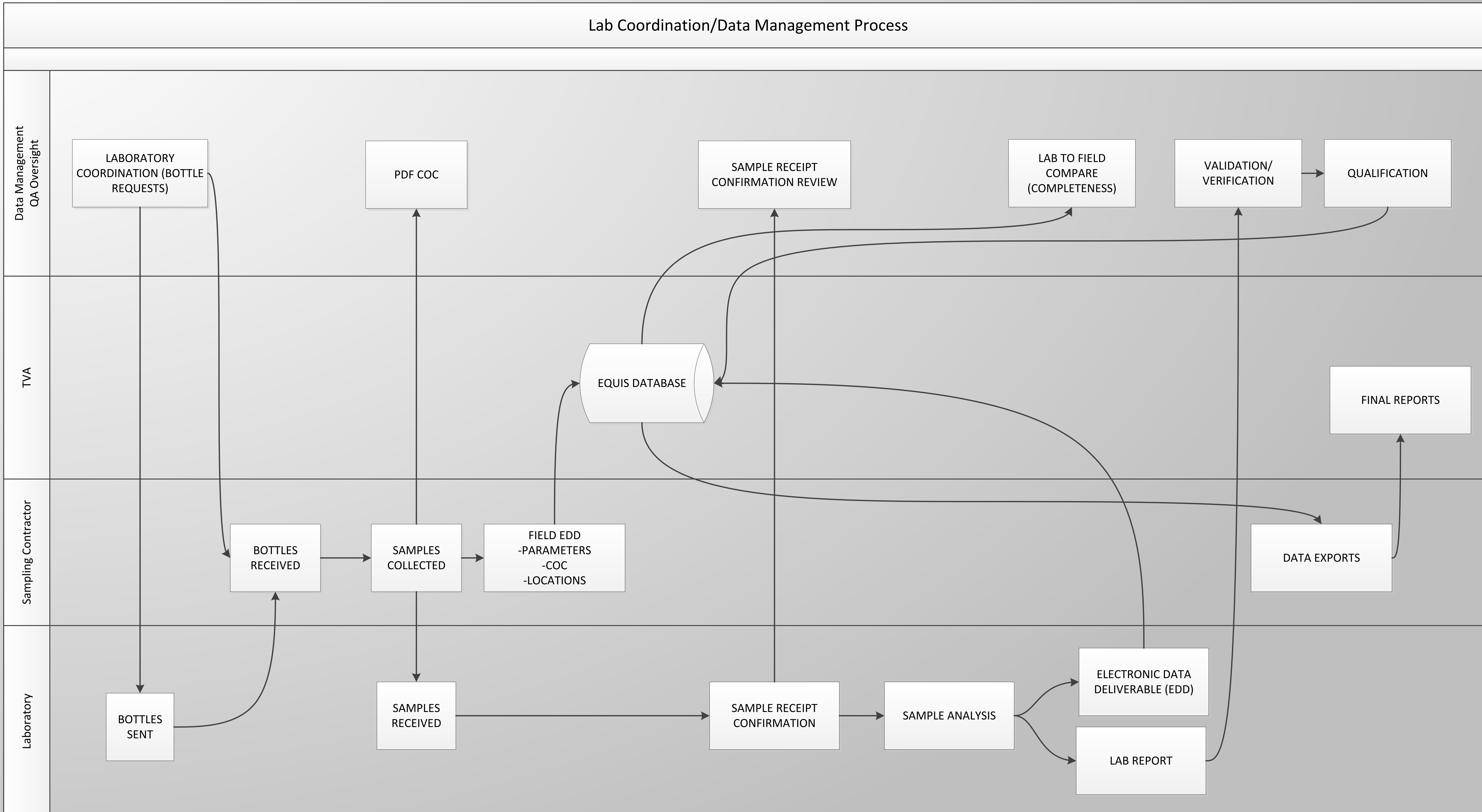
1987 - 2017

TVA DATA MANAGEMENT PROCESS/VERIFICATION AND VALIDATION (CONT)





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APPENDIX B

EQUIS EDD SPECIFICATIONS

ENVIRONMENTAL STANDARDS

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.

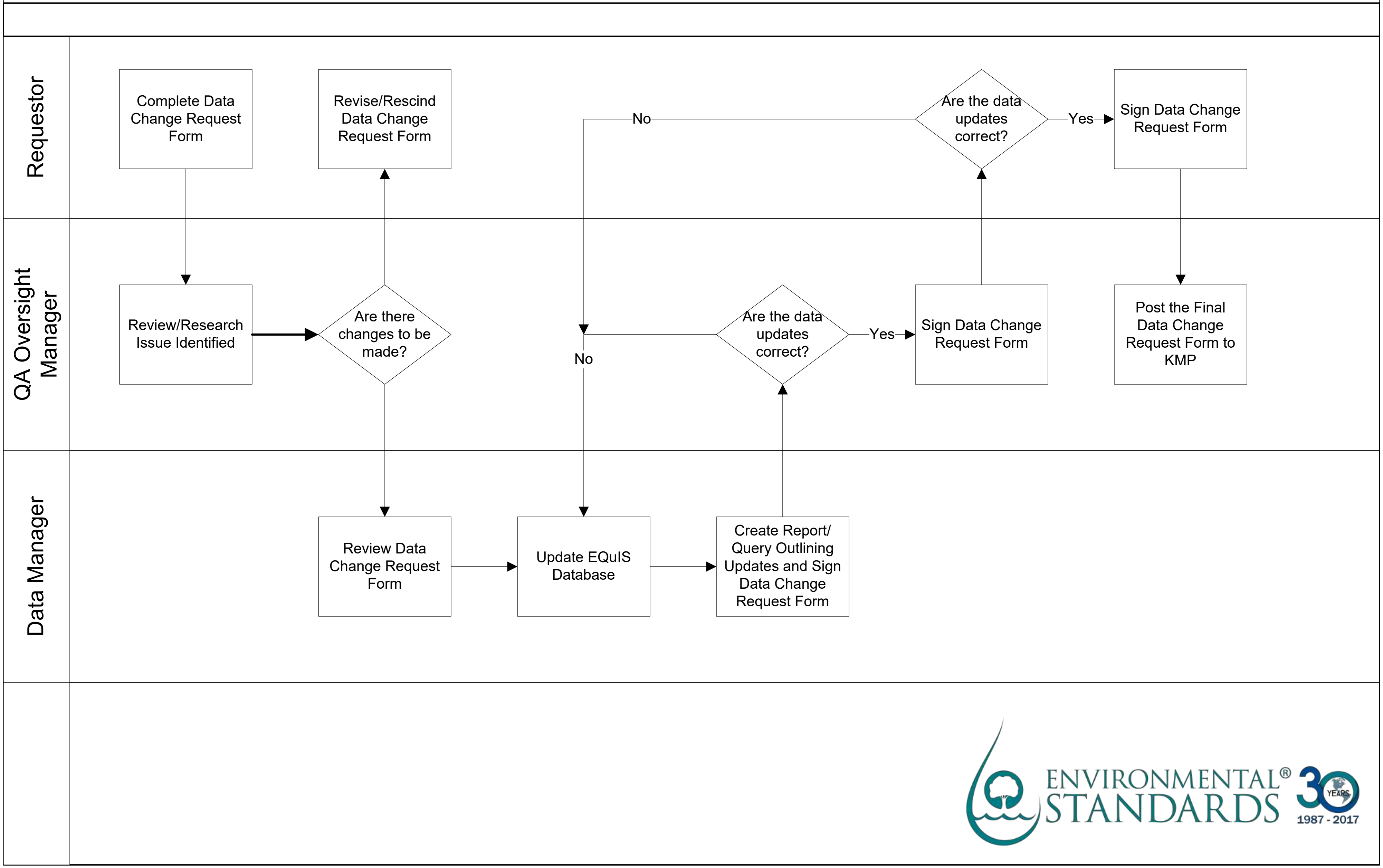
Well Construction

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



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 F
GROUNDWATER REPORTS

Tennessee Valley Authority
John Sevier Fossil Plant
Dry Fly Ash Landfill (IDL 37-0097)

GROUNDWATER ASSESSMENT MONITORING REPORT APRIL 2011

Prepared by

Matthew D. Williams, PE

Knoxville, Tennessee
June 15, 2011

DOCUMENT CERTIFICATION

I certify under penalty of law that this document was prepared by me or under my supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. The information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

Matthew D. Williams, P.E.
Environmental Engineer

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INTRODUCTION

This report provides results of the seventh semiannual monitoring event of *Groundwater Assessment Monitoring - Phase 2* for the Class II Dry Fly Ash Landfill. In addition to monitoring well data, effluent sample results and flow rate data are provided for the facility leachate collection system (LCS). All water samples were analyzed by Environmental Science Corporation (ESC), an EPA-certified laboratory. Split samples for comparison cadmium analysis of well W31 samples were sent to Test America in Nashville (TAN) and TVA's Central Laboratory Service (CLS) in Chattanooga. Sample collection and laboratory analysis of the analytical data were performed in accordance with Tennessee Department of Environment and Conservation (TDEC) Rule 1200-1-7-.04 and the approved facility groundwater monitoring plan (February 25, 1998). In addition, site-specific monitoring requirements of *Groundwater Assessment Monitoring - Phase 2* were followed, as outlined in the letter dated April 5, 2007 from W.N. Smith to G.G. Park.

GROUNDWATER SAMPLING

Groundwater sampling was conducted April 18-20, 2011 by W.F. Nichols and G.R. Vincent of TVA at monitoring wells 1, W28 through W32, and at the LCS. A peristaltic pump was used to purge and sample wells W28 through W30 and W32, while well 1 was sampled with a centrifugal pump, and W31 was sampled with a bladder pump. The LCS water sample was collected directly from the discharge pipe at the coal yard drainage basin. QC duplicate samples were collected from well W31. An equipment blank was collected between wells W28 and W31 for the April event. Field splits for cadmium where collected from well W31 for comparison analysis by auxiliary labs. Field parameters (i.e., temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential) were monitored during well purging using a flow-through cell and calibrated instruments. Each well was considered properly evacuated when field parameters remained stable after purging a minimum of two well volumes, the well was purged to dryness, or field parameters reached stability (+/-10% difference for several readings) during low-flow purging. Field data sheets are included in Appendix A.

Following collection, samples were transferred to new sample bottles with appropriate preservatives, where applicable. The samples were then sealed, labeled, recorded on a custody form, and placed in a container for transport. Samples were delivered to ESC for analysis on April 22, 2011. Split samples for comparison cadmium analysis from W31 were received by CLS on April 22 and TAN on May 12. Copies of the sample custody records are given in Appendix B.

ANALYTICAL RESULTS

Table 1 presents Groundwater Protection Standards (GWPS) for facility constituents falling under Appendix II of Rule 1200-1-7-.04, which are as defined in Section IV(1)(d) of the monitoring policy. GWPS, per policy, are selected as the greater of the MCL or other promulgated limit (such as EPA primary or secondary MCLs) and the background concentration (here represented by the upper predicted limit of the background data set). Table 2 presents a summary of the laboratory analytical results for the monitoring well samples. LCS sample data given in Table 3. Laboratory analyses for all samples were completed within recommended sample holding times. The complete laboratory report is presented in Appendix C and includes analytical methods, detection limits, and any data qualifiers.

TABLE 1. April 18-20, 2011 Groundwater Protection Standards

Parameter	Units	UPL	MCL	GWPS	MCL Source
Antimony	µg/L	6.0	6	6	TDEC
Arsenic	µg/L	2.5	10	10	TDEC
Barium	µg/L	255	2000	2000	TDEC
Beryllium	µg/L	2.7	4	4	TDEC
Cadmium	µg/L	0.5	5	5	TDEC
Chromium	µg/L	4.0	100	100	TDEC
Cobalt	µg/L	2	--	2	--
Copper	µg/L	10	1000	1000	EPA-SMCL
Cyanide	mg/L	0.005	0.2	0.2	EPA-PMCL
Lead	µg/L	1	15	15	TDEC
Mercury	µg/L	0.2	2	2	TDEC
Nickel	µg/L	3.3	100	100	TDEC
Selenium	µg/L	1.9	50	50	TDEC
Silver	µg/L	1.0	100	100	TDEC
Sulfide	mg/L	0.05	--	0.05	--
Thallium	µg/L	1	2	2	TDEC
Tin	µg/L	490	--	490	--
Vanadium	µg/L	2	--	2.0	--
Zinc	µg/L	95.5	5000	5000	EPA-SMCL

TDEC - Solid Waste Processing and Disposal Rule 1200-1-7-.04
EPA-PMCL - EPA Primary MCL
EPA-SMCL - EPA Secondary MCL

TABLE 2. April 18-20, 2011 Groundwater Monitoring Results

Analytical Results for Appendix II Constituents								Groundwater Protection Standard[b] (GWPS)	MCL	Comparison to GWPS[c]				
		1	W28	W29	W30	W31[a]	W32							
Parameter	Units	upgradient	downgradient	downgradient	downgradient	downgradient	downgradient			W28	W29	W30	W31	W32
Antimony	µg/L	<1	<1	<1	<1	<1	<1	6	6	L	L	L	L	L
Arsenic	µg/L	<1	<1	<1	<1	<1	<1	10	10	L	L	L	L	L
Barium	µg/L	220	20	30	19	23.5	64	2000	2,000	L	L	L	L	L
Beryllium	µg/L	<1	<1	<1	<1	<1	<1	4	4	L	L	L	L	L
Cadmium	µg/L	<0.5	<0.5	<0.5	<0.5	1.33	<0.5	5	5	L	L	L	L	L
Chromium	µg/L	<2	<2	<2	<2	<2	<2	100	100	L	L	L	L	L
Cobalt	µg/L	<1	4.5	<1	1.2	<1	<1	2	--	G	L	L	L	L
Copper	µg/L	<2	2.1	<2	<2	2.05	<2	1000	1,000	L	L	L	L	L
Cyanide	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.20	0.2	L	L	L	L	L
Lead	µg/L	<1	<1	<1	<1	<1	<1	15	15	L	L	L	L	L
Mercury	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	2	2	L	L	L	L	L
Nickel	µg/L	3.3	21	6.3	33	16	5.4	100	100	L	L	L	L	L
Selenium	µg/L	<1	2.1	4	2.1	4.1	1	50	50	L	L	L	L	L
Silver	µg/L	<1	<1	<1	<1	<1	<1	100	100	L	L	L	L	L
Sulfide	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	--	L	L	L	L	L
Thallium	µg/L	<1	<1	<1	<1	<1	<1	2	2	L	L	L	L	L
Tin	µg/L	<1	<1	<1	<1	<1	<1	490	--	L	L	L	L	L
Vanadium	µg/L	<2	<2	<2	<2	<2	<2	2	--	L	L	L	L	L
Zinc	µg/L	11	<10	<10	<10	<10	<10	5000	5,000	L	L	L	L	L

Analytical Results for Other Permit-Required Constituents								Upper Prediction Limits (UPL)[b]	MCL	Comparison to UPL[c]				
		1	W28	W29	W30	W31[a]	W32							
Parameter	Units	upgradient	downgradient	downgradient	downgradient	downgradient	downgradient			W28	W29	W30	W31	W32
Alkalinity	mg/L	218	239	303	314	304.5	301	222	--	G	G	G	G	G
Aluminum	µg/L	<100	690	110	<100	505	260	200	200	G	L	L	G	G
Ammonia	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.14	--	L	L	L	L	L
Boron	µg/L	<200	2700	900	4800	11000	240	225	--	G	G	G	G	G
Chloride	mg/L	9.5	14	4.8	17	10	11	15	250	L	L	G	L	L
Fluoride	mg/L	<0.1	<0.1	0.1	0.34	0.3	<0.1	0.23	4	L	L	G	G	L
Iron	µg/L	260	1200	<100	<100	375	150	5,400	300	L	L	L	L	L
Manganese	µg/L	25	3600	1200	1200	<10	<10	53	50	G	G	G	L	L
Nitrate-Nitrite	mg/L	0.22	0.19	3.2	<0.1	0.42	0.8	0.40	10	L	G	L	G	G
pH	SU	6.7	5.9	5.9	6.2	6.3	6.4	6.7-7.3	6.5-8.5	L	L	L	L	L
Potassium	mg/L	0.5	1.3	1.4	1	14.5	1.6	2	--	L	L	L	G	L
Redox	mV	207	368	441	224	477	464	600	--	L	L	L	L	L
Sodium	mg/L	5.7	21	9.2	39	72	7.1	10	--	G	L	G	G	L
Sp. Cond.	µmhos/cm	485	1806	893	2024	2268	688	499	--	G	G	G	G	G
Strontium	µg/L	710	950	960	3200	3600	280	840	--	G	G	G	G	L
Sulfate	mg/L	26	880	170	960	1150	50	32	250	G	G	G	G	G
Temperature	°C	16.0	15.1	14.0	14.4	13.3	15.4	16	--	L	L	L	L	L

[a] *Reported concentrations are averages of duplicate samples.*
[b] *Established April 2011; based on background data (well 1) from 01/06/00 to 04/20/11*
[c] *L = less than or equal to L; G = greater than; W = within UPL range (pH only); Low = Out of UPL range low (pH only)*

TABLE 3. April 20, 2011 Leachate Collection System Monitoring Results

Parameter	Units	Concentration	MCL	Comparison to MCL*
Alkalinity	mg/L	406	--	--
Aluminum	ug/L	100	--	--
Ammonia (as N)	mg/L	0.39	--	--
Antimony	ug/L	<1	6	L
Arsenic	ug/L	10	10	L
Barium	ug/L	46	2,000	L
Beryllium	ug/L	<1	4	L
Boron	ug/L	4000	--	--
Cadmium	ug/L	<0.5	5	L
Chloride	mg/L	12	--	--
Chromium	ug/L	<2	100	L
Cobalt	ug/L	7.3	--	--
Copper	ug/L	<2	1,000	L
Cyanide	mg/L	<0.005	0.2	L
Fluoride	mg/L	<0.1	4	L
Iron	ug/L	1500	--	--
Lead	ug/L	<1	15	L
Manganese	ug/L	3700	--	--
Mercury	ug/L	<0.2	2	L
Nickel	ug/L	16	100	L
Nitrate-Nitrite	mg/L	0.55	10	L
pH	s.u.	6.3	--	--
Potassium	mg/L	17	--	--
Redox	mV	377	--	--
Selenium	ug/L	1.4	50	L
Silver	ug/L	<1	100	L
Sodium	mg/L	24	--	--
Sp. Cond.	umhos/cm	1888	--	--
Strontium	ug/L	5600	--	--
Sulfate	mg/L	730	--	--
Sulfide	mg/L	<0.05	--	--
Temperature	°C	16.3	--	--
Thallium	ug/L	<1	2	L
Tin	ug/L	<1	--	--
Vanadium	ug/L	<2	--	--
Zinc	ug/L	<10	5,000	L

**L = less than or equal to MCL; G = greater than MCL*

STATISTICAL EVALUATION

Facility constituents falling under Appendix II of Rule 1200-1-7-.04 were evaluated against their Groundwater Protection Standards (GWPS) as defined in Section IV(1)(d) of the monitoring policy. The remaining non-Appendix II facility constituents were statistically evaluated using either parametric or non-parametric prediction intervals, depending on data normality, applied on an interwell basis with no verification samples. This report marks the third statistical submission for interwell comparison, as agreed upon by TDEC and TVA during a June 2, 2010 teleconference. Upper prediction limits (UPL) for the original permit-required constituents presented in Table 2 were computed using historical data for upgradient well 1 collected between January 6, 2000, and April 20, 2011 (Appendix D). Truncating the data set to the period since 2000 when modern sampling protocol had been implemented gives a greater confidence in the results, as well as more conservatism in the background data pool, from the full poll of data from 1986 to date.

Results given in Table 2 indicate GWPS exceedances for Appendix II constituent cobalt in well W28. Among the non-Appendix II parameters, UPL exceedances were observed for alkalinity (all downgradient wells), aluminum (wells W28, W31, and W32), boron (all downgradient wells), chloride (well W30), fluoride (wells W30 and W31), manganese (wells W28, W29, and W30), nitrate-nitrite (wells W29, W31, and W32), pH (all downgradient wells are below the lower limit), potassium (well W31), sodium (wells W28, W30, and W31), specific conductivity (all downgradient wells), strontium (wells W28, W29, W30, W31), and sulfate (all downgradient wells). There were no MCL exceedances at the LCS sampling point. James Thornburgh (TDEC) was notified by Darrell Tipton (TVA) of the GWPS exceedance on April 28, 2011.

Elevated levels of cobalt causing a GWPS exceedance may be partially due to high turbidity and high suspended solids in the sample. During sampling, the well was nearly evacuated by pumping, necessitating sampling the following day, when elevated turbidity values were noted.

DISCUSSION OF CADMIUM INTERLABORATORY COMPARITIVE ANALYSIS

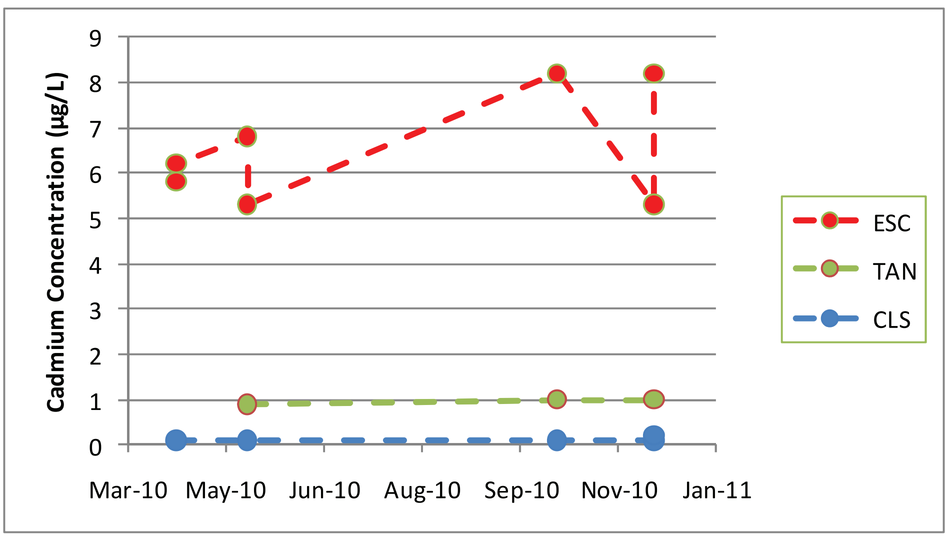
There was no GWPS exceedance of cadmium in well W31, following a recent spate of elevated concentrations in this well. Cadmium was never observed in this well before 2007, or in any other well since 2000. Cadmium has not been typically found at this facility, with most results since 2000 being largely non-detectable values. This lead to a concern regarding erratic patterns in cadmium results for well W31 since switching labs and analytical methods for this parameter in 2007.

Interlaboratory comparative analyses began in April 2010 to compare agreement between labs and testing methods, to try to explain recent erratic cadmium results for well W31. Samples sent to the comparison labs for evaluation were field splits, field replicates, or remaining ESC sample volume or digestate. Comparison labs include TVA's Central Laboratory Service (CLS), who run a different analytical method than ESC (EPA method 7131 – Graphite Furnace Atomic Absorption or GFAA) that appears generally less vulnerable to certain interferences, and Test America Nashville (TAN) who use the same analytical method as ESC (EPA method 6020 (Inductively Coupled Plasma Mass Spectrometer or ICP-MS). JSF groundwater samples were tested by CLS utilizing GFAA from 2000 to 2006. Table 4 below shows the comparative results for cadmium samples from April, May, October, and December 2010, as analyzed for by ESC, CLS, and TAN; these results are shown graphically in Figure 1.

TABLE 4. Results of April to December 2010 W31 Cadmium Comparative Analysis

Lab Sample ID	Date Sampled	Lab	Cadmium Result (µg/L)	Detection Limit (µg/L)	Method	Notes
L459067-01	04/07/2010	ESC	5.8	0.5	EPA 6020	ICP-MS Standard Mode
L459067-02	04/07/2010	ESC	6.2	0.5	EPA 6020	ICP-MS DRC Mode
AL24744	04/07/2010	CLS	< 0.1	0.1	EPA 7131	GFAA
L459059-01	05/13/2010	ESC	6.8	0.5	EPA 6020	ICP-MS Standard Mode
L459059-02	05/13/2010	ESC	5.3	0.5	EPA 6020	ICP-MS DRC Mode
AL24743	05/13/2010	CLS	< 0.1	0.1	EPA 7131	GFAA
NTE1266-01	05/13/2010	TAN	0.89	0.5	EPA 6020	ICP-MS
L485263-05	10/18/2010	ESC	8.2	0.5	EPA 6020	ICP-MS DRC Mode
AL39107	10/18/2010	CLS	< 0.1	0.1	EPA 7131	GFAA
NUA1506-03	10/18/2010	TAN	< 1	1.0	EPA 6020	ICP-MS
L492562-01	12/06/2010	ESC	5.3	0.5	EPA 6020	ICP-MS DRC Mode
AL40089	12/06/2010	CLS	< 0.1	0.1	EPA 7131	GFAA
NUA1506-04	12/06/2010	TAN	< 1	1.0	EPA 6020	ICP-MS
L492553-02	12/06/2010	ESC	8.2	0.5	EPA 6020	ICP-MS DRC Mode
AL40092	12/06/2010	CLS	0.2	0.1	EPA 7131	GFAA
NTL0724-02	12/06/2010	TAN	< 1	1.0	EPA 6020	ICP-MS

FIGURE 1. Plot of April to December 2010 W31 Cadmium Comparative Analysis



After viewing the comparison results, the primary lab (ESC) conducted an internal audit of their processes and quality control procedures. A groundwater sample from well W31 was collected on January 27, 2011, for laboratory quality control procedural analysis during February and March, 2011. As a result of the audit effort, an interference caused by the presence of elevated levels of molybdenum oxide (correlating with an elevated presence of molybdenum) was identified, and an increased flow of oxygen within the instrument can help to control this interference. This procedure is detailed in an application note by the lab equipment manufacturer PerkinElmer Life and Analytical Sciences found in Appendix E.

Table 5 shows the results of the April 2011 well W31 cadmium comparative analysis, giving results from ESC without the molybdenum oxide QA/QC correction, the ESC results with the molybdenum oxide QA/QC correction, the results from CLS, and the results from Test America Nashville. The QA/QC correction appears to influence the sample result, bringing it closer in line with what was observed from to comparison labs, but does not lower it to match either the comparison lab results (non-detect) nor the historical results from this facility. There appears to be an identified issue, causing artificially high results, but it is unclear whether the issue is completely solved or not. This issue will continue to be investigated by both ESC and TVA, and split samples will continue to be collected for cadmium interlaboratory analytical comparison for at least the next few sampling events.

TABLE 5. Results of April 2011 W31 Cadmium Comparative Analysis

TVA Sample ID	JSF-W31-0411	JSF-W31-DUP-0411	Unit	Method	Analysis Date
ESC original result	7.8	8.4	µg/L	EPA 6020	04/26/2011
ESC Re-run in DRC mode with the molybdenum oxide QA/QC correction result	3.2	3.2	µg/L	EPA 6020	05/20/2011
TVA Central Labs result	< 0.1	N/A	µg/L	EPA 7131	05/07/2011
Test America Nashville result	< 1	N/A	µg/L	EPA 6020	05/24/2011

HYDROGEOLOGIC CONDITIONS

Groundwater levels measured in site monitoring wells on April 18, 2011, prior to sample collection are given in Table 6. The groundwater potentiometric surface derived from these measurements is presented on Figure 2. Groundwater generally flows northwestward across the fly ash landfill toward the Holston River.

TABLE 6. April 18, 2011 Groundwater Level Measurements

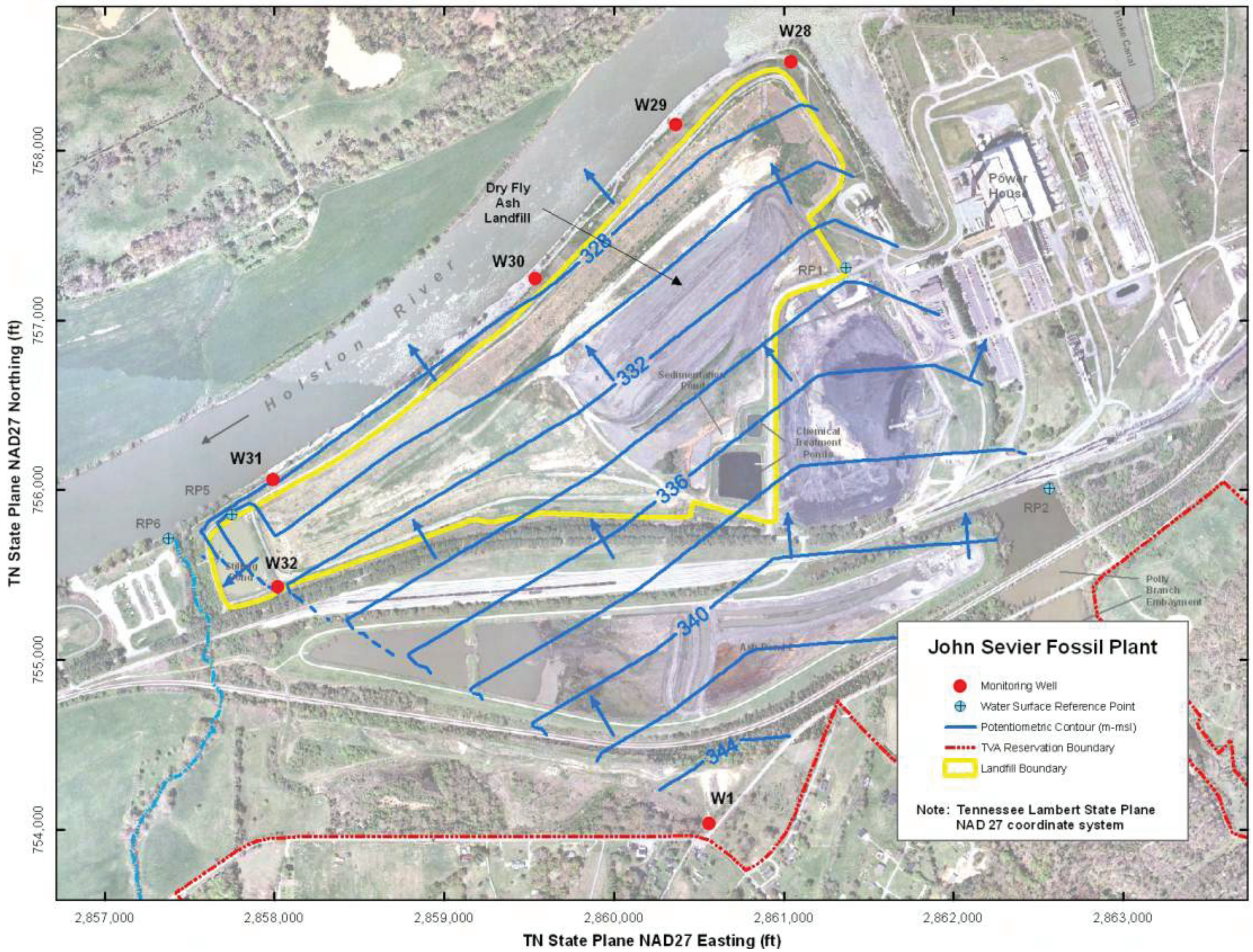
Well No.	Top of Casing Elevation (m)	Depth to Water (m)	Water Elevation (m)	Bottom Depth (m)
1	349.04	3.24	345.80	23.13
W28	331.54	5.01	326.53	8.59
W29	328.71	2.05	326.66	6.44
W30	328.99	1.50	327.49	6.12
W31	330.59	2.81	327.78	5.36
W32	336.48	4.56	331.92	7.80

An average hydraulic gradient of approximately 0.0179 is estimated between the southeastern and northwestern boundaries of the landfill. The shallow alluvial aquifer underlying the dry fly ash landfill exhibits a mean horizontal hydraulic conductivity of 0.006 m/d (7×10^{-6} cm/s). The local Darcy flux is therefore estimated to be approximately 1.1×10^{-4} m/d.

LEACHATE COLLECTION SYSTEM DISCHARGE

Appendix F provides a complete record of average daily discharge estimates for the LCS since operation began in April 2000. Also included at the bottom of the table is the estimated average LCS discharge rate observed during the past semiannual monitoring period, i.e., between October 29, 2010, and April 26, 2011. Pumpage during this period averaged approximately 6,000 gpd.

FIGURE 2. Groundwater Potentiometric Surface on April 18, 2011



CONCLUSIONS

Groundwater monitoring data for the April 18-20, 2011, sampling event indicated a GWPS exceedance for cobalt in well 28. The cobalt result from well W28 is likely biased high by turbidity due to elevated suspended solids. Among the non-Appendix II parameters, UPL exceedances were observed for alkalinity (all downgradient wells), aluminum (wells W28, W31, and W32), boron (all downgradient wells), chloride (well W30), fluoride (wells W30 and W31), manganese (wells W28, W29, and W30), nitrate-nitrite (wells W29, W31, and W32), pH (all downgradient wells are below the lower limit), potassium (well W31), sodium (wells W28, W30, and W31), specific conductivity (all downgradient wells), strontium (wells W28, W29, W30, W31), and sulfate (all downgradient wells). There were no MCL exceedances at the LCS sampling point.

Investigation into a potential interference in the TVA contract lab's (ESC) ability to assess accurate cadmium results for well W31 have identified a potential QA/QC implementation that has been previously overlooked by the lab. The manufacturer (ParkinElmer) has identified known molybdenum oxide interference for this equipment (ICP-MS) that can be controlled by adjusting the flow rate of oxygen within the sampling device. Application of this QA/QC control has resulted in greatly reduced cadmium levels, as observed comparing adjusted and non-adjusted ESC results from April 2011 well W31 cadmium samples. Still, levels do not match up with those observed at comparison labs, historical values for this well, or historical values for the site. This issue has been a continuing and erratic problem observed since switching laboratories and analysis methods in 2007, and based upon contradictory results from separate labs for the five sets of results collected from April 2010 through April 2011. Further investigation into laboratory analytical methods relating to the suspected cadmium interference will continue, and the results will be submitted to TDEC.

The full facility groundwater monitoring network will next be sampled during October 2011.

APPENDIX A

FIELD DATA SHEETS

Preliminary Groundwater Data Field Worksheet

Sheet 1 of 1

Project/Site	Well Number		Purge Date	Year	Month	Day
John Sevier Ground Water	1	84068		11	4	20

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
3.24 4195	23.95 4194	102 4188	WFN	GRV

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	☒ Unfiltered ☐ Filtered ☐ Both
7.8 4191		24.2 4190	JSF-1-0411	Filter Type and Size:

[Bottom of Well	-	Depth to Water]	x	Volume Factor	=	Well Volume	Target Purge Volume	Actual Purge Volume
[(23.95)m	-	(3.24)m]	x	(8.107)L/m	=	168 (L)	~~N/A~~ 336 (L)	~~503~~ 355 (L) 4186

Purge Pump: ☐ Bladder ☒ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☐ Bladder ☒ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1326	9.5	3.24	11	15.5	6.6	0.4	495	318	10.6
40L	1331	8	6.27	11	15.7	6.6	0.4	487	255	5.4
75L	1336	7	6.76	11	15.8	6.6	0.3	486	238	3.1
110L	1341	7	7.05	11	15.9	6.7	0.3	485	230	3.3
145L	1346	7	7.16	11	15.9	6.7	0.3	487	226	2.1
180L	1351	7	7.22	11	15.9	6.7	0.3	486	222	2.0
250L	1401	7	7.32	11	15.9	6.7	0.3	486	215	2.1
320L	1411	7	7.38	11	16.0	6.7	0.3	487	210	2.1
355L	1416	7	7.35	11	16.0	6.7	0.3	485	207	1.3

Remarks:

Reviewed By: [signature] 5/12/11 — Survey Leader, Date; [signature] 05/24/11 — Project Leader, Date

Sample Collector: WFN

Sample Date			Time
Year 11	Month 4	Day 20	ET CT

Pump Duration: 50 min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
1420	7	11	16.0	6.7	0.3	485	207	1.3
	4193	4192	10	400	300	94	90	

Additional Sample Data

Analyst: WFN

Date Analyzed	415 Phenol Alkalinity mg/L (EPA 310.1)	431 Total Alk. mg/L (EPA 310.1)	436 Mineral Acidity mg/L (EPA 305.1)	437 CO_2 Acidity mg/L (EPA 305.1)
Year 11 Month 4 Day 20	/	218	/	32
	Time:	Time: 1629	Time:	Time: 1634
	Initial:	Initial: WFN	Initial:	Initial: WFN

Well Diameter (mm)	Vol. Factor (L/m)
12.7 (0.5 in)	0.127
51 (2 in)	2.027
76 (3 in)	4.560
102 (4 in)	8.107
127 (5 in)	12.668
153 (6 in)	18.228

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ, Cyanide, Sulfide, Cl/Fl

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Preliminary Groundwater Data Field Worksheet

Sheet 1 of 2

Project/Site	Well Number		Purge Date	Year	Month	Day
John Sevier Ground Water	W28	84068		11	4	19

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
5.01 4195	8.52 4194	51 4188	WFN	GRV

☒ Depth of Screen ☐ Open Bore Hole

(m)		To	(m)	
4.21	4191		7.26	4190

Sample Label: JSF-W28-0411

☒ Unfiltered ☐ Filtered ☐ Both

Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor =	Well Volume	Target Purge Volume	Actual Purge Volume
[(8.52)m - (5.01)m] x (2.027)L/m =	7.1 (L)	~~N/A~~ 21.3 (L)	(L) 4186

Purge Pump: ☐ Bladder ☐ Centrifugal ☒ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☐ Bladder ☐ Centrifugal ☒ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1242	.5	5.01	7	16.2	6.13	.97	1821	407	7.8
	1246	.5	5.21	7	16.1	5.88	.95	1817	396	6.8
	1250	.5	5.32	7	15.8	6.04	.81	1820	385	4.7
	1254	.65	5.41	7	15.7	6.57	1.02	1796	380	3.5
	1258	.45	5.50	7	15.6	5.96	1.10	1796	378	3.9
	1302	.33	5.56	7	15.8	6.05	1.02	1799	370	3.7
4/20/11 09.32	~~1306~~	0.44	5.04	7	15.6	5.9	0.9	1822	465	216
0936	~~1310~~	0.47	5.20	7	15.1	5.9	0.8	1814	458	181
0940	~~1314~~	0.47	5.33	7	15.0	5.9	1.3	1803	450	116
0944	~~1318~~	0.47	5.38	6	14.8	5.9	2.7	1771	460	122
0948	0948	0.47	5.44	6	14.8	5.9	2.0	1784	455	120
	0952	0.43	5.49	6	14.9	5.9	1.4	1794	437	84
	0956	0.30	5.53	6	15.0	5.9	1.0	1805	404	67
12.52	1000	0.30	5.54	6	15.0	5.9	1.0	1803	399	53
	1004	0.30	5.56	6	15.0	5.9	0.9	1803	391	49

Remarks:

Reviewed By: Will Neal (signature) 5/12/11 Survey Leader Date — (signature) 05/24/11 Project Leader Date

Sample Collector: WFN

Sample Date			Time
Year	Month	Day	1025
11	4	20	☒ ET CT

Pump Duration: 999 min 72004

"999" = 2 days

Sample Readings

Analysis Time (ET) CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
1025	0.3	6	15.0	5.9	0.9	1806	368	28
	4193	4192	10	400	300	94	90	

Additional Sample Data

Analyst: WFN

Date Analyzed		
Year	Month	Day
11	4	20

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

415	431	436	437
Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)
	239		157
Time:	Time: 1605	Time:	Time: 1650
Initial:	Initial: WFN	Initial:	Initial: WFN

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

Preliminary Groundwater Data Field Worksheet

Sheet 2 of 2

Project/Site	Well Number		Purge Date	Year	Month	Day
John Sevier Ground Water	W28	84068		11	4	19

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
5.01 4195	8.52 4194	51 4188	WFN	GRV

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	
4.21 4191	To	7.26 4190	JSF-W28-0411	☒ Unfiltered ☐ Filtered ☐ Both Filter Type and Size:

[Bottom of Well	-	Depth to Water]	x	Volume Factor	=	Well Volume	Target Purge Volume	Actual Purge Volume
[(8.52)m	-	(5.01)m]	x	(2.027)L/m	=	7.1 (L)	~~N/A~~ 21.3 (L)	(L) 4186

Purge Pump: ☐ Bladder ☐ Centrifugal ☒ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☐ Bladder ☐ Centrifugal ☒ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1008	0.3	5.56	6	15.0	5.9	0.8	1803	381	44
	1012	0.3	5.60	6	15.1	5.9	0.8	1806	372	30
	1016	0.3	5.62	6	15.1	5.9	0.7	1806	369	30
	1020	0.3	5.65	6	15.1	5.9	0.7	1806	368	28

Remarks:

Reviewed By: William Neil (signature) Survey Leader 5/12/11 Date (signature) Project Leader 05/24/11 Date

Sample Collector: WFN

Sample Date			Time
Year	Month	Day	1025
11	4	20	ET CT

Pump Duration: 999 min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
1025	0.3	6	15.1	5.9	0.7	1806	368	28
	4193	4192	10	400	300	94	90	

Additional Sample Data

Analyst: WFN

Date Analyzed			415	431	436	437
Year	Month	Day	Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)
11	4	20		239		157
			Time:	Time: 1605	Time:	Time: 1650
			Initial:	Initial: WFN	Initial:	Initial: WFN

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

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Preliminary Groundwater Data Field Worksheet

Sheet 1 of 1

Project/Site	Well Number		Purge Date	Year	Month	Day
John Sevier Ground Water	W29	84068		11	4	18

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
2.05 4195	6.44 4194	51 4188	WFN	GRV

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	☒ Unfiltered ☐ Filtered ☐ Both
4.21 4191		6.44 4190	JSF-W29-0411	Filter Type and Size:

[Bottom of Well	-	Depth to Water]	x	Volume Factor	=	Well Volume	Target Purge Volume	Actual Purge Volume
[(6.44)m	-	(2.05)m]	x	(2.027)L/m	=	8.9 (L)	~~N/A~~ 26.7 (L)	27.0 (L) 4186

Purge Pump: ☐ Bladder ☐ Centrifugal ☒ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☐ Bladder ☐ Centrifugal ☒ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1322	1.1	2.05	4.5	13.6	6.1	1.7	782	388	2.0
	1326	0.75	3.50	4.5	13.7	6.0	1.4	797	393	2.0
	1330	0.75	3.58	4.5	13.7	6.0	1.3	829	395	6.4
14L	1334	0.75	3.64	4.5	13.8	5.9	1.1	853	397	8.6
	1338	0.75	3.75	4.5	13.9	5.9	0.9	867	401	9.2
20L	1342	0.75	3.80	4.5	13.9	5.9	0.7	875	414	9.0
	1346	0.7	3.82	4.5	14.1	5.9	0.7	878	420	7.6
25L	1350	0.7	3.85	4.5	14.2	5.9	0.6	883	427	5.6
27L	1354	0.7	3.85	4.5	14.0	5.9	0.6	893	441	5.2

Remarks:

Reviewed By: [signature] Survey Leader 5/12/11 Date [signature] Project Leader 05/24/11 Date

Sample Collector: WFN

Sample Date			Time
Year	Month	Day	1400
11	04	18	ET CT
Pump Duration:	32		min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
1400	0.7	4.5	14.0	5.9	0.6	893	441	5.2
	4193	4192	10	400	300	94	90	

Additional Sample Data

Analyst: WFN

Date Analyzed			415	431	436	437
Year	Month	Day	Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)
11	04	18	~~Time:~~ ~~Initial:~~	303 Time: 1600 Initial: WFN	~~Time:~~ ~~Initial:~~	174 Time: 1625 Initial: WFN

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Others (list): FQ Cyanide Sulfide Cl/Fl

TVA 30066A [2-2008]

Preliminary Groundwater Data Field Worksheet

Sheet 1 / of /

Project/Site	Well Number		Purge Date	Year	Month	Day
John Sevier Ground Water	W30	84068		11	4	19

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
1.54 (4195)	6.11 (4194)	51 (4188)	WFN	GRV

☒ Depth of Screen ☐ Open Bore Hole

(m)		(m)	Sample Label	
2.99 (4191)	To	6.11 (4190)	JSF-W30-0411	☒ Unfiltered ☐ Filtered ☐ Both Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor =	Well Volume	Target Purge Volume	Actual Purge Volume
[(6.11)m - (1.54)m] x (2.027)L/m =	9.3 (L)	~~N/A~~ 18.6 (L)	20L (L) 4186

Purge Pump: ☐ Bladder ☐ Centrifugal ☒ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☐ Bladder ☐ Centrifugal ☒ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1200	1.0	1.54	3	14.9	6.3	1.0	2044	294	4.1
	1204	1.0	2.07	3	14.2	6.3	0.5	2030	254	2.7
8L	1208	1.0	2.13	3	14.2	6.3	0.4	2035	231	0.9
12L	1212	1.0	2.16	3	14.3	6.2	0.4	2033	225	1.1
16L	1216	1.0	2.15	3	14.4	6.2	0.3	2026	223	1.2
20L	1220	1.0	2.15	3	14.4	6.2	0.3	2029	224	

Remarks:

Reviewed By: [signature] 5/12/11 [signature] 05/24/11

Survey Leader Date Project Leader Date

Sample Collector: WFN			
Sample Date			**Time**
Year 11	Month 4	Day 19	1225 ET CT
Pump Duration: 20			min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
	4193	4192	10	400	300	94	90	
1225	1.0	3	14.4	6.2	0.3	2024	224	1.2

Additional Sample Data

Analyst: WFN

	415	431	436	437
	/	314	/	117
	Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)
Time:		1535		1542
Initial:		GRV		GRV

Date Analyzed: Year 11 Month 4 Day 19

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

TVA 30066A [2-2008]

Preliminary Groundwater Data Field Worksheet

Sheet 1 / of /

Project/Site	Well Number		Purge Date	Year	Month	Day
John Sevier Ground Water	W31	84068		11	4	20

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
2.82 4195	5.36 4194	51 4188	WFN	GRV

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	
2.32 4191	To	5.36 4190	JSF-W31-0411	☒ Unfiltered ☐ Filtered ☐ Both Filter Type and Size:

[Bottom of Well	-	Depth to Water]	x	Volume Factor	=	Well Volume	Target Purge Volume	Actual Purge Volume
[(5.36)m	-	(2.82)m]	x	(2.027)L/m	=	5.1 (L)	~~N/A~~ 15.5 (L)	17.2 (L) 4186

Purge Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1130	0.46	2.82	5	14.5	6.4	4.5	2337	468	135
	1134	0.48	2.93	5	13.2	6.3	4.3	2241	465	331
	1138	0.48	2.93	5	13.2	6.3	4.4	2230	469	207
	1142	0.48	2.93	5	13.3	6.3	4.4	2235	470	77
	1146	0.47	2.93	5	13.3	6.3	4.4	2247	472	41
	1150	0.47	2.93	5	13.2	6.3	4.4	2251	473	39
11.5L	1154	0.47	2.93	5	13.2	6.3	4.3	2254	474	27
	1158	0.47	2.93	5	13.3	6.3	4.3	2260	475	21
15L	1202	0.47	2.93	5	13.3	6.3	4.3	2264	476	21
	1206	0.47	2.93	5	13.3	6.3	4.3	2268	477	18

Remarks: Duplicates collected. Equipment blank collected between 28 and 31.

Reviewed By: [signature] 5/12/11 [signature] 05/24/11

Survey Leader Date Project Leader Date

Sample Collector: WFN

Sample Date			Time
Year 11	Month 4	Day 20	1210 ET CT

Pump Duration: 36 min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
1210	0.47	5	13.3	6.3	4.3	2268	477	18
	4193	4192	10	400	300	94	90	

Additional Sample Data

Analyst: WFN

Date Analyzed: Year 11 Month 4 Day 20

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

	415	431	436	437
	~~Phenol Alkalinity mg/L (EPA 310.1)~~	305 / 304 Total Alk. mg/L (EPA 310.1)	~~Mineral Acidity mg/L (EPA 305.1)~~	84 / 85 CO_2 Acidity mg/L (EPA 305.1)
Time:		1612 1616		1646 1642
Initial:		WFN WFN		WFN WFN

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required

☐ BOD ☐ TOC ☐ Ferrous ☒ Mineral ☐ Phenol

☐ COD ☒ TIC ☒ Metals ☐ Dis. Mineral ☐ Filt TIC

☐ Dis. Metals ☒ Nutrient ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

TVA 30066A [2-2008]

Preliminary Groundwater Data Field Worksheet

Sheet 1 1 of 1

Project/Site	Well Number		Purge Date	Year	Month	Day
John Sevier Ground Water	W32	84068		11	04	18

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
4.56 4195	7.7 4194	51 4188	WFN	GRJ

☒ Depth of Screen ☐ Open Bore Hole

(m)		To	(m)	
4.79	4191		7.74	4190

Sample Label: JSF-W32-0411

☒ Unfiltered ☐ Filtered ☐ Both

Filter Type and Size:

[Bottom of Well	-	Depth to Water]	x	Volume Factor	=	Well Volume	Target Purge Volume	Actual Purge Volume
[(7.7)m	-	(4.56)m]	x	(2.027)L/m	=	6.36 (L)	~~N/A~~ 19.1 (L)	19.1 (L) 4186

Purge Pump: ☐ Bladder ☐ Centrifugal ☒ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☐ Bladder ☐ Centrifugal ☒ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1114	0.41	4.56	6	16.7	6.5	6.0	718	372	5.0
	1118	~~0.420~~	4.72	6	14.4	6.4	5.7	698	409	4.7
	1122	0.43	4.90	6	14.3	6.3	5.4	702	430	6.3
5.5L	1126	0.43	5.00	6	14.3	6.3	5.0	698	433	5.9
	1130	0.43	5.07	6	14.5	6.3	4.7	695	436	10.5
	1134	0.43	5.15	6	14.7	6.3	4.4	692	439	10.3
10L	1138	0.43	5.22	6	15.0	6.3	4.3	691	439	9.9
	1142	0.43	5.24	6	15.5	6.4	4.4	683	443	12.4
	1146	0.42	5.28	6	15.5	6.4	4.3	695	446	8.7
	1150	0.42	5.32	6	15.3	6.4	4.4	690	448	8.4
13L	1154	0.42	5.35	6	15.4	6.4	4.4	695	451	6.7
	1158	0.43	5.42	6	15.5	6.3	4.5	688	456	7.9
	1202	0.43	5.44	6	15.4	6.4	4.5	689	455	6.4
	1206	0.43	5.46	6	15.4	6.4	4.5	687	460	6.2
18	1210 / 1214	0.43 / 0.43	5.49 / 5.52	6 / 6	15.4 / 15.4	6.4 / 6.4	4.5 / 4.6	688 / 688	462 / 464	5.5 / 8.1

Remarks:

Reviewed By: [signature] Survey Leader 5/12/11 Date [signature] Project Leader 08/24/11 Date

Sample Collector: WFN

Sample Date			Time
Year	Month	Day	1220
11	04	18	ET CT

Pump Duration: 60 min 72004

"999" = 2 days

Sample Readings

1220	0.43	6	15.4	6.4	4.6	688	464	8.1
	4193	4192	10	400	300	94	90	
Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1

Additional Sample Data

Analyst: WFN

Date Analyzed			415	431	436	437
Year	Month	Day	Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)
11	4	18		301		74
			Time:	Time: 1610	Time:	Time: 1615
			Initial:	Initial: WFN	Initial:	Initial: WFN

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required

☐ BOD ☐ TOC ☐ Ferrous ☒ Mineral ☐ Phenol

☐ COD ☒ TIC ☒ Metals ☐ Dis. Mineral ☐ Filt TIC

☐ Dis. Metals ☒ Nutrient ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

APPENDIX B

SAMPLE CUSTODY RECORD

TVA-Environmental Affairs

400 W. Summit Hill Mailstop TVA WT
Knoxville,TN 37902

Billing information:

Ms. Cynthia Anderson
1101 Market St. Mailstop: LP-5D-C
Chattanooga,TN 37402

Chain of Custody
Page of
A137

ESC
LAB SCIENCES
12065 Lebanon Road
Mt. Juliet, TN 37122
Phone: (800) 767-5859
Phone: (615) 758-5858
Fax: (615) 758-5859

Report to: **Mr. J. Mark Boggs**

Email: jmboggs@tva.gov,edmsvk@t

Project Description: **JSF Groundwater**

City/State Collected:

Phone: **(865) 632-6941**
FAX:

Client Project #: **JSF-1**

Lab Project #: **TVAENVAFF-JSF GRDWAT**

Collected by (print): William Nichols

Site/Facility ID#:

P.O.#:

Collected by (signature): [signature]

Immediately Packed on Ice N ___ Y ✓

Rush? (Lab MUST Be Notified)
___ Same Day 200%
___ Next Day 100%
___ Two Day 50%
___ Three Day 25%

Date Results Needed: STD
Email? __No X Yes
FAX? __No __Yes

Acctnum: **TVAENVAFF** (lab use only)
Template/Prelogin: **T57200/ P350791**
Cooler #: 3-24-11 KC
Shipped Via: **FedEX Ground**

Analysis/Container/Preservative

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	CN 250mlHDPEAmb-NaOH 7/2	Cl,F,SO4 125mlHDPE-NoPres	IC 250mlAmb-No Pres	Metals 500mlHDPE-HNO3 <2	Nitrogens 250mlHDPE-H2SO4 <2	SULFIDE 500mlHDPE-NaOH+ZnAc 7/2	TDS 250mlHDPE-NoPres	TSS 1L-HDPE NoPres	Remarks/Contaminant	Sample # (lab only)
JSF-1-0411	G	GW	11	4/20/11	1420	8	X	X	X	X	X	X	X	X	EDD	L512564-01
JSF-LCS-0411	G	GW	—	4/20/11	1055	8	X	X	X	X	X	X	X	X	EDD	02
JSF-W28-0411	G	GW	6	4/20/11	1025	8	X	X	X	X	X	X	X	X	EDD	03
JSF-W29-0411	G	GW	4.5	4/18/11	1400	8	X	X	X	X	X	X	X	X	EDD	04
JSF-W30-0411	G	GW	3	4/19/11	1225	8	X	X	X	X	X	X	X	X	EDD	05
JSF-W31-0411	G	GW	5	4/20/11	1210	8	X	X	X	X	X	X	X	X	EDD	06
JSF-W31-DUP-0411	G	GW	5	4/20/11	1210	8	X	X	X	X	X	X	X	X	EDD	07
JSF-W32-0411	G	GW	6	4/18/11	1220	8	X	X	X	X	X	X	X	X	EDD	08
~~JSF-AP3-EQ-0411~~ wh JSF-DFS-EQ-0411	G	GW	—	4/20/11	1115	8	X	X	X	X	X	X	X	X	EDD	09

*Matrix: SS - Soil GW - Groundwater WW - WasteWater DW - Drinking Water OT - Other______

Remarks:

pH ________ Temp ________
Flow ________ Other ________

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Samples returned via: ☐ UPS ☐ FedEx ☒ Courier ☐	Condition: ok (lab use only)
[signature]	4/21/11	1030			
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Temp: 3°C Bottles Received: 72	COC Seal Intact: ✓ Y ___ N ___ NA
Relinquished by: (Signature)	Date:	Time:	Received for lab by: (Signature) J. Fuller	Date: 04-22-11 Time: 0915	pH Checked: <2, 7/2 NCF:

APPENDIX C

LABORATORY ANALYTICAL REPORT

ESC LAB SCIENCES
YOUR LAB OF CHOICE

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT 9D-K
Knoxville, TN 37902

Report Summary

Friday May 20, 2011

Report Number: L512564
Samples Received: 04/22/11
Client Project: JSF-1

Description: JSF Groundwater

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By: ______________________

Roberto Celia , ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT - PH-0197, FL - E87487
GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375/DW21704, ND - R-140
NJ - TN002,NJ NELAP - TN002, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032008A,
TX - T104704245, OK-9915

Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.
Note: The use of the preparatory EPA Method 3511 is not approved or endorsed by the CA ELAP.

Where applicable, sampling conducted by ESC is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.

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Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT 9D-K
Knoxville, TN 37902

Case Narrative

Friday May 20, 2011

Report Number: L512564
Samples Received: 04/22/11
Client Project: JSF-1

Description: JSF Groundwater

Other Comments

Final Revised Report. Arsenic, Cadmium & Selenium reran using ICPMS-DRC.

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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

Date Received : 04/22/11 09:15
Description : JSF

Sample ID : JSF-1-0411 11 FT

Collected By : William Nichols
Collection Date : 04/20/11 14:20

ESC Sample # : L512564-01

Site ID :

Project # : JSF-1

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	9.5	1.0	mg/l	9056	04/23/11 1146	477	04/23/11 1738	RBS
Fluoride	BDL	0.10	mg/l	9056	04/23/11 1146	477	04/23/11 1738	RBS
Sulfate	26.	5.0	mg/l	9056	04/23/11 1146	477	04/23/11 1738	RBS
Cyanide	BDL	0.0050	mg/l	9012B	04/28/11 1621	524	04/29/11 1135	CWP
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	04/29/11 1800	183	05/02/11 1153	CBD
Nitrate-Nitrite	0.22	0.10	mg/l	353.2	04/27/11 0835	479	04/27/11 1442	RBS
Sulfide	BDL	0.050	mg/l	4500-S2 D	04/26/11 1922	159	04/26/11 1923	MCH
Kjeldahl Nitrogen, TKN	BDL	0.10	mg/l	351.2	04/29/11 1011	518	04/30/11 0037	MCH
Total Inorganic Carbon	47.	1.0	mg/l	9060A	04/26/11 1619	239	04/26/11 1748	CSU
Dissolved Solids	290	10.	mg/l	2540C	04/23/11 1507	503	04/27/11 1409	PED
Suspended Solids	BDL	1.0	mg/l	2540D	04/23/11 1202	503	04/23/11 1203	PED
Antimony	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Arsenic	0.0022	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1716	LAT
Beryllium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Cadmium	BDL	0.00050	mg/l	6020	05/16/11 0849	119	05/19/11 1716	LAT
Chromium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Copper	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Cobalt	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Lead	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Nickel	0.0033	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Selenium	BDL	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1716	LAT
Silver	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Thallium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Tin	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Vanadium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Zinc	0.011	0.010	mg/l	6020	04/25/11 0906	119	04/26/11 1224	LAT
Mercury	BDL	0.00020	mg/l	7470A	04/22/11 1958	416	04/25/11 1122	MDC
Aluminum	BDL	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1848	ZCS
Barium	0.22	0.0050	mg/l	6010B	04/25/11 1008	529	04/25/11 1848	ZCS
Boron	BDL	0.20	mg/l	6010B	04/25/11 1008	529	04/25/11 1848	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
The reported analytical results relate only to the sample submitted

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Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # :   L512564-01

Date Received   :   04/22/11 09:15
Description   :   JSF

Site ID :

Sample ID   :   JSF-1-0411 11 FT

Project # :   JSF-1

Collected By   :   William Nichols
Collection Date :   04/20/11 14:20

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	81.	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1848	ZCS
Iron	0.26	0.10	mg/l	6010B	04/26/11 1547	529	04/27/11 1109	ARF
Magnesium	8.6	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1848	ZCS
Manganese	0.025	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1848	ZCS
Potassium	0.50	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1848	ZCS
Sodium	5.7	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1848	ZCS
Strontium	0.71	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1848	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
The reported analytical results relate only to the sample submitted

Reported: 05/17/11 16:43 Revised: 05/20/11 15:35

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Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # :   L512564-02

Date Received   :   04/22/11 09:15
Description   :   JSF

Site ID :

Sample ID   :   JSF-LCS-0411

Project # :   JSF-LCS

Collected By   :   William Nichols
Collection Date :   04/20/11 10:55

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	12.	1.0	mg/l	9056	04/23/11 1146	477	04/23/11 1826	RBS
Fluoride	BDL	0.10	mg/l	9056	04/23/11 1146	477	04/23/11 1826	RBS
Sulfate	730	100	mg/l	9056	04/25/11 0901	477	04/25/11 1221	LLS
Cyanide	BDL	0.0050	mg/l	9012B	04/28/11 1621	524	04/29/11 1137	CWP
Ammonia Nitrogen	0.39	0.10	mg/l	350.1	04/29/11 2048	183	05/02/11 1027	CBD
Nitrate-Nitrite	0.55	0.10	mg/l	353.2	04/27/11 0835	479	04/27/11 1443	RBS
Sulfide	BDL	0.050	mg/l	4500-S2 D	04/25/11 1337	183	04/25/11 1415	MCG
Kjeldahl Nitrogen, TKN	0.32	0.10	mg/l	351.2	04/29/11 1011	518	04/30/11 0039	MCH
Total Inorganic Carbon	84.	1.0	mg/l	9060A	04/26/11 1619	239	04/26/11 1823	CSU
Dissolved Solids	1600	10.	mg/l	2540C	04/23/11 1507	503	04/27/11 1409	PED
Suspended Solids	7.1	1.0	mg/l	2540D	04/23/11 1202	503	04/23/11 1203	PED
Antimony	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Arsenic	0.0047	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1720	LAT
Beryllium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Cadmium	BDL	0.00050	mg/l	6020	05/16/11 0849	119	05/19/11 1720	LAT
Chromium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Copper	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Cobalt	0.0073	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Lead	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Nickel	0.016	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Selenium	0.0010	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1720	LAT
Silver	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Thallium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Tin	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Vanadium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Zinc	BDL	0.010	mg/l	6020	04/25/11 0906	119	04/26/11 1227	LAT
Mercury	BDL	0.00020	mg/l	7470A	04/22/11 1958	416	04/25/11 1124	MDC
Aluminum	0.10	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1851	ZCS
Barium	0.046	0.0050	mg/l	6010B	04/25/11 1008	529	04/25/11 1851	ZCS
Boron	4.0	0.20	mg/l	6010B	04/25/11 1008	529	04/25/11 1851	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-02

Date Received : 04/22/11 09:15
Description : JSF

Site ID :

Sample ID : JSF-LCS-0411

Project # : JSF-LCS

Collected By : William Nichols
Collection Date : 04/20/11 10:55

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	300	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1851	ZCS
Iron	1.5	0.10	mg/l	6010B	04/26/11 1547	529	04/27/11 1125	ARF
Magnesium	67.	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1851	ZCS
Manganese	3.7	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1851	ZCS
Potassium	17.	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1851	ZCS
Sodium	24.	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1851	ZCS
Strontium	5.6	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1851	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Reported: 05/17/11 16:43 Revised: 05/20/11 15:35

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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-03

Date Received : 04/22/11 09:15
Description : JSF

Site ID :

Sample ID : JSF-W28-0411 6 FT

Project # : JSF-W28

Collected By : William Nichols
Collection Date : 04/20/11 10:25

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	14.	1.0	mg/l	9056	04/23/11 1146	477	04/23/11 1858	RBS
Fluoride	BDL	0.10	mg/l	9056	04/23/11 1146	477	04/23/11 1858	RBS
Sulfate	880	100	mg/l	9056	04/25/11 0901	477	04/25/11 1253	LLS
Cyanide	BDL	0.0050	mg/l	9012B	04/28/11 1621	524	04/29/11 1138	CWP
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	04/29/11 2048	183	05/02/11 1028	CBD
Nitrate-Nitrite	0.19	0.10	mg/l	353.2	04/27/11 0835	479	04/27/11 1444	RBS
Sulfide	BDL	0.050	mg/l	4500-S2 D	04/25/11 1337	183	04/25/11 1415	MCG
Kjeldahl Nitrogen, TKN	BDL	0.10	mg/l	351.2	04/29/11 1011	518	04/30/11 0041	MCH
Total Inorganic Carbon	49.	1.0	mg/l	9060A	04/26/11 1619	239	04/26/11 1842	CSU
Dissolved Solids	1600	10.	mg/l	2540C	04/23/11 1507	503	04/27/11 1410	PED
Suspended Solids	16.	1.0	mg/l	2540D	04/23/11 1202	503	04/23/11 1203	PED
Antimony	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Arsenic	0.0016	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1724	LAT
Beryllium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Cadmium	BDL	0.00050	mg/l	6020	05/16/11 0849	119	05/19/11 1724	LAT
Chromium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Copper	0.0021	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Cobalt	0.0045	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Lead	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Nickel	0.021	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Selenium	BDL	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1724	LAT
Silver	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Thallium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Tin	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Vanadium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Zinc	BDL	0.010	mg/l	6020	04/25/11 0906	119	04/26/11 1230	LAT
Mercury	BDL	0.00020	mg/l	7470A	04/22/11 1958	416	04/25/11 1127	MDC
Aluminum	0.69	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1914	ZCS
Barium	0.020	0.0050	mg/l	6010B	04/25/11 1008	529	04/25/11 1914	ZCS
Boron	2.7	0.20	mg/l	6010B	04/25/11 1008	529	04/25/11 1914	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-03

Site ID :

Project # : JSF-W28

Date Received : 04/22/11 09:15
Description : JSF

Sample ID : JSF-W28-0411 6 FT

Collected By : William Nichols
Collection Date : 04/20/11 10:25

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	320	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1914	ZCS
Iron	1.2	0.10	mg/l	6010B	04/26/11 1547	529	04/27/11 1129	ARF
Magnesium	48.	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1914	ZCS
Manganese	3.6	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1914	ZCS
Potassium	1.3	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1914	ZCS
Sodium	21.	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1914	ZCS
Strontium	0.95	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1914	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Reported: 05/17/11 16:43 Revised: 05/20/11 15:35

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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-04

Site ID :

Project # : JSF-W29

Date Received : 04/22/11 09:15
Description : JSF
Sample ID : JSF-W29-0411 4.5 FT
Collected By : William Nichols
Collection Date : 04/18/11 14:00

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	4.8	1.0	mg/l	9056	04/23/11 1146	477	04/23/11 1914	RBS
Fluoride	0.10	0.10	mg/l	9056	04/23/11 1146	477	04/23/11 1914	RBS
Sulfate	170	25.	mg/l	9056	04/25/11 0901	477	04/25/11 1309	LLS
Cyanide	BDL	0.0050	mg/l	9012B	04/28/11 1621	524	04/29/11 1139	CWP
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	04/29/11 2048	183	05/02/11 1029	CBD
Nitrate-Nitrite	3.2	0.10	mg/l	353.2	04/27/11 0835	479	04/27/11 1445	RBS
Sulfide	BDL	0.050	mg/l	4500-S2 D	04/26/11 1922	159	04/26/11 1923	MCH
Kjeldahl Nitrogen, TKN	BDL	0.10	mg/l	351.2	04/29/11 1011	518	04/30/11 0043	MCH
Total Inorganic Carbon	68.	1.0	mg/l	9060A	04/26/11 1619	239	04/26/11 1900	CSU
Dissolved Solids	610	10.	mg/l	2540C	04/23/11 1507	503	04/27/11 1410	PED
Suspended Solids	1.0	1.0	mg/l	2540D	04/23/11 1202	503	04/23/11 1203	PED
Antimony	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Arsenic	0.0021	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1728	LAT
Beryllium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Cadmium	BDL	0.00050	mg/l	6020	05/16/11 0849	119	05/19/11 1728	LAT
Chromium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Copper	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Cobalt	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Lead	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Nickel	0.0063	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Selenium	0.0024	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1728	LAT
Silver	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Thallium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Tin	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Vanadium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Zinc	BDL	0.010	mg/l	6020	04/25/11 0906	119	04/26/11 1234	LAT
Mercury	BDL	0.00020	mg/l	7470A	04/22/11 1958	416	04/25/11 1130	MDC
Aluminum	0.11	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1918	ZCS
Barium	0.030	0.0050	mg/l	6010B	04/25/11 1008	529	04/25/11 1918	ZCS
Boron	0.90	0.20	mg/l	6010B	04/25/11 1008	529	04/25/11 1918	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
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KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-04

Date Received : 04/22/11 09:15
Description : JSF

Site ID :

Sample ID : JSF-W29-0411 4.5 FT

Project # : JSF-W29

Collected By : William Nichols
Collection Date : 04/18/11 14:00

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	140	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1918	ZCS
Iron	BDL	0.10	mg/l	6010B	04/26/11 1547	529	04/27/11 1132	ARF
Magnesium	31.	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1918	ZCS
Manganese	1.2	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1918	ZCS
Potassium	1.4	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1918	ZCS
Sodium	9.2	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1918	ZCS
Strontium	0.96	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1918	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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Notes:
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Reported: 05/17/11 16:43 Revised: 05/20/11 15:35

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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-05

Site ID :

Project # : JSF-W30

Date Received : 04/22/11 09:15
Description : JSF

Sample ID : JSF-W30-0411 3 FT

Collected By : William Nichols
Collection Date : 04/19/11 12:25

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	17.	1.0	mg/l	9056	04/23/11 1146	477	04/23/11 1929	RBS
Fluoride	0.34	0.10	mg/l	9056	04/23/11 1146	477	04/23/11 1929	RBS
Sulfate	960	100	mg/l	9056	04/25/11 0901	477	04/25/11 1325	LLS
Cyanide	BDL	0.0050	mg/l	9012B	04/28/11 1621	524	04/29/11 1140	CWP
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	04/29/11 2048	183	05/02/11 1031	CBD
Nitrate-Nitrite	BDL	0.10	mg/l	353.2	04/27/11 0835	479	04/27/11 1446	RBS
Sulfide	BDL	0.050	mg/l	4500-S2 D	04/26/11 1922	159	04/26/11 1923	MCH
Kjeldahl Nitrogen, TKN	BDL	0.10	mg/l	351.2	04/29/11 1011	518	04/30/11 0044	MCH
Total Inorganic Carbon	67.	1.0	mg/l	9060A	04/26/11 1619	239	04/26/11 1918	CSU
Dissolved Solids	1800	10.	mg/l	2540C	04/23/11 1507	503	04/27/11 1410	PED
Suspended Solids	BDL	1.0	mg/l	2540D	04/23/11 1202	503	04/23/11 1203	PED
Antimony	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Arsenic	0.0022	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1732	LAT
Beryllium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Cadmium	BDL	0.00050	mg/l	6020	05/16/11 0849	119	05/19/11 1732	LAT
Chromium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Copper	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Cobalt	0.0012	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Lead	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Nickel	0.033	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Selenium	BDL	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1732	LAT
Silver	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Thallium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Tin	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Vanadium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Zinc	BDL	0.010	mg/l	6020	04/25/11 0906	119	04/26/11 1237	LAT
Mercury	BDL	0.00020	mg/l	7470A	04/22/11 1958	416	04/25/11 1132	MDC
Aluminum	BDL	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1921	ZCS
Barium	0.019	0.0050	mg/l	6010B	04/25/11 1008	529	04/25/11 1921	ZCS
Boron	4.8	0.20	mg/l	6010B	04/25/11 1008	529	04/25/11 1921	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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Notes:
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # :   L512564-05

Date Received   :   04/22/11 09:15
Description   :   JSF

Site ID :

Sample ID   :   JSF-W30-0411 3 FT

Project # :   JSF-W30

Collected By   :   William Nichols
Collection Date :   04/19/11 12:25

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	310	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1921	ZCS
Iron	BDL	0.10	mg/l	6010B	04/26/11 1547	529	04/27/11 1136	ARF
Magnesium	84.	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1921	ZCS
Manganese	1.2	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1921	ZCS
Potassium	1.0	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1921	ZCS
Sodium	39.	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1921	ZCS
Strontium	3.2	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1921	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Reported: 05/17/11 16:43 Revised: 05/20/11 15:35

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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-06

Date Received : 04/22/11 09:15
Description : JSF

Site ID :

Sample ID : JSF-W31-0411 5 FT

Project # : JSF-W31

Collected By : William Nichols
Collection Date : 04/20/11 12:10

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	10.	1.0	mg/l	9056	04/23/11 1146	477	04/23/11 1945	RBS
Fluoride	0.30	0.10	mg/l	9056	04/23/11 1146	477	04/23/11 1945	RBS
Sulfate	1100	250	mg/l	9056	04/25/11 0901	477	04/25/11 1340	LLS
Cyanide	BDL	0.0050	mg/l	9012B	04/28/11 1621	524	04/29/11 1141	CWP
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	04/29/11 2048	183	05/02/11 1032	CBD
Nitrate-Nitrite	0.42	0.10	mg/l	353.2	04/27/11 0835	479	04/27/11 1449	RBS
Sulfide	BDL	0.050	mg/l	4500-S2 D	04/26/11 1922	159	04/26/11 1923	MCH
Kjeldahl Nitrogen, TKN	BDL	0.10	mg/l	351.2	04/29/11 1011	518	04/30/11 0046	MCH
Total Inorganic Carbon	64.	1.0	mg/l	9060A	04/26/11 1619	239	04/26/11 1936	CSU
Dissolved Solids	2000	10.	mg/l	2540C	04/23/11 1507	503	04/27/11 1411	PED
Suspended Solids	13.	1.0	mg/l	2540D	04/23/11 1202	503	04/23/11 1203	PED
Antimony	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Arsenic	0.0025	0.0010	mg/l	6020	05/16/11 0849	119	05/20/11 1247	LAT
Beryllium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Cadmium	0.0032	0.00050	mg/l	6020	05/16/11 0849	119	05/20/11 1247	LAT
Chromium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Copper	0.0020	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Cobalt	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Lead	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Nickel	0.015	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Selenium	BDL	0.0010	mg/l	6020	05/16/11 0849	119	05/20/11 1247	LAT
Silver	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Thallium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Tin	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Vanadium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Zinc	BDL	0.010	mg/l	6020	04/25/11 0906	119	04/26/11 1444	LAT
Mercury	BDL	0.00020	mg/l	7470A	04/22/11 1958	416	04/25/11 1135	MDC
Aluminum	0.46	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1925	ZCS
Barium	0.023	0.0050	mg/l	6010B	04/25/11 1008	529	04/25/11 1925	ZCS
Boron	11.	0.20	mg/l	6010B	04/25/11 1008	529	04/25/11 1925	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # :   L512564-06

Date Received   :   04/22/11 09:15
Description   :   JSF

Site ID :

Sample ID   :   JSF-W31-0411 5 FT

Project # :   JSF-W31

Collected By   :   William Nichols
Collection Date :   04/20/11 12:10

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	350	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1925	ZCS
Iron	0.39	0.10	mg/l	6010B	04/26/11 1547	529	04/27/11 1139	ARF
Magnesium	76.	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1925	ZCS
Manganese	BDL	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1925	ZCS
Potassium	14.	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1925	ZCS
Sodium	72.	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1925	ZCS
Strontium	3.6	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1925	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Reported: 05/17/11 16:43 Revised: 05/20/11 15:35

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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-07

Site ID :

Project # : JSF-W31

Date Received : 04/22/11 09:15
Description : JSF

Sample ID : JSF-W31-DUP-0411 5 FT

Collected By : William Nichols
Collection Date : 04/20/11 12:10

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	10.	1.0	mg/l	9056	04/23/11 1146	477	04/23/11 2001	RBS
Fluoride	0.30	0.10	mg/l	9056	04/23/11 1146	477	04/23/11 2001	RBS
Sulfate	1200	250	mg/l	9056	04/25/11 0901	477	04/25/11 1356	LLS
Cyanide	BDL	0.0050	mg/l	9012B	04/28/11 1621	524	04/29/11 1141	CWP
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	04/29/11 2048	183	05/02/11 1036	CBD
Nitrate-Nitrite	0.42	0.10	mg/l	353.2	04/27/11 0835	479	04/27/11 1450	RBS
Sulfide	BDL	0.050	mg/l	4500-S2 D	04/26/11 1922	159	04/26/11 1923	MCH
Kjeldahl Nitrogen, TKN	BDL	0.10	mg/l	351.2	04/29/11 1011	518	04/30/11 0048	MCH
Total Inorganic Carbon	63.	1.0	mg/l	9060A	04/26/11 1619	239	04/26/11 1955	CSU
Dissolved Solids	2000	10.	mg/l	2540C	04/23/11 1507	503	04/27/11 1411	PED
Suspended Solids	12.	1.0	mg/l	2540D	04/23/11 1202	503	04/23/11 1203	PED
Antimony	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Arsenic	0.0028	0.0010	mg/l	6020	05/16/11 0849	119	05/20/11 1251	LAT
Beryllium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Cadmium	0.0032	0.00050	mg/l	6020	05/16/11 0849	119	05/20/11 1251	LAT
Chromium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Copper	0.0021	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Cobalt	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Lead	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Nickel	0.017	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Selenium	BDL	0.0010	mg/l	6020	05/16/11 0849	119	05/20/11 1251	LAT
Silver	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Thallium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Tin	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Vanadium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Zinc	BDL	0.010	mg/l	6020	04/25/11 0906	119	04/26/11 1447	LAT
Mercury	BDL	0.00020	mg/l	7470A	04/22/11 1958	416	04/25/11 1138	MDC
Aluminum	0.55	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1929	ZCS
Barium	0.024	0.0050	mg/l	6010B	04/25/11 1008	529	04/25/11 1929	ZCS
Boron	11.	0.20	mg/l	6010B	04/25/11 1008	529	04/25/11 1929	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-07

Date Received : 04/22/11 09:15
Description : JSF

Site ID :

Sample ID : JSF-W31-DUP-0411 5 FT

Project # : JSF-W31

Collected By : William Nichols
Collection Date : 04/20/11 12:10

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	360	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1929	ZCS
Iron	0.36	0.10	mg/l	6010B	04/26/11 1547	529	04/27/11 1143	ARF
Magnesium	78.	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1929	ZCS
Manganese	BDL	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1929	ZCS
Potassium	15.	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1929	ZCS
Sodium	72.	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1929	ZCS
Strontium	3.6	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1929	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Reported: 05/17/11 16:43 Revised: 05/20/11 15:35

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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # :   L512564-08

Date Received   :   04/22/11 09:15
Description   :   JSF

Site ID :

Sample ID   :   JSF-W32-0411 6 FT

Project # :   JSF-W32

Collected By   :   William Nichols
Collection Date :   04/18/11 12:20

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	11.	1.0	mg/l	9056	04/23/11 1146	477	04/23/11 2017	RBS
Fluoride	BDL	0.10	mg/l	9056	04/23/11 1146	477	04/23/11 2017	RBS
Sulfate	50.	5.0	mg/l	9056	04/23/11 1146	477	04/23/11 2017	RBS
Cyanide	BDL	0.0050	mg/l	9012B	04/29/11 1253	524	05/02/11 1638	CBD
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	04/29/11 2048	183	05/02/11 1038	CBD
Nitrate-Nitrite	0.80	0.10	mg/l	353.2	04/27/11 0835	479	04/27/11 1451	RBS
Sulfide	BDL	0.050	mg/l	4500-S2 D	04/26/11 1922	159	04/26/11 1923	MCH
Kjeldahl Nitrogen, TKN	BDL	0.10	mg/l	351.2	04/29/11 1011	518	04/30/11 0050	MCH
Total Inorganic Carbon	65.	1.0	mg/l	9060A	04/26/11 1619	239	04/26/11 2010	CSU
Dissolved Solids	420	10.	mg/l	2540C	04/23/11 1507	503	04/27/11 1412	PED
Suspended Solids	3.8	1.0	mg/l	2540D	04/23/11 1202	503	04/23/11 1203	PED
Antimony	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Arsenic	BDL	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1744	LAT
Beryllium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Cadmium	BDL	0.00050	mg/l	6020	05/16/11 0849	119	05/19/11 1744	LAT
Chromium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Copper	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Cobalt	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Lead	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Nickel	0.0054	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Selenium	BDL	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1744	LAT
Silver	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Thallium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Tin	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Vanadium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Zinc	BDL	0.010	mg/l	6020	04/25/11 0906	119	04/26/11 1450	LAT
Mercury	BDL	0.00020	mg/l	7470A	04/27/11 1020	448	04/27/11 1537	WC
Aluminum	0.26	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1932	ZCS
Barium	0.064	0.0050	mg/l	6010B	04/25/11 1008	529	04/25/11 1932	ZCS
Boron	0.24	0.20	mg/l	6010B	04/25/11 1008	529	04/25/11 1932	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # :   L512564-08

Date Received   :   04/22/11 09:15
Description   :   JSF

Site ID :

Sample ID   :   JSF-W32-0411 6 FT

Project # :   JSF-W32

Collected By   :   William Nichols
Collection Date :   04/18/11 12:20

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	130	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1932	ZCS
Iron	0.15	0.10	mg/l	6010B	04/26/11 1547	529	04/27/11 1146	ARF
Magnesium	5.8	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1932	ZCS
Manganese	BDL	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1932	ZCS
Potassium	1.6	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1932	ZCS
Sodium	7.1	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1932	ZCS
Strontium	0.28	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1932	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Reported: 05/17/11 16:43 Revised: 05/20/11 15:35

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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-09

Date Received : 04/22/11 09:15
Description : JSF

Site ID :

Sample ID : JSF-DFS-EQ-0411

Project # : JSF-DFS-EQ

Collected By : William Nichols
Collection Date : 04/20/11 11:15

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	BDL	1.0	mg/l	9056	04/23/11 1146	477	04/23/11 2033	RBS
Fluoride	BDL	0.10	mg/l	9056	04/23/11 1146	477	04/23/11 2033	RBS
Sulfate	BDL	5.0	mg/l	9056	04/23/11 1146	477	04/23/11 2033	RBS
Cyanide	BDL	0.0050	mg/l	9012B	04/29/11 1253	524	05/02/11 1640	CBD
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	04/29/11 2048	183	05/02/11 1039	CBD
Nitrate-Nitrite	BDL	0.10	mg/l	353.2	04/27/11 0835	479	04/27/11 1452	RBS
Sulfide	BDL	0.050	mg/l	4500-S2 D	04/25/11 1337	183	04/25/11 1415	MCG
Kjeldahl Nitrogen, TKN	BDL	0.10	mg/l	351.2	04/29/11 1011	518	04/30/11 0052	MCH
Total Inorganic Carbon	BDL	1.0	mg/l	9060A	04/26/11 1619	239	04/26/11 2024	CSU
Dissolved Solids	BDL	10.	mg/l	2540C	04/23/11 1507	503	04/27/11 1412	PED
Suspended Solids	BDL	1.0	mg/l	2540D	04/23/11 1202	503	04/23/11 1203	PED
Antimony	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Arsenic	BDL	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1337	LAT
Beryllium	BDL	0.0010	mg/l	6020	05/16/11 0849	119	05/16/11 1757	LAT
Cadmium	BDL	0.00050	mg/l	6020	05/16/11 0849	119	05/19/11 1337	LAT
Chromium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Copper	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Cobalt	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Lead	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Nickel	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Selenium	BDL	0.0010	mg/l	6020	05/16/11 0849	119	05/19/11 1337	LAT
Silver	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Thallium	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Tin	BDL	0.0010	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Vanadium	BDL	0.0020	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Zinc	BDL	0.010	mg/l	6020	04/25/11 0906	119	04/26/11 1454	LAT
Mercury	BDL	0.00020	mg/l	7470A	04/27/11 1020	448	04/27/11 1540	WC
Aluminum	BDL	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1936	ZCS
Barium	BDL	0.0050	mg/l	6010B	04/25/11 1008	529	04/25/11 1936	ZCS
Boron	BDL	0.20	mg/l	6010B	04/25/11 1008	529	04/25/11 1936	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
The reported analytical results relate only to the sample submitted

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Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

May 20,2011

ESC Sample # : L512564-09

Date Received : 04/22/11 09:15
Description : JSF

Site ID :

Sample ID : JSF-DFS-EQ-0411

Project # : JSF-DFS-EQ

Collected By : William Nichols
Collection Date : 04/20/11 11:15

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	BDL	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1936	ZCS
Iron	BDL	0.10	mg/l	6010B	04/26/11 1547	529	04/27/11 1150	ARF
Magnesium	BDL	0.10	mg/l	6010B	04/25/11 1008	529	04/25/11 1936	ZCS
Manganese	BDL	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1936	ZCS
Potassium	BDL	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1936	ZCS
Sodium	BDL	0.50	mg/l	6010B	04/25/11 1008	529	04/25/11 1936	ZCS
Strontium	BDL	0.010	mg/l	6010B	04/25/11 1008	529	04/25/11 1936	ZCS

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
The reported analytical results relate only to the sample submitted

Reported: 05/17/11 16:43 Revised: 05/20/11 15:35

Attachment A
List of Analytes with QC Qualifiers

Sample Number	Work Group	Sample Type	Analyte	Run ID	Qualifier
L512564-07	WG532351	SAMP	Suspended Solids	R1664529	J3

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
J3	The associated batch QC was outside the established quality control range for precision.

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC.
Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods,it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable "unless qualified as 'R' (Rejected)."

Definitions

Accuracy - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.

Precision - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Differrence.

Surrogate - Organic compounds that are similar in chemical composition, extraction, and chromotography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

TIC - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Summary of Remarks For Samples Printed
05/20/11 at 15:35:23

TSR Signing Reports: 400
RX - Priority Rush

PO 143505 replace 5/6/11. RC

Sample: L512564-01 Account: TVAENVAFF Received: 04/22/11 09:15 Due Date: 05/18/11 00:00 RPT Date: 05/17/11 16:43
UNI 584666 dor 5/12/11, 5/17/11
Sample: L512564-02 Account: TVAENVAFF Received: 04/22/11 09:15 Due Date: 05/18/11 00:00 RPT Date: 05/17/11 16:43

Sample: L512564-03 Account: TVAENVAFF Received: 04/22/11 09:15 Due Date: 05/18/11 00:00 RPT Date: 05/17/11 16:43

Sample: L512564-04 Account: TVAENVAFF Received: 04/22/11 09:15 Due Date: 05/18/11 00:00 RPT Date: 05/17/11 16:43

Sample: L512564-05 Account: TVAENVAFF Received: 04/22/11 09:15 Due Date: 05/18/11 00:00 RPT Date: 05/17/11 16:43

Sample: L512564-06 Account: TVAENVAFF Received: 04/22/11 09:15 Due Date: 05/18/11 00:00 RPT Date: 05/17/11 16:43

Sample: L512564-07 Account: TVAENVAFF Received: 04/22/11 09:15 Due Date: 05/18/11 00:00 RPT Date: 05/17/11 16:43

Sample: L512564-08 Account: TVAENVAFF Received: 04/22/11 09:15 Due Date: 05/18/11 00:00 RPT Date: 05/17/11 16:43

Sample: L512564-09 Account: TVAENVAFF Received: 04/22/11 09:15 Due Date: 05/18/11 00:00 RPT Date: 05/17/11 16:43

APPENDIX D

WELL 1 BACKGROUND DATA (2000-2011) AND STATISTICAL ANALYSIS OUTPUT

Well 1 Background Data (2000-2011)

Parameter Name	Measurement Unit	01/06/2000	04/05/2000	07/06/2000	01/22/2001	07/17/2001	01/16/2002	07/24/2002	01/28/2003	06/30/2003	10/16/2003	01/06/2004
Alkalinity, total (field)	mg/L CaCO3	212	210	222	207.5	215	212.5	211	210	220	205	210
Aluminum, total	ug/L	80	< 50	< 50	82	< 50	54	< 50	150	< 50	80	< 50
Antimony, total	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 6	< 0.1	< 0.6
Arsenic, total	ug/L	< 1	< 1	< 1	< 1	1.8	< 1	< 1	< 1	3	< 0.1	< 0.1
Barium, total	ug/L	210	200	230	240	< 10	220	230	230	250	238	200
Beryllium, total	ug/L	< 1	< 1	< 1	< 1	2.7	< 1	< 1	< 1	< 1	< 1	< 1
Boron, total	ug/L	< 200	< 200	< 200	< 200	< 200	250	< 200	< 200	< 200	< 200	< 200
Cadmium, total	ug/L	< 0.1	< 0.1	< 0.1	< 0.1	0.4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.05	< 0.05
Chloride, total	mg/L	14	11	13	12	11	11	11	10	9.5	10	11
Chromium, total	ug/L	1.1	< 1	< 1	< 1	2	< 1	< 1	< 1	< 1	< 0.1	< 0.1
Cobalt, total	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	0.8	0.5
Copper, total	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Cyanide, total	mg/L											
Fluoride, total	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.12	0.11	0.1
Iron, total	ug/L	1200	2200	4500	2200	< 10	2600	3200	1800	5200	4000	550
Lead, total	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	0.4	< 0.1
Manganese, total	ug/L	26	18	33	28	< 5	39	30	22	36	27	18
Mercury, total	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Nickel, total	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1.5	1.4
Nitrite + Nitrate	mg/L											
Nitrogen, Ammonia	mg/L											
Oxidation reduction potential	mV	360	288	345	381	254	425	355	386	371	328	373
pH (field)	pH	7.1	7	6.9	7.2	7.2	7.1	7	7	7	7.2	6.9
Potassium, total	mg/L	0.63	0.69	0.49	0.53	0.43	0.41	0.4	0.63	0.45	0.5	0.9
Selenium, total	ug/L	< 1	< 1	< 1	< 1	1.9	< 1	< 1	< 1	< 1	< 0.2	< 0.2
Silver, total	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	< 10
Sodium, total	mg/L	5.4	5.2	5.8	5.3	5	3.8	3.9	6.2	6	5.4	6.8
Specific conductance @ 25C (field)	umhos/cm	495	499	488	481	473	484	476	490	480	405	485
Strontium, total	ug/L	670	600	700	850	< 50	800	760	760	800	742	710
Sulfate, total	mg/L	25	26	26	25	27	26	25	29	30	30	27
Sulfide, total	mg/L											
Temperature, Celsius	degrees C	14.5	15.3	15.7	15.2	15.9	15.1	15.2	15	15.2	15.4	15.2
Thallium, total	ug/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 0.1	< 0.1
Tin, total	ug/L	< 50	< 50	< 50	< 50	< 50	< 50	< 50	490			< 50
Vanadium, total	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Zinc, total	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	10	< 10	< 10	< 10	< 10

Well 1 Background Data (2000-2011) - Continued

Parameter Name	Measurement Unit	04/05/2004	07/06/2004	10/18/2004	01/03/2005	07/05/2005	07/13/2005	09/14/2005	01/18/2006	04/24/2006	07/24/2006	10/02/2006
Alkalinity, total (field)	mg/L CaCO3	212	211	207.5	210	213.5		186	213.5	211	212.5	213
Aluminum, total	ug/L	50	< 50	80	< 50	< 50		< 50	< 200	< 200	< 200	< 200
Antimony, total	ug/L	< 0.6	< 3	< 3	< 3	< 3		< 3	< 3	< 3	< 3	< 3
Arsenic, total	ug/L	< 0.1	< 1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	< 1
Barium, total	ug/L	220	220	260	210	220		240	230	220	230	230
Beryllium, total	ug/L	< 1	< 1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	< 1
Boron, total	ug/L	< 200	< 200	< 200	< 200	< 200		< 200	< 200	< 200	< 200	< 200
Cadmium, total	ug/L	< 0.05	< 0.1	< 0.1	< 0.1	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chloride, total	mg/L	12	11	11	11	11		12	11	10	9.9	10
Chromium, total	ug/L	< 0.1	< 1	< 1	< 1	< 1		1	< 1	< 1	< 1	< 1
Cobalt, total	ug/L	0.8	< 1	< 1	1	1		1	< 1	< 1	< 1	< 1
Copper, total	ug/L	< 10	< 10	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10
Cyanide, total	mg/L						< 0.005	< 0.005				
Fluoride, total	mg/L	< 0.1	< 0.1	0.11	< 0.1	0.1		< 0.1	0.11	0.1	0.11	< 0.1
Iron, total	ug/L	730	1600	4000	2100	2000		1900	1200	1000	2800	1700
Lead, total	ug/L	< 0.1	1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	< 1
Manganese, total	ug/L	24	21	30	24	21		26	34	19	28	28
Mercury, total	ug/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Nickel, total	ug/L	2.2	< 1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	< 1
Nitrite + Nitrate	mg/L			0.18	0.26			0.24	0.12	0.21	0.19	0.1
Nitrogen, Ammonia	mg/L			0.01	0.01			0.01	< 0.01	0.01	< 0.01	0.03
Oxidation reduction potential	mV	340	341	226	355	240	263	310	372	304	303	241
pH (field)	pH	7.1	7.2	7.3	6.9	7	6.9	7.2	7.2	7.2	7.2	7.2
Potassium, total	mg/L	0.6	1.1	1.2	0.7	1.4		1.7	0.6	0.6	0.5	1.4
Selenium, total	ug/L	< 0.2	< 1	< 1	1	< 1		< 1	< 1	< 1	< 1	< 1
Silver, total	ug/L	< 10	< 10	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10
Sodium, total	mg/L	5.8	4.7	5.6	7.9	6.6		4.8	7.7	6	7.4	5.5
Specific conductance @ 25C (field)	umhos/cm	483	487	456	443	409	480	483	489	479	470	480
Strontium, total	ug/L	710	700	790	710	680		730	730	690	710	740
Sulfate, total	mg/L	28	31	31	25	26		26	29	27	24	25
Sulfide, total	mg/L						< 0.02				0	
Temperature, Celsius	degrees C	15.4	15.5	15.3	15.5	15.5	15.4	15.7	15.5	15.5	15.3	15.4
Thallium, total	ug/L	< 0.1	< 2	< 2	< 2	< 2		< 2	< 2	< 2	< 2	< 2
Tin, total	ug/L			< 50		< 50						
Vanadium, total	ug/L	< 10	< 10	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10
Zinc, total	ug/L	< 10	< 10	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10

Well 1 Background Data (2000-2011) – Continued

param_name	04/20/2011	04/20/2011
Alkalinity, total (field)	218	218
Aluminum, total	< 100	< 100
Antimony, total	< 1	< 1
Arsenic, total	< 1	< 1
Barium, total	220	220
Beryllium, total	< 1	< 1
Boron, total	< 200	< 200
Cadmium, total	< 0.5	< 0.5
Chloride, total	9.5	9.5
Chromium, total	< 2	< 2
Cobalt, total	< 1	< 1
Copper, total	< 2	< 2
Cyanide, total	< 0.005	< 0.005
Fluoride, total	< 0.1	< 0.1
Iron, total	260	260
Lead, total	< 1	< 1
Manganese, total	25	25
Mercury, total	< 0.2	< 0.2
Nickel, total	3.3	3.3
Nitrite + Nitrate	0.22	0.22
Nitrogen, Ammonia	< 0.1	< 0.1
Oxidation reduction potential	207	207
pH (field)	6.7	6.7
Potassium, total	0.5	0.5
Selenium, total	< 1	< 1
Silver, total	< 1	< 1
Sodium, total	5.7	5.7
Specific conductance @ 25C (field)	485	485
Strontium, total	710	710
Sulfate, total	26	26
Sulfide, total	< 0.05	< 0.05
Temperature, Celsius	16	16
Thallium, total	< 1	< 1
Tin, total	< 1	< 1
Vanadium, total	< 2	< 2
Zinc, total	11	11

Statistical Analysis Procedure

Background Date Range: 01/06/2000 to 04/20/2011
Background Locations: JSF-1

Number of Future Observations: 180.00

Compliance Date Range: 04/18/2011 to 04/20/2011
Compliance Locations: JSF-W28,JSF-W29,JSF-W30,JSF-W31,JSF-W32

Comparison Method if all Background Results are Non-Detect:	STmdl = Last MDL
Statistical Test for Parametric Background Data Distributions:	STpar = Parametric Prediction Interval on Background
Statistical Test for Cases with High Percentage of Non-Detect Background Data:	STlow1 = Non-Parametric Prediction Interval on Background (ND Frequency > 55%)
Statistical Test for Cases with High Percentage of Non-Detect Background Data:	STlow2 = Poisson Prediction Interval on Background (ND Frequency > 90%)
Statistical Test for Non-Parametric Background Data Distributions:	STnon = Non-Parametric Prediction Interval on Background
Background Comparison:	Interwell
Number of Verification Samples:	0
Default Type 1 Individual Comparison Error Level (False Positive Rate) for tests other than Prediction Interval	0.01
Type 1 Individual Comparison Error Level (False Positive Rate) for Prediction Interval	Calculate based on number of locations, parameters, and number of verification resamples, assumes site-wide Error Level of 0.05, using the approach of ASTM (1998).
Non-Detect Processing (Parametric Tests):	<=55% using MDL * 1.0 >55% using MDL * 1.0
Non-Detect Processing (All Other):	<=55% using MDL * 1.0 >55% using MDL * 1.0

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W28	Alkalinity, total (field), mg/L CaCO3	04/19/2011	30	0.00	No/No	STnon	85.71	222.000		239.000	Yes	
JSF-W28	Aluminum, total, ug/L	04/20/2011	30	73.33	No/No	STnon	85.71	200.000		690.000	Yes	
JSF-W28	Antimony, total, ug/L	04/20/2011	30	96.67	No/No	STnon	85.71	6.000		<1.000	No	
JSF-W28	Arsenic, total, ug/L	04/20/2011	30	93.33	No/No	STnon	85.71	2.500		<1.000	No	
JSF-W28	Barium, total, ug/L	04/20/2011	30	3.33	No/No	STnon	85.71	255.000		20.000	No	
JSF-W28	Beryllium, total, ug/L	04/20/2011	30	96.67	No/No	STnon	85.71	2.700		<1.000	No	
JSF-W28	Boron, total, ug/L	04/20/2011	30	96.67	No/No	STnon	85.71	225.000		2,700.000	Yes	
JSF-W28	Cadmium, total, ug/L	04/20/2011	30	96.67	No/No	STnon	85.71	0.500		<0.500	No	
JSF-W28	Chloride, total, mg/L	04/20/2011	30	0.00	Yes/Yes	STpar	99.97	15.364		14.000	No	
JSF-W28	Chromium, total, ug/L	04/20/2011	30	83.33	No/No	STnon	85.71	4.000		<2.000	No	
JSF-W28	Cobalt, total, ug/L	04/20/2011	30	80.00	No/No	STnon	85.71	2.000		4.500	Yes	
JSF-W28	Copper, total, ug/L	04/20/2011	30	96.67	No/No	STnon	85.71	10.000		2.100	No	
JSF-W28	Cyanide, total, mg/L	04/20/2011	10	100.00	No/No	STmdl	N/A	0.005		<0.005	No	
JSF-W28	Fluoride, total, mg/L	04/20/2011	30	70.00	No/No	STnon	85.71	0.230		<0.100	No	
JSF-W28	Iron, total, ug/L	04/20/2011	30	3.33	No/No	STnon	85.71	5,400.000		1,200.000	No	
JSF-W28	Lead, total, ug/L	04/20/2011	30	93.33	No/No	STnon	85.71	1.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W28	Manganese, total, ug/L	04/20/2011	30	3.33	Yes/No	STpar	99.97	53.074		3,600.000	Yes	
JSF-W28	Mercury, total, ug/L	04/20/2011	30	100.00	No/No	STmdl	N/A	0.200		<0.200	No	
JSF-W28	Nickel, total, ug/L	04/20/2011	30	63.33	No/No	STnon	85.71	3.300		21.000	Yes	
JSF-W28	Nitrite + Nitrate, mg/L	04/20/2011	16	12.50	Yes/Yes	STpar	99.97	0.401		0.190	No	
JSF-W28	Nitrogen, Ammonia, mg/L	04/20/2011	16	62.50	No/No	STnon	76.19	0.140		<0.100	No	
JSF-W28	ORP, mV	04/19/2011	31	0.00	Yes/No	STpar	99.97	599.564		368.000	No	
JSF-W28	pH (field), pH	04/19/2011	31	0.00	No/No	STnon	86.11	7.300	6.700	5.900	Yes	
JSF-W28	Potassium, total, mg/L	04/20/2011	30	10.00	No/No	STnon	85.71	1.700		1.300	No	
JSF-W28	Selenium, total, ug/L	04/20/2011	30	86.67	No/No	STnon	85.71	1.900		2.100	Yes	
JSF-W28	Silver, total, ug/L	04/20/2011	29	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W28	Sodium, total, mg/L	04/20/2011	30	0.00	Yes/Yes	STpar	99.97	9.800		21.000	Yes	
JSF-W28	Specific Cond. (Field), umhos/cm	04/19/2011	31	0.00	No/No	STnon	86.11	499.000		1,806.000	Yes	
JSF-W28	Strontium, total, ug/L	04/20/2011	30	3.33	No/No	STnon	85.71	840.000		950.000	Yes	
JSF-W28	Sulfate, total, mg/L	04/20/2011	30	0.00	No/No	STnon	85.71	31.500		880.000	Yes	
JSF-W28	Sulfide, total, mg/L	04/20/2011	10	100.00	No/No	STmdl	N/A	0.050		<0.050	No	
JSF-W28	Temperature, Celsius, degrees C	04/19/2011	31	0.00	No/No	STnon	86.11	16.300		15.100	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W28	Thallium, total, ug/L	04/20/2011	30	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W28	Tin, total, ug/L	04/20/2011	19	94.74	No/No	STnon	79.17	490.000		<1.000	No	
JSF-W28	Vanadium, total, ug/L	04/20/2011	30	100.00	No/No	STmdl	N/A	2.000		<2.000	No	
JSF-W28	Zinc, total, ug/L	04/20/2011	30	76.67	No/No	STnon	85.71	95.500		<10.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W29	Alkalinity, total (field), mg/L CaCO3	04/18/2011	30	0.00	No/No	STnon	85.71	222.000		303.000	Yes	
JSF-W29	Aluminum, total, ug/L	04/18/2011	30	73.33	No/No	STnon	85.71	200.000		110.000	No	
JSF-W29	Antimony, total, ug/L	04/18/2011	30	96.67	No/No	STnon	85.71	6.000		<1.000	No	
JSF-W29	Arsenic, total, ug/L	04/18/2011	30	93.33	No/No	STnon	85.71	2.500		<1.000	No	
JSF-W29	Barium, total, ug/L	04/18/2011	30	3.33	No/No	STnon	85.71	255.000		30.000	No	
JSF-W29	Beryllium, total, ug/L	04/18/2011	30	96.67	No/No	STnon	85.71	2.700		<1.000	No	
JSF-W29	Boron, total, ug/L	04/18/2011	30	96.67	No/No	STnon	85.71	225.000		900.000	Yes	
JSF-W29	Cadmium, total, ug/L	04/18/2011	30	96.67	No/No	STnon	85.71	0.500		<0.500	No	
JSF-W29	Chloride, total, mg/L	04/18/2011	30	0.00	Yes/Yes	STpar	99.97	15.364		4.800	No	
JSF-W29	Chromium, total, ug/L	04/18/2011	30	83.33	No/No	STnon	85.71	4.000		<2.000	No	
JSF-W29	Cobalt, total, ug/L	04/18/2011	30	80.00	No/No	STnon	85.71	2.000		<1.000	No	
JSF-W29	Copper, total, ug/L	04/18/2011	30	96.67	No/No	STnon	85.71	10.000		<2.000	No	
JSF-W29	Cyanide, total, mg/L	04/18/2011	10	100.00	No/No	STmdl	N/A	0.005		<0.005	No	
JSF-W29	Fluoride, total, mg/L	04/18/2011	30	70.00	No/No	STnon	85.71	0.230		0.100	No	
JSF-W29	Iron, total, ug/L	04/18/2011	30	3.33	No/No	STnon	85.71	5,400.000		<100.000	No	
JSF-W29	Lead, total, ug/L	04/18/2011	30	93.33	No/No	STnon	85.71	1.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W29	Manganese, total, ug/L	04/18/2011	30	3.33	Yes/No	STpar	99.97	53.074		1,200.000	Yes	
JSF-W29	Mercury, total, ug/L	04/18/2011	30	100.00	No/No	STmdl	N/A	0.200		<0.200	No	
JSF-W29	Nickel, total, ug/L	04/18/2011	30	63.33	No/No	STnon	85.71	3.300		6.300	Yes	
JSF-W29	Nitrite + Nitrate, mg/L	04/18/2011	16	12.50	Yes/Yes	STpar	99.97	0.401		3.200	Yes	
JSF-W29	Nitrogen, Ammonia, mg/L	04/18/2011	16	62.50	No/No	STnon	76.19	0.140		<0.100	No	
JSF-W29	ORP, mV	04/18/2011	31	0.00	Yes/No	STpar	99.97	599.564		441.000	No	
JSF-W29	pH (field), pH	04/18/2011	31	0.00	No/No	STnon	86.11	7.300	6.700	5.900	Yes	
JSF-W29	Potassium, total, mg/L	04/18/2011	30	10.00	No/No	STnon	85.71	1.700		1.400	No	
JSF-W29	Selenium, total, ug/L	04/18/2011	30	86.67	No/No	STnon	85.71	1.900		4.000	Yes	
JSF-W29	Silver, total, ug/L	04/18/2011	29	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W29	Sodium, total, mg/L	04/18/2011	30	0.00	Yes/Yes	STpar	99.97	9.800		9.200	No	
JSF-W29	Specific Cond. (Field), umhos/cm	04/18/2011	31	0.00	No/No	STnon	86.11	499.000		893.000	Yes	
JSF-W29	Strontium, total, ug/L	04/18/2011	30	3.33	No/No	STnon	85.71	840.000		960.000	Yes	
JSF-W29	Sulfate, total, mg/L	04/18/2011	30	0.00	No/No	STnon	85.71	31.500		170.000	Yes	
JSF-W29	Sulfide, total, mg/L	04/18/2011	10	100.00	No/No	STmdl	N/A	0.050		<0.050	No	
JSF-W29	Temperature, Celsius, degrees C	04/18/2011	31	0.00	No/No	STnon	86.11	16.300		14.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W29	Thallium, total, ug/L	04/18/2011	30	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W29	Tin, total, ug/L	04/18/2011	19	94.74	No/No	STnon	79.17	490.000		<1.000	No	
JSF-W29	Vanadium, total, ug/L	04/18/2011	30	100.00	No/No	STmdl	N/A	2.000		<2.000	No	
JSF-W29	Zinc, total, ug/L	04/18/2011	30	76.67	No/No	STnon	85.71	95.500		<10.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W30	Alkalinity, total (field), mg/L CaCO3	04/19/2011	30	0.00	No/No	STnon	85.71	222.000		314.000	Yes	
JSF-W30	Aluminum, total, ug/L	04/19/2011	30	73.33	No/No	STnon	85.71	200.000		<100.000	No	
JSF-W30	Antimony, total, ug/L	04/19/2011	30	96.67	No/No	STnon	85.71	6.000		<1.000	No	
JSF-W30	Arsenic, total, ug/L	04/19/2011	30	93.33	No/No	STnon	85.71	2.500		<1.000	No	
JSF-W30	Barium, total, ug/L	04/19/2011	30	3.33	No/No	STnon	85.71	255.000		19.000	No	
JSF-W30	Beryllium, total, ug/L	04/19/2011	30	96.67	No/No	STnon	85.71	2.700		<1.000	No	
JSF-W30	Boron, total, ug/L	04/19/2011	30	96.67	No/No	STnon	85.71	225.000		4,800.000	Yes	
JSF-W30	Cadmium, total, ug/L	04/19/2011	30	96.67	No/No	STnon	85.71	0.500		<0.500	No	
JSF-W30	Chloride, total, mg/L	04/19/2011	30	0.00	Yes/Yes	STpar	99.97	15.364		17.000	Yes	
JSF-W30	Chromium, total, ug/L	04/19/2011	30	83.33	No/No	STnon	85.71	4.000		<2.000	No	
JSF-W30	Cobalt, total, ug/L	04/19/2011	30	80.00	No/No	STnon	85.71	2.000		1.200	No	
JSF-W30	Copper, total, ug/L	04/19/2011	30	96.67	No/No	STnon	85.71	10.000		<2.000	No	
JSF-W30	Cyanide, total, mg/L	04/19/2011	10	100.00	No/No	STmdl	N/A	0.005		<0.005	No	
JSF-W30	Fluoride, total, mg/L	04/19/2011	30	70.00	No/No	STnon	85.71	0.230		0.340	Yes	
JSF-W30	Iron, total, ug/L	04/19/2011	30	3.33	No/No	STnon	85.71	5,400.000		<100.000	No	
JSF-W30	Lead, total, ug/L	04/19/2011	30	93.33	No/No	STnon	85.71	1.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W30	Manganese, total, ug/L	04/19/2011	30	3.33	Yes/No	STpar	99.97	53.074		1,200.000	Yes	
JSF-W30	Mercury, total, ug/L	04/19/2011	30	100.00	No/No	STmdl	N/A	0.200		<0.200	No	
JSF-W30	Nickel, total, ug/L	04/19/2011	30	63.33	No/No	STnon	85.71	3.300		33.000	Yes	
JSF-W30	Nitrite + Nitrate, mg/L	04/19/2011	16	12.50	Yes/Yes	STpar	99.97	0.401		<0.100	No	
JSF-W30	Nitrogen, Ammonia, mg/L	04/19/2011	16	62.50	No/No	STnon	76.19	0.140		<0.100	No	
JSF-W30	ORP, mV	04/19/2011	31	0.00	Yes/No	STpar	99.97	599.564		224.000	No	
JSF-W30	pH (field), pH	04/19/2011	31	0.00	No/No	STnon	86.11	7.300	6.700	6.200	Yes	
JSF-W30	Potassium, total, mg/L	04/19/2011	30	10.00	No/No	STnon	85.71	1.700		1.000	No	
JSF-W30	Selenium, total, ug/L	04/19/2011	30	86.67	No/No	STnon	85.71	1.900		2.100	Yes	
JSF-W30	Silver, total, ug/L	04/19/2011	29	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W30	Sodium, total, mg/L	04/19/2011	30	0.00	Yes/Yes	STpar	99.97	9.800		39.000	Yes	
JSF-W30	Specific Cond. (Field), umhos/cm	04/19/2011	31	0.00	No/No	STnon	86.11	499.000		2,024.000	Yes	
JSF-W30	Strontium, total, ug/L	04/19/2011	30	3.33	No/No	STnon	85.71	840.000		3,200.000	Yes	
JSF-W30	Sulfate, total, mg/L	04/19/2011	30	0.00	No/No	STnon	85.71	31.500		960.000	Yes	
JSF-W30	Sulfide, total, mg/L	04/19/2011	10	100.00	No/No	STmdl	N/A	0.050		<0.050	No	
JSF-W30	Temperature, Celsius, degrees C	04/19/2011	31	0.00	No/No	STnon	86.11	16.300		14.400	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W30	Thallium, total, ug/L	04/19/2011	30	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W30	Tin, total, ug/L	04/19/2011	19	94.74	No/No	STnon	79.17	490.000		<1.000	No	
JSF-W30	Vanadium, total, ug/L	04/19/2011	30	100.00	No/No	STmdl	N/A	2.000		<2.000	No	
JSF-W30	Zinc, total, ug/L	04/19/2011	30	76.67	No/No	STnon	85.71	95.500		<10.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W31	Alkalinity, total (field), mg/L CaCO3	04/20/2011	30	0.00	No/No	STnon	85.71	222.000		304.500	Yes	
JSF-W31	Aluminum, total, ug/L	04/20/2011	30	73.33	No/No	STnon	85.71	200.000		460.000	Yes	
		04/20/2011	30	73.33	No/No		85.71	200.000		550.000	Yes	
JSF-W31	Antimony, total, ug/L	04/20/2011	30	96.67	No/No	STnon	85.71	6.000		<1.000	No	
		04/20/2011	30	96.67	No/No		85.71	6.000		<1.000	No	
JSF-W31	Arsenic, total, ug/L	04/20/2011	30	93.33	No/No	STnon	85.71	2.500		<1.000	No	
		04/20/2011	30	93.33	No/No		85.71	2.500		<1.000	No	
JSF-W31	Barium, total, ug/L	04/20/2011	30	3.33	No/No	STnon	85.71	255.000		23.000	No	
		04/20/2011	30	3.33	No/No		85.71	255.000		24.000	No	
JSF-W31	Beryllium, total, ug/L	04/20/2011	30	96.67	No/No	STnon	85.71	2.700		<1.000	No	
		04/20/2011	30	96.67	No/No		85.71	2.700		<1.000	No	
JSF-W31	Boron, total, ug/L	04/20/2011	30	96.67	No/No	STnon	85.71	225.000		11,000.000	Yes	
		04/20/2011	30	96.67	No/No		85.71	225.000		11,000.000	Yes	
JSF-W31	Cadmium, total, ug/L	04/20/2011	30	96.67	No/No	STnon	85.71	0.500		7.800	Yes	
		04/20/2011	30	96.67	No/No		85.71	0.500		8.400	Yes	
JSF-W31	Chloride, total, mg/L	04/20/2011	30	0.00	Yes/Yes	STpar	99.97	15.364		10.000	No	
		04/20/2011	30	0.00	Yes/Yes		99.97	15.364		10.000	No	
JSF-W31	Chromium, total, ug/L	04/20/2011	30	83.33	No/No	STnon	85.71	4.000		<2.000	No	
		04/20/2011	30	83.33	No/No		85.71	4.000		<2.000	No	
JSF-W31	Cobalt, total, ug/L	04/20/2011	30	80.00	No/No	STnon	85.71	2.000		<1.000	No	
		04/20/2011	30	80.00	No/No		85.71	2.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W31	Copper, total, ug/L	04/20/2011	30	96.67	No/No	STnon	85.71	10.000		2.000	No	
		04/20/2011	30	96.67	No/No		85.71	10.000		2.100	No	
JSF-W31	Cyanide, total, mg/L	04/20/2011	10	100.00	No/No	STmdl	N/A	0.005		<0.005	No	
		04/20/2011	10	100.00	No/No		N/A	0.005		<0.005	No	
JSF-W31	Fluoride, total, mg/L	04/20/2011	30	70.00	No/No	STnon	85.71	0.230		0.300	Yes	
		04/20/2011	30	70.00	No/No		85.71	0.230		0.300	Yes	
JSF-W31	Iron, total, ug/L	04/20/2011	30	3.33	No/No	STnon	85.71	5,400.000		390.000	No	
		04/20/2011	30	3.33	No/No		85.71	5,400.000		360.000	No	
JSF-W31	Lead, total, ug/L	04/20/2011	30	93.33	No/No	STnon	85.71	1.000		<1.000	No	
		04/20/2011	30	93.33	No/No		85.71	1.000		<1.000	No	
JSF-W31	Manganese, total, ug/L	04/20/2011	30	3.33	Yes/No	STpar	99.97	53.074		<10.000	No	
		04/20/2011	30	3.33	Yes/No		99.97	53.074		<10.000	No	
JSF-W31	Mercury, total, ug/L	04/20/2011	30	100.00	No/No	STmdl	N/A	0.200		<0.200	No	
		04/20/2011	30	100.00	No/No		N/A	0.200		<0.200	No	
JSF-W31	Nickel, total, ug/L	04/20/2011	30	63.33	No/No	STnon	85.71	3.300		15.000	Yes	
		04/20/2011	30	63.33	No/No		85.71	3.300		17.000	Yes	
JSF-W31	Nitrite + Nitrate, mg/L	04/20/2011	16	12.50	Yes/Yes	STpar	99.97	0.401		0.420	Yes	
		04/20/2011	16	12.50	Yes/Yes		99.97	0.401		0.420	Yes	
JSF-W31	Nitrogen, Ammonia, mg/L	04/20/2011	16	62.50	No/No	STnon	76.19	0.140		<0.100	No	
		04/20/2011	16	62.50	No/No		76.19	0.140		<0.100	No	
JSF-W31	ORP, mV	04/20/2011	31	0.00	Yes/No	STpar	99.97	599.564		477.000	No	
JSF-W31	pH (field), pH	04/20/2011	31	0.00	No/No	STnon	86.11	7.300	6.700	6.300	Yes	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W31	Potassium, total, mg/L	04/20/2011	30	10.00	No/No	STnon	85.71	1.700		14.000	Yes	
		04/20/2011	30	10.00	No/No		85.71	1.700		15.000	Yes	
JSF-W31	Selenium, total, ug/L	04/20/2011	30	86.67	No/No	STnon	85.71	1.900		4.300	Yes	
		04/20/2011	30	86.67	No/No		85.71	1.900		3.900	Yes	
JSF-W31	Silver, total, ug/L	04/20/2011	29	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
		04/20/2011	29	100.00	No/No		N/A	1.000		<1.000	No	
JSF-W31	Sodium, total, mg/L	04/20/2011	30	0.00	Yes/Yes	STpar	99.97	9.800		72.000	Yes	
		04/20/2011	30	0.00	Yes/Yes		99.97	9.800		72.000	Yes	
JSF-W31	Specific Cond. (Field), umhos/cm	04/20/2011	31	0.00	No/No	STnon	86.11	499.000		2,268.000	Yes	
JSF-W31	Strontium, total, ug/L	04/20/2011	30	3.33	No/No	STnon	85.71	840.000		3,600.000	Yes	
		04/20/2011	30	3.33	No/No		85.71	840.000		3,600.000	Yes	
JSF-W31	Sulfate, total, mg/L	04/20/2011	30	0.00	No/No	STnon	85.71	31.500		1,100.000	Yes	
		04/20/2011	30	0.00	No/No		85.71	31.500		1,200.000	Yes	
JSF-W31	Sulfide, total, mg/L	04/20/2011	10	100.00	No/No	STmdl	N/A	0.050		<0.050	No	
		04/20/2011	10	100.00	No/No		N/A	0.050		<0.050	No	
JSF-W31	Temperature, Celsius, degrees C	04/20/2011	31	0.00	No/No	STnon	86.11	16.300		13.300	No	
JSF-W31	Thallium, total, ug/L	04/20/2011	30	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
		04/20/2011	30	100.00	No/No		N/A	1.000		<1.000	No	
JSF-W31	Tin, total, ug/L	04/20/2011	19	94.74	No/No	STnon	79.17	490.000		<1.000	No	
		04/20/2011	19	94.74	No/No		79.17	490.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W31	Vanadium, total, ug/L	04/20/2011	30	100.00	No/No	STmdl	N/A	2.000		<2.000	No	
		04/20/2011	30	100.00	No/No		N/A	2.000		<2.000	No	
JSF-W31	Zinc, total, ug/L	04/20/2011	30	76.67	No/No	STnon	85.71	95.500		<10.000	No	
		04/20/2011	30	76.67	No/No		85.71	95.500		<10.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W32	Alkalinity, total (field), mg/L CaCO3	04/18/2011	30	0.00	No/No	STnon	85.71	222.000		301.000	Yes	
JSF-W32	Aluminum, total, ug/L	04/18/2011	30	73.33	No/No	STnon	85.71	200.000		260.000	Yes	
JSF-W32	Antimony, total, ug/L	04/18/2011	30	96.67	No/No	STnon	85.71	6.000		<1.000	No	
JSF-W32	Arsenic, total, ug/L	04/18/2011	30	93.33	No/No	STnon	85.71	2.500		<1.000	No	
JSF-W32	Barium, total, ug/L	04/18/2011	30	3.33	No/No	STnon	85.71	255.000		64.000	No	
JSF-W32	Beryllium, total, ug/L	04/18/2011	30	96.67	No/No	STnon	85.71	2.700		<1.000	No	
JSF-W32	Boron, total, ug/L	04/18/2011	30	96.67	No/No	STnon	85.71	225.000		240.000	Yes	
JSF-W32	Cadmium, total, ug/L	04/18/2011	30	96.67	No/No	STnon	85.71	0.500		<0.500	No	
JSF-W32	Chloride, total, mg/L	04/18/2011	30	0.00	Yes/Yes	STpar	99.97	15.364		11.000	No	
JSF-W32	Chromium, total, ug/L	04/18/2011	30	83.33	No/No	STnon	85.71	4.000		<2.000	No	
JSF-W32	Cobalt, total, ug/L	04/18/2011	30	80.00	No/No	STnon	85.71	2.000		<1.000	No	
JSF-W32	Copper, total, ug/L	04/18/2011	30	96.67	No/No	STnon	85.71	10.000		<2.000	No	
JSF-W32	Cyanide, total, mg/L	04/18/2011	10	100.00	No/No	STmdl	N/A	0.005		<0.005	No	
JSF-W32	Fluoride, total, mg/L	04/18/2011	30	70.00	No/No	STnon	85.71	0.230		<0.100	No	
JSF-W32	Iron, total, ug/L	04/18/2011	30	3.33	No/No	STnon	85.71	5,400.000		150.000	No	
JSF-W32	Lead, total, ug/L	04/18/2011	30	93.33	No/No	STnon	85.71	1.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W32	Manganese, total, ug/L	04/18/2011	30	3.33	Yes/No	STpar	99.97	53.074		<10.000	No	
JSF-W32	Mercury, total, ug/L	04/18/2011	30	100.00	No/No	STmdl	N/A	0.200		<0.200	No	
JSF-W32	Nickel, total, ug/L	04/18/2011	30	63.33	No/No	STnon	85.71	3.300		5.400	Yes	
JSF-W32	Nitrite + Nitrate, mg/L	04/18/2011	16	12.50	Yes/Yes	STpar	99.97	0.401		0.800	Yes	
JSF-W32	Nitrogen, Ammonia, mg/L	04/18/2011	16	62.50	No/No	STnon	76.19	0.140		<0.100	No	
JSF-W32	ORP, mV	04/18/2011	31	0.00	Yes/No	STpar	99.97	599.564		464.000	No	
JSF-W32	pH (field), pH	04/18/2011	31	0.00	No/No	STnon	86.11	7.300	6.700	6.400	Yes	
JSF-W32	Potassium, total, mg/L	04/18/2011	30	10.00	No/No	STnon	85.71	1.700		1.600	No	
JSF-W32	Selenium, total, ug/L	04/18/2011	30	86.67	No/No	STnon	85.71	1.900		1.000	No	
JSF-W32	Silver, total, ug/L	04/18/2011	29	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W32	Sodium, total, mg/L	04/18/2011	30	0.00	Yes/Yes	STpar	99.97	9.800		7.100	No	
JSF-W32	Specific Cond. (Field), umhos/cm	04/18/2011	31	0.00	No/No	STnon	86.11	499.000		688.000	Yes	
JSF-W32	Strontium, total, ug/L	04/18/2011	30	3.33	No/No	STnon	85.71	840.000		280.000	No	
JSF-W32	Sulfate, total, mg/L	04/18/2011	30	0.00	No/No	STnon	85.71	31.500		50.000	Yes	
JSF-W32	Sulfide, total, mg/L	04/18/2011	10	100.00	No/No	STmdl	N/A	0.050		<0.050	No	
JSF-W32	Temperature, Celsius, degrees C	04/18/2011	31	0.00	No/No	STnon	86.11	16.300		15.400	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W32	Thallium, total, ug/L	04/18/2011	30	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W32	Tin, total, ug/L	04/18/2011	19	94.74	No/No	STnon	79.17	490.000		<1.000	No	
JSF-W32	Vanadium, total, ug/L	04/18/2011	30	100.00	No/No	STmdl	N/A	2.000		<2.000	No	
JSF-W32	Zinc, total, ug/L	04/18/2011	30	76.67	No/No	STnon	85.71	95.500		<10.000	No	

APPENDIX E

ParkinElmer Life and Analytical Sciences ICP-MS APPLICATION NOTE FOR TRACE ANALYSES IN METAL MATRICES

APPLICATION NOTE

Trace Analyses in Metal Matrices Using the ELAN DRC II

Introduction

Analyses of matrices containing high levels of metals present a challenge for ICP-MS. First, the concentrations of metals being introduced into the instrument may be high – up to 1,000 ppm. These high concentrations can cause instrumental drift resulting from deposition on the interface or other components. Also, the matrices may be complex due to both the composition of the materials (i.e., alloys) and the digestion solutions.

The usual interferences encountered with metal matrices are oxides and argides of the matrix species. However, the resulting interferences may be unusual compared to what is normally encountered with ICP-MS. For example, chloride is usually the major interfering species on As^+ ($ArCl^+$), but in a cobalt matrix, CoO^+ is the major interfering species for As^+. Also, interferences may form on elements which are normally interference-free, such as Rh which suffers from the $CuAr^+$ interference in a copper matrix. Additionally, because the matrix species are present at high concentrations, the interferences are usually significant.

Another problem posed by metal matrices is that the desired analyte levels are usually very low. After digestion and dilution, desired analyte levels are often low ppb (µg/L) to ppt (ng/L) levels. These low analyte levels, in combination with large interferences, present a challenge for the analysis of high metal matrices.

In this work, we show how Dynamic Reaction Cell™ (DRC™) ICP-MS can successfully perform low-level analyses in samples containing high metal concentrations.

Experimental

The instrument used in this work was the ELAN® DRC II. Specific operating conditions appear in Table 1. A highly energetic plasma is desirable to break down the matrix species; this condition was achieved by using high Radio Frequency (RF) power in combination with a low uptake nebulizer. Method-specific conditions for different matrices are discussed later.

All matrix solutions were made from 1,000 or 10,000 mg/L (ppm) single-element standards; analytes and internal standards were spiked into the matrix solutions at appropriate levels.

Table 1. Instrumental Operating Conditions

Parameter	Setting
Nebulizer	PFA-100 (ESI, Inc., Omaha, NE)
Sample Uptake Rate	≈175 µL/min (self aspiration)
Spray Chamber	Cyclonic
RF Power	1500 W
Nebulizer Flow	Set for ≤1.5% oxides (CeO^+/Ce^+)

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Results and Discussion

Cleanliness of the Reaction Cell

It may be expected that high-level metal matrices would contaminate the reaction cell. However, this is not the case – the reaction cell remains clean and does not become contaminated. The primary reason for this is the presence of an electrically neutral shadow stop positioned in-line between the orifice of the skimmer cone and the opening to the reaction cell, as shown in Figure 1. Because of this placement, non-ionized species collide with and deposit on the shadow stop, thus keeping the reaction cell clean. Neutral species, which expand around the shadow stop, deposit on the lens and differential aperture located before the entrance to the reaction cell. Because of the design and placement of these components, the reaction cell remains clean, and the reaction cell parameters remain constant.

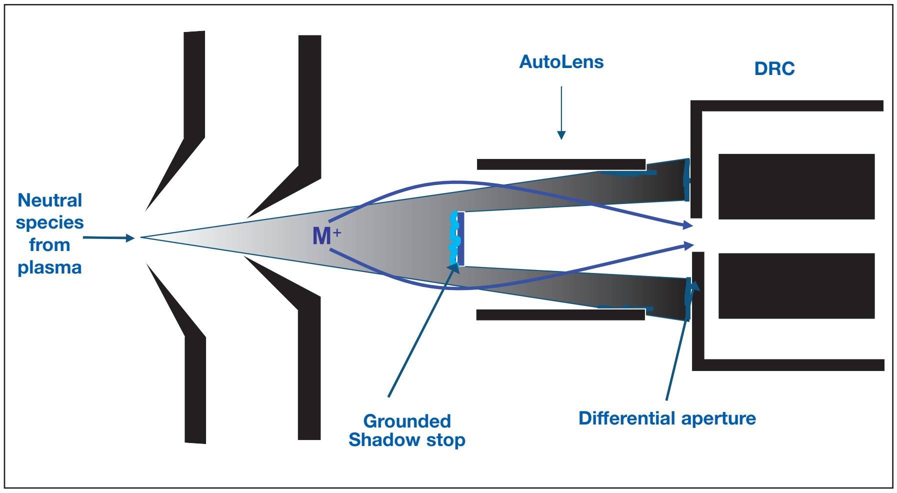

Figure 1. Schematic diagram of the ELAN DRC II showing how the reaction cell remains clean.

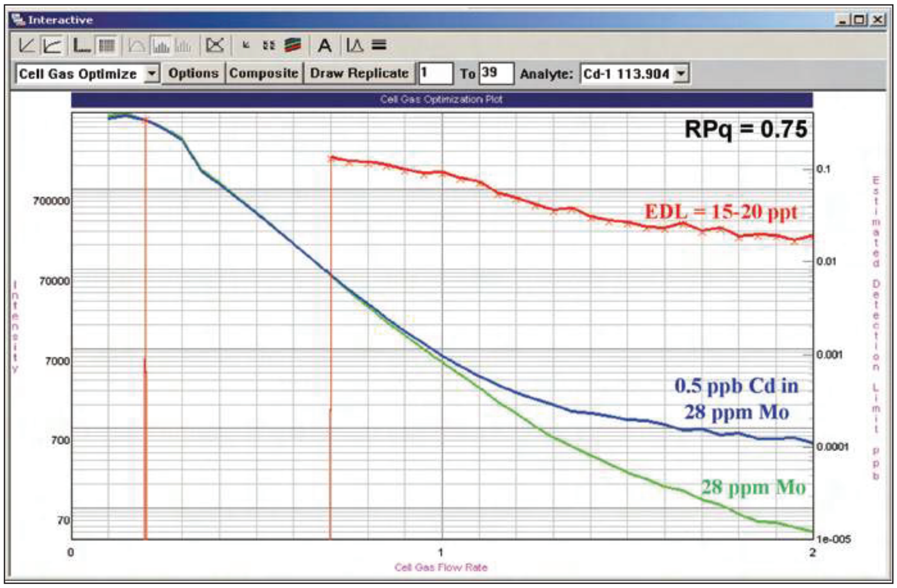

Figure 2. Cell gas optimization plot for Cd in a Mo matrix. The y-axis represents intensity at $^{114}Cd^+$; the x-axis represents O_2 gas flow in mL/min. The green line represents the signals from a solution of 28 ppm Mo. The blue line represents the signal from a solution of 28 ppm Mo spiked with 0.5 ppb Cd. The red line is the estimated detection limit (EDL). This data was taken with a bandpass parameter (RPq) of 0.75.

Cadmium in a Molybdenum Matrix

Determining trace levels of cadmium in the presence of high molybdenum levels is difficult due to the formation of molybdenum oxide, whose isotopes overlap all the cadmium isotopes. This type of analysis is important in the metallurgical industry because molybdenum is a major component in steels and alloys.

To solve this problem, O_2 is used as a reaction gas in combination with the appropriate bandpass setting. Figure 2 shows a reaction gas profile which demonstrates the removal of the MoO^+ interference on $^{114}Cd^+$, the major cadmium isotope. In this figure $^{114}Cd^+$ intensity is plotted versus O_2 gas flow. The blue line represents the signal resulting from a solution of 28 ppm Mo, while the green line shows the signal from a solution of 28 ppm Mo + 0.5 ppb Cd. At O_2 flows < 1 mL/min, the lines overlap indicating an interference. However, at higher flows, the lines diverge; the difference between the lines represents the signal due to Cd in the presence of Mo. At an O_2 flow of 2 mL/min, the signal due to Mo (MoO^+) is about 50 cps, while that resulting from 0.5 ppb Cd is about 700 cps. This difference results from the different reactivities of the species present: MoO^+ reacts readily with O_2 to form MoO_2^+, while Cd is unreactive with O_2 and is thus unaffected by the gas flow.

The reaction profile in Figure 2 was acquired with a bandpass setting (RPq) of 0.75. At this setting, Mo^+ is excluded from the reaction cell so that the only Mo species entering the cell is MoO^+ generated from the plasma. This latter species reacts with O_2 in the cell to form MoO_2^+.

These reaction cell conditions (O_2=2.0 mL/min; RPq=0.75) were applied to the determination of Cd in a cobalt alloy containing Mo as part of the matrix. After digestion and dilution, the Mo concentration entering the instrument was 28 ppm, while the desired Cd analytical level (after sample preparation) was 0.2 ppb. An external calibration curve in 1% HNO_3 (no matrix matching) was used, and the internal standard was Rh (10 ppb).

Table 2 shows the results of this analysis. First, the sample matrix was analyzed 3 consecutive times in both standard and DRC modes. In standard mode, the Cd concentration reads about 30 ppb, while in DRC mode, Cd reads 0.055 ppb. These results show that a large interference exists, which is eliminated with the DRC. A 0.2 ppb Cd spike was then analyzed, and the recoveries calculated. In DRC mode, the recoveries are 95%. These results demonstrate the successful determination of low-level Cd analysis in the presence of a high Mo level.

Table 2. Quantitative Determination of Cadmium in a Molybdenum Matrix

	Matrix		0.2 ppb Cd Spike		Recovery	
Sample #	***DRC*** *(ppb)*	***Std Mode*** *(ppb)*	***DRC*** *(ppb)*	***Std Mode*** *(ppb)*	***DRC*** *(ppb)*	***Std Mode*** *(ppb)*
1	0.054	32.0	0.242	32.1	94%	50%
2	0.059	31.6	0.259	32.0	100%	200%
3	0.056	32.3	0.236	32.3	90%	---
Average	**0.056**	**32.0**	**0.246**	**32.1**	**95%**	**---**

Molybdenum in an Iron Matrix

In matrices containing high quantities of iron, such as steels and alloys, low-level molybdenum determination is difficult due to the presence of $ArFe^+$ which overlaps the major Mo isotopes. To remove the effect of this interference, Mo^+ can be moved to a new analytical mass. In the previous section, it was seen that Mo reacts with O_2 to form MoO_2^+ (m/z 130); therefore, this reaction was used to move Mo to an analytical mass away from the interference.

Figure 3 shows a cell gas optimization plot of MoO_2^+ in the presence of iron with RPq=0.45. The matrix is 1,000 ppm Fe, and the spike level is 1 ppb Mo. The formation of MoO_2^+ is observed as O_2 is introduced into the reaction cell, yet the signal from the iron matrix remains low. Maximum MoO_2^+ sensitivity occurs at an O_2 flow of 0.35 mL/min.

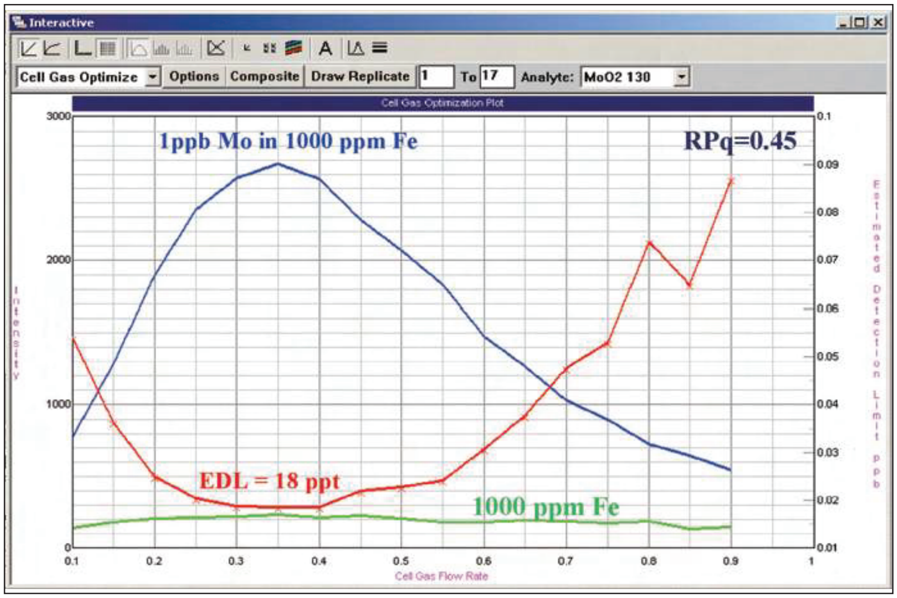

Figure 3. Cell gas optimization plot for Mo in an Fe matrix. The y-axis represents intensity at MoO_2^+(m/z 130); the x-axis represents O_2 gas flow in mL/min. The green line represents the signals from a solution of 1,000 ppm Fe. The blue line represents the signal from a solution of 1,000 ppm Fe spiked with 1 ppb Mo. The red line is the estimated detection limit (EDL). This data was taken with a bandpass parameter (RPq) of 0.45.

These reaction cell conditions were applied to the quantitative determination of Mo in an iron matrix. A 10,000 ppm Fe standard containing 1 ppb Mo was diluted ten times to give a sample consisting of 100 ppt Mo and 1,000 ppm Fe. Quantitative analysis was performed using external calibration standards in 1% HNO_3 (no matrix matching) with In (10 ppb) as an internal standard.

Figure 4 displays the calibration curve for 0.1, 0.5, and 1 ppb Mo standards while monitoring MoO_2^+ at m/z 130. The linearity of the curve demonstrates that the formation of MoO_2^+ is reproducible over an order of magnitude. This is expected since the reaction $Mo^+ + O_2 \rightarrow MoO_2^+$ is governed by kinetics and thermodynamics and, therefore, will always be constant. The quantitative results appear in Table 3. The data shows that 0.1 ppb Mo can be consistently determined in the presence of 1000 ppm Fe.

Table 3. Quantitative Determination of Molybdenum in an Iron Matrix

Sample	Mo Concentration (ppb)
1	0.114
2	0.111
3	0.111

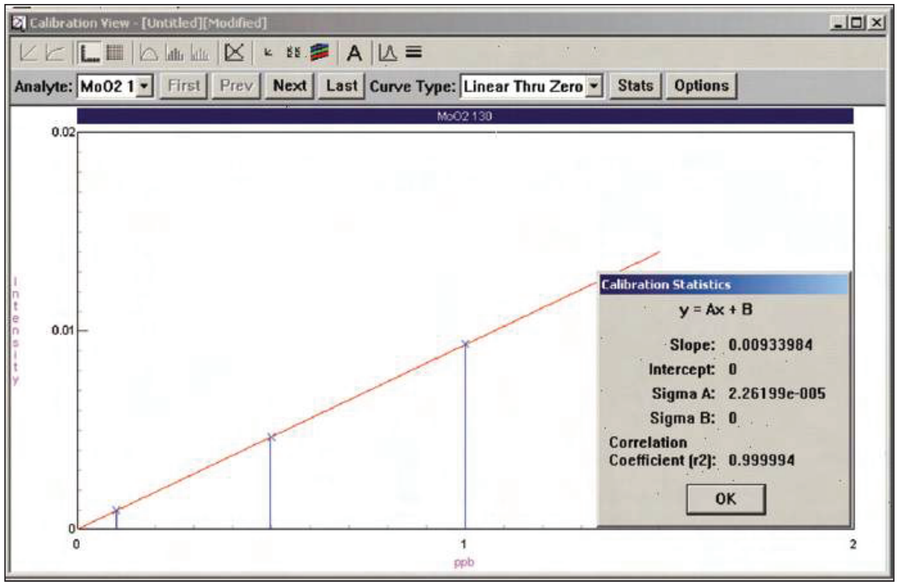

Figure 4. Calibration for 0.1, 0.5, and 1 ppb Mo monitoring MoO_2^+ (m/z 130). Reaction cell conditions: O_2 = 0.35 mL/min; RPq=0.45.

Multielement Analysis in a Copper Matrix

Determining trace contaminants in high purity metals is important so that final products made from these metals function properly. Major interferences in these matrix types result from matrix oxides, matrix argides, and matrix doubly-charged species. Elements commonly determined in a copper matrix include As, Ag, Cd, Sb, Pb, Bi, Rh, and Te. After sample preparation, the desired analytical level for these analytes is 100 ppt in a 1,000 ppm Cu matrix. Expected matrix-related interferences are $CuAr^+$ on Rh and Cu_2^+ on Te; other elements are interference-free. Table 4 shows the reaction cell conditions used for this analysis. NH_3 is used to eliminate the interferences on Rh and Te, while the interference-free elements are analyzed in standard mode. All elements are measured using one method and one analytical run.

Table 4. Reaction Cell Conditions for Multielement Analysis in a Copper Matrix

Analyte	*m/z*	*Reaction Gas*	*Gas Flow (mL/min)*	*RPq*
As	75	---	---	0.25
Ag	107	---	---	0.25
Cd	111	---	---	0.25
Sb	121	---	---	0.25
Pb	208	---	---	0.25
Bi	209	---	---	0.25
Rh	103	NH_3	0.60	0.75
Te	128	NH_3	0.60	0.60

Calibration was performed with external standards prepared in 1% HNO_3. Ten ppb each of Ga, Y, and Ir were used as internal standards. The 1,000 ppm Cu matrix was made by dilution of a 10,000 ppm Cu standard, and 100 ppt of each element was spiked into the matrix solution.

Table 5 shows the quantitative results for the unspiked 1,000 ppm Cu matrix, both at the beginning of the run and 65 minutes later after the spiked solution had been run 10 times. By comparing the two columns, it is evident that the measured concentrations did not change. This result shows the stability of the method and indicates that the reaction cell is not being contaminated during the analysis. By comparing the black and blue rows for Rh and Te, it is evident that interferences exist on both these species in the standard mode, yet the DRC mode removes the interfering species.

Spike recovery data is presented in Figure 5. The spiked sample was run 10 times over 1 hour after the unspiked sample had been run. These plots further demonstrate the stability of the instrument and method by showing that 100 ppt spike recoveries vary by less than ± 15% over one hour. These recoveries were calculated relative to the unspiked sample analyzed at the beginning of the run (Sample 1 in Table 5). A plot of spike recoveries calculated relative to the unspiked sample analyzed at the end of the run (Sample 11 in Table 5) looks identical and is not shown.

Table 5. Quantitative Results for Multielement Analysis in a Copper Matrix

Analyte	***Sample 1*** *(ppb)*	***Sample 11*** *(ppb)*
As	0.000	0.000
Ag	0.041	0.041
Rh	**0.001**	**0.000**
Rh	21.8	21.7
Cd	0.002	0.002
Sb	0.009	0.008
Te	**0.004**	**0.006**
Te	0.078	0.095
Pb	0.356	0.365
Bi	0.020	0.020

Blue = DRC mode
Black = Standard mode

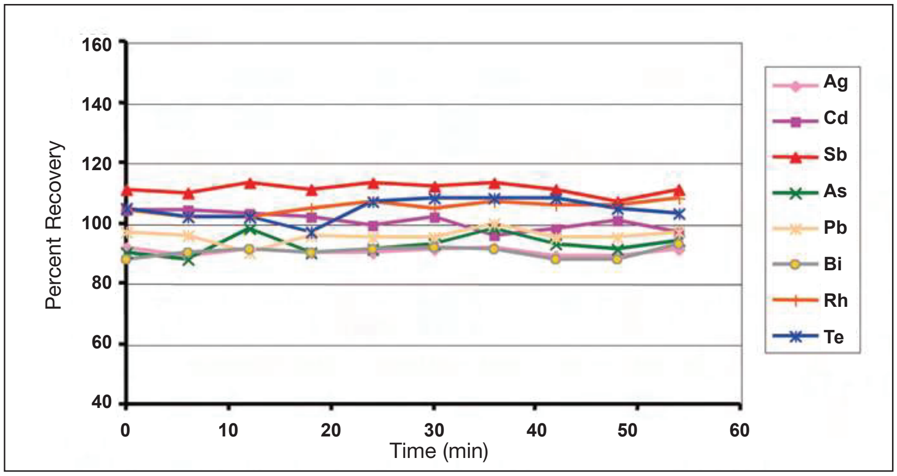

Figure 5. 100 ppt spike recoveries over 1 hour for several elements in 1000 ppm Cu. Rh and Te were analyzed in DRC mode (NH_3 as reaction gas); the other elements were run in standard mode.

Multielement Analysis of a Cobalt Alloy

Alloy analysis is more complex than high-purity metal matrices because of the multiple components present which lead to more possible interferences. Table 6 displays the composition of a cobalt alloy, as well as the desired analytes and their levels, both in the solid and after sample preparation. From this list, expected interferences are CoO^+ on As^+ and MoO^+ on Cd^+.

Table 7 shows the reaction cell conditions used. Most of the elements are run in standard mode because they are interference-free; the effects of the interfering species on As^+ and Cd^+ are eliminated using O_2 as a reaction gas. For this method, O_2 is used in two ways: first, to convert As^+ to a new analytical species (AsO^+) away from the CoO^+ interference, and second, to remove the MoO^+ interference on Cd^+.

External calibrations using standards made in 1% HNO_3 were used. Sc, Rh, In, and Ir were used as internal standards. The matrix solution was made in the laboratory by appropriate dilution of 10,000 ppm standards and then was spiked with the analytes at their desired analytical levels, as shown in Table 6.

Table 8 displays the quantitative results of analyzing the cobalt alloy matrix, both at the beginning of the run and 65 minutes later after the spiked solution had been run 10 times. By comparing the two sample columns in Table 8, it is evident that the measured concentrations do not change. This result shows the stability of the method and indicates that the reaction cell remains clean during the analysis.

Table 6. Composition of Cobalt Alloy

Component	**Solid** *(ppm)*	**After Sample Prep** *(ppb)*
Bi, Cd, Tl	0.4	0.2
Pb, Sb	2	1
Te	4	2
Sn, As	10	5
Mg	200	100
Matrix	**Solid** *(%)*	**After Sample Prep** *(ppm)*
Co	60	300
Cr	28	140
Mo	5.5	28
C, Mn, Si, Ni, Fe	≤ 1	≤ 10

Table 7. Reaction Cell Conditions for Analysis of a Cobalt Alloy

Analyte	***m/z***	***Reaction Gas***	***Gas Flow*** *(mL/min)*	***RPq***
Mg	24	---	---	0.25
Sn	120	---	---	0.25
Sb	121	---	---	0.25
Te	125	---	---	0.25
Tl	205	---	---	0.25
Pb	208	---	---	0.25
Bi	209	---	---	0.25
AsO	91	O_2	2.0	0.70
Cd	114	O_2	2.0	0.75

Table 8. Quantitative Results for Analysis of a Cobalt Alloy

Analyte	***Sample 1*** *(ppb)*	***Sample 11*** *(ppb)*
Mg	2.47	2.61
Sn	0.190	0.171
Sb	0.031	0.032
Te	0.292	0.263
Tl	0.004	0.003
Pb	0.328	0.335
Bi	0.178	0.188
Cd	**0.061**	**0.049**
As	**1.14**	**0.95**

Blue = DRC mode
Black = Standard mode

Figure 6 shows spike recovery data over one hour; the spiked sample was run 10 times after the unspiked sample had been run. These plots further demonstrate the stability of the instrument and method by showing that the spike recoveries vary by less than ± 15% over one hour. These recoveries were calculated relative to the unspiked sample analyzed at the beginning of the run (Sample 1 in Table 8). A plot of spike recoveries calculated relative to the unspiked sample analyzed at the end of the run (Sample 11 in Table 8) looks identical and is not shown. Further evidence of the stability is presented in Table 9 which shows that the RSD's (Relative Standard Deviation) for the spikes displayed in Figure 6 are less than or equal to 3%.

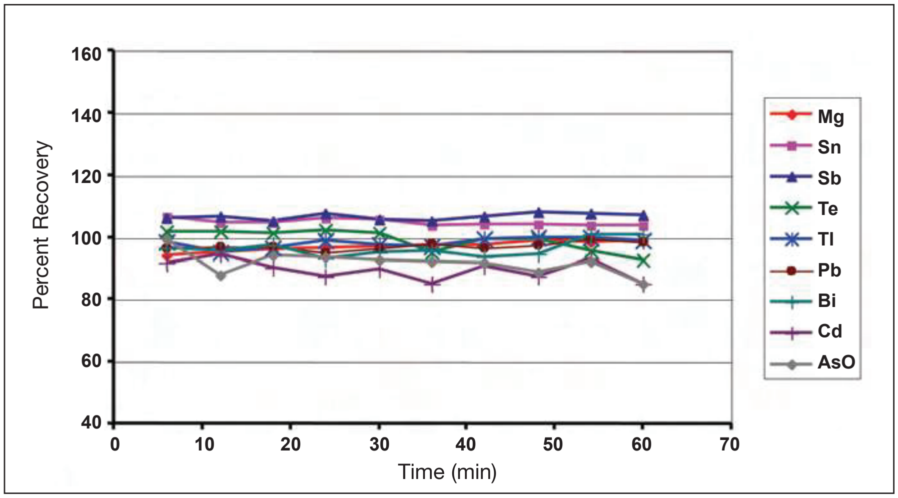

Figure 6. Spike recoveries over 1 hour for several elements in a cobalt alloy matrix. Cd and AsO were analyzed in DRC mode (O_2 as reaction gas); the other elements were run in standard mode.

Conclusions

This work demonstrates the ability of the ELAN DRC II to perform low-level analyses in samples containing high levels of metal species. It has been shown, both conceptually and with stability data, that the reaction cell does not become contaminated despite the high-level matrix samples being introduced to the instrument. The flexibility of the DRC has been demonstrated by showing that the effects of matrix-derived interferences can be eliminated by either removing the interference or by converting the analytes to new analytical masses away from the interferences. By utilizing these schemes, ppt levels of many analytes can be successfully measured in high metal matrices.

Table 9. Stability of Spike Recoveries in a Cobalt Alloy Over 1 Hour

Analyte	*Spike Level* (ppb)	*RSD* (%)
Mg	100	1.5
Sn	5	0.9
Sb	1	0.8
Te	2	2.9
Tl	0.2	1.6
Pb	1	0.9
Bi	0.1	1.3
Cd	**0.2**	**2.5**
As	**5**	**3.2**

Blue = DRC mode
Black = Standard mode

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APPENDIX F

LEACHATE COLLECTION SYSTEM DISCHARGE DATA

JOHN SEVIER FOSSIL PLANT
DRY ASH DISPOSAL FACILITY
LEACHATE COLLECTION SYSTEM DISCHARGE DATA

Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
04/05/2000	7	5,152,515	2,950,220	41,630	31,562	10,456	
04/12/2000	7	5,194,833	2,984,065	42,318	33,845	10,880	
04/19/2000	7	5,235,370	3,011,990	40,537	27,925	9,780	
04/26/2000	7	5,272,600	3,040,155	37,230	28,165	9,342	
05/03/2000	7	5,317,755	3,067,521	45,155	27,366	10,360	
05/10/2000	7	5,332,250	3,093,740	14,495	26,219	5,816	CP2 float out of service.
05/11/2000	1	5,337,388	3,097,390	5,138	3,650	8,788	CP2 float repaired 5/11/00 @1400
05/12/2000	1	5,341,485	3,101,125	4,097	3,735	7,832	
05/17/2000	5	5,374,408	3,125,110	32,923	23,985	11,382	
05/24/2000	7	5,414,040	3,155,749	39,632	30,639	10,039	
05/31/2000	7	5,448,964	3,180,333	34,924	24,584	8,501	
06/07/2000	7	5,486,658	3,206,380	37,694	26,047	9,106	
06/14/2000	7	5,525,309	3,236,275	38,651	29,895	9,792	
06/21/2000	7	5,562,272	3,266,160	36,963	29,885	9,550	
06/28/2000	7	5,600,612	3,297,865	38,340	31,705	10,006	
07/05/2000	7	5,635,501	3,336,455	34,889	38,590	10,497	
07/12/2000	7	5,671,050	3,375,810	35,549	39,355	10,701	
07/19/2000	7	5,707,920	3,411,235	36,870	35,425	10,328	
07/26/2000	7	5,746,989	3,446,986	39,069	35,751	10,689	
08/02/2000	7	5,787,930	3,480,505	40,941	33,519	10,637	
08/09/2000	7	5,831,350	3,519,060	43,420	38,555	11,711	
08/16/2000	7	5,874,545	3,557,890	43,195	38,830	11,718	
08/23/2000	7	5,918,873	3,597,042	44,328	39,152	11,926	
08/30/2000	7	5,964,439	3,636,868	45,566	39,826	12,199	
09/06/2000	7	6,010,100	3,675,240	45,661	38,372	12,005	
09/13/2000	7	6,055,140	3,714,215	45,040	38,975	12,002	
09/20/2000	7	6,100,070	3,753,310	44,930	39,095	12,004	
09/27/2000	7	6,142,800	3,790,810	42,730	37,500	11,461	
10/04/2000	7	6,179,972	3,822,708	37,172	31,898	9,867	
10/11/2000	7	6,210,838	3,855,490	30,866	32,782	9,093	
10/18/2000	7	6,240,206	3,889,325	29,368	33,835	9,029	
10/25/2000	7	6,276,502	3,922,275	36,296	32,950	9,892	
11/01/2000	7	6,313,928	3,962,970	37,426	40,695	11,160	
11/08/2000	7	6,352,119	4,002,525	38,191	39,555	11,107	
11/15/2000	7	6,388,760	4,041,690	36,641	39,165	10,829	
11/22/2000	7	6,427,720	4,081,640	38,960	39,950	11,273	
11/29/2000	7	6,468,103	4,122,669	40,383	41,029	11,630	
12/06/2000	7	6,506,070	4,159,388	37,967	36,719	10,669	
12/13/2000	7	6,545,180	4,196,353	39,110	36,965	10,868	
12/20/2000	7	6,583,633	4,236,870	38,453	40,517	11,281	
12/27/2000	7	6,620,799	4,277,665	37,166	40,795	11,137	
01/03/2001	7	6,660,610	4,317,098	39,811	39,433	11,321	
01/10/2001	7	6,699,522	4,350,955	38,912	33,857	10,396	
01/17/2001	7	6,737,050	4,399,084	37,528	48,129	12,237	
01/24/2001	7	6,784,250	4,446,887	47,200	47,803	13,572	
01/31/2001	7	6,826,315	4,485,610	42,065	38,723	11,541	
02/07/2001	7	6,868,590	4,517,040	42,275	31,430	10,529	
02/14/2001	7	6,905,740	4,551,990	37,150	34,950	10,300	
02/21/2001	7	6,959,538	4,605,964	53,798	53,974	15,396	
02/28/2001	7	7,010,088	4,656,430	50,550	50,466	14,431	
03/07/2001	7	7,058,849	4,702,658	48,761	46,228	13,570	
03/14/2001	7	7,103,309	4,744,842	44,460	42,184	12,378	
03/21/2001	7	7,152,068	4,793,356	48,759	48,514	13,896	
03/28/2001	7	7,201,602	4,843,250	49,534	49,894	14,204	
04/04/2001	7	7,254,740	4,890,960	53,138	47,710	14,407	
04/11/2001	7	7,308,972	4,936,970	54,232	46,010	14,320	
04/18/2001	7	7,364,355	4,978,151	55,383	41,181	13,795	
04/25/2001	7	7,414,818	5,021,540	50,463	43,389	13,407	
05/02/2001	7	7,460,028	5,063,450	45,210	41,910	12,446	
05/09/2001	7	7,512,480	5,103,315	52,452	39,865	13,188	
05/16/2001	7	7,553,340	5,140,005	40,860	36,690	11,079	
05/17/2001	1	7,553,487	5,157,120	147	17,115	17,262	CP2 rerouted to CP3 repairs on CP2 pump.
05/23/2001	6	7,586,575	5,186,615	33,088	29,495	10,431	
05/30/2001	7	7,608,787	5,217,838	22,212	31,223	7,634	
06/06/2001	7	7,636,514	5,250,475	27,727	32,637	8,623	
06/13/2001	7	7,672,408	5,283,740	35,894	33,265	9,880	
06/20/2001	7	7,700,585	5,318,708	28,177	34,968	9,021	
06/27/2001	7	7,731,225	5,356,400	30,640	37,692	9,762	
07/03/2001	6	7,782,988	5,383,402	51,763	27,002	13,128	
07/12/2001	8	7,785,070	5,422,612	2,082	39,210	5,162	
07/18/2001	8	7,811,225	5,450,270	26,155	27,658	6,727	
07/27/2001	6	7,849,280	5,488,568	38,055	38,298	12,726	
07/31/2001	9	7,870,375	5,511,778	21,095	23,210	4,923	
08/08/2001	4	7,908,958	5,554,208	38,583	42,430	20,253	
08/15/2001	8	7,941,985	5,591,235	33,027	37,027	8,757	
08/22/2001	7	7,975,952	5,630,725	33,967	39,490	10,494	
08/29/2001	7	8,009,260	5,665,732	33,308	35,007	9,759	
09/05/2001	7	8,038,785	5,698,560	29,525	32,828	8,908	
09/12/2001	7	8,069,746	5,731,490	30,961	32,930	9,127	

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Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
09/19/2001	7	8,101,192	5,769,000	31,446	37,510	9,851	
09/26/2001	7	8,134,320	5,804,015	33,128	35,015	9,735	
10/03/2001	7	8,164,682	5,837,628	30,362	33,613	9,139	
10/10/2001	7	8,195,991	5,872,503	31,309	34,875	9,455	
10/17/2001	7	8,227,115	5,905,505	31,124	33,002	9,161	
10/24/2001	7	8,258,245	5,960,420	31,130	54,915	12,292	
10/31/2001	7	8,290,105	6,003,875	31,860	43,455	10,759	
11/07/2001	7	8,324,165	6,019,587	34,060	15,712	7,110	
11/14/2001	7	8,358,248	6,019,587	34,083	0	4,869	
11/21/2001	7	8,392,418	6,061,300	34,170	41,713	10,840	
11/28/2001	7	8,422,457	6,104,911	30,039	43,611	10,521	
11/29/2001	1		6,112,141		7,230	7,230	Replaced CP3 Meter
11/29/2001			4,118,490	0			New meter reading on 11/29/2001
12/05/2001	7	8,457,589	4,137,550	5,019	19,060	3,440	
12/07/2001	2	8,457,589	4,137,550	0	0	0	
12/13/2001	8	8,499,312	4,171,983	41,723	34,433	9,520	
12/19/2001	7	8,532,030	4,206,388	32,718	34,405	9,589	
12/26/2001	7	8,568,500	4,237,100	36,470	30,712	9,597	
01/02/2002	7	8,568,528	4,288,685	28	51,585	7,373	CP2 routed to CP3 (accidentally turned off).
01/03/2002	7	8,573,510	4,292,258	4,982	3,573	1,222	
01/09/2002	6	8,604,158	4,319,908	30,648	27,650	9,716	
01/16/2002	7	8,638,541	4,351,680	34,383	31,772	9,451	
01/23/2002	7	8,676,040	4,383,550	37,499	31,870	9,910	
01/30/2002	7	8,719,755	4,452,872	43,715	69,322	16,148	
02/06/2002	7	8,757,538	4,483,940	37,783	31,068	9,836	
02/13/2002	7	8,798,135	4,515,728	40,597	31,788	10,341	
02/20/2002	7	8,837,740	4,541,620	39,605	25,892	9,357	
02/27/2002	7	8,878,300	4,566,800	40,560	25,180	9,391	
03/06/2002	7	8,914,308	4,590,236	36,008	23,436	8,492	
03/13/2002	7	8,951,801	4,615,485	37,493	25,249	8,963	
03/20/2002	7	8,994,950	4,663,900	43,149	48,415	13,081	Rainfall event 4.11"
03/27/2002	7	9,035,660	4,697,590	40,710	33,690	10,629	
04/03/2002	7	9,077,495	4,729,382	41,835	31,792	10,518	
04/10/2002	7	9,116,802	4,757,108	39,307	27,726	9,576	
04/17/2002	7	9,155,900	4,781,600	39,098	24,492	9,084	
04/24/2002	7	9,193,895	4,803,640	37,995	22,040	8,576	
05/01/2002	7	9,232,712	4,826,310	38,817	22,670	8,784	
05/08/2002	7	9,272,695	4,851,275	39,983	24,965	9,278	
05/15/2002	7	9,310,330	4,875,995	37,635	24,720	8,908	
05/22/2002	7	9,348,655	4,896,819	38,325	20,824	8,450	
05/29/2002	7	9,381,365	4,918,360	32,710	21,541	7,750	
06/05/2002	7	9,426,040	4,936,710	44,675	18,350	9,004	
06/12/2002	7	9,465,260	4,954,710	39,220	18,000	8,174	
06/19/2002	7	9,496,040	4,972,945	30,780	18,235	7,002	
06/26/2002	7	9,528,200	4,988,100	32,160	15,155	6,759	
07/03/2002	7	9,558,570	4,993,130	30,370	5,030	5,057	
07/10/2002	7	9,590,995	5,004,305	32,425	11,175	6,229	Replaced check valve
07/17/2002	7	9,621,490	5,023,370	30,495	19,065	7,080	
07/24/2002	7	9,654,015	5,042,790	32,525	19,420	7,421	
07/31/2002	7	9,686,532	5,062,264	32,517	19,474	7,427	
08/07/2002	7	9,719,203	5,080,948	32,671	18,684	7,336	
08/14/2002	7	9,752,575	5,099,303	33,372	18,355	7,390	
08/21/2002	7	9,786,250	5,118,165	33,675	18,862	7,505	
08/28/2002	7	9,818,500	5,136,705	32,250	18,540	7,256	
09/04/2002	7	9,850,370	5,155,120	31,870	18,415	7,184	
09/11/2002	7	9,882,735	5,173,830	32,365	18,710	7,296	
09/18/2002	7	9,916,000	5,192,700	33,265	18,870	7,448	
09/25/2002	7	9,946,280	5,211,225	30,280	18,525	6,972	
10/02/2002	7	9,979,830	5,237,540	33,550	26,315	8,552	
10/09/2002	7	10,012,390	5,257,215	32,560	19,675	7,462	
10/16/2002	7	10,044,720	5,277,685	32,330	20,470	7,543	
10/23/2002	7	10,077,585	5,299,470	32,865	21,785	7,807	
10/30/2002	7	10,110,650	5,328,225	33,065	28,755	8,831	
11/06/2002	7	10,147,210	5,361,850	36,560	33,625	10,026	
11/13/2002	7	10,188,215	5,423,120	41,005	61,270	14,611	one and half inches of rain on 11/11/2002
11/20/2002	7	10,232,520	5,471,235	44,305	48,115	13,203	
12/04/2002	14	10,307,175	5,549,205	74,655	77,970	10,902	
12/11/2002	7	10,307,160	5,615,100	-15	65,895	9,411	CP2 Meter out
12/13/2002	28	6,112,400	5,630,325		15,225	544	Replaced CP2 meter
12/16/2002	2	6,124,170	5,654,000	11,770	23,675	17,723	
12/18/2002	2	6,132,180	5,666,070	8,010	12,070	10,040	
01/06/2003	19	6,215,630	5,790,590	83,450	124,520	10,946	
01/08/2003	2	6,225,260	5,802,040	9,630	11,450	10,540	
01/15/2003	7	6,259,210	5,838,580	33,950	36,540	10,070	
01/22/2003	7	6,292,015	5,872,325	32,805	33,745	9,507	
01/29/2003	7	6,325,620	5,907,950	33,605	35,625	9,890	
02/05/2003	7	6,364,925	5,971,110	39,305	63,160	14,638	Heavy rain the week of 2/5/2003
02/12/2003	7	6,406,520	6,024,330	41,595	53,220	13,545	
02/19/2003	7	6,460,330	6,126,550	53,810	102,220	22,290	Heavy rain the week of 2/14/2003

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Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
02/26/2003	7	6,519,370	6,229,840	59,040	103,290	23,190	
03/04/2003	6	6,564,540	6,298,850	45,170	69,010	19,030	
03/12/2003	8	6,623,382	6,366,407	58,842	67,557	15,800	
03/19/2003	7	6,674,940	6,414,030	51,558	47,623	14,169	
03/29/2003	7	6,726,460	6,458,730	51,520	44,700	13,746	
04/02/2003	7	6,776,810	6,500,900	50,350	42,170	13,217	
04/09/2003	7	6,831,150	6,553,360	54,340	52,460	15,257	
04/16/2003	7	6,898,928	6,646,522	67,778	93,162	22,991	Heavy rain the week of 4/7/2003
04/24/2003	8	6,968,990	6,710,620	70,062	64,098	16,770	
04/30/2003	7	7,017,305	6,753,910	48,315	43,290	13,086	
05/07/2003	7	7,076,700	6,807,140	59,395	53,230	16,089	Over 1" of rain this week
05/14/2003	7	7,141,395	6,872,615	64,695	65,475	18,596	
05/21/2003	7	7,212,452	6,943,602	71,057	70,987	20,292	
05/28/2003	7	7,290,780	7,008,569	78,328	64,967	20,471	
06/04/2003	7	7,379,122	7,070,611	88,342	62,042	21,483	
06/11/2003	7	7,461,040	7,136,420	81,918	65,809	21,104	
06/18/2003	7	7,550,250	7,203,036	89,210	66,616	22,261	
06/25/2003	7	7,652,220	7,252,360	101,970	49,324	21,613	
07/02/2003	7	10,307,515	7,301,710		49,350		Heavy rain week of 7/1/03; CP2 meter changed
07/09/2003	7	10,347,625	7,269,770	40,110			CP3 Meter Out
07/16/2003	7	10,388,325		40,700			CP3 Meter Out
07/23/2003	7	10,434,390	7,788,450	46,065			New meter installed on 7/17/2003 7754310
07/30/2003	7	10,490,740	7,826,720	56,350	38,270	13,517	
08/06/2003	7	10,555,045	7,887,385	64,305	60,665	17,853	
08/13/2003	7	10,624,998	7,935,370	69,953	47,985	16,848	
08/20/2003	7	10,700,110	7,977,124	75,112	41,754	16,695	
08/27/2003	7	10,775,019	8,015,135	74,909	38,011	16,131	
09/03/2003	7	10,853,775	8,052,225	78,756	37,090	16,549	
09/10/2003	7	10,941,675	8,104,510	87,900	52,285	20,026	
09/17/2003	7	11,018,948	8,140,871	77,273	36,361	16,233	
09/24/2003	7	11,098,860	8,176,460	79,912	35,589	16,500	
10/01/2003	7	11,181,450	8,217,280	82,590	40,820	17,630	
10/08/2003	7	11,266,790	8,253,895	85,340	36,615	17,422	
10/15/2003	7	11,352,730	8,289,410	85,940	35,515	17,351	
10/22/2003	7	11,417,640	8,324,300	64,910	34,890	14,257	
10/29/2003	7	11,484,830	8,360,855	67,190	36,555	14,821	
11/05/2003	7	11,541,930	8,395,800	57,100	34,945	13,149	
11/12/2003	7	11,596,275	8,453,990	54,345	58,190	16,076	
11/19/2003	7	11,656,870	8,514,950	60,595	60,960	17,365	
11/26/2003	7	11,717,670	8,592,400	60,800	77,450	19,750	
12/03/2003	7	11,778,490	8,652,730	60,820	60,330	17,307	
12/10/2003	7	11,843,675	8,716,650	65,185	63,920	18,444	
12/17/2003	7	11,916,450	8,764,250	72,775	47,600	17,196	
12/24/2003	7	11,995,075	8,843,455	78,625	79,205	22,547	
12/31/2003	7	12,076,430	8,891,442	81,355	47,987	18,477	
01/07/2004	7	12,170,358	8,961,054	93,928	69,612	23,363	
01/14/2004	7	12,271,310	9,009,785	100,952	48,731	21,383	
01/21/2004	7	12,371,680	9,052,470	100,370	42,685	20,436	
01/28/2004	7	12,468,300	9,090,170	96,620	37,700	19,189	
02/04/2004	7	12,581,050	9,119,802	112,750	29,632	20,340	
02/11/2004	7	12,716,720	9,167,285	135,670	47,483	26,165	
02/18/2004	7	12,920,630	9,167,295	203,910	10	29,131	CP3 pump out of service
02/25/2004	7	13,022,775	9,204,425	102,145	37,130	19,896	
03/03/2004	7	13,109,570	9,239,200	86,795	34,775	17,367	
03/10/2004	7	13,196,945	9,271,183	87,375	31,983	17,051	
03/17/2004	7	13,282,165	9,286,170	85,220	14,987	14,315	CP3 Meter Out
03/18/2004	1	13,297,500	7,270,300	15,335		15,335	CP3 Meter Out
03/19/2004	1	13,312,900	7,276,380	15,400	6,080	21,480	
03/24/2004	5	13,359,965	7,285,843	47,065	9,463	11,306	
03/31/2004	7	13,417,260	7,285,843	57,295	0	8,185	CP2 Meter out
04/01/2004	1	13,417,280	9,288,300	20		20	CP2 meter out
04/02/2004	1	13,417,255	9,291,577	-25	3,277	3,252	
04/07/2004	5	13,422,621	9,315,569	5,366	23,992	5,872	
04/08/2004	1	13,428,755	9,321,849	6,134	6,280	12,414	
04/09/2004	1	13,434,145	9,327,184	5,390	5,335	10,725	
04/12/2004	3	13,452,195	9,342,815	18,050	15,631	11,227	
04/14/2004	2	13,475,650	9,351,755	23,455	8,940	16,198	
04/21/2004	7	13,536,910	9,388,575	61,260	36,820	14,011	
04/28/2004	7	13,624,735	9,417,310	87,825	28,735	16,651	
05/05/2004	7	13,729,550	9,440,130	104,815	22,820	18,234	
05/06/2004	1	13,745,970	680	16,420		16,420	CP3 meter replaced
05/07/2004	1	13,753,180	5,685	7,210	5,005	12,215	
05/10/2004	3	13,778,302	21,229	25,122	15,544	13,555	
05/12/2004	2	13,795,080	31,830	16,778	10,601	13,690	
05/17/2004	5	13,833,411	56,946	38,331	25,116	12,689	
05/19/2004	2	13,849,530	67,210	16,119	10,264	13,192	
05/26/2004	7	13,904,835	77,840	55,305	10,630	9,419	
06/02/2004	7	13,970,215	77,840	65,380	0	9,340	
06/09/2004	7	14,049,205	77,840	78,990	0	11,284	

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Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
06/10/2004	1	14,062,245	9,443,800	13,040		13,040	CP3 meter replaced
06/14/2004	4	14,105,700	9,468,840	43,455	25,040	17,124	
06/16/2004	2	14,127,090	9,481,957	21,390	13,117	17,254	
06/23/2004	7	14,231,470	9,507,155	104,380	25,198	18,511	
06/30/2004	7	14,383,590	9,519,755	152,120	12,600	23,531	
07/02/2004	3	14,429,806	419	46,216		15,405	CP3 meter replaced
07/07/2004	5	14,538,290	40,105	108,484	39,686	29,634	
07/14/2004	7	14,699,480	84,470	161,190	44,365	29,365	
07/21/2004	7	14,874,870	125,240	175,390	40,770	30,880	
07/28/2004	7	14,874,575	168,350	-295	43,110	6,116	Clay pipe # 2 meter out of service.
08/04/2004	7	14,874,575	212,160	0	43,810	6,259	New meter on order
08/11/2004	7	6,954	260,892		48,732		Clay pipe #2 meter installed on 08/10/2004
08/12/2004	1	13,500	266,355	6,546	5,463	12,009	
08/18/2004	6	66,230	299,320	52,730	32,965	14,283	
08/25/2004	7	133,690	342,160	67,460	42,840	15,757	
09/01/2004	7	193,430	386,859	59,740	44,699	14,920	
09/08/2004	7	241,160	437,695	47,730	50,836	14,081	
09/14/2004	7	285,978	498,212	44,818	60,517	15,048	
09/22/2004	7	314,990	576,125	29,012	77,913	15,275	Meter replaced on Clay pipe 2 and 3
09/23/2004	1	5,400	4,600			0	
09/24/2004	1	5,128	15,122	-272	10,522	10,250	Repaired plugged line on Clay pipe 2
09/27/2004	3	21,780	29,710	16,652	14,588	10,413	
09/29/2004	2	36,070	40,470	14,290	10,760	12,525	
10/06/2004	7	88,301	75,505	52,231	35,035	12,467	
10/13/2004	7	106,720	143,625	18,419	68,120	12,363	CP2 overflowing into CP3
10/15/2004	2	105,855	168,556		24,931		CP2 check valve had been put in backwards, it was put in correctly.
10/20/2004	5	136,130	195,595	30,275	27,039	11,463	
10/27/2004	7	183,710	234,830	47,580	39,235	12,402	
11/03/2004	7	237,560	278,175	53,850	43,345	13,885	
11/10/2004	7	293,565	333,970	56,005	55,795	15,971	
11/17/2004	7	354,560	390,010	60,995	56,040	16,719	
11/24/2004	7	429,180	439,460	74,620	49,450	17,724	
12/01/2004	7	538,850	507,490	109,670	68,030	25,386	Heavy rain the week of 11/24/2004.
12/08/2004	7	659,420	574,450	120,570	66,960	26,790	Heavy rain the week of 12/01/2004
12/15/2004	7	849,710	628,690	190,290	54,240	34,933	
12/22/2004	7	938,510	680,750	88,800	52,060	20,123	
12/29/2004	7	1,033,618	724,785	95,108	44,035	19,878	
01/05/2005	7	1,138,310	767,909	104,692	43,124	21,117	
01/12/2005	7	1,260,190	821,950	121,880	54,041	25,132	
01/19/2005	7	1,402,880	868,890	142,690	46,940	27,090	
01/26/2005	7	1,433,020	920,370	30,140	51,480	11,660	#2 Meter out of service work order to flush or replace.
01/28/2005	2	1,433,020	935,590		15,220	7,610	#2 Meter replaced
01/28/2005	0	315,602	935,590				
02/02/2005	5	353,160	970,160	37,558	34,570	14,426	
02/09/2005	7	426,080	1,005,680	72,920	35,520	15,491	
02/16/2005	7	515,190	1,032,550	89,110	26,870	16,569	# 3 Meter plugged, plans to replace
02/16/2005	1	515,190	577,710				# 3 Meter replaced and line flushed back in well.
02/17/2005	1	525,050	582,760	9,860	5,050	14,910	
02/23/2005	6	589,670	620,522	64,620	37,762	17,064	
03/02/2005	7	663,710	663,940	74,040	43,418	16,780	
03/09/2005	7	757,885	695,180	94,175	31,240	17,916	
03/10/2005	1	775,104	699,950	17,219	4,770	21,989	
03/10/2005	1	775,104	14,875,427				# 3 Meter replaced and line flushed back in well.
03/11/2005	1	781,450	14,880,015	6,346	4,588	10,934	
03/16/2005	5	825,150	14,910,280	43,700	30,265	14,793	
03/23/2005	7	887,285	14,953,785	62,135	43,505	15,091	#2 well overflowing to #3 well, repairs planned today.
03/28/2005	5	958,982	14,977,780	71,697	23,995	19,138	Clay Pipe 2 and 3 meter replaced, plugged with mud.
03/28/2005		1,034,526	1,433,904	75,544		15,109	
03/30/2005	2	1,049,175	1,440,470	14,649	6,566	10,608	
04/06/2005	6	1,103,140	1,486,750	53,965	46,280	16,708	
04/13/2005	7	1,164,410	1,535,714	61,270	48,964	15,748	
04/20/2005	7	1,233,169	1,584,161	68,759	48,447	16,744	Back flushed #2 and #3 meter back in well.
04/21/2005	1	1,241,571	1,591,908	8,402	7,747	16,149	
04/27/2005	6	1,287,790	1,628,230	46,219	36,322	13,757	
05/04/2005	7	1,360,170	1,675,655	72,380	47,425	17,115	
05/11/2005	7	1,423,230	1,720,542	63,060	44,887	15,421	
05/18/2005	7	1,479,170	1,767,050	55,940	46,508	14,635	
05/25/2005	7	1,553,690	1,809,715	74,520	42,665	16,741	
06/01/2005	7	1,640,675	1,842,790	86,985	33,075	17,151	#2 and #3 meters replaced
06/01/2005	1	964,204	14,980,193				New meter reading on 06/01/2005
06/08/2005	6	976,222	15,013,198	12,018	33,005	7,504	
06/13/2005	5	1,018,190	15,038,615	41,968	25,417	13,477	
06/15/2005	2	1,037,385	15,046,640	19,195	8,025	13,610	
06/22/2005	7	1,107,370	15,075,690	69,985	29,050	14,148	
06/29/2005	7	1,169,278	15,105,690	61,908	30,000	13,130	
07/06/2005	7	1,264,535	15,111,845	95,257	6,155	14,487	# 3 overflowing to # 2 repairs being made today.
07/06/2005	0	1,843,855	1,642,603				Replaced meters on # 2 and # 3.
07/13/2005	7	1,887,158	1,655,021	43,303	12,418	7,960	Flushed line on CP-2 and CP-3.
07/20/2005	7	1,941,470	1,695,400	54,312	40,379	13,527	

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Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
07/27/2005	7	2,005,115	1,736,260	63,645	40,860	14,929	
08/03/2005	7	2,062,555	1,770,820	57,440	34,560	13,143	
08/10/2005	7	2,120,908	1,804,613	58,353	33,793	13,164	
08/17/2005	7	2,182,800	1,837,460	61,892	32,847	13,534	
08/24/2005	7	2,245,265	1,872,810	62,465	35,350	13,974	
08/31/2005	7	2,310,790	1,907,750	65,525	34,940	14,352	
09/07/2005	7	2,387,625	1,940,180	76,835	32,430	15,609	
09/14/2005	7	2,468,148	1,973,645	80,523	33,465	16,284	Both well removed from service to pull cable to silo building.
09/16/2005	2	2,483,962	1,979,568	15,814	5,923	10,869	
09/21/2005	5	2,536,930	2,003,795	52,968	24,227	15,439	Leak found CP-2, repairs made 9/27/05.
09/28/2005	7	2,596,315	2,033,400	59,385	29,605	12,713	
10/05/2005	7	2,647,860	2,061,840	51,545	28,440	11,426	
10/12/2005	7	2,700,270	2,090,420	52,410	28,580	11,570	
10/19/2005	7	2,759,210	2,120,415	58,940	29,995	12,705	
10/26/2005	7	2,811,020	2,150,815	51,810	30,400	11,744	
11/02/2005	7	2,853,250	2,181,725	42,230	30,910	10,449	
11/09/2005	7	2,881,195	2,208,023	27,945	26,298	7,749	
11/16/2005	7	2,929,260	2,233,880	48,065	25,857	10,560	
11/23/2005	7	2,980,820	2,261,230	51,560	27,350	11,273	
11/30/2005	7	3,032,050	2,289,320	51,230	28,090	11,331	
12/07/2005	7	3,084,505	2,321,358	52,455	32,038	12,070	
12/14/2005	7	3,135,210	2,356,240	50,705	34,882	12,227	
12/21/2005	7	3,205,215	2,377,340	70,005	21,100	13,015	Clay pipe #3 overflowing to Clay pipe #2 repairs planned
12/22/2005	1	3,217,985	699,456				#3 pump and meter changed out
12/28/2005	6	3,255,840	726,025	37,855	26,569	10,737	
01/04/2006	7	3,294,810	773,790	38,970	47,765	12,391	
01/11/2006	7	3,294,810	811,025				No. 2 meter out of service estimated weekly flow is 38970
01/13/2006	2	2,377,210	820,972				No. 2 meter replaced on 1/13/06 the new reading is 2377210
01/18/2006	5	2,405,720	858,840	28,510	37,868	13,276	
01/25/2006	7	2,450,460	909,736	44,740	50,896	13,662	
02/01/2006	7	2,497,450	946,740	46,990	37,004	11,999	
02/08/2006	7	2,546,110	981,415	48,660	34,675	11,905	
02/15/2006	7	2,597,545	1,015,095	51,435	33,680	12,159	
02/22/2006	7	2,655,790	1,049,690	58,245	34,595	13,263	
03/01/2006	7	2,707,030	1,091,335	51,240	41,645	13,269	
03/08/2006	7	2,761,295	1,125,178	54,265	33,843	12,587	
03/15/2006	7	2,820,418	1,160,863	59,123	35,685	13,544	
03/22/2006	7	2,881,519	1,201,090	61,101	40,227	14,475	
03/29/2006	7	2,935,740	1,245,540	54,221	44,450	14,096	
04/05/2006	7	2,990,830	1,286,610	55,090	41,070	13,737	
04/12/2006	7	3,059,595	1,347,215	68,765	60,605	18,481	
04/19/2006	7	3,128,770	1,389,810	69,175	42,595	15,967	
04/26/2006	7	3,198,390	1,455,450	69,620	65,640	19,323	
05/03/2006	7	3,277,229	1,506,188	78,839	50,738	18,511	
05/10/2006	7	3,365,701	1,551,710	88,472	45,522	19,142	
05/17/2006	7	3,455,520	1,595,190	89,819	43,480	19,043	
05/24/2006	7	3,541,540	1,641,010	86,020	45,820	18,834	
05/31/2006	7	3,623,070	1,685,360	81,530	44,350	17,983	
06/07/2006	7	3,724,840	1,733,830	101,770	48,470	21,463	
06/14/2006	7	3,834,830	1,784,790	109,990	50,960	22,993	
06/21/2006	7	3,951,030	1,833,220	116,200	48,430	23,519	
06/28/2006	7	4,057,400	1,877,370	106,370	44,150	21,503	
07/05/2006	7	4,122,050	1,917,980	64,650	40,610	15,037	
07/12/2006	7	4,192,518	1,960,690	70,468	42,710	16,168	
07/19/2006	7	4,263,615	1,999,365	71,097	38,675	15,682	
07/26/2006	7	4,335,310	2,037,460	71,695	38,095	15,684	
08/02/2006	7	4,396,030	2,074,160	60,720	36,700	13,917	
08/09/2006	7	4,451,232	2,112,092	55,202	37,932	13,305	
08/11/2006	2	4,454,142	2,119,315				17,250 gal removed from CP-2 and CP-3 to upgrade wells/meters
08/11/2006	0	0	0				New Meters & Pumps installed on 8/11/06.
08/14/2006	3	17,903	16,870	17,903	16,870	11,591	
08/16/2006	2	29,783	25,388	11,880	8,518	10,199	
08/18/2006	2	41,663	33,687	11,880	8,299	10,090	
08/22/2006	2	61,501	47,672	19,838	13,985	16,912	
08/23/2006	1	65,400	50,554	3,899	2,882	6,781	
08/30/2006	7	98,178	73,412	32,778	22,858	7,948	
09/06/2006	7	130,951	99,313	32,773	25,901	8,382	
09/13/2006	7	163,087	123,977	32,136	24,664	8,114	
09/20/2006	7	195,190	148,009	32,103	24,032	8,019	
09/27/2006	7	228,032	178,279	32,842	30,270	9,016	
10/04/2006	7	260,792	210,768	32,760	32,489	9,321	
10/11/2006	7	294,454	241,165	33,662	30,397	9,151	
10/18/2006	7	325,550	267,304	31,096	26,139	8,176	
10/25/2006	7	358,657	299,839	33,107	32,535	9,377	
11/01/2006	7	391,447	331,141	32,790	31,302	9,156	
11/08/2006	7	424,772	365,548	33,325	34,407	9,676	
11/15/2006	7	459,157	406,323	34,385	40,775	10,737	
11/22/2006	7	494,195	448,552	35,038	42,229	11,038	
11/29/2006	7	527,004	478,269	32,809	29,717	8,932	

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Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
12/06/2006	7	559,348	507,372	32,344	29,103	8,778	
12/13/2006	7	591,867	535,432	32,519	28,060	8,654	
12/20/2006	7	623,352	562,547	31,485	27,115	8,371	
12/27/2006	7	655,602	594,813	32,250	32,266	9,217	
01/03/2007	7	688,820	627,828	33,218	33,015	9,462	
01/10/2007	7	721,349	660,959	32,529	33,131	9,380	
01/17/2007	7	753,499	693,318	32,150	32,359	9,216	
01/24/2007	7	785,183	727,381	31,684	34,063	9,392	
01/31/2007	7	815,560	759,012	30,377	31,631	8,858	
02/07/2007	7	845,024	786,819	29,464	27,807	8,182	
02/14/2007	7	875,058	814,714	30,034	27,895	8,276	
02/21/2007	7	903,843	841,399	28,785	26,685	7,924	
02/28/2007	7	932,374	869,371	28,531	27,972	8,072	
03/07/2007	7	963,283	903,269	30,909	33,898	9,258	
03/14/2007	7	991,608	930,717	28,325	27,448	7,968	
03/21/2007	7	1,021,478	965,248	29,870	34,531	9,200	
03/28/2007	7	1,052,090	995,349	30,612	30,101	8,673	
04/04/2007	7	1,081,931	1,023,509	29,841	28,160	8,286	
04/11/2007	7	1,111,038	1,051,052	29,107	27,543	8,093	
04/17/2007	6	1,137,466	1,082,141	26,428	31,089	9,586	
04/23/2007	6	1,163,981	1,109,163	26,515	27,022	8,923	
04/30/2007	7	1,196,324	1,139,347	32,343	30,184	8,932	
05/07/2007	7	1,226,691	1,169,777	30,367	30,430	8,685	
05/14/2007	7	1,257,485	1,197,232	30,794	27,455	8,321	
05/21/2007	7	1,288,362	1,220,400	30,877	23,168	7,721	
05/24/2007	4	1,305,578	1,234,162	17,216	13,762	7,745	
05/30/2007	5	1,327,725	1,250,202	22,147	16,040	7,637	
06/06/2007	7	1,351,617	1,277,729	23,892	27,527	7,346	
06/13/2007	7	1,368,917	1,316,272	17,300	38,543	7,978	CP-2 pump replaced.
06/20/2007	7	1,395,306	1,335,835	26,389	19,563	6,565	
06/27/2007	7	1,421,426	1,354,796	26,120	18,961	6,440	
07/03/2007	6	1,444,617	1,371,141	23,191	16,345	6,589	
07/10/2007	7	1,469,667	1,388,667	25,050	17,526	6,082	
07/17/2007	7	1,495,571	1,406,460	25,904	17,793	6,242	
07/18/2007	1	1,499,139	1,408,693	3,568	2,233	5,801	
07/25/2007	7	1,523,337	1,425,209	24,198	16,516	5,816	
08/01/2007	7	1,548,434	1,448,020	25,097	22,811	6,844	
08/08/2007	7	1,573,575	1,466,537	25,141	18,517	6,237	
08/15/2007	7	1,597,898	1,483,940	24,323	17,403	5,961	
08/22/2007	7	1,621,776	1,504,183	23,878	20,243	6,303	
08/27/2007	5	1,638,978	1,518,912	17,202	14,729	6,386	
08/31/2007	4	1,652,566	1,530,801	13,588	11,889	6,369	
09/05/2007	5	1,669,431	1,545,549	16,865	14,748	6,323	
09/12/2007	7	1,692,955	1,566,101	23,524	20,552	6,297	
09/17/2007	7	1,715,087	1,586,974	22,132	20,873	6,144	
09/26/2007	7	1,737,911	1,607,375	22,824	20,401	6,175	
10/03/2007	7	1,760,183	1,627,462	22,272	20,087	6,051	
10/10/2007	7	1,782,072	1,647,942	21,889	20,480	6,053	
10/17/2007	7	1,803,327	1,667,553	21,255	19,611	5,838	
10/24/2007	7	1,824,474	1,687,635	21,147	20,082	5,890	
10/31/2007	7	1,846,712	1,709,452	22,238	21,817	6,294	
11/05/2007	5	1,862,266	1,724,095	15,554	14,643	6,039	
11/09/2007	4	1,874,312	1,735,505	12,046	11,410	5,864	
11/14/2007	5	1,889,810	1,749,606	15,498	14,101	5,920	
11/21/2007	7	1,910,093	1,771,680	20,283	22,074	6,051	
11/28/2007	7	1,931,098	1,791,319	21,005	19,639	5,806	
12/05/2007	7	1,951,137	1,809,240	20,039	17,921	5,423	
12/12/2007	7	1,971,166	1,828,542	20,029	19,302	5,619	
12/19/2007	7	1,991,037	1,850,305	19,871	21,763	5,948	
12/26/2007	7	2,011,086	1,871,893	20,049	21,588	5,948	
01/02/2008	7	2,031,507	1,900,761	20,421	28,868	7,041	
01/09/2008	7	2,051,822	1,921,530	20,315	20,769	5,869	
01/16/2008	7	2,091,779	1,962,834	39,957	41,304	11,609	
01/23/2008	7	2,113,561	1,988,319	21,782	25,485	6,752	
01/30/2008	7	2,135,717	2,011,599	22,156	23,280	6,491	
02/06/2008	7	2,163,871	2,052,082	28,154	40,483	9,805	
02/13/2008	7	2,191,316	2,091,165	27,445	39,083	9,504	
02/20/2008	7	2,214,465	2,118,442	23,149	27,277	7,204	
02/27/2008	7	2,237,387	2,143,621	22,922	25,179	6,872	
03/05/2008	7	2,264,666	2,171,879	27,279	28,258	7,934	
03/12/2008	7	2,290,769	2,211,200	26,103	39,321	9,346	
03/19/2008	7	2,316,227	2,243,529	25,458	32,329	8,255	
03/26/2008	7	2,344,963	2,281,076	28,736	37,547	9,469	
04/02/2008	7	2,370,147	2,305,864	25,184	24,788	7,139	
04/09/2008	7	2,399,891	2,335,438	29,744	29,574	8,474	
04/16/2008	7	2,429,436	2,373,884	29,545	38,446	9,713	
04/23/2008	7	2,454,950	2,397,856	25,514	23,972	7,069	
04/29/2008	6	2,476,351	2,418,665	21,401	20,809	7,035	
05/05/2008	6	2,497,975	2,439,455	21,624	20,790	7,069	

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Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
05/14/2008	9	2,529,744	2,466,719	31,769	27,264	6,559	
05/21/2008	7	2,554,609	2,487,559	24,865	20,840	6,529	
05/28/2008	7	2,578,890	2,506,885	24,281	19,326	6,230	
06/04/2008	7	2,604,692	2,526,833	25,802	19,948	6,536	
06/11/2008	7	2,630,200	2,545,243	25,508	18,410	6,274	
06/18/2008	7	2,655,942	2,563,566	25,742	18,323	6,295	
06/25/2008	7	2,681,003	2,581,989	25,061	18,423	6,212	
07/02/2008	7	2,704,946	2,606,822	23,943	24,833	6,968	
07/09/2008	7	2,729,877	2,628,989	24,931	22,167	6,728	
07/16/2008	7	2,752,812	2,653,653	22,935	24,664	6,800	
07/23/2008	7	2,775,037	2,676,221	22,225	22,568	6,399	
07/30/2008	7	2,797,105	2,698,981	22,068	22,760	6,404	
08/06/2008	7	2,818,384	2,720,996	21,279	22,015	6,185	
08/11/2008	5	2,833,567	2,736,335	15,183	15,339	6,104	
08/20/2008	10	2,860,375	2,763,455	26,808	27,120	5,393	
08/27/2008	7	2,881,176	2,784,281	20,801	20,826	5,947	
09/03/2008	7	2,901,723	2,805,514	20,547	21,233	5,969	
09/10/2008	7	2,921,613	2,827,124	19,890	21,610	5,929	
09/17/2008	7	2,943,054	2,852,852	21,441	25,728	6,738	
09/24/2008	7	2,965,068	2,878,262	22,014	25,410	6,775	
10/01/2008	7	2,987,301	2,903,595	22,233	25,333	6,795	
10/08/2008	7	3,009,230	2,929,206	21,929	25,611	6,791	
10/15/2008	7	3,030,773	2,955,205	21,543	25,999	6,792	
10/22/2008	7	3,052,384	2,980,853	21,611	25,648	6,751	
10/29/2008	7	3,073,550	3,005,846	21,166	24,993	6,594	
11/05/2008	7	3,095,224	3,030,196	21,674	24,350	6,575	
11/12/2008	7	3,116,397	3,053,189	21,173	22,993	6,309	
11/19/2008	7	3,137,111	3,080,416	20,714	27,227	6,849	
11/26/2008	7	3,156,598	3,104,120	19,487	23,704	6,170	
12/02/2008	6	3,173,108	3,125,590	16,510	21,470	6,330	
12/09/2008	7	3,191,613	3,150,624	18,505	25,034	6,220	
12/16/2008	7	3,213,333	3,188,513	21,720	37,889	8,516	Heavy rain the week of 12/16/2008.
12/23/2008	7	3,245,635	3,235,358	32,302	46,845	11,307	Heavy rain the week of 12/23/2008.
12/30/2008	7	3,269,282	3,273,886	23,647	38,528	8,882	
01/06/2009	7	3,290,931	3,303,107	21,649	29,221	7,267	
01/13/2009	7	3,342,115	3,347,302	51,184	44,195	13,626	Heavy rain the week of 01/06/2009.
01/20/2009	7	3,359,865	3,384,591	17,750	37,289	7,863	
01/21/2009	1	3,359,865	3,390,339	0	5,748	5,748	Clay Pipe 2 pump out of service. Back in service on 1/21/09 @1130 ct. Replaced fuse on controls. Flow from clay pipe 2 overflowed to clay pipe 3.
01/28/2009	7	3,383,898	3,422,995	24,033	32,656	8,098	
02/04/2009	7	3,410,274	3,459,371	26,376	36,376	8,965	
02/11/2009	7	3,435,120	3,488,651	24,846	29,280	7,732	
02/18/2009	7	3,460,750	3,517,287	25,630	28,636	7,752	
02/25/2009	7	3,490,211	3,553,802	29,461	36,515	9,425	
03/04/2009	7	3,518,804	3,588,761	28,593	34,959	9,079	
03/11/2009	7	3,544,987	3,617,140	26,183	28,379	7,795	
03/18/2009	7	3,573,865	3,652,778	28,878	35,638	9,217	
03/25/2009	7	3,602,022	3,682,412	28,157	29,634	8,256	
04/01/2009	7	3,631,491	3,714,057	29,469	31,645	8,731	
04/08/2009	7	3,661,967	3,747,932	30,476	33,875	9,193	
04/15/2009	7	3,694,477	3,783,733	32,510	35,801	9,759	
04/22/2009	7	3,725,012	3,813,492	30,535	29,759	8,613	
04/29/2009	7	3,755,568	3,841,543	30,556	28,051	8,372	
05/06/2009	7	3,778,951	3,871,505	23,383	29,962	7,621	Removed 3, 000 gallons from Clay Pipe 2 well during outage for drilling wells around Clay Pipe 2 and 3.
05/13/2009	7	3,815,013	3,923,298	36,062	51,793	12,551	
05/20/2009	7	3,839,203	3,962,447	24,190	39,149	9,048	
05/27/2009	7	3,869,421	4,000,429	30,218	37,982	9,743	
06/03/2009	7	3,913,277	4,039,299	43,856	38,870	11,818	
06/04/2009	1	3,917,947	4,044,193	4,670	4,894	9,564	Remove from srevice Clay Pipe 2&3 for repair on discharge line. Removed 4300 gallon with vacuum truck
06/05/2009	1	3,918,159	4,048,683	212	4,490	4,702	Removed from service Clay Pipe 2&3 to back flush lines. Removed 6000 gallon with vacuum truck.
06/08/2009	3	3,932,325	4,064,546	14,166	15,863	10,010	
06/09/2009	1	3,937,460	4,069,704	5,135	5,158	10,293	
06/10/2009	1	3,943,146	4,075,609	5,686	5,905	11,591	
06/17/2009	7	3,979,254	4,111,661	36,108	36,052	10,309	
06/24/2009	7	4,017,505	4,153,374	38,251	41,713	11,423	
07/01/2009	7	4,054,034	4,189,039	36,529	35,665	10,313	
07/08/2009	7	4,089,210	4,223,389	35,176	34,350	9,932	
07/15/2009	7	4,126,605	4,255,731	37,395	32,342	9,962	
07/22/2009	7	4,162,429	4,286,398	35,824	30,667	9,499	
07/29/2009	7	4,196,613	4,313,898	34,184	27,500	8,812	
08/05/2009	7	4,247,647	4,351,115	51,034	37,217	12,607	From 7/29/09 thru 8/5/09 3.45" rain.
08/07/2009	2	4,259,077	4,362,429	11,430	11,314	11,372	
08/14/2009	7	4,295,053	4,389,740	35,976	27,311	9,041	
08/19/2009	5	4,320,694	4,406,803	25,641	17,063	8,541	
08/26/2009	7	4,356,289	4,435,195	35,595	28,392	9,141	

JOHN SEVIER FOSSIL PLANT
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Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
09/02/2009	7	4,389,023	4,463,538	32,734	28,343	8,725	
09/07/2009	7	4,420,612	4,489,984	31,589	26,446	8,291	
09/15/2009	6	4,447,863	4,512,555	27,251	22,571	8,304	
09/22/2009	7	4,477,606	4,536,994	29,743	24,439	7,740	
09/29/2009	7	4,519,028	4,562,903	41,422	25,909	9,619	
10/01/2009	2	4,528,533	4,572,069	9,505	9,166	9,336	
10/07/2009	6	4,555,527	4,591,344	26,994	19,275	7,712	
10/14/2009	7	4,575,172	4,614,728	19,645	23,384	6,147	
10/21/2009	7	4,608,111	4,653,680	32,939	38,952	10,270	
10/28/2009	7	4,640,268	4,686,716	32,157	33,036	9,313	
11/04/2009	7	4,665,298	4,722,812	25,030	36,096	8,732	
11/09/2009	5	4,684,292	4,747,199	18,994	24,387	8,676	
11/16/2009	7	4,721,394	4,787,708	37,102	40,509	11,087	
11/23/2009	7	4,754,524	4,824,003	33,130	36,295	9,918	
11/25/2009	2	4,759,391	4,833,762	4,867	9,759	7,313	
12/02/2009	7	4,791,433	4,869,054	32,042	35,292	9,619	
12/04/2009	2	4,799,487	4,881,282	8,054	12,228	10,141	
12/11/2009	7	4,827,766	4,924,217	28,279	42,935	10,173	
12/16/2009	5	4,852,086	4,955,911	24,320	31,694	11,203	
12/23/2009	7	4,888,408	5,003,880	36,322	47,969	12,042	
12/30/2009	7	4,911,512	5,048,006	23,104	44,126	9,604	
01/06/2010	7	4,928,862	5,086,278	17,350	38,272	7,946	
01/13/2010	7	4,949,731	5,123,807	20,869	37,529	8,343	
01/20/2010	7	4,971,869	5,164,437	22,138	40,630	8,967	
01/27/2010	7	5,007,101	5,213,212	35,232	48,775	12,001	
02/03/2010	7	5,032,695	5,258,188	25,594	44,976	10,081	
02/10/2010	7	5,070,151	5,308,706	37,456	50,518	12,568	
02/16/2010	6	5,094,062	5,347,296	23,911	38,590	10,417	
02/23/2010	7	5,114,341	5,372,256	20,279	24,960	6,463	
02/24/2010	1	5,117,380	5,377,028	3,039	4,772	7,811	
03/02/2010	6	5,146,115	5,405,022	28,735	27,994	9,455	
03/05/2010	3	5,160,153	5,418,749	14,038	13,727	9,255	
03/10/2010	5	5,182,639	5,439,457	22,486	20,708	8,639	
03/17/2010	7	5,214,373	5,468,332	31,734	28,875	8,658	
03/24/2010	7	5,245,327	5,495,931	30,954	27,599	8,365	
03/31/2010	7	5,277,040	5,529,062	31,713	33,131	9,263	
04/07/2010	7	5,308,689	5,559,991	31,649	30,929	8,940	
04/14/2010	7	5,339,727	5,587,003	31,038	27,012	8,293	
04/21/2010	7	5,370,055	5,611,344	30,328	24,341	7,810	
04/27/2010	6	5,395,923	5,631,785	25,868	20,441	7,718	
05/04/2010	7	5,425,732	5,659,997	29,809	28,212	8,288	
05/11/2010	7	5,455,566	5,686,639	29,834	26,642	8,068	
05/18/2010	7	5,484,627	5,709,726	29,061	23,087	7,450	
05/25/2010	7	5,513,524	5,732,036	28,897	22,310	7,315	
06/01/2010	7	5,542,248	5,755,167	28,724	23,131	7,407	
06/08/2010	7	5,570,582	5,779,388	28,334	24,221	7,508	
06/15/2010	7	5,599,489	5,803,136	28,907	23,748	7,523	
06/22/2010	7	5,627,745	5,825,971	28,256	22,835	7,299	
06/29/2010	7	5,655,528	5,849,226	27,783	23,255	7,291	
07/06/2010	7	5,683,758	5,874,300	28,230	25,074	7,615	
07/13/2010	7	5,711,944	5,897,307	28,186	23,007	7,314	
07/20/2010	7	5,739,772	5,922,689	27,828	25,382	7,601	
07/27/2010	7	5,849,302	5,943,283	109,530	20,594	18,589	Estimated flow on Clay Pipe 2 meter malfunction, repairs planned. Flow was estimated 3623 daily flow by 5.46 gallon in 2 minutes and 7 seconds.
07/28/2010	1	5,868,871	5,946,142	19,569	2,859	22,428	Repairs made on Clay Pipe 2, check valve not seated, cleaned and back in service flow number for 7/27-28/2010 incorrect. Daily flow 3623 per day.
07/29/2010	1	5,872,466	5,948,451	3,595	2,309	5,904	Checked to make sure check valve holding, repairs complete.
07/30/2010	1	5,877,423	5,951,722	4,957	3,271	8,228	
08/06/2010	7	5,905,722	5,970,462	28,299	18,740	6,720	
08/13/2010	7	5,933,245	5,988,085	27,523	17,623	6,450	
08/18/2010	5	5,960,061	5,989,241	26,816	1,156	5,594	Clay Pipe 3 out of service, repairs planned. Clay Pipe 3 flowing to Clay Pipe 2 for discharge. Repairs complete at 1700 8/18/10 fuse blown.
08/19/2010	1	5,964,298	5,992,719	4,237	3,478	7,715	Clay Pipe 3 back in service flows back to normal.
08/25/2010	6	5,986,709	6,010,480	22,411	17,761	6,695	
09/01/2010	7	6,013,226	6,028,481	26,517	18,001	6,360	
09/08/2010	7	6,037,575	6,044,444	24,349	15,963	5,758	
09/15/2010	7	6,062,635	6,061,577	25,060	17,133	6,028	
09/21/2010	6	6,083,019	6,075,938	20,384	14,361	5,791	
09/24/2010	3	6,093,692	6,083,435	10,673	7,497	6,057	
09/30/2010	6	6,113,892	6,098,108	20,200	14,673	5,813	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
10/01/2010	1	6,116,534	6,100,296	2,642	2,188	4,830	
10/04/2010	4	6,126,743	6,107,237	10,209	6,941	4,287	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1500 gallons vacuumed out of Clay Pipe 2 and 3.
10/05/2010	1	6,128,795	6,109,610	2,052	2,373	4,425	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3.

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Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
10/06/2010	1	6,131,231	6,112,009	2,436	2,399	4,835	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1100 gallons vacuumed out of Clay Pipe 2 and 3
10/07/2010	1	6,133,650	6,114,250	2,419	2,241	4,660	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3
10/08/2010	1	6,136,979	6,117,136	3,329	2,886	6,215	
10/12/2010	4	6,153,097	6,125,699	16,118	8,563	6,171	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3
10/13/2010	1	6,155,645	6,128,049	2,548	2,350	4,898	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3
10/14/2010	1	6,157,770	6,130,411	2,125	2,362	4,487	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3. Clay Well 2 Level at 1400 hrs was not high enough to activate float switch. Pump was checked at 1700 hours and float switch activation was confirmed.
10/15/2010	1	6,160,553	6,132,999	2,783	2,588	5,371	
10/18/2010	3	6,170,284	6,139,345	9,731	6,346	5,359	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3.
10/19/2010	1	6,172,480	6,141,650	2,196	2,305	4,501	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3.
10/21/2010	2	6,177,797	6,146,329	5,317	4,679	4,999	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1560 gallons vacuumed out of Clay Pipe 2 and 3.
10/22/2010	1	6,180,130	6,148,804	2,333	2,475	4,808	
10/26/2010	4	6,192,041	6,157,721	11,911	8,917	5,207	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 850 gallons vacuumed out of Clay Pipe 2 and 3.
10/29/2010	3	6,201,222	6,167,997	9,181	10,276	6,485	
11/01/2010	3	6,210,269	6,175,855	9,047	7,858	5,635	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1075 gallons vacuumed out of Clay Pipe 2 and 3.
11/02/2010	1	6,212,425	6,178,251	2,156	2,396	4,552	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 850 gallons vacuumed out of Clay Pipe 2 and 3.
11/03/2010	1	6,214,570	6,180,732	2,145	2,481	4,626	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 900 gallons vacuumed out of Clay Pipe 2 and 3.
11/04/2010	1	6,216,972	6,183,419	2,402	2,687	5,089	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 575 gallons vacuumed out of Clay Pipe 2 and 3.
11/05/2010	1	6,219,604	6,186,712	2,632	3,293	5,925	
11/09/2010	4	6,231,691	6,197,648	12,087	10,936	5,756	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 850 gallons vacuumed out of Clay Pipe 2 and 3.
11/10/2010	1	6,233,724	6,200,160	2,033	2,512	4,545	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 900 gallons vacuumed out of Clay Pipe 2 and 3.
11/11/2010	1	6,236,233	6,202,940	2,509	2,780	5,289	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 600 gallons vacuumed out of Clay Pipe 2 and 3.
11/12/2010	1	6,238,475	6,205,534	2,242	2,594	4,836	
11/16/2010	4	6,250,200	6,215,457	11,725	9,923	5,412	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1050 gallons vacuumed out of Clay Pipe 2 and 3.
11/17/2010	1	6,252,524	6,219,337	2,324	3,880	6,204	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 850 gallons vacuumed out of Clay Pipe 2 and 3.
11/18/2010	1	6,254,442	6,222,670	1,918	3,333	5,251	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 850 gallons vacuumed out of Clay Pipe 2 and 3.
11/19/2010	1	6,256,536	6,225,709	2,094	3,039	5,133	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 850 gallons vacuumed out of Clay Pipe 2 and 3.
11/22/2010	3	6,264,622	6,234,179	8,086	8,470	5,519	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 850 gallons vacuumed out of Clay Pipe 2 and 3.
11/24/2010	2	6,268,953	6,239,671	4,331	5,492	4,912	
11/29/2010	5	6,283,848	6,255,368	14,895	15,697	6,118	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 550 gallons vacuumed out of Clay Pipe 2 and 3.
11/30/2010	1	6,286,148	6,258,660	2,300	3,292	5,592	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 1000 gallons vacuumed out of Clay Pipe 2 and 3.
12/01/2010	1	6,297,981	6,265,009	11,833	6,349	18,182	1.80" Rain in the last 24 hours
12/06/2010	5	6,313,572	6,291,274	15,591	26,265	8,371	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 865 gallons vacuumed out of Clay Pipe 2 and 3.
12/07/2010	1	6,315,779	6,295,047	2,207	3,773	5,980	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 875 gallons vacuumed out of Clay Pipe 2 and 3.
12/08/2010	1	6,318,010	6,298,269	2,231	3,222	5,453	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 875 gallons vacuumed out of Clay Pipe 2 and 3.
12/09/2010	1	6,320,265	6,301,476	2,255	3,207	5,462	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 875 gallons vacuumed out of Clay Pipe 2 and 3.
12/13/2010	3	6,331,750	6,313,328	11,485	11,852	7,779	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 700 gallons vacuumed out of Clay Pipe 2 and 3.
12/14/2010	1	6,333,988	6,316,081	2,238	2,753	4,991	Clay pipe 2 and 3 out of service for Toe Drain Project approximatley 250 gallons vacuumed out of Clay Pipe 2 and 3.
12/20/2010	6	6,354,044	6,343,023	20,056	26,942	7,833	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 750 gallons vacuumed out of Clay Pipe 2 and 3.
12/21/2010	1	6,356,357	6,346,470	2,313	3,447	5,760	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 925 gallons vacuumed out of Clay Pipe 2 and 3.
12/22/2010	1	6,358,527	6,350,206	2,170	3,736	5,906	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1050 gallons vacuumed out of Clay Pipe 2 and 3.
12/23/2010	1	6,360,481	6,353,455	1,954	3,249	5,203	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 500 gallons vacuumed out of Clay Pipe 2 and 3.
12/29/2010	6	6,379,059	6,377,023	18,578	23,568	7,024	
01/05/2010	7	6,400,626	6,396,303	21,567	19,280	5,835	
01/12/2011	7	6,422,450	6,420,220	21,824	23,917	6,534	

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Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
01/19/2011	7	6,444,308	6,442,997	21,858	22,777	6,376	
01/20/2011	1	6,447,485	6,445,778	3,177	2,781	5,958	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
01/24/2011	4	6,459,135	6,457,334	11,650	11,556	5,802	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 750 gallons vacuumed out of Clay Pipe 2 and 3.
01/25/2011	1	6,461,339	6,460,040	2,204	2,706	4,910	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1150 gallons vacuumed out of Clay Pipe 2 and 3.
01/27/2011	2	6,467,027	6,466,286	5,688	6,246	5,967	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
01/31/2011	4	6,479,044	6,478,832	12,017	12,546	6,141	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 750 gallons vacuumed out of Clay Pipe 2 and 3.
02/01/2011	1	6,481,341	6,481,675	2,297	2,843	5,140	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
02/02/2011	1	6,483,772	6,484,471	2,431	2,796	5,227	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
02/03/2011	1	6,486,297	6,487,349	2,525	2,878	5,403	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 900 gallons vacuumed out of Clay Pipe 2 and 3.
02/04/2011	1	6,489,024	6,490,999	2,727	3,650	6,377	
02/07/2011	3	6,497,941	6,498,771	8,917	7,772	5,563	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
02/08/2011	1	6,500,075	6,501,477	2,134	2,706	4,840	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
02/09/2011	1	6,502,406	6,504,115	2,331	2,638	4,969	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1250 gallons vacuumed out of Clay Pipe 2 and 3.
02/10/2011	1	6,504,522	6,506,758	2,116	2,643	4,759	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 925 gallons vacuumed out of Clay Pipe 2 and 3.
02/16/2011	6	6,522,758	6,522,392	18,236	15,634	5,645	
02/21/2011	5	6,537,478	6,535,233	14,720	12,841	5,512	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 750 gallons vacuumed out of Clay Pipe 2 and 3.
02/22/2011	1	6,539,853	6,537,569	2,375	2,336	4,711	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 750 gallons vacuumed out of Clay Pipe 2 and 3.
02/23/2011	1	6,542,094	6,539,877	2,241	2,308	4,549	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 750 gallons vacuumed out of Clay Pipe 2 and 3.
02/24/2011	1	6,544,509	6,542,473	2,415	2,596	5,011	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 250 gallons vacuumed out of Clay Pipe 2 and 3.
02/28/2011	4	6,559,593	6,559,415	15,084	16,942	8,007	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 250 gallons vacuumed out of Clay Pipe 2 and 3.
03/01/2011	1	6,566,044	6,567,279	6,451	7,864	14,315	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1750 gallons vacuumed out of Clay Pipe 2 and 3. Heavy Rain in the last 24 hours
03/02/2011	1	6,568,739	6,570,897	2,695	3,618	6,313	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
03/03/2011	1	6,571,507	6,573,990	2,768	3,093	5,861	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
03/07/2011	4	6,586,371	6,591,376	14,864	17,386	8,063	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1250 gallons vacuumed out of Clay Pipe 2 and 3. Heavy Rain on 03/06/2011.
03/08/2011	1	6,588,802	6,594,546	2,431	3,170	5,601	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
03/09/2011	1	6,591,482	6,597,725	2,680	3,179	5,859	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 250 gallons vacuumed out of Clay Pipe 2 and 3.
03/14/2011	6	6,611,442	6,623,726	19,960	26,001	7,660	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3.
03/15/2011	1	6,614,278	6,627,755	2,836	4,029	6,865	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 50 gallons vacuumed out of Clay Pipe 2 and 3.
03/17/2011	2	6,621,554	6,633,678	7,276	5,923	6,600	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3.
03/21/2011	4	6,634,652	6,641,007	13,098	7,329	5,107	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
03/22/2011	1	6,637,206	6,642,877	2,554	1,870	4,424	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
03/23/2011	1	6,639,957	6,644,716	2,751	1,839	4,590	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
03/24/2011	1	6,642,576	6,646,594	2,619	1,878	4,497	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3.
03/29/2011	4	6,659,149	6,656,116	16,573	9,522	6,524	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
04/04/2011	6	6,680,307	6,668,652	21,158	12,536	5,616	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 700 gallons vacuumed out of Clay Pipe 2 and 3.
04/07/2011	3	6,690,830	6,680,224	10,523	11,572	7,365	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
04/13/2011	6	6,715,873	6,700,639	25,043	20,415	7,576	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3. Heavy rain event on 04/09/2011
04/14/2011	1	6,718,547	6,702,508	2,674	1,869	4,543	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1000 gallons vacuumed out of Clay Pipe 2 and 3.
04/18/2011	4	6,733,486	6,712,374	14,939	9,866	6,201	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1500 gallons vacuumed out of Clay Pipe 2 and 3.

JOHN SEVIER FOSSIL PLANT
DRY ASH DISPOSAL FACILITY
LEACHATE COLLECTION SYSTEM DISCHARGE DATA

Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
04/19/2011	1	6,735,762	6,714,350	2,276	1,976	4,252	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1500 gallons vacuumed out of Clay Pipe 2 and 3.
04/21/2011	2	6,741,780	6,718,007	6,018	3,657	4,838	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1500 gallons vacuumed out of Clay Pipe 2 and 3.
04/25/2011	4	6,755,539	6,725,736	13,759	7,729	5,372	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1200 gallons vacuumed out of Clay Pipe 2 and 3.
04/26/2011	1	6,758,073	6,727,575	2,534	1,839	4,373	Clay pipe 2 and 3 out of service for Toe Drain Project approximately 1250 gallons vacuumed out of Clay Pipe 2 and 3.

Average Flowrate October 29, 2010 through April 26, 2011 = 6,000

Tennessee Valley Authority
John Sevier Fossil Plant
Dry Fly Ash Landfill (IDL 37-0097)

GROUNDWATER ASSESSMENT MONITORING REPORT OCTOBER 2012

Prepared by

Matthew D. Williams, PE

Knoxville, Tennessee
December 10, 2012

DOCUMENT CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information.

David P. Ball

David P. Ball, John Sevier Fossil Plant Manager
December 13, 2012

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INTRODUCTION

This report provides results of the October 2012 semiannual monitoring event of *Groundwater Assessment Monitoring - Phase 2* for the Class II Dry Fly Ash Landfill. In addition to monitoring well data, effluent sample results and flow rate data are provided for the facility leachate collection system (LCS). All water samples were analyzed by Environmental Science Corporation (ESC), an EPA-certified laboratory. Sample collection and analysis were performed in accordance with Tennessee Department of Environment and Conservation (TDEC) Rule 0400-11-01-.04 and the approved facility groundwater monitoring plan (February 25, 1998). In addition, site-specific monitoring requirements of *Groundwater Assessment Monitoring - Phase 2* were followed, as outlined in the letter dated April 5, 2007 from W.N. Smith (TDEC) to G.G. Park (TVA).

GROUNDWATER SAMPLING

Groundwater sampling was conducted October 22-25, 2012 by W.F. Nichols and J.E. Stockburger of TVA at monitoring wells 1, W28 through W32, and at the LCS. A peristaltic pump was used to purge and sample all wells. The LCS water sample was collected directly from the discharge pipe at the coal yard drainage basin. Quality control (QC) duplicate samples were collected from well W31. An equipment blank was collected between wells W31 and well W32. Field parameters (i.e., temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential) were monitored during well purging using a flow-through cell and calibrated instruments. Wells were purged utilizing EPA's Low Stress (low-flow) purging procedures[1]. Low-flow sampling involves pumping from the well at a rate that equals inflow of groundwater through the well screen, then sampling after three consecutive five-minute intervals showed stable readings of field parameters (+/-10% difference for several readings). Field data sheets are included in Appendix A.

Following collection, samples were transferred to new sample bottles with appropriate preservatives, where applicable. The samples were then sealed, labeled, recorded on a

[1]US EPA Region 1, *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*, Revision 2. July 1996.

custody form, and placed in a container for transport. Samples were delivered to ESC for analysis on October 27, 2012. Copies of the sample custody records are given in Appendix B.

ANALYTICAL RESULTS

Laboratory results for the assessment samples were completed on November 29, 2012. Table 1 presents Groundwater Protection Standards (GWPS) for facility constituents falling under Appendix II of Rule 0400-11-01-.04; GWPS are as defined in Section IV(1)(d) of *TDEC Ground Water Monitoring Guidance for Solid Waste Landfill Units Policy*. Per Policy, GWPS require consideration of the constituent MCL listed in Appendix III of Rule 0400-11-01-.04, and for constituents having no MCL (cobalt, copper, tin, vanadium, and zinc), EPA preliminary remediation goals (PRG) for tap water are applied pursuant to *Section IV(1)(d)(iii)* of the *Policy.* The GWPS was set in April 2012, and will be used until TDEC directs them to be updated. Table 2 presents a summary of the laboratory analytical results for the Appendix II samples. Other permit-required groundwater constituent results are presented in Table 3. LCS sample data are given in Table 4. Laboratory analyses of all samples were completed within recommended sample holding times. The complete laboratory report is presented in Appendix C and includes analytical methods, detection limits, and any data qualifiers.

EVALUATION OF ASSESSMENT MONITORING DATA

Facility constituents falling under Appendix II of Rule 0400-11-01-.04 were evaluated against their GWPS; the remaining non-Appendix II facility constituents were statistically evaluated using either parametric or non-parametric prediction intervals, depending on data normality, applied on an interwell basis with no verification samples. Application of interwell comparison was agreed upon by TDEC and TVA during a June 2, 2010 teleconference. Upper prediction limits (UPL) for the original permit-required constituents presented in Table 3 were computed using historical data for upgradient well 1 collected between January 6, 2000, and October 22, 2012 (Appendix D). Truncating the data set to the period since 2000 when modern sampling protocol had been implemented gives a greater confidence in the results, as well as more conservatism in the background data pool, than the full pool of data from 1986 to date.

Table 1. Groundwater Protection Standards

Parameter	Units	UPL	MCL	GWPS	MCL Source
Antimony	µg/L	6	6	6	TDEC
Arsenic	µg/L	2.5	10	10	TDEC
Barium	µg/L	255	2,000	2,000	TDEC
Beryllium	µg/L	2.7	4	4	TDEC
Cadmium	µg/L	0.5	5	5	TDEC
Chromium	µg/L	4	100	100	TDEC
Cobalt	µg/L	2	11	11	EPA-RSL
Copper	µg/L	10	620	620	EPA-RSL
Cyanide	mg/L	0.005	N/A	0.005	N/A
Lead	µg/L	1	15	15	TDEC
Mercury	µg/L	0.2	2	2	TDEC
Nickel	µg/L	3.3	100	100	TDEC
Selenium	µg/L	1.9	50	50	TDEC
Silver	µg/L	0.5	100	100	TDEC
Sulfide	mg/L	0.05	--	0.05	--
Thallium	µg/L	1	2	2	TDEC
Tin	µg/L	490	22,000	22,000	EPA-RSL
Vanadium	µg/L	2	180	180	EPA-RSL
Zinc	µg/L	95.5	4,700	4,700	EPA-RSL

TDEC - Solid Waste Processing and Disposal Rule 0400-11-01-.04
EPA-RSL - EPA Regional Screening Limit (Health-based Standard)

Results given in Table 2 indicate no GWPS exceedance for Appendix II constituents. For the non-Appendix II parameters given in Table 3, UPL exceedances were observed for alkalinity (all downgradient wells), aluminum (well W28), ammonia (wells W28 and W29), boron (all downgradient wells), chloride (well W30), fluoride (wells W30 and W31), manganese (wells W28, W29, and W30), potassium (wells W31 and W32), oxygen-reduction potential (well W29), sodium (wells W28, W29, W30, and W31), specific conductivity (all downgradient wells), strontium (all downgradient wells), and sulfate (all downgradient wells). Four wells had lower predicted limit (LPL) exceedances for pH (wells W28, W29, W30, W31).

Table 2. October 22-25, 2012 Appendix II Constituent Groundwater Monitoring Results

Analytical Results for Appendix II Constituents								Groundwater Protection Standard[b] (GWPS)	MCL	Comparison to GWPS[c]				
		1	W28	W29	W30	W31[a]	W32							
Parameter	**Units**	upgradient	downgradient	downgradient	downgradient	downgradient	downgradient			**W28**	**W29**	**W30**	**W31**	**W32**
Antimony	µg/L	<1	<1	<1	<1	<1	<1	6	6	L	L	L	L	L
Arsenic	µg/L	<1	1.9	<1	1.2	1.4	<1	10	10	L	L	L	L	L
Barium	µg/L	220	24	18	25	29.5	52	2,000	2,000	L	L	L	L	L
Beryllium	µg/L	<1	<1	<1	<1	<1	<1	4	4	L	L	L	L	L
Cadmium	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5	5	L	L	L	L	L
Chromium	µg/L	<1	<1	<1	<1	2.6	2.5	100	100	L	L	L	L	L
Cobalt	µg/L	<1	6.4	<1	2.9	<1	<1	11	11	L	L	L	L	L
Copper	µg/L	<1	<1	<1	<1	1.25	<1	620	620	L	L	L	L	L
Cyanide	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	N/A	L	L	L	L	L
Lead	µg/L	<1	<1	<1	<1	<1	<1	15	15	L	L	L	L	L
Mercury	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	2	2	L	L	L	L	L
Nickel	µg/L	1.5	9.7	4.7	11	9.4	2	100	100	L	L	L	L	L
Selenium	µg/L	<1	<1	<1	<1	3.25	<1	50	50	L	L	L	L	L
Silver	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	100	100	L	L	L	L	L
Sulfide	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	--	L	L	L	L	L
Thallium	µg/L	<1	<1	<1	<1	<1	<1	2	2	L	L	L	L	L
Tin	µg/L	<1	<1	<1	<1	<1	<1	22,000	22,000	L	L	L	L	L
Vanadium	µg/L	<2	<2	<2	<2	3.5	<2	180	180	L	L	L	L	L
Zinc	µg/L	<10	<10	<10	<10	<10	<10	4,700	4,700	L	L	L	L	L

[a] *Reported concentrations are averages of duplicate samples.*
[b] *Established April 2012.*
[c] *L = less than or equal to the GWPS; G = greater than the GWPS*

Table 3. October 22-25, 2012 Other Permit-Required Constituent Groundwater Monitoring Results

Analytical Results for Other Permit-Required Constituents								Upper Prediction Limits (UPL)[b]	MCL	Comparison to UPL[c]				
Parameter	Units	1 upgradient	W28 downgradient	W29 downgradient	W30 downgradient	W31[a] downgradient	W32 downgradient			W28	W29	W30	W31	W32
Alkalinity	mg/L	20.5	316	322	340	359.5	300	222	--	G	G	G	G	G
Aluminum	µg/L	<100	240	<100	<100	145	<100	200	--	G	L	L	L	L
Ammonia	mg/L	0.1	0.16	0.21	<0.1	<0.1	<0.1	0.14	--	G	G	L	L	L
Boron	µg/L	<200	2800	1400	4600	15500	330	225	--	G	G	G	G	G
Chloride	mg/L	9.1	13	5.8	16	10	12	15.218	--	L	L	G	L	L
Fluoride	mg/L	<0.1	<0.1	0.18	0.34	0.34	<0.1	0.23	4	L	L	G	G	L
Iron	µg/L	420	1800	<100	<100	190	<100	5400	--	L	L	L	L	L
Manganese	µg/L	32	4000	2500	2700	<10	<10	53.79	--	G	G	G	L	L
Nitrate-Nitrite	mg/L	<0.1	<0.1	<0.1	<0.1	0.175	0.53	0.53	10	L	L	L	L	L
pH	SU	7.0	6.0	6.1	6.3	6.6	6.7	6.7-7.3	--	Low	Low	Low	Low	W
Potassium	mg/L	<0.5	1.4	1.1	1.6	22	1.9	1.7	--	L	L	L	G	G
Redox	mV	143	86	617	332	420	435	606.073	--	L	G	L	L	L
Sodium	mg/L	6.5	21	11	39	99	8	9.729	--	G	G	G	G	L
Sp. Cond.	µmhos/cm	480	1768	961	2147	2931	668	499	--	G	G	G	G	G
Strontium	µg/L	800	870	900	4500	4900	290	840	--	G	G	G	G	L
Sulfate	mg/L	27	760	220	1000	1600	51	31.5	--	G	G	G	G	G
Temperature	°C	16.6	19.8	20	20.8	18	18	16.6	--	G	G	G	G	G

[a] Reported concentrations are averages of duplicate samples.

[b] Established April 2012; based on background data (well 1) from 01/06/00 to 10/22/2012.

[c] L = less than or equal to UPL; G = greater than UPL; W = within the LPL to UPL range (pH only); Low = Below the LPL (pH only)

Table 4. October 23, 2012 Leachate Collection System Monitoring Results

Parameter	Units	Concentration
Alkalinity	mg/L	295
Aluminum	ug/L	<100
Ammonia (as N)	mg/L	0.11
Antimony	ug/L	<1
Arsenic	ug/L	1
Barium	ug/L	40
Beryllium	ug/L	<1
Boron	ug/L	5300
Cadmium	ug/L	<0.5
Chloride	mg/L	13
Chromium	ug/L	1.2
Cobalt	ug/L	<1
Copper	ug/L	<1
Cyanide	mg/L	<0.005
Fluoride	mg/L	0.3
Iron	ug/L	180
Lead	ug/L	<1
Manganese	ug/L	72
Mercury	ug/L	<0.2
Nickel	ug/L	5.2
Nitrate-Nitrite	mg/L	0.3
pH	s.u.	6.58
Potassium	mg/L	5.8
Redox	mV	374
Selenium	ug/L	1.5
Silver	ug/L	<0.5
Sodium	mg/L	38
Sp. Cond.	umhos/cm	1679
Strontium	ug/L	3100
Sulfate	mg/L	740
Sulfide	mg/L	<0.05
Temperature	°C	22.7
Thallium	ug/L	<1
Tin	ug/L	<1
Vanadium	ug/L	<2
Zinc	ug/L	<10

Time-series graphs of Appendix II sample constituent data for wells 1, W28, W29, W30, W31, and W32 are presented in Appendix E. Nearly all constituent concentration trends are stable or declining. Cobalt concentrations in well W30 appear to be trending slightly upward, but the magnitude of this increase is relatively small, and is still well below the site GWPS. Nickel concentrations in most facility wells have been seen increases in magnitude since 2007, likely due to a change in laboratories and analytical methods, but have remained relatively steady since the switch. Sporadic spikes in cadmium concentrations in well W31 have been noted since a change in laboratories in 2007, and were the focus of a previous investigation into an analytical interference.

DISCUSSION OF CADMIUM INTERFERENCE

Elevated concentrations of cadmium in well W31 observed over the past five years are attributed to laboratory interference. An interference caused by the presence of elevated levels of molybdenum oxide (correlating with an elevated presence of molybdenum) was identified by ESC following an internal lab audit performed during Spring 2011. An increased flow of oxygen within the Inductively Coupled Plasma Mass Spectrometry (ICP-MS, EPA method 6020) instrument (ELAN DRC II) utilized for cadmium analysis can help to control this interference. This is detailed in an application note by the lab equipment manufacturer PerkinElmer Life and Analytical Sciences published in Appendix E of the April 2011 facility monitoring report.

Analysis of the October 2012 well W31 cadmium metals sample was performed by ESC both with and without the molybdenum interference correction. The result for the uncorrected sample and duplicate analyzed October 31, 2012, were 7.6 µg/L and 8.6 µg/L, respectively. The corrected sample and duplicate analyzed November 28, 2012, were below the detectable level (0.5 µg/L). Cadmium was never observed in this well before 2007, when cadmium was analyzed by another lab (TVA Central Laboratory Service) using an alternative analysis method (Graphite Furnace Atomic Absorption or GFAA, EPA method 7131). Typically cadmium has not been found at this facility, with most results since 2000 being largely non-detectable values. The QA/QC correction appears to influence the sample result, bringing it closer in line with what was observed from to comparison labs, as detailed in the April 2011 Groundwater Assessment Monitoring Report.

HYDROGEOLOGIC CONDITIONS

Groundwater levels measured in site monitoring wells on October 22, 2012, prior to sample collection are given in Table 5. The groundwater potentiometric surface derived from these measurements is presented on Figure 1. Groundwater generally flows northwestward across the fly ash landfill toward the Holston River.

Table 5. October 22, 2012 Groundwater Level Measurements

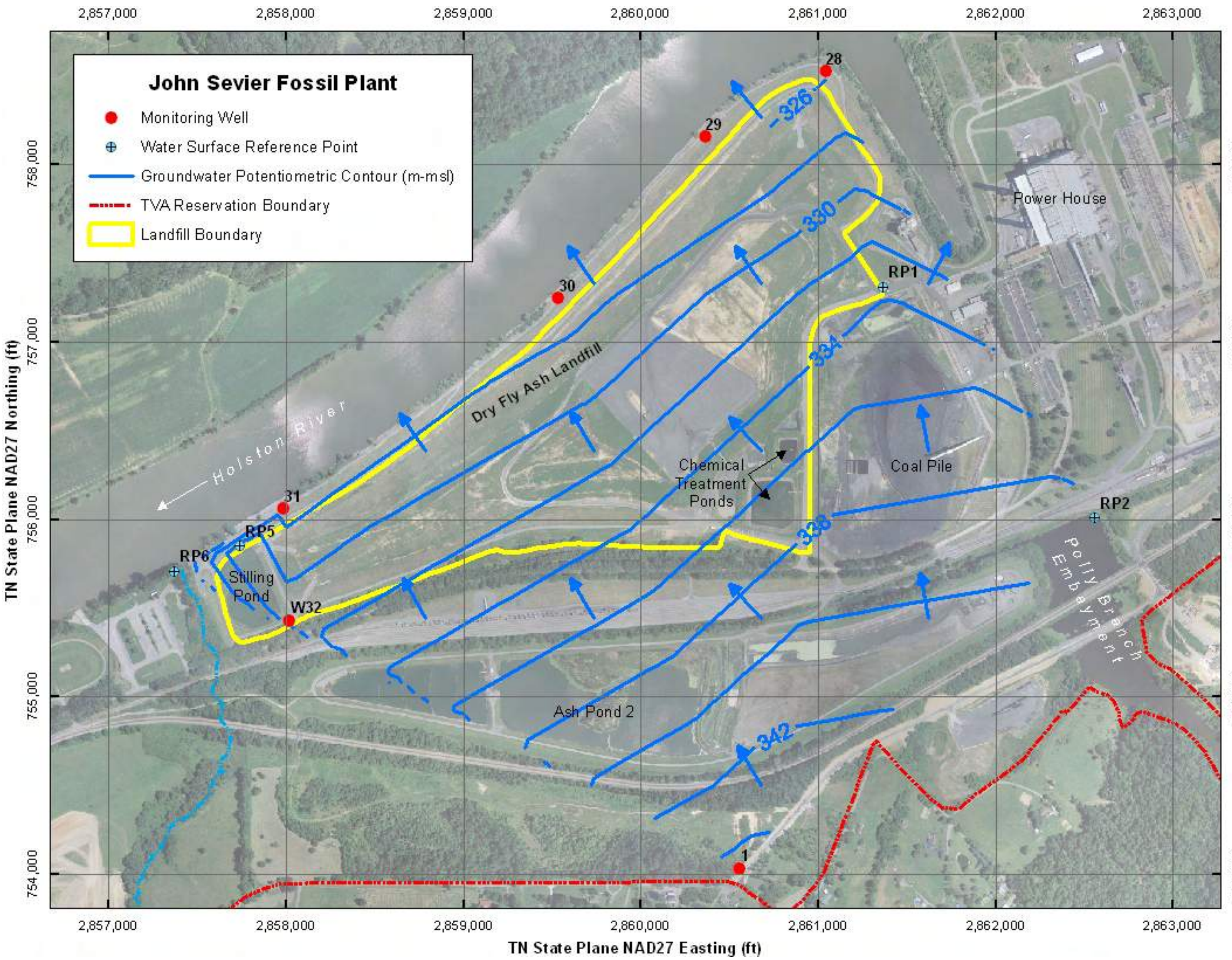
Well No.	Top of Casing Elevation (m)	Depth to Water (m)	Water Elevation (m)	Bottom Depth (m)
1	349.04	4.44	344.60	23.13
W28	331.54	5.80	325.74	8.59
W29	328.71	4.02	324.69	6.44
W30	328.99	2.15	326.84	6.12
W31	330.59	3.26	327.33	5.36
W32	336.48	5.21	331.27	7.80
MW-3	328.89	3.29	325.60	6.97

An average hydraulic gradient of approximately 0.0173 is estimated between the southeastern and northwestern boundaries of the landfill. The shallow alluvial aquifer underlying the dry fly ash landfill exhibits a mean horizontal hydraulic conductivity of 0.006 m/d (7×10^{-6} cm/s). The local Darcy flux is therefore estimated to be approximately 1.0×10^{-4} m/d.

LEACHATE COLLECTION SYSTEM DISCHARGE

Appendix F provides a complete record of average daily discharge estimates for the LCS since operation began in April 2000. Three additional pumps were placed into service with the addition of a toe drain system for the Dry Fly Ash Stack during the Spring 2011. Also included at the bottom of the table is the estimated average LCS discharge rate observed during the past semiannual monitoring period, i.e., between April 30, 2012, and October 22, 2012. Pumpage during this period averaged approximately 9,827 gpd.

Figure 1. Groundwater Potentiometric Surface on October 22, 2012



CONCLUSIONS

Groundwater monitoring data for the October 22-25, 2012, sampling event indicated no GWPS exceedance for any Appendix II parameter. Among the non-Appendix II parameters, UPL exceedances were observed for alkalinity (all downgradient wells), aluminum (well W28), ammonia (wells W28 and W29), boron (all downgradient wells), chloride (well W30), fluoride (wells W30 and W31), manganese (wells W28, W29, and W30), potassium (wells W31 and W32), oxygen-reduction potential (well W29), sodium (wells W28, W29, W30, and W31), specific conductivity (all downgradient wells), strontium (all downgradient wells), and sulfate (all downgradient wells). In addition, the pH for wells W28, W29, W30, and W31 were all below the LPL.

An investigation into a potential interference that has hindered the TVA contract lab's (ESC) ability to accurately assess cadmium results for well W31 has identified a potential QA/QC issue that appears to be correctable. The equipment manufacturer (ParkinElmer) has identified known molybdenum oxide interference for the equipment ESC utilizes for this ICP-MS analysis that can be controlled by adjusting the flow rate of oxygen within the sampling device (ELAN DRC II). Application of this QA/QC control has resulted in a less than detectable cadmium concentration (< 0.5 µg/L) in the well W31 sample collected during the October 2012 sampling event. Comparative laboratory testing has demonstrated a bias in the uncorrected samples that inflate the cadmium result. There is no further planned cadmium analytical method comparison testing, but comparison samples could be run should any well W31 cadmium result be observed significantly above the historical range.

The facility groundwater monitoring network will next be sampled during April 2013.

APPENDIX A

FIELD DATA SHEETS

Preliminary Groundwater Data Field Worksheet

Sheet 1 of 1

Project/Site	Well Number	Purge Date	Year	Month	Day
John Sevier Ground Water	LCS 84068		12	10	23

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
--------- 4195	-------- 4194	--------- 4188	WFN	JES

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	
---------- 4191	To	---------- 4190	JSF-LSC-~~0412~~102312	☒ Unfiltered ☐ Filtered ☐ Both Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor =	Well Volume	Target Purge Volume	Actual Purge Volume
[(--------)m - (---------)m] x (--------)L/m =	--------- (L)	N/A (L)	-------- (L) 4186

Purge Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): none

Sample Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): none

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge ➔	1345	—	—	—	22.7	6.58	6.87	1679	374	33.3

Remarks:

Reviewed By: 10/31/12 11/09/12

Survey Leader Date Project Leader Date

Sample Collector: WFN			
Sample Date			Time
Year 12	Month 10	Day 23	1350 ET CT
Pump Duration: —			min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
1350	—	—	22.7	6.58	6.87	1679	374	33.3
	4193	4192	10	400	300	94	90	

Additional Sample Data

Analyst: JES					Well Diameter (mm)	Vol. Factor (L/m)
Date Analyzed	415	431	436	437	12.7 (0.5 in)	0.127
Year 12 / Month 10 / Day 23	Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)	51 (2 in)	2.027
		295		80	76 (3 in)	4.560
Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid	Time:	Time: 1722	Time:	Time: 1936	102 (4 in)	8.107
	Initial:	Initial: JES	Initial:	Initial: JES	127 (5 in)	12.668
					153 (6 in)	18.228

Color: none

Odor: none

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

TVA 30066A [2-2008]

Preliminary Groundwater Data Field Worksheet

Sheet 1 of 1

Project/Site	Well Number	Purge Date	Year	Month	Day
John Sevier Ground Water	1 84068		12	10	22

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
4.44 4195	23.95 4194	102 4188	WFN	JES

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	☒ Unfiltered ☐ Filtered ☐ Both
7.8 4191		24.2 4190	JSF-1-102212	Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor =	Well Volume	Target Purge Volume	Actual Purge Volume
[(23.95)m - (4.44)m] x (8.107)L/m =	158.2 (L)	N/A (L)	13.0 (L) 4186

Purge Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1054	440	4.44	11	16.5	7.1	1.3	500	90	49.3
pump ID:100	1058	440	4.77		16.4	6.8	0.4	500	128	33.9
98	1102	340	4.79		16.5	6.9	0.3	495	138	35.6
	1106	350	4.77		16.5	6.9	0.3	491	143	20.9
	1110	350	4.77		16.5	6.9	0.2	485	144	15.7
	1114	350	4.77		16.5	6.9	0.2	482	145	10.9
	1118	355	4.77		16.5	6.9	0.2	482	145	6.0
	1122	355	4.77		16.6	7.0	0.2	480	144	3.6
	1126	355	4.77		16.6	7.0	0.2	480	144	3.7
	1130	355	4.77		16.6	7.0	0.2	480	143	3.6

Remarks:

Reviewed By: William Neil (Survey Leader) 10/31/12 (Date) [signature] (Project Leader) 11/09/12 (Date)

Sample Collector: WFN

Sample Date			Time
Year	Month	Day	1140
12	10	22	ET CT

Pump Duration: 36 min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
1140	355	11	16.6	7.0	0.2	480	143	3.6
	4193	4192	10	400	300	94	90	

Additional Sample Data

Analyst: JES

415	431	436	437
	20.5		23
Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)
Time:	Time: 1555	Time:	Time: 1739
Initial:	Initial: JES	Initial:	Initial: JES

Date Analyzed		
Year	Month	Day
12	10	22

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required: ☐ BOD ☐ TOC ☐ COD ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☐ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

TVA 30066A [2-2008]

Preliminary Groundwater Data Field Worksheet

Sheet 1 of 2

Project/Site	Well Number	Purge Date	Year	Month	Day
John Sevier Ground Water	W28 84068		12	10	22

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
5.80 4195	8.52 4194	51 4188	WFN	JES

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	☒ Unfiltered ☐ Filtered ☐ Both
4.21 4191	To	7.26 4190	JSF-W28-102212	Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor =	Well Volume	Target Purge Volume	Actual Purge Volume
[(8.52)m - (5.80)m] x (2.027)L/m =	5.5 (L)	N/A (L)	15.2 (L) 4186

Purge Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge ➔	1302	230	5.80	7	20.3	5.6	1.1	1770	156	>1K
pump ID: 97	1306	250	5.92		19.3	5.7	0.8	1762	121	>1K
	1310	250	5.98		19.2	5.5	0.6	1764	117	977
	1314	250	6.04		19.2	5.5	0.5	1767	118	754
	1318	250	6.09		19.2	5.6	0.5	1766	114	480
	1322	250	6.15		19.1	5.6	0.4	1770	107	336
Pump ID: 96	1326	200	6.17		19.4	5.7	0.5	1770	99	237
	1330	200	6.20		19.4	5.7	0.4	1768	96	182
	1334	200	6.23		19.4	5.7	0.4	1770	94	140
95	1338	140	6.24		20.0	5.8	0.5	1765	89	120
	1342	140	6.25		20.1	5.8	0.5	1772	85	96
	1346	140	6.25		20.0	5.9	0.5	1764	85	89
	1350	140	6.26		19.9	5.9	0.5	1769	84	81
	1354	140	6.28		20.0	5.9	0.5	1768	84	75
	1358	140	6.28		20.0	5.9	0.5	1768	85	73

Remarks:

Reviewed By: [signature] 10/31/12 [signature] 11/09/12

Survey Leader Date Project Leader Date

Sample Collector: WFN

Sample Date			Time
Year	Month	Day	1430
12	10	22	ET CT

Pump Duration: 80 min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
1430	140	7	19.8	6.0	0.5	1768	86	44
	4193	4192	10	400	300	94	90	

Additional Sample Data

Analyst: JES		316		360	Well Diameter (mm)	Vol. Factor (L/m)
Date Analyzed	415	431	436	437	12.7 (0.5 in)	0.127
Year 12 Month 10 Day 22	Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)	51 (2 in) / 76 (3 in) / 102 (4 in)	2.027 / 4.560 / 8.107
Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid	Time: / Initial:	Time: 1616 Initial: JES	Time: Initial:	Time: 1828 Initial: JES	127 (5 in) / 153 (6 in)	12.668 / 18.228

Color: none

Odor: none

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

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Preliminary Groundwater Data Field Worksheet

Sheet 2 of 2

Project/Site	Well Number	Purge Date Year	Month	Day
John Sevier Ground Water	W28 (84068)	12	10	22

Depth to Water (m) 4195	Bottom of Well (m) 4194	Well Diameter (mm) 4188	Survey Leader	Field Crew
5.80	8.52	51	WFN	JES

☒ Depth of Screen ☐ Open Bore Hole

4.21 (m) 4191 To 7.26 (m) 4190

Sample Label: JSF-28-102212

☒ Unfiltered ☐ Filtered ☐ Both
Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor = Well Volume
[(8.52)m - (5.80)m] x (2.027)L/m = 5.5 (L)

Target Purge Volume: N/A (L)
Actual Purge Volume: 15.2 (L) 4186

Purge Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):
Sample Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1402	140	6.29	7	20.0	5.9	0.5	1770	86	63
	1406	140	6.30		20.0	5.9	0.5	1769	86	56
	1410	140	6.31		20.0	5.9	0.5	1769	86	54
	1414	140	6.31		19.9	5.9	0.5	1767	87	46
	1418	140	6.32		19.9	6.0	0.5	1764	86	45
	1422	140	6.33		19.8	6.0	0.5	1768	86	44

Remarks:

Reviewed By: [signature] Survey Leader, Date 10/31/12; [signature] Project Leader, Date 11/09/12

Sample Collector: WFN
Sample Date: Year 12, Month 10, Day 22; Time 1430 ET CT
Pump Duration: 80 min 72004
"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min) 4193	Pump Depth (m) 4192	Temp °C EPA 170.1 (10)	pH (s.u.) EPA 150.1 (400)	DO (mg/L) EPA 360.1 (300)	COND (umhos/cm) EPA 120.1 (94)	(+/-) ORP (mv) SM 2580B (90)	Turbidity (NTU) EPA 180.1
1430	140	7	19.8	6.0	0.5	1768	86	44

Additional Sample Data

Analyst: JES
Date Analyzed: Year 12, Month 10, Day 22

	415 Phenol Alkalinity mg/L (EPA 310.1)	431 Total Alk. mg/L (EPA 310.1)	436 Mineral Acidity mg/L (EPA 305.1)	437 CO_2 Acidity mg/L (EPA 305.1)
Value	/	31.6	/	360
Time:	/	1616	/	1828
Initial:		JES		JES

Turbidity 1350: ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid
Color: None
Odor: None

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☐ TIC ☐ Ferrous ☐ Metals ☐ Dis. Metals ☐ Mineral ☐ Dis. Mineral ☐ Nutrient ☐ Phenol ☐ Filt TIC ☐ TSS/TDS
Others (list):

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Preliminary Groundwater Data Field Worksheet

Project/Site	Well Number	Purge Date Year	Month	Day
John Sevier Ground Water	W29 84068	12	10	23

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
3.99 4195	6.44 4194	51 4188	WFN	JES

☒ Depth of Screen ☐ Open Bore Hole

(m)		(m)	Sample Label	☒ Unfiltered ☐ Filtered ☐ Both
4.21 4191	To	6.44 4190	JSF-W29-102312	Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor =	Well Volume	Target Purge Volume	Actual Purge Volume
[(6.44)m - (3.99)m] x (2.027)L/m =	5.6 (L)	N/A (L)	7.5 (L) 4186

Purge Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1112	310	3.99	4.5	20.0	6.0	0.9	927	427	36.0
	1116	260	4.11		19.9	6.0	0.8	961	530	12.2
	1120	200	4.17		19.9	6.1	0.7	981	589	8.0
	1124	180	4.20		19.9	6.1	0.6	981	604	6.0
	1128	180	4.24		19.9	6.1	0.6	976	611	5.7
	1132	180	4.28		19.9	6.1	0.6	972	618	3.8
	1136	180	4.33		20.0	6.1	0.6	969	625	3.4
	1140	180	4.37		20.0	6.1	0.5	950	619	3.9
	1144	170	4.40		19.9	6.1	0.5	957	612	4.1
	1148	170	4.44		20.0	6.1	0.5	960	616	3.9
	1152	170	4.46		20.0	6.1	0.5	961	617	4.0

Remarks:

Reviewed By: Willie Neil 10/31/12 Matt Wilde 11/09/12

Survey Leader Date Project Leader Date

Sample Collector: WFN

Sample Date Year	Month	Day	Time
12	10	23	1200 ET CT

Pump Duration: 40 min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
	4193	4192	10	400	300	94	90	
1200	170	4.5	20.0	6.1	0.5	961	617	4.0

Additional Sample Data

Analyst: JES

Date Analyzed Year	Month	Day
12	10	23

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

415 Phenol Alkalinity mg/L (EPA 310.1)	431 Total Alk. mg/L (EPA 310.1)	436 Mineral Acidity mg/L (EPA 305.1)	437 CO_2 Acidity mg/L (EPA 305.1)
	322		190
Time:	Time: 1635	Time:	Time: 1846
Initial:	Initial: JES	Initial:	Initial: JES

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

TVA 30066A [2-2008]

Preliminary Groundwater Data Field Worksheet

Sheet 1 of 1

Project/Site	Well Number	Purge Date	Year	Month	Day
John Sevier Ground Water	W30 84068		12	10	23

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
2.11 4195	6.11 4194	51 4188	WFN	JES

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	
2.99 4191	To	6.11 4190	JSF-W30-102312	☒ Unfiltered ☐ Filtered ☐ Both Filter Type and Size:

[Bottom of Well	-	Depth to Water]	x	Volume Factor	=	Well Volume	Target Purge Volume	Actual Purge Volume
[(6.11)m	-	(2.11)m]	x	(2.027)L/m	=	8.1 (L)	N/A (L)	16.2 (L) 4186

Purge Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge ➔	1236	450	2.11	3	22.0	6.4	3.3	2006	404	25.1
	1240	450	2.36		21.3	6.4	0.4	2143	376	18.3
	1244	450	2.38		21.0	6.3	0.3	2151	363	8.31
	1248	450	2.38		20.9	6.3	0.2	2147	356	6.6
	1252	450	2.38		20.8	6.3	0.2	2150	350	4.9
	1256	450	2.38		20.8	6.3	0.2	2151	345	4.6
	1300	450	2.38		20.8	6.3	0.2	2151	341	4.3
	1304	450	2.38		20.7	6.3	0.2	2150	338	3.6
	1308	450	2.38		20.8	6.3	0.2	2150	335	3.6
	1312	450	2.38		20.8	6.3	0.2	2147	332	4.1

Remarks:

Reviewed By: [signature] 10/31/12 [signature] 11/09/12

Survey Leader Date Project Leader Date

Sample Collector:	WFN	
Sample Date		**Time**
Year	Month	Day
12	10	23
Time	1315	ET CT
Pump Duration:	36	min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
1315	450	3	20.8	6.3	0.2	2147	332	4.1
	4193	4192	10	400	300	94	90	

Additional Sample Data

Analyst: JES	415 Phenol Alkalinity mg/L (EPA 310.1)	431 Total Alk. mg/L (EPA 310.1)	436 Mineral Acidity mg/L (EPA 305.1)	437 CO_2 Acidity mg/L (EPA 305.1)
Value	/	340	/	285
Time:		1655		1922
Initial:		JES		JES

Date Analyzed: Year 12, Month 10, Day 23

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

TVA 30066A [2-2008]

Preliminary Groundwater Data Field Worksheet

Sheet 1 of 1

Project/Site	Well Number	Purge Date	Year	Month	Day
John Sevier Ground Water	W31 84068		12	10	25

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
3.26 4195	5.36 4194	51 4188	WFN	JES

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	
2.32 4191		5.36 4190	JSF-W31102512 JSF-W31-102512-DUP	☒ Unfiltered ☐ Filtered ☐ Both Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor =	Well Volume	Target Purge Volume	Actual Purge Volume
[(5.36)m - (3.26)m] x (2.027)L/m =	4.3 (L)	N/A (L)	11.0 (L) 4186

Purge Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	0850	~~0850~~	3.26	5	18.2	6.6	0.6	2921	438	68.5
PumpID: 96	0854	260	3.27		18.1	6.6	0.6	2889	429	58.1
	0858	260	3.28		17.7	6.6	0.6	2883	428	73.0
	0902	260	3.27		17.7	6.6	0.6	2900	426	76.0
	0906	260	3.27		17.8	6.6	0.6	2911	424	70.2
95	0910	160	3.26		17.7	6.6	0.5	2918	424	56.0
	0914	150	3.26		17.3	6.6	0.6	2927	424	46.5
	0918	160	3.26		17.2	6.6	0.6	2930	424	49.1
	0922	160	3.26		17.4	6.6	0.6	2927	424	42.6
	0926	160	3.26		17.5	6.6	0.6	2928	424	37.7
Changed CO2	0930	160	3.26		17.0	6.6	0.7	2943	423	34.1
	0934	160	3.26		17.0	6.6	0.6	2940	423	30.4
	0938	160	3.26		17.9	6.6	0.6	2930	422	31.2
	0942	160	3.26		17.9	6.6	0.6	2931	421	32.7
	0946	160	3.26		18.0	6.6	0.5	2931	420	32.1

Remarks: Duplicates collected at W31.

Reviewed By: [signature] Survey Leader 10/31/12 Date [signature] Project Leader 11/01/12 Date

Sample Collector:	WFN	
Sample Date		**Time**
Year 12	Month 10	Day 25 — 0950 ET CT
Pump Duration:	56 min	72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min) 4193	Pump Depth (m) 4192	Temp °C EPA 170.1 (10)	pH (s.u.) EPA 150.1 (400)	DO (mg/L) EPA 360.1 (300)	COND (umhos/cm) EPA 120.1 (94)	(+/-) ORP (mv) SM 2580B (90)	Turbidity (NTU) EPA 180.1
0950	160	5	18.0	6.6	0.5	2931	420	32.1

Additional Sample Data

Analyst: JES	415 Phenol Alkalinity mg/L (EPA 310.1)	431 Total Alk. mg/L (EPA 310.1)	436 Mineral Acidity mg/L (EPA 305.1)	437 CO_2 Acidity mg/L (EPA 305.1)
Date Analyzed: Year 12, Month 10, Day 25		362 | 357		91 | 93
Time:		1605 1545		1440 1500
Initial:		JES JES		JES JES

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Turbidity 1350: ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

TVA 30066A [2-2008]

Preliminary Groundwater Data Field Worksheet

Sheet 1 of 2

Project/Site	Well Number	Purge Date	Year	Month	Day
John Sevier Ground Water	W32 84068		12	10	25

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
5.21 4195	7.7 4194	51 4188	WFN	JES

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	
4.79 4191	To	7.74 4190	JSF-W32-102512	☒ Unfiltered ☐ Filtered ☐ Both Filter Type and Size:

[Bottom of Well	-	Depth to Water]	x	Volume Factor	=	Well Volume	Target Purge Volume	Actual Purge Volume
[(7.7)m	-	(5.21)m]	x	(2.027)L/m	=	5.1 (L)	N/A (L)	10.3 (L) 4186

Purge Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →	1108	150	5.21	6	17.5	6.6	2.8	673	418	55.9
pump ID: 96	1112	160	5.28		17.5	6.6	2.2	655	427	62.6
	1116	160	5.32		17.5	6.6	2.3	645	432	57.4
	1120	160	5.36		17.6	6.6	2.5	624	440	39.4
	1124	160	5.40		17.6	6.6	2.4	623	443	27.6
	1128	160	5.43		17.7	6.6	2.1	624	445	24.7
	1132	160	5.47		17.8	6.6	2.0	624	447	18.8
	1136	160	5.50		18.0	6.6	1.8	628	447	15.4
	1140	160	5.53		18.0	6.6	1.6	632	447	13.1
	1144	160	5.56		18.1	6.6	1.5	637	446	11.9
	1148	160	5.59		18.4	6.6	1.4	643	444	10.3
	1152	160	5.62		18.3	6.6	1.3	649	443	10.0
	1156	160	5.65		18.1	6.6	1.1	657	441	8.5
	1200	160	5.68		18.1	6.7	0.9	666	438	8.0
	1204	160	5.70		18.0	6.7	0.9	669	437	7.1

Remarks:

Reviewed By: [signature] 10/31/12 [signature] 11/09/12

Survey Leader Date Project Leader Date

Sample Collector: WFN

Sample Date			Time
Year	Month	Day	1215
12	10	25	ET CT

Pump Duration: 64 min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
1215	160	6	18.0	6.7	0.9	668	435	7.3
	4193	4192	10	400	300	94	90	

Additional Sample Data

Analyst: JES

Date Analyzed		
Year	Month	Day
12	10	25

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

	415	431	436	437
Value		300		70
Parameter	Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)
Time:		1529		1512
Initial:		JES		JES

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

TVA 30066A [2-2008]

Preliminary Groundwater Data Field Worksheet

Sheet 2 of 2

Project/Site	Well Number	Purge Date	Year	Month	Day
John Sevier Ground Water	W32 84068		12	10	25

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
5.21 4195	7.7 4194	51 4188	WFN	JES

☒ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	
4.79 4191	To	7.74 4190	JSF-W32-102512	☒ Unfiltered ☐ Filtered ☐ Both Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor =	Well Volume	Target Purge Volume	Actual Purge Volume
[(7.7)m - (5.21)m] x (2.027)L/m =	5.1 (L)	N/A (L)	10.3 (L) 4186

Purge Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Sample Pump: ☒ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list):

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge ➔	1208	160	5.73	6	17.9	6.7	0.9	668	436	7.0
	1212	160	5.76		18.0	6.7	0.9	668	435	7.3

Remarks:

Reviewed By: [signature] 10/31/12 [signature] 11/09/12

Survey Leader Date Project Leader Date

Sample Collector: WFN			
Sample Date			Time
Year 12	Month 10	Day 25	1215 ET CT
Pump Duration: 64			min 72004

"999" = 2 days

Sample Readings

Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1
	4193	4192	10	400	300	94	90	
1215	160	6	18.0	6.7	0.9	668	435	7.3

Additional Sample Data

Analyst: JES	415	431	436	437
Date Analyzed: Year 12 Month 10 Day 25	Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)
	/	300	/	70
	Time:	Time: 1529	Time:	Time: 1512
	Initial:	Initial: JES	Initial:	Initial: JES

Turbidity 1350 ☒ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid

Color: none

Odor: none

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☒ TIC ☐ Ferrous ☒ Metals ☐ Dis. Metals ☒ Mineral ☐ Dis. Mineral ☒ Nutrient ☐ Phenol ☐ Filt TIC ☒ TSS/TDS

Others (list): FQ Cyanide Sulfide Cl/Fl

TVA 30066A [2-2008]

APPENDIX B

SAMPLE CUSTODY RECORD

G207

Chain of Custody Page 1 of 1

TVA-Environmental Affairs

400 W. Summit Hill Mailstop TVA WT
Knoxville,TN 37902

Billing information:

TVA Accounts Payable
1101 Market St. Mailstop: LP-5D-C

Chattanooga,TN 37402

ESC LAB SCIENCES
12065 Lebanon Road
Mt. Juliet, TN 37122

Phone: (800) 767-5859
Phone: (615) 758-5858
Fax: (615) 758-5859

Report to: Mr. J. Mark Boggs

Email: jmboggs@tva.gov,edmsvk@t

Project Description: JSF Dry Stack

City/State Collected:

Phone: (865) 632-6941
FAX:

Client Project #: JSF Dry Stack

Lab Project #: TVAENVAFF-JSF DRYSTK

Collected by (print): William Nichols

Site/Facility ID#:

P.O.#:

Collected by (signature): [signature]

Immediately Packed on Ice N ___ Y ✓

Rush? (Lab MUST Be Notified)
___ Same Day 200%
___ Next Day 100%
___ Two Day 50%
___ Three Day 25%

Date Results Needed: STD

Email? __No X Yes
FAX? __No __Yes

Acctnum: TVAENVAFF (lab use only)
Template/Prelogin: T81336/ P406927
Cooler #:
Shipped Via: FedEX Ground

Analysis/Container/Preservative

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	CN 250mlHDPEAmb-NaOH >12	Cl,F,SO4 125mlHDPE-NoPres	IC 250mlAmb-No Pres	Metals 500mlHDPE-HNO3 <2	NH3 500mlHDPENaThioH2SO4 <2	SULFIDE 500mlHDPE-NaOH+ZnAc >12	TDS 250mlHDPE-NoPres	TKN,NO2NO3 250mlHDPE-H2SO4 <2	Remarks/Contaminant	Sample # (lab only)
JSF-W1-102212	Grab	WW	11	102212	1140	9	X	X	X	X	X	X	X	X	EDD	L603152-01
JSF-W28-102212		WW	7	102212	1430	9	X	X	X	X	X	X	X	X		02
JSF-W29-102312		WW	4.5	102312	1200	9	X	X	X	X	X	X	X	X		03
JSF-W30-102312		WW	3	102312	1315	9	X	X	X	X	X	X	X	X		04
JSF-W31-102512		WW	5	102512	0950	9	X	X	X	X	X	X	X	X		05
JSF-W31-102512-DUP		WW	~~6~~ 5	102512	0950	9	X	X	X	X	X	X	X	X		06
JSF-W32-102512		WW	6	102512	1215	9	X	X	X	X	X	X	X	X		07
JSF-LCS-102312		WW	N/A	102312	1350	9										
JSF-EQ-Blank-102512		WW	N/A	102512	1050	9										

*Matrix: **SS** - Soil **GW** - Groundwater **WW** - WasteWater **DW** - Drinking Water **OT** - Other ________

Remarks:

pH ________ Temp ________

Flow ________ Other ________

541347767900
541347767896 541347767885

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)
[signature]	102612	1400	
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)
Relinquished by: (Signature)	Date:	Time:	Received for lab by: (Signature)
			Kim Wilson

Samples returned via: ☐ UPS ☑ FedEx ☐ Courier ☐ ____

Temp: 3.4 Bottles Received: 81

Date: 10/27/12 Time: 1000

Condition: OK (lab use only)

COC Seal Intact: ✓ Y ___ N ___ NA

pH Checked: <2 >12

NCF: X

APPENDIX C

LABORATORY ANALYTICAL REPORT

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT 9D-K
Knoxville, TN 37902

Report Summary

Thursday November 29, 2012

Report Number: L603152
Samples Received: 10/27/12
Client Project: JSF-W1

Description: JSF Dry Stack

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By:

Roberto Celia , ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - 01157CA, CT - PH-0197,
FL - E87487, GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016,
NC - ENV375/DW21704/BIO041, ND - R-140. NJ - TN002, NJ NELAP - TN002,
SC - 84004, TN - 2006, VA - 460132, WV - 233, AZ - 0612,
MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032011-1,
TX - T104704245-11-3, OK - 9915, PA - 68-02979, IA Lab #364

Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.
Note: The use of the preparatory EPA Method 3511 is not approved or endorsed by the CA ELAP.

Where applicable, sampling conducted by ESC is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-01

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W1-102212 11 FT

Project # : JSF-W1

Collected By : William Nichols
Collection Date : 10/22/12 11:40

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	9.1	1.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1119	KSG
Fluoride	BDL	0.10	mg/l	300.0	11/02/12 1254	236	11/03/12 1119	KSG
Sulfate	27.	5.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1119	KSG
Cyanide	BDL	0.0050	mg/l	4500CN-E	10/30/12 1755	556	10/31/12 1219	JAL
Ammonia Nitrogen	0.10	0.10	mg/l	350.1	11/13/12 1630	556	11/14/12 1138	JAL
Nitrate-Nitrite	BDL	0.10	mg/l	353.2	11/03/12 1126	508	11/03/12 1138	LED
Sulfide	BDL	0.050	mg/l	4500-S2 D	10/29/12 1700	143	10/29/12 1727	CWP
Kjeldahl Nitrogen, TKN	0.14	0.10	mg/l	351.2	11/13/12 1005	556	11/15/12 0835	JAL
Total Inorganic Carbon	49.	1.0	mg/l	5310B	11/05/12 1040	526	11/08/12 1219	CJM
Dissolved Solids	290	10.	mg/l	2540C	10/29/12 1516	365	10/30/12 1021	RHK
Suspended Solids	BDL	1.0	mg/l	2540D	10/29/12 1626	519	10/29/12 1635	MGM
Antimony	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Arsenic	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Barium	0.22	0.010	mg/l	200.8	10/30/12 1549	549	11/01/12 1142	LAT
Beryllium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Cadmium	BDL	0.00050	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Chromium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Cobalt	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Copper	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Lead	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Nickel	0.0015	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Selenium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Silver	BDL	0.00050	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Thallium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Tin	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Vanadium	BDL	0.0020	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Zinc	BDL	0.010	mg/l	200.8	10/30/12 1549	549	11/01/12 1928	LAT
Mercury	BDL	0.00020	mg/l	245.1	10/30/12 1140	529	10/30/12 2116	CCE
Aluminum	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1545	WC
Boron	BDL	0.20	mg/l	200.7	11/01/12 1128	580	11/05/12 1545	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
The reported analytical results relate only to the sample submitted

L603152-01 (TSS) - Sample split with duplicate.

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-01

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W1-102212 11 FT

Project # : JSF-W1

Collected By : William Nichols
Collection Date : 10/22/12 11:40

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	83.	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1545	WC
Iron	0.42	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1545	WC
Magnesium	8.8	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1545	WC
Manganese	0.032	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1545	WC
Potassium	BDL	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1545	WC
Sodium	6.5	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1545	WC
Strontium	0.80	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1545	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Reported: 11/29/12 10:16 Printed: 11/29/12 11:43
L603152-01 (TSS) - Sample split with duplicate.

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Sample ID : JSF-W28-102212 7 FT

Collected By : William Nichols
Collection Date : 10/22/12 14:30

ESC Sample # : L603152-02

Site ID :

Project # : JSF-W28

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	13.	1.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1418	KSG
Fluoride	BDL	0.10	mg/l	300.0	11/02/12 1254	236	11/03/12 1418	KSG
Sulfate	760	50.	mg/l	300.0	11/02/12 1254	236	11/03/12 1923	KSG
Cyanide	BDL	0.0050	mg/l	4500CN-E	10/30/12 1755	556	10/31/12 1223	JAL
Ammonia Nitrogen	0.16	0.10	mg/l	350.1	11/13/12 1630	556	11/14/12 1139	JAL
Nitrate-Nitrite	BDL	0.10	mg/l	353.2	11/03/12 1126	508	11/03/12 1139	LED
Sulfide	BDL	0.050	mg/l	4500-S2 D	10/29/12 1700	143	10/29/12 1727	CWP
Kjeldahl Nitrogen, TKN	0.23	0.10	mg/l	351.2	11/13/12 1005	556	11/15/12 0837	JAL
Total Inorganic Carbon	73.	1.0	mg/l	5310B	11/05/12 1040	526	11/08/12 1238	CJM
Dissolved Solids	1400	10.	mg/l	2540C	10/29/12 1516	365	10/30/12 1021	RHK
Suspended Solids	12.	1.0	mg/l	2540D	10/29/12 1626	519	10/29/12 1635	MGM
Antimony	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Arsenic	0.0019	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Barium	0.024	0.0020	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Beryllium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Cadmium	BDL	0.00050	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Chromium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Cobalt	0.0064	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Copper	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Lead	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Nickel	0.0097	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Selenium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Silver	BDL	0.00050	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Thallium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Tin	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Vanadium	BDL	0.0020	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Zinc	BDL	0.010	mg/l	200.8	10/30/12 1549	549	11/01/12 1146	LAT
Mercury	BDL	0.00020	mg/l	245.1	10/30/12 1140	529	10/30/12 2118	CCE
Aluminum	0.24	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1549	WC
Boron	2.8	0.20	mg/l	200.7	11/01/12 1128	580	11/05/12 1549	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Sample ID : JSF-W28-102212 7 FT

Collected By : William Nichols
Collection Date : 10/22/12 14:30

ESC Sample # : L603152-02

Site ID :

Project # : JSF-W28

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	330	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1549	WC
Iron	1.8	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1549	WC
Magnesium	48.	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1549	WC
Manganese	4.0	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1549	WC
Potassium	1.4	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1549	WC
Sodium	21.	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1549	WC
Strontium	0.87	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1549	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-03

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W29-102312 4.5 FT

Project # : JSF-W29

Collected By : William Nichols
Collection Date : 10/23/12 12:00

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	5.8	1.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1515	KSG
Fluoride	0.18	0.10	mg/l	300.0	11/02/12 1254	236	11/03/12 1515	KSG
Sulfate	220	25.	mg/l	300.0	11/02/12 1254	236	11/03/12 1936	KSG
Cyanide	BDL	0.0050	mg/l	4500CN-E	10/30/12 1755	556	10/31/12 1227	JAL
Ammonia Nitrogen	0.21	0.10	mg/l	350.1	11/01/12 1318	577	11/05/12 1109	JAL
Nitrate-Nitrite	BDL	0.10	mg/l	353.2	11/03/12 1126	508	11/03/12 1140	LED
Sulfide	BDL	0.050	mg/l	4500-S2 D	10/30/12 2100	556	10/30/12 2139	MCG
Kjeldahl Nitrogen, TKN	0.23	0.10	mg/l	351.2	11/01/12 1115	556	11/07/12 1744	LED
Total Inorganic Carbon	72.	1.0	mg/l	5310B	11/05/12 1040	526	11/08/12 1252	CJM
Dissolved Solids	640	10.	mg/l	2540C	10/30/12 1925	519	10/31/12 1252	RHK
Suspended Solids	1.4	1.0	mg/l	2540D	10/30/12 0943	519	10/30/12 0950	MGM
Antimony	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Arsenic	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Barium	0.018	0.0020	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Beryllium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Cadmium	BDL	0.00050	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Chromium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Cobalt	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Copper	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Lead	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Nickel	0.0047	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Selenium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Silver	BDL	0.00050	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Thallium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Tin	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Vanadium	BDL	0.0020	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Zinc	BDL	0.010	mg/l	200.8	10/30/12 1549	549	11/01/12 1149	LAT
Mercury	BDL	0.00020	mg/l	245.1	10/30/12 1140	529	10/30/12 2121	CCE
Aluminum	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1553	WC
Boron	1.4	0.20	mg/l	200.7	11/01/12 1128	580	11/05/12 1553	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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L603152-03 (TSS) - used all available sample

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Tax I.D. 62-0814289

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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-03

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W29-102312 4.5 FT

Project # : JSF-W29

Collected By : William Nichols
Collection Date : 10/23/12 12:00

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	160	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1553	WC
Iron	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1553	WC
Magnesium	36.	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1553	WC
Manganese	2.5	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1553	WC
Potassium	1.1	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1553	WC
Sodium	11.	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1553	WC
Strontium	0.90	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1553	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Reported: 11/29/12 10:16 Printed: 11/29/12 11:43
L603152-03 (TSS) - used all available sample

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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-04

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W30-102312 3 FT

Project # : JSF-W30

Collected By : William Nichols
Collection Date : 10/23/12 13:15

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	16.	1.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1527	KSG
Fluoride	0.34	0.10	mg/l	300.0	11/02/12 1254	236	11/03/12 1527	KSG
Sulfate	1000	100	mg/l	300.0	11/06/12 1119	236	11/06/12 1859	NJM
Cyanide	BDL	0.0050	mg/l	4500CN-E	10/30/12 1755	556	10/31/12 1229	JAL
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	11/14/12 1503	556	11/15/12 1119	JAL
Nitrate-Nitrite	BDL	0.10	mg/l	353.2	11/03/12 1126	508	11/03/12 1141	LED
Sulfide	BDL	0.050	mg/l	4500-S2 D	10/30/12 2100	556	10/30/12 2140	MCG
Kjeldahl Nitrogen, TKN	0.18	0.10	mg/l	351.2	11/13/12 1005	556	11/15/12 0839	JAL
Total Inorganic Carbon	77.	1.0	mg/l	5310B	11/05/12 1040	526	11/08/12 1308	CJM
Dissolved Solids	1800	10.	mg/l	2540C	10/30/12 1925	519	10/31/12 1252	RHK
Suspended Solids	BDL	1.0	mg/l	2540D	10/30/12 0943	519	10/30/12 0950	MGM
Antimony	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Arsenic	0.0012	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Barium	0.025	0.0020	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Beryllium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Cadmium	BDL	0.00050	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Chromium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Cobalt	0.0029	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Copper	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Lead	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Nickel	0.011	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Selenium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Silver	BDL	0.00050	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Thallium	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Tin	BDL	0.0010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Vanadium	BDL	0.0020	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Zinc	BDL	0.010	mg/l	200.8	10/30/12 1549	549	11/01/12 1152	LAT
Mercury	BDL	0.00020	mg/l	245.1	10/30/12 1140	529	10/30/12 2036	CCE
Aluminum	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1558	WC
Boron	4.6	0.20	mg/l	200.7	11/01/12 1128	580	11/05/12 1558	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-04

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W30-102312 3 FT

Project # : JSF-W30

Collected By : William Nichols
Collection Date : 10/23/12 13:15

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	340	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1558	WC
Iron	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1558	WC
Magnesium	94.	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1558	WC
Manganese	2.7	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1558	WC
Potassium	1.6	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1558	WC
Sodium	39.	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1558	WC
Strontium	4.5	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1558	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-05

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W31-102512 5 FT

Project # : JSF-W31

Collected By : William Nichols
Collection Date : 10/25/12 09:50

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	10.	1.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1540	KSG
Fluoride	BDL	0.10	mg/l	300.0	11/02/12 1254	236	11/03/12 1540	KSG
Sulfate	1600	100	mg/l	300.0	11/02/12 1254	236	11/03/12 2001	KSG
Cyanide	BDL	0.0050	mg/l	4500CN-E	10/30/12 1755	556	10/31/12 1230	JAL
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	11/13/12 1630	556	11/14/12 1143	JAL
Nitrate-Nitrite	0.17	0.10	mg/l	353.2	11/03/12 1126	508	11/03/12 1146	LED
Sulfide	BDL	0.050	mg/l	4500-S2 D	10/30/12 2100	556	10/30/12 2140	MCG
Kjeldahl Nitrogen, TKN	0.14	0.10	mg/l	351.2	11/13/12 1005	556	11/15/12 0841	JAL
Total Inorganic Carbon	80.	1.0	mg/l	5310B	11/05/12 1040	526	11/08/12 1450	CJM
Dissolved Solids	2500	10.	mg/l	2540C	11/01/12 1524	519	11/02/12 1118	RHK
Suspended Solids	8.4	1.0	mg/l	2540D	10/31/12 1616	519	10/31/12 1620	MGM
Antimony	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Arsenic	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Barium	0.029	0.0020	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Beryllium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Cadmium	BDL	0.00050	mg/l	200.8	10/30/12 2033	388	11/28/12 1946	LAT
Chromium	0.0029	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Cobalt	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Copper	0.0015	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Lead	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Nickel	0.0088	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Selenium	0.0039	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Silver	BDL	0.00050	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Thallium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Tin	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Vanadium	0.0042	0.0020	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Zinc	BDL	0.010	mg/l	200.8	10/30/12 2033	388	10/31/12 1256	LAT
Mercury	BDL	0.00020	mg/l	245.1	10/30/12 1140	529	10/30/12 2123	CCE
Aluminum	0.15	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1602	WC
Boron	15.	0.20	mg/l	200.7	11/01/12 1128	580	11/05/12 1602	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-05

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W31-102512 5 FT

Project # : JSF-W31

Collected By : William Nichols
Collection Date : 10/25/12 09:50

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	450	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1602	WC
Iron	0.18	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1602	WC
Magnesium	100	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1602	WC
Manganese	BDL	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1602	WC
Potassium	21.	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1602	WC
Sodium	98.	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1602	WC
Strontium	4.8	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1602	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-06

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W31-102512 DUP 5 FT

Project # : JSF-W31

Collected By : William Nichols
Collection Date : 10/25/12 09:50

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	10.	1.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1234	KSG
Fluoride	0.34	0.10	mg/l	300.0	11/02/12 1254	236	11/03/12 1234	KSG
Sulfate	1600	100	mg/l	300.0	11/02/12 1254	236	11/03/12 1821	KSG
Cyanide	BDL	0.0050	mg/l	4500CN-E	10/30/12 1755	556	10/31/12 1231	JAL
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	11/13/12 1630	556	11/14/12 1145	JAL
Nitrate-Nitrite	0.18	0.10	mg/l	353.2	11/03/12 1126	508	11/03/12 1147	LED
Sulfide	BDL	0.050	mg/l	4500-S2 D	10/30/12 2100	556	10/30/12 2140	MCG
Kjeldahl Nitrogen, TKN	0.14	0.10	mg/l	351.2	11/15/12 1808	577	11/16/12 1418	LED
Total Inorganic Carbon	62.	1.0	mg/l	5310B	11/05/12 1040	526	11/08/12 1511	CJM
Dissolved Solids	2500	10.	mg/l	2540C	11/01/12 1524	519	11/02/12 1121	RHK
Suspended Solids	6.9	1.0	mg/l	2540D	10/31/12 1616	519	10/31/12 1620	MGM
Antimony	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Arsenic	0.0014	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Barium	0.030	0.0020	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Beryllium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Cadmium	BDL	0.00050	mg/l	200.8	10/30/12 2033	388	11/28/12 1950	LAT
Chromium	0.0023	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Cobalt	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Copper	0.0010	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Lead	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Nickel	0.010	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Selenium	0.0026	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Silver	BDL	0.00050	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Thallium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Tin	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Vanadium	0.0028	0.0020	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Zinc	BDL	0.010	mg/l	200.8	10/30/12 2033	388	10/31/12 1259	LAT
Mercury	BDL	0.00020	mg/l	245.1	10/30/12 1140	529	10/30/12 2126	CCE
Aluminum	0.14	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1607	WC
Boron	16.	0.20	mg/l	200.7	11/01/12 1128	580	11/05/12 1607	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
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KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-06

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W31-102512 DUP 5 FT

Project # : JSF-W31

Collected By : William Nichols
Collection Date : 10/25/12 09:50

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	460	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1607	WC
Iron	0.20	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1607	WC
Magnesium	110	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1607	WC
Manganese	BDL	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1607	WC
Potassium	23.	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1607	WC
Sodium	100	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1607	WC
Strontium	5.0	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1607	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
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KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-07

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W32-102512 6 FT

Project # : JSF-W32

Collected By : William Nichols
Collection Date : 10/25/12 12:15

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	12.	1.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1311	KSG
Fluoride	BDL	0.10	mg/l	300.0	11/02/12 1254	236	11/03/12 1311	KSG
Sulfate	51.	5.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1311	KSG
Cyanide	BDL	0.0050	mg/l	4500CN-E	11/01/12 1238	556	11/05/12 1006	JAL
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	11/13/12 1630	556	11/14/12 1146	JAL
Nitrate-Nitrite	0.53	0.10	mg/l	353.2	11/03/12 1126	508	11/03/12 1148	LED
Sulfide	BDL	0.050	mg/l	4500-S2 D	10/30/12 2100	556	10/30/12 2140	MCG
Kjeldahl Nitrogen, TKN	BDL	0.10	mg/l	351.2	11/13/12 1005	556	11/15/12 0846	JAL
Total Inorganic Carbon	60.	1.0	mg/l	5310B	11/05/12 1040	526	11/08/12 1530	CJM
Dissolved Solids	370	10.	mg/l	2540C	11/01/12 1524	519	11/02/12 1119	RHK
Suspended Solids	1.6	1.0	mg/l	2540D	10/31/12 1616	519	10/31/12 1620	MGM
Antimony	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Arsenic	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Barium	0.052	0.0020	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Beryllium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Cadmium	BDL	0.00050	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Chromium	0.0025	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Cobalt	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Copper	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Lead	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Nickel	0.0020	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Selenium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Silver	BDL	0.00050	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Thallium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Tin	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Vanadium	BDL	0.0020	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Zinc	BDL	0.010	mg/l	200.8	10/30/12 2033	388	10/31/12 1302	LAT
Mercury	BDL	0.00020	mg/l	245.1	10/30/12 1509	529	10/30/12 2229	JEC
Aluminum	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1611	WC
Boron	0.33	0.20	mg/l	200.7	11/01/12 1128	580	11/05/12 1611	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-07

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-W32-102512 6 FT

Project # : JSF-W32

Collected By : William Nichols
Collection Date : 10/25/12 12:15

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	130	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1611	WC
Iron	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1611	WC
Magnesium	4.6	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1611	WC
Manganese	BDL	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1611	WC
Potassium	1.9	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1611	WC
Sodium	8.0	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1611	WC
Strontium	0.29	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1611	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
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Notes:
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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-08

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-LCS-102312

Project # : JSF-LCS

Collected By : William Nichols
Collection Date : 10/23/12 13:50

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	13.	1.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1324	KSG
Fluoride	0.30	0.10	mg/l	300.0	11/02/12 1254	236	11/03/12 1324	KSG
Sulfate	740	50.	mg/l	300.0	11/02/12 1254	236	11/03/12 2013	KSG
Cyanide	BDL	0.0050	mg/l	4500CN-E	11/01/12 1238	556	11/05/12 1008	JAL
Ammonia Nitrogen	0.11	0.10	mg/l	350.1	11/01/12 1318	577	11/05/12 1115	JAL
Nitrate-Nitrite	0.30	0.10	mg/l	353.2	11/03/12 1126	508	11/03/12 1149	LED
Sulfide	BDL	0.050	mg/l	4500-S2 D	10/30/12 2100	556	10/30/12 2141	MCG
Kjeldahl Nitrogen, TKN	3.7	0.10	mg/l	351.2	11/01/12 1115	556	11/07/12 1749	LED
Total Inorganic Carbon	60.	1.0	mg/l	5310B	11/05/12 1040	526	11/08/12 1547	CJM
Dissolved Solids	1300	10.	mg/l	2540C	10/30/12 1925	519	10/31/12 1253	RHK
Suspended Solids	7.3	1.0	mg/l	2540D	10/30/12 0943	519	10/30/12 0950	MGM
Antimony	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Arsenic	0.0010	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Barium	0.040	0.0020	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Beryllium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Cadmium	BDL	0.00050	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Chromium	0.0012	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Cobalt	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Copper	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Lead	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Nickel	0.0052	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Selenium	0.0015	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Silver	BDL	0.00050	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Thallium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Tin	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Vanadium	BDL	0.0020	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Zinc	BDL	0.010	mg/l	200.8	10/30/12 2033	388	10/31/12 1305	LAT
Mercury	BDL	0.00020	mg/l	245.1	10/30/12 1509	529	10/30/12 2252	JEC
Aluminum	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1615	WC
Boron	5.3	0.20	mg/l	200.7	11/01/12 1128	580	11/05/12 1615	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
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REPORT OF ANALYSIS

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TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-08

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-LCS-102312

Project # : JSF-LCS

Collected By : William Nichols
Collection Date : 10/23/12 13:50

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	270	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1615	WC
Iron	0.18	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1615	WC
Magnesium	72.	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1615	WC
Manganese	0.38	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1615	WC
Potassium	5.8	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1615	WC
Sodium	38.	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1615	WC
Strontium	3.1	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1615	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
The reported analytical results relate only to the sample submitted

Reported: 11/29/12 10:16 Printed: 11/29/12 11:43

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-09

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-E2-BLANK-102512

Project # : JSF-E2-BLANK

Collected By : William Nichols
Collection Date : 10/25/12 10:50

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Chloride	BDL	1.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1406	KSG
Fluoride	BDL	0.10	mg/l	300.0	11/02/12 1254	236	11/03/12 1406	KSG
Sulfate	BDL	5.0	mg/l	300.0	11/02/12 1254	236	11/03/12 1406	KSG
Cyanide	BDL	0.0050	mg/l	4500CN-E	11/01/12 1238	556	11/05/12 1009	JAL
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	11/01/12 1318	577	11/05/12 1116	JAL
Nitrate-Nitrite	BDL	0.10	mg/l	353.2	11/03/12 1126	508	11/03/12 1150	LED
Sulfide	BDL	0.050	mg/l	4500-S2 D	10/30/12 2100	556	10/30/12 2141	MCG
Kjeldahl Nitrogen, TKN	BDL	0.10	mg/l	351.2	11/13/12 1005	556	11/15/12 0848	JAL
Total Inorganic Carbon	BDL	1.0	mg/l	5310B	11/09/12 1332	526	11/13/12 1048	CJM
Dissolved Solids	BDL	10.	mg/l	2540C	11/01/12 1524	519	11/02/12 1120	RHK
Suspended Solids	BDL	1.0	mg/l	2540D	10/31/12 1616	519	10/31/12 1625	MGM
Antimony	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Arsenic	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Barium	BDL	0.0020	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Beryllium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Cadmium	BDL	0.00050	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Chromium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Cobalt	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Copper	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Lead	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Nickel	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Selenium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Silver	BDL	0.00050	mg/l	200.8	11/13/12 0829	388	11/13/12 1138	LAT
Thallium	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Tin	BDL	0.0010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Vanadium	BDL	0.0020	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Zinc	BDL	0.010	mg/l	200.8	10/30/12 2033	388	10/31/12 1117	LAT
Mercury	BDL	0.00020	mg/l	245.1	10/30/12 1509	529	10/30/12 2255	JEC
Aluminum	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1619	WC
Boron	BDL	0.20	mg/l	200.7	11/01/12 1128	580	11/05/12 1619	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
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KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ -0612, MN - 047-999-395, NY - 11742, NJ - TN002, WI - 998093910

Notes:
The reported analytical results relate only to the sample submitted

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REPORT OF ANALYSIS

Mr. J. Mark Boggs
TVA-Environmental Affairs
400 W. Summit Hill Mailstop TVA WT
Knoxville, TN 37902

November 29,2012

ESC Sample # : L603152-09

Date Received : 10/27/12 10:00
Description : JSF Dry Stack

Site ID :

Sample ID : JSF-E2-BLANK-102512

Project # : JSF-E2-BLANK

Collected By : William Nichols
Collection Date : 10/25/12 10:50

Parameter	Result	Det. Limit	Units	Method	Prep	PID	Analyzed	AID
Calcium	BDL	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1619	WC
Iron	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1619	WC
Magnesium	BDL	0.10	mg/l	200.7	11/01/12 1128	580	11/05/12 1619	WC
Manganese	BDL	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1619	WC
Potassium	BDL	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1619	WC
Sodium	BDL	0.50	mg/l	200.7	11/01/12 1128	580	11/05/12 1619	WC
Strontium	BDL	0.010	mg/l	200.7	11/01/12 1128	580	11/05/12 1619	WC

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

Laboratory Certification Numbers:
AIHA - 09227, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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Notes:
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Reported: 11/29/12 10:16 Printed: 11/29/12 11:43

Attachment A
List of Analytes with QC Qualifiers

Sample Number	Work Group	Sample Type	Analyte	Run ID	Qualifier
L603152-01	WG622660	SAMP	Ammonia Nitrogen	R2441757	P1
	WG620344	SAMP	Suspended Solids	R2413559	T4
L603152-02	WG622660	SAMP	Ammonia Nitrogen	R2441757	P1
	WG622667	SAMP	Kjeldahl Nitrogen, TKN	R2443148	P1
	WG620359	SAMP	Sulfide	R2413622	J6
L603152-03	WG620345	SAMP	Suspended Solids	R2415877	T4
L603152-06	WG621092	SAMP	Fluoride	R2425839	J6
	WG623142	SAMP	Kjeldahl Nitrogen, TKN	R2445917	P1
L603152-09	WG620713	SAMP	Cyanide	R2425317	J6
	WG620583	SAMP	Dissolved Solids	R2421857	T4

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low
P1	RPD value not applicable for sample concentrations less than 5 times the reporting limit.
T4	(ESC) - Additional method/sample information: QNS - Quantity Not Sufficient

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC.
Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods,it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable "unless qualified as 'R' (Rejected)."

Definitions

Accuracy - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.

Precision - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Differrence.

Surrogate - Organic compounds that are similar in chemical composition, extraction, and chromotography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

TIC - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Summary of Remarks For Samples Printed
11/29/12 at 11:43:29

TSR Signing Reports: 400
RX - Priority Rush

Sample: L603152-01 Account: TVAENVAFF Received: 10/27/12 10:00 Due Date: 11/28/12 00:00 RPT Date: 11/29/12 10:16
Redo's TKN 01,02,04,05,06,07,09 AGG -09, IC-09. Due date changed RC 11/9. uni 673766 dor 11/26/12.
Sample: L603152-02 Account: TVAENVAFF Received: 10/27/12 10:00 Due Date: 11/28/12 00:00 RPT Date: 11/29/12 10:16

Sample: L603152-03 Account: TVAENVAFF Received: 10/27/12 10:00 Due Date: 11/28/12 00:00 RPT Date: 11/29/12 10:16

Sample: L603152-04 Account: TVAENVAFF Received: 10/27/12 10:00 Due Date: 11/28/12 00:00 RPT Date: 11/29/12 10:16

Sample: L603152-05 Account: TVAENVAFF Received: 10/27/12 10:00 Due Date: 11/29/12 00:00 RPT Date: 11/29/12 10:16
CdG set to REDO. Rc 11/26
Sample: L603152-06 Account: TVAENVAFF Received: 10/27/12 10:00 Due Date: 11/29/12 00:00 RPT Date: 11/29/12 10:16
CdG set to REDO. Rc 11/26
Sample: L603152-07 Account: TVAENVAFF Received: 10/27/12 10:00 Due Date: 11/28/12 00:00 RPT Date: 11/29/12 10:16

Sample: L603152-08 Account: TVAENVAFF Received: 10/27/12 10:00 Due Date: 11/28/12 00:00 RPT Date: 11/29/12 10:16

Sample: L603152-09 Account: TVAENVAFF Received: 10/27/12 10:00 Due Date: 11/28/12 00:00 RPT Date: 11/29/12 10:16

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APPENDIX D

WELL 1 BACKGROUND DATA (2000-2012) AND STATISTICAL ANALYSIS OUTPUT

Well 1 Background Data (2000-2012)

Parameter Name	Measurement Unit	01/06/2000	04/05/2000	07/06/2000	01/22/2001	07/17/2001	01/16/2002	07/24/2002	01/28/2003	06/30/2003	10/16/2003	01/06/2004
Alkalinity, total (field)	mg/L CaCO3	212	210	222	207.5	215	212.5	211	210	220	205	210
Aluminum, total	ug/L	80	< 50	< 50	82	< 50	54	< 50	150	< 50	80	< 50
Antimony, total	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 6	< 0.1	< 0.6
Arsenic, total	ug/L	< 1	< 1	< 1	< 1	1.8	< 1	< 1	< 1	3	< 0.1	< 0.1
Barium, total	ug/L	210	200	230	240	< 10	220	230	230	250	238	200
Beryllium, total	ug/L	< 1	< 1	< 1	< 1	2.7	< 1	< 1	< 1	< 1	< 1	< 1
Boron, total	ug/L	< 200	< 200	< 200	< 200	< 200	250	< 200	< 200	< 200	< 200	< 200
Cadmium, total	ug/L	< 0.1	< 0.1	< 0.1	< 0.1	0.4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.05	< 0.05
Chloride, total	mg/L	14	11	13	12	11	11	11	10	9.5	10	11
Chromium, total	ug/L	1.1	< 1	< 1	< 1	2	< 1	< 1	< 1	< 1	< 0.1	< 0.1
Cobalt, total	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	0.8	0.5
Copper, total	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Cyanide, total	mg/L											
Fluoride, total	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.12	0.11	0.1
Iron, total	ug/L	1200	2200	4500	2200	< 10	2600	3200	1800	5200	4000	550
Lead, total	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	0.4	< 0.1
Manganese, total	ug/L	26	18	33	28	< 5	39	30	22	36	27	18
Mercury, total	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Nickel, total	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1.5	1.4
Nitrite + Nitrate	mg/L											
Nitrogen, Ammonia	mg/L											
Oxidation reduction potential	mV	360	288	345	381	254	425	355	386	371	328	373
pH (field)	pH	7.1	7	6.9	7.2	7.2	7.1	7	7	7	7.2	6.9
Potassium, total	mg/L	0.63	0.69	0.49	0.53	0.43	0.41	0.4	0.63	0.45	0.5	0.9
Selenium, total	ug/L	< 1	< 1	< 1	< 1	1.9	< 1	< 1	< 1	< 1	< 0.2	< 0.2
Silver, total	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10		< 10	< 10
Sodium, total	mg/L	5.4	5.2	5.8	5.3	5	3.8	3.9	6.2	6	5.4	6.8
Specific conductance @ 25C (field)	umhos/cm	495	499	488	481	473	484	476	490	480	405	485
Strontium, total	ug/L	670	600	700	850	< 50	800	760	760	800	742	710
Sulfate, total	mg/L	25	26	26	25	27	26	25	29	30	30	27
Sulfide, total	mg/L											
Temperature, Celsius	degrees C	14.5	15.3	15.7	15.2	15.9	15.1	15.2	15	15.2	15.4	15.2
Thallium, total	ug/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 0.1	< 0.1
Tin, total	ug/L	< 50	< 50	< 50	< 50	< 50	< 50	< 50	490			< 50
Vanadium, total	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Zinc, total	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	10	< 10	< 10	< 10	< 10
Total Suspended Solids	mg/L	2	7	11	4.5	3	5.5	8	7	12	17	2

Well 1 Background Data (2000-2012) - Continued

Parameter Name	Measurement Unit	04/05/2004	07/06/2004	10/18/2004	01/03/2005	07/05/2005	07/13/2005	09/14/2005	01/18/2006	04/24/2006	07/24/2006	10/02/2006
Alkalinity, total (field)	mg/L CaCO3	212	211	207.5	210	213.5		186	213.5	211	212.5	213
Aluminum, total	ug/L	50	< 50	80	< 50	< 50		< 50	< 200	< 200	< 200	< 200
Antimony, total	ug/L	< 0.6	< 3	< 3	< 3	< 3		< 3	< 3	< 3	< 3	< 3
Arsenic, total	ug/L	< 0.1	< 1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	< 1
Barium, total	ug/L	220	220	260	210	220		240	230	220	230	230
Beryllium, total	ug/L	< 1	< 1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	< 1
Boron, total	ug/L	< 200	< 200	< 200	< 200	< 200		< 200	< 200	< 200	< 200	< 200
Cadmium, total	ug/L	< 0.05	< 0.1	< 0.1	< 0.1	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chloride, total	mg/L	12	11	11	11	11		12	11	10	9.9	10
Chromium, total	ug/L	< 0.1	< 1	< 1	< 1	< 1		1	< 1	< 1	< 1	< 1
Cobalt, total	ug/L	0.8	< 1	< 1	1	1		1	< 1	< 1	< 1	< 1
Copper, total	ug/L	< 10	< 10	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10
Cyanide, total	mg/L						< 0.005	< 0.005				
Fluoride, total	mg/L	< 0.1	< 0.1	0.11	< 0.1	0.1		< 0.1	0.11	0.1	0.11	< 0.1
Iron, total	ug/L	730	1600	4000	2100	2000		1900	1200	1000	2800	1700
Lead, total	ug/L	< 0.1	1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	< 1
Manganese, total	ug/L	24	21	30	24	21		26	34	19	28	28
Mercury, total	ug/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Nickel, total	ug/L	2.2	< 1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	< 1
Nitrite + Nitrate	mg/L			0.18	0.26			0.24	0.12	0.21	0.19	0.1
Nitrogen, Ammonia	mg/L			0.01	0.01			0.01	< 0.01	0.01	< 0.01	0.03
Oxidation reduction potential	mV	340	341	226	355	240	263	310	372	304	303	241
pH (field)	pH	7.1	7.2	7.3	6.9	7	6.9	7.2	7.2	7.2	7.2	7.2
Potassium, total	mg/L	0.6	1.1	1.2	0.7	1.4		1.7	0.6	0.6	0.5	1.4
Selenium, total	ug/L	< 0.2	< 1	< 1	1	< 1		< 1	< 1	< 1	< 1	< 1
Silver, total	ug/L	< 10	< 10	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10
Sodium, total	mg/L	5.8	4.7	5.6	7.9	6.6		4.8	7.7	6	7.4	5.5
Specific conductance @ 25C (field)	umhos/cm	483	487	456	443	409	480	483	489	479	470	480
Strontium, total	ug/L	710	700	790	710	680		730	730	690	710	740
Sulfate, total	mg/L	28	31	31	25	26		26	29	27	24	25
Sulfide, total	mg/L						< 0.02				0	
Temperature, Celsius	degrees C	15.4	15.5	15.3	15.5	15.5	15.4	15.7	15.5	15.5	15.3	15.4
Thallium, total	ug/L	< 0.1	< 2	< 2	< 2	< 2		< 2	< 2	< 2	< 2	< 2
Tin, total	ug/L			< 50		< 50						
Vanadium, total	ug/L	< 10	< 10	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10
Zinc, total	ug/L	< 10	< 10	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10
Total Suspended Solids	mg/L	4	6	14.5	7	5		6	4	4	8	4

Well 1 Background Data (2000-2012) – Continued

Parameter Name	Measurement Unit	04/03/2007	10/01/2007	10/02/2007	11/13/2007	04/08/2008	10/27/2008	04/07/2009	10/07/2009	04/05/2010
Alkalinity, total (field)	mg/L CaCO3	215		214		214	214	211	205	219
Aluminum, total	ug/L	< 100	< 100			160	< 100	< 100	< 100	< 100
Antimony, total	ug/L	< 1	< 1			< 1	< 1	< 1	< 1	< 1
Arsenic, total	ug/L	< 1	< 1			< 1	< 1	< 1	< 1	< 1
Barium, total	ug/L	230	220			220	220	200	200	210
Beryllium, total	ug/L	< 1	< 2			< 1	< 1	< 1	< 1	< 1
Boron, total	ug/L	< 200	< 200			< 200	< 200	< 200	< 200	< 200
Cadmium, total	ug/L	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloride, total	mg/L	8.8	10			9.1	11	10	9.8	10
Chromium, total	ug/L	< 1	< 1			< 1	4	< 1	< 2	< 2
Cobalt, total	ug/L	< 1	< 1			< 1	< 1	< 1	< 1	< 1
Copper, total	ug/L	< 1	< 1			< 1	< 1	1.7	< 2	< 2
Cyanide, total	mg/L				< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Fluoride, total	mg/L	< 0.1	0.23			< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Iron, total	ug/L	1500	880			580	2000	380	1300	620
Lead, total	ug/L	< 1	< 1			< 1	< 1	< 1	< 1	< 1
Manganese, total	ug/L	26	34			26	28	18	22	39
Mercury, total	ug/L	< 0.2	< 0.2			< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Nickel, total	ug/L	2	2.9			1.3	2.8	3.6	< 1	2.2
Nitrite + Nitrate	mg/L	0.13	< 0.1			< 0.1	< 0.1	0.16	0.11	0.19
Nitrogen, Ammonia	mg/L	< 0.1	< 0.1			< 0.1	< 0.1	< 0.1	0.14	< 0.1
Oxidation reduction potential	mV	323		229		220	202	174	136	209
pH (field)	pH	7.1		7		7.1	7.1	6.9	7	7
Potassium, total	mg/L	< 0.5	< 0.5			< 0.5	0.92	0.6	0.6	0.58
Selenium, total	ug/L	1.7	< 1			< 1	< 1	1.8	< 1	< 1
Silver, total	ug/L	< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 1	< 1
Sodium, total	mg/L	5.8	5.9			6.6	6.4	5.9	5.6	7.5
Specific conductance @ 25C (field)	umhos/cm	485		484		480	487	481	475	479
Strontium, total	ug/L	750	710			740	800	680	720	700
Sulfate, total	mg/L	25	25			25	25	25	26	26
Sulfide, total	mg/L				< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Temperature, Celsius	degrees C	15.4		15.3		15.4	15.5	15.3	15.5	15.6
Thallium, total	ug/L	< 1	< 1			< 1	< 1	< 1	< 1	< 1
Tin, total	ug/L		< 1			< 1	< 1	< 1	< 1	< 1
Vanadium, total	ug/L	< 10	< 10			< 10	< 10	< 2	< 2	< 10
Zinc, total	ug/L	< 10	< 10			23	16	180	11	< 10
Total Suspended Solids	mg/L	6.5	2.9			1.75	7.6	5	4.9	3.8

Well 1 Background Data (2000-2012) – Continued

param_name	measure_unit	10/21/2010	04/20/2011	10/19/2011	04/11/2012	10/22/2012
Alkalinity, total (field)	mg/L CaCO3	220.5	218	216	219	20.5
Aluminum, total	ug/L	< 100	< 100	< 100	<100	<100
Antimony, total	ug/L	< 1	< 1	< 1	<1	<1
Arsenic, total	ug/L	< 1	< 1	< 1	<1	<1
Barium, total	ug/L	230	220	230	190	220
Beryllium, total	ug/L	< 2	< 1	< 1	<1	<1
Boron, total	ug/L	< 200	< 200	< 200	<200	<200
Cadmium, total	ug/L	< 0.5	< 0.5	< 0.5	<0.5	<0.5
Chloride, total	mg/L	10	9.5	9.6	11	9.1
Chromium, total	ug/L	< 2	< 2	< 2	<2	<1
Cobalt, total	ug/L	< 1	< 1	< 1	<1	<1
Copper, total	ug/L	< 2	< 2	< 2	<2	<1
Cyanide, total	mg/L	< 0.005	< 0.005	< 0.005	<0.005	<0.005
Fluoride, total	mg/L	< 0.1	< 0.1	0.1	<0.1	<0.1
Iron, total	ug/L	320	260	240	110	420
Lead, total	ug/L	< 1	< 1	< 1	<1	<1
Manganese, total	ug/L	28	25	28	<10	32
Mercury, total	ug/L	< 0.2	< 0.2	< 0.2	<0.2	<0.2
Nickel, total	ug/L	1.6	3.3	< 1	<1	1.5
Nitrite + Nitrate	mg/L	0.12	0.22	0.15	0.53	<0.1
Nitrogen, Ammonia	mg/L	< 0.1	< 0.1	< 0.1	<0.1	0.1
Oxidation reduction potential	mV	119	207	124	284	143
pH (field)	pH	6.9	6.7	6.9	6.8	7
Potassium, total	mg/L	0.63	0.5	0.6	<0.5	<0.5
Selenium, total	ug/L	< 1	< 1	< 1	<1	<1
Silver, total	ug/L	< 1	< 1	< 1	<1	<0.5
Sodium, total	mg/L	6.2	5.7	6.7	6.7	6.5
Specific conductance @ 25C (field)	umhos/cm	483	485	486	498	480
Strontium, total	ug/L	770	710	800	590	800
Sulfate, total	mg/L	26	26	26	27	27
Sulfide, total	mg/L	< 0.05	< 0.05	< 0.05	<0.05	<0.05
Temperature, Celsius	degrees C	16.3	16	15.7	15.4	16.6
Thallium, total	ug/L	< 1	< 1	< 1	<1	<1
Tin, total	ug/L	< 1	< 1	< 1	<1	<1
Vanadium, total	ug/L	< 2	< 2	< 2	<2	<2
Zinc, total	ug/L	17	11	< 10	<10	<10
Total Suspended Solids	mg/L	< 1	< 1	< 1		< 1

Statistical Analysis Procedure

Background Date Range: 01/06/2000 to 10/30/2012
Background Locations: JSF-1

Number of Future Observations: 180.00

Compliance Date Range: 10/01/2012 to 10/30/2012
Compliance Locations: JSF-W28,JSF-W29,JSF-W30,JSF-W31,JSF-W32

Comparison Method if all Background Results are Non-Detect:	STmdl = Last MDL
Statistical Test for Parametric Background Data Distributions:	STpar = Parametric Prediction Interval on Background
Statistical Test for Cases with High Percentage of Non-Detect Background Data:	STlow1 = Non-Parametric Prediction Interval on Background (ND Frequency > 55%)
Statistical Test for Cases with High Percentage of Non-Detect Background Data:	STlow2 = Poisson Prediction Interval on Background (ND Frequency > 90%)
Statistical Test for Non-Parametric Background Data Distributions:	STnon = Non-Parametric Prediction Interval on Background
Background Comparison:	Interwell
Number of Verification Samples:	0
Default Type 1 Individual Comparison Error Level (False Positive Rate) for tests other than Prediction Interval	0.01
Type 1 Individual Comparison Error Level (False Positive Rate) for Prediction Interval	Calculate based on number of locations, parameters, and number of verification resamples, assumes site-wide Error Level of 0.05, using the approach of ASTM (1998).
Non-Detect Processing (Parametric Tests):	<=55% using MDL * 1.0 >55% using MDL * 1.0
Non-Detect Processing (All Other):	<=55% using MDL * 1.0 >55% using MDL * 1.0

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W28	Alkalinity, total (field), mg/L CaCO3	10/22/2012	33	0.00	No/No	STnon	86.84	222.000		316.000	Yes	
JSF-W28	Aluminum, total, ug/L	10/22/2012	33	75.76	No/No	STnon	86.84	200.000		240.000	Yes	
JSF-W28	Antimony, total, ug/L	10/22/2012	33	96.97	No/No	STnon	86.84	6.000		<1.000	No	
JSF-W28	Arsenic, total, ug/L	10/22/2012	33	93.94	No/No	STnon	86.84	2.500		1.900	No	
JSF-W28	Barium, total, ug/L	10/22/2012	33	3.03	No/No	STnon	86.84	255.000		24.000	No	
JSF-W28	Beryllium, total, ug/L	10/22/2012	33	96.97	No/No	STnon	86.84	2.700		<1.000	No	
JSF-W28	Boron, total, ug/L	10/22/2012	33	96.97	No/No	STnon	86.84	225.000		2,800.000	Yes	
JSF-W28	Cadmium, total, ug/L	10/22/2012	33	96.97	No/No	STnon	86.84	0.500		<0.500	No	
JSF-W28	Chloride, total, mg/L	10/22/2012	33	0.00	Yes/Yes	STpar	99.97	15.218		13.000	No	
JSF-W28	Chromium, total, ug/L	10/22/2012	33	84.85	No/No	STnon	86.84	4.000		<1.000	No	
JSF-W28	Cobalt, total, ug/L	10/22/2012	33	81.82	No/No	STnon	86.84	2.000		6.400	Yes	
JSF-W28	Copper, total, ug/L	10/22/2012	33	96.97	No/No	STnon	86.84	10.000		<1.000	No	
JSF-W28	Cyanide, total, mg/L	10/22/2012	13	100.00	No/No	STmdl	N/A	0.005		<0.005	No	
JSF-W28	Fluoride, total, mg/L	10/22/2012	33	69.70	No/No	STnon	86.84	0.230		<0.100	No	
JSF-W28	Iron, total, ug/L	10/22/2012	33	3.03	No/No	STnon	86.84	5,400.000		1,800.000	No	
JSF-W28	Lead, total, ug/L	10/22/2012	33	93.94	No/No	STnon	86.84	1.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W28	Manganese, total, ug/L	10/22/2012	33	6.06	Yes/No	STpar	99.97	53.790		4,000.000	Yes	
JSF-W28	Mercury, total, ug/L	10/22/2012	33	100.00	No/No	STmdl	N/A	0.200		<0.200	No	
JSF-W28	Nickel, total, ug/L	10/22/2012	33	63.64	No/No	STnon	86.84	3.300		9.700	Yes	
JSF-W28	Nitrite + Nitrate, mg/L	10/22/2012	19	15.79	No/No	STnon	79.17	0.530		<0.100	No	
JSF-W28	Nitrogen, Ammonia, mg/L	10/22/2012	19	63.16	No/No	STnon	79.17	0.140		0.160	Yes	
JSF-W28	ORP, mV	10/22/2012	34	0.00	Yes/No	STpar	99.97	606.073		86.000	No	
JSF-W28	pH (field), pH	10/22/2012	34	0.00	No/No	STnon	87.18	7.300	6.700	6.000	Yes	
JSF-W28	Potassium, total, mg/L	10/22/2012	33	15.15	No/No	STnon	86.84	1.700		1.400	No	
JSF-W28	Selenium, total, ug/L	10/22/2012	33	87.88	No/No	STnon	86.84	1.900		<1.000	No	
JSF-W28	Silver, total, ug/L	10/22/2012	32	100.00	No/No	STmdl	N/A	0.500		<0.500	No	
JSF-W28	Sodium, total, mg/L	10/22/2012	33	0.00	Yes/Yes	STpar	99.97	9.729		21.000	Yes	
JSF-W28	Specific Cond. (Field), umhos/cm	10/22/2012	34	0.00	No/No	STnon	87.18	499.000		1,768.000	Yes	
JSF-W28	Strontium, total, ug/L	10/22/2012	33	3.03	No/No	STnon	86.84	840.000		870.000	Yes	
JSF-W28	Sulfate, total, mg/L	10/22/2012	33	0.00	No/No	STnon	86.84	31.500		760.000	Yes	
JSF-W28	Sulfide, total, mg/L	10/22/2012	13	100.00	No/No	STmdl	N/A	0.050		<0.050	No	
JSF-W28	Temperature, Celsius, degrees C	10/22/2012	34	0.00	No/No	STnon	87.18	16.600		19.800	Yes	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W28	Thallium, total, ug/L	10/22/2012	33	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W28	Tin, total, ug/L	10/22/2012	22	95.45	No/No	STnon	81.48	490.000		<1.000	No	
JSF-W28	Vanadium, total, ug/L	10/22/2012	33	100.00	No/No	STmdl	N/A	2.000		<2.000	No	
JSF-W28	Zinc, total, ug/L	10/22/2012	33	78.79	No/No	STnon	86.84	95.500		<10.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W29	Alkalinity, total (field), mg/L CaCO3	10/23/2012	33	0.00	No/No	STnon	86.84	222.000		322.000	Yes	
JSF-W29	Aluminum, total, ug/L	10/23/2012	33	75.76	No/No	STnon	86.84	200.000		<100.000	No	
JSF-W29	Antimony, total, ug/L	10/23/2012	33	96.97	No/No	STnon	86.84	6.000		<1.000	No	
JSF-W29	Arsenic, total, ug/L	10/23/2012	33	93.94	No/No	STnon	86.84	2.500		<1.000	No	
JSF-W29	Barium, total, ug/L	10/23/2012	33	3.03	No/No	STnon	86.84	255.000		18.000	No	
JSF-W29	Beryllium, total, ug/L	10/23/2012	33	96.97	No/No	STnon	86.84	2.700		<1.000	No	
JSF-W29	Boron, total, ug/L	10/23/2012	33	96.97	No/No	STnon	86.84	225.000		1,400.000	Yes	
JSF-W29	Cadmium, total, ug/L	10/23/2012	33	96.97	No/No	STnon	86.84	0.500		<0.500	No	
JSF-W29	Chloride, total, mg/L	10/23/2012	33	0.00	Yes/Yes	STpar	99.97	15.218		5.800	No	
JSF-W29	Chromium, total, ug/L	10/23/2012	33	84.85	No/No	STnon	86.84	4.000		<1.000	No	
JSF-W29	Cobalt, total, ug/L	10/23/2012	33	81.82	No/No	STnon	86.84	2.000		<1.000	No	
JSF-W29	Copper, total, ug/L	10/23/2012	33	96.97	No/No	STnon	86.84	10.000		<1.000	No	
JSF-W29	Cyanide, total, mg/L	10/23/2012	13	100.00	No/No	STmdl	N/A	0.005		<0.005	No	
JSF-W29	Fluoride, total, mg/L	10/23/2012	33	69.70	No/No	STnon	86.84	0.230		0.180	No	
JSF-W29	Iron, total, ug/L	10/23/2012	33	3.03	No/No	STnon	86.84	5,400.000		<100.000	No	
JSF-W29	Lead, total, ug/L	10/23/2012	33	93.94	No/No	STnon	86.84	1.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W29	Manganese, total, ug/L	10/23/2012	33	6.06	Yes/No	STpar	99.97	53.790		2,500.000	Yes	
JSF-W29	Mercury, total, ug/L	10/23/2012	33	100.00	No/No	STmdl	N/A	0.200		<0.200	No	
JSF-W29	Nickel, total, ug/L	10/23/2012	33	63.64	No/No	STnon	86.84	3.300		4.700	Yes	
JSF-W29	Nitrite + Nitrate, mg/L	10/23/2012	19	15.79	No/No	STnon	79.17	0.530		<0.100	No	
JSF-W29	Nitrogen, Ammonia, mg/L	10/23/2012	19	63.16	No/No	STnon	79.17	0.140		0.210	Yes	
JSF-W29	ORP, mV	10/23/2012	34	0.00	Yes/No	STpar	99.97	606.073		617.000	Yes	
JSF-W29	pH (field), pH	10/23/2012	34	0.00	No/No	STnon	87.18	7.300	6.700	6.100	Yes	
JSF-W29	Potassium, total, mg/L	10/23/2012	33	15.15	No/No	STnon	86.84	1.700		1.100	No	
JSF-W29	Selenium, total, ug/L	10/23/2012	33	87.88	No/No	STnon	86.84	1.900		<1.000	No	
JSF-W29	Silver, total, ug/L	10/23/2012	32	100.00	No/No	STmdl	N/A	0.500		<0.500	No	
JSF-W29	Sodium, total, mg/L	10/23/2012	33	0.00	Yes/Yes	STpar	99.97	9.729		11.000	Yes	
JSF-W29	Specific Cond. (Field), umhos/cm	10/23/2012	34	0.00	No/No	STnon	87.18	499.000		961.000	Yes	
JSF-W29	Strontium, total, ug/L	10/23/2012	33	3.03	No/No	STnon	86.84	840.000		900.000	Yes	
JSF-W29	Sulfate, total, mg/L	10/23/2012	33	0.00	No/No	STnon	86.84	31.500		220.000	Yes	
JSF-W29	Sulfide, total, mg/L	10/23/2012	13	100.00	No/No	STmdl	N/A	0.050		<0.050	No	
JSF-W29	Temperature, Celsius, degrees C	10/23/2012	34	0.00	No/No	STnon	87.18	16.600		20.000	Yes	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W29	Thallium, total, ug/L	10/23/2012	33	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W29	Tin, total, ug/L	10/23/2012	22	95.45	No/No	STnon	81.48	490.000		<1.000	No	
JSF-W29	Vanadium, total, ug/L	10/23/2012	33	100.00	No/No	STmdl	N/A	2.000		<2.000	No	
JSF-W29	Zinc, total, ug/L	10/23/2012	33	78.79	No/No	STnon	86.84	95.500		<10.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W30	Alkalinity, total (field), mg/L CaCO3	10/23/2012	33	0.00	No/No	STnon	86.84	222.000		340.000	Yes	
JSF-W30	Aluminum, total, ug/L	10/23/2012	33	75.76	No/No	STnon	86.84	200.000		<100.000	No	
JSF-W30	Antimony, total, ug/L	10/23/2012	33	96.97	No/No	STnon	86.84	6.000		<1.000	No	
JSF-W30	Arsenic, total, ug/L	10/23/2012	33	93.94	No/No	STnon	86.84	2.500		1.200	No	
JSF-W30	Barium, total, ug/L	10/23/2012	33	3.03	No/No	STnon	86.84	255.000		25.000	No	
JSF-W30	Beryllium, total, ug/L	10/23/2012	33	96.97	No/No	STnon	86.84	2.700		<1.000	No	
JSF-W30	Boron, total, ug/L	10/23/2012	33	96.97	No/No	STnon	86.84	225.000		4,600.000	Yes	
JSF-W30	Cadmium, total, ug/L	10/23/2012	33	96.97	No/No	STnon	86.84	0.500		<0.500	No	
JSF-W30	Chloride, total, mg/L	10/23/2012	33	0.00	Yes/Yes	STpar	99.97	15.218		16.000	Yes	
JSF-W30	Chromium, total, ug/L	10/23/2012	33	84.85	No/No	STnon	86.84	4.000		<1.000	No	
JSF-W30	Cobalt, total, ug/L	10/23/2012	33	81.82	No/No	STnon	86.84	2.000		2.900	Yes	
JSF-W30	Copper, total, ug/L	10/23/2012	33	96.97	No/No	STnon	86.84	10.000		<1.000	No	
JSF-W30	Cyanide, total, mg/L	10/23/2012	13	100.00	No/No	STmdl	N/A	0.005		<0.005	No	
JSF-W30	Fluoride, total, mg/L	10/23/2012	33	69.70	No/No	STnon	86.84	0.230		0.340	Yes	
JSF-W30	Iron, total, ug/L	10/23/2012	33	3.03	No/No	STnon	86.84	5,400.000		<100.000	No	
JSF-W30	Lead, total, ug/L	10/23/2012	33	93.94	No/No	STnon	86.84	1.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W30	Manganese, total, ug/L	10/23/2012	33	6.06	Yes/No	STpar	99.97	53.790		2,700.000	Yes	
JSF-W30	Mercury, total, ug/L	10/23/2012	33	100.00	No/No	STmdl	N/A	0.200		<0.200	No	
JSF-W30	Nickel, total, ug/L	10/23/2012	33	63.64	No/No	STnon	86.84	3.300		11.000	Yes	
JSF-W30	Nitrite + Nitrate, mg/L	10/23/2012	19	15.79	No/No	STnon	79.17	0.530		<0.100	No	
JSF-W30	Nitrogen, Ammonia, mg/L	10/23/2012	19	63.16	No/No	STnon	79.17	0.140		<0.100	No	
JSF-W30	ORP, mV	10/23/2012	34	0.00	Yes/No	STpar	99.97	606.073		332.000	No	
JSF-W30	pH (field), pH	10/23/2012	34	0.00	No/No	STnon	87.18	7.300	6.700	6.300	Yes	
JSF-W30	Potassium, total, mg/L	10/23/2012	33	15.15	No/No	STnon	86.84	1.700		1.600	No	
JSF-W30	Selenium, total, ug/L	10/23/2012	33	87.88	No/No	STnon	86.84	1.900		<1.000	No	
JSF-W30	Silver, total, ug/L	10/23/2012	32	100.00	No/No	STmdl	N/A	0.500		<0.500	No	
JSF-W30	Sodium, total, mg/L	10/23/2012	33	0.00	Yes/Yes	STpar	99.97	9.729		39.000	Yes	
JSF-W30	Specific Cond. (Field), umhos/cm	10/23/2012	34	0.00	No/No	STnon	87.18	499.000		2,147.000	Yes	
JSF-W30	Strontium, total, ug/L	10/23/2012	33	3.03	No/No	STnon	86.84	840.000		4,500.000	Yes	
JSF-W30	Sulfate, total, mg/L	10/23/2012	33	0.00	No/No	STnon	86.84	31.500		1,000.000	Yes	
JSF-W30	Sulfide, total, mg/L	10/23/2012	13	100.00	No/No	STmdl	N/A	0.050		<0.050	No	
JSF-W30	Temperature, Celsius, degrees C	10/23/2012	34	0.00	No/No	STnon	87.18	16.600		20.800	Yes	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W30	Thallium, total, ug/L	10/23/2012	33	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W30	Tin, total, ug/L	10/23/2012	22	95.45	No/No	STnon	81.48	490.000		<1.000	No	
JSF-W30	Vanadium, total, ug/L	10/23/2012	33	100.00	No/No	STmdl	N/A	2.000		<2.000	No	
JSF-W30	Zinc, total, ug/L	10/23/2012	33	78.79	No/No	STnon	86.84	95.500		<10.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W31	Alkalinity, total (field), mg/L CaCO3	10/25/2012	33	0.00	No/No	STnon	86.84	222.000		359.500	Yes	
JSF-W31	Aluminum, total, ug/L	10/25/2012	33	75.76	No/No	STnon	86.84	200.000		150.000	No	
		10/25/2012	33	75.76	No/No		86.84	200.000		140.000	No	
JSF-W31	Antimony, total, ug/L	10/25/2012	33	96.97	No/No	STnon	86.84	6.000		<1.000	No	
		10/25/2012	33	96.97	No/No		86.84	6.000		<1.000	No	
JSF-W31	Arsenic, total, ug/L	10/25/2012	33	93.94	No/No	STnon	86.84	2.500		<1.000	No	
		10/25/2012	33	93.94	No/No		86.84	2.500		1.400	No	
JSF-W31	Barium, total, ug/L	10/25/2012	33	3.03	No/No	STnon	86.84	255.000		29.000	No	
		10/25/2012	33	3.03	No/No		86.84	255.000		30.000	No	
JSF-W31	Beryllium, total, ug/L	10/25/2012	33	96.97	No/No	STnon	86.84	2.700		<1.000	No	
		10/25/2012	33	96.97	No/No		86.84	2.700		<1.000	No	
JSF-W31	Boron, total, ug/L	10/25/2012	33	96.97	No/No	STnon	86.84	225.000		15,000.000	Yes	
		10/25/2012	33	96.97	No/No		86.84	225.000		16,000.000	Yes	
JSF-W31	Cadmium, total, ug/L	10/25/2012	33	96.97	No/No	STnon	86.84	0.500		<0.500	No	
		10/25/2012	33	96.97	No/No		86.84	0.500		<0.500	No	
JSF-W31	Chloride, total, mg/L	10/25/2012	33	0.00	Yes/Yes	STpar	99.97	15.218		10.000	No	
		10/25/2012	33	0.00	Yes/Yes		99.97	15.218		10.000	No	
JSF-W31	Chromium, total, ug/L	10/25/2012	33	84.85	No/No	STnon	86.84	4.000		2.900	No	
		10/25/2012	33	84.85	No/No		86.84	4.000		2.300	No	
JSF-W31	Cobalt, total, ug/L	10/25/2012	33	81.82	No/No	STnon	86.84	2.000		<1.000	No	
		10/25/2012	33	81.82	No/No		86.84	2.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W31	Copper, total, ug/L	10/25/2012	33	96.97	No/No	STnon	86.84	10.000		1.500	No	
		10/25/2012	33	96.97	No/No		86.84	10.000		1.000	No	
JSF-W31	Cyanide, total, mg/L	10/25/2012	13	100.00	No/No	STmdl	N/A	0.005		<0.005	No	
		10/25/2012	13	100.00	No/No		N/A	0.005		<0.005	No	
JSF-W31	Fluoride, total, mg/L	10/25/2012	33	69.70	No/No	STnon	86.84	0.230		<0.100	No	
		10/25/2012	33	69.70	No/No		86.84	0.230		0.340	Yes	
JSF-W31	Iron, total, ug/L	10/25/2012	33	3.03	No/No	STnon	86.84	5,400.000		180.000	No	
		10/25/2012	33	3.03	No/No		86.84	5,400.000		200.000	No	
JSF-W31	Lead, total, ug/L	10/25/2012	33	93.94	No/No	STnon	86.84	1.000		<1.000	No	
		10/25/2012	33	93.94	No/No		86.84	1.000		<1.000	No	
JSF-W31	Manganese, total, ug/L	10/25/2012	33	6.06	Yes/No	STpar	99.97	53.790		<10.000	No	
		10/25/2012	33	6.06	Yes/No		99.97	53.790		<10.000	No	
JSF-W31	Mercury, total, ug/L	10/25/2012	33	100.00	No/No	STmdl	N/A	0.200		<0.200	No	
		10/25/2012	33	100.00	No/No		N/A	0.200		<0.200	No	
JSF-W31	Nickel, total, ug/L	10/25/2012	33	63.64	No/No	STnon	86.84	3.300		8.800	Yes	
		10/25/2012	33	63.64	No/No		86.84	3.300		10.000	Yes	
JSF-W31	Nitrite + Nitrate, mg/L	10/25/2012	19	15.79	No/No	STnon	79.17	0.530		0.170	No	
		10/25/2012	19	15.79	No/No		79.17	0.530		0.180	No	
JSF-W31	Nitrogen, Ammonia, mg/L	10/25/2012	19	63.16	No/No	STnon	79.17	0.140		<0.100	No	
		10/25/2012	19	63.16	No/No		79.17	0.140		<0.100	No	
JSF-W31	ORP, mV	10/25/2012	34	0.00	Yes/No	STpar	99.97	606.073		420.000	No	
JSF-W31	pH (field), pH	10/25/2012	34	0.00	No/No	STnon	87.18	7.300	6.700	6.600	Yes	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W31	Potassium, total, mg/L	10/25/2012	33	15.15	No/No	STnon	86.84	1.700		21.000	Yes	
		10/25/2012	33	15.15	No/No		86.84	1.700		23.000	Yes	
JSF-W31	Selenium, total, ug/L	10/25/2012	33	87.88	No/No	STnon	86.84	1.900		3.900	Yes	
		10/25/2012	33	87.88	No/No		86.84	1.900		2.600	Yes	
JSF-W31	Silver, total, ug/L	10/25/2012	32	100.00	No/No	STmdl	N/A	0.500		<0.500	No	
		10/25/2012	32	100.00	No/No		N/A	0.500		<0.500	No	
JSF-W31	Sodium, total, mg/L	10/25/2012	33	0.00	Yes/Yes	STpar	99.97	9.729		98.000	Yes	
		10/25/2012	33	0.00	Yes/Yes		99.97	9.729		100.000	Yes	
JSF-W31	Specific Cond. (Field), umhos/cm	10/25/2012	34	0.00	No/No	STnon	87.18	499.000		2,931.000	Yes	
JSF-W31	Strontium, total, ug/L	10/25/2012	33	3.03	No/No	STnon	86.84	840.000		4,800.000	Yes	
		10/25/2012	33	3.03	No/No		86.84	840.000		5,000.000	Yes	
JSF-W31	Sulfate, total, mg/L	10/25/2012	33	0.00	No/No	STnon	86.84	31.500		1,600.000	Yes	
		10/25/2012	33	0.00	No/No		86.84	31.500		1,600.000	Yes	
JSF-W31	Sulfide, total, mg/L	10/25/2012	13	100.00	No/No	STmdl	N/A	0.050		<0.050	No	
		10/25/2012	13	100.00	No/No		N/A	0.050		<0.050	No	
JSF-W31	Temperature, Celsius, degrees C	10/25/2012	34	0.00	No/No	STnon	87.18	16.600		18.000	Yes	
JSF-W31	Thallium, total, ug/L	10/25/2012	33	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
		10/25/2012	33	100.00	No/No		N/A	1.000		<1.000	No	
JSF-W31	Tin, total, ug/L	10/25/2012	22	95.45	No/No	STnon	81.48	490.000		<1.000	No	
		10/25/2012	22	95.45	No/No		81.48	490.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W31	Vanadium, total, ug/L	10/25/2012	33	100.00	No/No	STmdl	N/A	2.000		4.200	Yes	
		10/25/2012	33	100.00	No/No		N/A	2.000		2.800	Yes	
JSF-W31	Zinc, total, ug/L	10/25/2012	33	78.79	No/No	STnon	86.84	95.500		<10.000	No	
		10/25/2012	33	78.79	No/No		86.84	95.500		<10.000	No	

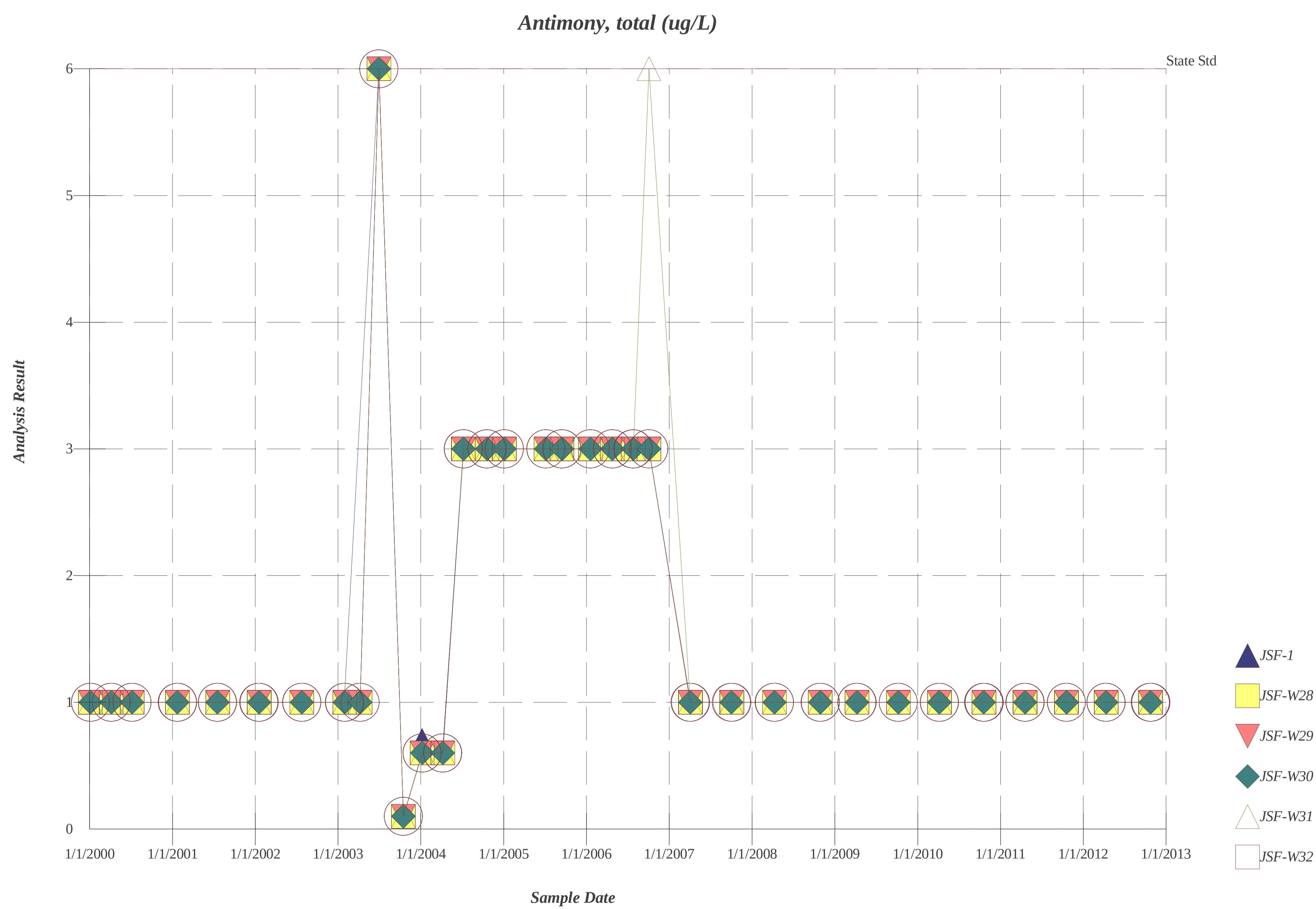
Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W32	Alkalinity, total (field), mg/L CaCO3	10/25/2012	33	0.00	No/No	STnon	86.84	222.000		300.000	Yes	
JSF-W32	Aluminum, total, ug/L	10/25/2012	33	75.76	No/No	STnon	86.84	200.000		<100.000	No	
JSF-W32	Antimony, total, ug/L	10/25/2012	33	96.97	No/No	STnon	86.84	6.000		<1.000	No	
JSF-W32	Arsenic, total, ug/L	10/25/2012	33	93.94	No/No	STnon	86.84	2.500		<1.000	No	
JSF-W32	Barium, total, ug/L	10/25/2012	33	3.03	No/No	STnon	86.84	255.000		52.000	No	
JSF-W32	Beryllium, total, ug/L	10/25/2012	33	96.97	No/No	STnon	86.84	2.700		<1.000	No	
JSF-W32	Boron, total, ug/L	10/25/2012	33	96.97	No/No	STnon	86.84	225.000		330.000	Yes	
JSF-W32	Cadmium, total, ug/L	10/25/2012	33	96.97	No/No	STnon	86.84	0.500		<0.500	No	
JSF-W32	Chloride, total, mg/L	10/25/2012	33	0.00	Yes/Yes	STpar	99.97	15.218		12.000	No	
JSF-W32	Chromium, total, ug/L	10/25/2012	33	84.85	No/No	STnon	86.84	4.000		2.500	No	
JSF-W32	Cobalt, total, ug/L	10/25/2012	33	81.82	No/No	STnon	86.84	2.000		<1.000	No	
JSF-W32	Copper, total, ug/L	10/25/2012	33	96.97	No/No	STnon	86.84	10.000		<1.000	No	
JSF-W32	Cyanide, total, mg/L	10/25/2012	13	100.00	No/No	STmdl	N/A	0.005		<0.005	No	
JSF-W32	Fluoride, total, mg/L	10/25/2012	33	69.70	No/No	STnon	86.84	0.230		<0.100	No	
JSF-W32	Iron, total, ug/L	10/25/2012	33	3.03	No/No	STnon	86.84	5,400.000		<100.000	No	
JSF-W32	Lead, total, ug/L	10/25/2012	33	93.94	No/No	STnon	86.84	1.000		<1.000	No	

Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W32	Manganese, total, ug/L	10/25/2012	33	6.06	Yes/No	STpar	99.97	53.790		<10.000	No	
JSF-W32	Mercury, total, ug/L	10/25/2012	33	100.00	No/No	STmdl	N/A	0.200		<0.200	No	
JSF-W32	Nickel, total, ug/L	10/25/2012	33	63.64	No/No	STnon	86.84	3.300		2.000	No	
JSF-W32	Nitrite + Nitrate, mg/L	10/25/2012	19	15.79	No/No	STnon	79.17	0.530		0.530	No	
JSF-W32	Nitrogen, Ammonia, mg/L	10/25/2012	19	63.16	No/No	STnon	79.17	0.140		<0.100	No	
JSF-W32	ORP, mV	10/25/2012	34	0.00	Yes/No	STpar	99.97	606.073		435.000	No	
JSF-W32	pH (field), pH	10/25/2012	34	0.00	No/No	STnon	87.18	7.300	6.700	6.700	No	
JSF-W32	Potassium, total, mg/L	10/25/2012	33	15.15	No/No	STnon	86.84	1.700		1.900	Yes	
JSF-W32	Selenium, total, ug/L	10/25/2012	33	87.88	No/No	STnon	86.84	1.900		<1.000	No	
JSF-W32	Silver, total, ug/L	10/25/2012	32	100.00	No/No	STmdl	N/A	0.500		<0.500	No	
JSF-W32	Sodium, total, mg/L	10/25/2012	33	0.00	Yes/Yes	STpar	99.97	9.729		8.000	No	
JSF-W32	Specific Cond. (Field), umhos/cm	10/25/2012	34	0.00	No/No	STnon	87.18	499.000		668.000	Yes	
JSF-W32	Strontium, total, ug/L	10/25/2012	33	3.03	No/No	STnon	86.84	840.000		290.000	No	
JSF-W32	Sulfate, total, mg/L	10/25/2012	33	0.00	No/No	STnon	86.84	31.500		51.000	Yes	
JSF-W32	Sulfide, total, mg/L	10/25/2012	13	100.00	No/No	STmdl	N/A	0.050		<0.050	No	
JSF-W32	Temperature, Celsius, degrees C	10/25/2012	34	0.00	No/No	STnon	87.18	16.600		18.000	Yes	

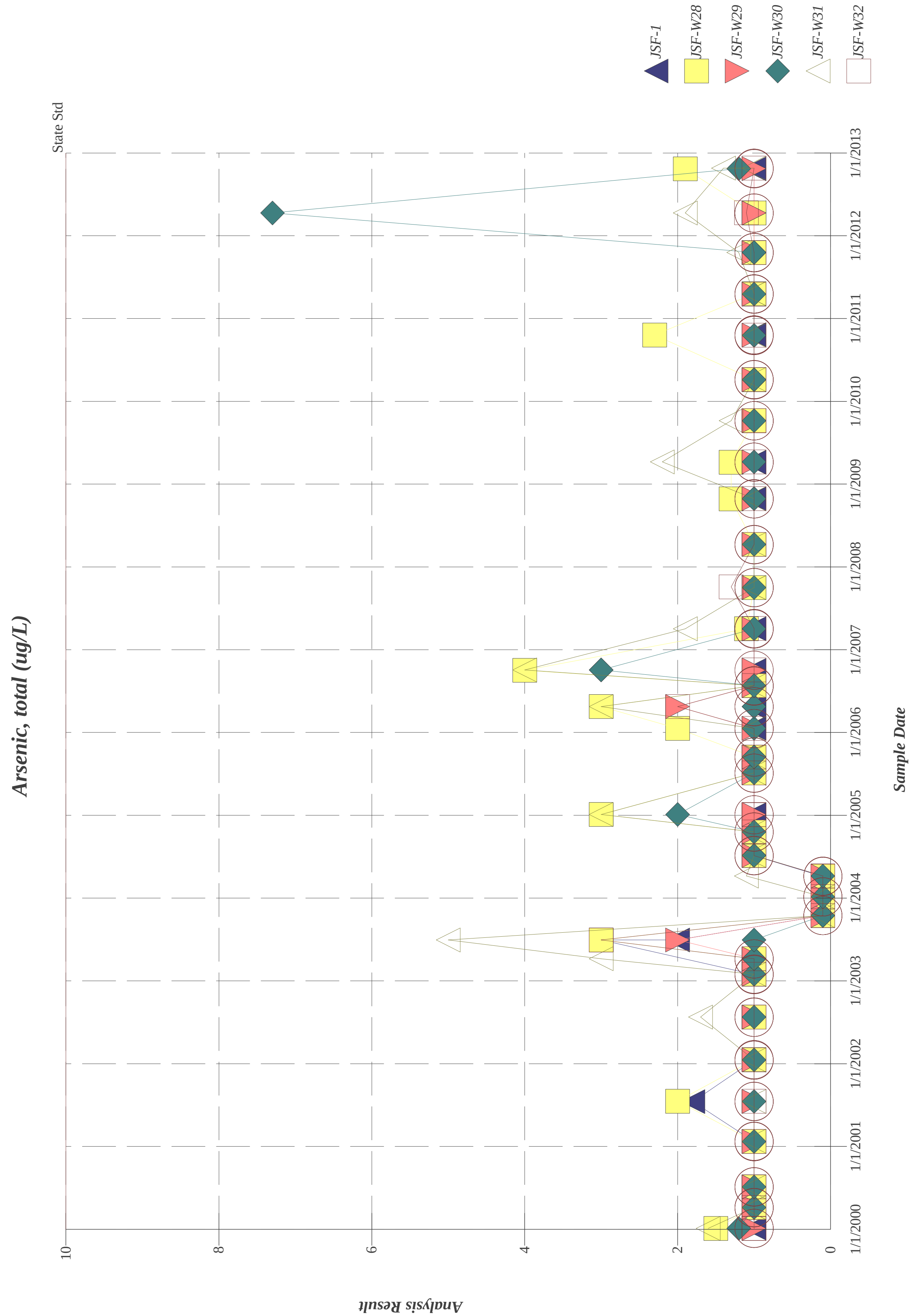
Compliance Location	Parameter	Sample Date	Count Of Bkg Results	Percent of Non detects	Normal / Lognormal	Test	Confidence Level	Upper Limit	Lower Limit	Analysis Result	Exceedance	Trend
JSF-W32	Thallium, total, ug/L	10/25/2012	33	100.00	No/No	STmdl	N/A	1.000		<1.000	No	
JSF-W32	Tin, total, ug/L	10/25/2012	22	95.45	No/No	STnon	81.48	490.000		<1.000	No	
JSF-W32	Vanadium, total, ug/L	10/25/2012	33	100.00	No/No	STmdl	N/A	2.000		<2.000	No	
JSF-W32	Zinc, total, ug/L	10/25/2012	33	78.79	No/No	STnon	86.84	95.500		<10.000	No	

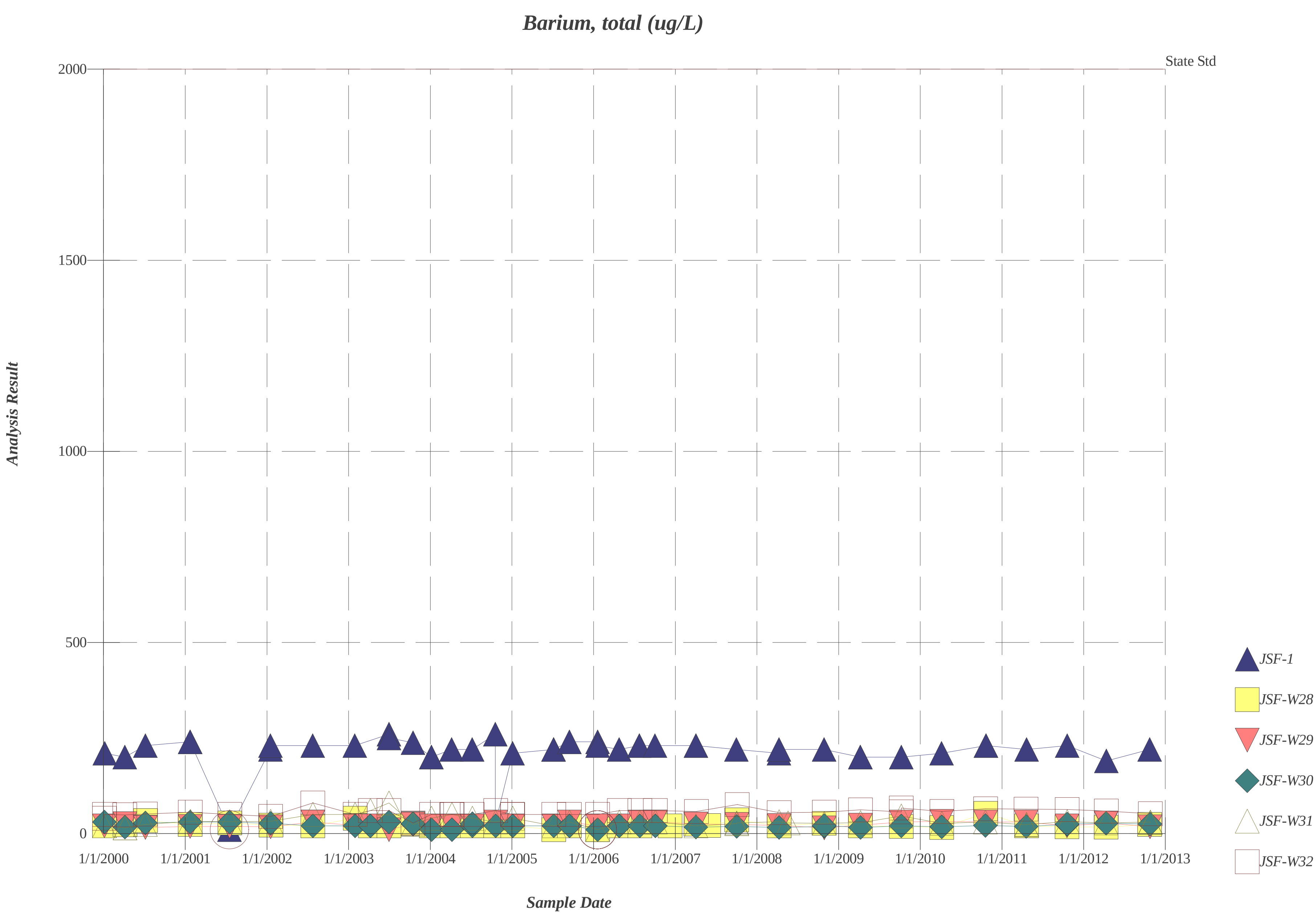
APPENDIX E

TIME-SERIES GRAPHS OF SAMPLE CONSTITUENT DATA



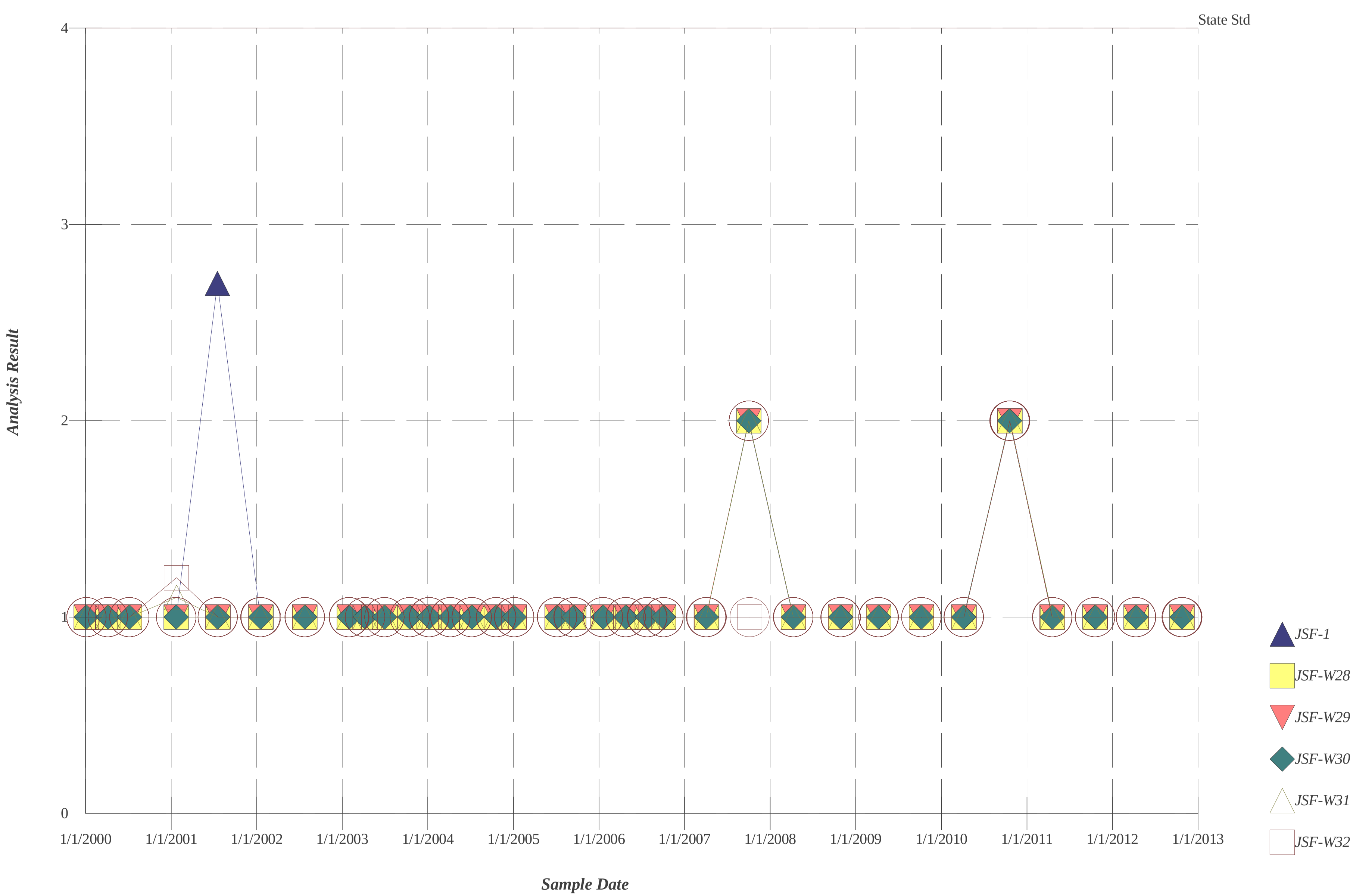
Antimony, total (ug/L)
State Std
6
5
4
3
2
1
0
Analysis Result
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Sample Date
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32

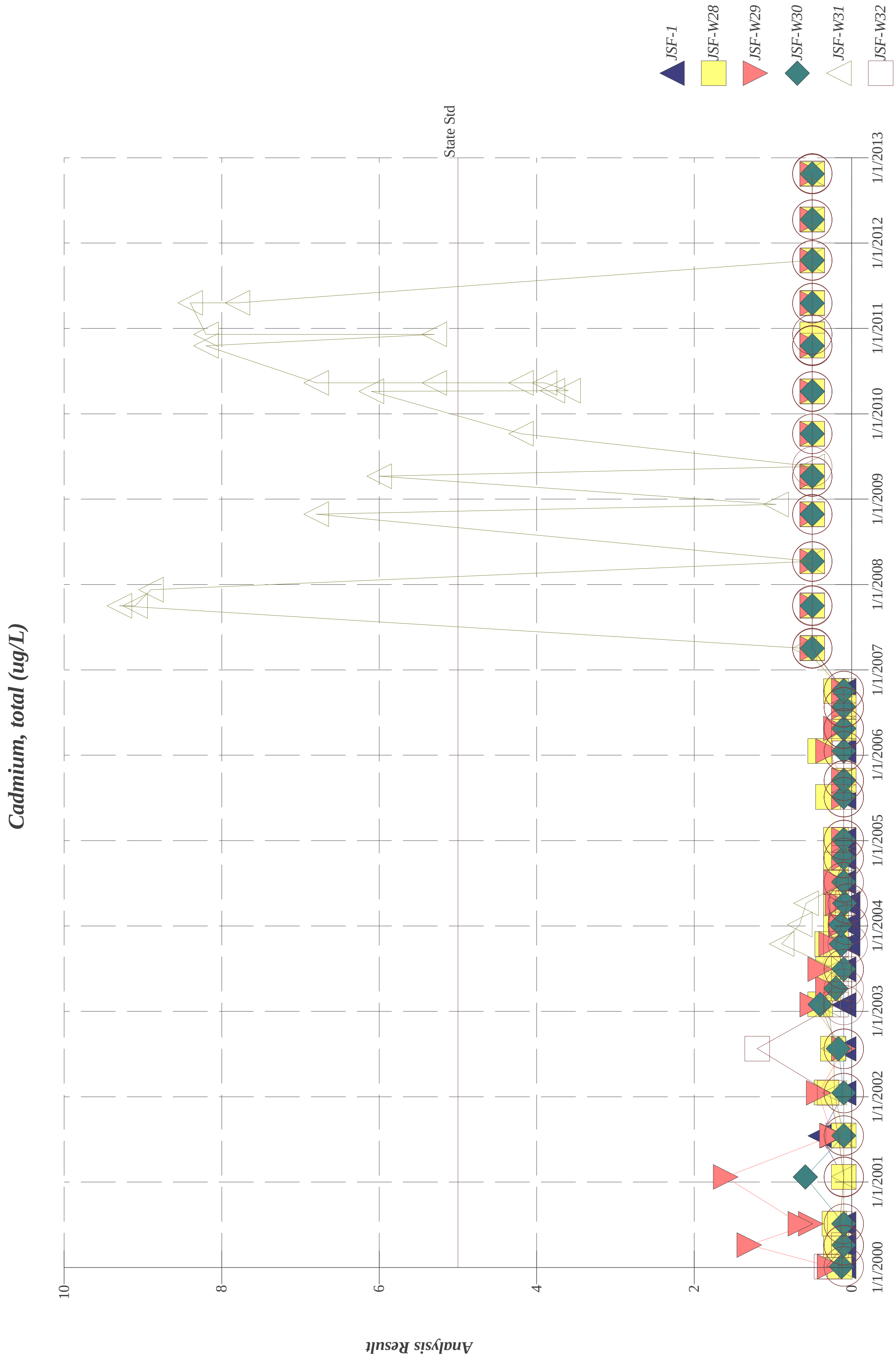

Arsenic, total (ug/L)
State Std
Analysis Result
10
8
6
4
2
0
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Sample Date
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32



Barium, total (ug/L)
State Std
Analysis Result
2000
1500
1000
500
0
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Sample Date
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32

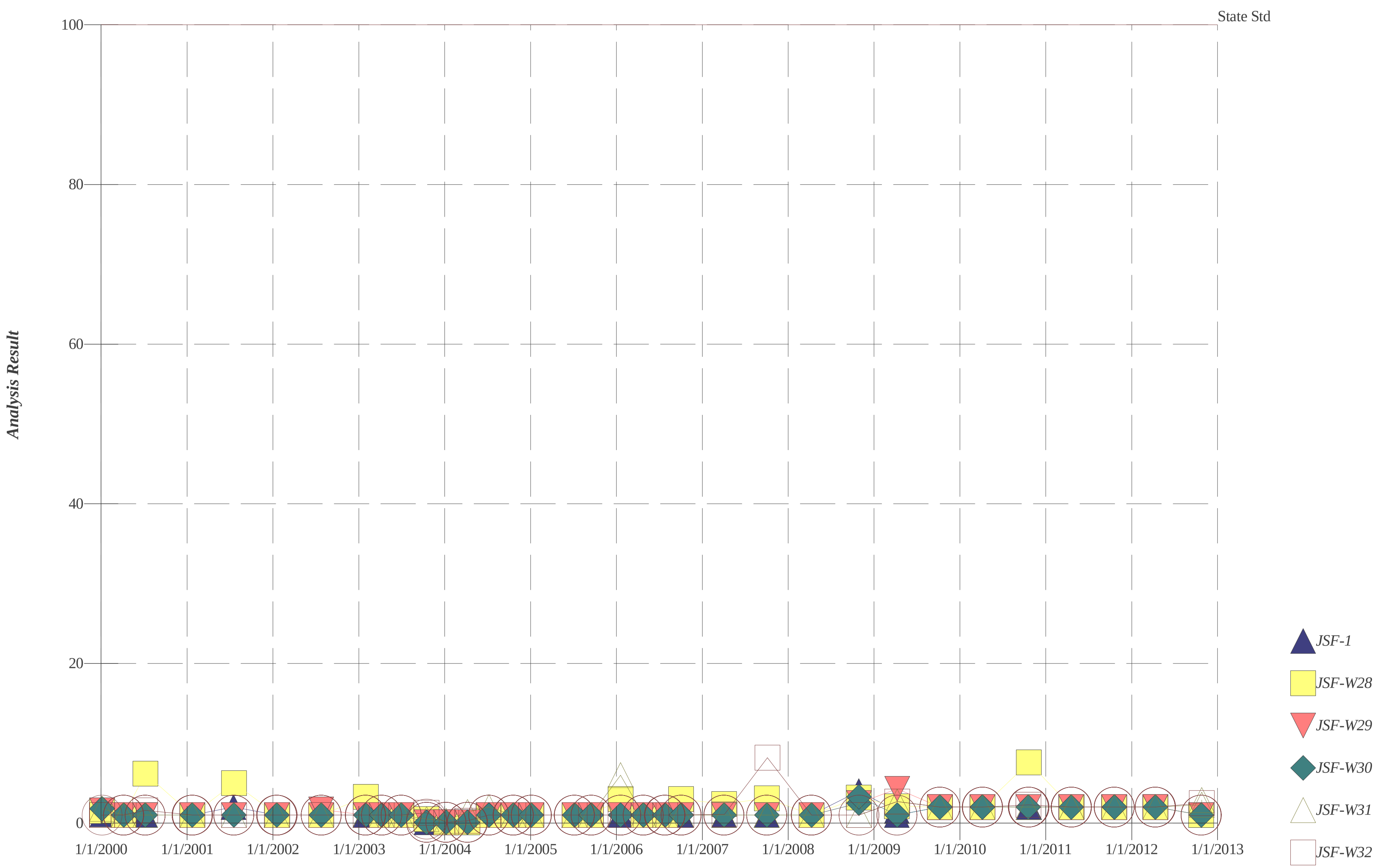
Beryllium, total (ug/L)



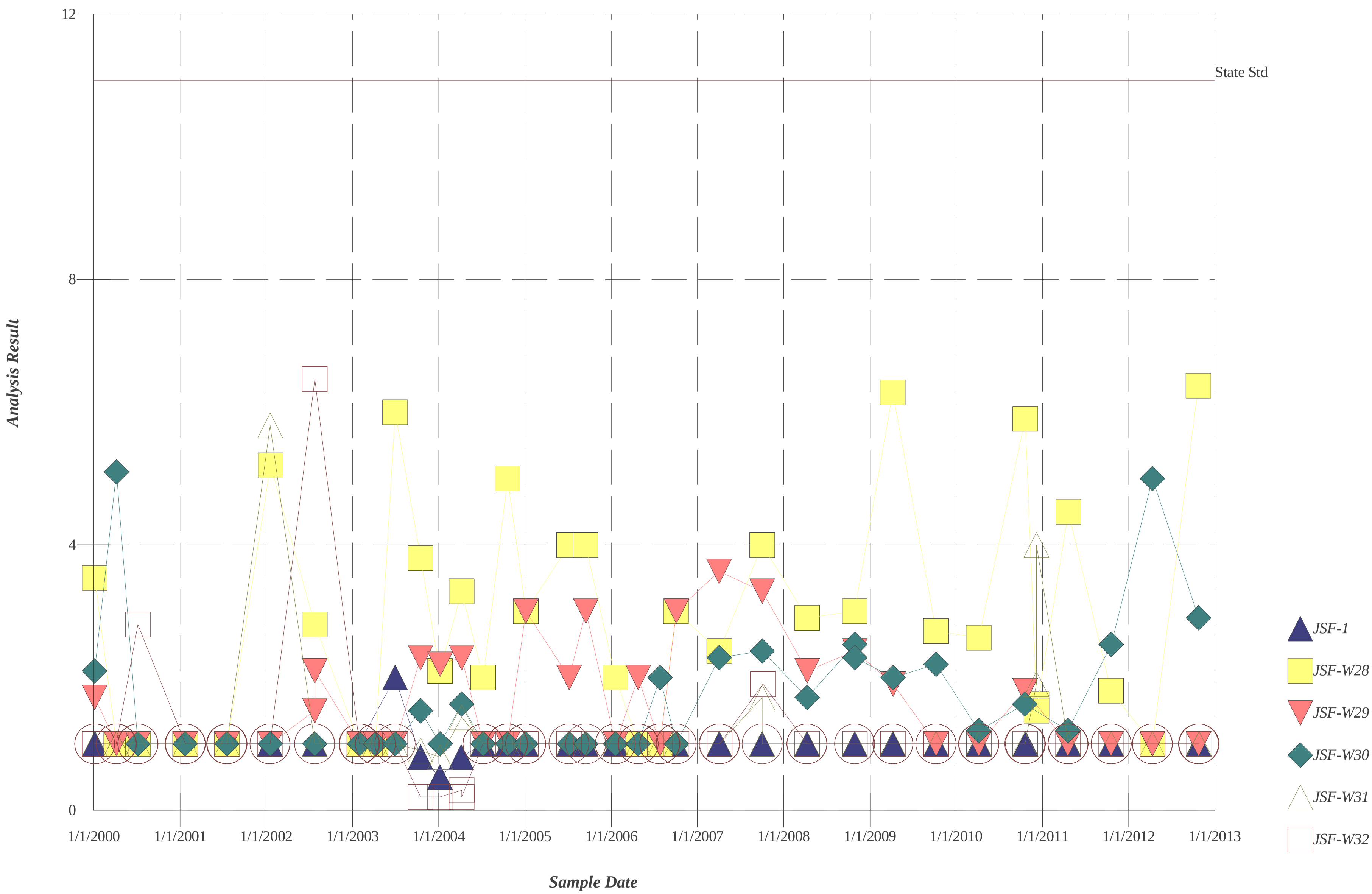


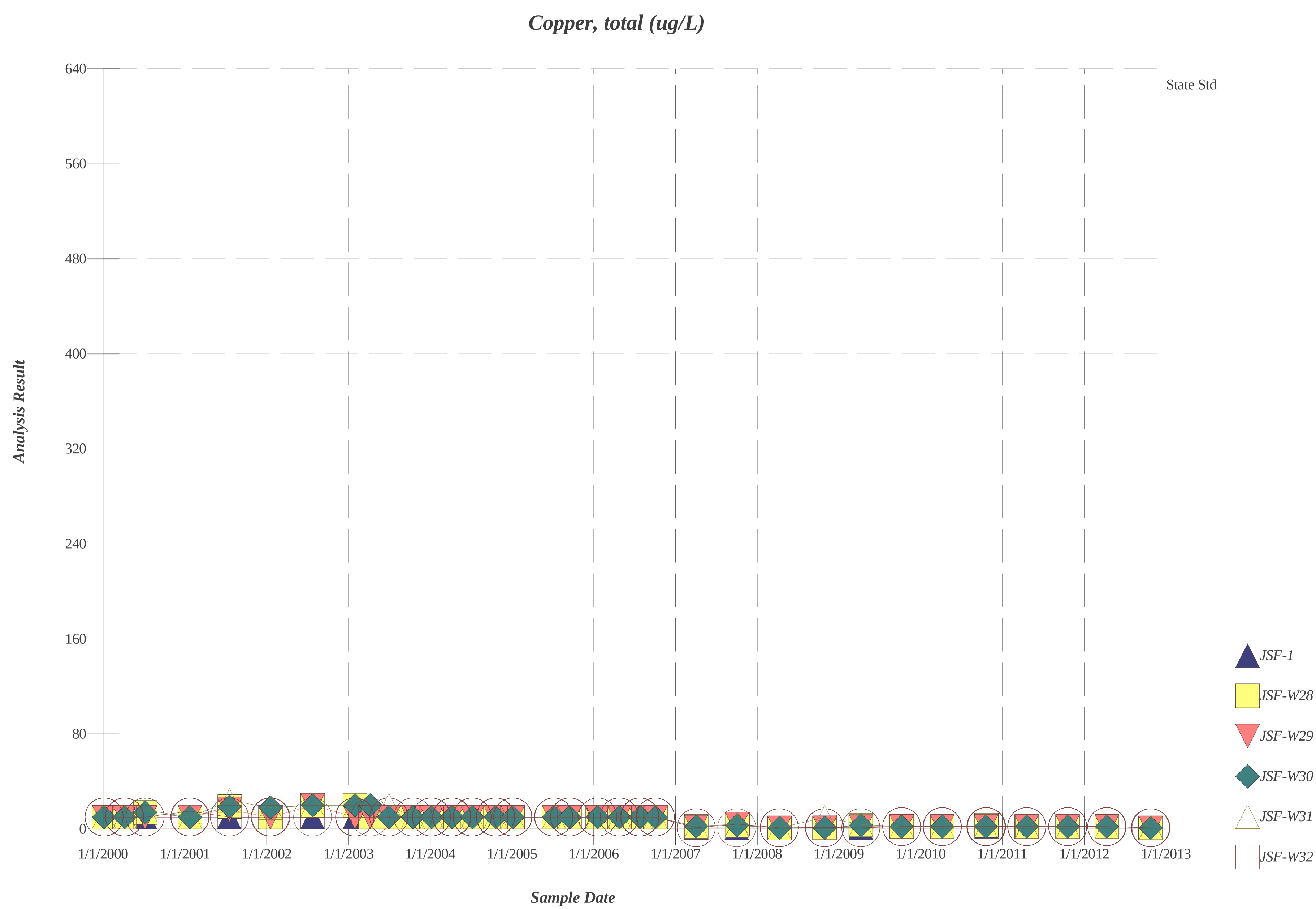
Cadmium, total (ug/L)
Analysis Result
Sample Date
State Std
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32
0
2
4
6
8
10
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013

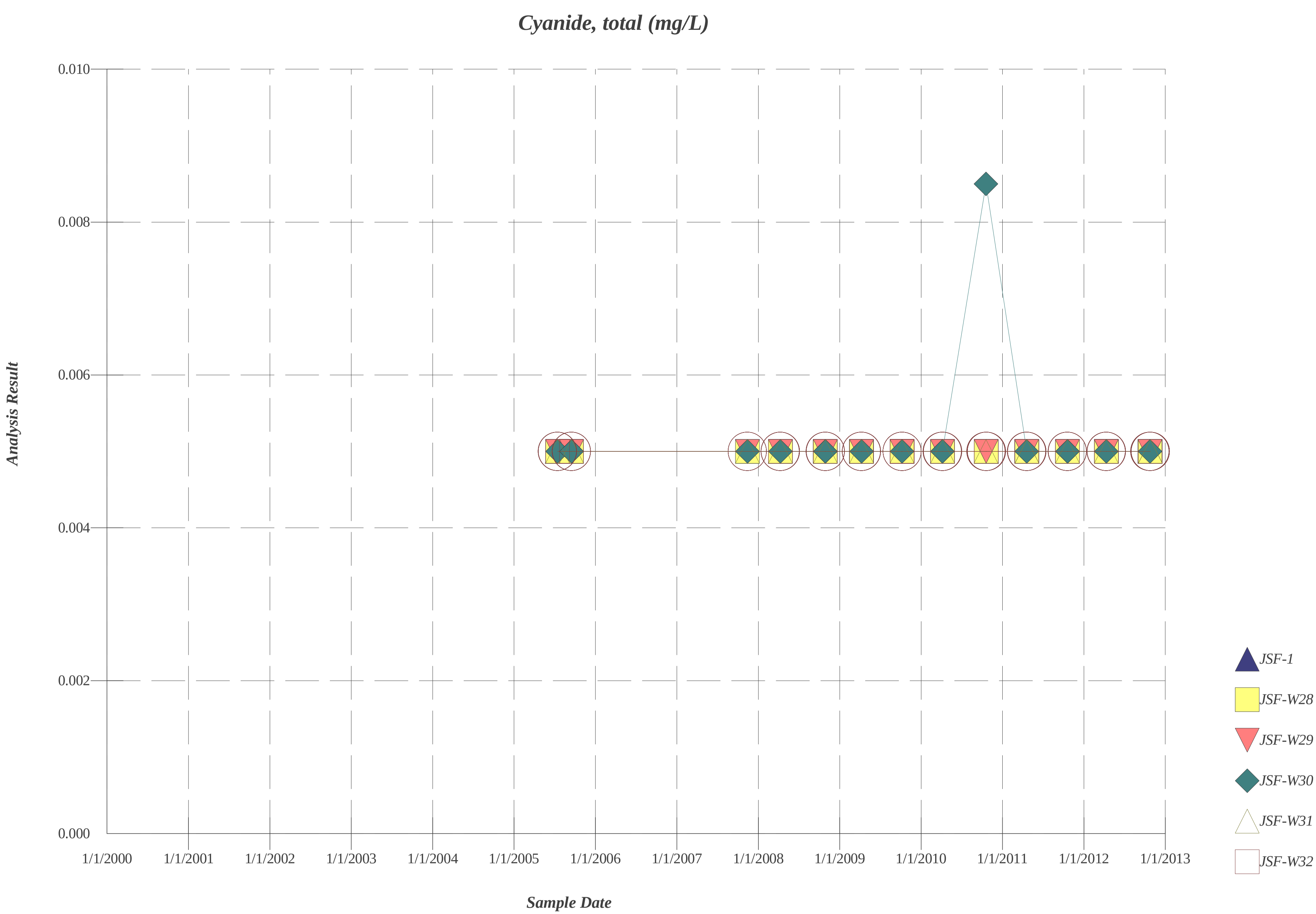
Chromium, total (ug/L)

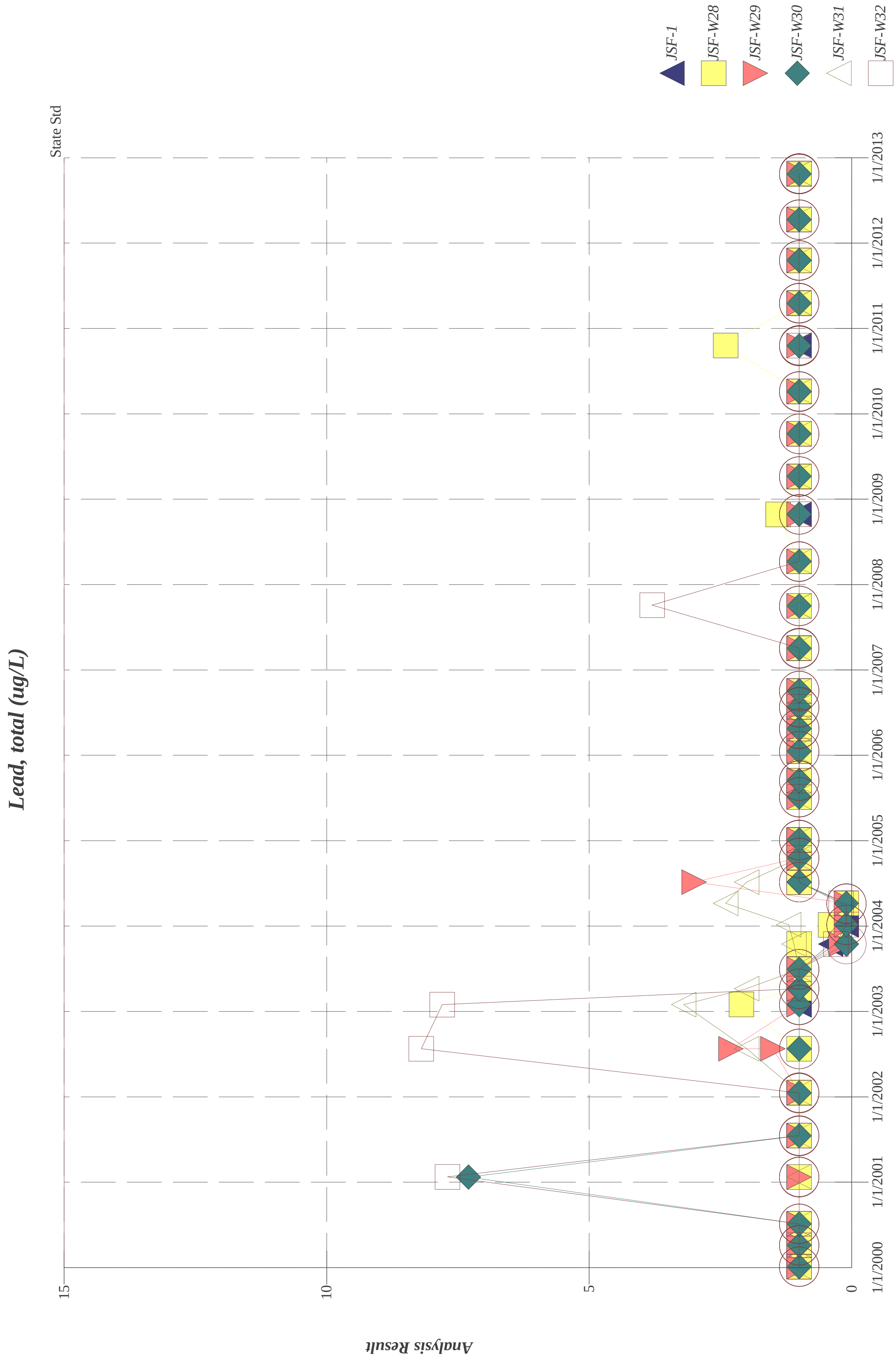


Cobalt, total (ug/L)



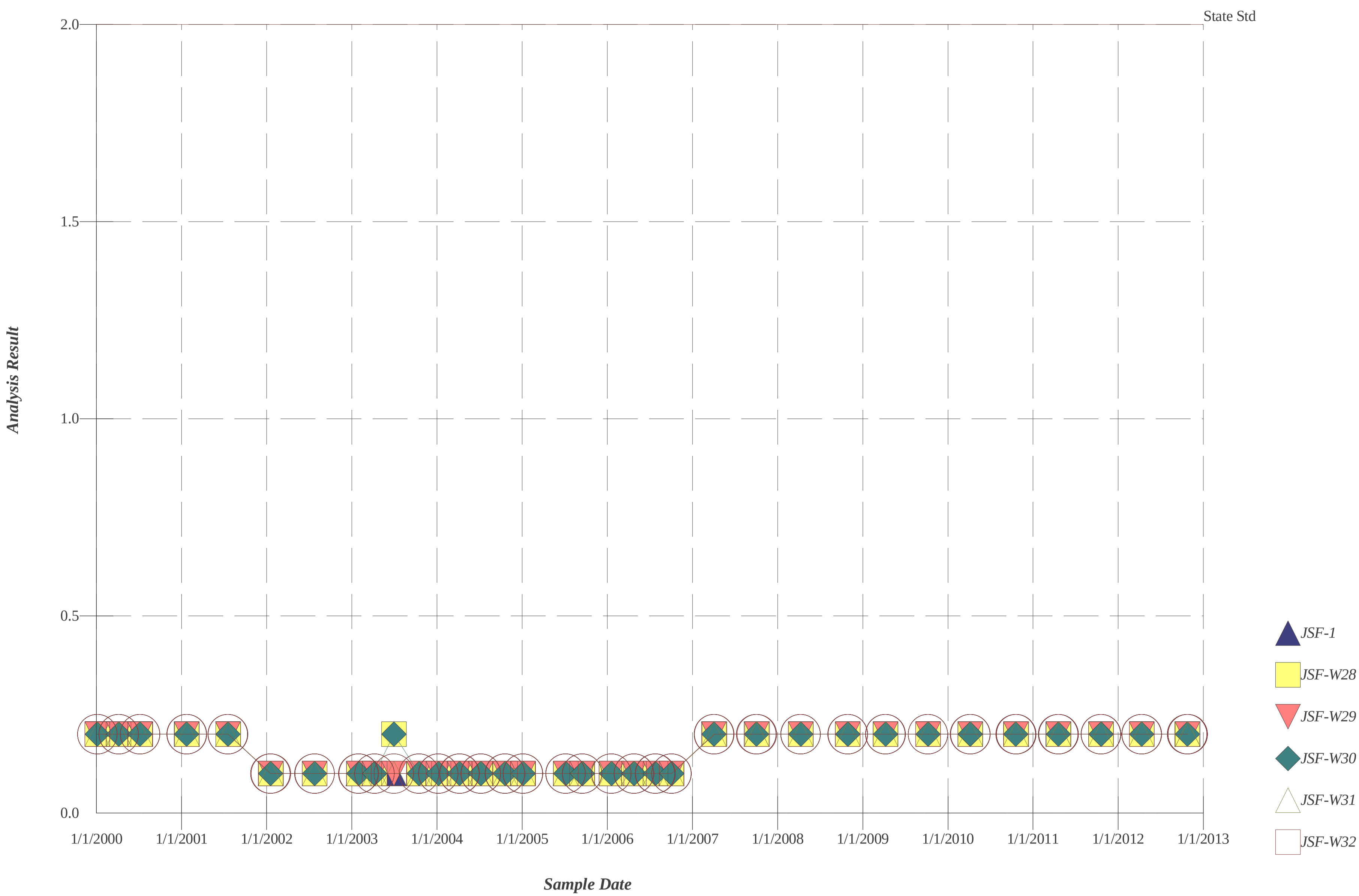

Copper, total (ug/L)
Analysis Result
640
560
480
400
320
240
160
80
0
State Std
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Sample Date
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32


Cyanide, total (mg/L)
Analysis Result
0.010
0.008
0.006
0.004
0.002
0.000
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Sample Date
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32

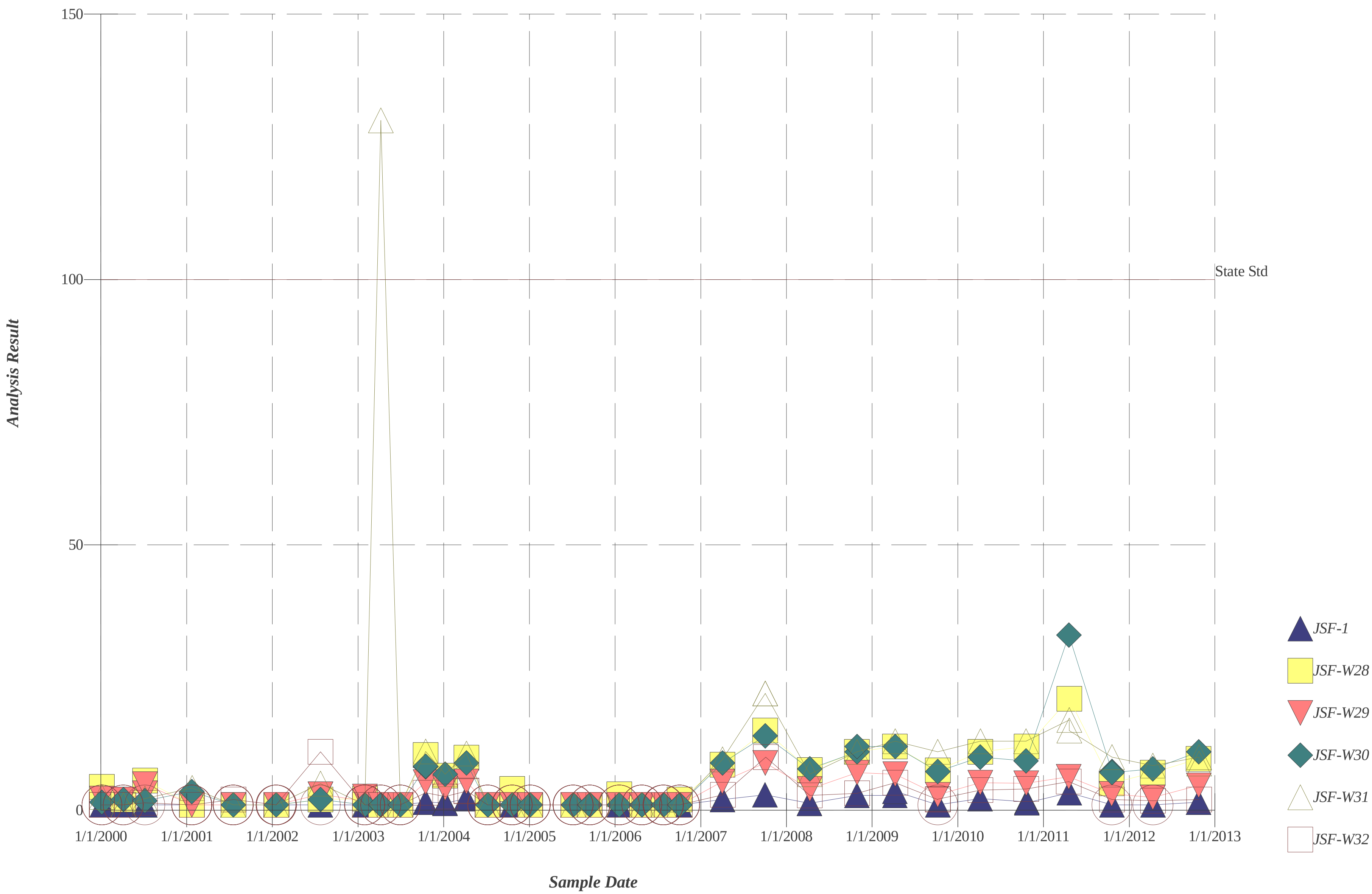


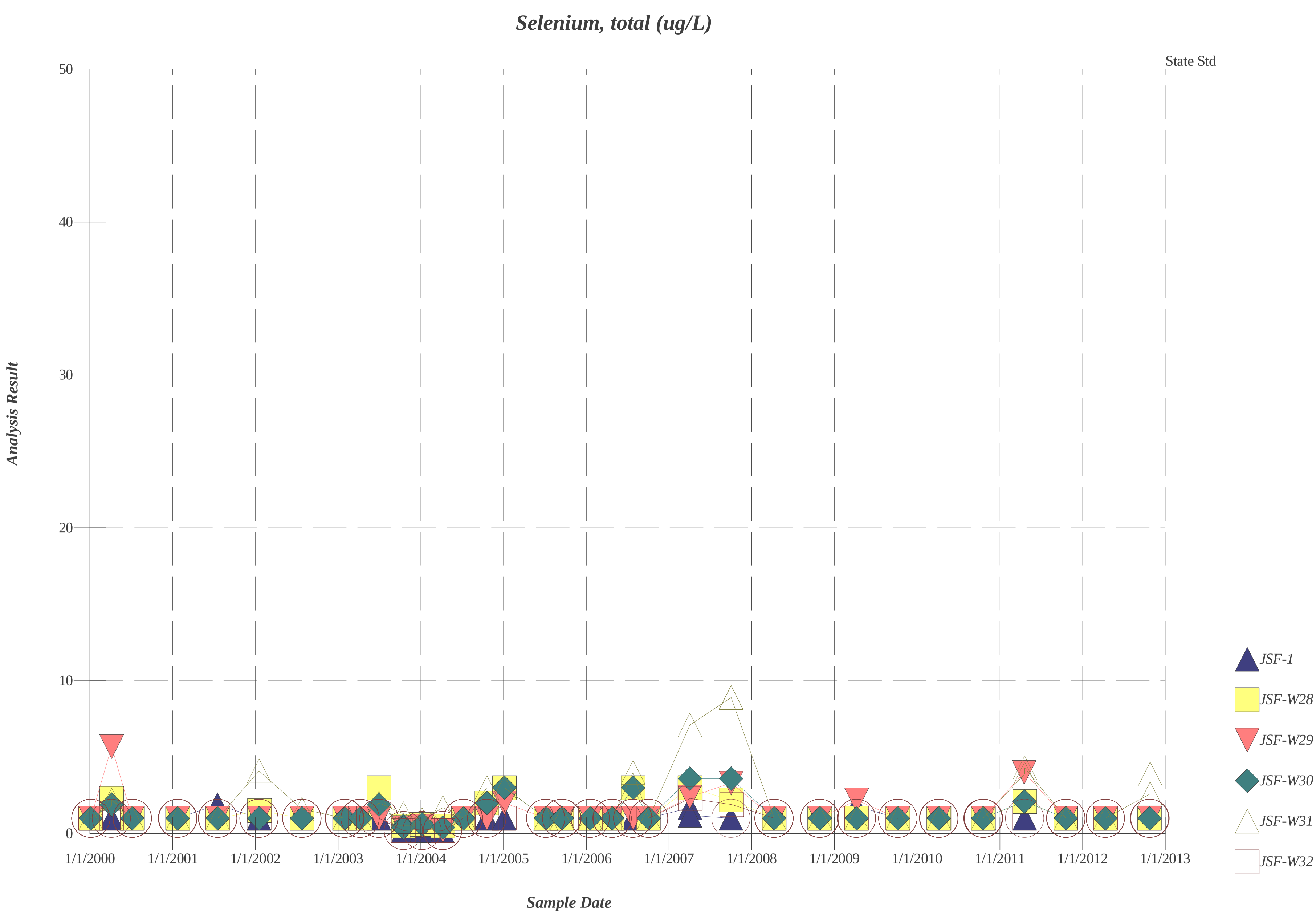
Lead, total (ug/L)
Analysis Result
Sample Date
State Std
0
5
10
15
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32

Mercury, total (ug/L)

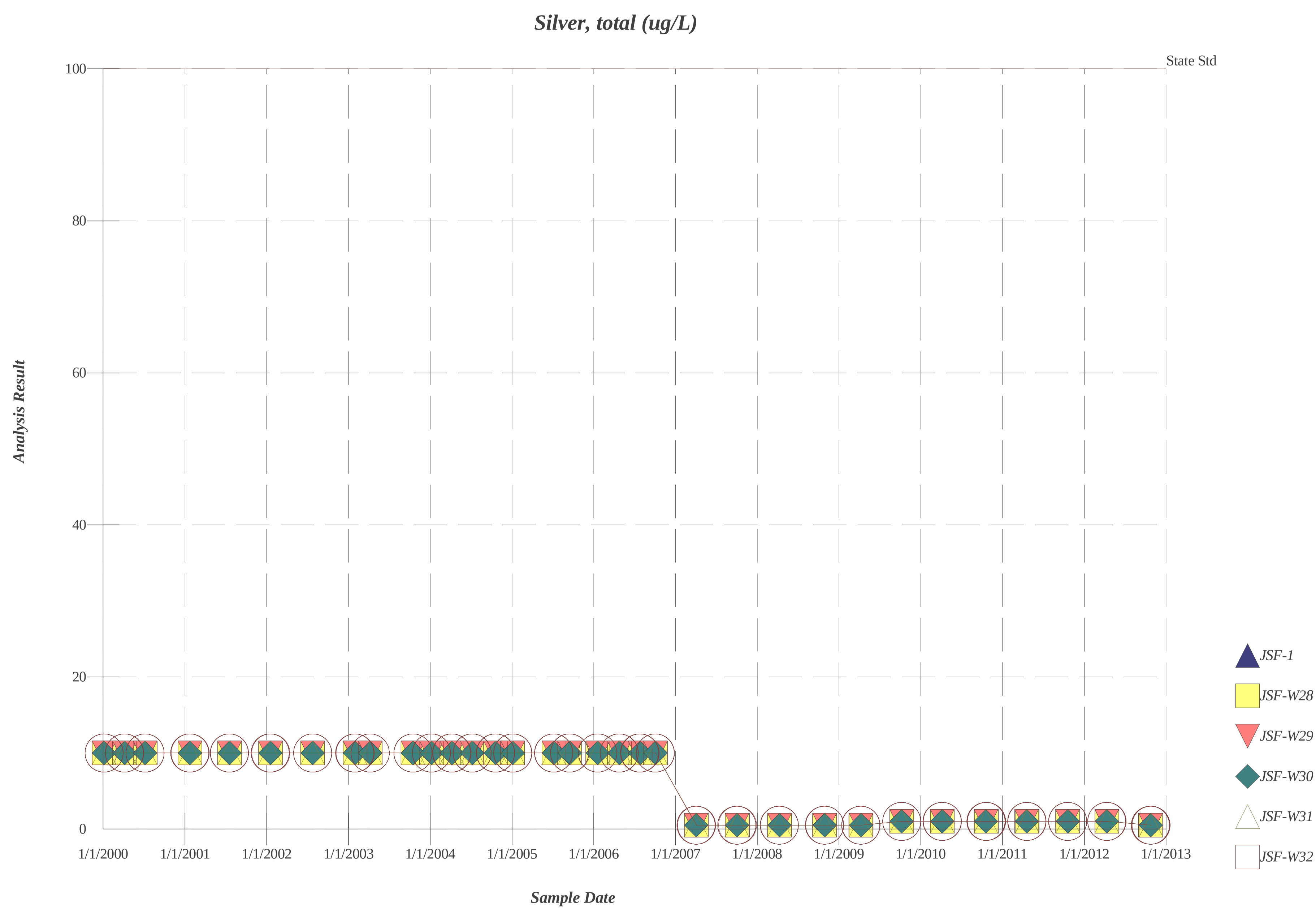


Nickel, total (ug/L)





Selenium, total (ug/L)
State Std
50
40
30
20
10
0
Analysis Result
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Sample Date
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32



Silver, total (ug/L)
State Std
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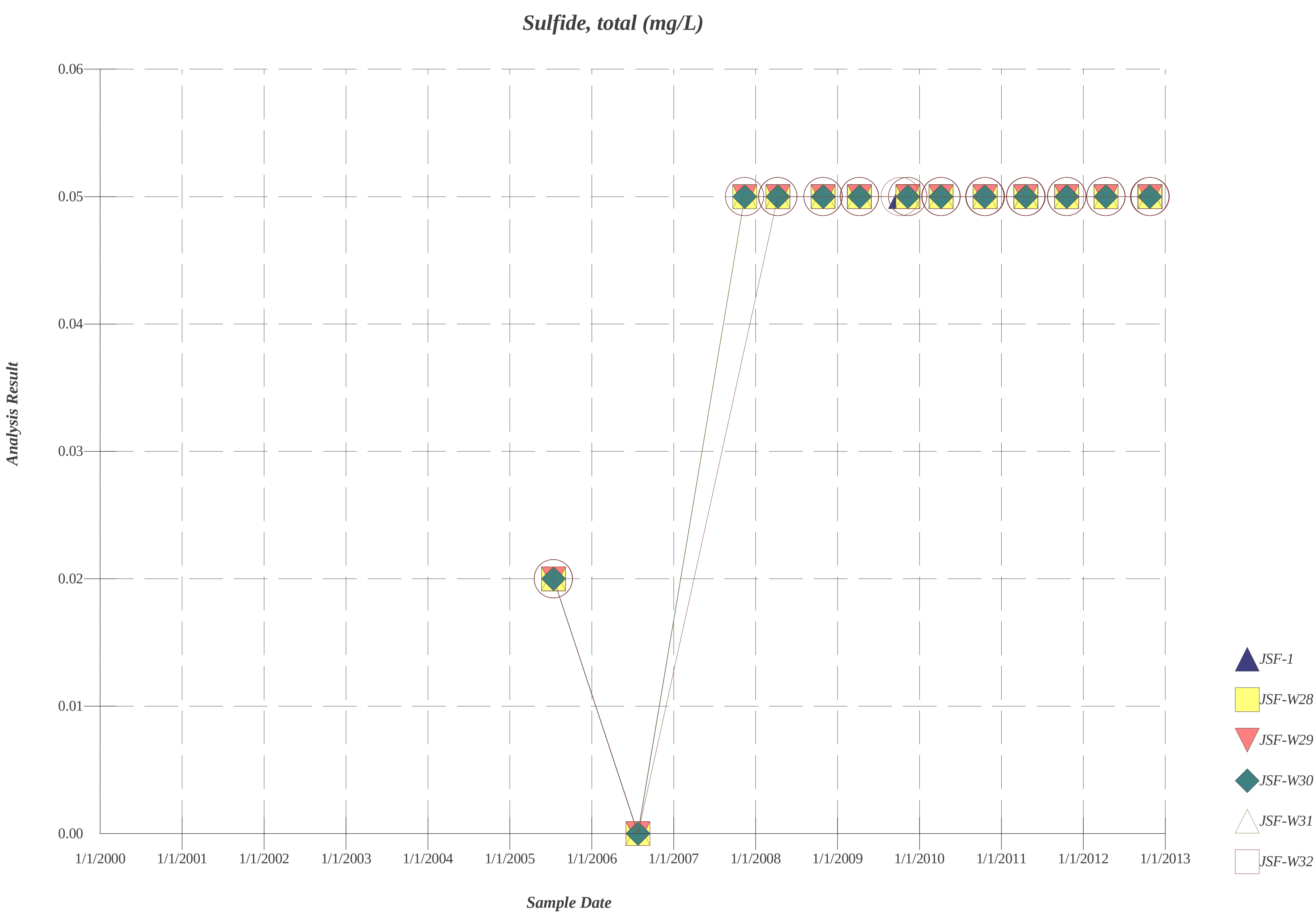
80
60
40
20
0
Analysis Result
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Sample Date
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32



Sulfide, total (mg/L)
Analysis Result
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0.05
0.04
0.03
0.02
0.01
0.00
1/1/2000
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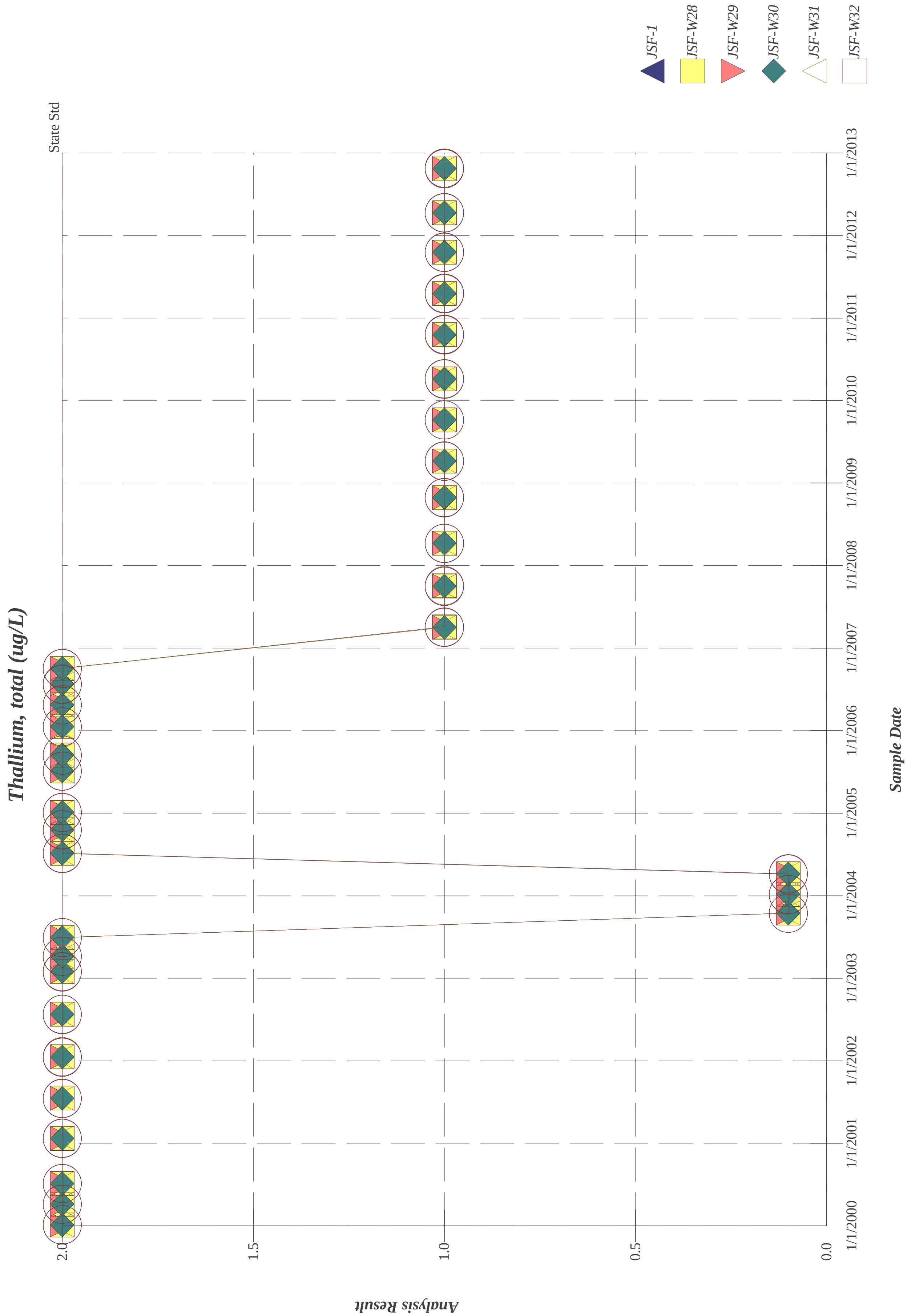
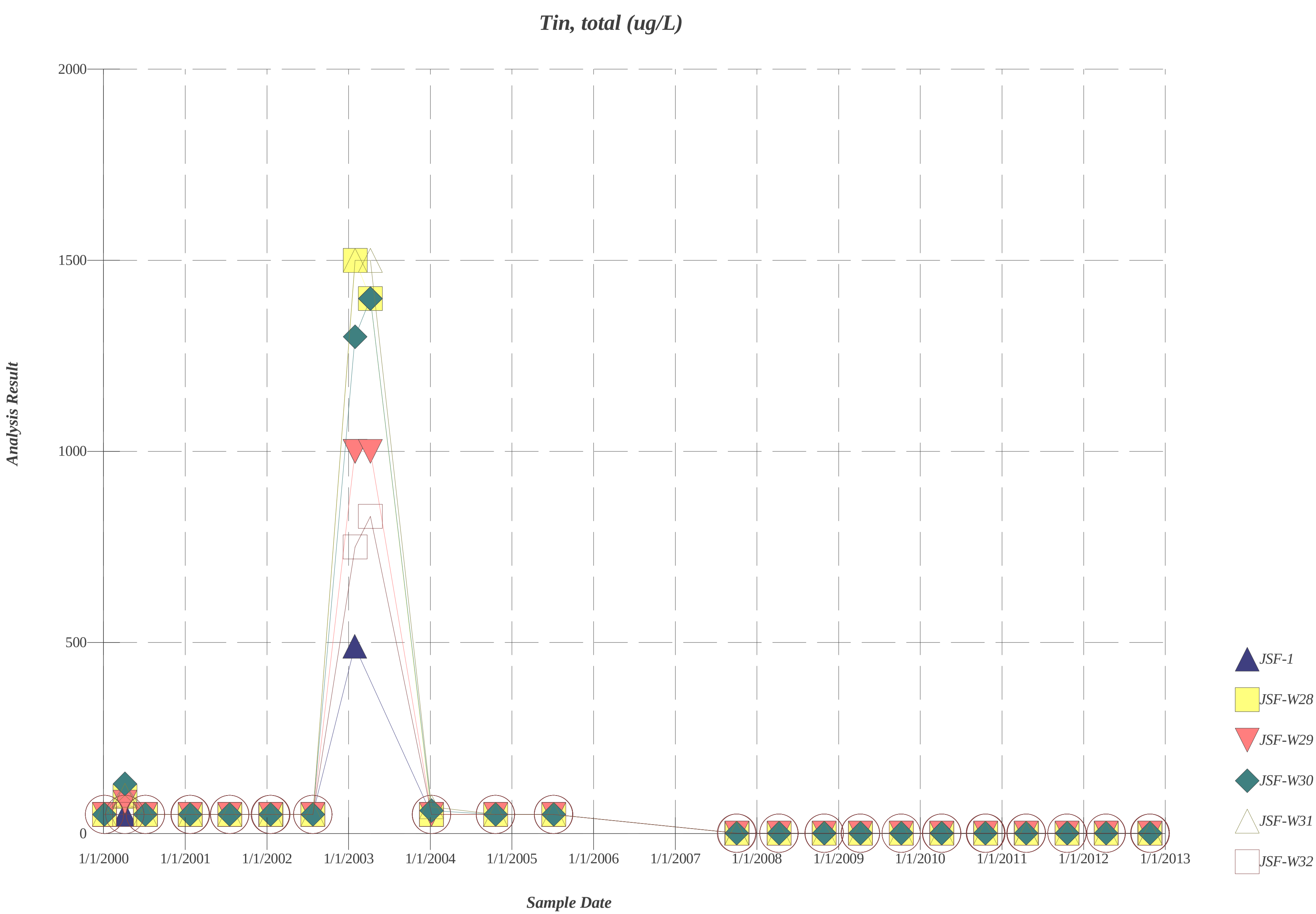
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Sample Date
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32



Thallium, total (ug/L)
State Std
Analysis Result
2.0
1.5
1.0
0.5
0.0
Sample Date
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32


Tin, total (ug/L)
Analysis Result
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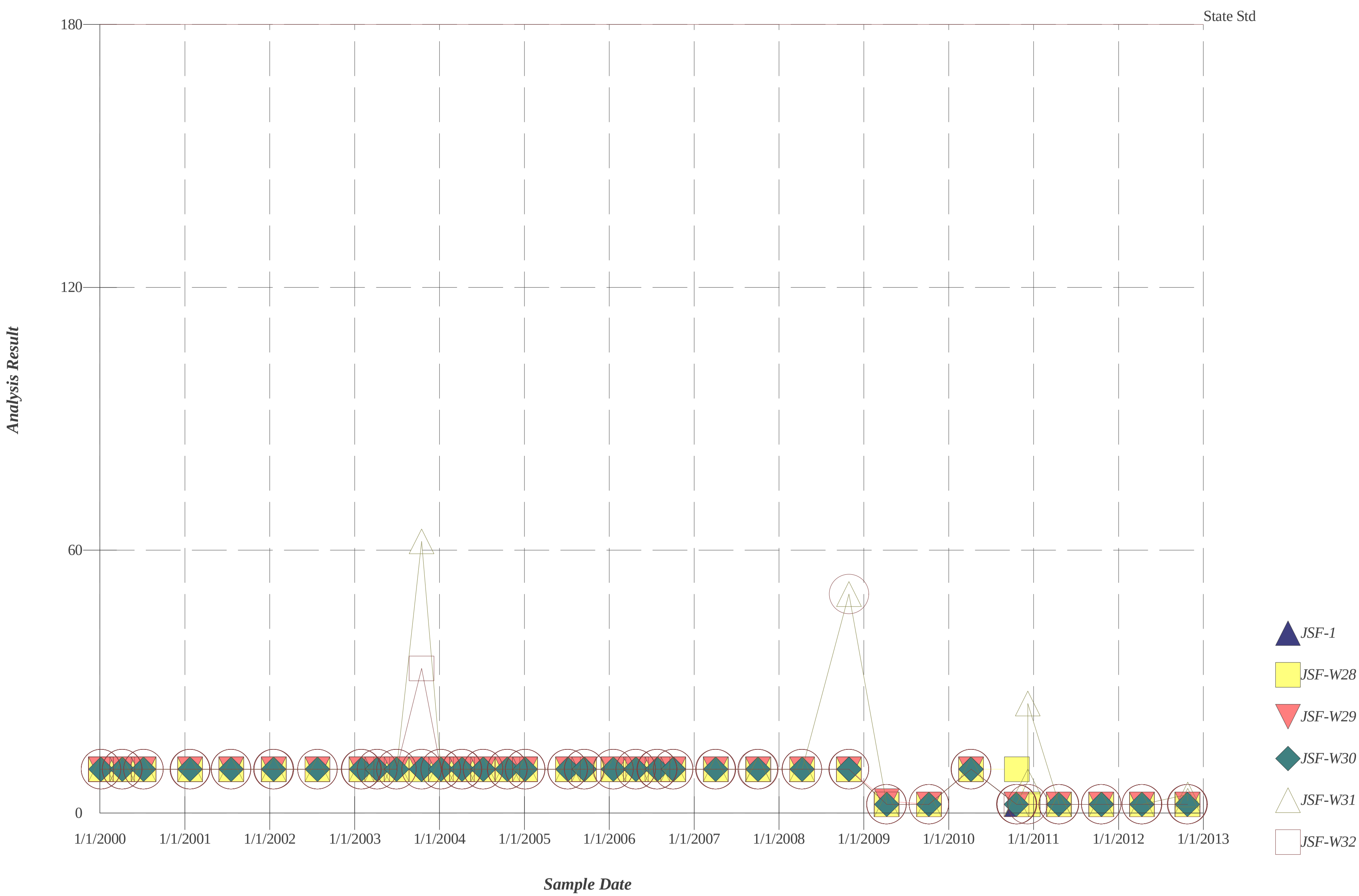
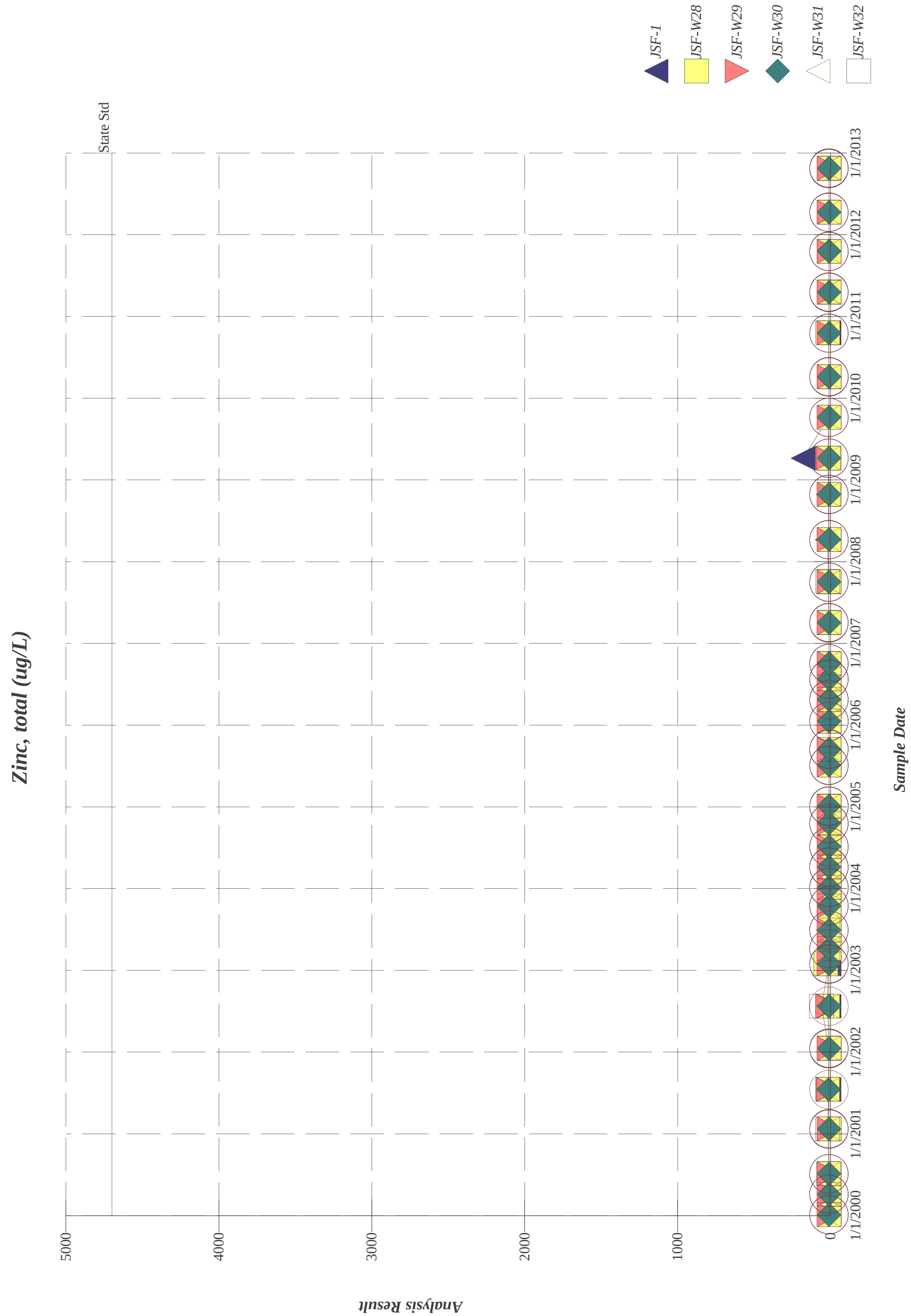
1500
1000
500
0
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Sample Date
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32

Vanadium, total (ug/L)




Zinc, total (ug/L)
State Std
JSF-1
JSF-W28
JSF-W29
JSF-W30
JSF-W31
JSF-W32
Analysis Result
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4000
3000
2000
1000
0
1/1/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
Sample Date

APPENDIX F

LEACHATE COLLECTION SYSTEM DISCHARGE DATA

JOHN SEVIER FOSSIL PLANT
DRY ASH DISPOSAL FACILITY
LEACHATE COLLECTION SYSTEM DISCHARGE DATA

Measurement Date	Number of Days in Measurement Period	CP-2 Flowmeter Reading (Gallons)	CP-3 Flowmeter Reading (Gallons)	CP-4 Flowmeter Reading (Gallons)	CP-5 Flowmeter Reading (Gallons)	CP-6 Flowmeter Reading (Gallons)	CP-2 Volume Pumped during Period (Gallons)	CP-3 Volume Pumped during Period (Gallons)	CP-4 Volume Pumped during Period (Gallons)	CP-5 Volume Pumped during Period (Gallons)	CP-6 Volume Pumped during Period (Gallons)	Average Flowrate during Measurement Period (GPD)	Comments
04/30/2012	6	8,074,898	7,468,271	1,143,660	124,205	343,267	19,399	8,796	20,839	573	6,706	9,386	
05/02/2012	2	8,081,858	7,471,362	1,150,600	124,205	345,609	6,960	3,091	6,940	0	2,342	9,667	
05/09/2012	7	8,107,677	7,482,297	1,174,460	124,490	352,984	25,819	10,935	23,860	285	7,375	9,753	
05/16/2012	7	8,134,078	7,494,151	1,201,744	130,189	364,232	26,401	11,854	27,284	5,699	11,248	11,784	
05/23/2012	7	8,159,198	7,505,437	1,226,515	130,189	372,614	25,120	11,286	24,771	0	8,382	9,937	
05/30/2012	7	8,183,367	7,516,178	1,251,289	131,368	382,398	24,169	10,741	24,774	1,179	9,784	10,092	
06/06/2012	7	8,207,981	7,527,590	1,277,892	133,452	393,151	24,614	11,412	26,603	2,084	10,753	10,781	
06/12/2012	6	8,229,503	7,537,058	1,299,632	133,738	400,861	21,522	9,468	21,740	286	7,710	10,121	
06/13/2012	1	8,233,148	7,538,764	1,303,561	134,024	402,200	3,645	1,706	3,929	286	1,339	10,905	
06/20/2012	7	8,257,230	7,549,296	1,328,311	134,593	410,924	24,082	10,532	24,750	569	8,724	9,808	
06/27/2012	7	8,282,502	7,560,344	1,353,468	134,878	419,974	25,272	11,048	25,157	285	9,050	10,116	
07/04/2012	7	8,307,276	7,570,992	1,372,591	134,878	427,672	24,774	10,648	19,123	0	7,698	8,892	
07/11/2012	7	8,331,832	7,581,295	1,401,012	137,843	438,122	24,556	10,303	28,421	2,965	10,450	10,956	
07/18/2012	7	8,355,114	7,591,489	1,425,451	139,883	446,505	23,282	10,194	24,439	2,040	8,383	9,763	
07/25/2012	7	8,381,283	7,603,285	1,453,036	144,567	458,054	26,169	11,796	27,585	4,684	11,549	11,683	
07/29/2012	4	8,396,444	7,689,652	1,468,141	144,852	463,406	15,161	86,367	15,105	285	5,352	30,568	
08/04/2012	7	8,418,191	7,619,127	1,491,409	147,264	472,518	21,747	-70,525	23,268	2,412	9,112	-1,998	
08/08/2012	7	8,431,265	7,624,898	1,504,382	147,264	477,207	13,074	5,771	12,973	0	4,689	5,215	
08/15/2012	7	8,455,418	7,635,836	1,529,719	148,421	485,584	24,153	10,938	25,337	1,157	8,377	9,995	
08/21/2012	6	8,474,170	7,644,480	1,548,112	148,421	491,285	18,752	8,644	18,393	0	5,701	8,582	
08/28/2012	7	8,497,292	7,655,123	1,569,798	148,421	497,654	23,122	10,643	21,686	0	6,369	8,831	
08/30/2012	2	8,502,498	7,657,420	1,574,614	148,421	498,996	5,206	2,297	4,816	0	1,342	6,831	
09/05/2012	6	8,522,187	7,662,825	1,593,903	148,701	504,362	19,689	5,405	19,289	280	5,366	8,338	
09/11/2012	6	8,538,948	7,674,735	1,610,186	148,701	508,389	16,761	11,910	16,283	0	4,027	8,164	
09/16/2012	5	8,553,093	7,681,968	1,624,030	148,701	511,743	14,145	7,233	13,844	0	3,354	7,715	
09/21/2012	5	8,570,023	7,691,377	1,643,980	153,650	518,788	16,930	9,409	19,950	4,949	7,045	11,657	
09/25/2012	4	8,583,302	7,696,933	1,660,464	157,284	525,513	13,279	5,556	16,484	3,634	6,725	11,420	
10/02/2012	7	8,590,021	7,700,001	1,672,424	157,503	530,261	6,719	3,068	11,960	219	4,748	3,816	
10/08/2012	7	8,607,001	7,708,263	1,684,602	157,861	532,249	16,980	8,262	12,178	358	1,988	5,681	
10/12/2012	4	8,635,843	7,722,394	1,713,888	157,861	539,327	28,842	14,131	29,286	0	7,078	19,834	
10/15/2012	3	8,642,361	7,725,580	1,721,162	159,358	542,065	6,518	3,186	7,274	1,497	2,738	7,071	
10/22/2012	7	8,663,946	7,736,581	1,745,678	159,647	548,485	21,585	11,001	24,516	289	6,420	9,116	
											Average Flow During Six-Month Period	**9,827**	**GPD**

APPENDIX G
GROUNDWATER MONITORING DATA

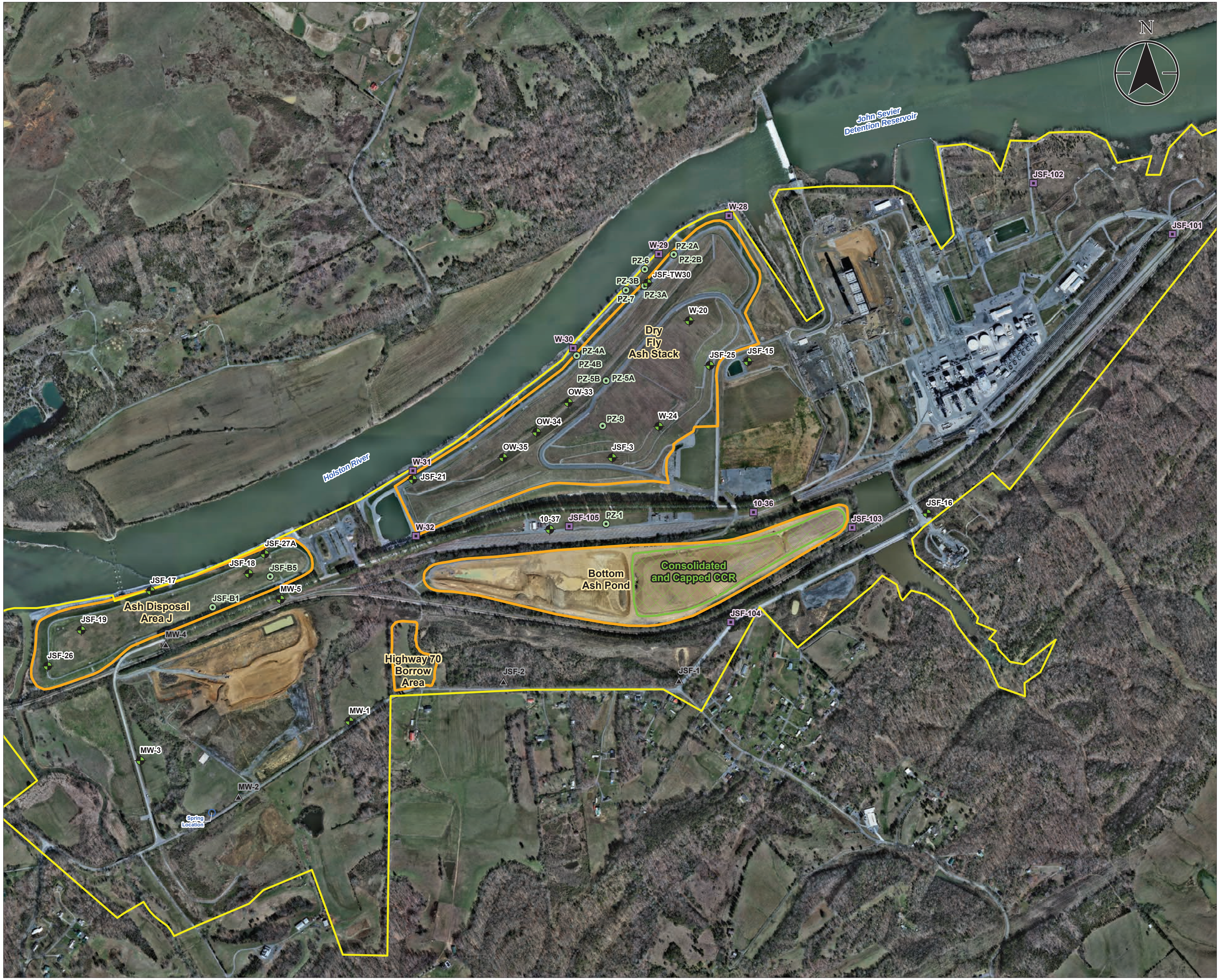

Figure No.
1

Title
John Sevier Fossil Plant Existing and Closed Wells

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-16
Technical Review by RAA on 2018-05-16

0 450 900 1,350 1,800 Feet
1:5,400 (At original document size of 22x34)

Legend

- Existing Groundwater Monitoring Well
- Closed Groundwater Monitoring Well
- Closed Piezometer
- Existing Observation Well
- Spring Location
- TVA Property Boundary
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec

TVA

U:\TVA-EP\175566338\gis\mxds\JSF_Existing_Closed_Wells.mxd Revised: 2018-05-16 By: tblackman

TVA John Sevier Fossil Plant
Existing Monitoring Well Construction Details

Well ID	Historical Well 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)
JSF-28	W-28	STA	WQS	6/1/1998	Dry Fly Ash Stack	Overburden	Active Compliance	17.3 - 27.3	737167.43	2892566.51	758561.78	2861077.85	1089.14	1085.3	2.0	29.8	3.8	28.0	1061.1
JSF-29	W-29	STA	WQS	6/3/1998	Dry Fly Ash Stack	Overburden	Active Compliance	12.3 - 22.2	736796.24	2891888.11	758190.57	2860399.46	1079.82	1076.0	2.0	22.5	3.8	20.5	1059.3
JSF-30	W-30	STA	WQS	6/4/1998	Dry Fly Ash Stack	Overburden	Active Compliance	12.0 - 21.9	735887.25	2891060.44	757281.55	2859571.81	1081.33	1077.1	2.0	22.2	4.2	20.0	1061.3
JSF-31	W-31	STA	WQS	5/25/1998	Dry Fly Ash Stack	Overburden	Active Compliance	8.3 - 18.3	734701.22	2889512.35	756095.49	2858023.76	1085.61	1082.1	2.0	18.8	3.5	17.0	1068.6
JSF-32	W-32	STA	WQS	5/19/1998	Dry Fly Ash Stack and Bottom Ash Pond	Overburden	Active Compliance	15.1 - 25.0	734072.67	2889541.80	755466.93	2858053.22	1105.12	1101.2	2.0	27.1	3.9	25.0	1080.1
JSF-10-36	10-36	STA	WQS	10/19/2010	Bottom Ash Pond	Overburden	Existing well	12.7 - 22.5	734301.94	2892802.65	755696.28	2861314.06	1120.38	1116.5	2.0	23.1	3.9	21.0	1099.4
JSF-1	W-1	STA	WQS	12/1/1986	Background	Bedrock	Active Compliance - Background	Rock well no Screen	732675.61	2892082.97	754069.93	2860594.41	1147.65	1144.4	4.0	82.6	3.3	79.0	1068.7
JSF-2	W-2	STA	WLS	12/1/1986	Sander's Property / Hwy. 70 / Combined Cycle	Bedrock	Existing well	Rock well no Screen	732666.84	2890385.54	754061.12	2858897.00	1134.82	1131.2	4.0	59.6	3.6	No pump	NA
JSF-MW2	MW-2	STA	WLS	1/31/2007	Sander's Property / Hwy. 70 / Combined Cycle	Weathered Bedrock	Existing well	22.7 - 32.7	731554.28	2887828.31	752948.49	2856339.80	1131.24	1127.8	2.0	33.2	3.4	No pump	NA
JSF-MW4	MW-4	STA	WLS	1/31/2007	Sander's Property / Hwy. 70 / Combined Cycle	Weathered Shale	Existing well	12.5 - 27.3	733026.15	2887126.31	754420.35	2855637.76	1097.23	1093.0	2.0	27.9	4.2	No pump	NA
JSF-101	---	STA	WQS	10/19/2015	Background	Overburden	Existing well	17.1 - 27.2	736987.62	2896848.94	758382.08	2865360.28	1110.43	1106.6	4.0	27.7	3.8	26.0	1084.4
JSF-102	---	STA	WQS	10/16/2015	Background	Overburden	Existing well	9.9 - 20.0	737479.31	2895507.94	758873.73	2864019.27	1091.42	1087.6	4.0	20.0	3.8	18.0	1073.4
JSF-103	---	STA	WQS	10/21/2015	Bottom Ash Pond	Overburden	Existing well	13.6 - 23.7	734153.67	2893755.99	755,548.04	2862267.40	1126.73	1122.8	4.0	23.7	3.9	22.0	1104.7

TVA John Sevier Fossil Plant
Existing Monitoring Well Construction Details

Well ID	Historical Well 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)
JSF-104	---	STA	WQS	10/21/2015	Bottom Ash Pond	Overburden	Existing well	20.4 - 30.6	733240.19	2892583.71	754,634.52	2861095.14	1145.69	1141.9	4.0	31.0	3.8	29.0	1116.7
JSF-105	---	STA	WQS	10/21/2015	Bottom Ash Pond	Overburden	Existing well	11.2 - 21.3	734165.34	2891021.79	755,559.64	2859533.21	1121.11	1117.3	4.0	21.8	3.8	20.0	1101.1

Well construction depths based on video logging performed by Stantec.
Ground surface elevations are based on survey datum and/or well completion data.

Abbreviations:

---	No data available
CCR	CCR Rule compliance well
CCR-STA	CCR and State compliance well
D M S	Degrees, Minutes, Seconds
ft	feet
ft ags	feet above ground surface
ft btoc	feet below top of casing
ft NGVD 29	Feet North American Vertical Datum 1929
in	inches
NAD27	North American Datum of 1927
NAD83	North American Datum of 1983
STA	State compliance well
WLS	water level measurement
WQS	water quality sample

TVA John Sevier Fossil Plant
Closed Monitoring Well Construction Details

Well ID	Historical Well 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
JSF-10-37	10-37	Monitoring Well	Bottom Ash Pond	10/19/2010	10/9/2015	734132.8	2890835.88	1119.80	1117.22	22.70	2.58	2	Highly Weathered Shale	12.0 - 22.0	Well screen location not suitable for current groundwater monitoring networks.
JSF-B1	J-92-B1	Piezometer	Ash Disposal Area J	3/26/1992	NA	733,383.20	2887579.00	NA	1104.70	35.00	NA	NA	NA	NA	No information available.
JSF-B5	J-92-B5	Piezometer	Ash Disposal Area J	3/27/1992	NA	733680.5	2888134.60	1103.90	1101.90	36.20	2	NA	NA	NA	No information available.
JSF-MW1	MW1	Monitoring Well	Proposed Gypsum Stack	2/1/2007	10/9/2015	732280.68	2888899.82	1135.63	1132.02	25.42	5.01	2	Bedrock	15.0 - 25.0	Well screen location not suitable for current groundwater monitoring networks.
JSF-MW3	MW3	Monitoring Well	Proposed Gypsum Stack	1/31/2007	10/8/2015	731900.73	2886882.08	1079.02	1075.30	19.10	0.76	2	Cobbles of Sandstone and Shale	10-.0 - 1 9.1	Well screen location not suitable for current groundwater monitoring networks.
JSF-MW5	MW5	Monitoring Well	Proposed Gypsum Stack	2/1/2007	10/7/2015	733457.32	2888206.11	1101.46	1097.94	11.58	2.94	2	NA	NA	Well lithology unknown.
JSF-OW33	OW-33	Monitoring Well	HERT Demo Disposal Area	3/27/2007	12/3/2008	735362.577	2891014.37	1141.87	1139.31	55.67	2.12	2	NA	NA	Well in proposed construction limits.
JSF-OW34	OW-34	Monitoring Well	HERT Demo Disposal Area	3/8/2007	12/3/2008	735076.294	2890708.05	1143.12	1140.21	56.93	2.4	2	NA	NA	Well in proposed construction limits.
JSF-OW35	OW-35	Monitoring Well	HERT Demo Disposal Area	3/29/2007	12/5/2008	734829.587	2890385.78	1145.64	1142.96	54.55	2	2	NA	NA	Well in proposed construction limits.
JSF-PZ1	PZ-1	Piezometer	Dry Fly Ash Stack	11/5/1986	11/10/2010	734189	2891379.00	1124.22	1/25/1903	1/20/1900	2.52	2	Clay	17.9 - 20.4	Well construction not suitable for compliance monitoring.
JSF-PZ2A	PZ-2A	Piezometer	Dry Fly Ash Stack	11/3/1986	2001	736792	2892033.00	1116.30	1113.80	55.50	2.5	2	NST	53.0 - 55.5	Well construction not suitable for compliance monitoring.
JSF-PZ2B	PZ-2B	Piezometer	Dry Fly Ash Stack	11/3/1986	2001	736792	2892033.00	1116.82	1114.30	40.50	2.52	2	Sand	38.0 - 40.5	Well construction not suitable for compliance monitoring.
JSF-PZ3A	PZ-3A	Piezometer	Dry Fly Ash Stack	11/31/1986	2001	736486.73	2891751.22	1114.60	1112.10	53.50	2.5	2	Sand	50.5 - 53.0	Well construction not suitable for compliance monitoring.
JSF-PZ3B	PZ-3B	Piezometer	Dry Fly Ash Stack	10/31/1986	2001	736486.73	2891751.22	1114.90	1112.40	40.50	2.5	2	Clay	38.0 - 40.5	Well construction not suitable for compliance monitoring.
JSF-PZ4A	PZ-4A	Piezometer	Dry Fly Ash Stack	11/3/1986	2001	735812.07	2891096.17	1112.92	1110.40	49.50	2.52	2	Silt	47.0 - 49.5	Well construction not suitable for compliance monitoring.

TVA John Sevier Fossil Plant
Closed Monitoring Well Construction Details

Well ID	Historical Well 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
JSF-PZ4B	PZ-4B	Piezometer	Dry Fly Ash Stack	11/5/1986	2001	735812.07	2891096.17	1113.55	1111.10	37.50	2.45	2	Silt	35.0 - 37.5	Well construction not suitable for compliance monitoring.
JSF-PZ5A	PZ-5A	Piezometer	Dry Fly Ash Stack	10/28/1986	NA	735571.5321	2891379.04	1100.76	1098.30	23.50	2.46	2	Clay	6.4 - 21.0	Well construction not suitable for compliance monitoring.
JSF-PZ5B	PZ-5B	Piezometer	Dry Fly Ash Stack	10/28/1986	NA	735571.5321	2891379.036	1/5/1903	1/3/1903	23.00	2.49	2	Ash	16.5 - 19.0	Well construction not suitable for compliance monitoring.
JSF-PZ6	PZ-6	Piezometer	Dry Fly Ash Stack	5/1998	7/18/2017	736648.41	2891752.52	1079.26	12/11/1902	NA	2.5	2	NA	NA	Well construction not suitable for compliance monitoring. Piezometer closed as unnamed Piezometer 1.
JSF-PZ7	PZ-7	Piezometer	Dry Fly Ash Stack	5/1998	7/18/2017	736446.28	2891571.22	1077.88	12/11/1902	NA	1.53	2	NA	NA	Well construction not suitable for compliance monitoring. Piezometer closed as unnamed Piezometer 2.
JSF-PZ8	PZ-8	Piezometer	Dry Fly Ash Stack	5/22/1998	NA	735136.58	-6.00	1138.12	2/8/1903	2/16/1900	2.73	2	Sand	25.0 - 46.0	Well construction not suitable for compliance monitoring.
JSF-TW30	TW-30	Monitoring Well	Dry Fly Ash Stack	5/22/1998	NA	736516.64	2891779.25	1115.23	1112.38	45.90	2.85	2	Sand	NA	No information available.
JSF-3	3	Monitoring Well	Dry Fly Ash Stack	10/1/1986	NA	734828.3	2891439.60	1115.21	1113.40	NA	1.81	4	NA	24.5 - 29.9	No information available.
JSF-15	15	Monitoring Well	Coal Yard Drainage Basin	2/14/1991	NA	735758.56	2892749.50	1102.09	1099.05	22.70	3.04	2	Clay	10.16-11.16	No information available.
JSF-16	16	Monitoring Well	East of Polly Branch	2/13/1991	10/7/2015	734249.67	2894479.16	1124.58	1121.47	19.50	3.11	2	Silty Clay and Shale Fragments	7.0 - 17.0	Well location not suitable for current monitoring groundwater network. Well not located downstream of ash facilities.
JSF-17	17	Piezometer	Ash Disposal Area J	2/12/1991	NA	733540.59	2886980.83	1104.46	1102.02	37.50	2.44	2	Clay	25.0 - 35.0	Well usually dry or do not have sufficient water volume for sampling.
JSF-18	18	Ash well point	Ash Disposal Area J	NA	NA	733707.57	2887929.35	1100.82	1097.06	NA	3.76	NA	NA	NA	Well usually dry or do not have sufficient water volume for sampling.
JSF-19	19	Ash well point	Ash Disposal Area J	NA	NA	NA	NA	1101.21	1099.07	NA	2.14	NA	NA	NA	Well usually dry or do not have sufficient water volume for sampling.
JSF-20	W-20	Drive point	Dry Fly Ash Stack	NA	NA	757544.5086	2892181.34	NA	NA	NA	NA	NA	NA	NA	No information available.
JSF-21	W-21	Monitoring Well	Dry Fly Ash Stack	2/15/1991	NA	734618.84	2889512.24	1130.90	NA	NA	NA	NA	Clay	17.0 - 27.0	Well not suitable for compliance monitoring.
JSF-22	22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Wells located off site. No information available.
JSF-23	23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Wells located off site. No information available.
JSF-24	W-24	Monitoring Well	Dry Fly Ash Stack	4/26/1993	NA	735131.28	2891888.89	1136.25	1133.25	51.50	3	2	Sand	22.0 - 47.5	No information available.

TVA John Sevier Fossil Plant
Closed Monitoring Well Construction Details

Well ID	Historical Well 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
JSF-25	25	Piezometer	Dry Fly Ash Stack	4/26/1993	NA	735719.08	2892381.15	1137.03	1135.13	61.00	1.9	2	Sand	57.5 - 63.0	No information available.
JSF-26	26	Monitoring Well	Ash Disposal Area J	6/8/1996	10/14/2015	732842.82	2885980.93	1105.72	1104.17	45.00	1.55	4	Sand	36.6 - 46.6	Monitoring discontinued in 2003 with approval from TDEC.
JSF-27A	27A	Monitoring Well	Ash Disposal Area J	6/10/1996	10/13/2015	733889.51	2888074.31	1106.50	1104.60	34.00	1.9	NA	Clay	25.9 - 35.9	Well usually dry or do not have sufficient water volume for sampling.

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 ags	feet above ground surface
ft-amsl	feet above mean sea level
ft btoc	feet below top of casing
ft NGVD 29	Feet North American Vertical Datum 1929
in	inches
NA	No information available
NAD27	North American Datum of 1927

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	-
JSF-1	1	12/1/86	50	--	<1	270	--	--	4	77.7	5	--	10	150	9	--	12.6	7	<0.2	--	2	0.25	--	--	--	<10	--	6	--	--	--	--	20	--	--	42
		3/19/87	--	--	--	--	--	--	--	82.6	--	--	--	2600	--	--	--	30	--	--	--	--	--	--	--	--	--	4.9	--	--	--	--	--	--	--	34
		5/21/87	260	--	1	140	--	--	<0.1	94.3	<1	--	30	30	<1	--	9.5	26	<0.2	--	2	0.57	0.58	<1	--	<0.1	--	5.2	--	--	--	--	--	12	--	31
		6/4/87	<50	--	<1	--	--	--	0.2	83.9	--	--	<10	20	--	--	8.7	18	--	--	--	--	0.48	--	--	--	--	5.2	--	--	--	--	--	10	--	24
		6/18/87	50	--	<1	170	--	--	0.2	83.8	<1	--	10	10	2	--	8.9	12	<0.2	--	<1	0.59	0.51	<1	--	<0.1	--	5.4	--	--	--	--	--	12	--	23
		12/16/87	<50	--	<1	180	--	<500	0.1	78	6	--	<10	280	2	--	8.6	18	--	--	7	--	--	<1	--	--	--	5	--	--	--	--	20	10	--	22
		3/8/88	<50	--	<1	220	--	<500	0.2	83	7	--	30	120	<1	--	8.7	20	--	--	4	--	--	<1	--	--	--	5.3	--	--	--	--	10	10	--	23
		6/21/88	<50	--	<1	180	--	<500	<0.1	93	7	--	30	90	2	--	9.9	<5	--	--	6	--	--	<1	--	--	--	5	--	--	--	--	20	12	--	29
		9/15/88	<50	--	<1	180	--	--	<0.1	82	<1	--	<10	60	2	--	9.9	<5	--	--	<1	--	--	<1	--	--	--	5.6	--	--	--	--	<10	--	--	2
		12/6/88	1600	--	5	210	--	<500	0.4	87	4	--	<10	1700	6	--	9.3	<5	--	--	16	--	--	<1	--	--	--	5.4	--	--	--	--	40	--	--	25
		3/15/89	<50	--	<1	190	--	<500	<0.1	79	<1	--	<10	540	<1	--	9.2	30	--	--	<1	--	--	<1	--	--	--	4.9	--	--	--	--	30	--	--	25
		6/7/89	840	--	<1	230	--	<500	<0.1	80	<1	--	<10	720	<1	--	9.5	<5	--	--	3	--	--	<1	--	--	--	5.1	<50	--	--	--	130	--	--	25
		8/30/89	100	--	<1	190	--	<500	<0.1	84	<1	--	60	330	<1	--	9.1	32	--	--	2	--	--	<1	--	--	--	5.7	--	--	--	--	30	--	--	32
		11/1/89	1400	--	<1	170	--	<500	<0.1	77	2	--	<10	290	10	--	11	45	--	--	3	--	--	<1	--	--	--	5.9	--	--	--	--	50	10	--	30
		2/6/90	1500	--	<1	200	--	<500	<0.1	87	3	--	<10	270	<1	--	13	46	--	--	4	--	--	<1	--	--	--	5.8	--	--	--	--	50	10	--	31
		5/22/90	<50	--	<1	180	--	<500	<0.1	79	<1	--	<10	2400	6	--	9.2	10	--	--	<1	--	--	<1	--	--	--	6.4	--	--	--	--	20	13	--	22
		5/22/90	80	--	1	180	--	<500	<0.1	83	<1	--	<10	3400	2	--	9.4	<5	--	--	1	--	--	<1	--	--	--	6.2	--	--	--	--	130	13	--	23
		8/8/90	300	--	1	220	--	<500	<0.1	78	<1	--	50	3700	2	--	6.1	150	--	--	1	--	--	<1	--	--	--	5.1	--	--	--	--	20	12	--	27
		11/27/90	290	<1	<1	200	--	<500	0.1	75	<1	--	<10	3100	2	<10	8.3	21	--	<20	2	--	0.49	<1	8000	--	650	5.4	--	--	--	<10	10	11	--	35
		2/27/91	220	<1	<1	200	--	<500	0.3	88	<1	--	<10	6100	8	10	9.1	56	--	<20	35	--	0.62	<1	8500	--	640	4.9	--	--	--	<10	120	14	--	30
		3/26/91	<50	2	<1	170	--	<500	0.1	86	<1	--	<10	3100	2	10	7.9	18	--	<20	6	--	0.65	<1	6500	--	550	4.5	--	--	--	<10	240	15	--	30
		4/30/91	1200	<1	7	240	--	<500	0.4	85	2	--	<10	9000	8	10	9.2	57	--	<20	16	--	0.52	2	9000	--	730	5.4	--	--	--	<10	10	14	--	29
		8/26/91	280	4	<1	240	--	<500	0.2	87	<1	--	<10	3600	2	20	11	71	--	<20	8	--	0.6	<1	9200	--	870	4.9	--	--	--	<10	20	12	--	35
		2/20/92	730	--	4	270	--	<500	<0.1	86	2	--	<10	7900	2	<10	10	65	--	30	3	--	--	<1	10000	--	810	5.1	--	--	--	<10	<10	13	--	36
		12/1/92	160	--	<1	210	<1	<500	--	85	1	--	<10	2400	1	--	8.7	9	--	<20	<1	--	0.4	<1	--	--	820	5.4	--	--	--	--	<10	12	--	30
		3/1/93	80	<1	<1	210	<1	<500	0.1	89	--	--	<10	3400	1	--	7.9	16	--	<20	2	--	0.5	--	--	--	700	5.1	--	--	--	--	10	14	--	25
		5/24/93	290	--	<1	220	<1	<500	--	94	<1	--	<10	7	2	--	9	41	--	<20	<1	--	0.5	1	--	--	700	5.1	--	--	--	--	20	14	--	27
		8/16/93	<50	<1	<1	200	<1	<500	<0.1	84	--	--	<10	2100	1	--	8.7	12	--	<20	<1	--	0.5	--	--	--	760	4.7	--	--	--	--	<10	13	--	26
		8/16/93	<50	<1	<1	200	<1	<500	<0.1	84	--	--	<10	2000	<1	--	8.8	12	--	<20	<1	--	0.5	--	--	--	800	4.8	--	--	--	--	<10	13	--	26
		8/16/93	<50	<1	<1	200	<1	<500	<0.1	81	--	--	<10	400	2	--	9	16	--	<20	<1	--	0.5	--	--	--	890	4.9	--	--	--	--	<10	13	--	27
		8/16/93	<50	<1	<1	210	<1	<500	<0.1	82	--	--	<10	310	<1	--	8.7	28	--	<20	<1	--	0.6	--	--	--	830	4.9	--	--	--	--	<10	12	--	27
		11/17/93	460	--	<1	240	<1	<500	--	84	6	--	<10	6300	3	--	9.2	70	--	30	5	--	0.5	<1	--	--	720	5.3	--	--	--	--	<10	12	--	31
		11/17/93	50	--	<1	200	<1	<500	--	81	1	--	<10	2100	<1	--	9.1	<5	--	<20	<1	--	0.5	<1	--	--	840	5.2	--	--	--	--	<10	12	--	30
		11/17/93	<50	--	<1	230	<1	<500	--	82	<1	--	<10	1100	<1	--	9.7	<5	--	<20	<1	--	0.5	<1	--	--	900	5.5	--	--	--	--	<10	12	--	30
		2/22/94	<50	<1	<1	200	<1	<500	<0.1	84	--	--	<10	560	<1	--	8.6	10	--	<20	<1	--	0.5	<1	--	--	690	5	--	--	--	--	<10	13	--	24
		2/22/94	<50	<1	<1	210	<1	<500	<0.1	87	--	--	<10	190	<1	--	9.3	11	--	<20	<1	--	0.5	<1	--	--	750	5.2	--	--	--	--	<10	13	--	25
		5/16/94	<50	<1	<1	270	<1	<500	0.1	110	<1	<1	<10	160	3	--	12	25	<0.2	<20	<1	--	0.5	<1	--	<10	1000	5.1	<50	--	--	--	<10	13	0.2	27
		5/18/94	<50	<1	<1	270	<1	<500	<0.1	100	<1	<1	<10	420	<1	--	11	27	<0.2	<20	<1	--	0.5	<1	--	<10	970	5.2	<50	--	--	--	<10	13	0.2	25
		8/15/94	<50	<1	<1	220	<1	<500	0.1	88	<1	<1	<10	280	<1	--	9	18	<0.2	<20	<1	--	0.6	1	--	<10	650	5.2	<50	--	--	<10	<10	12	<0.1	26
		11/7/94	<50	<1	<1	200	<1	<500	0.1	90	9	<1	<10	2400	<1	--	9.5	<5	<0.2	<20	31	--	0.5	<1	--	<10	760	5.2	<2	--	--	<10	100	12	<0.1	30

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**	**-**
JSF-1 (cont.)	1	5/23/95	310	<1	<1	220	<1	<500	<0.1	88	1	<1	<10	3900	<1	--	9.9	20	<0.2	<20	1	--	0.6	<1	--	<10	810	5.2	<2	--	--	<10	<10	13	<0.1	26
		5/23/95	290	<1	<1	230	<1	<500	<0.1	86	2	<1	<10	4200	<1	--	9.8	20	<0.2	<20	<1	--	0.6	<1	--	<10	820	5.2	<2	--	--	<10	<10	14	<0.1	25
		1/23/96	80	<1	<1	220	<1	<500	<0.1	88	<1	<1	<10	2600	<1	--	9.6	12	<0.2	<20	<1	--	0.6	1	--	<10	790	5.1	**5**	--	--	<10	<10	12	<0.1	29
		8/6/96	70	<1	**13**	230	<1	<500	<0.1	81	<1	12	<10	6000	<1	--	9.3	31	<0.2	<20	<1	--	0.5	<1	--	<10	760	5.5	<2	--	--	<10	<10	13	0.6	29
		1/8/97	<50	<1	<1	230	<1	<500	<0.1	89	<1	<1	<10	3300	<1	--	9.8	19	<0.2	--	2	--	0.5	<1	--	<10	740	5	<1	--	--	<10	40	13	<0.1	25
		1/8/97	<50	<1	<1	220	<1	<500	<0.1	92	<1	<1	<10	1600	<1	--	9.9	15	<0.2	--	<1	--	0.5	<1	--	<10	770	5	<1	--	--	<10	<10	12	<0.1	25
		7/14/97	<50	<1	<1	220	<1	<500	<0.1	90	6	<1	<10	4300	<1	--	9.5	53	<0.2	--	2	--	0.5	<1	--	<10	730	5.4	<2	--	--	<10	10	14	<0.1	23
		7/14/97	<50	<1	<1	250	<1	<500	<0.1	92	2	<1	<10	5900	<1	--	9.7	55	<0.2	--	<1	--	0.5	<1	--	<10	720	5.4	<2	--	--	<10	<10	14	<0.1	25
		1/19/98	<50	<1	<1	200	<1	<500	<0.1	84	3	3	<10	1700	<1	--	8.7	9	<0.2	--	4	--	0.5	<1	--	<10	730	5.6	<2	--	--	<10	<10	13	<0.1	23
		1/19/98	100	<1	<1	230	<1	<500	<0.1	83	<1	<1	<10	3600	<1	--	9.3	22	<0.2	--	<1	--	0.5	<1	--	<10	820	5.7	<2	--	--	<10	<10	12	<0.1	24
		1/19/98	50	<1	<1	240	<1	<500	<0.1	86	<1	<1	<10	3800	<1	--	9.4	22	<0.2	--	2	--	0.5	<1	--	<10	810	5.7	<2	--	--	<10	<10	12	<0.1	24
		6/25/98	170	<1	2	260	<1	<200	<0.1	94	<1	<1	<10	5300	<1	--	9.9	33	<0.2	--	<1	--	0.5	<1	--	<10	790	5.4	<2	--	--	<10	<10	12	<0.1	25
		7/28/98	120	<1	<1	250	<1	<200	<0.1	80	3	<1	<10	13000	3	--	9	79	<0.2	--	5	--	0.6	<1	--	<10	730	5.4	<2	--	--	<10	<10	14	<0.1	26
		7/28/98	130	<1	<1	210	<1	<200	<0.1	79	<1	<1	<10	2300	2	--	8.9	34	<0.2	--	<1	--	0.5	1	--	<10	680	5.3	<2	--	--	<10	<10	13	<0.1	28
		11/4/98	150	<1	<1	220	<1	<200	<0.1	85	<1	<1	<10	3200	<1	--	9.6	15	<0.2	--	<1	--	0.5	<1	--	<10	750	5.6	<1	--	--	<10	<10	14	<0.1	31
		11/4/98	290	<1	<1	190	<1	<200	<0.1	83	<1	<1	<10	3300	<1	--	9.2	14	<0.2	--	<1	--	0.5	1	--	<10	670	5.5	<1	--	--	<10	<10	14	<0.1	27
		1/21/99	130	<1	<1	220	<1	<200	<0.1	87	2	<1	<10	3300	2	--	9.2	42	<0.2	--	2	--	0.6	<1	--	<10	680	5.2	<2	--	--	<10	<10	13	<0.1	36
		1/21/99	100	<1	<1	240	<1	<200	0.2	86	<1	<1	<10	5100	<1	--	9.4	26	<0.2	--	1	--	0.6	<1	--	<10	740	5.3	<2	--	--	<10	10	13	<0.1	38
		4/14/99	90	<1	<1	220	<1	<200	<0.1	82	2	<1	<10	6100	<1	--	8.9	33	<0.2	--	<1	--	0.6	<1	--	<10	670	5.5	<2	--	--	<10	<10	12	<0.1	38
		7/29/99	60	<1	<1	200	<1	<200	<0.1	85	<1	<1	<10	750	2	--	8.8	18	<0.2	--	<1	--	0.5	<1	--	<10	730	5.3	<2	--	--	<10	<10	12	<0.1	36
		7/29/99	<50	<1	<1	210	<1	<200	<0.1	87	<1	<1	<10	670	2	--	9.2	23	<0.2	--	<1	--	0.5	<1	--	<10	780	5.6	<2	--	--	<10	<10	11	<0.1	37
		10/28/99	150	<1	<1	240	<1	<200	<0.1	84	<1	<1	<10	5200	<1	--	8.8	25	<0.2	--	<1	--	0.6	<1	--	<10	670	5.4	<2	--	--	<10	<10	12	0.1	35
		1/6/00	80	<1	<1	210	<1	<200	<0.1	78	1.1	<1	<10	1200	<1	--	8.5	26	<0.2	<20	<1	--	0.63	<1	15000	<10	670	5.4	<2	<50	<5	<10	<10	14	<0.1	25
		4/5/00	<50	<1	<1	200	<1	<200	<0.1	73	<1	<1	<10	2200	<1	--	7.8	18	<0.2	<20	<1	--	0.69	<1	6700	<10	600	5.2	<2	<50	<5	<10	<10	11	<0.1	26
		7/6/00	<50	<1	<1	230	<1	<200	<0.1	80	<1	<1	<10	4500	<1	--	8.8	33	<0.2	<20	<1	--	0.49	<1	7900	<10	700	5.8	<2	<50	<5	<10	<10	13	<0.1	26
		1/22/01	82	<1	<1	240	<1	<200	<0.1	85	<1	<1	<10	2200	<1	--	10	28	<0.2	<20	<1	--	0.53	<1	--	<10	850	5.3	<2	<50	<5	<10	<10	12	<0.1	25
		1/22/01	69	<1	<1	240	<1	<200	<0.1	85	<1	<1	<10	2200	<1	--	10	28	<0.2	<20	<1	--	0.5	<1	--	<10	830	5	<2	<50	<5	<10	<10	13	<0.1	26
		7/17/01	<50	<1	1.8	<10	2.7	<200	0.4	<0.1	2	<1	<10	<10	<1	--	<0.01	<5	<0.2	<20	<1	--	0.43	1.9	<20	<10	<50	5	<2	<50	<5	<10	<10	11	<0.1	27
		1/16/02	54	<1	<1	220	<1	250	<0.1	87	<1	<1	<10	2600	<1	--	9.9	39	<0.1	<20	<1	--	0.41	<1	--	<10	800	3.8	<2	<50	11	<10	<10	11	<0.1	26
		1/16/02	58	<1	<1	230	<1	<200	<0.1	89	<1	<1	<10	2800	<1	--	10	29	<0.1	<20	<1	--	0.4	<1	--	<10	820	3.9	<2	<50	11	<10	<10	11	<0.1	26
		7/24/02	<50	<1	<1	230	<1	<200	<0.1	85	<1	<1	<10	3200	<1	--	9.5	30	<0.1	<20	<1	--	0.4	<1	--	<10	760	3.9	<2	<50	<5	<10	10	11	<0.1	25
		1/28/03	150	<1	<1	230	<1	<200	<0.1	86	<1	<1	<10	1800	<1	--	8.9	22	<0.1	<20	<1	--	0.63	<1	--	<10	760	6.2	<2	490	<5	<10	<10	10	<0.1	29
		6/30/03	<50	<6	3	250	<1	<200	<0.1	84	<1	2	<10	5200	<1	--	8.9	36	<0.1	--	<1	--	0.45	<1	--	--	800	6	<2	--	--	<10	<10	9.5	0.12	30
		6/30/03	<50	<6	2	260	<1	<200	<0.1	86	<1	2	<10	5600	<1	--	9.2	39	0.1	--	<1	--	0.44	<1	--	--	820	6	<2	--	--	<10	<10	9.7	0.11	33
		10/16/03	80	<0.1	<0.1	238	<1	<200	<0.05	82	<0.1	0.8	<10	4000	0.4	--	8.6	27	<0.1	<20	1.5	--	0.5	<0.2	--	<10	742	5.4	<0.1	--	--	<10	<10	10	0.11	30
		1/6/04	<50	<0.6	<0.1	200	<1	<200	<0.05	85	<0.1	0.5	<10	550	<0.1	--	8.9	18	<0.1	<20	1.4	--	0.9	<0.2	--	<10	710	6.8	<0.1	<50	<5	<10	<10	11	0.1	27
		1/6/04	<50	0.7	<0.1	200	<1	<200	<0.05	85	<0.1	0.5	<10	520	<0.1	--	8.7	17	<0.1	<20	1.3	--	0.9	<0.2	--	<10	710	6.9	<0.1	<50	<5	<10	<10	11	0.1	27
		4/5/04	50	<0.6	<0.1	220	<1	<200	<0.05	85	<0.1	0.8	<10	730	<0.1	--	8.6	24	<0.1	<20	2.2	--	0.6	<0.2	--	<10	710	5.8	<0.1	--	--	<10	<10	12	<0.1	28
		7/6/04	<50	<3	<1	220	<1	<200	<0.1	81	<1	<1	<10	1600	1	--	8.3	21	<0.1	<20	<1	--	1.1	<1	--	<10	700	4.7	<2	--	--	<10	<10	11	<0.1	31
		10/18/04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/18/04	80	<3	<1	260	<1	<200	<0.1	87	<1	<1	<10	4000	<1	--	9.2	30	<0.1	<20	<1	0.18	1.2	<1	--	<10	790	5.6	<2	<50	<5	<10	<10	11	0.11	31

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	-
JSF-1 (cont.)	1	10/18/04	60	<3	1	26	<1	200	<0.1	87	<1	<1	<10	3900	<1	--	9.2	30	<0.1	<20	<1	0.16	1.3	<1	--	<10	800	5.6	<2	<50	<5	<10	<10	11	0.11	32
		1/3/05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/3/05	<50	<3	<1	210	<1	<200	<0.1	86	<1	1	<10	2100	<1	--	8.7	24	<0.1	<20	<1	0.26	0.7	1	--	<10	710	7.9	<2	--	<5	<10	<10	11	<0.1	25
		7/5/05	<50	<3	<1	220	<1	<200	<0.1	84	<1	1	<10	2000	<1	--	8.3	21	<0.1	<20	<1	--	1.4	<1	--	<10	680	6.6	<2	<50	<5	<10	<10	11	0.1	26
		7/5/05	<50	<3	<1	220	<1	<200	<0.1	86	<1	<1	<10	2000	<1	--	8.4	25	<0.1	<20	<1	--	1.4	<1	--	<10	700	7	<2	<50	<5	<10	<10	11	0.1	26
		7/13/05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		9/14/05	<50	<3	<1	240	<1	<200	<0.1	85	1	1	<10	1900	<1	--	8.5	26	<0.1	<20	<1	0.24	1.7	<1	--	<10	730	4.8	<2	--	--	<10	<10	12	<0.1	26
		1/18/06	<200	<3	<1	230	<1	<200	<0.1	84	<1	<1	<10	1200	<1	--	8.8	34	<0.1	<20	<1	0.12	0.6	<1	--	<10	730	7.7	<2	--	--	<10	<10	11	0.11	29
		1/18/06	<200	<3	<1	240	<1	<200	<0.1	86	<1	<1	<10	1300	<1	--	8.9	35	<0.1	<20	<1	0.14	0.6	<1	--	<10	770	7.7	<2	--	--	<10	<10	12	0.1	29
		4/24/06	<200	<3	<1	220	<1	<200	<0.1	81	<1	<1	<10	1000	<1	--	8.4	19	<0.1	<20	<1	0.21	0.6	<1	--	<10	690	6	<2	--	--	<10	<10	10	0.1	27
		7/24/06	<200	<3	<1	230	<1	<200	<0.1	84	<1	<1	<10	2800	<1	--	8.3	28	<0.1	<20	<1	0.19	0.5	<1	--	<10	710	7.4	<2	--	--	<10	<10	9.9	0.11	24
		7/24/06	<200	<3	<1	230	<1	<200	<0.1	83	<1	<1	<10	2500	<1	--	8.5	27	<0.1	<20	<1	0.19	0.5	<1	--	<10	720	7.5	<2	--	--	<10	<10	10	0.11	25
		10/2/06	<200	<3	<1	230	<1	<200	<0.1	80	<1	<1	<10	1700	<1	--	8.4	28	<0.1	<20	<1	0.1	1.4	<1	--	<10	740	5.5	<2	--	--	<10	<10	10	<0.1	25
		10/2/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/3/07	<100	<1	<1	230	<1	<200	<0.5	81	<1	<1	<1	1500	<1	--	8.9	26	<0.2	<5	2	0.13	<0.5	1.7	--	<0.5	750	5.8	<1	--	--	<10	<10	8.8	<0.1	25
		4/3/07	<100	<1	<1	230	<1	<200	<0.5	82	<1	<1	<1	1500	<1	--	8.9	26	<0.2	<5	2	0.13	<0.5	1.2	--	<0.5	770	5.8	<1	--	--	<10	<10	8.1	<0.1	25
		10/1/07	<100	<1	<1	220	<2	<200	<0.5	81	<1	<1	<1	880	<1	--	8.9	34	<0.2	<5	2.9	<0.1	<0.5	<1	--	<0.5	710	5.9	<1	--	--	<10	<10	10	0.23	25
		10/1/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--	--
		10/2/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		11/13/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/8/08	160	<1	<1	220	<1	<200	<0.5	79	<1	<1	<1	580	<1	--	8.6	26	<0.2	<5	1.3	<0.1	<0.5	<1	--	<0.5	740	6.6	<1	<1	--	<10	23	9.1	<0.1	25
		4/8/08	120	<1	<1	210	<1	<200	<0.5	80	<1	<1	<1	530	<1	--	8.6	23	<0.2	<5	1.3	0.13	<0.5	<1	--	<0.5	700	6.8	<1	<1	--	<10	<10	8.6	<0.1	25
		10/27/08	<100	<1	<1	220	<1	<200	<0.5	83	4	<1	<1	2000	<1	--	8.8	28	<0.2	--	2.8	<0.1	0.92	<1	--	<0.5	800	6.4	<1	<1	--	<10	16	11	<0.1	25
		4/7/09	<100	<1	<1	200	<1	<200	<0.5	80	<1	<1	1.7	380	<1	--	8.3	18	<0.2	--	3.6	0.16	0.6	1.8	--	<0.5	680	5.9	<1	<1	--	<2	180	10	<0.1	25
		4/7/09	<100	<1	<1	200	<1	<200	<0.5	78	1.5	<1	<1	610	<1	--	8.3	17	<0.2	--	2.8	0.19	0.61	<1	--	<0.5	690	6	<1	<1	--	<2	11	12	<0.1	24
		10/7/09	<100	<1	<1	200	<1	<200	<0.5	82	<2	<1	<2	1300	<1	--	9.1	22	<0.2	--	<1	0.11	0.6	<1	--	<1	720	5.6	<1	<1	--	<2	11	9.8	<0.1	26
		4/5/10	<100	<1	<1	210	<1	<200	<0.5	82	<2	<1	<2	620	<1	--	9.1	39	<0.2	--	2.2	0.19	0.58	<1	--	<1	700	7.5	<1	<1	--	<10	<10	10	<0.1	26
		10/21/10	<100	<1	<1	230	<2	<200	<0.5	84	<2	<1	<2	320	<1	--	8.9	28	<0.2	--	1.6	0.12	0.63	<1	--	<1	770	6.2	<1	<1	--	<2	17	10	<0.1	26
		10/21/10	<100	<1	<1	230	<2	<200	<0.5	84	<2	<1	<2	330	<1	--	8.9	28	<0.2	--	1.4	0.12	<0.5	<1	--	<1	760	6.2	<1	<1	--	<2	11	11	<0.1	26
		4/20/11	<100	<1	<1	220	<1	<200	<0.5	81	<2	<1	<2	260	<1	--	8.6	25	<0.2	--	3.3	0.22	0.5	<1	--	<1	710	5.7	<1	<1	--	<2	11	9.5	<0.1	26
		10/19/11	<100	<1	<1	230	<1	<200	<0.5	86	<2	<1	<2	240	<1	--	9.6	28	<0.2	--	<1	0.15	0.6	<1	--	<1	800	6.7	<1	<1	--	<2	<10	9.6	0.1	26
		10/19/11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/11/12	<100	<1	<1	190	<1	<200	<0.5	--	<2	<1	<2	110	<1	--	--	<10	<0.2	--	<1	0.53	<0.5	<1	--	<1	590	6.7	<1	<1	--	<2	<10	11	<0.1	27
		10/22/12	<100	<1	<1	220	<1	<200	<0.5	83	<1	<1	<1	420	<1	--	8.8	32	<0.2	--	1.5	<0.1	<0.5	<1	--	<0.5	800	6.5	<1	<1	--	<2	<10	9.1	<0.1	27
		4/11/13	<100	<1	<1	210	<1	<200	<0.5	--	<2	<1	<2	210	<1	--	--	28	<0.2	--	3.2	0.17	<0.5	<1	--	<1	770	6.3	<1	<1	--	<2	<10	9	<0.1	27
		11/14/13	<100	<2	<2	259	<2	<50	<1	95.9	<2	<2	<2	222	<2	--	9.72	31.9	<0.2	<2	<2	0.128	<1	<2	--	<2	867	6.83	<2	<50	--	<2	<25	10	<0.1	28.1
		4/10/14	<100	<2	<2	227	<2	65.4	<1	--	<2	<2	<2	188	<2	--	--	28	<0.2	--	<2	0.187	<1	<2	--	<2	751	6.62	<2	<50	--	<2	<25	8.47	<0.1	31.8
		11/19/14	<0.1	<2	<2	253	<2	<50	<1	--	6.75	<2	<2	549	<2	--	--	29.8	<0.2	<2	<2	0.128	<1	<2	--	<2	835	6.58	<2	<50	--	<2	<25	7.56	0.11	28.7
		5/7/15	<0.1	<2	<2	211	<2	<50	<1	--	<2	<2	<2	223	<2	--	--	25.9	<0.2	--	<2	0.225	<1	<2	--	<2	738	6.19	<2	<50	--	<2	<25	7.03	<0.1	22.6
		11/16/15	<0.1	<2	<2	226	<2	<50	<1	86	<2	<2	<2	236	<2	--	8.82	49.2	<0.2	--	<2	0.147	<1	<2	--	<2	766	6.53	<2	<50	--	<2	<25	6.4	<0.1	23.8

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	-
JSF-10-36	10-36	4/19/11	<100	<1	1.5	57	<1	<200	<0.5	150	<2	3.4	<2	1200	<1	--	38	1900	<0.2	--	7.3	<0.1	1.5	2.1	--	<1	850	20	<1	<1	--	<2	<10	9.8	<0.1	120
		4/19/11	<100	<1	1.6	56	<1	<200	<0.5	150	<2	3.3	<2	1100	<1	--	37	1800	<0.2	--	7.8	<0.1	1.5	2.5	--	<1	850	20	<1	<1	--	<2	<10	9.7	<0.1	120
		10/17/11	<100	<1	1.4	60	<1	<200	<0.5	170	<2	3.3	<2	360	<1	--	42	2800	<0.2	--	4.4	<0.1	1.3	<1	--	<1	1100	15	<1	<1	--	<2	<10	9.2	<0.1	130
		4/9/12	--	<1	2.5	47	<1	--	<0.5	--	<2	--	--	--	<1	--	--	--	<0.2	--	3.3	<0.1	--	<1	--	<1	--	--	<1	--	--	--	--	--	<0.1	--
		4/9/12	--	<1	<1	47	<1	--	<0.5	--	<2	--	--	--	<1	--	--	--	<0.2	--	3.3	<0.1	--	<1	--	<1	--	--	<1	--	--	--	--	--	<0.1	--
		10/29/12	--	<1	1.6	55	<1	--	<0.5	--	<2	--	--	--	<1	--	--	--	<0.2	--	4.9	<0.1	--	<1	--	<1	--	--	<1	--	--	--	--	--	<0.1	--
		4/10/13	--	<1	2.5	50	<1	--	<0.5	--	<2	--	--	--	<1	--	--	--	<0.2	--	7.1	<0.1	--	<1	--	<1	--	--	<1	--	--	--	--	--	0.12	--
		11/18/13	--	<2	3.23	<100	<2	--	<1	--	<2	--	--	--	<2	--	--	--	<0.2	--	<2	<0.1	--	<2	--	<2	--	--	<2	--	--	--	--	--	0.12	--
		11/18/13	--	<2	3.23	63.8	<2	--	<1	--	<2	--	--	--	<2	--	--	--	<0.2	--	<2	<0.1	--	<2	--	<2	--	--	<2	--	--	--	--	--	<0.1	--
		4/9/14	--	<2	<2	55.6	<2	--	<1	--	<5	--	--	--	<5	--	--	--	<0.2	--	<10	<0.1	--	<10	--	<5	--	--	<2	--	--	--	--	--	<0.1	--
JSF-10-37	10-37	4/19/11	<100	<1	3.7	59	<1	<200	<0.5	73	<2	<1	<2	1200	<1	--	3.6	750	<0.2	--	2.4	<0.1	1.1	<1	--	<1	210	42	<1	<1	--	<2	<10	7.7	<0.1	65
		10/18/11	<100	<1	1.4	40	<1	<200	<0.5	70	<2	<1	<2	180	<1	--	3.6	140	<0.2	--	<1	0.2	0.97	<1	--	<1	210	8.2	<1	<1	--	<2	<10	4	<0.1	30
		10/18/11	<100	<1	1.5	39	<1	<200	<0.5	68	<2	<1	<2	180	<1	--	3.6	140	<0.2	--	<1	0.2	0.96	<1	--	<1	200	7.9	<1	<1	--	<2	<10	4	<0.1	30
		4/9/12	--	<1	<1	58	<1	--	<0.5	--	<2	--	--	--	<1	--	--	--	<0.2	--	<1	<0.1	--	<1	--	<1	--	--	<1	--	--	--	--	--	<0.1	--
		10/29/12	--	<1	<1	33	<1	--	<0.5	--	<2	--	--	--	<1	--	--	--	<0.2	--	<1	0.34	--	<1	--	<1	--	--	<1	--	--	--	--	--	<0.1	--
		10/29/12	--	<1	<1	34	<1	--	<0.5	--	<2	--	--	--	<1	--	--	--	<0.2	--	<1	0.34	--	<1	--	<1	--	--	<1	--	--	--	--	--	<0.1	--
		4/10/13	--	<1	1.2	47	<1	--	<0.5	--	<2	--	--	--	<1	--	--	--	<0.2	--	2.3	0.1	--	<1	--	<1	--	--	<1	--	--	--	--	--	0.15	--
		4/10/13	--	<1	2.4	47	<1	--	<0.5	--	<2	--	--	--	<1	--	--	--	<0.2	--	2.4	<0.1	--	<1	--	<1	--	--	<1	--	--	--	--	--	0.15	--
		11/18/13	--	<2	<2	37.3	<2	--	<1	--	<2	--	--	--	<2	--	--	--	<0.2	--	<2	0.201	--	<2	--	<2	--	--	<2	--	--	--	--	--	<0.1	--
		4/9/14	--	<2	<2	52.5	<2	--	<1	--	<5	--	--	--	<5	--	--	--	<0.2	--	<10	<0.1	--	<10	--	<5	--	--	<2	--	--	--	--	--	<0.1	--
		4/9/14	--	<2	<2	54.4	<2	--	<1	--	<5	--	--	--	<5	--	--	--	<0.2	--	<10	<0.1	--	<10	--	<5	--	--	<2	--	--	--	--	--	<0.1	--
JSF-15	15	3/28/91	91000	<1	6	630	--	<500	0.1	280	34	--	90	110000	40	30	34	5100	--	90	40	--	27	<1	24000	--	1300	5.7	--	--	--	70	220	29	--	30
		4/29/91	80000	<1	2	620	--	<500	0.4	260	62	--	<10	140000	57	40	31	5300	--	170	67	--	2.8	<1	55000	--	1000	6.3	--	--	--	110	190	29	--	19
		8/27/91	50000	3	<1	460	--	<500	0.2	210	38	--	40	88000	36	80	28	6900	--	20	44	--	15	<1	450	--	1000	6.6	--	--	--	70	200	30	--	17
		2/19/92	11000	--	5	330	<1	<500	<0.1	130	11	--	<10	40000	6	<10	16	4300	--	<20	11	--	--	<1	19000	--	760	5.9	--	--	--	<10	<10	31	--	18
		12/1/92	2500	--	4	260	<1	<500	--	110	<1	--	<10	38000	7	--	12	3200	--	<20	<1	--	1.7	<1	--	--	610	5.6	--	--	--	--	10	29	--	6
		3/2/93	7400	<1	<1	280	<1	<500	<0.1	98	--	--	<10	45000	5	--	12	4000	--	<20	6	--	1.8	--	--	--	580	5.7	--	--	--	--	20	28	--	8
		5/25/93	860	--	4	240	<1	<500	--	94	1	--	<10	4400	1	--	12	3800	--	<20	1	--	1.6	<1	--	--	530	5.7	--	--	--	--	10	29	--	5
		8/17/93	90	<1	5	210	<1	<500	<0.1	97	--	--	<10	27000	<1	--	12	3900	--	<20	2	--	1.9	--	--	--	630	5	--	--	--	--	<10	29	--	5
		8/17/93	<50	<1	5	200	<1	<500	<0.1	100	--	--	<10	2100	<1	--	12	3500	--	<20	<1	--	1.8	--	--	--	690	4.9	--	--	--	--	2700	30	--	16
		8/17/93	230	<1	5	200	<1	<500	<0.1	100	--	--	<10	24	<1	--	12	3400	--	<20	1	--	1.8	--	--	--	680	4.9	--	--	--	--	140	30	--	16
		11/18/93	200	--	7	180	<1	<500	--	96	6	--	<10	26000	1	--	12	3700	--	<20	10	--	1.9	<1	--	--	470	5.7	--	--	--	--	<10	27	--	5
		11/18/93	150	--	7	210	<1	<500	--	110	2	--	<10	1200	<1	--	13	2900	--	40	38	--	1.9	<1	--	--	590	6.2	--	--	--	--	<10	29	--	24
		2/23/94	310	<1	4	230	<1	<500	0.1	89	--	--	<10	30000	<1	--	12	3300	--	<20	1	--	1.8	<1	--	--	520	5.6	--	--	--	--	<10	29	--	11
		2/23/94	2400	1	5	250	<1	<500	<0.1	95	--	--	<10	36000	1	--	12	2800	--	<20	2	--	2	<1	--	--	540	5.4	--	--	--	--	<10	29	--	11
		5/17/94	2300	<1	5	320	<1	<500	0.1	120	12	4	<10	46000	5	--	15	3600	0.2	<20	8	--	1.6	<1	--	<10	710	5.2	<50	--	--	--	<10	29	0.2	11
		8/15/94	570	<1	3	240	<1	<500	<0.1	110	5	<1	<10	27000	<1	--	12	3300	<0.2	<20	2	--	1.9	<1	--	<10	570	5.5	<50	--	--	<10	<10	30	0.1	15
		11/7/94	380	<1	3	230	<1	<500	0.2	120	29	<1	<10	23000	3	--	15	3800	<0.2	<20	21	--	1.8	<1	--	<10	740	5.9	<2	--	--	<10	1200	30	0.1	14
		5/24/95	6800	<1	6	290	<1	<500	<0.1	110	10	2	<10	39000	3	--	15	4100	<0.2	<20	7	--	1.8	<1	--	<10	660	5.6	<2	--	--	<10	10	30	<0.1	28
		8/7/96	1000	<1	<1	220	<1	<500	<0.1	99	1	<1	<10	28000	1	--	12	2300	<0.2	<20	4	--	1.6	4	--	<10	600	5.3	<50	--	--	<10	<10	30	0.2	15

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**	**-**
JSF-15 (cont.)	15	8/7/96	1100	<1	1	230	<1	<500	<0.1	100	<1	3	<10	28000	<1	--	13	2500	<0.2	<20	3	--	1.7	4	--	<10	640	5.4	<50	--	--	<10	<10	30	0.2	14
		1/9/97	970	<1	**11**	280	<1	<500	<0.1	110	<1	<1	<10	32000	2	--	13	2500	<0.2	--	3	--	1.6	2	--	<10	560	5	<1	--	--	<10	<10	28	<0.1	6
		7/15/97	2000	<1	5	260	<1	<500	<0.1	91	7	3	<10	42000	4	--	12	3100	<0.2	--	5	--	2	<1	--	<10	460	5.2	<2	--	--	<10	<10	28	<0.1	4
		7/15/97	2600	<1	5	260	<1	<500	<0.1	90	6	3	<10	43000	3	--	12	3100	<0.2	--	5	--	2	<1	--	<10	430	5.1	<2	--	--	<10	<10	28	<0.1	5
		1/21/98	1500	<1	6	260	<1	<500	<0.1	99	2	<1	<10	28000	<1	--	12	2600	<0.2	--	2	--	1.7	<1	--	<10	550	5.5	<2	--	--	10	<10	26	<0.1	10
		7/29/98	3400	<1	9	240	<1	<200	<0.1	91	3	<1	<10	43000	25	--	12	1900	<0.2	--	8	--	1.7	2	--	<10	430	5.1	<2	--	--	<10	20	28	<0.1	6
JSF-16	16	3/26/91	52000	<1	2	240	--	<500	0.3	230	36	--	<10	46000	12	60	18	770	--	<20	41	--	18	<1	45000	--	760	5.6	--	--	--	40	120	20	--	52
		4/30/91	94000	<1	1	500	--	<500	0.4	470	74	--	60	120000	74	90	29	1900	--	<20	**110**	--	3	1	52000	--	970	4.9	--	--	--	130	280	28	--	62
		8/26/91	36000	5	**110**	230	--	<500	0.3	240	34	--	50	47000	25	70	19	740	--	<20	97	--	12	<1	560	--	500	5.1	--	--	--	40	310	30	--	63
		2/20/92	12000	--	<1	150	<1	<500	0.1	150	9	--	<10	14000	5	<10	13	270	--	30	15	--	--	<1	21000	--	410	4.6	--	--	--	<10	10	26	--	52
		12/1/92	3700	--	<1	120	<1	<500	--	120	2	--	<10	3900	3	--	11	110	--	<20	4	--	1.2	<1	--	--	290	5	--	--	--	--	10	29	--	60
		3/2/93	1700	<1	<1	90	<1	<500	0.1	130	--	--	<10	1500	2	--	9.2	32	--	<20	9	--	0.8	--	--	--	370	4.5	--	--	--	--	10	23	--	56
		5/24/93	2000	--	<1	70	<1	<500	--	130	3	--	<10	2300	1	--	8.9	68	--	<20	2	--	0.8	<1	--	--	320	4.4	--	--	--	--	10	25	--	53
		8/16/93	7500	<1	<1	100	<1	<500	<0.1	110	--	--	<10	7100	4	--	11	89	--	<20	6	--	1.2	--	--	--	260	4.2	--	--	--	--	250	30	--	60
		8/16/93	2200	<1	<1	80	<1	<500	<0.1	100	--	--	<10	2000	<1	--	10	22	--	<20	<1	--	1.2	--	--	--	280	4.2	--	--	--	--	<10	30	--	60
		11/17/93	2000	--	<1	80	<1	<500	--	100	7	--	<10	2200	2	--	12	50	--	<20	9	--	1.3	<1	--	--	140	6.6	--	--	--	--	<10	25	--	100
		2/22/94	3300	<1	<1	80	<1	<500	0.1	110	--	--	<10	3300	1	--	9.2	52	--	<20	7	--	0.9	--	--	--	300	4.3	--	--	--	--	10	25	--	56
		5/16/94	950	<1	<1	100	<1	<500	0.1	150	8	2	<10	1400	1	--	12	41	<0.2	<20	7	--	0.8	<1	--	<10	400	4.2	<50	--	--	--	<10	26	0.2	52
		8/15/94	2600	<1	<1	90	<1	<500	0.1	120	7	1	<10	2300	3	--	9.9	58	<0.2	<20	6	--	1.1	1	--	<10	260	4.5	<50	--	--	<10	<10	31	<0.1	61
		11/7/94	2900	2	<1	80	<1	<500	0.2	99	54	<1	<10	7600	6	--	10	63	<0.2	<20	62	--	1.1	<1	--	<10	250	4.8	<2	--	--	<10	1500	26	0.1	53
		5/23/95	4000	<1	<1	90	<1	<500	<0.1	130	8	2	<10	4900	<1	--	11	45	<0.2	<20	9	--	0.9	<1	--	<10	360	4.5	2	--	--	<10	<10	24	<0.1	<2
		1/23/96	9400	<1	3	120	<1	<500	<0.1	130	18	9	<10	9800	7	--	11	150	<0.2	<20	32	--	2.2	3	--	<10	340	5.1	<2	--	--	<10	20	24	0.2	68
		8/6/96	4400	<1	<1	90	<1	<500	<0.1	110	6	<1	<10	4400	2	--	10	66	<0.2	<20	5	--	1	4	--	<10	310	4.4	<50	--	--	<10	10	32	0.3	70
		1/8/97	5400	<1	3	120	<1	<500	0.1	140	4	2	<10	5500	4	--	12	150	<0.2	--	9	--	2.3	<1	--	<10	340	5	<1	--	--	<10	10	28	<0.1	62
		7/15/97	4800	<1	<1	80	<1	<500	<0.1	120	9	3	<10	5200	4	--	9.9	120	<0.2	--	6	--	1.5	<1	--	<10	300	4.6	<2	--	--	<10	<10	26	<0.1	58
		1/19/98	5600	<1	<1	100	<1	<500	0.3	110	16	8	<10	5600	4	--	11	120	<0.2	--	21	--	1.1	<1	--	<10	350	5.7	<2	--	--	<10	10	25	<0.1	59
		7/28/98	6200	<1	<1	80	<1	<200	<0.1	110	6	4	<10	5300	5	--	10	110	<0.2	--	9	--	1	<1	--	<10	280	4.7	<2	--	--	<10	30	31	<0.1	68
JSF-17	17	5/28/91	8400	<1	**18**	100	--	5300	<0.1	240	13	--	20	9300	4	30	49	370	--	1800	4	--	5.6	<1	13000	--	1600	12	--	--	--	<10	50	24	--	600
		2/18/92	1900	--	2	70	--	3100	0.1	230	5	--	<10	1600	1	19	50	200	--	1600	38	--	--	<1	8500	--	1200	11	--	--	--	<10	<10	25	--	290
		5/19/92	1300	--	<1	20	--	5900	4	220	62	--	<10	1500	69	30	43	110	--	1600	53	--	1.7	<1	7200	--	1100	11	--	--	--	<10	<10	21	--	500
		8/18/92	3700	--	3	490	--	6100	0.2	280	7	--	<10	4500	8	20	51	730	--	1200	13	--	--	<1	13000	--	1200	13	--	--	--	<10	160	17	--	550
		12/2/92	1500	--	2	120	<1	6000	--	290	1	--	<10	1700	4	--	52	440	--	1200	7	--	1.4	<1	--	--	1200	11	--	--	--	--	20	19	--	500
		3/2/93	310	<1	<1	40	<1	5800	0.2	260	--	--	<10	210	<1	--	50	290	--	1400	4	--	1.3	--	--	--	1200	11	--	--	--	--	<10	19	--	250
		5/25/93	630	--	<1	40	<1	3100	--	260	<1	--	<10	560	<1	--	51	1200	--	1500	2	--	1.3	<1	--	--	1100	11	--	--	--	--	10	18	--	510
		8/18/93	36000	<1	**77**	340	2	2600	1	300	--	--	100	32000	1000	--	52	780	--	1100	92	--	2.6	--	--	--	1500	8.6	--	--	--	--	650	17	--	410
		11/18/93	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		2/24/94	1400	<1	2	40	<1	2600	0.2	270	--	--	<10	1700	9	--	47	660	--	1000	13	--	1.5	<1	--	--	110	11	--	--	--	--	20	19	--	480
		5/18/94	1100	2	<1	50	<1	2500	<0.1	310	3	2	<10	1200	2	--	56	940	<0.2	1300	4	--	1.4	<1	--	<10	1400	10	<50	--	--	--	<10	17	0.2	420
		8/17/94	2900	1	3	30	<1	4100	0.3	180	8	1	<10	2600	8	--	31	380	<0.2	690	8	--	1	5	--	<10	760	6.7	<50	--	--	<10	<10	9	<0.1	250
		9/10/99	16000	3	10	100	<1	7400	0.4	280	24	3	10	14000	45	--	58	260	<0.2	--	30	--	1.5	<1	--	<10	1400	9.9	<2	--	--	<10	40	9	0.2	28
		7/7/00	720	<1	<1	42	<1	7300	**6.8**	260	1.5	2.8	16	470	2.7	--	54	47	<0.2	<20	5.9	--	1.4	<1	7600	<10	1400	10	<2	<50	11	<10	<10	12	0.29	480

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**	**-**
JSF-18	18	3/28/91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/30/91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		2/18/92	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	120
		8/6/96	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/8/97	<50	**18**	**710**	240	<1	2000	<0.1	170	<1	2	<10	120	3	--	36	140	<0.2	--	3	--	10	<1	--	<10	3800	5	<1	--	--	20	540	9	0.8	150
JSF-19	19	4/30/91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
JSF-2	2	12/1/86	<50	--	<1	80	--	--	0.4	66.7	<1	--	<10	230	3	--	5.1	120	<0.2	--	3	0.25	--	--	--	<10	--	3.1	--	--	--	--	10	--	--	18
		3/19/87	--	--	--	--	--	--	--	69	--	--	--	5200	--	--	--	140	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	22
		5/21/87	220	--	<1	30	--	--	<0.1	73.6	<1	--	30	50	<1	--	5.7	120	<0.2	--	<1	0.07	0.57	<1	--	<0.1	--	4.3	--	--	--	--	--	14	--	21
		6/4/87	50	--	<1	--	--	--	0.1	66.3	--	--	<10	120	--	--	5	120	--	--	--	--	0.48	--	--	--	--	3.6	--	--	--	--	--	11	--	15
		6/18/87	<50	--	<1	50	--	--	0.1	61.9	<1	--	10	20	<1	--	4.4	120	<0.2	--	<1	0.08	0.47	<1	--	<0.1	--	3.3	--	--	--	--	--	8	--	16
		12/16/87	<50	--	<1	30	--	<500	<0.1	60	50	--	<10	990	1	--	4.8	110	--	--	20	--	--	<1	--	--	--	3	--	--	--	--	<10	6	--	14
		3/8/88	<50	--	<1	60	--	<500	0.2	68	3	--	10	340	<1	--	5.3	120	--	--	2	--	--	<1	--	--	--	4.8	--	--	--	--	10	16	--	16
		6/21/88	<50	--	<1	50	--	<500	<0.1	71	3	--	20	580	1	--	5.8	100	--	--	2	--	--	<1	--	--	--	3.9	--	--	--	--	10	12	--	19
		9/15/88	<50	--	<1	50	--	--	<0.1	64	<1	--	<10	670	<1	--	5	75	--	--	<1	--	--	<1	--	--	--	3.3	--	--	--	--	<10	--	--	26
		12/7/88	70	--	<1	60	--	<500	<0.1	67	<1	--	<10	360	2	--	5.2	85	--	--	<1	--	--	<1	--	--	--	2.8	--	--	--	--	<10	--	--	17
		3/22/89	<50	--	<1	70	--	<500	<0.1	63	<1	--	<10	480	1	--	5.2	98	--	--	1	--	--	<1	--	--	--	4.9	--	--	--	--	<10	--	--	18
		6/7/89	730	--	<1	70	--	<500	0.1	72	<1	--	<10	950	<1	--	5.6	86	--	--	<1	--	--	<1	--	--	--	5	<50	--	--	--	60	--	--	17
		8/29/89	<50	--	<1	60	--	<500	<0.1	70	<1	--	30	1900	<1	--	5.5	110	--	--	4	--	--	<1	--	--	--	4.5	--	--	--	--	10	--	--	15
		11/1/89	<50	--	<1	30	--	<500	<0.1	65	<1	--	<10	300	<1	--	5	110	--	--	1	--	--	<1	--	--	--	4.7	--	--	--	--	10	14	--	20
		2/6/90	1600	--	<1	60	--	<500	<0.1	77	3	--	<10	400	<1	--	9.2	130	--	--	4	--	--	<1	--	--	--	5.6	--	--	--	--	60	18	--	22
		2/6/90	1100	--	<1	60	--	<500	<0.1	73	1	--	<10	510	<1	--	8.4	140	--	--	3	--	--	<1	--	--	--	5.5	--	--	--	--	60	18	--	21
		5/22/90	<50	--	<1	60	--	<500	0.1	76	<1	--	<10	510	<1	--	6.3	97	--	--	2	--	--	<1	--	--	--	6.3	--	--	--	--	20	20	--	17
		8/8/90	650	--	<1	50	--	<500	0.4	70	<1	--	100	820	3	--	17	21	--	--	<1	--	--	1	--	--	--	4.3	--	--	--	--	10	1	--	18
		11/27/90	<50	<1	<1	70	--	<500	0.3	75	<1	--	<10	1800	1	<10	5.9	120	--	<20	3	--	0.59	<1	8300	--	220	4.7	--	--	--	<10	<10	14	--	31
		2/27/91	390	<1	<1	80	--	<500	0.1	82	2	--	<10	4500	10	10	6.4	200	--	<20	<1	--	0.6	<1	8600	--	270	4.9	--	--	--	10	20	2	--	24
		3/27/91	<50	<1	1	70	--	<500	2	71	<1	--	<10	330	<1	10	5.6	100	--	<20	5	--	0.56	<1	6300	--	210	4.5	--	--	--	<10	10	20	--	25
		4/30/91	210	<1	<1	80	--	<500	0.1	80	1	--	<10	1800	8	10	6.1	140	--	<20	3	--	0.52	<1	7100	--	250	5.8	--	--	--	<10	20	20	--	25
		8/26/91	150	3	<1	70	--	<500	<0.1	77	<1	--	<10	4800	<1	10	6.2	160	--	<20	2	--	0.6	<1	8700	--	250	4	--	--	--	<10	<10	13	--	24
		2/20/92	90	--	1	100	--	<500	<0.1	74	2	--	<10	3400	<1	<10	6	150	--	20	2	--	--	<1	8800	--	240	4.5	--	--	--	<10	<10	16	--	16
		12/1/92	<50	--	<1	60	<1	<500	--	74	<1	--	<10	1600	<1	--	4.6	120	--	<20	<1	--	0.4	<1	--	--	200	3.7	--	--	--	--	<10	12	--	20
		3/1/93	<50	<1	<1	80	<1	<500	0.1	81	--	--	<10	1800	1	--	5.3	130	--	<20	<1	--	0.5	--	--	--	250	4.5	--	--	--	--	<10	16	--	22
		5/24/93	60	--	<1	70	<1	<500	--	81	<1	--	<10	3500	<1	--	5.3	130	--	<20	<1	--	0.5	<1	--	--	250	4.7	--	--	--	--	<10	16	--	22
		8/17/93	<50	<1	<1	50	<1	<500	<0.1	71	--	--	<10	960	<1	--	5	110	--	<20	<1	--	0.6	--	--	--	220	3.2	--	--	--	--	<10	12	--	19
		8/17/93	<50	<1	<1	50	<1	<500	<0.1	70	--	--	<10	810	<1	--	5	110	--	<20	<1	--	0.6	--	--	--	230	3.2	--	--	--	--	<10	12	--	20
		8/17/93	100	<1	<1	70	<1	<500	<0.1	73	--	--	<10	6600	<1	--	4.9	130	--	<20	2	--	0.6	--	--	--	270	3.1	--	--	--	--	<10	12	--	21
		8/17/93	180	<1	<1	60	<1	<500	0.1	67	--	--	<10	3000	<1	--	4.7	120	--	<20	2	--	0.6	--	--	--	230	3.1	--	--	--	--	<10	11	--	21
		11/18/93	<50	--	<1	60	<1	<500	--	67	<1	--	<10	1400	<1	--	5	95	--	50	1	--	0.5	<1	--	--	100	3.5	--	--	--	--	<10	11	--	21
		11/18/93	100	--	<1	50	<1	<500	--	70	1	--	<10	3800	<1	--	4.7	110	--	<20	<1	--	0.5	<1	--	--	250	3.2	--	--	--	--	<10	10	--	22
		11/18/93	100	--	<1	70	<1	<500	--	70	2	--	<10	6800	<1	--	4.8	120	--	<20	1	--	0.5	<1	--	--	270	3.3	--	--	--	--	<10	10	--	24

Well ID	Historical Well ID Ref.	Date	Inorganics: 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)	Anions: 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**	**-**
JSF-2 (cont.)	2	11/18/93	60	--	<1	80	<1	<500	--	71	<1	--	<10	15000	<1	--	4.8	120	--	<20	<1	--	0.5	<1	--	--	290	3.3	--	--	--	--	<10	10	--	23
		2/22/94	180	<1	2	120	<1	<500	<0.1	74	--	--	<10	36000	<1	--	5.6	170	--	<20	2	--	0.5	<1	--	--	250	4.6	--	--	--	--	<10	15	--	20
		2/22/94	<50	<1	<1	70	<1	<500	<0.1	72	--	--	<10	2000	<1	--	5.1	120	--	<20	<1	--	0.5	<1	--	--	220	3.7	--	--	--	--	<10	13	--	20
		5/16/94	60	<1	4	200	<1	<500	0.2	95	2	<1	<10	78000	1	--	6.7	200	<0.2	<20	1	--	0.5	1	--	<10	370	4.6	<50	--	--	--	<10	16	0.1	20
		5/16/94	<50	<1	<1	90	<1	<500	<0.1	93	1	<1	<10	1400	<1	--	6.3	160	<0.2	<20	<1	--	0.5	<1	--	<10	290	4	<50	--	--	--	<10	13	0.1	21
		8/16/94	<50	<1	<1	70	<1	<500	0.1	71	<1	<1	<10	440	<1	--	4.8	130	<0.2	<20	<1	--	0.6	<1	--	<10	190	3.5	<50	--	--	<10	<10	11	<0.1	21
		11/8/94	<50	<1	<1	60	<1	<500	0.1	75	17	<1	<10	5000	1	--	5.5	160	<0.2	<20	10	--	0.5	<1	--	<10	130	3.6	<2	--	--	<10	1200	11	<0.1	23
		5/23/95	<50	<1	<1	70	<1	<500	0.1	74	<1	<1	<10	970	<1	--	5.2	170	<0.2	<20	1	--	0.6	<1	--	<10	240	3.8	<2	--	--	<10	<10	12	<0.1	35
		1/23/96	<50	<1	<1	60	<1	<500	<0.1	76	<1	<1	<10	430	<1	--	5.2	120	<0.2	<20	6	--	0.5	<1	--	<10	190	3.5	**3**	--	--	<10	<10	11	<0.1	29
		8/6/96	<50	<1	<1	60	<1	<500	<0.3	72	<1	<1	<10	390	<1	--	5.2	120	<0.2	<20	<1	--	0.6	<1	--	<10	220	3.6	<50	--	--	<10	<10	11	0.5	27
		1/8/97	<50	<1	<1	80	<1	<500	<0.1	76	<1	<1	<10	7000	1	--	5.9	120	<0.2	--	4	--	0.6	<1	--	<10	220	4	<1	--	--	<10	<10	12	<0.1	21
		1/8/97	<50	<1	3	70	<1	<500	<0.1	77	<1	<1	<10	2100	<1	--	5.6	140	<0.2	--	3	--	0.6	<1	--	<10	220	3	<1	--	--	<10	<10	11	<0.1	22
		7/14/97	<50	<1	<1	90	<1	<500	<0.1	77	<1	<1	<10	12000	<1	--	5.8	150	<0.2	--	<1	--	0.5	<1	--	<10	190	4.7	<2	--	--	<10	<10	14	<0.1	22
		7/14/97	<50	<1	<1	80	<1	<500	<0.1	79	1	<1	<10	4000	<1	--	5.4	150	<0.2	--	<1	--	0.5	<1	--	<10	210	3.8	<2	--	--	<10	<10	12	<0.1	23
		1/19/98	80	<1	<1	70	<1	<500	<0.1	69	<1	<1	<10	7300	<1	--	4.8	140	0.6	--	2	--	0.5	<1	--	<10	230	3.6	<2	--	--	<10	<10	10	<0.1	26
		1/20/98	90	<1	<1	80	<1	<500	<0.1	72	<1	<1	<10	11000	<1	--	5.4	180	<0.2	--	3	--	0.5	<1	--	<10	240	4.2	<2	--	--	<10	<10	11	<0.1	22
		7/28/98	<50	<1	<1	70	<1	<200	<0.1	68	<1	<1	<10	5100	2	--	5.2	130	<0.2	--	<1	--	0.5	<1	--	<10	200	4.2	<2	--	--	<10	<10	12	<0.1	22
		7/28/98	100	<1	<1	80	<1	<200	<0.1	69	<1	<1	<10	8500	2	--	4.9	150	<0.2	--	<1	--	0.5	<1	--	<10	210	3.5	<2	--	--	<10	<10	11	<0.1	25
JSF-20	W-20	4/2/91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/30/91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		2/20/92	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	210
JSF-21	21	5/28/91	75000	<1	5	800	--	7900	1	480	77	--	140	240000	80	60	60	7300	--	550	**150**	--	6.6	<1	40000	--	1900	17	--	--	--	200	430	14	--	440
		8/27/91	18000	2	<1	420	--	8200	1	370	71	--	60	180000	61	200	47	2700	--	820	86	--	26	<1	720	--	1500	11	--	--	--	110	250	15	--	500
		2/18/92	25000	--	9	290	--	4700	0.4	380	44	--	<10	78000	13	33	56	1700	--	1200	52	--	--	<1	35000	--	2000	18	--	--	--	40	100	15	--	290
		5/18/92	11000	--	2	90	--	8900	<0.1	340	13	--	<10	27000	6	750	46	670	--	1300	18	--	--	<1	19000	--	2000	27	--	--	--	<10	50	15	--	350
		8/18/92	63000	--	9	660	--	9300	1	580	93	--	150	170000	160	570	64	3300	--	990	**130**	--	--	<1	13000	--	2200	22	--	--	--	80	280	18	--	710
		12/2/92	490	--	<1	30	<1	8000	--	240	<1	--	<10	920	<1	--	34	140	--	920	<1	--	2	<1	--	--	1200	22	--	--	--	--	<10	16	--	700
		3/2/93	1500	<1	<1	50	<1	10000	0.1	360	--	--	<10	3400	<1	--	55	160	--	1400	3	--	3.9	--	--	--	2400	46	--	--	--	--	<10	17	--	440
		5/25/93	980	--	<1	40	<1	5500	--	420	<1	--	<10	2200	<1	--	65	160	--	1700	1	--	64	<1	--	--	2700	4.8	--	--	--	--	<10	18	--	1000
		8/17/93	970	<1	<1	40	<1	5900	<0.1	480	--	--	<10	2200	<1	--	72	120	--	1600	3	--	5.8	--	--	--	3100	90	--	--	--	--	<10	20	--	1200
		11/17/93	410	--	<1	30	<1	10000	--	480	3	--	<10	1	<1	--	70	160	--	1500	<1	--	4.2	<1	--	--	2800	99	--	--	--	--	<10	20	--	1400
		2/23/94	920	<1	<1	60	<1	7400	0.1	550	--	--	<10	1700	<1	--	83	130	--	2000	5	--	5	<1	--	--	3200	100	--	--	--	--	<10	21	--	1300
		5/17/94	450	4	1	50	<1	5400	0.2	560	<1	<1	<10	860	<1	--	88	140	<0.2	2100	<1	--	6	1	--	<10	3600	98	<50	--	--	--	<10	18	0.2	1000
		8/16/94	600	1	<1	40	<1	14000	0.2	490	5	7	<10	1100	<1	--	70	130	<0.2	1600	<1	--	6.8	10	--	<10	2900	110	<50	--	--	<10	<10	20	0.1	1300
		11/8/94	610	2	<1	40	<1	23000	0.2	670	39	12	<10	2100	2	--	110	250	<0.2	2600	5	--	10	<1	--	<10	4800	180	<2	--	--	<10	700	24	0.2	1800
		5/23/95	2200	<1	<1	50	<1	18000	<0.1	600	4	<1	<10	5600	<1	--	94	230	<0.2	2800	6	--	13	<1	--	<10	3900	170	<2	--	--	<10	<10	22	0.1	1660
		1/24/96	880	1	<1	40	<1	19000	<0.1	440	<1	2	<10	2300	<1	--	79	150	<0.2	2400	8	--	15	3	--	<10	3000	170	<2	--	--	<10	<10	20	0.2	1900
		8/6/96	620	<1	<1	20	<1	20000	<0.1	620	<1	<1	<10	1300	<1	--	100	230	<0.2	3400	2	--	20	20	--	<10	4300	170	<2	--	--	<10	<10	20	0.2	1400
		1/9/97	2000	<1	3	60	<1	22000	<0.1	580	1	<1	<10	4500	4	--	110	250	<0.2	--	8	--	25	<1	--	<10	4000	180	<1	--	--	<10	<10	20	0.1	1600
		7/15/97	330	<1	<1	30	<1	17000	<0.1	540	<1	<1	<10	2400	<1	--	93	240	<0.2	--	5	--	20	<1	--	<10	3600	140	<2	--	--	<10	<10	19	0.1	1500

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	-
JSF-21 (cont.)	21	1/21/98	830	<1	<1	50	<1	21000	<0.1	610	2	<1	<10	2200	<1	--	130	350	<0.2	--	9	--	46	<1	--	<10	4800	170	<2	--	--	<10	<10	16	0.2	2100
		6/25/98	920	<1	5	30	<1	17000	<0.1	500	2	1	<10	3900	8	--	100	270	<0.2	--	<1	--	44	<1	--	<10	3600	120	<2	--	--	<10	<10	14	0.2	1400
		7/28/98	790	<1	<1	30	<1	18000	<0.1	540	1	<1	<10	1500	2	--	100	290	<0.2	--	9	--	47	<1	--	<10	3800	140	<2	--	--	<10	<10	17	0.2	1800
		1/17/02	10000	<1	2.2	110	<1	18000	0.42	540	2	6.5	25	11000	<1	--	100	450	<0.1	2900	2	--	18	3.4	--	<10	4000	120	<2	<50	290	<10	20	17	0.12	1900
JSF-25	25	11/18/93	90	--	<1	30	<1	<500	--	97	4	--	<10	240	2	--	7.4	290	--	50	8	--	1.1	<1	--	--	490	22	--	--	--	--	<10	30	--	180
		11/18/93	<50	--	<1	30	<1	<500	--	110	<1	--	<10	30	<1	--	8.1	260	--	<20	2	--	0.9	<1	--	--	650	21	--	--	--	--	<10	30	--	180
		2/22/94	<50	<1	<1	40	<1	<500	0.1	93	--	--	<10	160	<1	--	7.3	270	--	<20	4	--	0.9	<1	--	--	720	21	--	--	--	--	<10	32	--	170
		5/17/94	<50	<1	<1	50	<1	<500	<0.1	120	<1	<1	<10	80	<1	--	9.3	310	<0.2	<20	<1	--	0.9	<1	--	<10	1000	20	<50	--	--	--	<10	32	0.2	160
		8/17/94	<50	<1	1	40	<1	500	<0.1	98	<1	<1	<10	30	1	--	6.7	230	<0.2	<20	<1	--	0.9	2	--	<10	690	20	<50	--	--	<10	<10	31	<0.1	180
		11/9/94	<50	2	<1	30	<1	500	0.1	110	87	<1	<10	1600	1	--	9.1	280	<0.2	<20	16	--	0.9	2	--	10	840	20	<2	--	--	<10	540	32	0.1	210
		5/24/95	<50	<1	<1	40	<1	500	<0.1	110	<1	<1	<10	20	6	--	8.5	240	<0.2	<20	<1	--	1.2	<1	--	<10	830	20	<2	--	--	<10	<10	30	0.1	200
		1/24/96	<50	<1	<1	30	<1	590	<0.1	96	<1	<1	<10	20	<1	--	7.6	240	<0.2	<20	<1	--	<0.1	<1	--	<10	770	20	<2	--	--	<10	<10	29	0.2	210
		1/24/96	<50	<1	<1	20	<1	540	<0.1	96	<1	<1	<10	10	<1	--	7.5	240	<0.2	<20	<1	--	3	<1	--	<10	770	20	<2	--	--	<10	<10	29	0.2	200
		8/6/96	<50	<1	<1	30	<1	500	<0.1	96	<1	<1	<10	<10	<1	--	8.5	240	<0.2	<20	<1	--	3.4	3	--	<10	800	20	<50	--	--	<10	<10	30	0.2	200
		1/8/97	<50	<1	2	40	<1	500	<0.1	120	<1	<1	<10	40	1	--	9.4	270	<0.2	--	<1	--	2.1	<1	--	<10	890	19	<1	--	--	<10	<10	28	0.1	240
		7/15/97	<50	<1	<1	40	<1	600	<0.1	110	3	<1	<10	40	<1	--	8.7	280	<0.2	--	2	--	1.8	<1	--	<10	820	21	<2	--	--	<10	<10	25	0.1	210
		1/21/98	50	<1	<1	30	<1	800	<0.1	110	<1	<1	<10	110	<1	--	9.3	310	<0.2	--	2	--	3	<1	--	<10	1000	22	<2	--	--	<10	<10	25	0.1	240
		7/29/98	<50	<1	<1	30	<1	600	<0.1	110	2	<1	<10	30	<1	--	9.3	280	<0.2	--	<1	--	1.6	<1	--	<10	910	21	<2	--	--	<10	<10	26	<0.1	250
		7/29/98	<50	<1	<1	40	<1	600	<0.1	110	1	<1	<10	60	<1	--	9.4	280	<0.2	--	<1	--	1.4	<1	--	<10	900	20	<2	--	--	<10	<10	27	<0.1	260
JSF-26	26	8/6/96	890	<1	**13**	120	<1	<500	0.4	160	1	14	<10	2100	1	--	28	22000	<0.2	<20	9	--	13	7	--	<10	450	19	<2	--	--	<10	10	16	0.3	120
		1/7/97	470	<1	8	150	<1	<500	<0.1	180	2	11	<10	2200	1	--	29	25000	<0.2	--	3	--	33	<1	--	<10	450	16	<1	--	--	<10	<10	13	0.1	69
		7/15/97	70	<1	3	110	<1	<500	<0.1	170	2	7	<10	1200	<1	--	27	23000	<0.2	--	4	--	29	<1	--	<10	690	19	<2	--	--	<10	<10	15	0.1	76
		1/21/98	320	<1	4	110	<1	<500	<0.1	160	5	16	<10	2700	<1	--	26	27000	<0.2	--	7	--	6.7	<1	--	<10	530	12	<2	--	--	<10	<10	13	0.1	100
		7/30/98	200	<1	3	120	<1	200	<0.1	160	4	12	<10	3100	<1	--	27	24000	<0.2	--	7	--	25	<1	--	<10	490	16	<2	--	--	<10	<10	14	0.1	81
		1/21/99	250	<1	2	130	<1	<200	0.2	160	<1	10	<10	1100	<1	--	28	21000	<0.2	--	5	--	8.6	<1	--	<10	480	12	<2	--	--	<10	<10	14	<0.1	94
		9/10/99	12000	<1	**12**	210	<1	200	<0.1	170	17	15	<10	18000	6.6	--	30	22000	<0.2	--	28	--	8.9	<1	--	<10	480	11	<2	--	--	10	40	12	0.1	85
		1/6/00	2800	<1	7.1	170	<1	300	0.17	170	4.5	11	<10	5200	1.4	--	30	22000	<0.2	<20	7	--	8.5	<1	13000	<10	520	12	<2	90	35	<10	<10	15	<0.1	78
		7/7/00	1300	<1	2.1	120	<1	310	0.41	150	6.9	<1	<10	5300	<1	--	26	22000	<0.2	<20	6.9	--	2.9	<1	5500	<10	450	11	<2	83	22	<10	<10	18	0.14	56
		1/23/01	1200	<1	4.3	150	<1	280	<0.1	160	2.6	<1	<10	5400	<1	--	29	20000	<0.2	<20	4.9	--	4.8	<1	--	<10	510	11	<2	<50	15	<10	12	16	0.12	58
		7/17/01	1400	<1	9.8	140	<1	290	<0.1	170	9	25	12	9600	<1	--	29	21000	<0.2	<20	3.8	--	3.4	<1	4500	<10	500	11	<2	<50	24	<10	15	16	0.13	57
		1/19/02	10000	<1	<1	170	<1	520	0.56	160	<1	27	<10	8700	<1	--	29	20000	<0.1	<20	<1	--	2.6	<1	--	<10	450	9	<2	<50	300	<10	15	17	0.11	54
		7/24/02	3400	<1	4.7	160	<1	<200	<0.1	170	6.4	14	10	11000	3	--	30	22000	<0.1	<20	6	--	2.7	<1	--	<10	500	8.3	<2	<50	44	<10	40	17	0.13	42
		1/28/03	240	<1	1.7	150	<1	300	<0.1	170	<1	6.7	20	3900	<1	--	27	17000	<0.1	<20	<1	--	5.7	2.8	--	<10	560	15	<2	1100	<5	<10	<10	17	0.13	43
JSF-27A	27A	6/17/97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
JSF-3	3	12/1/86	--	--	<1	--	--	--	--	110	<1	--	--	110	--	--	--	22	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	230
		5/21/87	250	--	2	60	--	--	<0.1	130	<1	--	30	20	<1	--	13.1	34	<0.2	--	3	0.03	0.79	2	--	<0.1	--	13	--	--	--	--	--	24	--	130
		6/4/87	<50	--	<1	--	--	--	0.3	130	--	--	<10	<10	--	--	11.6	43	--	--	--	--	0.75	--	--	--	--	13	--	--	--	--	--	22	--	180
		6/18/87	<50	--	<1	80	--	--	0.2	120	<1	--	10	<10	<1	--	11.7	22	<0.2	--	4	0.03	0.71	<1	--	<0.1	--	14	--	--	--	--	--	22	--	150
		12/16/87	<50	--	<1	120	--	1800	0.2	140	28	--	10	170	<1	--	12	40	--	--	14	--	--	<1	--	--	--	14	--	--	--	--	<10	22	--	190
		3/8/88	20000	--	**58**	370	--	1600	1	140	15	--	80	13000	23	--	14	150	--	--	18	--	--	2	--	--	--	13	--	--	--	--	70	21	--	110

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**	**-**
JSF-3 (cont.)	3	6/21/88	30000	--	<1	560	--	1800	<0.1	170	24	--	160	20000	17	--	17	150	--	--	17	--	--	<1	--	--	--	14	--	--	--	--	90	24	--	250
		9/15/88	19000	--	**59**	430	--	--	0.1	160	13	--	50	16000	31	--	18	110	--	--	18	--	--	2	--	--	--	15	--	--	--	--	40	--	--	19
		11/30/88	5900	--	**25**	190	--	1900	0.4	160	9	--	<10	4000	18	--	16	62	--	--	12	--	--	2	--	--	--	14	--	--	--	--	30	--	--	270
		3/15/89	11000	--	**21**	250	--	1700	<0.1	160	6	--	50	7200	8	--	18	66	--	--	9	--	--	<1	--	--	--	14	--	--	--	--	60	--	--	250
		6/6/89	5900	--	10	160	--	2000	0.4	170	3	--	<10	3800	4	--	17	<5	--	--	8	--	--	<1	--	--	--	15	--	--	--	--	120	--	--	170
		8/29/89	590	--	7	70	--	2100	<0.1	200	4	--	30	630	11	--	16	20	--	--	9	--	--	<1	--	--	--	16	--	--	--	--	10	--	--	280
		11/2/89	4400	--	4	110	**110**	1800	<0.1	190	3	--	<10	2700	<1	--	14	67	--	--	<1	--	--	<1	--	--	--	17	--	--	--	--	<10	23	--	310
		11/2/89	3600	--	**13**	100	--	1800	0.1	175	2	--	<10	2400	5	--	14	46	--	--	7	--	--	<1	--	--	--	16	--	--	--	--	<10	23	--	310
		2/7/90	1800	--	5	80	--	2000	<0.1	170	2	--	<10	460	2	--	19	32	--	--	7	--	--	<1	--	--	--	15	--	--	--	--	40	23	--	310
		5/22/90	1600	--	6	90	--	1900	0.3	160	<1	--	<10	1600	2	--	17	<5	--	--	6	--	--	<1	--	--	--	19	--	--	--	--	50	24	--	300
		8/8/90	570	--	2	60	--	2000	<0.1	180	<1	--	120	840	<1	--	19	48	--	--	<1	--	--	<1	--	--	--	16	--	--	--	--	30	24	--	42
		11/27/90	2700	<1	**11**	90	--	2100	0.1	170	<1	--	<10	1900	5	20	18	14	--	<20	4	--	1	<1	11000	--	640	16	--	--	--	<10	<10	25	--	360
		4/2/91	2100	<1	10	120	--	2100	<0.1	190	<1	--	20	1900	2	20	18	43	--	<20	<1	--	1.2	<1	10000	--	810	16	--	--	--	10	30	24	--	340
		4/29/91	4500	<1	7	120	--	2000	0.3	190	5	--	<10	3900	9	20	16	52	--	<20	9	--	1.1	1	13000	--	660	16	--	--	--	<10	50	25	--	340
		8/27/91	4200	<1	2	110	--	2200	0.7	190	2	--	<10	3400	4	20	19	37	--	<20	7	--	1.4	3	14000	--	700	15	--	--	--	10	10	24	--	360
		11/13/91	2200	--	6	100	--	2300	<0.1	190	3	--	<10	1700	3	10	190	35	--	<20	5	--	--	<1	5900	--	750	16	--	--	--	<10	<10	25	--	370
		2/20/92	300	--	4	70	--	1000	<0.1	210	1	--	<10	490	<1	<10	21	<5	--	<20	<1	--	--	<1	8700	--	740	16	--	--	--	<10	<10	26	--	210
		2/20/92	220	--	3	40	--	1000	<0.1	200	<1	--	<10	440	2	<10	19	<5	--	<20	2	--	--	<1	8200	--	680	16	--	60	--	<10	<10	24	--	260
		5/18/92	350	--	2	20	--	2100	<0.1	200	<1	--	<10	520	<1	<10	16	<5	--	<20	<1	--	--	2	8	--	650	16	--	--	--	<10	<10	26	--	350
		8/19/92	1500	--	5	70	--	2300	0.2	210	<1	--	<10	860	1	10	19	16	--	<20	5	--	--	<1	12000	--	660	18	--	--	--	<10	<10	25	--	380
		12/2/92	50	--	1	30	<1	2200	--	230	<1	--	<10	90	<1	--	19	<5	--	<20	<1	--	0.75	<1	--	--	680	16	--	--	--	--	<10	24	--	400
		3/2/93	110	<1	<1	20	<1	2100	<0.1	230	--	--	<10	190	<1	--	19	<5	--	<20	1	--	0.9	--	--	--	680	16	--	--	--	--	<10	24	--	200
		5/24/93	60	--	<1	30	<1	1100	--	220	<1	--	<10	100	<1	--	19	16	--	<20	<1	--	4.8	<1	--	--	640	64	--	--	--	--	<10	24	--	390
		8/17/93	140	<1	1	30	<1	1100	<0.1	240	--	--	<10	160	<1	--	21	7	--	<20	6	--	1	--	--	--	710	15	--	--	--	--	<10	23	--	390
		8/17/93	110	<1	1	20	<1	1100	<0.1	240	--	--	<10	120	<1	--	21	7	--	<20	3	--	1	--	--	--	700	15	--	--	--	--	<10	23	--	390
		8/17/93	130	<1	2	<20	<1	1100	<0.1	230	--	--	<10	150	<1	--	20	9	--	<20	2	--	1.1	--	--	--	650	15	--	--	--	--	<10	23	--	370
		8/17/93	140	<1	<1	20	<1	1000	<0.1	220	--	--	<10	160	<1	--	19	9	--	<20	3	--	1	--	--	--	670	15	--	--	--	--	<10	23	--	370
		11/18/93	190	--	2	<10	<1	1600	--	230	1	--	<10	190	<1	--	21	<5	--	30	1	--	0.9	<1	--	--	590	17	--	--	--	--	<10	21	--	460
		11/18/93	160	--	2	10	<1	1500	--	220	1	--	<10	150	<1	--	20	<5	--	<20	<1	--	0.9	<1	--	<10	440	17	--	--	--	--	<10	21	--	420
		2/22/94	130	<1	2	30	<1	1100	<0.1	240	--	--	<10	140	<1	--	21	8	--	<20	3	--	0.9	1	--	--	350	16	--	--	--	--	<10	23	--	400
		2/22/94	150	<1	1	30	<1	1000	<0.1	220	--	--	<10	130	<1	--	19	12	--	<20	3	--	0.9	--	--	--	600	16	--	--	--	--	<10	24	--	360
		5/17/94	70	3	1	40	<1	1100	0.1	320	2	<1	<10	150	<1	--	28	25	<0.2	<20	1	--	0.9	<1	--	<10	920	16	<50	--	--	--	<10	23	0.1	380
		5/17/94	50	<1	1	40	<1	1000	0.1	290	2	1	<10	130	<1	--	25	21	<0.2	<20	1	--	0.9	<1	--	<10	830	16	<50	--	--	--	<10	23	<0.1	370
		8/16/94	<50	2	1	20	<1	2300	0.1	250	1	<1	<10	80	<1	--	20	19	<0.2	<20	<1	--	1	3	--	<10	590	16	<50	--	--	<10	<10	23	<0.1	370
		11/8/94	160	<1	2	20	<1	2500	0.2	260	31	<1	<10	2000	2	--	23	30	<0.2	<20	19	--	0.9	<1	--	<10	660	16	<2	--	--	<10	530	23	<0.1	430
		5/23/95	80	<1	1	20	<1	2300	<0.1	250	<1	<1	<10	140	<1	--	22	21	<0.2	<20	2	--	1	<1	--	<10	670	17	<2	--	--	<10	<10	23	<0.1	390
		8/6/96	60	<1	<1	20	<1	2100	<0.1	220	<1	<1	<10	170	<1	--	21	56	<0.2	<20	<1	--	1.1	3	--	<10	590	17	<50	--	--	<10	<10	21	0.2	330
		1/8/97	<50	<1	3	30	<1	2300	<0.1	260	<1	<1	<10	140	<1	--	23	120	<0.2	--	1	--	1.2	<1	--	<10	600	16	<1	--	--	<10	<10	22	<0.1	320
		1/8/97	<50	<1	3	30	<1	2300	<0.1	260	<1	<1	<10	140	<1	--	23	110	<0.2	--	2	--	1.2	<1	--	<10	590	16	<1	--	--	<10	<10	22	<0.1	300
		7/15/97	<50	<1	2	20	<1	2000	<0.1	220	2	2	<10	160	<1	--	21	130	<0.2	--	<1	--	1.2	<1	--	<10	540	18	<2	--	--	<10	<10	23	<0.1	320

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**	**-**
JSF-3 (cont.)	3	1/21/98	120	<1	<1	30	<1	1100	<0.1	180	<1	<1	<10	160	<1	--	18	140	<0.2	--	3	--	1.2	<1	--	<10	520	17	<2	--	--	<10	<10	23	<0.1	310
		7/29/98	640	<1	<1	40	<1	1800	<0.1	200	<1	<1	<10	170	<1	--	20	250	<0.2	--	4	--	1.3	<1	--	<10	480	18	<2	--	--	<10	<10	24	<0.1	270
JSF-MW1	MW-1	7/19/07	11000	<1	5.7	330	1	<200	<0.5	120	33	18	16	25000	14	--	9.4	570	<0.2	15	25	--	2.4	<1	--	0.55	770	3.8	<1	--	--	17	70	11	<0.1	47
JSF-MW2	MW-2	7/19/07	2300	<1	1.4	60	<1	<200	<0.5	97	8.1	13	1.7	11000	1.3	--	9.5	170	<0.2	12	6.7	--	1.7	1.3	--	<0.5	340	6	<1	--	--	<10	<10	23	<0.1	27
JSF-MW3	MW-3	7/18/07	1500	<1	5.3	82	<1	<200	<0.5	120	22	12	7.6	3400	6.6	--	8.3	320	<0.2	13	16	--	1.9	1.6	--	<0.5	450	12	<1	--	--	<10	35	21	0.16	85
		7/19/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		8/30/12	340	<1	1.5	53	<1	<200	<0.5	--	<2	<1	<2	460	<1	--	--	160	--	--	1.7	<0.1	0.71	<1	--	<1	380	14	<1	<1	--	<2	<10	15	--	82
		10/29/12	130	--	--	--	--	<200	--	--	--	--	--	700	--	--	7.7	300	--	--	--	--	0.69	--	--	--	340	14	--	--	--	--	--	--	--	--
		10/30/12	--	<1	<1	41	<1	--	<0.5	--	<2	--	--	--	<1	--	--	--	<0.2	--	2.1	<0.1	--	<1	--	<1	--	--	<1	--	--	--	--	15	0.17	92
		10/30/12	--	--	--	--	--	--	--	--	--	<1	<2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	<2	<10	--	--	--
		2/25/13	<100	<1	1.9	39	<1	<200	<0.5	110	<2	<1	<10	1400	<1	--	8.3	310	--	--	2.2	<0.1	<0.5	<5	--	<1	370	15	<1	<1	--	<2	<10	12	0.18	90
		4/11/13	<100	<1	1	31	<1	<200	<0.5	110	<2	<1	<2	270	<1	--	8.2	360	<0.2	--	4.4	<0.1	<0.5	<1	--	<1	370	16	<1	<1	--	<2	<10	12	0.18	94
JSF-MW4	MW-4	7/19/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		9/19/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		9/20/07	720	<1	<1	27	<2	<200	<0.5	110	1.1	3	1.1	400	<1	--	7.4	72	<0.2	<5	5.1	0.93	1.8	<1	--	0.54	250	4.9	<1	--	--	<10	<10	3	<0.1	19
JSF-MW5	MW-5	7/19/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		9/19/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		9/20/07	710	<1	<1	34	<2	<200	<0.5	76	2.4	1.9	1	350	<1	--	3.1	<10	<0.2	<5	3	4	0.87	<1	--	<0.5	180	2.8	<1	--	--	<10	<10	6.1	<0.1	14
JSF-OW33	OW-33	4/3/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/18/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/1/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/28/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/28/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/10/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/29/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
JSF-OW34	OW-34	4/3/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/18/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/1/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/28/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/10/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/29/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
JSF-OW35	OW-35	4/3/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/18/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/1/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/1/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/28/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.55	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/28/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/10/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/29/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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	-
JSF-PZ1	PZ-1	5/21/87	590	--	<1	--	--	--	<0.1	83.4	--	--	50	<10	--	--	9.3	1700	--	--	--	--	3.1	--	--	--	--	12	--	--	--	--	--	12	--	85
		6/4/87	<50	--	2	--	--	--	0.2	75.7	--	--	<10	290	--	--	9.1	1200	--	--	--	--	2.8	--	--	--	--	8.5	--	--	--	--	--	11	--	64
		6/18/87	490	--	1	--	--	--	**8**	79.1	--	--	50	<10	--	--	9.8	1600	--	--	--	--	3.5	--	--	--	--	11	--	--	--	--	--	11	--	40
		3/28/91	39000	<1	8	280	--	<500	0.9	190	24	--	90	47000	47	20	23	1000	--	70	33	--	13	<1	19000	--	660	15	--	--	--	40	110	3	--	180
JSF-PZ2A	PZ-2A	6/4/87	<50	--	<1	--	--	--	2	550	--	--	30	360	--	--	130	10000	--	--	--	--	3.4	--	--	--	--	24	--	--	--	--	--	14	--	1600
		6/18/87	<50	--	2	--	--	--	**22**	550	--	--	<10	<10	--	--	130	9500	--	--	--	--	5.6	--	--	--	--	28	--	--	--	--	--	16	--	1400
		3/27/91	2500	<1	2	70	--	1500	2	90	<1	--	<10	3200	24	<10	21	1100	--	<20	65	--	1.5	<1	7100	--	740	12	--	--	--	<10	30	14	--	320
		11/14/91	11000	--	2	120	--	1400	**37**	110	12	--	20	15000	10	<10	27	1100	--	<20	19	--	--	<1	10000	--	1000	15	--	--	--	20	80	17	--	300
		2/19/92	14000	--	3	190	--	760	**13**	120	13	--	<10	17000	6	<10	29	1400	--	30	16	--	--	<1	23000	--	1200	15	--	--	--	10	40	21	--	270
		5/18/92	2300	--	<1	20	--	1600	4	140	3	--	<10	2600	2	<10	25	1300	--	<20	8	--	--	<1	8100	--	1200	15	--	--	--	<10	30	17	--	1700
		8/18/92	1700	--	<1	40	--	1300	**9**	140	2	--	20	1900	2	<10	28	1500	--	<20	7	--	--	<1	6700	--	1300	17	--	--	--	40	10	18	--	360
		12/2/92	360	--	<1	30	<1	1300	--	160	<1	--	<10	450	<1	--	31	1800	--	<20	<1	--	1.7	<1	--	--	1400	16	--	--	--	--	<10	17	--	435
		3/1/93	220	<1	<1	30	<1	1200	1	180	--	--	<10	260	1	--	34	2400	--	<20	5	--	2	--	--	--	1600	17	--	--	--	--	<10	16	--	200
		5/25/93	160	--	<1	30	<1	700	--	200	<1	--	<10	320	<1	--	39	2900	--	<20	2	--	1.9	<1	--	--	1700	17	--	--	--	--	<10	17	--	480
		8/18/93	750	<1	<1	30	<1	590	2	220	--	--	<10	950	<1	--	42	3400	--	<20	1	--	2.4	--	--	--	2200	17	--	--	--	--	<10	17	--	480
		8/18/93	220	<1	<1	20	<1	600	0.9	210	--	--	<10	390	<1	--	40	3200	--	<20	5	--	2.4	--	--	--	2000	17	--	--	--	--	<10	17	--	490
		8/18/93	50	<1	<1	20	<1	610	0.1	200	--	--	<10	190	<1	--	39	3000	--	<20	4	--	2.3	--	--	--	1800	16	--	--	--	--	<10	17	--	470
		8/18/93	<50	<1	<1	20	<1	600	<0.1	200	--	--	<10	180	<1	--	39	2900	--	<20	6	--	2.2	--	--	--	1900	16	--	--	--	--	<10	17	--	470
		11/17/93	130	--	<1	<10	<1	850	--	230	2	--	<10	290	<1	--	44	3800	--	<20	4	--	2.2	<1	--	--	1900	19	--	--	--	--	<10	16	--	560
		2/24/94	260	<1	<1	30	<1	600	0.4	270	--	--	<10	370	<1	--	48	4200	--	<20	4	--	2.3	<1	--	--	2200	20	--	--	--	--	<10	19	--	650
		5/18/94	100	4	2	20	<1	<500	0.5	310	3	5	<10	300	<1	--	58	4500	<0.2	<20	2	--	2.3	<1	--	<10	2600	19	<50	--	--	--	<10	18	0.3	600
		8/17/94	<50	2	<1	20	<1	1200	0.4	280	2	10	<10	170	<1	--	45	3600	<0.2	<20	2	--	2.5	6	--	<10	1900	20	<50	--	--	<10	<10	18	0.2	680
		11/9/94	<50	2	<1	20	<1	1600	0.2	370	14	5	<10	1900	1	--	63	5100	<0.2	<20	4	--	<0.1	3	--	<10	3100	20	<2	--	--	<10	270	19	0.2	770
		5/23/95	550	<1	<1	20	<1	1600	1	350	2	6	<10	790	<1	--	61	5200	<0.2	<20	<1	--	2.9	<1	--	<10	3100	21	<2	--	--	<10	<10	16	0.2	780
		1/23/96	280	2	1	10	<1	1400	0.8	300	9	4	<10	460	<1	--	54	4400	<0.2	<20	8	--	2.6	2	--	<10	2600	20	<2	--	--	<10	<10	16	0.2	780
		8/7/96	110	<1	<1	10	<1	1400	0.8	290	<1	<1	<10	210	<1	--	53	3600	<0.2	<20	4	--	2.1	4	--	<10	2300	20	<50	--	--	<10	<10	17	0.2	620
		6/24/98	600	<1	2	20	<1	1700	2	280	2	4	<10	750	2	--	51	3600	<0.2	--	6	--	1.8	<1	--	<10	2100	18	<2	--	--	<10	40	16	0.1	740
PZ-2B	PZ-2B	6/4/87	<50	--	1	--	--	--	0.6	440	--	--	30	10	--	--	65.6	4100	--	--	--	--	26	--	--	--	--	12	--	--	--	--	--	17	--	950
		6/18/87	<50	--	2	--	--	--	4	480	--	--	<10	20	--	--	63.7	4200	--	--	--	--	28	--	--	--	--	14	--	--	--	--	--	16	--	150
		3/27/91	2000	<1	**32**	120	--	890	0.2	190	<1	--	<10	2800	6	150	24	1400	--	40	14	--	15	<1	12000	--	3900	18	--	--	--	<10	30	18	--	480
		2/19/92	8200	--	**35**	200	--	500	0.5	200	3	--	<10	9700	8	19	29	3000	--	40	33	--	--	3	24000	--	4200	17	--	--	--	30	<10	19	--	280
		12/2/92	480	--	**34**	60	<1	1200	--	330	<1	--	<10	29000	1	--	47	5400	--	30	17	--	19	<1	--	--	6100	19	--	--	--	--	<10	18	--	500
		3/2/93	1400	<1	**42**	80	<1	1700	<0.1	400	--	--	<10	48000	3	--	56	7700	--	30	31	--	20	--	--	--	7400	20	--	--	--	--	20	18	--	530
		5/25/93	1300	--	**43**	70	<1	1200	--	490	<1	--	<10	64000	<1	--	66	11000	--	<20	30	--	23	<1	--	--	8200	22	--	--	--	--	30	21	--	1200
		8/18/93	1700	<1	**52**	60	<1	1300	<0.1	510	--	--	<10	63000	3	--	69	11000	--	<20	34	--	23	--	--	--	8400	21	--	--	--	--	20	21	--	1200
		11/17/93	850	--	**52**	50	<1	2200	--	350	3	--	<10	58000	2	--	47	7400	--	<20	24	--	23	<1	--	--	5700	20	--	--	--	--	20	18	--	960
		2/24/94	320	<1	**45**	40	<1	1300	<0.1	300	--	--	50	46000	<1	--	43	6200	--	20	21	--	21	<1	--	--	5100	20	--	--	--	--	40	19	--	790
		5/18/94	170	2	**56**	50	<1	1200	0.1	430	7	63	<10	63000	<1	--	55	8000	<0.2	20	28	--	22	<1	--	<10	7100	21	<50	--	--	--	10	19	0.3	830
		8/17/94	200	1	**50**	30	<1	2500	0.1	400	4	53	<10	63000	<1	--	45	5900	<0.2	20	29	--	23	10	--	<10	4700	21	<50	--	--	<10	<10	16	0.2	860
		11/9/94	1200	3	**35**	40	<1	4500	0.2	410	41	46	<10	76000	2	--	52	4700	<0.2	20	42	--	21	3	--	10	6300	18	<2	--	--	<10	--	16	0.3	860

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	-
PZ-2B (cont.)	PZ-2B	5/24/95	620	<1	**41**	50	<1	3900	<0.1	340	3	36	<10	46000	1	--	45	3500	<0.2	40	25	--	20	<1	--	<10	5600	19	<2	--	--	<10	<10	15	0.2	690
		1/23/96	4300	2	**120**	110	<1	4200	0.2	320	100	41	<10	44000	31	--	44	3300	<0.2	40	80	--	20	8	--	<10	5500	19	<2	--	--	<10	20	14	0.3	770
		8/6/96	1800	<1	<1	70	<1	3400	0.4	330	4	2	<10	44000	9	--	48	3200	<0.2	60	31	--	20	7	--	<10	5600	17	<50	--	--	<10	20	9	0.4	470
		6/24/98	1600	2	**61**	60	<1	5100	0.4	440	2	32	<10	49000	6	--	62	3600	<0.2	--	30	--	23	<1	--	<10	6900	18	<2	--	--	<10	70	11	0.3	920
JSF-PZ3A	PZ-3A	6/4/87	<50	--	<1	--	--	--	0.2	140	--	--	<10	30	--	--	24.2	2500	--	--	--	--	3.8	--	--	--	--	22	--	--	--	--	--	45	--	220
		6/18/87	<50	--	<1	--	--	--	2	140	--	--	<10	10	--	--	21.1	2000	--	--	--	--	4.2	--	--	--	--	23	--	--	--	--	--	44	--	230
		3/27/91	53000	<1	4	410	--	2000	0.5	160	38	--	70	82000	38	40	34	3200	--	90	57	--	30	<1	41000	--	1800	16	--	--	--	90	300	17	--	350
		11/14/91	110000	--	6	850	**13**	1700	1	130	**130**	--	160	190000	81	60	48	3300	--	<20	**190**	--	--	<1	54000	--	2500	15	--	--	--	230	480	18	--	300
		2/19/92	7400	--	3	90	--	820	0.2	110	12	--	<10	11000	3	22	24	1400	--	110	9	--	--	<1	14000	--	1900	15	--	--	--	<10	<10	18	--	260
		5/18/92	11000	--	2	80	--	1600	0.3	110	14	--	<10	16000	8	41	20	1400	--	90	18	--	--	<1	18000	--	2000	15	--	--	--	20	50	18	--	290
		8/18/92	3500	--	2	690	--	5800	0.2	260	9	--	<10	4300	8	30	49	710	--	1200	14	--	--	<1	12000	--	1200	17	--	--	--	<10	200	18	--	300
		12/3/92	900	--	<1	50	<1	1600	--	140	<1	--	<10	1500	1	--	24	1800	--	50	<1	--	11	<1	--	--	2200	16	--	--	--	--	<10	17	--	300
		3/3/93	460	<1	<1	50	<1	1600	<0.1	140	--	--	<10	900	<1	--	25	1900	--	30	3	--	10	--	--	--	2300	15	--	--	--	--	<10	17	--	320
		5/26/93	280	--	<1	50	<1	800	--	150	<1	--	<10	850	<1	--	29	2000	--	50	2	--	10	<1	--	--	2200	16	--	--	--	--	10	17	--	410
		8/18/93	220	<1	1	60	<1	890	<0.1	180	--	--	<10	800	5	--	33	2300	--	<20	3	--	11	--	--	--	3000	16	--	--	--	--	<10	17	--	440
		11/17/93	180	--	1	50	<1	1400	--	210	3	--	<10	700	<1	--	40	2200	--	60	4	--	12	<1	--	--	3100	18	--	--	--	--	<10	16	--	530
		2/23/94	300	<1	<1	60	<1	1100	<0.1	250	--	--	<10	850	<1	--	46	2300	--	50	<1	--	12	<1	--	--	3900	18	--	--	--	--	<10	17	--	650
		5/18/94	150	1	<1	50	<1	1000	<0.1	270	<1	7	<10	740	<1	--	49	2500	<0.2	50	2	--	12	<1	--	<10	4200	18	<50	--	--	--	<10	17	0.2	580
		8/16/94	130	<1	1	50	<1	3100	0.1	270	3	4	<10	650	<1	--	44	2400	<0.2	50	<1	--	13	6	--	<10	3800	18	<50	--	--	<10	<10	17	0.2	670
		11/8/94	<50	<1	<1	40	<1	3400	0.1	320	6	6	<10	3000	1	--	54	2600	<0.2	80	<1	--	13	<1	--	<10	4800	18	<2	--	--	<10	230	17	0.2	810
		5/24/95	190	<1	<1	40	<1	3600	<0.1	320	1	7	<10	670	<1	--	54	2300	<0.2	80	2	--	13	<1	--	<10	4800	19	<2	--	--	<10	<10	16	0.2	780
		1/24/96	140	<1	2	40	<1	3900	<0.1	320	<1	4	<10	680	<1	--	53	2700	<0.2	90	3	--	13	3	--	<10	4600	20	<2	--	--	<10	<10	17	0.3	880
		8/7/96	150	<1	1	20	<1	3900	0.4	340	<1	2	<10	600	<1	--	57	2500	<0.2	70	6	--	13	7	--	<10	4700	20	<50	--	--	<10	<10	17	0.4	760
		6/24/98	310	<1	3	30	<1	5000	0.2	420	3	4	<10	780	4	--	66	3300	<0.2	--	3	--	13	<1	--	<10	5800	25	<2	--	--	<10	10	16	0.2	1100
JSF-PZ3B	PZ-3B	6/4/87	<50	--	2	--	--	--	0.3	300	--	--	<10	40	--	--	81.2	1700	--	--	--	--	15	--	--	--	--	16	--	--	--	--	--	13	--	960
		6/18/87	<50	--	2	--	--	--	2	350	--	--	<10	<10	--	--	85.8	1800	--	--	--	--	14	--	--	--	--	16	--	--	--	--	--	13	--	610
		3/27/91	15000	<1	**11**	220	--	1800	0.2	110	3	--	<10	19000	9	50	22	1200	--	130	8	--	16	<1	19000	--	2100	14	--	--	--	<10	60	16	--	320
		2/19/92	8800	--	6	110	--	770	<0.1	120	7	--	<10	10000	6	11	25	1000	--	110	8	--	--	<1	14000	--	2300	14	--	--	--	<10	<10	17	--	260
		12/2/92	290	--	3	30	<1	1400	--	120	<1	--	<10	1100	<1	--	21	1000	--	70	<1	--	12	<1	--	--	2200	15	--	--	--	--	<10	16	--	400
		3/2/93	90	<1	3	40	<1	1500	<0.1	150	--	--	<10	1000	<1	--	24	1200	--	50	1	--	12	--	--	--	2700	15	--	--	--	--	10	16	--	360
		5/26/93	280	--	4	40	<1	800	--	180	<1	--	<10	950	<1	--	29	1200	--	80	<1	--	13	<1	--	--	3100	17	--	--	--	--	<10	16	--	440
		8/18/93	80	<1	5	50	<1	830	<0.1	210	--	--	<10	760	<1	--	34	1200	--	40	<1	--	14	--	--	--	4200	16	--	--	--	--	<10	17	--	500
		11/17/93	180	--	7	60	<1	1400	--	240	2	--	<10	980	<1	--	41	1300	--	80	7	--	15	<1	--	--	4600	19	--	--	--	--	<10	16	--	590
		2/23/94	160	<1	10	80	<1	1100	0.2	280	--	--	<10	1100	<1	--	44	1400	--	80	1	--	16	<1	--	--	5000	19	--	--	--	--	<10	17	--	630
		5/18/94	50	3	9	90	<1	1000	<0.1	320	3	3	<10	980	<1	--	51	1700	<0.2	80	2	--	15	<1	--	<10	5800	18	<50	--	--	--	<10	17	0.2	610
		8/16/94	<50	1	10	70	<1	2600	0.1	290	2	3	<10	780	<1	--	42	1500	<0.2	50	<1	--	16	6	--	<10	4100	19	<50	--	--	<10	<10	17	0.2	690
		11/9/94	<50	2	10	70	<1	3300	0.2	350	26	2	<10	2800	2	--	53	1700	<0.2	60	8	--	17	3	--	<10	6000	18	<2	--	--	<10	--	18	0.2	810
		6/24/98	90	<1	**23**	80	<1	5700	<0.1	500	<1	2	<10	1600	2	--	77	2600	<0.2	--	<1	--	18	<1	--	<10	8100	26	<2	--	--	<10	20	16	0.2	1000

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**	**-**
JSF-PZ4A	PZ-4A	6/4/87	<50	--	2	--	--	--	0.2	330	--	--	<10	10	--	--	87	7500	--	--	--	--	1.8	--	--	--	--	36	--	--	--	--	--	26	--	900
		6/18/87	<50	--	2	--	--	--	1	350	--	--	<10	<10	--	--	91.3	6800	--	--	--	--	2.5	--	--	--	--	37	--	--	--	--	--	27	--	620
		3/28/91	120	<1	7	80	--	4700	<0.1	460	<1	--	80	1000	4	<10	150	3800	--	70	10	--	1.1	<1	7200	--	4400	32	--	--	--	<10	70	19	--	1400
		11/14/91	28000	--	7	230	--	5300	0.3	420	31	--	30	40000	18	20	160	2700	--	20	35	--	--	<1	40000	--	5900	30	--	--	--	50	110	21	--	1500
		2/19/92	28000	--	9	200	--	2700	0.3	490	28	--	<10	39000	24	20	160	3100	--	50	31	--	--	<1	40000	--	6400	33	--	--	--	40	70	21	--	1400
		5/19/92	11000	--	**20**	110	--	5700	3	480	14	--	10	13000	24	33	140	2900	--	<20	34	--	--	<1	21000	--	6400	37	--	--	--	20	90	21	--	1600
		8/18/92	12000	--	**31**	450	--	6300	2	470	8	--	10	15000	18	30	150	3100	--	<20	27	--	--	<1	23000	--	6500	46	--	--	--	30	190	20	--	1800
		12/2/92	760	--	<1	30	<1	6200	--	530	<1	--	<10	1200	<1	--	160	3000	--	<20	3	--	1.1	<1	--	--	6900	46	--	--	--	--	<10	20	--	1600
		3/1/93	1400	2	<1	40	<1	6900	<0.1	510	--	--	<10	1600	<1	--	62	2900	--	<20	4	--	1.2	--	--	--	6900	49	--	--	--	--	<10	20	--	640
		3/3/93	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		5/26/93	510	--	1	30	<1	3500	--	460	<1	--	<10	840	<1	--	74	3200	--	<20	2	--	1.3	<1	--	--	6100	49	--	--	--	--	80	20	--	1200
		8/18/93	1400	<1	<1	30	<1	3500	0.1	480	--	--	<10	1800	<1	--	130	3100	--	<20	4	--	1.5	--	--	--	6600	52	--	--	--	--	30	21	--	1200
		11/17/93	120	--	<1	<10	<1	5600	--	480	2	--	<10	330	3	--	120	3500	--	<20	<1	--	1.4	<1	--	--	7000	58	--	--	--	--	<10	20	--	1400
		2/23/94	490	<1	<1	40	<1	3900	0.1	480	--	--	<10	760	<1	--	130	4000	--	<20	<1	--	1.6	1	--	--	6900	60	--	--	--	--	40	22	--	1200
		5/17/94	220	<1	1	30	<1	3200	0.2	480	<1	4	<10	480	<1	--	140	4300	<0.2	<20	<1	--	1.7	<1	--	<10	7300	56	<50	--	--	--	490	22	0.4	1000
		8/16/94	220	2	<1	20	<1	8400	0.3	430	3	<1	<10	370	<1	--	100	3800	<0.2	<20	<1	--	1.8	9	--	<10	6000	60	<50	--	--	<10	<10	23	0.4	1100
		11/8/94	520	3	<1	30	<1	8700	0.3	560	33	10	<10	2400	3	--	110	5100	<0.2	<20	<1	--	7.5	<1	--	<10	7600	65	<2	--	--	<10	340	23	0.4	1300
		5/24/95	820	<1	2	20	<1	7400	0.4	440	2	6	<10	1300	1	--	110	4500	<0.2	<20	4	--	2.8	<1	--	<10	6700	70	<2	--	--	<10	<10	23	0.3	1300
		1/24/96	710	2	2	20	<1	7700	0.9	390	14	7	<10	1200	22	--	96	5700	<0.2	<20	6	--	2.7	4	--	<10	6200	59	<2	--	--	<10	60	21	0.5	1300
		8/7/96	170	<1	1	10	<1	6400	<0.1	320	<1	<1	<10	280	<1	--	79	3400	<0.2	<20	2	--	2.2	7	--	<10	5200	55	<50	--	--	<10	<10	23	0.4	810
		6/24/98	320	<1	2	30	<1	8600	0.3	380	<1	3	<10	430	7	--	86	4000	<0.2	--	<1	--	3.2	<1	--	<10	5700	51	<2	--	--	<10	20	19	0.4	840
JSF-PZ4B	PZ-4B	6/4/87	<50	--	1	--	--	--	0.8	520	--	--	<10	40	--	--	250	27000	--	--	--	--	4	--	--	--	--	59	--	--	--	--	--	14	--	1900
		6/18/87	<50	--	1	--	--	--	2	580	--	--	<10	320	--	--	250	34000	--	--	--	--	4.3	--	--	--	--	57	--	--	--	--	--	16	--	1400
JSF-W28	W-28	7/30/98	39000	<1	9	200	2	2500	1	420	59	36	20	62000	21	--	59	4500	<0.2	--	49	--	1.8	3	--	<10	1000	22	<2	--	--	40	140	18	<0.1	1100
		11/4/98	3400	4	<1	20	<1	2700	0.1	460	5	19	<10	5800	1	--	58	4300	<0.2	--	11	--	1.5	<1	--	<10	1100	22	<1	--	--	<10	<10	18	<0.1	900
		1/20/99	2900	3	2	30	<1	3000	0.4	460	2	7	<10	3900	2	--	57	3500	<0.2	--	8	--	1.3	<1	--	<10	1000	22	<2	--	--	<10	40	18	<0.1	1400
		4/14/99	24000	<1	3	120	1	2800	0.8	410	20	28	<10	21000	8	--	57	9800	<0.2	--	25	--	1.8	2	--	<10	1500	22	<2	--	--	20	50	16	<0.1	1400
		7/28/99	5900	2	2	40	<1	3200	0.3	440	5	10	<10	7900	3	--	60	3700	<0.2	--	13	--	1.3	2	--	<10	1100	22	<2	--	--	<10	20	18	<0.1	1400
		10/28/99	140000	6	**35**	680	4	1400	4.3	360	**160**	110	120	160000	86	--	71	5100	0.3	--	**200**	--	2.2	6	--	<10	1100	22	<2	--	--	130	480	18	<0.1	1600
		1/5/00	<50	<1	1.5	20	<1	3200	0.15	420	1.5	3.5	<10	890	<1	--	58	3200	<0.2	<20	4.4	--	1.5	<1	18000	<10	1200	22	<2	<50	<5	<10	<10	18	<0.1	1000
		4/6/00	1000	<1	<1	23	<1	2600	0.2	350	1	<1	<10	3600	<1	--	49	2300	<0.2	<20	2	--	1.8	2.3	8600	<10	960	22	<2	97	24	<10	<10	16	<0.1	1100
		7/7/00	3900	<1	<1	34	<1	2800	0.22	370	6.2	<1	14	5200	<1	--	54	3300	<0.2	<20	5.6	--	1.3	<1	14000	<10	1100	22	<2	<50	66	<10	11	19	<0.1	980
		1/22/01	660	<1	<1	24	<1	2900	<0.1	400	<1	<1	<10	1600	<1	--	58	2900	<0.2	<20	<1	--	1.8	<1	--	<10	1300	22	<2	<50	8.9	<10	<10	17	<0.1	1000
		4/3/01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/19/01	1300	<1	2	28	<1	2900	<0.1	410	5	<1	19	9100	<1	--	57	2600	<0.2	<20	<1	--	1.2	<1	8900	<10	1100	21	<2	<50	33	<10	19	17	<0.1	1000
		9/26/01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/19/02	530	<1	<1	22	<1	2400	0.32	380	<1	5.2	<10	2200	<1	--	54	2500	<0.1	<20	<1	--	1	1.5	--	<10	1000	19	<2	<50	27	<10	<10	16	<0.1	960
		3/11/02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/25/02	1300	<1	<1	20	<1	1400	0.24	380	<1	2.8	20	5700	<1	--	53	2900	<0.1	<20	2	--	1.2	<1	--	<10	1100	15	<2	<50	14	<10	20	16	<0.1	1000
		1/31/03	3700	<1	<1	40	<1	2700	0.4	370	3.3	<1	20	7600	2.1	--	52	2400	<0.1	<20	2.2	--	1.1	<1	--	<10	1000	19	<2	1500	38	<10	30	17	0.1	980

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	-
JSF-W28	W-28	4/8/03	500	<1	<1	20	<1	2800	0.3	400	<1	<1	10	2400	<1	--	55	3300	<0.1	<20	<1	--	1.2	<1	--	<10	1200	20	<2	1400	<5	<10	<10	16	<0.1	1000
		6/30/03	700	<6	3	20	<1	2700	0.3	370	<1	6	10	2500	<1	--	57	4000	0.2	--	<1	--	1.2	3	--	--	1100	22	<2	--	--	<10	<10	17	<0.1	1000
		10/16/03	640	<0.1	0.1	26	<1	3140	0.31	380	<0.5	3.8	10	3100	1	--	54	3500	<0.1	<20	10.4	--	1.1	0.5	--	<10	1160	21.5	<0.1	--	--	<10	<10	17	0.1	1000
		1/6/04	450	<0.6	<0.1	20	<1	2400	0.2	390	<0.1	2.1	<10	3100	0.4	--	56	2600	<0.1	<20	6.5	--	1.4	0.6	--	<10	1000	24	<0.1	50	<5	<10	<10	17	<0.1	1000
		4/7/04	<50	<0.6	<0.1	20	<1	2500	0.2	390	<0.1	3.3	<10	510	<0.1	--	55	2800	<0.1	<20	9.9	--	1.4	0.5	--	<10	1100	21	<0.1	--	--	<10	<10	17	<0.1	1100
		7/7/04	140	<3	<1	20	<1	2100	0.2	350	<1	2	<10	1500	<1	--	51	3600	<0.1	<20	<1	--	1.4	<1	--	<10	1000	21	<2	--	--	<10	<10	16	<0.1	1200
		10/19/04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/19/04	280	<3	1	20	<1	2800	0.2	400	<1	5	<10	1600	<1	--	59	3600	<0.1	<20	4	0.11	2.2	2	--	<10	1200	21	<2	<50	<5	<10	<10	16	0.1	1000
		1/4/05	3200	<3	3	20	<1	2900	0.2	390	1	3	<10	4600	<1	--	57	3000	<0.1	<20	1	0.13	1.8	3	--	<10	1100	28	<2	--	--	<10	<10	16	<0.1	860
		3/7/05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--
		7/6/05	60	3	1	10	<1	2600	0.3	380	<1	4	<10	2100	<1	--	50	3500	<0.1	<20	<1	--	2.1	<1	--	<10	1100	23	<2	<50	<5	<10	<10	15	<0.1	920
		7/14/05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
JSF-W29	W-29	7/30/98	23000	<1	4	100	1	1500	0.3	160	49	20	10	37000	13	--	42	8500	<0.2	--	47	--	1.1	3	--	<10	500	11	<2	--	--	20	80	9	0.2	370
		11/4/98	4900	2	<1	20	<1	1700	0.1	160	5	9	<10	6600	2	--	43	9100	<0.2	--	10	--	0.9	<1	--	<10	470	12	<1	--	--	<10	<10	12	0.1	390
		1/20/99	1200	<1	<1	20	<1	1500	3.1	150	<1	4	<10	1200	<1	--	36	8300	<0.2	--	4	--	0.7	4	--	<10	400	11	<2	--	--	<10	10	9	0.1	500
		4/14/99	2800	<1	<1	30	<1	1100	1.6	120	3	3	<10	2000	2	--	32	6600	<0.2	--	3	--	0.7	2	--	<10	410	9.7	<2	--	--	<10	10	6	0.2	380
		7/28/99	5600	<1	<1	50	<1	1600	0.6	150	4	10	<10	6000	2	--	38	8200	<0.2	--	9	--	1	<1	--	<10	430	22	<2	--	--	<10	10	8	<0.1	420
		10/28/99	3900	<1	<1	40	<1	1700	0.6	150	6	6	<10	4000	<1	--	38	7900	<0.2	--	8	--	0.8	<1	--	<10	470	11	<2	--	--	<10	<10	10	0.1	420
		1/5/00	60	<1	<1	20	<1	1800	0.28	160	1.6	1.7	<10	110	<1	--	39	9000	<0.2	<20	2.2	--	0.84	<1	8300	<10	550	11	<2	<50	<5	<10	<10	11	0.1	330
		4/6/00	680	<1	<1	26	<1	1200	1.3	120	<1	<1	<10	580	<1	--	27	4700	<0.2	<20	2	--	1.3	5.7	4200	<10	610	9.2	<2	82	19	<10	<10	5	0.2	280
		7/6/00	<50	<1	<1	17	<1	1600	0.52	140	<1	<1	<10	50	<1	--	36	7900	<0.2	<20	3.2	--	0.64	<1	4300	<10	450	12	<2	<50	<5	<10	<10	10	0.16	320
		7/6/00	<50	<1	<1	16	<1	1700	0.65	140	<1	<1	10	35	<1	--	36	8000	<0.2	<20	4.9	--	0.64	<1	4300	<10	460	12	<2	<50	<5	<10	<10	10	0.17	320
		1/22/01	130	<1	<1	19	<1	1500	1.6	150	<1	<1	<10	140	<1	--	38	8400	<0.2	<20	<1	--	0.81	<1	--	<10	520	11	<2	<50	<5	<10	<10	10	0.15	370
		7/18/01	<50	<1	<1	19	<1	1700	0.25	150	<1	<1	17	15	<1	--	39	8600	<0.2	<20	<1	--	0.53	<1	3700	<10	450	11	<2	<50	<5	<10	12	10	0.17	380
		7/18/01	<50	<1	<1	19	<1	1700	0.24	150	<1	<1	16	25	<1	--	39	8500	<0.2	<20	<1	--	0.54	<1	3500	<10	450	11	<2	<50	<5	<10	14	10	0.17	380
		1/17/02	750	<1	<1	18	<1	1500	0.42	150	<1	<1	<10	390	<1	--	37	6400	<0.1	<20	<1	--	0.6	<1	--	<10	480	10	<2	<50	33	<10	<10	11	0.14	380
		7/25/02	2500	<1	<1	30	<1	1200	<0.1	170	1.7	2.1	20	2900	2.3	--	44	9800	<0.1	<20	3	--	1	<1	--	<10	590	10	<2	<50	25	<10	20	12	0.16	450
		7/25/02	1200	<1	<1	30	<1	1200	<0.1	170	<1	1.5	20	1500	1.5	--	43	9700	<0.1	<20	3	--	0.9	<1	--	<10	580	10	<2	<50	11	<10	10	12	0.16	470
		10/22/02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9400	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/30/03	<50	<1	<1	21	<1	1500	0.5	150	<1	<1	<10	120	<1	--	37	8500	<0.1	<20	2.6	--	0.3	<1	--	<10	530	11	<2	1000	<5	<10	<10	10	0.16	370
		1/30/03	<50	<1	<1	20	<1	1500	0.5	150	<1	<1	<10	200	<1	--	37	8500	<0.1	<20	1.7	--	0.3	<1	--	<10	540	11	<2	1000	<5	<10	<10	10	0.16	370
		4/8/03	530	<1	<1	20	<1	1600	0.3	150	<1	<1	10	40	<1	--	39	8900	<0.1	<20	<1	--	0.6	<1	--	<10	530	11	<2	1000	<5	<10	<10	10	0.15	1400
		6/30/03	<50	<6	2	10	<1	1500	0.4	150	<1	1	<10	40	<1	--	37	8000	<0.1	--	<1	--	0.88	<1	--	--	310	13	<2	--	--	<10	<10	10	0.18	330
		10/16/03	<50	<0.1	<0.1	25	<1	1800	0.26	160	<0.1	2.3	10	70	0.2	--	39	8200	<0.1	<20	5.3	--	0.7	0.4	--	<10	625	12.4	<0.1	--	--	<10	<10	11	0.18	370
		1/7/04	<50	<0.6	<0.1	20	<1	1200	0.14	150	<0.1	2.2	<10	20	<0.1	--	37	7800	<0.1	<20	4.2	--	1.1	0.5	--	<10	620	13	<0.1	<50	<5	<10	<10	11	0.17	330
		4/7/04	<50	<0.6	<0.1	20	<1	1200	0.18	170	<0.1	2.3	<10	<10	<0.1	--	38	7700	<0.1	<20	5.4	--	0.9	<0.2	--	<10	770	11	<0.1	--	--	<10	<10	11	0.16	3100
		7/7/04	<50	<3	<1	20	<1	1300	0.2	160	<1	<1	<10	<10	3	--	37	7100	<0.1	<20	<1	--	1.6	<1	--	<10	830	11	<2	--	--	<10	<10	10	0.18	350
		10/19/04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/19/04	<50	<3	<1	30	<1	1700	0.1	180	<1	<1	<10	<10	<1	--	41	9000	<0.1	<20	<1	<0.01	1.8	1	--	<10	770	12	<2	<50	<5	<10	<10	12	0.18	300

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	-
JSF-W29 (cont.)	W-29	1/4/05	<50	<3	1	20	<1	1600	0.1	173	1	3	<10	<10	<1	--	43	8500	<0.1	<20	<1	<0.01	1.2	2	--	<10	820	17	<2	--	--	<10	<10	11	0.17	300
		3/7/05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/6/05	<50	<3	<1	20	<1	1500	0.1	190	<1	2	<10	<10	<1	--	40	7600	<0.1	<20	<1	--	1.9	<1	4400	<10	940	14	<2	<50	<5	<10	<10	9	0.19	290
		7/14/05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		9/15/05	<50	<3	<1	30	<1	1800	<0.1	190	<1	3	<10	<10	<1	--	43	8500	<0.1	<20	<1	<0.01	2.3	<1	--	<10	880	12	<2	--	--	<10	<10	12	0.21	310
		1/18/06	70	<3	<1	20	<1	1600	0.3	170	<1	<1	<10	57	<1	--	40	7300	<0.1	<20	1	0.14	1.1	1	--	<10	800	12	<2	--	--	<10	<10	11	0.18	330
		4/25/06	<200	<3	2	20	<1	1300	0.2	160	<1	2	<10	<30	<1	--	37	6800	<0.1	<20	<1	0.03	0.9	<1	--	<10	800	12	<2	--	--	<10	<10	8	0.2	292
		7/26/06	<200	<3	<1	30	<1	1600	0.1	180	<1	1	<10	<30	<1	--	39	7700	<0.1	<20	<1	0.02	0.8	1	--	<10	860	15	<2	--	--	<10	<10	9	0.22	310
		10/3/06	<200	<3	1	30	<1	1700	0.1	180	<1	3	<10	<30	<1	--	40	7600	<0.1	<20	<1	0.08	1.7	<1	--	<10	890	13	<2	--	--	<10	<10	10	0.17	320
		10/3/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		12/7/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		12/8/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	940	--	--	--	--	--	--	--	--	--
		4/2/07	<100	<1	<1	25	<1	1300	<0.5	180	<1	3.6	2	<100	<1	--	40	8200	<0.2	<5	5.4	<0.1	0.77	2.4	--	<0.5	920	12	<1	--	--	<10	<10	6.5	0.15	300
		4/3/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		5/29/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	840	--	--	--	--	--	--	--	--	--
		10/2/07	190	<1	<1	24	<2	1700	<0.5	190	<1	3.3	4.2	110	<1	--	44	8200	<0.2	<5	8.9	<0.1	1.1	3.3	--	<0.5	840	13	<1	--	--	<10	<10	<1	<0.1	410
		10/2/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--	--
		4/9/08	560	<1	<1	21	<1	1100	<0.5	140	<1	2.1	<1	250	<1	--	33	6200	<0.2	<5	4	0.14	0.86	<1	--	<0.5	720	11	<1	<1	--	<10	<10	5.4	0.16	230
		10/28/08	<100	<1	<1	15	<1	1700	<0.5	170	2.5	2.4	<1	<100	<1	--	43	6700	<0.2	--	7.1	<0.1	1.2	<1	--	<0.5	680	14	<1	<1	--	<10	<10	9.5	0.16	390
		4/8/09	760	<1	<1	22	<1	1000	<0.5	130	4.3	1.9	2	940	<1	--	32	5700	<0.2	--	6.8	0.24	0.96	2.2	--	<0.5	640	11	<1	<1	--	2.7	21	6.6	0.15	260
		10/6/09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/7/09	<100	<1	<1	30	<1	1400	<0.5	150	<2	<1	<2	<100	<1	--	34	5600	<0.2	--	2.9	0.33	1.1	<1	--	<1	790	12	<1	<1	--	<2	<10	7.3	0.22	260
		11/9/09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/6/10	270	<1	<1	32	<1	1100	<0.5	150	<2	<1	<2	280	<1	--	33	2800	<0.2	--	5.2	0.32	1.2	<1	--	<1	1000	10	<1	<1	--	<10	<10	5	0.21	200
		10/19/10	<100	<1	<1	30	<2	1700	<0.5	180	<2	1.8	<2	<100	<1	--	42	8300	<0.2	--	5.1	<0.1	1.1	<1	--	<1	930	14	<1	<1	--	<2	<10	7	0.14	330
		4/18/11	110	<1	<1	30	<1	900	<0.5	140	<2	<1	<2	<100	<1	--	31	1200	<0.2	--	6.3	3.2	1.4	4	--	<1	960	9.2	<1	<1	--	<2	<10	4.8	0.1	170
		10/18/11	<100	<1	<1	20	<1	1800	<0.5	170	<2	<1	<2	<100	<1	--	41	3000	<0.2	--	3.1	<0.1	1.1	<1	--	<1	1000	14	<1	<1	--	<2	<10	6.1	0.2	260
		4/10/12	<100	<1	<1	28	<1	1000	<0.5	--	<2	<1	<2	<100	<1	--	--	980	<0.2	--	2.4	<0.1	1.1	<1	--	<1	1100	9.9	<1	<1	--	<2	<10	5.3	0.19	190
		4/10/12	<100	<1	<1	27	<1	1000	<0.5	--	<2	<1	<2	<100	<1	--	--	1100	<0.2	--	2.4	<0.1	1	<1	--	<1	1100	10	<1	<1	--	<2	<10	5.3	0.18	190
		10/23/12	<100	<1	<1	18	<1	1400	<0.5	160	<1	<1	<1	<100	<1	--	36	2500	<0.2	--	4.7	<0.1	1.1	<1	--	<0.5	900	11	<1	<1	--	<2	<10	5.8	0.18	220
		4/8/13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/9/13	<100	<1	<1	25	<1	850	<0.5	--	<2	<1	<2	<100	<1	--	--	1600	<0.2	--	7.6	<0.1	2.1	<1	--	<1	1200	9.9	<1	<1	--	<2	<10	3.2	0.2	150
		11/12/13	<100	<2	<2	25.2	<2	1560	<1	187	<2	<2	<2	<100	<2	--	38.8	3250	<0.2	<2	<2	<0.1	1.43	<2	--	<2	1250	11.4	<2	<50	--	<2	<25	4.68	0.18	217
		4/8/14	<100	<2	<2	20.3	<2	1020	<1	--	<2	<2	<2	<100	<2	--	--	4180	<0.2	--	<2	0.184	<1	<2	--	<2	833	9.29	<2	<50	--	<2	<25	3.45	0.13	159
		11/18/14	0.117	<2.86	<2.86	27	<2.86	1340	<1.43	--	<2.86	<2.86	<2.86	<100	<2.86	--	--	3710	<0.2	<2.86	<2.86	0.307	1.63	<2.86	--	<2.86	1320	10.9	<2.86	<50	--	<2.86	<35.7	3.28	0.26	137
		11/18/14	0.238	<2	<2	26.2	<2	1340	<1	--	<2	<2	<2	<100	<2	--	--	3160	<0.2	<2	<2	0.307	1.62	<2	--	<2	1290	10.7	<2	<50	--	<2	37.8	3.3	0.25	136
		5/5/15	0.164	<2	<2	44.7	<2	1020	<1	--	<2	<2	<2	224	<2	--	--	794	<0.2	--	<2	<0.1	1.45	<2	--	<2	1540	9.64	<2	<50	--	<2	<25	1.89	0.19	129
		11/16/15	<0.1	<2	<2	32.3	<2	1220	<1	163	8.34	<2	<2	<100	<2	--	34.4	6550	<0.2	--	<2	<0.1	1.29	<2	--	<2	1120	9.47	<2	<50	--	<2	<25	3.15	0.23	131

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	-
JSF-W30	W-30	7/30/98	2000	<1	<1	40	<1	5900	<0.1	340	5	4	<10	2800	3	--	77	1700	<0.2	--	9	--	1	<1	--	<10	2600	43	<2	--	--	<10	<10	19	0.3	890
		11/4/98	1600	4	<1	20	<1	5500	0.2	370	2	7	<10	2000	<1	--	85	1500	<0.2	--	4	--	1.2	<1	--	<10	2900	48	1	--	--	<10	<10	20	0.3	1100
		1/20/99	130	3	<1	10	<1	4600	0.2	390	<1	9	<10	270	4	--	87	5000	<0.2	--	6	--	1.6	<1	--	<10	3700	40	<2	--	--	<10	<10	13	0.2	<1500
		1/20/99	160	3	<1	20	<1	4900	0.2	370	<1	8	<10	270	10	--	85	4900	<0.2	--	5	--	1.7	<1	--	<10	3500	40	<2	--	--	<10	<10	13	0.2	1500
		4/14/99	450	<1	<1	20	<1	4600	0.2	370	<1	5	<10	460	2	--	83	2400	<0.2	--	3	--	1.5	<1	--	<10	3400	39	<2	--	--	<10	<10	13	0.3	1400
		7/28/99	810	4	<1	30	<1	6400	<0.1	380	2	4	<10	980	<1	--	91	2000	<0.2	--	3	--	1.2	<1	--	<10	3100	47	<2	--	--	<10	<10	18	0.3	1400
		10/28/99	6000	3	<1	60	<1	6000	0.2	320	7	5	<10	5700	2	--	77	1100	<0.2	--	8	--	1.1	<1	--	<10	2700	48	<2	--	--	<10	<10	19	0.3	1300
		1/5/00	170	<1	1.2	30	<1	6300	0.13	350	1.8	2.1	<10	250	<1	--	83	1200	<0.2	<20	1.5	--	1.3	<1	12000	<10	2900	44	<2	<50	<5	<10	<10	20	0.3	1000
		4/6/00	<50	<1	<1	17	<1	4000	0.1	330	<1	5.1	<10	140	<1	--	76	6000	<0.2	<20	2	--	2.5	1.9	3200	<10	3700	35	<2	130	<5	<10	<10	11	0.2	920
		7/6/00	<50	<1	<1	28	<1	5800	<0.1	310	<1	<1	14	110	<1	--	79	1400	<0.2	<20	1.8	--	0.98	<1	5700	<10	2700	48	<2	<50	<5	<10	<10	20	0.33	960
		1/22/01	820	<1	<1	30	<1	4100	0.59	370	<1	<1	<10	1100	7.3	--	86	6800	<0.2	<20	3.5	--	2	<1	--	<10	4600	37	<2	<50	15	<10	<10	13	0.21	1100
		4/3/01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/18/01	<50	<1	<1	30	<1	5900	<0.1	320	<1	<1	19	200	<1	--	74	960	<0.2	<20	<1	--	0.83	<1	5800	<10	2400	42	<2	<50	7.2	<10	13	19	0.37	970
		10/24/01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/17/02	<50	<1	<1	27	<1	5300	<0.1	330	<1	<1	18	85	<1	--	84	2200	<0.1	<20	<1	--	0.93	<1	--	<10	3100	35	<2	<50	16	<10	<10	17	0.31	1000
		3/11/02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/17/02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2800	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/17/02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2900	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/25/02	<50	<1	<1	20	<1	4100	0.17	330	<1	<1	20	30	<1	--	80	2300	<0.1	<20	2	--	1.1	<1	--	<10	3100	33	<2	<50	<5	<10	<10	17	0.34	1000
		10/22/02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1900	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/22/02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1800	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/30/03	<50	<1	<1	20	<1	5400	0.4	330	<1	<1	20	20	<1	--	86	2500	<0.1	<20	<1	--	0.6	<1	--	<10	3300	36	<2	1300	<5	<10	<10	17	0.33	1000
		4/8/03	<50	<1	<1	20	<1	5300	0.2	340	<1	<1	20	50	<1	--	90	2900	<0.1	<20	<1	--	1.1	<1	--	<10	3400	36	<2	1400	<5	<10	<10	18	0.33	1100
		4/8/03	<50	<1	<1	20	<1	5300	0.2	330	<1	<1	20	70	<1	--	89	3000	<0.1	<20	<1	--	1.1	<1	--	<10	3300	37	<2	1400	<5	<10	<10	18	0.33	1100
		6/30/03	<50	<6	1	30	<1	5400	<0.1	310	<1	<1	10	50	<1	--	80	1100	0.2	--	<1	--	0.87	1.9	--	--	2600	44	<2	--	--	<10	<10	20	0.37	1000
		10/16/03	<50	<0.1	<0.1	25	<1	5880	0.13	300	<0.1	1.5	10	40	0.1	--	78	2100	<0.1	<20	8.2	--	1.1	0.5	--	<10	3020	32.2	<0.1	--	--	<10	<10	19	0.38	1000
		10/16/03	<50	<0.1	<0.1	26	<1	5920	0.13	300	<0.1	1.5	10	20	<0.1	--	79	2200	<0.1	<20	8.3	--	0.9	0.4	--	<10	3020	134	<0.1	--	--	<10	<10	19	0.41	1100
		1/7/04	<50	<0.6	<0.1	10	<1	5000	0.14	320	<0.1	1	<10	<10	<0.1	--	87	2200	<0.1	<20	6.8	--	1.6	0.6	--	<10	3200	47	<0.1	60	<5	<10	<10	20	0.37	1100
		4/7/04	<50	<0.6	<0.1	10	<1	4700	0.09	330	<0.1	1.6	<10	22	<0.1	--	87	2800	<0.1	<20	8.9	--	1.2	0.4	--	<10	3400	43	<0.1	--	--	<10	<10	19	0.33	1100
		7/7/04	<50	<3	<1	20	<1	4600	0.1	300	<1	<1	<10	13	<1	--	75	1000	<0.1	<20	<1	--	1.1	<1	--	<10	2500	43	<2	--	--	<10	<10	20	0.34	1100
		7/7/04	<50	<3	<1	26	<1	4600	<0.1	290	<1	<1	<10	10	<1	--	74	940	<0.1	<20	<1	--	0.99	<1	--	<10	2400	43	<2	--	--	<10	<10	20	0.36	1100
		10/19/04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/19/04	<50	<3	<1	20	<1	6200	0.1	340	<1	<1	<10	<10	<1	--	88	2700	<0.1	<20	<1	<0.01	2.2	2	--	<10	3700	45	<2	<50	<5	<10	<10	19	0.31	1100
		1/4/05	<50	3	2	20	<1	5700	0.1	360	<1	1	<10	10	<1	--	96	2900	<0.1	<20	<1	0.01	1.6	3	--	<10	3900	54	<2	--	--	<10	<10	19	0.32	940
		7/6/05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/6/05	<50	3	1	20	<1	4900	<0.1	300	<1	1	<10	<10	<1	--	76	1400	<0.1	<20	<1	--	2	<1	--	<10	2700	46	<2	<50	<5	<10	<10	19	0.39	881
		7/14/05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		9/15/05	<50	<3	<1	20	<1	5600	<0.1	330	<1	1	<10	<10	<1	--	88	2200	<0.1	<20	1	<0.01	2.7	<1	--	<10	3300	45	<2	--	--	<10	<10	20	0.37	950
		9/15/05	<50	<3	<1	20	<1	5500	<0.1	330	<1	1	<10	<10	<1	--	87	2100	<0.1	<20	<1	<0.01	2.8	<1	--	<10	3300	46	<2	--	--	<10	<10	20	0.38	920
		1/18/06	<200	<3	<1	<10	<1	5100	<0.1	350	<1	<1	<10	<30	<1	--	90	2900	<0.1	<20	<1	0.02	1.7	<1	--	<10	4000	44	<2	--	--	<10	<10	19	0.37	1100

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	-
JSF-W30 (cont.)	W-30	4/25/06	<200	<3	<1	20	<1	4800	<0.1	320	<1	<1	<10	<30	<1	--	88	2700	<0.1	<20	<1	<0.01	1.8	<1	--	<10	3400	39	<2	--	--	<10	<10	19	0.4	945
		4/25/06	<200	<3	<1	20	<1	4700	<0.1	310	<1	<1	<10	<30	<1	--	87	2700	<0.1	<20	<1	<0.01	1.8	<1	--	<10	3400	39	<2	--	--	<10	<10	19	0.4	933
		4/25/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/25/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/26/06	<200	<3	<1	20	<1	5100	<0.1	310	<1	2	<10	90	<1	--	80	3000	<0.1	<20	<1	<0.1	1.2	3	--	<10	3100	51	<2	--	--	<10	<10	20	0.39	950
		10/3/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/3/06	<200	3	3	20	<1	5000	<0.1	310	<1	1	<10	90	<1	--	83	2600	<0.1	<20	<1	<0.01	2	<1	--	<10	3300	44	<2	--	--	<10	<10	20	0.35	930
		10/3/06	<200	3	3	20	<1	5000	<0.1	310	<1	1	<10	90	<1	--	83	2600	<0.1	<20	<1	<0.01	2	<1	--	<10	3300	47	<2	--	--	<10	<10	20	0.35	910
		12/7/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/3/07	<100	<1	<1	17	<1	4700	<0.5	320	<1	2.3	2.2	<100	<1	--	95	2900	<0.2	<5	8.9	<0.1	1.1	3.6	--	<0.5	3700	42	<1	--	--	<10	<10	16	0.31	960
		5/29/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/2/07	<100	<1	<1	19	<2	5300	<0.5	320	<1	2.4	3.1	<100	<1	--	92	2500	<0.2	<5	14	<0.1	1.4	3.6	--	<0.5	3300	43	<1	--	--	<10	<10	17	<0.1	1200
		10/2/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--	--
		4/9/08	110	<1	<1	16	<1	4800	<0.5	320	<1	1.7	<1	<100	<1	--	92	2800	<0.2	<5	7.8	<0.1	1.1	<1	--	<0.5	3600	42	<1	<1	--	<10	<10	16	0.31	980
		5/19/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/28/08	<100	<1	<1	19	<1	5500	<0.5	330	3.3	2.3	<1	<100	<1	--	94	2600	<0.2	--	12	<0.1	1.4	<1	--	<0.5	3700	47	<1	<1	--	<10	<10	18	0.35	1000
		10/28/08	<100	<1	<1	21	<1	5600	<0.5	330	2.5	2.5	<1	<100	<1	--	95	2800	<0.2	--	11	<0.1	1.4	<1	--	<0.5	3800	47	<1	<1	--	<10	<10	18	0.35	1000
		4/8/09	<100	<1	<1	16	<1	4900	<0.5	320	<1	2	3.1	<100	<1	--	94	2400	<0.2	--	12	<0.1	1.3	<1	--	<0.5	3700	44	<1	<1	--	<2	<10	17	0.33	980
		5/20/09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/7/09	<100	<1	<1	20	<1	5300	<0.5	320	<2	2.2	<2	<100	<1	--	92	2800	<0.2	--	7.3	<0.1	1.3	<1	--	<1	3400	42	<1	<1	--	<2	<10	18	0.42	980
		11/9/09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/6/10	<100	<1	<1	18	<1	5000	<0.5	310	<2	1.2	<2	<100	<1	--	90	1600	<0.2	--	10	<0.1	1.1	<1	--	<1	3400	42	<1	<1	--	<10	<10	16	0.4	960
		4/6/10	<100	<1	<1	18	<1	5000	<0.5	320	<2	1.2	<2	<100	<1	--	89	1600	<0.2	--	10	<0.1	1	<1	--	<1	3300	40	<1	<1	--	<10	<10	16	0.4	980
		10/18/10	<100	<1	<1	21	<2	5400	<0.5	350	<2	1.6	<2	<100	<1	--	93	2500	<0.2	--	9.3	<0.1	1.4	<1	--	<1	3700	43	<1	<1	--	<2	<10	17	0.38	1100
		4/19/11	<100	<1	<1	19	<1	4800	<0.5	310	<2	1.2	<2	<100	<1	--	84	1200	<0.2	--	33	<0.1	1	2.1	--	<1	3200	39	<1	<1	--	<2	<10	17	0.34	960
		10/19/11	<100	<1	<1	24	<1	5600	<0.5	400	<2	2.5	<2	<100	<1	--	110	3000	<0.2	--	7.1	<0.1	1.8	<1	--	<1	4900	44	<1	<1	--	<2	<10	15	0.36	1100
		10/19/11	<100	<1	<1	25	<1	5700	<0.5	410	<2	2.5	<2	<100	<1	--	110	3000	<0.2	--	7.3	<0.1	1.7	<1	--	<1	5200	46	<1	<1	--	<2	<10	15	0.36	1100
		4/10/12	<100	<1	7.3	27	<1	4300	<0.5	--	<2	5	<2	210	<1	--	--	3800	<0.2	--	7.8	<0.1	1.2	<1	--	<1	4600	40	<1	<1	--	<2	<10	15	0.34	1100
		10/23/12	<100	<1	1.2	25	<1	4600	<0.5	340	<1	2.9	<1	<100	<1	--	94	2700	<0.2	--	11	<0.1	1.6	<1	--	<0.5	4500	39	<1	<1	--	<2	<10	16	0.34	1000
		4/8/13	<100	<1	<1	20	<1	4100	<0.5	--	<2	3.2	<2	<100	<1	--	--	3000	<0.2	--	19	<0.1	1.3	<1	--	<1	4600	39	<1	<1	--	<2	<10	15	0.39	1100
		11/12/13	<100	<2	<2	23.7	<2	4480	<1	381	<2	2.91	<2	<100	<2	--	98	2820	<0.2	<2	<2	<0.1	1.67	<2	--	<2	4600	37.4	<2	<50	--	<2	<25	17.4	0.37	1080
		4/7/14	<100	<2	<2	22.2	<2	4020	<1	--	<2	2.75	<2	<100	<2	--	--	3130	<0.2	--	2.05	<0.1	1.28	<2	--	<2	4320	33.8	<2	<50	--	<2	<25	15.5	0.27	997
		11/18/14	0.14	<2	<2	27.2	<2	4410	<1	--	<2	2.86	2.41	<100	<2	--	--	2950	<0.2	<2	<2	<0.1	1.81	<2	--	<2	4660	41.5	<2	<50	--	<2	<25	13.3	0.42	949
		5/5/15	<0.1	<2	<2	22.2	<2	4070	<1	--	<2	2.88	<2	<100	<2	--	--	3150	<0.2	--	<2	<0.1	1.3	<2	--	<2	5060	33.3	<2	<50	--	<2	<25	10.9	0.27	961
		5/5/15	<0.1	<2	<2	22	<2	4220	<1	--	<2	2.73	<2	<100	<2	--	--	3020	<0.2	--	<2	<0.1	1.29	<2	--	<2	5220	34.8	<2	<50	--	<2	<25	10.8	0.26	958
		11/16/15	<0.1	<2	<2	25.2	<2	4360	<1	406	<2	3.01	<2	<100	<2	--	102	3870	<0.2	--	2.24	<0.1	1.57	<2	--	<2	5090	34.9	<2	<50	--	<2	<25	10.2	0.37	1090
		11/18/15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		5/10/16	<0.1	<2	<2	23.8	<2	4050	<1	--	<2	2.33	<2	<100	<2	--	--	3120	<0.2	--	<2	<0.1	1.48	<2	--	<2	5450	34.2	<2	<50	--	<4	<25	12.5	0.29	1150
		11/7/16	<0.2	<2	<1	<200	<1	4630	<1	425	<2	2.97	<2	<100	<1	<5	--	3160	<0.2	<5	2.22	<0.1	<5	<5	--	<1	4950	35	<1	<100	--	<1	<5	10.4	0.34	952

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	-
JSF-W31	W-31	6/25/98	4300	<1	4	40	<1	13000	<0.1	500	2	2	<10	6600	5	--	87	470	<0.2	--	3	--	12	<1	--	<10	3600	51	<2	--	--	<10	40	17	0.2	1200
		7/30/98	4800	<1	2	60	<1	14000	<0.1	510	11	3	<10	9000	6	--	87	240	<0.2	--	17	--	13	<1	--	<10	3800	69	<2	--	--	<10	10	18	0.2	1500
		11/4/98	2000	5	<1	20	<1	13000	<0.1	570	3	9	<10	3400	<1	--	99	66	<0.2	--	9	--	17	<1	--	<10	4300	74	<1	--	--	<10	<10	21	0.3	1400
		1/20/99	730	4	<1	20	<1	11000	<0.1	440	<1	<1	<10	1300	<1	--	78	41	<0.2	--	8	--	12	<1	--	<10	3400	54	<2	--	--	<10	<10	13	0.2	930
		4/14/99	5400	<1	<1	40	<1	11000	<0.1	460	4	<1	<10	5100	2	--	79	61	<0.2	--	7	--	11	2	--	<10	3500	52	<2	--	--	<10	<10	17	0.3	1600
		4/14/99	3400	<1	<1	30	<1	11000	<0.1	450	4	<1	<10	3800	2	--	79	52	<0.2	--	8	--	11	3	--	<10	3500	50	<2	--	--	<10	10	17	0.3	1600
		7/28/99	2600	2	2	30	<1	12000	0.2	440	4	3	<10	4700	2	--	84	61	<0.2	--	7	--	13	2	--	<10	3600	56	<2	--	--	<10	30	20	0.3	1800
		10/28/99	160000	**8**	**74**	860	4	9300	1.3	570	**310**	110	130	220000	95	--	110	2200	**4.3**	--	**400**	--	13	10	--	<10	4400	61	<2	--	--	100	500	21	0.2	2200
		1/4/00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/5/00	190	<1	1.6	20	<1	14000	<0.1	490	1.8	<1	<10	220	<1	--	90	12	<0.2	3800	2.5	--	12	<1	16000	<10	4500	64	<2	<50	<5	<10	<10	21	0.2	1500
		4/6/00	110	<1	<1	15	<1	8600	<0.1	310	<1	<1	<10	120	<1	--	57	10	<0.2	3000	1	--	9.7	2.2	6300	<10	2700	39	<2	100	<5	<10	<10	13	0.3	860
		4/6/00	81	<1	<1	15	<1	8700	<0.1	310	<1	<1	<10	67	<1	--	59	8.8	<0.2	2900	<1	--	9.8	1.8	6300	<10	2900	39	<2	100	<5	<10	<10	13	0.3	960
		7/6/00	95	<1	<1	24	<1	13000	<0.1	440	<1	<1	16	43	<1	--	86	5	<0.2	3800	2.2	--	12	<1	8200	<10	4300	70	<2	<50	<5	<10	<10	23	0.28	1300
		1/24/01	600	<1	<1	32	1.1	13000	<0.1	460	<1	<1	<10	620	<1	--	87	19	<0.2	3600	4.2	--	16	<1	--	<10	4600	87	<2	<50	<5	<10	<10	22	0.28	1500
		4/3/01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	69	--	--	--	--	--	--	--	--
		7/18/01	110	<1	<1	31	<1	16000	<0.1	510	<1	<1	24	40	<1	--	94	6.8	<0.2	4100	<1	--	14	<1	7000	<10	4800	110	<2	<50	15	<10	13	19	0.31	1600
		9/26/01	--	--	--	--	--	17000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	130	--	--	--	--	--	--	--	--
		1/17/02	1000	<1	<1	32	<1	16000	0.22	530	<1	5.8	18	750	<1	--	100	19	<0.1	3900	<1	--	14	4.1	--	<10	4900	140	<2	<50	29	<10	<10	19	0.26	1700
		3/11/02	--	--	--	--	--	18000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4900	110	--	--	--	--	--	--	--	--
		4/17/02	--	--	--	--	--	14000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4200	87	--	--	--	--	--	--	--	--
		7/25/02	3000	<1	1.7	50	<1	13000	0.23	510	<1	<1	20	4100	2	--	92	51	<0.1	3500	5	--	16	1.6	--	<10	4900	100	<2	<50	42	<10	20	19	0.3	1700
		10/22/02	--	--	--	--	--	19000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5500	150	--	--	--	--	--	--	--	--
		1/30/03	3200	<1	<1	50	<1	12000	0.3	410	<1	<1	20	4000	3.2	--	84	43	<0.1	2800	<1	--	11	<1	--	<10	4000	93	<2	1500	13	<10	20	16	0.25	1300
		4/8/03	4200	<1	3	60	<1	12000	0.2	410	<1	<1	20	3000	2	--	79	37	<0.1	2200	**130**	--	9.9	<1	--	<10	3800	80	<2	1500	33	<10	10	16	0.22	1200
		6/30/03	7200	<6	5	80	<1	11000	0.2	420	<1	<1	20	6300	<1	--	82	74	0.1	--	<1	--	11	2	--	--	3800	80	<2	--	--	<10	20	16	0.26	1300
		10/16/03	1800	<0.1	<0.1	24	<1	6310	0.89	450	0.5	0.9	10	1700	1.1	--	86	28	<0.1	809	11.1	--	10.7	1.3	--	<10	1290	82.7	<0.1	--	--	62	<10	19	0.27	1600
		1/7/04	2300	<0.6	<0.1	40	<1	9000	0.66	330	0.3	0.8	<10	2100	1.2	--	65	25	<0.1	2200	6.8	--	10	0.9	--	<10	3100	73	<0.1	70	22	<10	<10	14	0.25	1100
		4/7/04	4500	<0.6	1.1	50	<1	10000	0.58	380	1.4	1.4	<10	4600	2.4	--	74	51	0.1	2400	10.7	--	9.3	1.7	--	<10	3500	70	<0.1	--	--	<10	<10	17	0.26	1300
		7/7/04	1300	<3	<1	40	<1	9100	0.1	380	2	<1	<10	1700	2	--	70	42	<0.1	2300	<1	--	9.7	<1	--	<10	3400	67	<2	--	--	<10	<10	16	0.26	1400
		10/19/04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/19/04	680	<3	1	30	<1	15000	<0.1	500	<1	<1	<10	500	<1	--	99	27	<0.1	3200	<1	13	12	3	--	<10	4800	100	<2	<50	<5	<10	<10	19	0.24	630
		1/4/05	440	3	3	40	<1	13000	<0.1	470	<1	<1	<10	350	<1	--	94	16	<0.1	2800	<1	0.28	11	3	--	<10	4400	89	<2	--	--	<10	<10	18	0.23	1400
		7/6/05	530	3	1	20	<1	9600	<0.1	390	<1	<1	<10	430	<1	--	68	23	<0.1	2100	<1	--	11	<1	--	<10	3600	79	<2	<50	<5	<10	<10	16	0.28	1236
		7/14/05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		9/15/05	560	<3	1	30	<1	14000	<0.1	500	<1	<1	<10	510	<1	--	93	27	<0.1	2900	<1	0.12	13	<1	--	<10	4700	110	<2	--	--	<10	<10	19	0.28	1500
		1/18/06	240	3	1	<10	<1	10000	<0.1	380	6	<1	<10	190	<1	--	73	7	<0.1	2400	<1	2.7	11	<1	--	<10	3400	100	<2	--	--	<10	<10	17	0.29	1700
		4/25/06	300	<3	3	30	<1	9800	<0.1	360	<1	<1	<10	230	<1	--	69	21	<0.1	2500	<1	1.5	10	<1	--	<10	3300	75	<2	--	--	<10	<10	14	0.3	1060
		4/25/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/26/06	<200	<3	<1	30	<1	11000	<0.1	410	<1	<1	<10	70	<1	--	76	11	<0.1	2400	<1	0.7	11	4	<10	<10	3800	98	<2	--	--	<10	<10	16	0.3	1300
		10/3/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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	-
JSF-W31 (cont.)	W31	10/3/06	<200	6	4	30	<1	13000	<0.1	470	<1	<1	<10	40	<1	--	89	12	<0.1	3000	<1	0.4	14	<1	--	<10	4500	110	<2	--	--	<10	<10	17	0.26	1500
		4/3/07	130	<1	1.9	20	<1	12000	0.6	420	<1	<1	2.4	<100	<1	--	85	<10	<0.2	2800	9.6	0.36	9.7	7.1	--	<0.5	4200	85	<1	--	--	<10	<10	12	0.24	1400
		10/2/07	430	<1	<1	26	<2	15000	**9.3**	500	<1	<1	3	250	<1	--	100	<10	<0.2	3200	22	<0.1	12	8.9	--	<0.5	5100	120	<1	--	--	<10	<10	13	0.24	2000
		10/2/07	1000	<1	<1	28	<2	15000	**9.1**	490	<1	1.7	4.2	640	<1	--	100	37	<0.2	3200	22	<0.1	12	8.9	--	<0.5	4800	120	<1	--	--	<10	<10	14	0.23	1700
		10/2/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--	--
		10/2/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--	--
		12/10/07	--	--	--	--	--	--	**8.9**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/9/08	880	<1	<1	31	<1	9000	<0.5	300	<1	<1	<1	520	<1	--	60	<10	<0.2	2200	6.8	3	8.1	<1	--	<0.5	3000	65	<1	<1	--	<10	<10	8.1	0.17	860
		5/19/08	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/28/08	<500	<1	<1	27	<1	18000	**6.8**	530	<1	<1	9.7	<500	<1	--	110	<50	<0.2	--	11	<0.1	13	<1	--	<0.5	5300	140	<1	<1	--	<50	16	14	0.36	1800
		12/9/08	--	--	--	--	--	--	0.96	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/8/09	200	<1	2.2	29	<1	11000	**6**	340	2.7	<1	3.8	440	<1	--	72	<10	<0.2	--	13	0.6	8.8	<1	--	<0.5	3400	75	<1	<1	--	<2	<10	10	0.27	1000
		5/20/09	--	--	--	--	--	--	<0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/7/09	210	<1	1.3	46	<1	13000	4.2	410	<2	<1	<2	210	<1	--	91	6.7	<0.2	--	11	0.45	13	<1	--	<1	4100	87	<1	<1	--	<2	<10	12	0.38	1300
		11/9/09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/7/10	160	<1	<1	27	<1	12000	**6.1**	390	<2	<1	<2	140	<1	--	84	<10	<0.2	--	13	0.29	9.4	<1	--	<1	4000	82	<1	<1	--	<10	<10	11	0.32	1300
		4/9/10	--	--	--	--	--	--	3.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/9/10	--	--	--	--	--	--	3.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		5/13/10	--	--	--	--	--	--	**6.8**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1300
		5/13/10	--	--	--	--	--	--	**5.3**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		5/13/10	--	--	--	--	--	--	3.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		5/13/10	--	--	--	--	--	--	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/18/10	<100	<1	<1	30	<2	16000	**8.2**	520	<2	<1	<2	<100	<1	--	110	<10	<0.2	--	13	<0.1	13	<1	--	<1	5100	110	<1	<1	--	<2	<10	12	0.33	1800
		12/6/10	--	--	--	--	--	--	**8.2**	--	--	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.2	--	--	--	--
		12/6/10	--	--	--	--	--	--	**5.3**	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25	--	--	--	--
		1/27/11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/20/11	460	<1	<1	23	<1	11000	**7.8**	350	<2	<1	2	390	<1	--	76	<10	<0.2	--	15	0.42	14	4.3	--	<1	3600	72	<1	<1	--	<2	<10	10	0.3	1100
		4/20/11	550	<1	<1	24	<1	11000	**8.4**	360	<2	<1	2.1	360	<1	--	78	<10	<0.2	--	17	0.42	15	3.9	--	<1	3600	72	<1	<1	--	<2	<10	10	0.3	1200
		10/19/11	140	<1	1.2	31	<1	18000	--	530	<2	<1	<2	<100	<1	--	120	<10	<0.2	--	10	0.13	24	<1	--	<1	6300	120	<1	<1	--	<2	<10	11	0.25	1500
		10/19/11	--	--	--	--	--	--	<0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/10/12	1300	<1	1.9	28	<1	12000	<0.5	--	<2	<1	<2	1000	<1	--	--	<10	<0.2	--	8.4	0.45	11	1	--	<1	4000	88	<1	<1	--	<2	<10	10	0.33	1300
		10/25/12	150	<1	<1	29	<1	15000	<0.5	450	2.9	<1	1.5	180	<1	--	100	<10	<0.2	--	8.8	0.17	21	3.9	--	<0.5	4800	98	<1	<1	--	4.2	<10	10	<0.1	1600
		10/25/12	140	<1	1.4	30	<1	16000	<0.5	460	2.3	<1	1	200	<1	--	110	<10	<0.2	--	10	0.18	23	2.6	--	<0.5	5000	100	<1	<1	--	2.8	<10	10	0.34	1600
		4/10/13	<100	<1	1.3	30	<1	11000	1.4	--	<2	<1	<2	<100	<1	--	--	<10	<0.2	--	19	0.24	8.5	<1	--	<1	3700	75	<1	<1	--	<2	<10	8.8	0.36	1100
		11/13/13	<100	<2	<2	37.5	<2	15400	1.7	457	<2	<2	<2	<100	<2	--	123	12.5	<0.2	4420	<2	<0.1	26.9	<2	--	<2	4820	103	<2	<50	--	<2	<25	11.1	0.34	1670
		4/7/14	<100	<2	<2	31.5	<2	13600	1.46	--	<2	<2	<2	<100	<2	--	--	5.53	<0.2	--	<2	0.393	11.1	<2	--	<2	3870	80.3	<2	<50	--	<2	<25	7.96	0.27	1190
		11/17/14	0.21	<2	<2	41.1	<2	8590	<1	--	<2	<2	<2	<100	<2	--	--	2.14	<0.2	2210	<2	0.806	22.4	<2	--	<2	3070	50.8	<2	<50	--	<2	<25	6.85	0.42	826
		5/6/15	0.154	<2	<2	64.5	<2	13400	1.46	--	2.15	<2	<2	<100	<2	--	--	15.3	<0.2	--	<2	0.135	48.2	<2	--	<2	4380	55.7	<2	<50	--	<2	<25	7.18	0.38	1190
		11/16/15	0.142	<2	<2	34.5	<2	15500	<1	475	<2	<2	<2	<100	<2	--	115	4.88	<0.2	--	2.14	0.302	40.5	<2	--	<2	4870	76.3	<2	<50	--	<2	<25	7.31	0.41	1470
		11/16/15	0.122	<2	<2	35.1	<2	15500	<1	472	<2	<2	<2	<100	<2	--	115	3.74	<0.2	--	<2	0.309	40.4	<2	--	<2	4890	76.8	<2	<50	--	<2	<25	7.37	0.42	1500

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	-
JSF-W32	W-32	7/30/98	9000	<1	2	80	<1	<200	<0.1	180	26	8	<10	15000	10	--	9.2	470	<0.2	--	23	--	3.7	<1	--	<10	390	10	<2	--	--	<10	40	11	<0.1	79
		11/4/98	1200	2	<1	20	<1	<200	<0.1	140	2	3	<10	1500	<1	--	6.3	370	<0.2	--	14	--	2.9	1	--	<10	280	8.3	<1	--	--	<10	<10	12	<0.1	60
		1/21/99	3400	<1	<1	70	<1	<200	0.6	160	4	3	<10	4100	5	--	7	77	<0.2	--	11	--	3	<1	--	<10	330	8.5	<2	--	--	<10	20	11	<0.1	100
		4/14/99	3000	<1	<1	50	<1	<200	<0.1	140	3	<1	<10	2500	2	--	6.2	50	<2	--	<1	--	2	<1	--	<10	270	8.3	<2	--	--	<10	10	11	<0.1	100
		7/28/99	40000	2	8	200	<1	<200	0.2	280	24	22	20	59000	16	--	15	770	<0.2	--	57	--	3.2	<1	--	<10	530	7.7	<2	--	--	30	140	11	<0.1	56
		10/28/99	28000	<1	4	150	<1	<200	0.4	250	28	20	20	41000	21	--	13	820	<0.2	--	48	--	2.4	<1	--	<10	500	6.1	<2	--	--	20	100	12	0.2	94
		1/5/00	140	<1	<1	50	<1	330	0.28	170	<1	<1	<10	190	<1	--	5.7	22	<0.2	<20	<1	--	1.9	<1	14000	<10	390	6.7	<2	<50	<5	<10	<10	11	0.1	73
		1/5/00	--	<1	<1	40	<1	<200	0.32	150	1	<1	<10	120	<1	--	5.2	18	<0.2	<20	<1	--	1.9	<1	12000	<10	360	6.8	<2	<50	<5	<10	<10	13	0.2	68
		4/5/00	190	<1	<1	49	<1	200	<0.1	150	<1	<1	<10	360	<1	--	5.5	12	<0.2	<20	<1	--	2	<1	5300	<10	330	7	<2	<50	<5	<10	10	12	<0.1	66
		7/6/00	1100	<1	<1	51	<1	<200	0.15	140	1.6	2.8	<10	1100	<1	--	5.4	26	<0.2	<20	1.4	--	1.7	<1	7100	<10	320	7.5	<2	<50	13	<10	<10	13	<0.1	60
		1/23/01	800	<1	<1	56	1.2	290	<0.1	140	<1	<1	15	1000	7.7	--	4.9	300	<0.2	<20	<1	--	1.6	<1	--	<10	350	5.9	<2	<50	<5	<10	19	13	<0.1	51
		4/3/01	--	--	--	--	--	<200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/19/01	260	<1	<1	50	<1	280	0.17	140	<1	<1	<10	420	<1	--	5.1	350	<0.2	<20	2	--	1	<1	5200	<10	310	5.7	<2	<50	6.6	<10	12	12	<0.1	52
		9/26/01	--	--	--	--	--	<200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/17/02	530	<1	<1	45	1	420	0.28	140	<1	<1	<10	410	<1	--	4.4	<5	<0.1	<20	<1	--	1.1	<1	--	<10	<200	4.3	<2	<50	15	<10	<10	13	0.26	48
		7/25/02	7300	<1	<1	80	<1	<200	1.2	160	<1	6.5	10	11000	8.2	--	6.8	370	<0.1	<20	11	--	2.2	<1	--	<10	360	4.2	<2	<50	34	10	60	11	0.11	46
		10/22/02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		1/30/03	<50	<1	<1	50	<1	200	0.2	150	<1	<1	<10	80	7.8	--	5.1	7	<0.1	<20	<1	--	0.9	<1	--	<10	330	5.6	<2	750	<5	<10	<10	11	<0.1	52
		4/8/03	210	<1	<1	60	<1	200	<0.1	150	<1	<1	<10	240	<1	--	5.8	9	<0.1	<20	<1	--	1.5	<1	--	<10	330	5.4	<2	830	<5	<10	<10	11	<0.1	50
		6/30/03	180	<6	3	60	<1	200	<0.1	150	<1	<1	<10	280	<1	--	6.5	<5	<0.1	--	<1	--	1.6	<1	--	--	330	7.5	<2	--	--	<10	<10	12	<0.1	55
		10/16/03	110	<0.1	<0.1	28	<1	2910	0.2	150	1.3	0.2	<10	100	0.3	--	5.9	8	<0.1	194	3.3	--	1.3	<0.2	--	<10	319	6.9	<0.1	--	--	33	<10	11	<0.1	60
		1/7/04	<50	<0.6	<0.1	50	<1	<200	0.13	140	<0.1	0.2	<10	90	<0.1	--	6.7	<5	<0.1	<20	2.6	--	2.1	0.3	--	<10	300	9	<0.1	<50	<5	<10	<10	12	0.1	60
		4/7/04	270	<0.6	<0.1	50	<1	<200	<0.05	140	0.3	0.3	<10	310	0.2	--	6.2	7	<0.1	<20	3.7	--	1.8	<0.2	--	<10	310	7.9	<0.1	--	--	<10	<10	11	<0.1	66
		4/7/04	190	<0.6	<0.1	50	<1	<200	0.12	140	0.3	0.2	<10	170	0.1	--	6.2	<5	<0.1	<20	3.6	--	1.4	<0.2	--	<10	300	7.8	<0.1	--	--	<10	<10	11	<0.1	63
		7/6/04	230	<3	<1	50	<1	<200	0.2	140	<1	<1	<10	260	1	--	6.1	<5	<0.1	<20	<1	--	1.6	<1	--	<10	300	6.2	<2	--	--	<10	<10	11	<0.1	70
		10/19/04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/19/04	530	<3	<1	60	<1	500	0.1	160	<1	<1	<10	400	<1	--	6.4	6	<0.1	<20	<1	0.42	2.8	<1	--	<10	340	7.3	<2	<50	<5	<10	<10	11	<0.1	60
		1/3/05	500	<3	<1	50	<1	240	<0.1	160	<1	<1	<10	330	<1	--	6.5	<5	<0.1	<20	<1	0.39	2.6	1	--	<10	330	10	<2	--	--	<10	<10	12	<0.1	51
		1/3/05	390	<3	<1	50	<1	<200	<0.1	140	<1	<1	<10	300	<1	--	5.9	<5	<0.1	<20	<1	0.39	1.8	1	--	<10	300	10	<2	--	--	<10	<10	12	<0.1	51
		7/6/05	660	<3	<1	50	<1	310	<0.1	140	1	<1	<10	400	1	--	5.3	5	<0.1	<20	<1	--	2.6	<1	--	<10	290	8.8	<2	<50	11	<10	<10	10	<0.1	55
		7/14/05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		9/14/05	1300	<3	1	50	<1	<200	<0.1	150	1	<1	<10	1300	<1	--	5.6	21	<0.1	<20	<1	0.14	3	<1	--	<10	300	7.3	<2	--	--	<10	<10	16	<0.1	50
		1/18/06	210	<3	<1	50	<1	<200	<0.1	130	<1	<1	<10	260	<1	--	4.3	<5	<0.1	<20	<1	0.07	1.7	<1	--	<10	260	5.8	<2	--	--	<10	<10	13	<0.1	53
		4/25/06	<200	<3	2	60	<1	<200	<0.1	140	<1	<1	<10	160	<1	--	5.6	6	<0.1	<20	<1	0.22	1.9	<1	--	<10	300	7.2	<2	--	--	<10	<10	11	0.1	50
		4/25/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		7/26/06	300	>3	<1	60	<1	<200	<0.1	150	<1	<1	<10	240	<1	--	5.4	6	<0.1	<20	<1	0.53	1.4	<1	--	<10	330	9.7	<2	--	--	<10	<10	11	<0.1	54
		10/3/06	200	<3	<1	60	<1	<200	0.1	140	<1	<1	<10	230	<1	--	5.1	6	<0.1	<20	<1	0.12	2.2	<1	--	<10	300	5.5	<2	--	--	<10	<10	12	<0.1	52
		10/3/06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/3/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/5/07	180	<1	<1	58	<1	<200	<0.5	140	1.1	<1	1.1	120	<1	--	5.4	<10	<0.2	<5	2.9	0.61	1.4	2.3	--	<0.5	300	7.2	<1	--	--	<10	<10	9	<0.1	53

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**	-
JSF-W32 (cont.)	W32	10/4/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		10/5/07	7800	<1	1.3	76	<1	<200	<0.5	140	8.2	1.9	4.2	5100	3.8	--	6.5	42	<0.2	<5	10	<0.1	4	1.9	--	<0.5	310	6	<1	--	--	<10	18	9.7	<0.1	48
		10/5/07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1	--	--	--	--	--	--
		4/8/08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/9/08	400	<1	<1	55	<1	<200	<0.5	140	<1	<1	<1	180	<1	--	5.4	<10	<0.2	<5	2.8	0.26	1.4	<1	--	<0.5	310	6.7	<1	<1	--	<10	<10	9.7	<0.1	51
		10/28/08	140	<1	<1	56	<1	250	<0.5	150	<1	<1	1.4	140	<1	--	5.6	<10	<0.2	--	3.2	<0.1	1.9	<1	--	<0.5	340	7	<1	<1	--	<10	<10	12	<0.1	54
		4/8/09	180	<1	1	62	<1	<200	<0.5	140	2.7	<1	<1	250	<1	--	6.2	<10	<0.2	--	5.2	0.62	1.9	<1	--	<0.5	300	7.5	<1	<1	--	<2	15	11	<0.1	50
		10/7/09	210	<1	<1	57	<1	<200	<0.5	140	<2	<1	<2	250	<1	--	6.1	3.7	<0.2	--	2	0.56	1.7	<1	--	<1	290	7.3	<1	<1	--	<2	<10	11	<0.1	52
		10/7/09	310	<1	<1	67	<1	360	<0.5	140	<2	<1	<2	340	<1	--	6.3	4.9	<0.2	--	2.1	0.56	1.7	<1	--	<1	290	7.3	<1	<1	--	<2	<10	12	0.12	53
		11/9/09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		4/7/10	200	<1	<1	58	<1	250	<0.5	130	<2	<1	<2	170	<1	--	5.4	<10	<0.2	--	3.8	0.72	1.5	<1	--	<1	270	7	<1	<1	--	<10	<10	11	0.1	48
		10/19/10	1000	<1	<1	65	<2	290	<0.5	150	2.3	<1	<2	1100	<1	--	5.9	12	<0.2	--	4	0.41	2	<1	--	<1	340	8.2	<1	<1	--	<2	<10	11	<0.1	51
		4/18/11	260	<1	<1	64	<1	240	<0.5	130	<2	<1	<2	150	<1	--	5.8	<10	<0.2	--	5.4	0.8	1.6	1	--	<1	280	7.1	<1	<1	--	<2	<10	11	<0.1	50
		10/19/11	<100	<1	<1	63	<1	440	<0.5	140	<2	<1	<2	<100	<1	--	5.5	<10	<0.2	--	2	0.66	1.8	<1	--	<1	330	8.6	<1	<1	--	<2	<10	11	0.12	49
		4/11/12	340	<1	1.1	59	<1	260	<0.5	--	<2	<1	<2	300	<1	--	--	<10	<0.2	--	1.8	0.96	1.5	<1	--	<1	260	7.9	<1	<1	--	<2	<10	11	<0.1	50
		10/25/12	<100	<1	<1	52	<1	330	<0.5	130	2.5	<1	<1	<100	<1	--	4.6	<10	<0.2	--	2	0.53	1.9	<1	--	<0.5	290	8	<1	<1	--	<2	<10	12	<0.1	51
		4/9/13	<100	<1	<1	53	<1	290	<0.5	--	<2	<1	<2	<100	<1	--	--	<10	<0.2	--	5.9	0.65	1.6	<1	--	<1	270	7.4	<1	<1	--	<2	<10	11	<0.1	47
		4/9/13	<100	<1	<1	51	<1	<200	<0.5	--	<2	<1	<2	<100	<1	--	--	<10	<0.2	--	5.4	0.64	1.6	<1	--	<1	270	7.4	<1	<1	--	<2	<10	11	<0.1	47
		11/13/13	<100	<2	<2	57.9	<2	87.8	<1	134	<2	<2	<2	116	<2	--	4.49	9.92	<0.2	3.3	<2	0.681	1.55	<2	--	<2	272	7.41	<2	<50	--	<2	<25	12.6	<0.1	49.3
		11/13/13	<100	<2	<2	57.3	<2	69.6	<1	131	<2	<2	<2	100	<2	--	4.44	42.8	<0.2	<2	<2	0.683	1.51	<2	--	<2	265	7.23	<2	<50	--	<2	<25	12.5	<0.1	49.1
		4/8/14	<100	<2	<2	53.7	<2	53.9	<1	--	<2	<2	<2	<100	<2	--	--	<2	<0.2	--	<2	0.761	1.29	<2	--	<2	291	7.09	<2	<50	--	<2	<25	11.5	<0.1	45.4
		11/17/14	0.283	<2	<2	62.8	<2	87.2	<1	--	<2	<2	<2	367	<2	--	--	6.24	<0.2	5.81	<2	0.408	1.53	<2	--	<2	308	7.4	<2	<50	--	<2	<25	13.6	<0.1	51.6
		5/6/15	0.157	<2	<2	54.7	<2	66.2	<1	--	4.78	<2	<2	206	<2	--	--	22.9	<0.2	--	<2	0.778	1.42	<2	--	<2	282	7.39	<2	<50	--	<2	<25	9.03	<0.1	42.8
		11/16/15	<0.1	<2	<2	52.5	<2	84.8	<1	116	<2	<2	<2	<100	<2	--	4.38	2.94	<0.2	--	<2	0.459	1.53	<2	--	<2	235	7.07	<2	<50	--	<2	<25	11.2	<0.1	49.5

~ Action Level
^ nitrate TDEC MCL is listed since there is no MCL for nitrite
^^ nitrite MCL is listed since it is a more conservative value
-- 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 Grey cells indicate that measured values exceed EPA MCLs
MCL - Maximum Contaminant Level
mg/L - milligrams per liter
Ref. - reference
TDEC - Tennessee Department of Environment and Conservation; MCLs established in Rules of TDEC Solid Waste Management Appendix III
ug/L - micrograms per liter

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)
JSF-1	1	12/1/86	--	213	--	--	--	7.7	170	14	270	--	--
		3/19/87	--	208	--	--	--	7.4	470	14.8	270	--	--
		5/21/87	--	208	--	--	--	7.1	470	15.1	230	--	--
		6/4/87	--	205	--	--	0.9	6.9	440	14.8	300	--	--
		6/18/87	--	201	--	--	1	7	240	16.8	290	--	--
		12/16/87	--	--	--	--	0.3	7.28	454	13.7	190	--	--
		3/8/88	--	204	--	--	0.2	7.2	480	15.3	270	--	--
		6/21/88	--	226	--	104	0.4	7.11	263	15.8	290	--	--
		9/15/88	--	306	--	67	0.5	7.1	470	15.6	--	--	--
		12/6/88	--	250	--	--	1.7	7.2	440	13.2	290	--	--
		3/15/89	--	216	--	0	0.2	7	470	15	270	--	--
		6/7/89	--	--	--	0	0.2	7.2	440	14.9	290	--	--
		8/30/89	--	209	--		0.1	7.3	430	15.6	260	--	--
		11/1/89	--	206	--	0	0.3	7	446	14.7	270	--	--
		2/6/90	--	213	--	0	0.5	7.3	422	15.1	280	--	--
		5/22/90	--	213	--	213	0.7	7.3	497	13.9	300	--	--
		5/22/90	--	--	--	--	--	--	--	--	290	--	--
		8/8/90	--	210	--	211	0.4	7.4	430	15.4	300	--	--
		11/27/90	--	196	--	225	0.4	7.1	476	15.9	310	11	--
		2/27/91	--	--	--	291	0.9	7.1	463	14.9	290	24	--
		3/26/91	--	221	--	303	0.5	7.2	488	15.2	300	2	--
		4/30/91	--	213	--	253	2.5	7.3	474	14.6	300	57	--
		8/26/91	--	196	--	124	0.6	6.9	466	15.3	300	23	--
		2/20/92	--	211	--	58	0.8	7.3	477	14.8	270	54	--
		12/1/92	--	--	--	197	0.9	7.1	466	14.1	280	13	--
		3/1/93	--	210	--	460	1	7.1	489	14.8	270	15	--
		5/24/93	--	212	--	183	0.8	7.2	480	16.6	280	29	--
		8/16/93	--	205	--	270	0.3	7.2	493	17.6	260	8	--
		8/16/93	--	201	--	268	0.2	7.2	492	17	260	6	--
		8/16/93	--	200	--	189	0.7	7.3	473	15.5	280	<1	--
		8/16/93	--	202	--	161	0.6	7.3	468	16.6	270	<1	--
		11/17/93	--	201	--	158	0.5	7.09	470	17.8	280	11	--
		11/17/93	--	207	--	161	0.1	7.14	473	15.8	290	8	--
		11/17/93	--	206	--	127	0.07	7.16	474	15.7	280	1	--
		2/22/94	--	235	--	246	0.2	7.2	480	15.8	240	<1	--
		2/22/94	--	239	--	193	0.1	7.2	480	15.2	290	<1	--
		5/16/94	--	210	--	256	0.1	7.1	433	15.3	300	<1	--
		5/18/94	--	206	--	240	0.7	7.1	451	15	300	<1	--
		8/15/94	--	208	--	356	0.1	7.1	492	16	320	<1	--
		11/7/94	--	206	--	219	0.6	7.2	480	15.1	290	4	--
		5/23/95	--	216	--	266	0.1	7.2	492	15.5	300	22	--
		5/23/95	--	--	--	--	--	--	--	--	310	25	--
		1/23/96	--	212	--	380	1.2	7	481	14.9	300	9	--
		8/6/96	--	213	--	383	0.9	7.2	500	15.9	310	22	--
		1/8/97	--	207	--	523	0.6	7.2	494	10	290	10	--
		1/8/97	--	209	--	316	0.3	7.2	500	14.7	290	6	--
		7/14/97	--	208	--	297	0.7	7.1	467	24.1	290	14	--
		7/14/97	--	208	--	207	0.2	7.1	458	16	300	17	--
		1/19/98	--	208	--	295	0.3	7.1	459	14.9	290	4	--
		1/19/98	--	208	--	383	0.7	7.1	452	11.7	250	11	--

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)
JSF-1 (cont.)	1	1/19/98	--	208	--	--	--	--	--	--	240	11	--
		6/25/98	--	214	--	627	0.9	7.1	463	15.2	300	16	--
		7/28/98	--	220	--	433	0.4	6.9	472	19.3	270	57	--
		7/28/98	--	210	--	416	0.7	7	465	15.5	270	11	--
		11/4/98	--	208	--	382	1.1	7.2	501	14.9	310	12	--
		11/4/98	--	--	--	--	--	--	--	--	290	13	--
		1/21/99	--	210	--	444	0.8	6.9	492	15.3	290	8	--
		1/21/99	--	204	--	397	1.1	7	491	15.3	300	15	--
		4/14/99	--	238	--	393	0.5	7	477	15.3	270	13	--
		7/29/99	--	242	--	240	0.8	7.2	512	15.1	310	4	--
		7/29/99	--	--	--	--	--	--	--	--	310	2	--
		10/28/99	--	246	--	310	1.4	7	493	15.4	300	15	--
		1/6/00	--	212	--	360	1	7.1	495	14.5	280	2	--
		4/5/00	--	210	--	288	0.3	7	499	15.3	280	7	--
		7/6/00	--	222	--	345	1.3	6.9	488	15.7	300	11	--
		1/22/01	--	207.5	--	381	2	7.2	481	15.2	310	4	--
		1/22/01	--	--	--	--	--	--	--	--	330	5	--
		7/17/01	--	215	--	254	1.2	7.2	473	15.9	290	3	--
		1/16/02	--	212.5	--	425	1.3	7.1	484	15.1	290	7	--
		1/16/02	--	--	--	--	--	--	--	--	290	4	--
		7/24/02	--	211	--	355	1.2	7	476	15.2	320	8	--
		1/28/03	--	210	--	386	1.5	7	490	15	290	7	--
		6/30/03	--	220	--	371	1.3	7	480	15.2	300	14	--
		6/30/03	--	--	--	--	--	--	--	--	300	10	--
		10/16/03	--	205	--	328	1.5	7.2	405	15.4	290	17	--
		1/6/04	--	210	--	373	1.2	6.9	485	15.2	290	2	--
		1/6/04	--	--	--	--	--	--	--	--	300	2	--
		4/5/04	--	212	--	340	0.85	7.1	483	15.4	310	4	--
		7/6/04	--	211	--	341	1	7.2	487	15.5	310	6	--
		10/18/04	--	207.5	--	226	1	7.3	456	15.3	--	--	--
		10/18/04	--	--	--	--	--	--	--	--	300	14	--
		10/18/04	--	--	--	--	--	--	--	--	310	15	--
		1/3/05	--	--	--	--	--	--	--	--	--	--	--
		1/3/05	--	210	--	355	1	6.9	443	15.5	290	7	--
		7/5/05	--	213.5	--	240	1.5	7	409	15.5	310	6	--
		7/5/05	--	--	--	--	--	--	--	--	310	4	--
		7/13/05	--	--	--	263	1.1	6.9	480	15.4	--	--	--
		9/14/05	--	186	--	310	1.1	7.2	483	15.7	300	6	--
		1/18/06	--	213.5	--	372	1.4	7.2	489	15.5	300	4	--
		1/18/06	--	--	--	--	--	--	--	--	290	4	--
		4/24/06	--	211	--	304	1.4	7.2	479	15.5	280	4	--
		7/24/06	--	212.5	--	303	1.7	7.2	470	15.3	310	8	--
		7/24/06	--	--	--	--	--	--	--	--	310	8	--
		10/2/06	--	--	--	--	--	--	--	--	320	4	--
		10/2/06	--	213	--	241	1.4	7.2	480	15.4	--	--	--
		4/3/07	--	215	--	323	1.4	7.1	485	15.4	280	7	--
		4/3/07	--	--	--	--	--	--	--	--	280	6	--
		10/1/07	--	--	--	--	--	--	--	--	300	2.9	--
		10/1/07	--	--	--	--	--	--	--	--	--	--	--
		10/2/07	--	214	--	229	1.1	7	484	15.3	--	--	--

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)
JSF-1 (cont.)	1	11/13/07	--	--	--	--	--	--	--	--	--	--	--
		4/8/08	--	214	--	220	0.9	7.1	480	15.4	270	1.6	--
		4/8/08	--	--	--	--	--	--	--	--	280	1.9	--
		10/27/08	--	214	--	202	1.2	7.1	487	15.5	270	7.6	--
		4/7/09	--	211	--	174	0.3	6.9	481	15.3	290	8	--
		4/7/09	--	--	--	--	--	--	--	--	290	2	--
		10/7/09	--	205	--	136	0.9	7	475	15.5	310	4.9	--
		4/5/10	--	219	--	209	0.7	7	479	15.6	260	3.8	--
		10/21/10	--	220.5	--	119	0.6	6.9	483	16.3	320	<1	--
		10/21/10	--	--	--	--	--	--	--	--	310	<1	--
		4/20/11	--	218	--	207	0.3	6.7	485	16	290	<1	--
		10/19/11	--	--	--	--	--	--	--	--	280	<1	--
		10/19/11	--	216	--	124	0.2	6.9	486	15.7	--	--	0.7
		4/11/12	--	219	--	284	0.2	6.8	498	15.4	--	--	--
		10/22/12	--	205	--	143	0.2	7	480	16.6	290	<1	3.6
		4/11/13	--	216	--	275	0.1	7	484	17.6	--	<1	0.2
		11/14/13	--	220	--	21	0.1	7	477	17.3	288	1.1	0.7
		4/10/14	--	216	--	170	0.1	7.1	483	18.6	--	1.1	2.1
		11/19/14	--	210	--	46	0.1	7	478	17.8	--	1.25	0.8
		5/7/15	--	214	--	--	--	--	--	--	--	1.3	1.3
		11/16/15	--	205	--	171	0.1	7.2	473	16.1	290	1.6	1.2
JSF-10-36	10-36	4/19/11	--	426.5	--	250	0.5	6.3	995	14.6	620	2.4	--
		4/19/11	--	--	--	--	--	--	--	--	630	2.7	--
		10/17/11	--	437	--	298	0.9	6.3	1064	21.2	660	<1	--
		4/9/12	--	430.5	--	310	0.4	6.3	1024	15.8	--	--	1
		4/9/12	--	--	--	--	--	--	--	--	--	--	--
		10/29/12	--	426	--	234	0.5	6.5	972	16.2	--	1.7	3.1
		4/10/13	--	457	--	277	1.4	6.6	1043	19.4	--	4.7	1.2
		11/18/13	--	450	--	163	1.9	6.5	1021	17	--	7.9	1
		11/18/13	--	--	--	--	--	--	--	--	--	7.5	--
		4/9/14	--	438	--	278	1	6.6	1008	15.1	--	2	2
JSF-10-37	10-37	4/19/11	--	225	--	80	0.5	6.8	567	16.4	350	5.6	--
		10/18/11	--	154.5	--	176	0.9	7.1	380	19.5	230	<1	--
		10/18/11	--	--	--	--	--	--	--	--	220	1.1	--
		4/9/12	--	223	--	158	0.5	6.8	477	17.5	--	--	7.9
		10/29/12	--	158	--	308	0.9	7.3	361	15.8	--	<1	3
		10/29/12	--	--	--	--	--	--	--	--	--	<1	--
		4/10/13	--	217	--	294	1.6	7.1	454	20.3	--	1	1.5
		4/10/13	--	--	--	--	--	--	--	--	--	<1	--
		11/18/13	--	164	--	155	1.4	7.3	370	19.3	--	<1	1.2
		4/9/14	--	196	--	166	0.6	7.1	408	19.2	--	<1	2.6
		4/9/14	--	--	--	--	--	--	--	--	--	<1	--
JSF-15	15	3/28/91	--	340	--	-84	0.2	6.6	730	16.9	470	2700	--
		4/29/91	--	328	--	-47	0.4	6.6	703	17.6	430	3000	--
		8/27/91	--	384	--	-51	0.2	6.6	735	18.1	430	1500	--
		2/19/92	--	360	--	-40	0.6	6.7	714	15.4	360	780	--
		12/1/92	--	323	--	-62	0.6	6.4	670	16.7	280	270	--
		3/2/93	--	315	--	307	0.3	6.7	669	14.8	310	230	--
		5/25/93	--	315	--	-63	0.2	6.6	669	16.4	290	190	--
		8/17/93	--	315	--	-19	0.4	6.4	619	23.5	330	61	--

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)
JSF-15 (cont.)	15	8/17/93	--	326	--	-61	0.3	6.5	666	24.6	--	37	--
		8/17/93	--	330	--	-90	0.3	6.6	709	23.7	350	34	--
		11/18/93	--	310	--	-58	0.2	6.49	638	20.6	380	68	--
		11/18/93	--	320	--	-85	0.09	6.66	682	19.9	440	34	--
		2/23/94	--	358	--	306	0.3	6.54	624	15.5	340	72	--
		2/23/94	--	362	--	133	0.1	6.5	647	16.1	340	130	--
		5/17/94	--	316	--	136	0.5	6.5	594	16.6	400	260	--
		8/15/94	--	316	--	145	0.2	6.4	709	23.7	400	56	--
		11/7/94	--	334	--	90	0.2	6.6	714	18.5	370	120	--
		5/24/95	--	336	--	95	0.2	6.6	697	17.5	400	310	--
		8/7/96	--	306	--	148	0.3	6.5	714	22	410	40	--
		8/7/96	--	--	--	--	--	--	--	--	380	44	--
		1/9/97	--	320	--	155	0.2	6.6	696	15.6	360	82	--
		7/15/97	--	301	--	108	0.2	6.4	620	20.7	300	200	--
		7/15/97	--	--	--	--	--	--	--	--	340	200	--
		1/21/98	--	299	--	225	0.2	6.9	155	15.8	280	140	--
		7/29/98	--	308	--	115	0.2	6.5	648	16.7	360	920	--
JSF-16	16	3/26/91	--	304	--	364	3	7	663	14.2	450	1900	--
		4/30/91	--	235	--	337	4.9	7.3	575	12.9	400	2100	--
		8/26/91	--	170	--	247	0.3	7.3	555	15.5	370	1600	--
		2/20/92	--	297	--	107	1	7.2	618	13	400	560	--
		12/1/92	--	207	--	262	3	7.2	548	14.1	330	160	--
		3/2/93	--	228	--	589	1.1	7.1	615	11.7	340	120	--
		5/24/93	--	216	--	290	0.9	7	627	16.4	370	120	--
		8/16/93	--	183	--	338	0.7	7.2	591	24.2	350	180	--
		8/16/93	--	182	--	328	0.5	7.3	587	20.2	350	55	--
		11/17/93	--	187	--	212	0.7	7.1	582	18.4	410	120	--
		2/22/94	--	238	--	345	4.1	7.1	597	12.9	320	110	--
		5/16/94	--	214	--	393	1.1	7	527	18.5	410	140	--
		8/15/94	--	182	--	665	1.8	7.1	597	21.7	440	95	--
		11/7/94	--	200	--	346	1.8	7.1	564	19.3	400	82	--
		5/23/95	--	249	--	270	0.1	7	620	16.4	390	70	--
		1/23/96	--	232	--	504	1.3	7	590	13.8	430	370	--
		8/6/96	--	188	--	463	0.6	7.1	632	20.3	430	150	--
		1/8/97	--	212	--	470	1.2	7.1	653	15	360	150	--
		7/15/97	--	225	--	261	0.4	6.9	604	18.9	450	170	--
		1/19/98	--	230	--	430	1	7.1	551	13.7	380	140	--
		7/28/98	--	198	--	499	0.5	6.9	580	17.7	380	240	--
JSF-17	17	5/28/91	--	212	--	258	0.4	6.9	1170	16.4	1200	340	--
		2/18/92	--	197	--	260	0.6	6.8	1322	15.5	1100	42	--
		5/19/92	--	185	--	170	0.2	6.9	1288	16.4	1000	59	--
		8/18/92	--	--	--	274	1.3	6.4	1323	20.5	1100	130	--
		12/2/92	--	317	--	274	2.2	6.4	1445	14	1200	240	--
		3/2/93	--	261	--	604	1	6.7	1430	13.9	1100	9	--
		5/25/93	--	268	--	437	0.4	6.5	1388	16.6	1100	17	--
		8/18/93	--	346	--	148	2.9	6.3	1212	28.6	890	2000	--
		11/18/93	--	--	--	267	5.8	6.2	1300	15.4	--	--	--
		2/24/94	--	500	--	385	2.5	6.7	1427	10.9	1300	410	--
		5/18/94	--	384	--	398	2.2	6.5	1276	18.7	1200	35	--
		8/17/94	--	278	--	463	2.5	6.3	1155	19.8	720	62	--

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)
JSF-17 (cont.)	17	9/10/99	--	364	--	492	9.4	6.4	1660	17.3	1300	370	--
		7/7/00	--	272	--	344	--	6.3	1414	--	1200	91	--
JSF-18	18	3/28/91	--	77	--	-62	4.7	7.8	672	24	--	--	--
		4/30/91	--	74	--	0	0	0	0	16.3	--	--	--
		2/18/92	--	190	--	-360	1.9	8.7	526	14	270	--	--
		8/6/96	--	404	--	445	--	7.5	1021	--	--	--	--
		1/8/97	--	472	--	443	6	6.9	951	9	590	<1	--
JSF-19	19	4/30/91	--	310	--	274	4.5	8	884	19.9	--	--	--
JSF-2	2	12/1/86	--	173	--	--	--	8.5	390	14	230	--	--
		3/19/87	--	155	--	--	--	7.4	380	13.2	220	--	--
		5/21/87	--	153	--	--	--	7	370	13.9	220	--	--
		6/4/87	--	152	--	--	0.4	6.9	340	14.6	250	--	--
		6/18/87	--	144	--	--	0.8	7.2	270	14.9	250	--	--
		12/16/87	--	--	--	--	0.8	7.26	327	14.2	210	--	--
		3/8/88	--	157	--	--	0.6	7.05	404	13.7	210	--	--
		6/21/88	--	157	--	36	0.2	6.97	371	14.9	230	--	--
		9/15/88	--	220	--	166	2.9	7.2	340	15.3	--	--	--
		12/7/88	--	154	--	--	1.3	7.1	310	14.7	210	--	--
		3/22/89	--	167	--	--	0.3	6.8	390	12.5	230	--	--
		6/7/89	--	187	--	40	0.2	6.9	380	13.6	230	--	--
		8/29/89	--	162	--	0	0.1	7.1	350	15.1	200	--	--
		11/1/89	--	165	--	0	0.3	6.7	376	15.5	230	--	--
		2/6/90	--	180	--	50	1	6.9	388	13.5	250	--	--
		2/6/90	--	--	--	--	--	--	--	--	250	--	--
		5/22/90	--	175	--	105	0.6	7	448	12.9	220	--	--
		8/8/90	--	168	--	189	0.2	7.2	358	14.7	240	--	--
		11/27/90	--	171	--	200	0.4	6.9	420	15.7	280	9	--
		2/27/91	--	183	--	249	0.8	7.3	430	13.4	270	21	--
		3/27/91	--	180	--	178	0.5	6.9	438	12.7	280	<1	--
		4/30/91	--	184	--	260	1.2	6.9	450	13.1	290	11	--
		8/26/91	--	174	--	212	2	6.6	415	14.9	250	18	--
		2/20/92	--	178	--	27	0.7	7	418	13.9	270	11	--
		12/1/92	--	162	--	122	0.5	7	384	14.2	240	5	--
		3/1/93	--	175	--	471	0.8	7	424	13.2	240	7	--
		5/24/93	--	175	--	152	0.8	7	416	14.1	250	10	--
		8/17/93	--	165	--	85	0.2	7.1	405	15.7	200	4	--
		8/17/93	--	164	--	76	0.2	7.1	400	16.6	220	2	--
		8/17/93	--	177	--	69	0.2	7.3	410	16.8	240	20	--
		8/17/93	--	165	--	111	1.9	7.3	396	15.7	190	15	--
		11/18/93	--	162	--	89	0.3	6.98	354	16.5	230	8	--
		11/18/93	--	168	--	50	0.1	7.13	359	16.2	250	29	--
		11/18/93	--	168	--	33	0.1	7.11	362	16.4	250	24	--
		11/18/93	--	168	--	14	0.07	7.11	360	15.8	250	39	--
		2/22/94	--	196	--	287	0.3	6.92	402	13.6	90	29	--
		2/22/94	--	191	--	189	0.2	7.1	396	14	90	4	--
		5/16/94	--	155	--	300	0.5	6.78	368	16.7	250	82	--
		5/16/94	--	169	--	282	0.4	7	351	14.3	250	2	--
		8/16/94	--	159	--	340	0.4	7	393	15.2	240	<1	--
		11/8/94	--	164	--	213	0.8	7	391	14.8	220	2	--
		5/23/95	--	166	--	212	0.1	7.1	396	14.6	260	1	--

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)
JSF-2 (cont.)	2	1/23/96	--	162	--	292	0.1	6.9	381	14.5	260	<1	--
		8/6/96	--	163	--	377	1	7.2	407	15.6	250	1	--
		1/8/97	--	160	--	512	0.4	7	398	11.7	240	15	--
		1/8/97	--	166	--	352	1.1	7.1	402	14.1	240	9	--
		7/14/97	--	169	--	307	0.6	6.8	397	20.2	240	45	--
		7/14/97	--	172	--	222	0.8	7.1	388	15	240	10	--
		1/19/98	--	170	--	352	0.4	6.9	374	11.9	230	16	--
		1/20/98	--	163	--	301	0.8	7.1	363	14.1	200	31	--
		7/28/98	--	170	--	484	0.4	6.7	389	18.8	250	9	--
		7/28/98	--	166	--	408	0.5	6.9	385	15	250	22	--
JSF-20	W-20	4/2/91	--	42	--	-303	0.3	6	313	18.6	--	--	--
		4/30/91	--	72	--	-12	0.3	6.5	346	20.8	--	--	--
		2/20/92	--	69	--	-43	0.5	6.7	622	12	500	--	--
JSF-21	21	5/28/91	--	570	--	337	1.6	6.8	1056	16.5	950	5900	--
		8/27/91	--	312	--	338	2.5	5.3	1160	21.7	1100	5500	--
		2/18/92	--	260	--	384	4.4	6.6	1446	15.5	1200	800	--
		5/18/92	--	260	--	216	1.1	6.9	1510	16.4	1000	560	--
		8/18/92	--	410	--	201	2.4	6.5	1352	20.2	1300	1500	--
		12/2/92	--	213	--	274	5.9	7	1365	13.5	1200	46	--
		3/2/93	--	235	--	511	0.6	6.9	1840	14.7	1600	54	--
		5/25/93	--	238	--	269	0.6	6.9	2090	14.5	2000	22	--
		8/17/93	--	248	--	295	0.4	6.9	2490	15.3	2200	38	--
		11/17/93	--	221	--	189	0.6	6.8	2530	16.8	2500	35	--
		2/23/94	--	275	--	447	0.5	6.9	2480	14.9	2400	19	--
		5/17/94	--	236	--	363	0.4	6.7	2065	15.2	2100	14	--
		8/16/94	--	231	--	444	0.3	6.5	2750	15.6	2600	16	--
		11/8/94	--	257	--	327	0.2	6.7	3276	15.8	3300	43	--
		5/23/95	--	260	--	285	0.2	6.9	3261	15.8	2100	76	--
		1/24/96	--	251	--	468	0.3	6.7	3430	14.7	3300	26	--
		8/6/96	--	272	--	497	0.3	6.8	3407	16.9	3400	17	--
		1/9/97	--	275	--	577	0.4	6.8	3419	13.9	2800	58	--
		7/15/97	--	281	--	309	0.3	6.7	2970	17.5	3000	31	--
		1/21/98	--	293	--	329	0.5	6.8	3243	14.3	3200	27	--
		6/25/98	--	304	--	468	0.5	6.7	2655	15.6	2600	19	--
		7/28/98	--	318	--	516	0.4	6.7	2144	16.6	3000	16	--
		1/17/02	--	292	--	553	2.8	6.9	3196	15.2	3100	890	--
JSF-25	25	11/18/93	--	92	--	49	0.3	7.1	600	21.4	450	1	--
		11/18/93	--	88	--	5	0.06	7.04	592	18.2	450	<1	--
		2/22/94	--	97	--	329	0.2	7.4	585	18.2	440	<1	--
		5/17/94	--	83	--	324	0.2	7.2	539	18.5	450	<1	--
		8/17/94	--	83	--	424	0.2	7.1	661	18.9	480	<1	--
		11/9/94	--	80	--	219	0.2	7.1	644	18.8	450	<1	--
		5/24/95	--	81	--	204	0.1	7.2	652	19.4	330	4	--
		1/24/96	--	64	--	404	0.2	7	660	16.4	450	<1	--
		1/24/96	--	--	--	--	--	--	--	--	430	<1	--
		8/6/96	--	76	--	465	0.5	7.3	680	20.7	470	<1	--
		1/8/97	--	75	--	436	0.3	7.3	681	15.9	490	1	--
		7/15/97	--	74	--	215	0.3	7.1	634	20.6	470	<1	--
		1/21/98	--	71	--	256	0.3	7.2	610	16.9	460	2	--
		7/29/98	--	78	--	416	0.2	6.9	709	20.1	500	<1	--

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			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)
JSF-25 (cont.)	25	7/29/98	--	--	--	--	--	--	--	--	560	<1	--
JSF-26	26	8/6/96	--	450	--	543	1.1	6.4	1106	15.6	690	62	--
		1/7/97	--	440	--	349	0.4	6.3	1126	15.5	720	16	--
		7/15/97	--	520	--	252	0.4	6.2	1073	24.7	680	7	--
		1/21/98	--	466	--	173	0.3	6.2	957	16.2	610	8	--
		7/30/98	--	270	--	216	0.3	6.2	1070	21.9	670	10	--
		1/21/99	--	484	--	393	0.4	6.1	1034	18.5	630	7	--
		9/10/99	--	454	--	264	0.2	6.3	1152	17.7	660	53	--
		1/6/00	--	684	--	423	--	6.3	997	--	560	78	--
		7/7/00	--	472	--	296	0.8	6	1054	22	640	36	--
		1/23/01	--	0	--	384	1.4	6.2	1014	16.4	680	20	--
		7/17/01	--	537	--	138	0.3	6.2	1025	18.4	650	55	--
		1/19/02	--	511	--	273	0.4	6	1045	16.4	640	26	--
		7/24/02	--	550	--	31	0.4	6.1	1087	20.7	670	65	--
		1/28/03	--	500	--	233	0.8	6.2	1054	15.6	640	10	--
JSF-27A	27A	6/17/97	--	263	--	467	0.9	7.2	518	19.5	--	--	--
JSF-3	3	12/1/86	--	160	--	--	--	8.1	630	17	350	--	--
		5/21/87	--	161	--	--	--	7.05	560	17.1	460	--	--
		6/4/87	--	169	--	--	4.7	6.9	700	16.2	540	--	--
		6/18/87	--	167	--	--	4.1	6.9	630	17.5	550	--	--
		12/16/87	--	--	--	--	0.1	7.09	744	14.9	480	--	--
		3/8/88	--	161	--	--	1.1	7.05	778	17.4	490	--	--
		6/21/88	--	176	--	0	0.2	6.94	807	19.7	580	--	--
		9/15/88	--	270	--	138	0.5	6.9	420	17.6	--	--	--
		11/30/88	--	183	--	--	1.4	7.2	200	15.3	610	--	--
		3/15/89	--	189	--	7	0.2	7	870	16.6	620	--	--
		6/6/89	--	179	--	80	0.2	6.9	800	17.3	640	--	--
		8/29/89	--	200	--	0	0.2	7	860	19.4	650	--	--
		11/2/89	--	189	--	0	0.2	6.8	886	15.6	650	--	--
		11/2/89	--	--	--	--	--	--	--	--	650	--	--
		2/7/90	--	190	--	60	0.4	7	840	17.1	680	--	--
		5/22/90	--	196	--	168	0.6	7.1	991	15.9	740	--	--
		8/8/90	--	193	--	252	0.3	7.1	882	17.4	730	--	--
		11/27/90	--	189	--	210	0.3	7	980	17	760	58	--
		4/2/91	--	42	--	172	0.2	7	1022	16.9	770	46	--
		4/29/91	--	199	--	241	0.9	7	952	17.6	760	99	--
		8/27/91	--	184	--	27	0.2	6.9	1020	17	780	90	--
		11/13/91	--	196	--	160	0.4	7	1051	16.2	770	52	--
		2/20/92	--	208	--	-157	1	7.1	1072	14.3	760	14	--
		2/20/92	--	--	--	--	--	--	--	--	790	11	--
		5/18/92	--	207	--	-151	0.2	7	1070	17.5	810	9	--
		8/19/92	--	204	--	182	0.1	7	1089	16.1	800	37	--
		12/2/92	--	205	--	131	0.4	6.8	1132	15.3	830	3	--
		3/2/93	--	209	--	627	0.4	6.9	1133	13.8	780	9	--
		5/24/93	--	203	--	168	0.2	6.7	1122	20.7	850	3	--
		8/17/93	--	226	--	404	0.7	6.8	1190	22.7	920	7	--
		8/17/93	--	225	--	387	0.7	6.5	1210	22.7	910	4	--
		8/17/93	--	210	--	333	0.1	6.9	1150	19.3	860	8	--
		8/17/93	--	202	--	328	0.2	7.1	1140	19.7	860	6	--
		11/18/93	--	215	--	172	0.3	6.87	1115	19	950	7	--

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JSF-3 (cont.)	3	11/18/93	--	213	--	136	0.06	6.81	1071	17.6	900	4	--
		2/22/94	--	252	--	315	0.6	6.93	1240	16.9	970	4	--
		2/22/94	--	237	--	276	0.2	6.9	1051	17	890	3	--
		5/17/94	--	219	--	343	0.7	6.5	1074	17.1	960	2	--
		5/17/94	--	212	--	305	0.2	6.7	1022	16.9	910	<1	--
		8/16/94	--	208	--	375	0.2	6.7	1226	17.9	940	<1	--
		11/8/94	--	214	--	267	0.3	6.7	1198	17.6	910	12	--
		5/23/95	--	217	--	212	0.2	6.8	1226	17.9	960	<1	--
		8/6/96	--	238	--	360	0.2	6.7	1205	20	930	2	--
		1/8/97	--	238	--	391	0.2	6.7	1194	14.3	860	2	--
		1/8/97	--	--	--	--	--	--	--	--	820	3	--
		7/15/97	--	243	--	278	0.1	6.4	1039	19	830	1	--
		1/21/98	--	242	--	302	0.1	6.4	971	16.4	690	2	--
		7/29/98	--	253	--	436	0.1	6.2	1048	18.3	780	<1	--
JSF-MW1	MW-1	7/19/07	--	--	--	337	4.3	6.9	595	20	380	540	--
JSF-MW2	MW-2	7/19/07	--	--	--	482	1.3	6.9	614	17.8	360	48	--
JSF-MW3	MW-3	7/18/07	--	--	--	--	--	--	--	--	420	300	--
		7/19/07	--	--	--	162	0.5	7.1	676	17.8	--	--	--
		8/30/12	--	233	--	206	0.6	7.1	625	20.1	390	6.8	11.4
		10/29/12	--	--	--	--	--	--	--	--	--	--	--
		10/30/12	--	223	--	198	0.3	6.8	636	15.7	370	4.4	--
		10/30/12	--	--	--	--	--	--	--	--	--	--	12.5
		2/25/13	--	211	--	245	0.4	6.9	627	12.5	400	8.9	14.3
		4/11/13	--	233	--	365	0.6	6.9	640	14.8	410	2.3	2.2
JSF-MW4	MW-4	7/19/07	--	--	--	483	0.5	6.8	586	18.6	--	--	--
		9/19/07	--	--	--	455	0.9	6.8	585	22.3	--	--	--
		9/20/07	--	--	--	--	--	--	--	--	390	15	--
JSF-MW5	MW-5	7/19/07	--	--	--	507	4	7.1	408	18	--	--	--
		9/19/07	--	--	--	544	2.9	7.1	388	16.6	--	--	--
		9/20/07	--	--	--	--	--	--	--	--	240	4.6	--
JSF-OW33	OW-33	4/3/07	--	80	--	266	0.5	9.5	2333	17.5	--	--	--
		7/18/07	--	--	--	266	1.2	8.4	2560	18.6	--	--	--
		10/1/07	--	117	--	182	2.2	8.6	2543	18.4	--	--	--
		1/28/08	--	144	--	263	1.9	8.4	2236	17.5	--	--	--
		1/28/08	--	--	--	--	--	--	--	--	--	--	--
		4/10/08	--	153	--	72	0.8	8.3	2607	17.7	--	--	--
		10/29/08	--	154	--	117	1.2	8.1	2692	17.5	--	--	--
JSF-OW34	OW-34	4/3/07	--	159	--	180	0.6	6.2	591	19.4	--	--	--
		7/18/07	--	--	--	337	2	6.2	580	18.3	--	--	--
		10/1/07	--	25	--	320	1	5.5	548	21.1	--	--	--
		1/28/08	--	22	--	388	0.9	5.2	719	17.5	--	--	--
		4/10/08	--	34	--	254	1.2	5.7	724	18.2	--	--	--
		10/29/08	--	13	--	320	2.3	5.1	784	16.9	--	--	--
JSF-OW35	OW-35	4/3/07	--	305	--	343	1.7	7.4	2398	16.7	--	--	--
		7/18/07	--	--	--	214	0.6	7.5	2478	18.7	--	--	--
		10/1/07	--	307	--	327	7	7.4	2436	18.4	--	--	--
		10/1/07	--	--	--	--	--	--	--	--	--	--	--
		1/28/08	--	--	--	--	--	--	--	--	--	--	--
		1/28/08	--	317	--	453	4.9	7.4	2591	14.4	--	--	--
		4/10/08	--	336	--	260	1.4	7.2	2547	18	--	--	--
		10/29/08	--	330	--	384	2.5	7.4	2410	15.2	--	--	--

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			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)
JSF-PZ1	PZ-1	5/21/87	--	150	--	--	--	7.2	460	20	280	--	--
		6/4/87	--	152	--	--	--	7.8	450	--	320	--	--
		6/18/87	--	160	--	--	--	7.2	500	18	310	--	--
		3/28/91	--	313	--	230	6	6.5	2140	18.4	590	410	--
JSF-PZ2A	PZ-2A	6/4/87	--	123	--	--	--	7.2	2600	17.2	2900	--	--
		6/18/87	--	172	--	--	--	6	2710	18.4	2800	--	--
		3/27/91	--	43	--	387	4.3	6	656	20.7	510	65	--
		11/14/91	--	430	--	261	0.5	6.3	784	19	540	290	--
		2/19/92	--	88	--	295	0.5	6.1	823	19.5	480	240	--
		5/18/92	--	90	--	216	0.6	6.1	852	20.9	540	38	--
		8/18/92	--	96	--	204	0.2	6.1	906	19.7	670	110	--
		12/2/92	--	105	--	170	0.3	6.2	981	18.7	700	18	--
		3/1/93	--	109	--	587	0.3	6.3	1048	17.8	760	9	--
		5/25/93	--	110	--	81	0.3	6.2	1118	19.6	870	5	--
		8/18/93	--	122	--	169	1.5	6.2	1323	23.2	1000	12	--
		8/18/93	--	126	--	162	0.8	6.2	1304	24	970	3	--
		8/18/93	--	119	--	150	0.4	6.2	1265	25.5	1000	<1	--
		8/18/93	--	117	--	147	0.3	6.2	1265	26.6	970	<1	--
		11/17/93	--	121	--	170	0.3	6.2	1336	19.9	1100	4	--
		2/24/94	--	151	--	599	0.4	6.3	1430	18.2	1300	5	--
		5/18/94	--	140	--	364	0.2	6.2	1330	18.9	1200	3	--
		8/17/94	--	153	--	444	0.3	6.1	1647	20.3	1400	3	--
		11/9/94	--	170	--	327	0.4	6.2	1732	18.6	1500	2	--
		5/23/95	--	179	--	229	0.3	6.3	1774	19.4	3300	68	--
		1/23/96	--	158	--	409	0.3	6.2	1638	18.2	1400	9	--
		8/7/96	--	142	--	390	0.3	6.2	1613	21.7	1300	2	--
		6/24/98	--	138	--	371	0.2	6	1469	20.9	1400	13	--
JSF-PZ2B	PZ-2B	6/4/87	--	295	--	--	--	7.4	2200	17	2000	--	--
		6/18/87	--	300	--	--	--	6.9	2240	18.3	2200	--	--
		3/27/91	--	160	--	210	0.2	7	1076	20.4	870	97	--
		2/19/92	--	170	--	119	0.5	6.9	1166	20.6	860	250	--
		12/2/92	--	195	--	-96	0.3	6.7	1820	18.6	1500	88	--
		3/2/93	--	217	--	193	0.3	6.9	2040	17.6	1800	160	--
		5/25/93	--	245	--	-88	0.2	6.7	2380	19.3	2200	98	--
		8/18/93	--	--	--	-97	0.1	6.6	2600	21.7	2100	100	--
		11/17/93	--	230	--	19	0.2	6.7	1900	19.2	1700	110	--
		2/24/94	--	312	--	100	0.2	6.7	1754	17.5	1500	43	--
		5/18/94	--	309	--	105	0.2	6.6	1820	19.7	1800	78	--
		8/17/94	--	328	--	151	0.5	6.5	2159	20.3	1900	80	--
		11/9/94	--	300	--	100	0.4	6.7	2002	18.1	1600	110	--
		5/24/95	--	320	--	102	0.6	6.7	1787	22.5	1100	84	--
		1/23/96	--	323	--	162	0.5	6.7	1791	17.4	1500	120	--
		8/6/96	--	138	--	107	0.2	6.7	1834	25.1	1400	180	--
		6/24/98	--	444	--	116	0.8	6.6	2050	21.5	1700	120	--

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			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)
JSF-PZ3A	PZ-3A	6/4/87	--	196	--	--	--	7.6	900	16.6	660	--	--
		6/18/87	--	177	--	--	--	7.1	930	17.1	700	--	--
		3/27/91	--	106	--	125	0.2	7	836	20	660	1800	--
		11/14/91	--	113	--	136	0.4	7	812	18.7	500	2900	--
		2/19/92	--	109	--	230	0.6	6.8	786	18.8	180	400	--
		5/18/92	--	106	--	126	0.3	6.8	762	19.9	370	310	--
		8/18/92	--	100	--	138	0.4	6.7	792	18.7	510	320	--
		12/3/92	--	98	--	192	0.6	6.6	860	18.2	590	28	--
		3/3/93	--	97	--	755	0.7	6.6	890	18.4	620	29	--
		5/26/93	--	104	--	142	0.3	6.6	985	18.6	730	20	--
		8/18/93	--	95	--	82	0.3	6.3	1163	18.8	850	8	--
		11/17/93	--	101	--	145	1	6.5	1246	18.5	1000	10	--
		2/23/94	--	120	--	382	0.8	6.5	1323	17.4	1100	8	--
		5/18/94	--	111	--	345	0.6	6.4	1273	17.9	1200	6	--
		8/16/94	--	115	--	395	0.4	6.3	1552	18	1300	11	--
		11/8/94	--	117	--	290	0.4	6.3	1560	17.5	1300	3	--
		5/24/95	--	132	--	242	1	6.5	1685	18.4	1300	6	--
		1/24/96	--	133	--	422	0.7	6.4	1833	15.7	1500	7	--
		8/7/96	--	134	--	407	1	6.5	1812	19.4	1500	6	--
		6/24/98	--	142	--	328	0.7	6.5	1963	19.5	1800	8	--
JSF-PZ3B	PZ-3B	6/4/87	--	107	--	--	--	7.3	1900	16.3	1700	--	--
		6/18/87	--	114	--	--	--	6.9	1770	16.6	1700	--	--
		3/27/91	--	--	--	144	0.2	6.6	780	19.9	610	450	--
		2/19/92	--	100	--	179	0.5	6.6	805	18.9	560	190	--
		12/2/92	--	103	--	169	0.7	6.5	921	17.1	640	23	--
		3/2/93	--	94	--	603	0.3	6.7	896	17.9	670	6	--
		5/26/93	--	102	--	94	0.3	6.6	1048	19.3	780	19	--
		8/18/93	--	101	--	20	0.3	6.6	1292	21.3	980	5	--
		11/17/93	--	105	--	99	0.1	6.6	1391	19.7	1200	14	--
		2/23/94	--	135	--	253	0.3	6.7	1419	18.6	1200	4	--
		5/18/94	--	121	--	245	0.4	6.6	1391	19.1	1300	2	--
		8/16/94	--	130	--	313	0.3	6.5	1653	20.2	1400	2	--
		11/9/94	--	131	--	225	0.6	6.6	1681	18.2	1500	2	--
		6/24/98	--	176	--	238	0.5	6.7	2094	22.1	1800	4	--
JSF-PZ4A	PZ-4A	6/4/87	--	216	--	--	--	7.6	2000	16.4	1700	--	--
		6/18/87	--	217	--	--	--	7	1920	17.4	1800	--	--
		3/28/91	--	27	--	55	--	6.9	2230	18	2200	9	--
		11/14/91	--	87	--	258	1.4	7.1	2430	15.2	2300	1900	--
		2/19/92	--	282	--	328	1.1	6.9	265	15.2	2300	710	--
		5/19/92	--	323	--	131	0.8	6.9	2788	16.2	2500	320	--
		8/18/92	--	358	--	221	0.4	6.9	2870	15.7	2800	3100	--
		12/2/92	--	349	--	261	1	6.7	2880	15	2700	50	--
		3/1/93	--	--	--	--	--	--	--	--	2700	67	--
		3/3/93	--	371	--	484	1.2	6.5	2750	15.1	--	--	--
		5/26/93	--	340	--	179	0.6	6.8	2380	15.6	2300	26	--
		8/18/93	--	342	--	191	1.3	6.7	1900	16.2	2300	35	--
		11/17/93	--	348	--	155	1	6.7	2660	17.6	2600	4	--
		2/23/94	--	430	--	363	0.9	6.7	2506	15	2500	8	--
		5/17/94	--	304	--	311	0.8	6.7	2077	16.1	2100	8	--

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)
JSF-PZ4A (cont.)	PZ-4A	8/16/94	--	300	--	397	1.4	6.6	2482	16.5	2300	7	--
		11/8/94	--	296	--	290	0.8	6.6	2488	16.4	2300	24	--
		5/24/95	--	322	--	289	0.7	6.7	2505	16.8	2000	14	--
		1/24/96	--	360	--	485	2.8	6.6	2583	14.4	2200	16	--
		8/7/96	--	246	--	444	0.8	6.7	1980	18.4	1800	4	--
		6/24/98	--	248	--	400	1.8	6.6	2044	19	2100	10	--
JSF-PZ4B	PZ-4B	6/4/87	--	390	--	--	--	7.5	2800	16.9	3500	--	--
		6/18/87	--	--	--	--	--	6.7	3190	16.9	3500	--	--
JSF-W28	W-28	7/30/98	--	225	--	625	0.4	6.9	2001	21	1500	1000	--
		11/4/98	--	224	--	372	0.2	6.5	2115	16.1	1800	50	--
		1/20/99	--	248	--	324	0.8	6.4	2068	16.5	1900	890	--
		4/14/99	--	160	--	391	1.8	6	1880	14.7	1600	290	--
		7/28/99	--	162	--	210	0.2	6.4	2120	20	2000	80	--
		10/28/99	--	264	--	286	0.9	6.4	2068	18.2	1900	2800	--
		1/5/00	--	248	--	310	0.9	6.4	2072	11.6	1800	5	--
		4/6/00	--	246	--	442	1.1	6.5	2114	16.7	1800	30	--
		7/7/00	--	256	--	329	0.4	6.4	2040	15	1900	57	--
		1/22/01	--	274	--	428	2	6.6	2026	13.7	2000	15	--
		4/3/01	--	245	--	384	0.8	6.5	2003	14.2	--	--	--
		7/19/01	--	290	--	293	0.7	6.6	1992	17.5	1900	77	--
		9/26/01	--	262	--	342	0.4	6.5	1980	16.9	--	--	--
		1/19/02	--	269	--	334	0.4	6.5	2042	15.4	1800	9	--
		3/11/02	--	264	--	415	0.6	6.5	2035	15.6	--	--	--
		7/25/02	--	255	--	203	0.5	6.4	1963	19.7	1800	12	--
		1/31/03	--	262	--	388	0.9	6.6	2010	14.5	1800	110	--
		4/8/03	--	236	--	378	0.6	6.4	1946	16	1800	11	--
		6/30/03	--	205	--	468	1.5	6.3	1883	17.4	1700	18	--
		10/16/03	--	226	--	371	0.5	6.3	1732	18.9	1700	18	--
		1/6/04	--	255	--	437	1.4	6.3	1960	9.7	1800	16	--
		4/7/04	--	247	--	445	1	6.6	1906	16.5	1700	3	--
		7/7/04	--	203	--	366	0.6	6.4	1889	17.7	1700	12	--
		10/19/04	--	237	--	254	0.5	6.6	1846	17.3	--	--	--
		10/19/04	--	--	--	--	--	--	--	--	1700	12	--
		1/4/05	--	259	--	392	0.6	6.4	1775	16.2	1700	50	--
		3/7/05	--	--	--	396	0.6	6.2	1762	15.1	--	--	--
		7/6/05	--	243	--	251	0.5	6.4	1636	16.8	1700	6	--
		7/14/05	--	--	--	300	0.5	6.3	1865	16.8	--	--	--
JSF-W29	W-29	7/30/98	--	225	--	694	3.2	6.7	979	24	700	760	--
		11/4/98	--	186	--	557	0.3	6.1	1072	17.6	840	130	--
		1/20/99	--	188	--	572	0.5	6	962	14.3	660	16	--
		4/14/99	--	204	--	554	0.3	6.1	831	12.8	590	55	--
		7/28/99	--	196	--	504	0.3	6.1	978	18.3	720	120	--
		10/28/99	--	222	--	517	1.5	6.1	986	17.9	760	110	--
		1/5/00	--	206	--	490	0.8	6.1	1013	14.6	930	2	--
		4/6/00	--	188	--	542	0.4	6.2	910	13.3	630	11	--
		7/6/00	--	179	--	464	0.6	6	980	15.3	730	<1	--
		7/6/00	--	--	--	--	--	--	--	--	720	<1	--
		1/22/01	--	170	--	505	1.2	6.1	972	13.6	800	<1	--
		7/18/01	--	169.5	--	549	1.2	6.1	977	18.4	740	<1	--
		7/18/01	--	--	--	--	--	--	--	--	760	<1	--

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)
JSF-W29 (cont.)	W-29	1/17/02	--	170	--	517	0.3	6	1024	15.2	840	7	--
		7/25/02	--	172	--	396	0.3	6	1085	16.7	900	4	--
		7/25/02	--	--	--	--	--	--	--	--	900	8	--
		10/22/02	--	165	--	516	0.5	6	1105	19.2	--	--	--
		1/30/03	--	187.5	--	506	0.8	6.1	1045	13	770	4	--
		1/30/03	--	--	--	--	--	--	--	--	760	6	--
		4/8/03	--	204	--	540	0.3	6.1	994	13.4	790	2	--
		6/30/03	--	230	--	546	0.4	6.1	982	18.2	740	3	--
		10/16/03	--	241	--	495	0.7	6	1012	20.4	760	2	--
		1/7/04	--	255	--	560	0.9	6	1002	12.3	720	2	--
		4/7/04	--	289	--	563	0.3	6.3	1032	13.2	760	<1	--
		7/7/04	--	311	--	470	0.2	6.2	1100	20.3	790	2	--
		10/19/04	--	286	--	330	0.2	6.3	1072	18.5	--	--	--
		10/19/04	--	--	--	--	--	--	--	--	840	2	--
		1/4/05	--	322	--	568	0.32	6	1042	15.4	810	2	--
		3/7/05	--	330	--	513	0.3	5.9	960	13.5	--	--	--
		7/6/05	--	344	--	380	0.4	6	1020	18.2	840	<1	--
		7/14/05	--	--	--	366	0.2	6	1081	18	--	--	--
		9/15/05	--	332	--	478	0.3	6.1	1132	19.1	860	2	--
		1/18/06	--	285	--	533	0.8	6.3	1072	13.9	760	2	--
		4/25/06	--	--	--	--	--	--	--	--	700	<1	--
		7/26/06	--	323	--	527	0.8	6.1	1123	21	880	1	--
		10/3/06	--	--	--	--	--	--	--	--	850	<1	--
		10/3/06	--	317	--	478	0.9	6.2	1153	19.6	--	--	--
		12/7/06	--	330	--	552	1.9	6.2	1188	13.3	--	--	--
		12/8/06	--	--	--	--	--	--	--	--	--	--	--
		4/2/07	--	--	--	--	--	--	--	--	770	2	--
		4/3/07	--	317	--	517	1.7	6	1105	16.4	--	--	--
		5/29/07	--	307	--	500	0.8	6.3	1169	18.8	--	--	--
		10/2/07	--	282	--	510	1.4	6.1	1194	18.6	900	3.1	--
		10/2/07	--	--	--	--	--	--	--	--	--	--	--
		4/9/08	--	259	--	385	1.5	6.3	911	13.1	660	5.8	--
		10/28/08	--	245	--	541	1	6.1	1163	14.8	850	<1	--
		4/8/09	--	243	--	436	0.7	6.1	891	12.3	660	20	--
		10/6/09	--	300	--	380	0.8	6.2	955	19.7	--	--	--
		10/7/09	--	--	--	--	--	--	--	--	730	1.1	--
		11/9/09	--	--	--	355	0.6	6.1	938	17.9	--	--	--
		4/6/10	--	334	--	347	0.8	6.2	939	14.6	640	4	--
		10/19/10	--	335	--	410	1.5	5.9	1137	17.9	860	4.1	--
		4/18/11	--	303	--	441	0.6	5.9	893	14	610	1	--
		10/18/11	--	314	--	460	0.9	5.9	1061	20.7	730	2.1	--
		4/10/12	--	344.5	--	703	0.2	6	932	14	--	--	1.7
		4/10/12	--	--	--	--	--	--	--	--	--	--	--
		10/23/12	--	322	--	617	0.5	6.1	961	20	640	1.4	4
		4/8/13	--	355	--	446	0.7	6.2	894	14.6	--	--	7.8
		4/9/13	--	--	--	--	--	--	--	--	--	4	--
		11/12/13	--	395	--	360	3.8	6.2	998	10.9	697	1.6	1.3
		4/8/14	--	335	--	394	0.2	6.2	881	12.6	--	1.2	4.1
		11/18/14	--	400.5	--	413	0.3	6.2	928	15.3	--	3.61	1.3
		11/18/14	--	--	--	--	--	--	--	--	--	4.53	--
		5/5/15	--	438	--	--	--	--	--	--	--	5.4	3.2
		11/16/15	--	--	--	--	--	--	--	--	642	1.3	--

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			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)
JSF-W30	W-30	7/30/98	--	214	--	656	0.2	6.8	1918	20.2	1800	33	--
		11/4/98	--	232	--	467	0.1	6.6	2158	16.7	1800	20	--
		1/20/99	--	251	--	576	0.3	6.2	2237	13.2	2100	8	--
		1/20/99	--	--	--	--	--	--	--	--	2000	10	--
		4/14/99	--	248	--	535	0.2	6.1	1985	13	1600	10	--
		7/28/99	--	240	--	367	0.2	6.4	2177	18.6	1900	29	--
		10/28/99	--	250	--	386	0.9	6.6	2052	18.2	1800	94	--
		1/5/00	--	232	--	530	0.6	6.5	2069	13.9	1600	<1	--
		4/6/00	--	252	--	485	0.4	6.2	2196	13	1900	2	--
		7/6/00	--	236	--	385	0.7	6.5	2041	16.1	1800	<1	--
		1/22/01	--	250	--	546	1.3	6.3	2144	12.6	2000	17	--
		4/3/01	--	--	--	503	0.5	6.3	1992	12	--	--	--
		7/18/01	--	220	--	463	0.2	6.7	1843	17.8	1700	2	--
		10/24/01	--	230	--	379	0.2	6.7	1838	17.5	--	--	--
		1/17/02	--	259	--	529	0.2	6.5	2150	14.4	1900	2	--
		3/11/02	--	259	--	525	0.4	6.4	2160	15	--	--	--
		4/17/02	--	251	--	471	0.3	6.4	1999	17	--	--	--
		4/17/02	--	--	--	--	--	--	--	--	--	--	--
		7/25/02	--	249	--	302	0.3	6.5	2038	18.7	2000	<1	--
		10/22/02	--	242.5	--	412	0.3	6.6	1921	20.5	--	--	--
		10/22/02	--	--	--	--	--	--	--	--	--	--	--
		1/30/03	--	249	--	545	0.7	6.4	2081	12.8	1700	2	--
		4/8/03	--	254	--	506	0.2	6.4	2033	14	1900	5	--
		4/8/03	--	--	--	--	--	--	--	--	1800	4	--
		6/30/03	--	230	--	517	0.2	6.6	1875	18.2	1700	<1	--
		10/16/03	--	234.5	--	487	0.3	6.5	1784	18.6	1600	2	--
		10/16/03	--	--	--	--	--	--	--	--	1600	2	--
		1/7/04	--	237	--	565	0.8	6.3	1923	12.3	1700	<1	--
		4/7/04	--	254	--	554	0.3	6.6	1997	13.9	1700	<1	--
		7/7/04	--	245.5	--	446	0.3	6.6	1925	20.7	1700	2	--
		7/7/04	--	--	--	--	--	--	--	--	1700	3	--
		10/19/04	--	263	--	282	0.2	6.7	1952	18.4	--	--	--
		10/19/04	--	--	--	--	--	--	--	--	1800	2	--
		1/4/05	--	116	--	586	0.2	6.4	1894	15.8	1800	<1	--
		7/6/05	--	--	--	--	--	--	--	--	--	--	--
		7/6/05	--	258	--	337	0.2	6.5	1693	17	1800	<1	--
		7/14/05	--	--	--	365	0.1	6.5	1854	17.1	--	--	--
		9/15/05	--	258	--	432	0.1	6.5	1950	19.3	1800	<1	--
		9/15/05	--	--	--	--	--	--	--	--	1700	<1	--
		1/18/06	--	284	--	524	0.3	6.6	2091	13.3	1800	2	--
		4/25/06	--	--	--	--	--	--	--	--	1700	<1	--
		4/25/06	--	--	--	--	--	--	--	--	1700	1	--
		4/25/06	--	119	--	479	0.2	6.4	2060	15.8	--	--	--
		4/25/06	--	120	--	--	--	--	--	--	--	--	--
		7/26/06	--	278	--	235	0.5	6.6	1975	19.9	1900	<1	--
		10/3/06	--	283	--	232	0.6	6.5	2021	20.5	--	--	--
		10/3/06	--	--	--	--	--	--	--	--	1800	<1	--
		10/3/06	--	--	--	--	--	--	--	--	1800	1	--

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)
JSF-W30 (cont.)	W-30	12/7/06	--	289	--	360	1.5	6.4	2110	13.6	--	--	--
		4/3/07	--	296	--	396	0.5	6.3	2006	15.8	1800	<1	--
		5/29/07	--	290	--	379	0.6	6.7	2107	18.9	--	--	--
		10/2/07	--	297	--	410	0.6	6.5	2078	19.6	1800	<1	--
		10/2/07	--	--	--	--	--	--	--	--	--	--	--
		4/9/08	--	295	--	305	2.5	6.5	2061	13.8	1800	<1	--
		5/19/08	--	298	--	268	0.5	6.5	2094	16.4	--	--	--
		10/28/08	--	299.5	--	299	0.5	6.5	2174	16.8	1800	<1	--
		10/28/08	--	--	--	--	--	--	--	--	1800	<1	--
		4/8/09	--	299	--	329	0.4	6.4	2071	12.7	1800	1	--
		5/20/09	--	296	--	294	0.3	6.3	1998	15.1	--	--	--
		10/7/09	--	284	--	296	0.5	6.4	2031	18.4	1800	1.2	--
		11/9/09	--	295	--	266	0.4	6.4	2023	17.7	--	--	--
		4/6/10	--	305.5	--	271	0.5	6.4	2054	15.8	1800	<1	--
		4/6/10	--	--	--	--	--	--	--	--	1700	<1	--
		10/18/10	--	309	--	151	0.6	6.3	2089	19.5	1900	<1	--
		4/19/11	--	314	--	224	0.3	6.2	2024	14.4	1800	<1	--
		10/19/11	--	348.5	--	381	0.5	6.3	2261	19.3	2000	<1	--
		10/19/11	--	--	--	--	--	--	--	--	2000	<1	--
		4/10/12	--	350	--	363	0.1	6.2	2218	14.8	--	--	1.5
		10/23/12	--	340	--	332	0.2	6.3	2147	20.8	1800	<1	4.1
		4/8/13	--	355	--	416	0.3	6.3	2133	15.4	--	1.1	0.6
		11/12/13	--	353	--	332	0.4	6.4	2116	17.1	1840	1	0.6
		4/7/14	--	352	--	320	0.2	6.4	2218	14	--	2	2.1
		11/18/14	--	368	--	340	0.1	6.3	2252	16.7	--	<1.02	0.4
		5/5/15	--	374	--	--	--	--	--	--	--	7.2	0.5
		5/5/15	--	--	--	--	--	--	--	--	--	<1	--
		11/16/15	--	--	--	--	--	--	--	--	1990	1	2.5
JSF-W31	W-31	6/25/98	--	310	--	504	0.3	6.7	2241	17.1	2200	660	--
		7/30/98	--	303	--	645	0.5	6.9	2496	21.8	2300	320	--
		11/4/98	--	309	--	565	0.2	6.8	2771	16.3	2800	110	--
		1/20/99	--	294	--	561	1.6	6.7	2392	12.1	2200	23	--
		4/14/99	--	301	--	535	0.7	6.6	2245	12.8	2000	110	--
		4/14/99	--	--	--	--	--	--	--	--	2100	93	--
		7/28/99	--	290	--	474	0.7	6.7	2595	19.5	2400	34	--
		10/28/99	--	350	--	461	2.2	6.7	2722	17.7	2500	740	--
		1/4/00	--	--	--	--	--	--	--	--	--	--	--
		1/5/00	--	314	--	545	1.8	6.7	2744	13	2600	<1	--
		4/6/00	--	266	--	503	3.4	6.8	2019	13.2	1700	<1	--
		4/6/00	--	--	--	--	--	--	--	--	1700	3	--
		7/6/00	--	258	--	415	1.5	6.7	2704	17.1	2500	<1	--
		1/24/01	--	291	--	532	6.4	6.9	2698	11.8	2400	15	--
		4/3/01	--	--	--	539	3.4	6.8	2286	12	--	--	--
		7/18/01	--	314	--	514	2.3	6.7	2827	18.7	2800	2	--
		9/26/01	--	--	--	411	1.2	6.8	2982	18.3	--	--	--
		1/17/02	--	318	--	554	1.8	6.8	3157	12.6	3000	7	--
		3/11/02	--	--	--	556	1.7	6.7	2926	12.9	--	--	--
		4/17/02	--	290	--	547	2.6	6.7	2396	15.6	--	--	--
		7/25/02	--	303	--	427	1.9	6.9	2909	19	2900	71	--
		10/22/02	--	310	--	506	1.6	6.8	3137	18.5	--	--	--

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)
JSF-W31 (cont.)	W-31	1/30/03	--	283	--	562	2.8	6.8	2551	10.6	2300	120	--
		4/8/03	--	273	--	553	1.8	6.6	2274	13.4	2100	78	--
		6/30/03	--	269	--	561	1	6.5	2272	19.7	2200	150	--
		10/16/03	--	293	--	510	0.9	6.6	2399	17.6	1600	43	--
		1/7/04	--	241	--	577	3.1	6.5	2003	9.2	1800	60	--
		4/7/04	--	280	--	575	0.8	6.8	2189	14.6	2000	130	--
		7/7/04	--	273	--	411	0.5	6.6	2203	21.2	2000	19	--
		10/19/04	--	302	--	335	0.3	6.8	2702	18.3	--	--	--
		10/19/04	--	--	--	--	--	--	--	--	2700	16	--
		1/4/05	--	295	--	581	0.6	6.5	2258	13.5	2400	11	--
		7/6/05	--	291	--	360	0.8	6.5	2138	18.4	2200	5	--
		7/14/05	--	--	--	384	0.4	6.5	2348	18.6	--	--	--
		9/15/05	--	280	--	448	0.4	6.7	2727	20	2700	8	--
		1/18/06	--	296	--	551	2.7	6.9	2660	12.2	2500	7	--
		4/25/06	--	--	--	--	--	--	--	--	2000	5	--
		4/25/06	--	284	--	521	3.3	6.7	2210	15.3	--	--	--
		7/26/06	--	297	--	524	1.2	6.6	2460	21.5	240	2	--
		10/3/06	--	325	--	468	0.9	6.7	2888	21	--	--	--
		10/3/06	--	--	--	--	--	--	--	--	2700	2	--
		4/3/07	--	314	--	491	1.1	6.5	2428	15.5	2200	3	--
		10/2/07	--	326.5	--	504	4.3	6.8	3047	21.1	3100	7.8	--
		10/2/07	--	--	--	--	--	--	--	--	3100	15	--
		10/2/07	--	--	--	--	--	--	--	--	--	--	--
		10/2/07	--	--	--	--	--	--	--	--	--	--	--
		12/10/07	--	--	--	--	--	--	--	--	--	--	--
		4/9/08	--	259	--	370	4.7	6.8	1885	13	1600	12	--
		5/19/08	--	--	--	322	2	6.7	2449	16.1	--	--	--
		10/28/08	--	327	--	420	2.5	6.7	3210	15.9	2900	3.1	--
		12/9/08	--	--	--	406	4.1	6.7	3250	13.7	--	--	--
		4/8/09	--	282	--	394	3.5	6.5	2177	12.1	1900	13	--
		5/20/09	--	--	--	376	3.3	6.4	1966	15.5	--	--	--
		10/7/09	--	289	--	341	1.3	6.6	2499	19	2200	4.6	--
		11/9/09	--	--	--	361	1.1	6.5	2597	17	--	--	--
		4/7/10	--	316	--	377	1.3	6.5	2422	13.4	2200	1.8	--
		4/9/10	--	--	--	--	--	--	--	--	--	--	--
		4/9/10	--	--	--	--	--	--	--	--	--	--	--
		5/13/10	--	--	--	356	1.6	6.4	2476	18.5	--	--	--
		5/13/10	--	--	--	--	--	--	--	--	--	--	--
		5/13/10	--	--	--	--	--	--	--	--	--	--	--
		5/13/10	--	--	--	--	--	--	--	--	--	--	--
		10/18/10	--	316	--	451	0.9	6.4	2945	18.5	2800	<1	--
		12/6/10	--	--	--	--	--	--	--	--	--	--	--
		12/6/10	--	--	--	462	4.6	5.8	2890	14.5	--	--	--
		1/27/11	--	--	--	404	2.6	6.6	2630	9.8	--	--	--
		4/20/11	--	304.5	--	477	4.3	6.3	2268	13.3	2000	13	--
		4/20/11	--	--	--	--	--	--	--	--	2000	12	--
		10/19/11	--	342	--	391	0.7	6.5	2971	18.8	2800	1.1	--
		10/19/11	--	--	--	--	--	--	--	--	--	--	--
		4/10/12	--	319	--	367	1.5	6.4	2447	14.4	--	--	10.1
		10/25/12	--	359.5	--	420	0.5	6.6	2931	18	2500	8.4	32.1

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)
JSF-W31 (cont.)	W-31	10/25/12	--	--	--	--	--	--	--	--	2500	6.9	--
		4/10/13	--	299	--	444	1.8	6.4	2183	13	--	2.1	0.7
		11/13/13	--	378	--	381	0.7	6.7	2880	17.3	2730	<1	77
		4/7/14	--	317	--	358	3	6.7	2438	12.8	--	1.9	3.5
		11/17/14	--	275	--	363	3	6.6	1773	15.4	--	<1	1.4
		5/6/15	--	421	--	--	--	--	--	--	--	2.5	2
		11/16/15	--	--	--	--	--	--	--	--	2490	<1	--
		11/16/15	--	--	--	--	--	--	--	--	2470	<1	--
JSF-W32	W-32	7/30/98	--	315	--	405	1.4	6.8	734	22.7	460	170	--
		11/4/98	--	332	--	583	2.6	6.8	735	15.9	440	56	--
		1/21/99	--	332	--	550	1.9	6.6	772	17.8	510	81	--
		4/14/99	--	302	--	545	0.7	6.7	693	14.6	390	55	--
		7/28/99	--	300	--	445	0.7	6.7	795	17.1	450	1400	--
		10/28/99	--	352	--	478	5.5	6.8	753	13	470	50	--
		1/5/00	--	341	--	549	1.4	6.6	794	14	510	4	--
		1/5/00	--	--	--	--	--	--	--	--	1400	2	--
		4/5/00	--	318	--	548	2	6.7	782	14.7	460	<1	--
		7/6/00	--	310	--	449	1.5	6.7	775	15.3	470	13	--
		1/23/01	--	333	--	428	2.5	6.7	730	15.3	440	4	--
		4/3/01	--	--	--	501	2.5	6.7	719	14.1	--	--	--
		7/19/01	--	308	--	557	3.5	6.8	679	16.3	410	11	--
		9/26/01	--	--	--	458	4	6.8	648	15.6	--	--	--
		1/17/02	--	314	--	554	2.1	6.7	706	14.7	430	6	--
		7/25/02	--	360	--	393	5.1	6.7	672	17	400	170	--
		10/22/02	--	296	--	534	3.3	6.8	686	16.6	--	--	--
		1/30/03	--	345	--	512	1.9	6.7	771	13.8	470	7	--
		4/8/03	--	334	--	550	2.4	6.7	730	14.2	450	4	--
		6/30/03	--	337	--	549	3.7	6.6	747	15.3	470	6	--
		10/16/03	--	334	--	540	3.9	6.6	720	20.3	450	4	--
		1/7/04	--	314	--	585	3.6	6.6	730	12	460	3	--
		4/7/04	--	306	--	595	3.9	6.8	709	14.5	430	5	--
		4/7/04	--	--	--	--	--	--	--	--	430	3	--
		7/6/04	--	311	--	486	3.4	6.8	736	18.3	470	10	--
		10/19/04	--	320	--	346	2.8	6.8	699	16.9	--	--	--
		10/19/04	--	--	--	--	--	--	--	--	480	6	--
		1/3/05	--	314.5	--	570	2.4	6.5	665	15.9	430	7	--
		1/3/05	--	--	--	--	--	--	--	--	440	4	--
		7/6/05	--	372	--	379	3.5	6.6	606	14.9	470	4	--
		7/14/05	--	--	--	389	2.9	6.7	700	15	--	--	--
		9/14/05	--	259	--	513	2.1	6.7	727	19.8	440	180	--
		1/18/06	--	347	--	548	1.8	6.8	761	14.5	460	6	--
		4/25/06	--	--	--	--	--	--	--	--	440	2	--
		4/25/06	--	327	--	542	3.9	6.7	731	15.6	--	--	--
		7/26/06	--	343	--	560	3.4	6.8	749	17.3	460	3	--
		10/3/06	--	--	--	--	--	--	--	--	470	4	--
		10/3/06	--	334	--	503	3.4	6.7	740	18.1	--	--	--
		4/3/07	--	309	--	522	4	6.6	696	16.5	--	--	--
		4/5/07	--	--	--	--	--	--	--	--	420	5	--
		10/4/07	--	315	--	520	4.2	6.7	678	17.3	--	--	--
		10/5/07	--	--	--	--	--	--	--	--	420	97	--

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)
JSF-W32 (cont.)	W-32	10/5/07	--	--	--	--	--	--	--	--	--	--	--
		4/8/08	--	328	--	434	5.4	6.6	731	14.5	--	--	--
		4/9/08	--	--	--	--	--	--	--	--	440	4.2	--
		10/28/08	--	337	--	457	5.2	6.7	753	13.5	440	2	--
		4/8/09	--	321	--	429	5.5	6.6	726	14.1	430	4	--
		10/7/09	--	--	--	--	--	--	--	--	440	7.1	--
		10/7/09	--	319.5	--	363	4.6	6.6	711	16.1	440	7.4	--
		11/9/09	--	--	--	401	4.2	6.5	702	16.6	--	--	--
		4/7/10	--	301	--	374	4.3	6.7	667	15.5	410	1.6	--
		10/19/10	--	305	--	431	2.8	6.5	725	15.8	460	5	--
		4/18/11	--	301	--	464	4.6	6.4	688	15.4	420	3.8	--
		10/19/11	--	314	--	398	2.9	6.5	702	16.7	420	1.2	--
		4/11/12	--	281	--	432	2.6	6.3	644	13.5	--	--	8.7
		10/25/12	--	300	--	435	0.9	6.7	668	18	370	1.6	7.3
		4/9/13	--	--	--	--	--	--	--	--	--	3	--
		4/9/13	--	293.5	--	462	4.7	6.6	664	21.4	--	2.6	4.3
		11/13/13	--	308	--	381	2.9	6.3	593	13.4	430	2.5	2
		11/13/13	--	--	--	--	--	--	--	--	423	1.9	--
		4/8/14	--	279	--	374	2.1	6.6	620	14.6	--	2.4	7.3
		11/17/14	--	298	--	356	0.8	6.7	668	15.3	--	14.8	4.7
		5/6/15	--	282	--	--	--	--	--	--	--	12	4.3
		11/16/15	--	--	--	--	--	--	--	--	370	1	--

-- no data
°C - degrees Celsius
cm - centimeters
cont. - continued
mg/L - milligrams per liter
mV - millivolts
Ref. - reference
NTU - Nephelometric Turbidity Unit

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-1	1	5/21/1987	1129.95	--	15.25
		6/4/1987	1126.17	80.08	19.03
		6/18/1987	1128.41	80.71	16.79
		12/16/1987	1129.20	80.08	16.00
		3/8/1988	1125.74	79.99	19.46
		6/21/1988	1124.38	--	20.82
		3/15/1989	1095.20	--	50.00
		6/7/1989	1132.23	--	12.97
		8/30/1989	--	83.99	15.50
		11/1/1989	--	83.99	16.90
		2/6/1990	1134.89	79.30	10.31
		5/22/1990	1134.15	79.99	11.05
		5/22/1990	1134.15	79.99	11.05
		8/8/1990	1127.40	79.99	17.80
		11/27/1990	1130.95	79.40	14.25
		2/27/1991	1130.40	--	14.80
		3/26/1991	1133.40	80.08	11.80
		4/30/1991	1133.08	79.99	12.12
		8/26/1991	1130.43	79.40	14.72
		2/18/1992	1133.41	79.40	11.74
		2/20/1992	1130.89	79.49	14.25
		8/17/1992	1131.53	79.49	13.62
		11/30/1992	1132.83	79.40	12.30
		12/1/1992	1128.96	79.40	16.17
		3/1/1993	1134.07	79.40	--
		5/20/1993	1134.07	80.08	--
		5/24/1993	1132.79	80.08	--
		8/16/1993	1130.56	79.46	--
		8/16/1993	1131.35	80.05	--
		8/16/1993	1131.35	80.05	--
		8/16/1993	1131.35	80.05	--
		8/16/1993	1131.35	80.05	--
		11/16/1993	1130.99	79.53	--
		11/17/1993	1129.71	79.53	--
		11/17/1993	1129.71	79.53	--
		11/17/1993	1129.71	79.53	--
		2/4/1994	1133.52	79.40	--
		2/22/1994	1134.04	79.40	--
		2/22/1994	1134.04	79.40	--
		5/16/1994	1132.37	79.40	--
		5/16/1994	1132.37	79.40	--
		5/18/1994	1134.47	79.40	--
		8/15/1994	1131.52	79.40	--
		8/15/1994	1131.52	79.40	--
		11/4/1994	1131.06	79.40	--
		11/7/1994	1131.06	79.40	--
		5/22/1995	1133.94	76.05	--
		1/22/1996	1133.75	79.30	--

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-1 (cont.)	1	1/23/1996	1133.81	79.30	--
		8/6/1996	1131.74	79.33	--
		1/7/1997	1133.68	78.94	--
		1/8/1997	1134.34	79.40	--
		1/8/1997	1134.34	79.40	--
		7/10/1997	1131.94	79.40	--
		7/14/1997	1131.52	79.40	--
		7/14/1997	1131.52	79.40	--
		1/13/1998	1133.12	79.43	--
		1/19/1998	1133.48	79.43	--
		1/19/1998	1133.48	79.43	--
		6/25/1998	1132.89	79.43	--
		7/28/1998	1131.35	79.40	--
		7/28/1998	1131.35	79.40	--
		11/4/1998	1129.19	79.40	--
		1/19/1999	1132.73	78.54	12.40
		1/21/1999	1132.96	78.54	12.17
		1/21/1999	1131.32	78.54	13.81
		4/13/1999	1133.84	78.48	11.29
		4/14/1999	1133.84	78.48	11.29
		7/26/1999	1131.38	78.54	13.75
		7/29/1999	1131.61	78.48	13.52
		10/27/1999	1128.56	78.54	16.57
		10/28/1999	1128.56	78.41	16.57
		1/4/2000	1129.38	78.48	15.75
		1/6/2000	1129.38	78.41	15.75
		4/4/2000	1133.88	78.48	11.25
		4/5/2000	1133.98	78.41	11.15
		7/5/2000	1130.83	78.48	14.30
		7/6/2000	1130.83	78.41	14.30
		1/22/2001	1130.37	78.48	14.76
		1/22/2001	1130.37	78.41	14.76
		7/17/2001	1130.50	78.67	14.63
		7/17/2001	1130.37	78.74	14.76
		1/16/2002	1130.76	78.58	14.37
		1/16/2002	1130.76	78.58	14.37
		7/24/2002	1129.02	78.48	16.11
		7/24/2002	1129.02	78.58	16.11
		1/28/2003	1132.60	78.58	12.53
		1/28/2003	1132.60	78.58	12.53
		6/30/2003	1132.34	78.58	12.80
		10/16/2003	1131.15	78.58	13.98
		1/6/2004	1134.11	75.88	11.02
		4/5/2004	1134.50	75.88	10.63
		7/6/2004	1133.98	75.88	11.15
		10/18/2004	1130.17	75.88	14.96
		1/3/2005	1133.22	75.88	11.91
		7/6/2005	1131.02	75.88	14.11

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-1 (cont.)	1	9/14/2005	1128.82	75.88	16.31
		1/18/2006	1130.37	75.88	14.76
		4/24/2006	1134.27	78.58	10.86
		7/24/2006	1129.81	--	--
		10/2/2006	1130.01	78.58	15.12
		4/3/2007	1133.09	78.58	12.04
		10/2/2007	1128.04	78.58	17.09
		4/8/2008	1134.07	78.58	11.06
		10/27/2008	1127.71	78.58	17.42
		4/7/2009	1134.37	78.58	10.76
		10/7/2009	1131.42	78.58	13.71
		4/5/2010	1134.24	78.58	10.89
		10/21/2010	1128.89	78.58	16.24
		4/20/2011	1134.50	78.58	10.63
		10/19/2011	1129.45	78.58	15.68
		4/11/2012	1134.17	78.58	26.25
		10/22/2012	1130.56	78.58	14.57
		4/11/2013	1134.89	78.58	10.43
		11/14/2013	1129.68	78.58	15.45
		4/10/2014	1134.63	78.58	10.50
		11/19/2014	1133.06	75.88	12.07
		11/16/2015	1129.55	75.88	15.58
JSF-10-36	10-36	4/19/2011	1111.86	21.92	7.32
		10/17/2011	1107.14	21.92	11.81
		4/9/2012	1110.16	21.92	8.79
		10/29/2012	1108.71	21.92	10.17
		4/10/2013	1111.73	21.92	7.68
		11/18/2013	1106.61	21.92	12.34
		4/9/2014	1111.17	21.88	7.78
JSF-10-37	10-37	4/19/2011	1110.06	24.93	9.94
		10/18/2011	1108.62	24.93	11.25
		4/9/2012	1109.30	24.93	10.56
		10/29/2012	1108.78	24.93	10.96
		4/10/2013	1109.96	24.93	10.14
		11/18/2013	1108.58	24.93	11.29
		4/9/2014	1107.40	24.93	12.47
JSF-15	15	3/28/1991	--	26.51	9.58
		4/29/1991	--	26.41	9.34
		8/27/1991	1092.43	26.41	9.65
		2/19/1992	1091.65	26.41	10.39
		12/1/1992	1092.24	26.41	9.81
		3/2/1993	1092.21	26.38	--
		5/25/1993	1092.54	27.72	--
		8/17/1993	1092.80	26.41	--
		8/17/1993	1092.80	26.41	--
		8/17/1993	1092.80	26.41	--
		11/18/1993	1092.31	26.41	--
		11/18/1993	1092.31	26.41	--

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-15 (cont.)	15	2/23/1994	1093.20	26.41	--
		2/23/1994	1093.20	26.41	--
		5/17/1994	1091.69	26.41	--
		8/15/1994	1092.11	26.41	--
		11/7/1994	1091.98	26.41	--
		5/22/1995	1092.60	26.41	--
		1/22/1996	1092.05	26.38	--
		8/7/1996	1092.60	26.25	--
		1/7/1997	1091.85	26.21	--
		1/9/1997	1089.29	26.38	--
		7/10/1997	1092.83	26.34	--
		7/15/1997	1092.70	26.34	--
		1/13/1998	1091.88	26.34	--
		1/21/1998	1091.26	26.25	--
		7/29/1998	1093.20	26.25	--
JSF-16	16	3/26/1991	--	23.00	7.95
		4/30/1991	--	23.00	8.52
		8/26/1991	1112.76	23.00	11.82
		2/20/1992	1115.64	23.00	8.94
		12/1/1992	1114.95	23.00	9.61
		3/2/1993	1116.69	22.97	--
		5/24/1993	1115.41	23.29	--
		8/16/1993	1113.34	23.29	--
		8/16/1993	1113.34	23.29	--
		11/17/1993	1111.44	22.97	--
		2/22/1994	1117.18	23.00	--
		5/16/1994	1115.14	23.00	--
		8/15/1994	1113.27	23.00	--
		11/7/1994	1112.39	23.00	--
		5/22/1995	1115.83	23.00	--
		1/22/1996	1116.85	23.00	--
		1/23/1996	1116.82	23.00	--
		8/6/1996	1113.41	26.25	--
		1/7/1997	1116.39	22.83	--
		1/8/1997	1116.29	22.97	--
		7/10/1997	1114.26	22.97	--
		7/15/1997	1113.57	22.97	--
		1/13/1998	1114.95	22.97	--
		1/19/1998	1115.31	22.97	--
		7/28/1998	1112.26	22.97	--
JSF-17	17	2/18/1992	1068.56	40.29	35.88
		5/19/1992	1068.46	40.29	35.98
		8/18/1992	1067.24	40.29	37.20
		12/2/1992	1067.15	40.29	37.29
		3/2/1993	1069.02	40.26	--
		5/25/1993	1070.66	40.26	--
		8/18/1993	1067.38	40.26	--
		11/18/1993	1065.08	40.29	--

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-17 (cont.)	17	2/24/1994	1070.39	40.29	--
		5/18/1994	1070.26	40.29	--
		8/17/1994	1068.85	40.29	--
		5/22/1995	1068.95	38.12	--
		1/22/1996	1068.72	40.29	--
		1/7/1997	1068.59	40.03	--
		7/10/1997	1068.88	40.39	--
		1/13/1998	1067.51	40.26	--
		1/19/1999	1068.20	40.22	36.25
		4/13/1999	1069.02	40.19	35.43
		7/26/1999	1068.06	40.22	36.38
		9/10/1999	1067.28	40.22	37.17
		10/27/1999	1066.59	40.22	37.86
		1/4/2000	1066.52	40.58	37.93
		1/6/2000	1066.52	40.58	37.93
		4/4/2000	1068.00	40.58	36.45
		7/5/2000	1067.21	40.58	37.24
		7/7/2000	1066.59	40.58	37.86
JSF-18	18	3/28/1991	--	15.29	4.30
		4/30/1991	--	15.29	7.42
		2/18/1992	1097.00	15.72	3.82
		1/22/1996	1090.34	19.68	--
		8/6/1996	1088.01	19.68	--
		1/7/1997	1089.23	19.52	--
		1/8/1997	1089.23	19.68	--
JSF-19	19	4/30/1991	--	12.40	2.52
JSF-2	2	5/21/1987	1120.67	--	12.13
		6/4/1987	1119.39	--	13.41
		6/18/1987	1117.98	--	14.82
		12/16/1987	1120.22	57.71	12.58
		3/8/1988	1121.18	57.71	11.62
		6/21/1988	1117.28	--	15.32
		8/29/1989	--	57.71	12.23
		11/1/1989	--	57.71	11.31
		2/6/1990	1128.07	56.40	4.73
		2/6/1990	1128.07	56.40	4.73
		5/22/1990	1127.27	50.59	5.53
		8/8/1990	1116.40	57.71	16.40
		11/27/1990	1123.10	57.18	9.70
		2/27/1991	1122.50	--	10.30
		3/27/1991	1127.58	57.81	5.22
		4/30/1991	1126.32	50.59	6.48
		8/26/1991	1122.23	55.90	10.61
		2/18/1992	1126.23	56.00	6.61
		2/20/1992	1122.59	55.90	10.23
		8/17/1992	1123.80	55.71	9.04
		11/30/1992	1125.31	56.00	7.50
		12/1/1992	1122.95	56.00	9.87

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-2 (cont.)	2	3/1/1993	1127.02	55.41	--
		5/20/1993	1124.79	55.41	--
		5/24/1993	1124.63	55.41	--
		8/16/1993	1122.20	55.28	--
		8/17/1993	1122.33	55.28	--
		8/17/1993	1122.33	55.28	--
		8/17/1993	1122.33	55.28	--
		8/17/1993	1122.33	55.28	--
		11/16/1993	1121.25	55.18	--
		11/18/1993	1121.25	55.18	--
		11/18/1993	1121.25	55.18	--
		11/18/1993	1121.25	55.18	--
		11/18/1993	1117.47	55.18	--
		2/4/1994	1125.77	55.25	--
		2/22/1994	1126.69	55.25	--
		2/22/1994	1126.69	55.25	--
		5/16/1994	1124.17	55.25	--
		5/16/1994	1124.17	55.25	--
		5/16/1994	1124.17	55.25	--
		8/15/1994	1121.64	55.25	--
		8/16/1994	1121.64	55.25	--
		11/4/1994	1121.77	55.25	--
		11/8/1994	1121.67	55.25	--
		5/22/1995	1125.35	55.25	--
		5/23/1995	0.00	55.25	--
		1/22/1996	1126.17	50.10	--
		1/23/1996	1126.10	50.10	--
		8/6/1996	1122.26	54.79	--
		1/7/1997	1125.81	54.79	--
		1/8/1997	1125.71	55.12	--
		1/8/1997	1125.71	--	--
		7/10/1997	1122.79	54.99	--
		7/14/1997	1122.13	54.99	--
		7/14/1997	1122.13	54.99	--
		1/13/1998	1124.10	54.92	--
		1/19/1998	1124.56	54.92	--
		1/20/1998	1124.56	54.92	--
		7/28/1998	1121.02	54.79	--
JSF-20	W-20	4/2/1991	--	13.62	2.80
		4/30/1991	--	13.48	2.98
		2/20/1992	1118.00	13.62	3.76
JSF-21	21	8/27/1991	1075.48	32.09	26.45
		2/18/1992	1075.64	32.18	26.27
		5/18/1992	1076.20	32.18	25.73
		8/18/1992	1074.37	--	27.56
		8/18/1992	1074.40	32.18	27.52
		12/2/1992	1074.30	32.18	27.64
		3/2/1993	1076.33	32.15	--

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-21 (cont.)	21	5/25/1993	1077.32	32.15	--
		8/17/1993	1076.33	32.15	--
		11/17/1993	1075.02	32.15	--
		2/23/1994	1078.01	32.15	--
		5/17/1994	1078.43	32.15	--
		8/16/1994	1078.53	32.15	--
		11/8/1994	1076.23	32.15	--
		5/22/1995	1077.19	32.15	--
		1/22/1996	1077.09	32.15	--
		1/24/1996	1077.19	32.15	--
		8/6/1996	1077.45	32.15	--
		1/7/1997	1076.46	32.15	--
		1/9/1997	1076.69	32.15	--
		7/10/1997	1077.91	32.15	--
		7/15/1997	1077.64	32.15	--
		1/13/1998	1075.38	32.15	--
		1/21/1998	1075.54	32.15	--
		6/25/1998	1078.66	32.15	--
		7/28/1998	1076.99	32.15	--
		1/19/1999	1075.81	32.15	26.12
		4/13/1999	1075.58	32.15	26.34
		7/26/1999	1074.95	32.15	26.97
		10/27/1999	1074.95	32.15	26.97
		4/4/2000	1074.99	32.15	26.94
		7/5/2000	1074.23	32.15	27.69
		1/16/2002	1073.74	32.05	28.18
		1/17/2002	1073.74	32.15	28.18
JSF-22*	22*	5/22/1995	1066.52	47.57	--
		1/22/1996	1079.06	39.86	--
		8/5/1996	1064.09	47.77	--
		1/7/1997	1079.06	39.66	--
		7/10/1997	1077.78	33.60	--
JSF-23*	23*	2/18/1992	1062.19	47.67	--
		8/17/1992	1045.10	47.70	--
		11/30/1992	1041.33	--	--
		3/1/1993	1126.33	47.57	--
		5/20/1993	1121.25	47.57	--
		8/16/1993	1124.86	48.00	--
		11/16/1993	1113.80	47.60	--
		2/4/1994	1125.08	47.60	--
		5/16/1994	1122.76	47.60	--
		8/15/1994	1117.51	47.60	--
		11/4/1994	1116.10	47.60	--
		5/22/1995	1133.42	39.50	--
		1/22/1996	1126.40	47.67	--
		8/5/1996	1132.17	33.17	--
		1/7/1997	1126.30	47.70	--
		7/10/1997	1118.52	47.77	--

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-23* (cont.)	23*	1/13/1998	1117.80	47.97	--
		1/19/1999	1119.57	53.25	28.90
		4/13/1999	1121.18	54.07	27.30
		7/26/1999	1115.24	53.25	33.23
		10/27/1999	1111.57	53.25	36.91
JSF-24	24	5/22/1995	1113.96	48.56	--
		1/22/1996	1111.76	48.56	--
		1/7/1997	1111.83	48.19	--
		7/10/1997	1113.77	48.56	--
		1/13/1998	1109.24	48.52	--
		1/19/1999	1110.32	48.42	25.82
		4/13/1999	1114.19	48.46	21.95
		7/26/1999	1111.11	48.42	25.03
		10/27/1999	1107.76	48.42	28.38
		1/4/2000	1107.20	48.42	28.94
		4/4/2000	1109.27	48.42	26.87
		7/5/2000	1109.60	48.42	26.54
JSF-25	25	5/22/1995	1100.02	84.25	--
		1/22/1996	1098.67	64.99	--
		1/24/1996	1099.07	64.99	--
		8/6/1996	1098.97	64.63	--
		1/7/1997	1098.08	64.57	--
		1/8/1997	1098.31	64.63	--
		7/10/1997	1099.13	64.99	--
		7/15/1997	1099.07	64.99	--
		1/13/1998	1097.49	64.99	--
		1/21/1998	1097.79	64.96	--
		7/29/1998	1098.64	64.96	--
JSF-26	26	8/6/1996	1066.75	46.92	--
		1/7/1997	1066.85	46.59	--
		1/7/1997	1066.98	46.92	--
		7/10/1997	1069.02	46.88	--
		7/15/1997	1067.80	46.92	--
		1/13/1998	1066.33	46.88	--
		1/21/1998	1066.39	46.88	--
		7/30/1998	1066.29	46.88	--
		1/19/1999	1066.85	46.92	38.84
		1/21/1999	1066.98	46.92	38.71
		4/13/1999	1066.82	46.65	38.88
		7/26/1999	1066.23	46.92	39.47
		9/10/1999	1064.26	46.92	41.44
		10/27/1999	1063.67	46.92	42.03
		1/4/2000	1063.77	46.59	41.93
		1/6/2000	1063.70	46.59	41.99
		4/4/2000	1066.65	46.59	39.04
		7/5/2000	1065.05	46.59	40.65
		7/7/2000	1065.05	46.59	40.65
		1/22/2001	1064.69	46.59	41.01

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-26 (cont.)	26	1/23/2001	1064.69	46.92	41.01
		7/17/2001	1065.47	46.85	40.22
		7/17/2001	1065.34	46.59	40.35
		1/16/2002	1064.49	46.72	41.21
		1/19/2002	1064.49	46.72	41.21
		7/24/2002	1064.88	46.59	40.81
		7/24/2002	1064.88	46.72	40.81
		1/28/2003	1066.33	46.72	39.37
		1/28/2003	1066.33	46.72	39.37
JSF-27A	27A	8/5/1996	1070.82	35.66	--
		1/7/1997	1071.12	35.40	--
		6/17/1997	872.23	--	--
JSF-3	3	5/21/1987	1102.00	--	13.20
		6/4/1987	1101.80	31.69	13.40
		6/18/1987	1101.46	31.69	13.74
		12/16/1987	1100.89	31.69	14.31
		3/8/1988	--	31.69	31.70
		6/21/1988	1097.00	31.40	18.20
		3/15/1989	1087.20	--	28.00
		6/6/1989	1097.11	35.79	18.09
		8/29/1989	--	36.09	17.98
		11/2/1989	--	36.09	19.60
		11/2/1989	--	36.09	19.60
		2/7/1990	1099.68	35.79	15.52
		5/22/1990	1099.08	35.79	16.12
		8/8/1990	1097.30	36.09	17.90
		11/27/1990	1091.80	35.99	23.40
		4/2/1991	1090.11	45.31	25.09
		4/29/1991	1089.40	45.60	25.80
		8/27/1991	1088.55	45.60	26.65
		11/13/1991	1102.67	46.49	26.00
		2/18/1992	1102.15	57.61	37.55
		2/20/1992	1101.92	57.61	37.81
		5/18/1992	1102.12	57.61	37.61
		8/17/1992	1089.66	57.61	39.01
		8/19/1992	1100.94	57.61	38.77
		11/30/1992	1100.61	57.51	39.10
		12/2/1992	1100.74	57.51	38.98
		3/1/1993	1101.17	--	0.00
		3/2/1993	1101.99	57.48	0.00
		5/20/1993	1102.02	57.48	0.00
		5/24/1993	1101.99	57.48	0.00
		8/16/1993	1100.71	57.55	0.00
		8/17/1993	1100.71	57.48	0.00
		8/17/1993	1100.71	57.48	0.00
		8/17/1993	1100.71	57.48	0.00
		8/17/1993	1100.71	57.48	0.00
		11/16/1993	1100.02	57.45	0.00

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-3 (cont.)	3	11/18/1993	1100.02	57.45	0.00
		11/18/1993	1098.02	57.41	0.00
		2/4/1994	1101.86	57.51	0.00
		2/22/1994	1102.38	57.51	0.00
		2/22/1994	1102.38	57.51	0.00
		5/16/1994	1103.60	57.51	0.00
		5/17/1994	1103.60	57.51	0.00
		5/17/1994	1103.60	57.51	0.00
		8/15/1994	1102.81	57.51	0.00
		8/16/1994	1102.81	57.51	0.00
		11/4/1994	1101.86	57.51	0.00
		11/8/1994	1101.79	57.51	0.00
		5/22/1995	1102.41	57.51	0.00
		1/22/1996	1101.92	57.55	0.00
		8/6/1996	1102.15	57.09	0.00
		1/7/1997	1104.12	57.09	0.00
		1/8/1997	1102.25	57.09	0.00
		7/10/1997	1105.30	57.51	0.00
		7/15/1997	1103.04	57.41	0.00
		1/13/1998	1103.83	57.55	0.00
		1/21/1998	1101.89	57.45	0.00
		7/29/1998	1103.20	57.55	0.00
JSF-B1	B-1	1/7/1997	1084.67	28.61	--
		7/10/1997	1083.45	28.67	--
		1/13/1998	1079.74	28.54	--
JSF-B5	B-5	1/7/1997	1082.63	38.12	--
		1/8/1997	1082.60	37.99	--
		7/10/1997	1080.27	37.89	--
		1/13/1998	1080.24	37.76	--
JSF-MW1	MW-1	7/19/2007	1116.03	28.67	19.88
JSF-MW2	MW-2	7/19/2007	1111.80	33.00	19.91
JSF-MW3	MW-3	7/19/2007	1067.90	22.87	11.38
		8/30/2012	1068.29	22.87	10.73
		10/30/2012	1068.23	22.87	10.79
		2/25/2013	1072.99	22.87	6.04
		4/11/2013	1073.12	22.87	5.91
JSF-MW4	MW-4	7/19/2007	1079.81	26.94	17.45
		9/19/2007	1089.49	26.94	18.73
JSF-MW5	MW-5	7/19/2007	1067.93	40.42	33.79
		9/19/2007	1090.77	40.39	34.02
JSF-OW33	OW-33	4/3/2007	1096.34	57.81	45.50
		7/18/2007	1095.82	57.74	46.32
		10/1/2007	1095.30	57.74	46.85
		1/28/2008	1094.84	57.74	47.31
		4/10/2008	1095.03	57.74	47.11
		10/29/2008	1094.38	57.74	47.77
JSF-OW34	OW-34	4/3/2007	1096.94	59.19	46.16
		7/18/2007	1096.57	59.05	46.82

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-OW34 (cont.)	OW-34	10/1/2007	1095.95	59.05	47.44
		1/28/2008	1095.36	59.05	48.03
		4/10/2008	1095.92	59.05	47.47
		10/29/2008	1095.56	59.05	47.83
JSF-OW35	OW-35	4/3/2007	1094.67	56.73	50.95
		7/18/2007	1094.54	56.76	51.38
		10/1/2007	1093.79	56.76	52.10
		1/28/2008	1086.73	56.76	53.35
		4/10/2008	1093.10	56.76	52.82
		10/29/2008	1093.65	56.76	52.26
JSF-PZ1	PZ-1	5/21/1987	--	22.51	14.80
		6/4/1987	--	22.51	15.13
		6/18/1987	--	22.51	15.41
		3/28/1991	--	23.00	13.72
JSF-PZ2A	PZ-2A	6/4/1987	--	57.71	31.30
		6/18/1987	--	57.71	31.41
		3/27/1991	--	57.91	29.68
		11/14/1991	--	57.71	30.51
		2/18/1992	1086.46	57.71	30.21
		2/19/1992	1086.08	57.71	30.21
		5/18/1992	1086.01	57.71	30.27
		8/17/1992	1083.55	57.71	32.75
		8/18/1992	1083.52	57.71	32.77
		11/30/1992	1081.78	57.71	34.50
		12/2/1992	1081.78	57.71	34.52
		3/1/1993	1080.86	57.68	--
		5/20/1993	1080.70	57.77	--
		5/25/1993	1080.53	57.77	--
		8/16/1993	1079.48	57.68	--
		8/18/1993	1079.42	57.68	--
		8/18/1993	1079.42	57.68	--
		8/18/1993	1079.42	57.68	--
		8/18/1993	1079.42	57.68	--
		11/16/1993	1078.46	57.64	--
		11/17/1993	1078.23	57.45	--
		2/4/1994	1078.53	57.64	--
		2/24/1994	1079.38	57.64	--
		5/16/1994	1079.65	57.64	--
		5/18/1994	1079.61	57.64	--
		8/15/1994	1079.09	57.64	--
		8/17/1994	1079.09	57.64	--
		11/4/1994	1078.20	57.64	--
		11/9/1994	1060.32	57.64	--
		5/22/1995	1076.99	57.64	--
		1/22/1996	1077.12	57.64	--
		1/23/1996	1073.77	57.64	--

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-PZ2A (cont.)	PZ-2A	8/7/1996	1077.22	57.28	--
		1/7/1997	1077.09	57.28	--
		7/10/1997	1077.74	57.64	--
		1/13/1998	1076.43	57.64	--
		6/24/1998	1077.58	57.74	--
JSF-PZ2B	PZ-2B	6/4/1987	--	42.68	25.00
		6/18/1987	--	42.68	25.03
		3/27/1991	--	43.01	20.33
		2/18/1992	1096.13	42.81	20.69
		2/19/1992	1096.12	42.81	20.69
		8/17/1992	1092.07	42.68	24.75
		11/30/1992	1088.77	42.81	28.05
		12/2/1992	1088.70	42.81	28.12
		3/2/1993	1086.96	42.98	--
		5/20/1993	1086.14	42.81	--
		5/25/1993	1085.98	42.81	--
		8/16/1993	1084.27	42.98	--
		8/18/1993	1084.30	42.98	--
		11/16/1993	1082.43	42.68	--
		11/17/1993	1082.37	42.65	--
		2/4/1994	1090.01	42.68	--
		2/24/1994	1083.02	42.68	--
		5/16/1994	1084.01	42.68	--
		5/18/1994	1083.94	42.68	--
		8/15/1994	1082.83	42.68	--
		8/17/1994	1082.83	42.68	--
		11/4/1994	1081.55	42.68	--
		11/9/1994	1081.75	42.68	--
		5/22/1995	1080.73	42.68	--
		1/22/1996	1079.06	42.81	--
		1/23/1996	1079.02	42.81	--
		8/6/1996	1080.24	42.32	--
		1/7/1997	1079.71	42.42	--
		7/10/1997	1081.29	42.72	--
		1/13/1998	1079.06	42.75	--
		6/24/1998	1080.73	42.65	--
JSF-PZ3A	PZ-3A	6/4/1987	--	55.71	20.00
		6/18/1987	--	55.71	21.00
		3/27/1991	--	55.51	14.60
		11/14/1991	--	55.41	15.41
		2/18/1992	1100.10	55.31	14.50
		2/19/1992	1100.09	55.31	14.50
		5/18/1992	1099.89	55.31	14.71
		8/17/1992	1095.59	55.41	19.01
		8/18/1992	1095.56	44.00	19.04
		11/30/1992	1092.28	55.31	22.30

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-PZ3A (cont.)	PZ-3A	12/3/1992	1092.15	55.31	22.45
		3/1/1993	1091.19	--	--
		3/3/1993	1091.29	49.87	--
		5/20/1993	1090.47	49.87	--
		5/26/1993	1090.31	49.87	--
		8/16/1993	1088.47	--	--
		8/18/1993	1088.41	49.87	--
		11/16/1993	1087.36	--	--
		11/17/1993	1087.36	55.28	--
		2/4/1994	1087.68	55.28	--
		2/23/1994	1088.44	55.28	--
		5/16/1994	1089.39	55.28	--
		5/18/1994	1089.36	55.28	--
		8/15/1994	1088.04	55.28	--
		8/15/1994	1088.04	55.28	--
		8/16/1994	1088.04	55.28	--
		11/4/1994	1086.93	55.28	--
		11/8/1994	1087.03	55.28	--
		5/22/1995	1086.54	55.28	--
		5/24/1995	--	55.28	--
		1/22/1996	1085.78	55.28	--
		1/24/1996	1085.91	55.28	--
		8/7/1996	1086.44	55.28	--
		1/7/1997	1085.81	55.28	--
		7/10/1997	1086.96	55.28	--
		1/13/1998	1085.09	55.28	--
		6/24/1998	1086.90	55.28	--
JSF-PZ3B	PZ-3B	6/4/1987	--	48.79	20.00
		6/18/1987	--	42.81	21.65
		3/27/1991	--	42.81	14.44
		2/18/1992	1100.17	42.68	14.73
		2/19/1992	1100.15	42.68	14.73
		8/17/1992	1096.24	42.81	18.66
		11/30/1992	1092.97	42.81	21.90
		12/2/1992	1092.74	42.81	22.15
		3/1/1993	1090.28	--	--
		3/2/1993	1091.92	--	--
		5/20/1993	1091.78	42.13	--
		5/26/1993	1089.95	42.13	--
		8/16/1993	1089.06	42.81	--
		8/18/1993	1087.75	41.99	--
		11/16/1993	1087.59	42.81	--
		11/17/1993	1087.65	42.81	--
		2/23/1994	1088.67	42.81	--
		5/16/1994	1089.85	42.81	--
		5/18/1994	1089.52	42.81	--
		8/15/1994	1088.47	42.81	--
		8/16/1994	1088.47	42.81	--
		11/4/1994	1087.29	42.81	--

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-PZ3B (cont.)	PZ-3B	11/9/1994	1087.29	42.81	--
		5/22/1995	1086.93	42.81	--
		1/22/1996	1086.40	42.75	--
		1/7/1997	1086.54	42.39	--
		7/10/1997	1087.62	42.75	--
		1/13/1998	1085.81	42.65	--
		6/24/1998	1087.26	42.65	--
JSF-PZ4A	PZ-4A	6/4/1987	--	52.69	27.10
		6/18/1987	--	52.69	31.48
		3/28/1991	--	52.69	25.72
		11/14/1991	--	52.69	27.52
		2/18/1992	1087.05	53.21	25.87
		2/19/1992	1087.03	53.21	25.87
		5/19/1992	1090.08	52.69	22.85
		8/17/1992	1085.71	52.69	27.21
		8/18/1992	1085.72	52.69	27.20
		11/30/1992	1084.83	52.69	28.10
		12/2/1992	1084.70	52.69	28.20
		3/1/1993	1083.48	--	--
		3/3/1993	1083.48	52.82	--
		5/20/1993	1085.35	52.82	--
		5/26/1993	1085.35	52.82	--
		8/16/1993	1083.65	--	--
		8/18/1993	1083.45	52.82	--
		11/16/1993	1082.93	--	--
		11/17/1993	1083.06	52.82	--
		2/4/1994	1084.14	52.82	--
		2/23/1994	1085.58	52.82	--
		5/16/1994	1086.08	52.82	--
		5/17/1994	1086.04	52.82	--
		8/15/1994	1084.96	52.82	--
		8/16/1994	1084.96	52.82	--
		11/4/1994	1083.45	52.82	--
		11/8/1994	1083.45	52.82	--
		5/22/1995	1083.39	52.82	--
		1/22/1996	1082.73	52.82	--
		1/24/1996	1082.96	52.82	--
		8/7/1996	1083.09	52.82	--
		1/7/1997	1082.37	52.82	--
		7/10/1997	1083.78	52.82	--
		1/13/1998	1081.45	52.82	--
		6/24/1998	1084.44	52.82	--
JSF-PZ4B	PZ-4B	6/4/1987	--	40.91	32.00
		6/18/1987	--	40.91	28.16
JSF-TW30	TW-30	1/4/2000	1083.78	47.28	31.43
		4/4/2000	1083.85	47.28	31.36
		7/5/2000	1083.58	47.28	31.63

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-W28	W-28	7/30/1998	1070.39	28.35	--
		11/4/1998	1069.47	28.28	--
		1/19/1999	1070.26	28.28	17.45
		1/20/1999	1070.45	28.28	17.26
		4/13/1999	1069.64	28.31	18.08
		4/14/1999	1069.67	28.31	18.04
		7/26/1999	1068.82	28.28	18.90
		7/28/1999	1069.02	28.44	18.70
		10/27/1999	1068.46	28.28	19.26
		10/28/1999	1068.46	28.21	19.36
		1/4/2000	1068.20	28.25	19.52
		1/5/2000	1068.20	28.21	19.52
		4/4/2000	1070.10	28.25	17.62
		4/6/2000	1070.09	28.21	17.62
		7/5/2000	1068.62	28.25	19.09
		7/7/2000	1068.62	28.21	19.09
		1/22/2001	1068.36	28.25	19.36
		1/22/2001	1068.35	28.31	19.36
		4/3/2001	1069.17	28.31	18.54
		7/17/2001	1068.16	28.18	19.55
		7/19/2001	1068.16	28.21	19.55
		9/26/2001	1068.35	28.21	19.36
		1/16/2002	1067.83	28.15	19.88
		1/19/2002	1067.83	28.21	19.88
		3/11/2002	1067.73	28.21	19.98
		7/24/2002	1067.90	28.25	19.82
		7/25/2002	1067.89	28.21	19.82
		1/28/2003	1068.65	28.21	19.06
		1/31/2003	1068.65	28.21	19.06
		4/8/2003	1068.69	28.25	19.03
		4/8/2003	1068.68	28.25	19.03
		6/30/2003	1073.51	28.21	14.21
		10/16/2003	1068.98	28.21	18.73
		1/6/2004	1070.30	28.18	17.42
		4/5/2004	1069.74	28.15	17.98
		7/6/2004	1073.05	28.18	14.67
		10/18/2004	1069.31	28.18	18.41
		1/3/2005	1069.38	28.18	18.34
		7/6/2005	1072.26	28.18	15.45
JSF-W29	W-29	7/30/1998	1067.87	21.16	--
		11/4/1998	1065.74	21.16	--
		1/19/1999	1068.56	21.23	9.88
		1/20/1999	1068.76	21.23	9.68
		4/13/1999	1066.95	21.23	11.48
		4/14/1999	1066.92	21.23	11.52
		7/26/1999	1065.77	21.23	12.66
		7/28/1999	1066.19	21.23	12.24
		10/27/1999	1064.59	21.23	13.84

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-W29 (cont.)	W-29	10/28/1999	1064.59	21.10	13.84
		1/4/2000	1064.55	21.10	13.88
		1/5/2000	1064.55	21.10	13.88
		4/4/2000	1070.56	21.10	7.87
		4/6/2000	1070.56	21.10	7.87
		7/5/2000	1066.10	21.10	12.34
		7/6/2000	1066.10	21.10	12.34
		1/22/2001	1067.61	21.10	10.83
		1/22/2001	1067.61	21.23	10.83
		7/17/2001	1066.29	21.10	12.14
		7/18/2001	1066.30	21.23	12.14
		1/16/2002	1065.21	21.13	13.22
		1/17/2002	1065.22	21.23	13.22
		7/24/2002	1066.36	21.10	12.07
		7/25/2002	1066.36	21.23	12.07
		10/22/2002	1066.10	21.23	12.34
		1/28/2003	1068.33	21.23	10.10
		1/30/2003	1068.33	21.23	10.10
		4/8/2003	1067.67	21.13	10.76
		4/8/2003	1067.68	21.13	10.76
		6/30/2003	1073.05	21.23	5.38
		10/16/2003	1066.98	21.23	11.45
		1/6/2004	1069.80	21.13	8.63
		4/5/2004	1069.77	21.13	8.66
		7/6/2004	1073.51	21.13	4.92
		10/18/2004	1067.74	21.13	10.70
		1/3/2005	1068.95	21.13	9.48
		7/6/2005	1072.23	21.13	6.20
		9/14/2005	1067.83	21.13	10.60
		1/18/2006	1070.85	21.13	7.58
		4/25/2006	1071.67	21.13	6.76
		7/26/2006	1067.57	21.13	7.58
		10/3/2006	1067.80	21.13	10.50
		12/7/2006	1068.13	21.13	10.30
		4/3/2007	1068.62	21.13	9.81
		5/29/2007	1068.62	21.13	10.76
		10/2/2007	1065.54	21.13	12.89
		4/9/2008	1071.12	21.13	7.32
		10/28/2008	1064.72	21.13	13.71
		4/8/2009	1070.07	21.13	8.37
		10/6/2009	1068.69	21.13	9.74
		11/9/2009	1068.98	21.13	9.45
		4/6/2010	1069.15	21.13	9.28
		10/19/2010	1065.24	21.13	13.19
		4/18/2011	1071.71	21.13	6.73
		10/18/2011	1064.78	21.13	13.65
		4/10/2012	1067.31	21.13	10.96
		10/23/2012	1065.24	21.13	13.09

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-W29 (cont.)	W-29	4/8/2013	1070.53	21.13	7.91
		11/12/2013	1065.18	21.13	13.25
		4/8/2014	1068.29	21.13	10.14
		11/18/2014	1068.79	21.13	9.65
JSF-W30	W-30	7/30/1998	1074.59	20.11	--
		11/4/1998	1074.00	20.08	--
		1/19/1999	1074.59	20.08	4.76
		1/20/1999	1074.46	20.08	4.89
		4/13/1999	1074.10	20.11	5.25
		4/14/1999	1074.13	20.11	5.22
		7/26/1999	1073.81	20.08	5.54
		7/28/1999	1073.94	20.11	5.41
		10/27/1999	1070.00	20.08	9.35
		10/28/1999	1070.00	20.01	9.35
		1/4/2000	1073.02	20.01	6.33
		1/5/2000	1073.02	20.01	6.33
		4/4/2000	1074.17	20.01	5.18
		4/6/2000	1074.17	20.01	5.18
		7/5/2000	1073.71	20.01	5.64
		7/6/2000	1073.71	20.01	5.64
		1/22/2001	1073.25	20.01	6.10
		1/22/2001	1073.25	20.11	6.10
		4/3/2001	1073.77	20.11	5.58
		7/17/2001	1073.25	20.08	6.10
		7/18/2001	1073.25	20.01	6.10
		10/24/2001	1073.22	20.01	6.14
		1/16/2002	1073.28	20.11	6.07
		1/17/2002	1073.28	20.11	6.07
		3/11/2002	1073.28	20.01	6.07
		4/17/2002	1073.25	20.01	6.10
		7/24/2002	1073.48	20.01	5.87
		7/25/2002	1073.48	20.11	5.87
		10/22/2002	1073.41	21.23	5.94
		1/28/2003	1074.00	20.01	5.35
		1/30/2003	1074.00	20.11	5.35
		4/8/2003	1074.23	20.11	5.12
		4/8/2003	1074.23	20.11	5.12
		6/30/2003	1076.23	20.01	3.12
		10/16/2003	1074.76	20.01	4.59
		1/6/2004	1074.95	20.08	4.40
		4/5/2004	1074.69	20.05	4.66
		7/6/2004	1076.30	20.08	3.05
		10/18/2004	1075.09	20.08	4.27
		1/3/2005	1074.59	20.08	4.76
		7/6/2005	1076.07	20.08	3.28
		9/14/2005	1074.66	20.08	4.69
		1/18/2006	1075.02	20.08	4.33
		4/25/2006	1075.09	20.05	4.27

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-W30 (cont.)	W-30	7/26/2006	1075.58	20.05	3.77
		10/3/2006	1074.69	20.05	4.66
		12/7/2006	1074.53	20.05	4.82
		4/3/2007	1074.30	20.05	5.05
		5/29/2007	1074.30	20.05	5.18
		10/2/2007	1073.87	20.05	5.48
		4/9/2008	1074.63	20.05	4.72
		5/19/2008	1074.56	20.05	4.79
		10/28/2008	1073.77	20.05	5.58
		4/8/2009	1074.69	20.05	4.66
		5/20/2009	1075.74	20.05	3.61
		10/7/2009	1075.02	20.05	4.33
		11/9/2009	1074.89	20.05	4.46
		4/6/2010	1074.66	20.05	4.69
		10/18/2010	1074.33	20.05	5.02
		4/19/2011	1074.43	20.05	5.05
		10/19/2011	1072.36	20.05	6.99
		4/10/2012	1072.99	20.05	6.33
		10/23/2012	1072.30	20.05	6.92
		4/8/2013	1073.28	20.05	6.07
		11/12/2013	1072.46	20.05	6.89
		4/7/2014	1073.41	20.08	5.94
		11/18/2014	1072.85	20.08	6.50
JSF-W31	W-31	6/25/1998	1075.85	17.65	--
		7/30/1998	1076.82	17.62	--
		11/4/1998	1074.77	17.65	--
		1/19/1999	1075.71	17.65	8.89
		1/20/1999	1075.69	--	8.92
		4/13/1999	1075.32	17.65	9.28
		4/14/1999	1075.36	17.65	9.25
		7/26/1999	1074.56	17.65	10.04
		7/28/1999	1074.53	17.55	10.07
		10/27/1999	1072.95	17.65	11.65
		10/28/1999	1072.96	17.65	11.65
		1/4/2000	1072.62	17.65	11.97
		1/5/2000	1072.62	17.65	11.97
		4/4/2000	1074.66	17.65	9.94
		4/6/2000	1074.67	17.65	9.94
		7/5/2000	1073.35	17.65	11.25
		7/6/2000	1073.36	17.65	11.25
		1/22/2001	1072.79	17.65	11.81
		1/24/2001	1072.80	17.55	11.81
		4/3/2001	1074.11	17.55	10.50
		7/17/2001	1073.51	17.62	11.09
		7/18/2001	1073.52	17.55	11.09
		9/26/2001	1073.45	17.55	11.15
		1/16/2002	1072.82	17.55	11.78
		1/17/2002	1072.83	17.55	11.78

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-W31 (cont.)	W-31	3/11/2002	1073.45	17.55	11.15
		4/17/2002	1074.10	17.55	10.50
		7/24/2002	1073.61	17.65	10.99
		7/25/2002	1073.62	17.55	10.99
		10/22/2002	1072.82	17.55	11.78
		1/28/2003	1074.76	17.55	9.84
		1/30/2003	1074.77	17.55	9.84
		4/8/2003	1075.35	17.55	9.25
		4/8/2003	1075.36	17.55	9.25
		6/30/2003	1078.14	17.55	6.46
		10/16/2003	1075.38	17.55	9.22
		1/6/2004	1076.56	17.59	8.04
		4/5/2004	1076.43	17.59	8.17
		7/6/2004	1078.27	17.59	6.33
		10/18/2004	1075.41	17.59	9.19
		1/3/2005	1078.92	17.59	5.68
		7/6/2005	1077.19	17.59	7.41
		9/14/2005	1075.09	17.59	9.51
		1/18/2006	1074.46	17.59	10.14
		4/25/2006	1075.77	17.59	8.83
		7/26/2006	1076.20	17.59	8.40
		10/3/2006	1074.17	17.59	10.43
		4/3/2007	1074.72	17.59	9.88
		10/2/2007	1072.79	17.59	11.81
		4/9/2008	1076.99	17.59	9.06
		5/19/2008	1074.82	17.59	9.78
		10/28/2008	1072.79	17.59	11.81
		12/9/2008	1072.36	17.59	12.24
		4/8/2009	1075.41	17.59	9.19
		5/20/2009	1076.63	17.59	7.97
		10/7/2009	1074.95	17.59	9.65
		11/9/2009	1074.86	17.59	9.74
		4/7/2010	1074.95	17.59	9.65
		5/13/2010	1074.69	17.59	9.91
		10/18/2010	1073.64	17.59	10.96
		12/6/2010	1074.00	17.59	10.60
		1/27/2011	1073.97	17.59	10.63
		4/20/2011	1075.38	17.59	9.25
		10/19/2011	1073.64	17.59	10.96
		4/10/2012	1075.02	17.59	9.58
		10/25/2012	1073.90	17.59	10.70
		4/10/2013	1076.00	17.59	8.66
		11/13/2013	1073.77	17.59	10.83
		4/7/2014	1075.18	17.59	9.42
		11/17/2014	1074.95	17.59	9.65

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-W32	W-32	7/30/1998	1085.49	25.59	--
		11/4/1998	1083.00	25.56	--
		1/19/1999	1086.60	25.59	17.32
		1/21/1999	1086.61	25.59	17.32
		4/13/1999	1086.86	25.59	17.06
		4/14/1999	1086.87	25.59	17.06
		7/26/1999	1085.32	25.59	18.60
		7/28/1999	1085.35	25.59	18.57
		10/27/1999	1081.81	25.59	22.11
		10/28/1999	1081.81	25.59	22.11
		1/4/2000	1083.85	25.59	20.08
		1/5/2000	1083.62	25.59	20.31
		4/4/2000	1086.99	25.59	16.93
		4/5/2000	1087.00	25.59	16.93
		7/5/2000	1084.83	25.59	19.09
		7/6/2000	1084.84	25.59	19.09
		1/22/2001	1088.18	25.59	15.75
		1/23/2001	1088.18	25.59	15.75
		4/3/2001	1088.18	25.59	15.75
		7/17/2001	1085.22	25.59	18.70
		7/19/2001	1085.23	25.59	18.70
		9/26/2001	1085.23	25.59	18.70
		1/16/2002	1084.89	25.59	19.03
		1/17/2002	1084.90	25.59	19.03
		7/24/2002	1081.71	25.59	22.21
		7/25/2002	1081.72	25.59	22.21
		10/22/2002	1083.68	25.59	20.24
		1/28/2003	1085.78	25.59	18.14
		1/30/2003	1066.47	25.59	18.14
		4/8/2003	1086.96	25.52	16.96
		4/8/2003	1086.97	25.52	16.96
		6/30/2003	1086.96	25.59	16.96
		10/16/2003	1086.34	25.59	17.59
		1/6/2004	1087.91	25.59	16.01
		4/5/2004	1088.08	25.59	15.85
		7/6/2004	1087.78	25.59	16.14
		1/3/2005	1087.03	25.59	16.90
		7/6/2005	1085.58	25.59	18.34
		9/14/2005	1082.37	25.59	21.55
		1/18/2006	1085.16	25.59	18.77
		4/25/2006	1087.78	25.59	16.14
		7/26/2006	1085.22	25.59	18.70
		10/3/2006	1085.88	25.59	18.04
		4/3/2007	1087.22	25.59	16.70
		10/4/2007	1081.91	25.26	22.18
		4/8/2008	1088.04	25.26	15.88
		10/28/2008	1084.11	25.26	19.82
		4/8/2009	1088.50	25.26	15.42

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
JSF-W32 (cont.)	W-32	10/7/2009	1087.49	25.26	16.44
		11/9/2009	1087.59	25.39	16.34
		4/7/2010	1087.91	25.26	16.01
		10/19/2010	1085.09	25.26	18.83
		4/18/2011	1088.96	25.26	14.96
		10/19/2011	1086.44	25.26	17.49
		4/11/2012	1087.55	25.26	16.47
		10/25/2012	1086.83	25.26	17.09
		4/9/2013	1088.21	25.26	15.88
		11/13/2013	1086.67	25.26	17.26
		4/8/2014	1087.88	25.59	16.04
		11/17/2014	1085.42	25.59	18.50

-- no data
cont. - continued
ft amsl = feet above mean sea level
ft = feet
GW = groundwater
Ref. - reference
* historical location unknown

APPENDIX H
GROUNDWATER INVESTIGATION SAP

Groundwater Investigation
Sampling and Analysis Plan
John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Public Comments, Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

GROUNDWATER INVESTIGATION
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Groundwater Investigation
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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 10/17/18

TVA Investigation Field Lead — Date 10/17/18

Health, Safety, and Environmental (HSE) Manager — Date 10/17/18

Kip Anderson
Investigation Project Manager — Date 10/08/18

Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.10.17 10:00:23 -04'00'
QA Oversight Manager — Date

Laboratory Project Manager — Date 10/16/18

Charles L. Head
Charles L. Head
TDEC Senior Advisor — Date 2018/10/31

Robert Wilkinson
TDEC CCR Technical Manager — Date 10/31/18

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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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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 JSF 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 JSF for TDEC Solid Waste Management permit requirements. Monitoring wells that are being sampled as part of the TDEC Solid Waste Management program will not be sampled as part of this SAP. However, groundwater levels will be measured in certain wells within the existing monitoring network as part of this SAP to provide information to prepare groundwater contour maps for the plant.

For the purposes of the SAP, observation wells are defined as wells that will be used primarily to observe changes in groundwater levels over time, and monitoring wells are defined as wells that will be used to monitor groundwater quality and measure groundwater levels. Existing wells that are screened completely or partially in bedrock or weathered shale were designated as observation wells because groundwater quality results from these wells may not be representative of the targeted overburden zone where groundwater has been encountered. However, groundwater level measurements from these wells provide useful information related to groundwater flow conditions. The existing wells designated as monitoring wells are screened in the overburden and provide useful information related to groundwater quality and groundwater flow conditions.

Sampling Scope

TVA will measure groundwater levels at the following monitoring and observation well locations across the site:

- Existing monitoring wells W-28, W-29, W-30, W-31, W-32, 10-36, JSF-101, JSF-102, JSF-103, JSF-104 and JSF-105
- Existing observation wells JSF-1, JSF-2, MW-2 and MW-4
- Eight proposed monitoring wells (JSF-106, JSF-107, JSF-108, JSF-109, JSF-110, JSF-111, JSF-112 and JSF-113) to be installed as part of the environmental investigation

The Hydrogeological Investigation SAP provides the rationale, locations, contingencies, and installation methods for proposed new monitoring wells.

Surface water elevations will be measured at the gauging station in the Holston River. Figure 1 (Attachment A) shows the location of the Holston River monitoring point.

Groundwater samples will be collected for chemical analyses from the eight 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 environmental investigation. The data utilized from other programs will be provided in the Environmental Assessment Report (EAR).

Figure 1 shows the monitoring and observation well locations that will be sampled or from which groundwater level measurements will be collected as part of this SAP. This figure will be updated to show the actual locations for proposed wells after execution of the Hydrogeological 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 groundwater seasonal 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 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% µS/cm
- Dissolved oxygen (DO) - ±10% for > 0.5 mg/L or <0.5 mg/L
- 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 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 (ºC) 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	5 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 (US EPA). 1989 "Sampling Frequency for Ground-Water Quality Monitoring Project Summary Document." September.

ATTACHMENT A
FIGURE

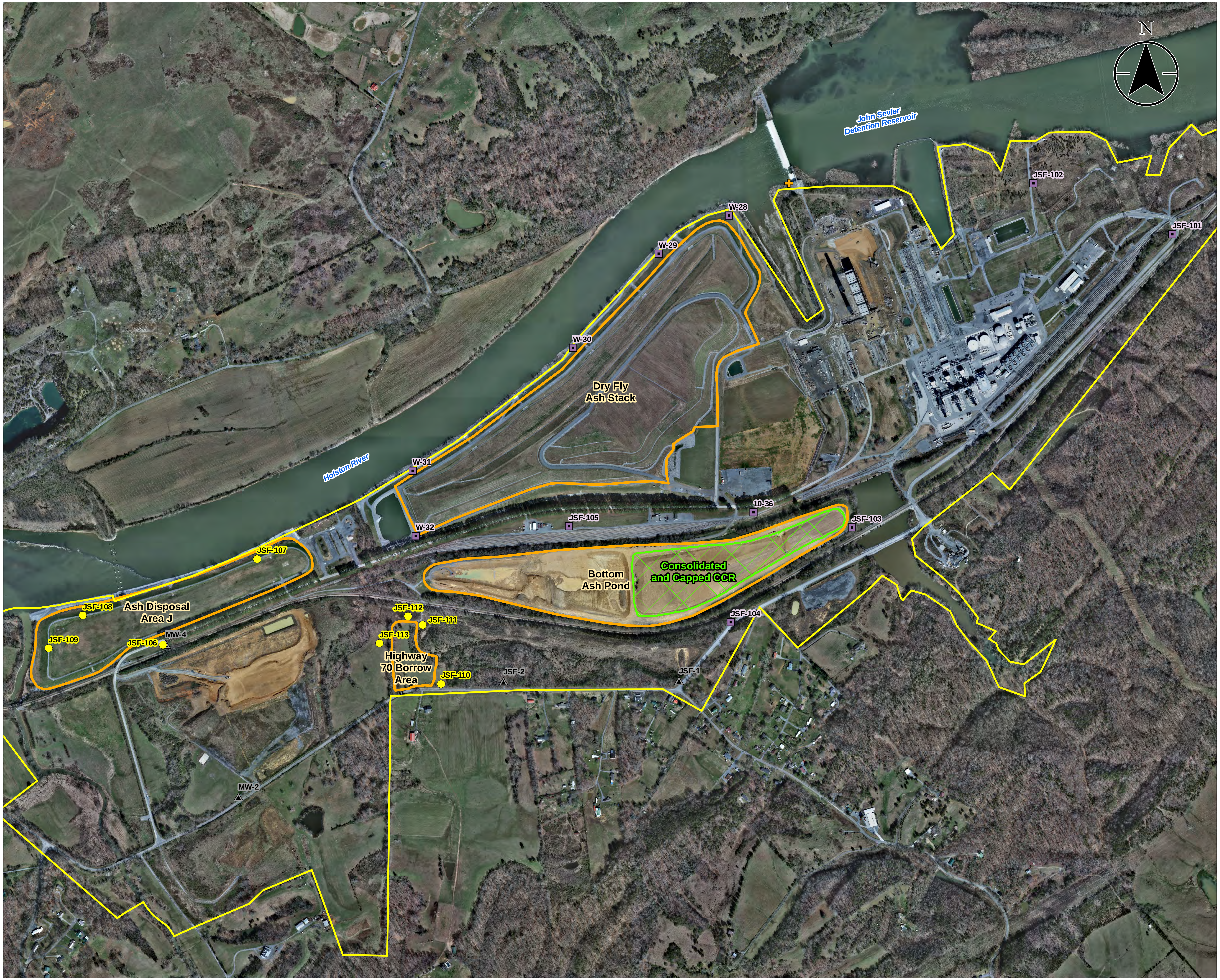


Figure No.
1

Title
John Sevier Fossil Plant Proposed Groundwater Well Locations

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 450 900 1,350 1,800 Feet

1:5,400 (At original document size of 22x34)

Legend

- River Gauge
- Existing Groundwater Monitoring Well
- Existing Observation Well
- Proposed Groundwater Monitoring Well
- TVA Property Boundary
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

\\us1269-f01\shared_projects\TVA-GP\175568225_JSF_Phase2\gis\mxd\JSF_Proposed_GW_Wells.mxd Revised: 2018-10-18 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
HYDROGEOLOGICAL INVESTIGATION
SAP

Hydrogeological Investigation
Sampling and Analysis Plan
John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Public Comments, Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

HYDROGEOLOGICAL INVESTIGATION
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Hydrogeological Investigation
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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	10/17/18 Date
TVA Investigation Field Lead	10/17/18 Date
Health, Safety, and Environmental (HSE) Manager	10/17/18 Date
Kip Anderson Investigation Project Manager	10-08-18 Date
Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@environsd.com, c=US Date: 2018.10.17 10:00:41 -04'00' QA Oversight Manager	Date
K. Ryan R. Jones Laboratory Project Manager	10-08-18 Date
Charles L. Head Charles L. Head TDEC Senior Advisor	2018/10/31 Date
Robert Wilkinson TDEC CCR Technical Manager	10/31/18 Date

Stantec

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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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 JSF 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 proposes to install eight monitoring wells at preliminarily identified locations in the saturated sand and gravel layer above bedrock within 150 meters of the boundary of CCR units. One background well (JSF-106) and three downgradient wells (JSF-107, JSF-108 and JSF-109) are proposed near the Ash Disposal Area J, and one background well (JSF-110) and three downgradient wells (JSF-111, JSF-112 and JSF-113) are proposed near the Highway 70 Borrow Area. Figure 1 (Attachment A) shows the locations of the proposed wells and Table 1 shows the proposed well construction details.

At JSF, the overburden consists of alluvial deposits of silt and clay underlain by a silty sand and gravel layer. Based on previous investigation activities conducted at JSF for the Dry Fly Ash Stack and the Bottom Ash Pond, groundwater may be present in the silty sand and gravel layer. However, this layer may be thin or absent near the western and southern boundaries of the plant. As a result, groundwater may not be present in the overburden south or west of the JSF plant and installation of useful monitoring wells in the overburden may not be possible. If bedrock monitoring wells are required, then the data collected as part of the initial investigation phase will be reviewed to identify alternative monitoring well 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.

The proposed background monitoring well location (JSF-106) for Ash Disposal Area J was selected to be in an up gradient location based on current groundwater elevation data showing groundwater flow to the north/northwest. The three downgradient locations (JSF-107, JSF-108 and JSF-109) were selected to provide downgradient sampling locations based on groundwater flow to the north/northwest and lithologic information regarding the presence of the silty sand and gravel layer. Locations JSF-107 and JSF-108 were selected based on historical boring log data that indicated the presence of a saturated sand and gravel layer in these areas. The historical boring logs indicate that the silty sand and gravel layer is absent in the central portion of the northern boundary of Ash Disposal Area J. The location of monitoring well JSF-109 was selected to provide a sampling point between the CCR unit and the creek located west of the unit.

The proposed background monitoring well location (JSF-110) for the Highway 70 Borrow Area was selected in an up gradient location based on current groundwater elevation data showing groundwater flow to the north/northwest. The three downgradient well locations (JSF-111, JSF-112 and JSF-113) were selected to provide downgradient sampling locations based on groundwater flow to the north/northwest.

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
JSF-106	15 - 20	10 - 15	Overburden
JSF-107	35	25 - 35	Overburden
JSF-108	35	25 - 35	Overburden
JSF-109	45	35 - 45	Overburden
JSF-110	12 - 13	3 - 13	Overburden
JSF-111	12 - 13	3 - 13	Overburden
JSF-112	12 - 13	3 - 13	Overburden
JSF-113	12 - 13	3 - 13	Overburden

Results of investigations to characterize groundwater quality and flow direction will be included and described in the Environmental Assessment Report (EAR). Should the drilling not encounter the expected unconsolidated materials at the anticipated depths, the field crews will stop work and call the Project Manager who in turn will discuss the findings with TVA. Work will only commence once a decision has been made and with the authorization from a TVA Project Manager.

TVA plans to complete the initial phase of the investigation and jointly review the results with TDEC to identify data gaps. If data gaps exist, then TVA will fill those gaps with additional investigation in collaboration with TDEC. This may include installing additional groundwater monitoring wells to further characterize the hydrogeology.

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 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 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.

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 5.2.5.2) 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.

5.2.5.2 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

5.2.5.3 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.

5.2.6 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.

5.2.7 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 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
- 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 bentonite-cement grout, sand filter zones, and bentonite pellets will be placed by tremie method through one-inch diameter PVC pipe. The bentonite-cement grout will be placed using pumps gauged to allow the installation crew to monitor pressures during the grouting process.

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	20 Days	Following EIP Approval
Conduct Field Activities	20 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
- Saturated overburden materials exist at each proposed location

9.0 REFERENCES

Tennessee Valley Authority (TVA). 2017a. "Field Record Keeping. Technical Instruction ENV-TI-05.80.03, Revision 0000." March 31.

Tennessee Valley Authority (TVA). 2017b. "Field Sampling Equipment Cleaning and Decontamination. Technical Instruction ENV-TI-05.80.05, Revision 0000." March 31.

Tennessee Valley Authority (TVA). 2017c. "Monitoring Well and Piezometer Installation and Development. Technical Instruction ENV-TI-05.80.25, Revision 0000." May 8.

ATTACHMENT A
FIGURES

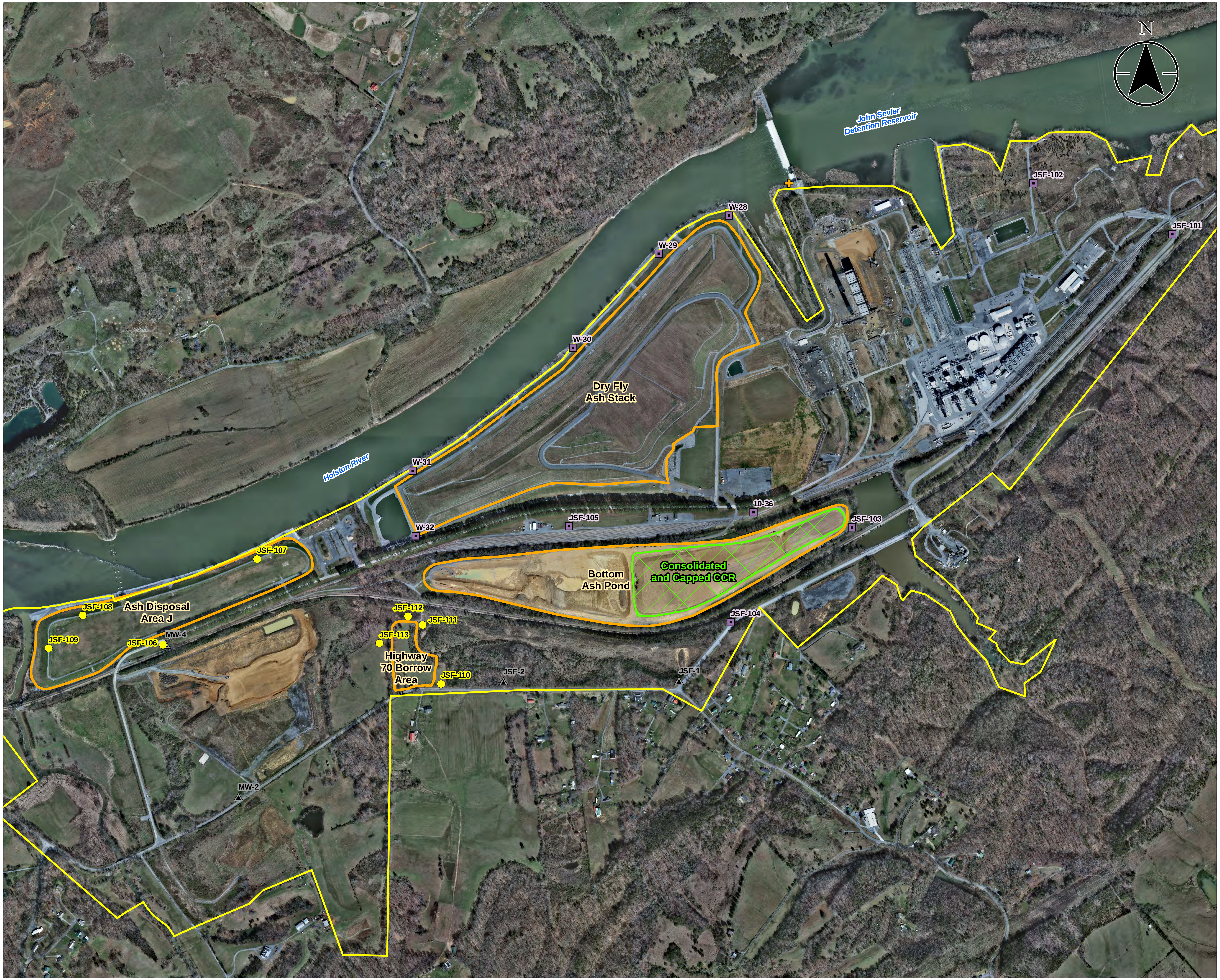


Figure No.
1

Title
John Sevier Fossil Plant Proposed Groundwater Well Locations

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

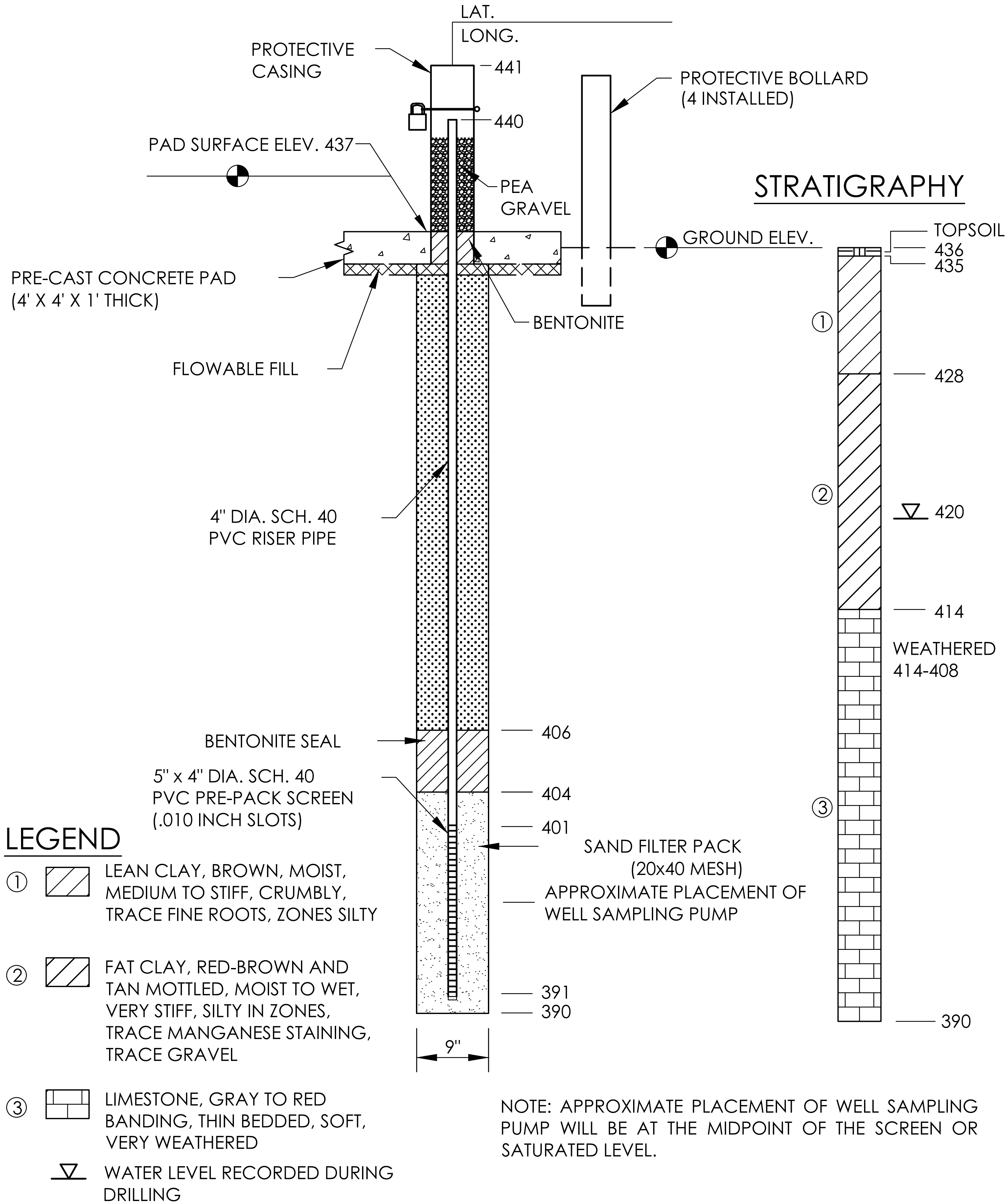
0 450 900 1,350 1,800 Feet
1:5,400 (At original document size of 22x34)

Legend

- River Gauge
- Existing Groundwater Monitoring Well
- Existing Observation Well
- Proposed Groundwater Monitoring Well
- TVA Property Boundary
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec TVA



NOTE: APPROXIMATE PLACEMENT OF WELL SAMPLING PUMP WILL BE AT THE MIDPOINT OF THE SCREEN OR SATURATED LEVEL.

NOTE: THIS FIGURE IS AN EXAMPLE MONITORING WELL LOG PROVIDED FOR REFERENCE PURPOSES AND DOES NOT REPRESENT CURRENT SITE CONDITIONS.

Figure 2. Typical Groundwater Monitoring Well Installation Log

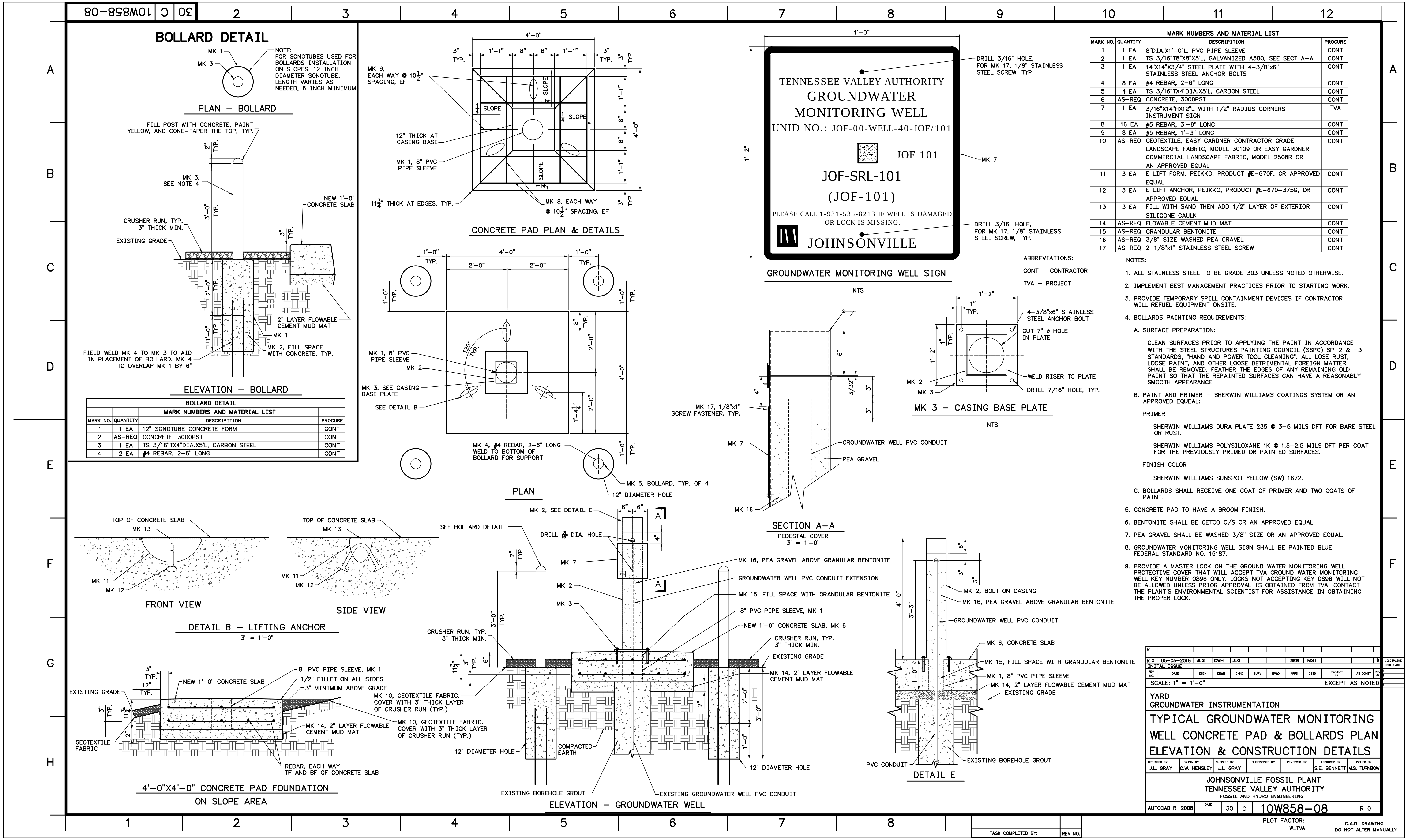


Figure 3. Typical Groundwater Monitoring Well Construction Details

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 J
STABILITY SAP

Stability
Sampling and Analysis Plan
John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

STABILITY
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Stability
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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: 10/17/18

TVA Investigation Field Lead — Date: 10/17/18

Health, Safety, and Environmental (HSE) Manager — Date: 10/17/18

Kip Anderson
Investigation Project Manager — Date: 10-08-18

Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.10.17 10:00:58 -04'00'
QA Oversight Manager — Date:

K. Ryan R. Jones
Laboratory Project Manager — Date: 10-08-18

Charles L. Head
Charles L. Head
TDEC Senior Advisor — Date: 2018/10/31

Robert Wilkinson
TDEC CCR Technical Manager — Date: 10/31/18

Stantec

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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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 JSF (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 JSF. 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

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
Dry Fly Ash Stack (Closed Condition)			x	x	x
Bottom Ash Pond (Closed Condition)		x	x	x	x
Ash Disposal Area J (Closed, Repaired Condition)	x	x	x	x	x
Highway 70 Borrow Area (Closed Condition)	x	x	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 Dry Fly Ash Stack lacks documented seismic global and seismic veneer slope stability analyses for the current, closed geometry.
- The Bottom Ash Pond lacks documented static veneer, seismic global, and seismic veneer slope stability analyses for the current, closed geometry.
- Scour protection was installed along the toe of the northern dike of Ash Disposal Area J in 2016. This unit (with the scour repairs) lacks documented static and seismic slope stability analyses for the current, closed geometry.
- The Highway 70 Borrow Area lacks documented static and seismic 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 the figures in Attachment A for a layout of the 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 ($FS_{pseudo-veneer} \geq 1.0$) 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 ($FS_{post-EQ}$) is 1.1 or greater. However, TVA guidance also allows an acceptable $FS_{post-EQ}$ 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
FIGURES

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
Ash Disposal Area J (Closed, Repaired Condition)	M	Typ.[4]	M	Typ.	M

[1] Pseudostatic, but related to a site-specific 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 was analyzed.

Blue cells are completed analyses. Yellow cells are proposed analyses.

Figure No.
1

Title

Completed and Proposed Stability Analyses Ash Disposal Area J

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location 175566338

Rogersville, Tennessee

Prepared by TKR on 2018-05-21
Technical Review by RAA on 2018-05-21

0 150 300 450 600 Feet

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

Legend

Stability Cross Section

CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec TVA

Figure No.
2

Title

Completed and Proposed Stability Analyses Bottom Ash Pond & Hwy 70 Borrow Area

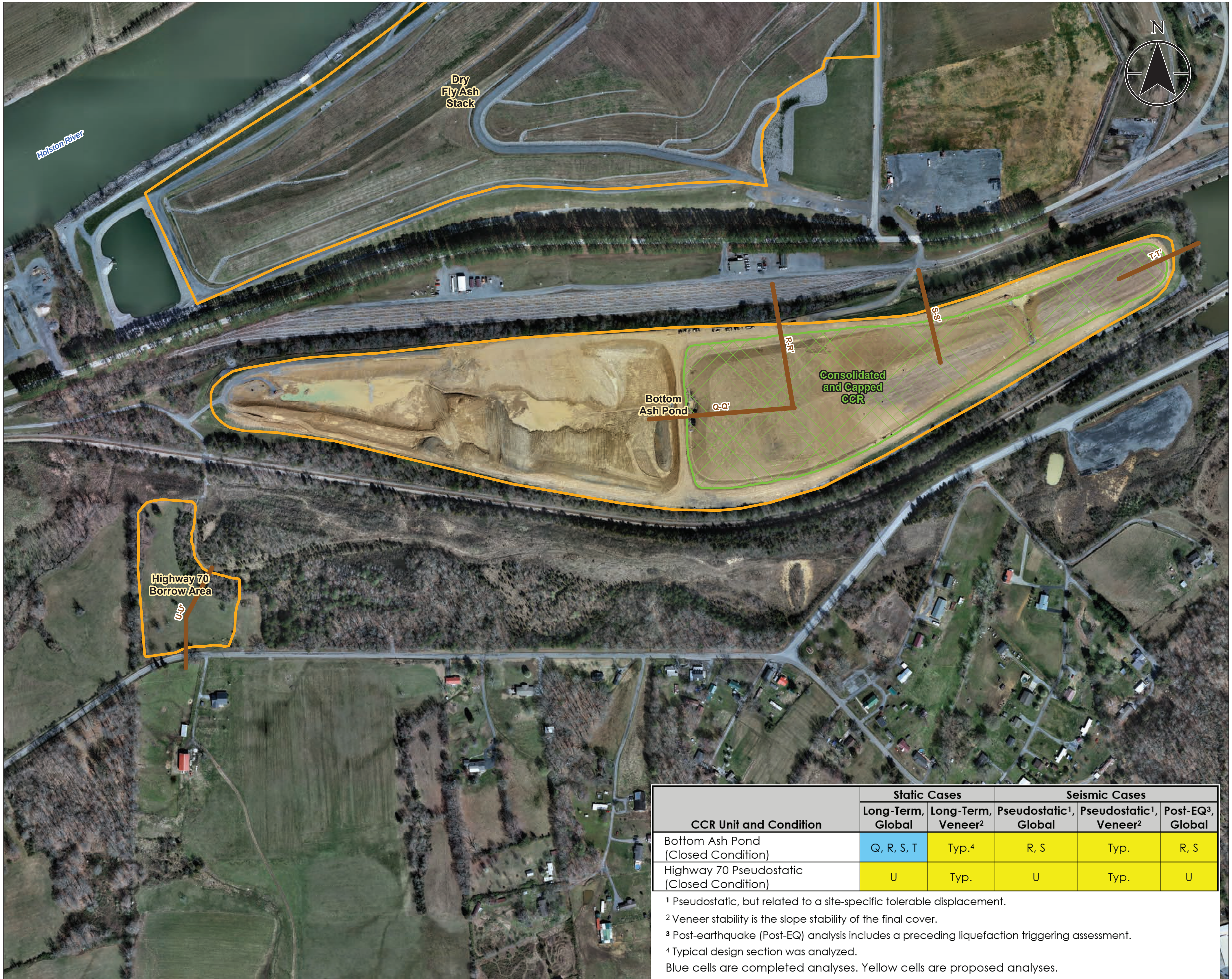
Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-21
Technical Review by RAA on 2018-05-21

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)



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
Bottom Ash Pond (Closed Condition)	Q, R, S, T	Typ.[4]	R, S	Typ.	R, S
Highway 70 Pseudostatic (Closed Condition)	U	Typ.	U	Typ.	U

1 Pseudostatic, but related to a site-specific 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 was analyzed.
Blue cells are completed analyses. Yellow cells are proposed analyses.

Legend

Stability Cross Section
CCR Unit Area (Approximate)
Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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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
Dry Fly Ash Stack (Closed Condition)	C, E, F	C, E, F	C, E	Typ.[4]	C, E

[1] Pseudostatic, but related to a site-specific 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 was analyzed.

Blue cells are completed analyses. Yellow cells are proposed analyses.

Figure No.
3

Title

Completed and Proposed Stability Analyses Dry Fly Ash Stack

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location 175566338

Rogersville, Tennessee

Prepared by TKR on 2018-05-21
Technical Review by RAA on 2018-05-21

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

Stability Cross Section

CCR Unit Area (Approximate)

Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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APPENDIX K
EVALUATION OF EXISTING GEOTECHNICAL DATA

Evaluation of Existing Geotechnical Data John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

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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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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. TVA (1952)

Table 1. Summary of Evaluation for TVA (1952)

Reference:	Tennessee Valley Authority (1952). "Preliminary Geologic Investigations for the John Sevier Steam Plant." September 3.	
Purpose:	Preliminary geologic investigation of the proposed stream plant site	
CCR Unit(s):	Dry Fly Ash Stack	
Spatial coverage:	100-foot grid spacing within the proposed steam plant footprint	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	60 borings – 20 borings within Dry Fly Ash Stack footprint
Rock coring:	Yes	60 borings – 20 borings within Dry Fly Ash Stack footprint
Other subsurface data:	Yes	Geologic sections
Boring locations surveyed:	Yes	Boring locations laid out on a 100-foot grid spacing with reported elevations
Data adequate to support three-dimensional model:	Yes	Data to support top of bedrock elevations and general soil and rock stratigraphy
Geometry at time of document representative of 2017 conditions:	No	Borings were performed prior to site development
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	Borings can be used for top of rock and bedrock stratigraphy
Other relevant analyses:	No	

3.1.1. Field Activities

Between April and May 1952, borings were advanced at the proposed stream plant site for a preliminary foundation investigation. The program included 60 borings advanced through overburden and rock. The borings were spaced in a grid on 100-foot centers within the proposed steam plant site. Of the 60 borings advanced for this program, 20 were located within the footprint of the future Dry Fly Ash Stack. The approximate locations of the borings are shown on the boring layout in Exhibit 1.

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. Bedrock stratigraphy
    a. Boring locations laid out on a 100-foot grid spacing with reported elevations,
    b. Geologic mapping can be correlated to rock cores and top of rock elevations,
    c. Geologic mapping methods meet current standard of practice.

3.2. TVA (1976)

Table 2. Summary of Evaluation for TVA (1976)

Reference:	Tennessee Valley Authority (1976). "Memorandum, John Sevier Steam Plant – New Ash Disposal Area – Soils Investigation, EN DES Soil Schedule No. 6." December 10.	
Purpose:	Field and laboratory investigation of foundation and borrow soils for proposed Bottom Ash Pond	
CCR Unit(s):	Bottom Ash Pond	
Spatial coverage:	Proposed Bottom Ash Pond perimeter dike and interior	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	51borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	Boring location plan elevations reported, but surveyed coordinates not available
Data adequate to support three-dimensional model:	Yes	Data to support dike geometry, foundation soil stratigraphy, and top of bedrock elevation
Geometry at time of document representative of 2017 conditions:	No	Borings were performed prior to site development
Piezometer installation:	No	
In-situ testing:	Yes	Standard penetration tests (SPT) in 13 borings
Laboratory testing:	Yes	Index testing appears to follow ASTM standards but not explicitly documented. Compaction testing references ASTM standard. Triaxial compression testing standard unknown, but appear to follow standard testing procedures.
Shear strength parameters:	Yes	UU "Q" and CU "R" parameters (foundation and borrow materials)
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	Triaxial compression testing appears to follow ASTM standards, but is not explicitly documented
Other relevant analyses:	No	

3.2.1. Field Activities

Between September 15 and September 30, 1976, 51 borings were advanced at locations along the proposed Bottom Ash Pond perimeter dike and interior. The purpose of this investigation was to characterize the proposed dike foundation and proposed borrow materials (from within the dike perimeter). The program included 13 standard penetration (SPT) borings along the perimeter dike, 2 undisturbed sample offset borings, and 36 auger borings within the interior of the proposed Bottom Ash Pond. Water levels are noted in three of the SPT borings. The borings were advanced using hollow-stem augers powered by a CME 45B drill rig. The approximate locations for each boring are shown on the boring layout in Exhibit 2.

3.2.2. Laboratory Testing

Select samples from the 51 borings were subject to index testing, including natural moisture content, Atterberg limits, particle-size distribution, and unit weight. It is not documented that index testing was performed to ASTM standards.

Seven soil classifications for the borrow material were established from the index testing. Compaction testing was performed on the seven soil classes in accordance to ASTM D698.

Select undisturbed samples and remolded samples from six of the seven borrow soil classes were subject to unconsolidated-undrained “Q” and consolidated-undrained “R” triaxial compression testing. The testing standards for these tests were not documented.

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, thicknesses, and elevations from profiles of borings
    a. Boring location plan provided and boring elevations were reported,
    b. Boring profiles document material descriptions and thicknesses,
    c. Results may be used comparatively to more recent explorations.
2. Soil properties (including shear strength)
    a. Testing appeared to follow conventional procedures, but testing standards are not documented. Thus, results may be used comparatively to more recent testing.
    b. Foundation conditions are substantially the same as current.

3.3. TVA (1981)

Table 3. Summary of Evaluation for TVA (1981)

Reference:	Tennessee Valley Authority (1981). "John Sevier Steam Plant, Ash Disposal Area, Soils Exploration and Testing, EN DES Soil Schedule No. 6.2."	
Purpose:	Field and laboratory investigation of foundation and borrow soils for proposed Ash Disposal Area J	
CCR Unit(s):	Ash Disposal Area J	
Spatial coverage:	Proposed Ash Disposal Area J perimeter dike and interior	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	61 borings – 36 borings located within Ash Disposal Area J
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	Boring location plan provided for borings within the Ash Disposal Area J footprint. Boring elevations were reported
Data adequate to support three-dimensional model:	Yes	Data to support foundation soil stratigraphy and top of bedrock elevation
Geometry at time of document representative of 2017 conditions:	No	Borings were performed prior to site development
Piezometer installation:	No	
In-situ testing:	Yes	SPT
Laboratory testing:	Yes	Index testing appears to follow ASTM standards but not explicitly documented. Compaction testing references ASTM standard. Triaxial compression testing standard unknown, but appear to follow standard testing procedures.
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	Triaxial compression testing appears to follow ASTM standards, but is not explicitly documented
Other relevant analyses:	No	

3.3.1. Field Activities

Between March 2 and May 5, 1981, 61 borings were advanced at locations along the proposed Ash Disposal Area J perimeter dike and two borrow areas (Borrow Area A and Borrow Area B). Borrow Area A is located within the interior of Ash Disposal Area J. The location of Borrow Area B is unknown based on available documentation. The program included 15 SPT borings and 6 undisturbed borings along the perimeter dike, 15 auger borings in Borrow Area A, and 24 auger borings and 1 SPT boring in Borrow Area B. The approximate locations for each boring (excluding those in Borrow Area B) are shown on the boring layout in Exhibit 3.

Boring logs are available for the 61 borings. Water levels are noted on most the boring logs, but it is unclear when the water levels were noted. It appears that the borings were discontinued at a specified depth or at refusal. The drill rig used for this exploration is not documented.

3.3.2. Laboratory Testing

Select samples from the 61 borings were subjected to index testing, including natural moisture content, Atterberg limits, particle-size distribution, unit weight, and specific gravity. It is not documented that index testing was performed to ASTM standards.

Five soil classes for the borrow material were established. Compaction testing was performed on the five soil classes in accordance to ASTM D698.

A value for coefficient of vertical permeability is provided for one undisturbed sample; however, the procedure used is not documented.

Select undisturbed samples and remolded samples from the five borrow soil classes were subject to unconsolidated-undrained “Q” and consolidated-undrained “R” triaxial compression testing. The testing standards for these tests were not documented.

3.3.3. 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 boring logs
    a. Boring location plan provided and boring elevations were reported,
    b. Boring logs document material descriptions and thicknesses,
    c. Results may be used comparatively to more recent explorations.
2. Soil properties (including shear strength)

a. Testing appeared to follow conventional procedures, but testing standards are not documented. Thus, results may be used comparatively to more recent testing.

b. Foundation conditions are substantially the same as current.

3.4. TVA (1984)

Table 4. Summary of Evaluation for TVA (1984)

Reference:	Tennessee Valley Authority (1984). "John Sevier Steam Plant – Ash Pond J – Soils Investigation on Ash Material – EN DES Soils Schedule 6.3." November 16.	
Purpose:	Laboratory testing of CCR from Ash Disposal Area J	
CCR Unit(s):	Ash Disposal Area J	
Spatial coverage:	Area J, southeast bank, east end	
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:	No	
Geometry at time of document representative of 2017 conditions:	No	
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	Yes	ASTM standards documented for soil index testing and compaction testing. Standards unknown for saturated triaxial R testing with pore pressure measurements and direct shear testing, but appear to follow standard testing procedures.
Shear strength parameters:	Yes	CU "R" and direct shear "S" parameters (CCR)
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	Triaxial compression and direct shear testing appear to follow ASTM standards, but is not explicitly documented
Other relevant analyses:	No	

3.4.1. Field Activities

Three bag samples of ash material were obtained from the southeast bank, east bank, and interior of Ash Disposal Area J. The methodology of obtaining the bag samples and the exact collection locations are not documented.

3.4.2. Laboratory Testing

Each bag sample was subjected to index testing, including Atterberg limits (ASTM D4318), particle-size distribution (ASTM D422), and specific gravity testing. Standard compaction tests were performed on each of the three samples according to ASTM D698.

Saturated triaxial “R” compression tests with pore pressure measurements were performed on the three samples, and direct shear testing was performed on two of the three samples. The standards for these tests were not documented.

3.4.3. 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. CCR properties (including shear strengths)
    a. Atterberg limits and particle-size distribution testing followed ASTM standards. However, the standards used for the specific gravity and strength testing were not documented. Thus, results may be used comparatively to more recent testing.

3.5. TVA (1985)

Table 5. Summary of Evaluation for TVA (1985)

Reference:	Tennessee Valley Authority (1985). "Cancellation Notice, John Sevier Fossil Plan – Construct Fly Ash Pond in Area J." August 29.	
Purpose:	Slope stability of northwest perimeter dike with proposed remediation	
CCR Unit(s):	Ash Disposal Area J	
Spatial coverage:	Perimeter dike	
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:	No	
Geometry at time of document representative of 2017 conditions:	No	Perimeter dike geometry similar.
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	Yes	Static drained strengths (clay fill, alluvial clay)
Static slope stability:	Yes	Slope stability of proposed dike remediation at Station 41+75 (7 load cases)
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	Shear strength parameters developed from laboratory tests that do not document the standard used. Assumptions of shear strength parameters for materials that did not have laboratory testing are not clearly documented.
Other relevant analyses:	No	

3.5.1. Analysis

This document stated that there was "a change in design criterion which made it necessary to change the dike configuration along Dodson Creek." Dodson Creek runs along the west side of Ash Disposal Area J. According to the repair drawing (Drawing No. 10W286-4), the exterior slope of the dike was flattened to 4:1 (horizontal to vertical), from the original 2.1:1 to 2.5:1 slope.

Seven static slope stability load cases were evaluated at Station 41+75 with various inside slope geometries and compacted ash shear strength parameters. Shear strength parameters for the compacted clay and cohesive alluvium were derived from the laboratory testing results from TVA (1981). Shear strength properties for the rockfill and compacted ash were assumed. This document stated that the cases would be revised with shear strength properties derived from laboratory testing of the compacted fly ash. However, stability analyses with revised strengths were not located.

Static slope stability analyses were performed using “Slope 2” software. Details on the methodology of this program are not provided in this document; however, input and output files are provided. A phreatic surface is drawn on the slope stability analysis sections, but it was not clearly documented how this was determined.

The recommended interior slope geometry included compacted clay at a 2:1 slope, compacted ash at a 2.5:1 slope, and a rockfill at the toe of the slope.

This document also includes information on the inspection and repair of the northern dike along the Holston River, which was observed to have a slide at the toe in March 1984. Slope stability analysis of this repair was not provided in this document.

3.5.2. 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 slope stability analyses
    a. Allows for comparison of design versus as-built conditions from later reports,
    b. Materials used in analyses are likely similar to current conditions. However, material parameters were developed from either assumed values or laboratory testing using undocumented standards. Thus, results may be used comparatively to more recent testing.

3.6. TVA (1986)

Table 6. Summary of Evaluation for TVA (1986)

Reference:	Tennessee Valley Authority (1986). "John Sevier Steam Plant, Ash Disposal Area, Proposed Dry Stacking." September 4.	
Purpose:	Soil investigation and laboratory testing for proposed dry stacking area at Dry Fly Ash Stack	
CCR Unit(s):	Dry Fly Ash Stack	
Spatial coverage:	perimeter dike and interior	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	16 borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	Coordinates and elevation provided
Data adequate to support three-dimensional model:	Yes	Data supports perimeter dike geometry, foundation soil stratigraphy, and top of rock elevation
Geometry at time of document representative of 2017 conditions:	No	
Piezometer installation:	No	
In-situ testing:	Yes	SPT
Laboratory testing:	Yes	Some testing follows ASTM standards
Shear strength parameters:	Yes	Static drained and undrained strengths (compacted bottom ash, dumped bottom ash, consolidated fly ash, very loose fly ash, compacted fly ash, compacted borrow fill, alluvial clay, rockfill)
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Material parameters can be used to support stability analyses
Other relevant analyses:	No	

3.6.1. Field Activities

Between July 1 and 16, 1986, 16 borings were advanced for the proposed dry stacking within the footprint of the "original disposal area", which eventually became the Dry Fly Ash Stack. The program included 11 standard penetration test borings and 5 undisturbed sample borings. The majority of the borings were located along the perimeter dike, with two located within the interior. Coordinates were provided for the 11 standard penetration test borings. The locations for the borings are shown on the boring layout in Exhibit 1.

The borings were advanced using a CME 55 drill rig with 3-3/8 inch and 6-inch hollow stem augers. Disturbed samples were obtained using a 2-inch diameter split spoon attached to AW rods, and undisturbed samples were obtained using 5-inch diameter thin wall tubes. Auger borings were advanced according to ASTM D1452. Sampling was performed in accordance with ASTM D1586 and D1587. Samples were visually described according to ASTM D2488. Six bag samples of fly ash were taken at random locations in the original disposal area.

Boring logs were recorded for the 16 borings. Initial and 24-hour water table elevations were noted on the boring logs. The borings were discontinued at a specified depth or at refusal. SPT N-values and field descriptions of the samples were provided in the boring logs.

Generalized cross sections were provided based on the results of the investigation.

3.6.2. Laboratory Testing

Natural moisture content testing was performed on samples according to ASTM D2216. Index testing included Atterberg limits (ASTM D4318), particle-size distribution (ASTM D422), unit weight determination (SLP-2), and specific gravity (ASTM D854) tests on select samples.

Standard proctor compaction testing was performed according to ASTM D698 on fly ash samples. One bearing ratio test (ASTM D1883) was performed on an undisturbed fly ash sample.

Select undisturbed samples were subject to unconsolidated-undrained “Q” (ASTM D2850) and consolidated-undrained “R” (SLP-7) triaxial compression testing. CU testing was also performed on one remolded fly ash sample.

3.6.3. 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 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. CCR and soil properties (including shear strengths)
    a. Sampling and some testing followed relevant standards,
    b. Foundation conditions are substantially the same as current.

3.7. TVA (1987)

Table 7. Summary of Evaluation for TVA (1987)

Reference:	Tennessee Valley Authority (1987). “John Sevier Steam Plant, Borrow Area Reclamation, DNE Soil Schedule 6.7.” April 15.	
Purpose:	Soil investigation to determine engineering properties of potential borrow soils	
CCR Unit(s):	Highway 70 Borrow Area	
Spatial coverage:	250-foot (east/west spacing) by 150-foot or 200-foot (north/south spacing) grid pattern in borrow area south of the Bottom Ash Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	39 borings – 3 borings located within Highway 70 Borrow Area, where CCR had already been placed prior to this investigation
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	Boring location plan provided and boring elevations were reported
Data adequate to support three-dimensional model:	Yes	Data support foundation geometry, foundation soil stratigraphy, and top of rock elevation
Geometry at time of document representative of 2017 conditions:	No	
Piezometer installation:	No	
In-situ testing:	Yes	SPT
Laboratory testing:	Yes	Some testing follows ASTM standards
Shear strength parameters:	Yes	UU “Q” and CU “R” parameters (borrow soil)
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Foundation soil material parameters can be used to support stability analyses
Other relevant analyses:	No	

3.7.1. Field Activities

In February 1987, 39 borings were advanced to determine engineering properties and available quantities of potential borrow soils. The program included 31 SPT borings, 4 undisturbed sample borings, and 4 auger borings. The borings were spaced on a grid pattern in the area south of the Bottom Ash Pond and north of State Highway 70. The approximate locations for the borings are shown on the boring layout in Exhibit 2. Note that prior to the investigation, CCR had already been placed in the Highway 70 Borrow Area.

Boring logs were recorded for the 39 borings. Initial and 24-hour water table elevations were noted on the boring logs. The borings were discontinued to a specified depth or refusal. SPT N-values and field descriptions of the samples were provided on the boring logs.

Generalized cross sections were provided based on the results of the investigation.

3.7.2. Laboratory Testing

Natural moisture content testing was performed on samples according to ASTM D2216. Index testing included Atterberg limits (ASTM D4318), particle-size distribution (ASTM D422), unit weight determination (SLP-2), and specific gravity (ASTM D854) tests on select samples.

Two soil classes were established for the borrow soils. Standard proctor compaction testing was performed according to ASTM D698 on the two borrow material soil classes.

Select undisturbed samples and remodeled samples from the two borrow material soil classes were subject to unconsolidated-undrained “Q” (ASTM D2850) and consolidated-undrained “R” (SLP-7) triaxial compression testing. Hydraulic conductivity testing was performed on select undisturbed samples and the two borrow material soil classes.

3.7.3. 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 boring logs
    a. Boring location plan provided and boring elevations were reported,
    b. Boring logs document material descriptions and thicknesses,
    c. Foundation geometry is substantially the same as current.
2. CCR and soil properties (including shear strengths)
    a. Sampling and testing followed relevant standards,

b. CCR fill and foundation conditions are substantially the same as current.

3.8. LAW (1992)

Table 8. Summary of Evaluation for Law (1992)

Reference:	Law. (1992). Ash Disposal Area J Closure Plan (boring logs only). March.	
Purpose:	Ash Disposal Area J Closure	
CCR Unit(s):	Ash Disposal Area J	
Spatial coverage:	Perimeter and Interior of Ash Disposal Area J	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	5 borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	Locations surveyed after drilling
Data adequate to support three-dimensional model:	Yes	Data to support CCR, dike fill, and foundation soil geometry
Geometry at time of document representative of 2017 conditions:	Yes	Borings reflect 2017 dike and bottom of CCR geometry, but not 2017 top of CCR or closure cap geometry.
Piezometer installation:	Yes	5 Open Standpipe piezometers installed
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	

3.8.1. Field Activities

A geotechnical drilling program was developed that consisted of 5 SPT borings in the perimeter and interior of Ash Disposal Area J. Water levels were recorded during drilling in March 1992 and from piezometers installed in the boreholes in May 1992. In the borings, SPTs were generally performed on 5-foot intervals. Classifications based on the disturbed samples were recorded on the boring logs. Upon completion of the field work, TVA surveyed as-drilled boring locations. The approximate locations are shown in Figure 1.

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. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses (top of CCR elevation is not representative of current, closed condition),
    c. Perimeter dike and foundation geometry is substantially the same as current.

3.9. LAW (1994)

Table 9. Summary of Evaluation for Law (1994)

Reference:	Law Engineering and Environmental Services, Inc. (1994). "Report of Hydrogeologic and Engineering Evaluation (Revised), Proposed Dry Fly Ash Disposal Facility Site." Prepared for Tennessee Valley Authority. October.	
Purpose:	A hydrogeologic assessment of the site in accordance with TDEC permitting requirements. Incorporates data from earlier explorations.	
CCR Unit(s):	Dry Fly Ash Stack	
Spatial coverage:	Perimeter dike and interior	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	10 borings performed in 1986 2 borings performed in 1991 4 borings performed in 1994 Also includes data from TVA (1986)
Rock coring:	No	
Other subsurface data:	Yes	Geologic cross sections, geologic features map
Boring locations surveyed:	Yes	Some boring locations not surveyed by report date, but surveyed locations and elevations provided in subsequent documents
Data adequate to support three-dimensional model:	Yes	Data to support dike geometry, clay thickness, CCR thickness, top of bedrock elevation
Geometry at time of document representative of 2017 conditions:	No	
Piezometer installation:	Yes	10 piezometers installed in 1986 2 piezometers installed in 1991
In-situ testing:	Yes	SPT, slug and pumping tests on 14 previously installed instruments
Laboratory testing:	Yes	Moisture content, unit weight, direct shear, and triaxial compression tests appear to follow ASTM standards, although not explicitly stated
Shear strength parameters:	Yes	Static drained strengths and seismic undrained strengths (fly ash, compacted fill, alluvium, residuum, bedrock)
Static slope stability:	Yes	Slope stability of the proposed stack configuration
Seismic slope stability:	Yes	Pseudostatic analysis
Information adequate to support stability evaluation:	Yes	Static drained and seismic undrained strengths (ash, compacted fill, alluvial soils, residual soils, bedrock)
Other relevant analyses:	No	

3.9.1. Field Activities

The report included data from four subsurface explorations. Results from the July 1986 exploration were originally presented in TVA (1986). The other three explorations included ten soil borings and piezometer installations in October and November 1986, two soil borings and well installations in December 1991, and four soil borings in August 1994. Soil sampling and penetration testing were performed in accordance with ASTM D1586 and ASTM D1587. Groundwater levels were observed after drilling and over a three-month period in 1991. The borings were terminated upon auger refusal. Elevations for the borings performed in 1994 were not documented. However, subsequent documents provided surveyed elevations and locations for the borings. The approximate locations for each boring are shown on the boring layout in Exhibit 1.

Slug and pump tests were performed on 14 previously installed instruments. Tests were performed on various subsurface strata to gauge hydraulic conductivity. A summary of the results was presented in a table in the report.

3.9.2. Laboratory Testing

Select samples from the 1994 borings were subject to moisture content testing. Two samples were subject to unit weight testing. Two CU triaxial compression tests with pore pressure measurements and one direct shear test were performed. The laboratory tests appear to follow ASTM standards, but it is not explicitly stated in the report or laboratory data sheets.

3.9.3. Analysis

Slope stability analyses were performed using the PCSTABL5M program to evaluate the stability of the proposed stack configuration, the disposal stack, and the underlying foundation. Two idealized cross sections were considered assuming the completion of the stack as designed. The two cross sections represented typical “worst case” profiles within the eastern and western sides of the disposal area.

Drained static and undrained seismic strength parameters for the materials were developed from laboratory testing results on undisturbed and remolded samples, correlations between standard penetration resistances, and strengths of similar materials at other geologically similar sites. Details on the parameter development was not documented.

Two load cases were analyzed for each cross section: static and pseudostatic. Pseudostatic analyses assumed a horizontal and vertical acceleration equal to 0.1g in accordance with seismic maps of the area at the time. For the two load cases, circular failures were evaluated using the PCSTABL5M program, and hand calculations were used to evaluate the slope for block (i.e., wedge) failures. Outputs of the PCSTABL5M analyses were provided in the report.

The factors of safety for the proposed slope configuration calculated using the PCSTABL5M program met the acceptable minimum accepted factors of safety at the time of this report. The source of the factor of safety criteria is not explicitly stated.

3.9.4. 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. Boring location plan provided and boring elevations were reported in Parsons (1999),
    b. Boring logs document material descriptions and thicknesses,
    c. Perimeter dike geometry is substantially the same as current.
2. Characterization of the hydraulic conductivity in the soil at the site
    a. Slug testing 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. Soil and CCR properties (including shear strength)
    a. Testing appeared to follow conventional procedures, but testing standards are not documented. Thus, results may be used comparatively to more recent testing.
    b. Subsurface conditions are substantially the same as current.
4. Slope stability analyses
    a. Allows for comparison of design versus as-built conditions from later reports,
    b. Materials used in analyses are likely similar to current conditions. However, material parameters were developed from either assumed values or laboratory testing using undocumented standards. Thus, results may be used comparatively to more recent testing.

3.10. TRIBBLE & RICHARDSON (1995)

Table 10. Summary of Evaluation for Tribble & Richardson (1995)

Reference:	Tribble & Richardson, Inc. and Law Engineering, Inc. (1995). "Closure Plan, Borrow Area Ash Stack." Prepared for Tennessee Valley Authority. January 10.	
Purpose:	Closure plan for the unit, including determination of the vertical and lateral extents of the existing ash and earth cover to support the closure plan.	
CCR Unit(s):	Highway 70 Borrow Area	
Spatial coverage:	Around periphery of disposal area and within disposal area	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	8 borings – 4 standard soil borings and 4 hand auger borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	Standard borings: elevations reported on borings logs and coordinates reported in TVA Drawing 10W288. Hand auger borings: boring location plan provided in TVA Drawing 10W288.
Data adequate to support three-dimensional model:	Yes	Data support CCR thickness, foundation soil stratigraphy, and top of rock elevation
Geometry at time of document representative of 2017 conditions:	Yes	Stopped receiving ash in 1985
Piezometer installation:	Yes	4 piezometers
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:	Yes	Stratigraphy from soil borings supports cross section development
Other relevant analyses:	No	

3.10.1. Field Activities

Law Engineering conducted a program of exploration from March to May 1992 to determine the vertical and lateral extents of the existing ash and earth cover to support the closure plan of the Highway 70 Borrow Area. The program consisted of four standard soil borings and four hand auger borings. A boring plan was provided in TVA Drawing 10W288. Elevations for the standard soil borings were documented in the report, and coordinates were provided in TVA Drawing 10W288. The elevations for the hand auger borings were not available. The approximate locations for the borings are shown on the boring layout in Exhibit 2.

Boring logs were provided for the four standard soil borings. Layer thicknesses, visual descriptions of the soils, penetration resistance, and water levels were provided in the boring logs. The borings were terminated at the depth of auger refusal.

Four piezometers were installed at the locations of the four standard soil borings. The boring logs indicated that the piezometers were installed with a 1-inch diameter PVC casing.

3.10.2. 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 location plan or coordinates provided and boring elevations were reported,
    b. Boring logs document material descriptions and thicknesses,
    c. CCR and foundation geometry is substantially the same as current.

3.11. LAW (1997)

Table 11. Summary of Evaluation for Law (1997)

Reference:	Law Engineering and Environmental Services, Inc. (1997). "Report of Additional Engineering Evaluation, Tennessee Valley Authority, John Sevier Fossil Plant, Dry Fly Ash Stack Facility." Prepared for Tennessee Valley Authority. May 12.	
Purpose:	Additional evaluation of the stability of the Dry Fly Ash Stack	
CCR Unit(s):	Dry Fly Ash Stack	
Spatial coverage:	Dry Fly Ash Stack	
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:	No	
Geometry at time of document representative of 2017 conditions:	No	
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	No	
Static slope stability:	No	Stability analysis outputs from Law (1994) provided
Seismic slope stability:	Yes	Updated seismic analysis from Law (1994)
Information adequate to support stability evaluation:	Yes	Shear strength parameters previously developed in Law (1994).
Other relevant analyses:	No	

3.11.1. Analysis

The pseudostatic analyses performed on the two cross sections in Law (1994) were updated using a horizontal seismic coefficient of 0.2g. The analysis methodology, geometry, and strength parameters of the materials did not change from Law (1994). Outputs of the updated analyses using the PCSTABL5M program were provided in the report.

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. Slope stability analyses

    a. Allows for comparison of design versus as-built conditions from later reports,

    b. Materials used in analyses are likely similar to current conditions. However, material parameters were developed from either assumed values or laboratory testing using undocumented standards. Thus, results may be used comparatively to more recent testing.

3.12. LAW (1999)

Table 12. Summary of Evaluation for Law (1999)

Reference:	Law Engineering and Environmental Services, Inc. (1999). "Report of Geotechnical Exploration, Dike Exploration and Testing Program." Prepared for Tennessee Valley Authority. October 1.	
Purpose:	Explore subsurface conditions and perform laboratory testing of samples obtained along approximately 4,500 feet of dike to support a slope stability analysis.	
CCR Unit(s):	Dry Fly Ash Stack	
Spatial coverage:	Most borings along north dike crest and toe, adjacent to Holston River. One additional boring on east dike of Pond A.	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	14 borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	Locations selected and established in field by others, geo-referenced drawings provide approximate coordinates.
Data adequate to support three-dimensional model:	Yes	Data support dike geometry, foundation soil stratigraphy, and top of rock.
Geometry at time of document representative of 2017 conditions:	No	Perimeter dike slopes flattened and toe drain constructed in 2000-2002; foundation geometry largely unchanged
Piezometer installation:	No	
In-situ testing:	Yes	SPT: 2.5-ft sampling for upper 10 feet, and 5-ft sampling below.
Laboratory testing:	Yes	Testing follows ASTM standards. Laboratory data sheets included in report.
Shear strength parameters:	Yes	Static drained and undrained strengths (soil fill, alluvium, fly ash).
Static slope stability:	No	Data used by others for analysis (Parsons 1999)
Seismic slope stability:	No	Data used by others for analysis (Parsons 1999)
Information adequate to support stability evaluation:	Yes	Geometry, strengths, and laboratory data can support analyses.
Other relevant analyses:	No	

3.12.1. Field Activities

The scope of the exploration included drilling at the north dike of the Dry Fly Ash Stack (six test borings along the crest and six borings along the road at the toe). One of the toe borings included a secondary offset location after shallow auger refusal on crushed limestone in the initial boring. One additional boring was drilled adjacent to the discharge canal on the top of the dike, on the east side of the stack. The borings were advanced using hollow-stem augers to the depth of auger refusal. The boring locations were selected and established in the field; however, survey information was not recorded on the boring logs. The approximate locations for each boring are shown on the boring layout in Exhibit 1.

SPTs were performed using an automatic hammer according to ASTM D 1586. The SPT samples were generally obtained at 2.5-foot intervals to a depth of 10 feet, and at 5-foot intervals thereafter. Additionally, nine undisturbed samples (3-inch Shelby tubes) were obtained according to ASTM D 1587.

Water levels were observed during drilling and prior to backfill of the boreholes with a Portland cement/grout mixture. A tremie pipe was used to facilitate backfill from the bottom of the boreholes up to the ground surface.

3.12.2. Laboratory Testing

The samples obtained from the borings were visually described by the field engineer, recorded on boring logs, and transported to the laboratory. Select disturbed and undisturbed samples were subjected to Atterberg limits testing (ASTM D 4318), natural moisture content (ASTM D 2216), and grain size distribution (ASTM D 422). Selected undisturbed samples were subjected to unit weight, specific gravity (ASTM D 854), and consolidated-undrained (CU) triaxial shear strength testing with pore pressure measurements. The strength parameters developed from the CU triaxial shear tests were based on maximum deviator stress criteria for both drained and undrained strengths.

3.12.3. Analysis

The data from the subsurface exploration was collected to support the engineering analyses by Parsons (1999) as described in Section 3.12.1.

3.12.4. Evaluation of Existing Data

Based on a review of the referenced document and the data therein, 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 from boring logs.

    a. Boring locations can be estimated based on geo-referencing of the boring location plan, and elevations can be estimated from topographic mapping at the time of drilling.

    b. Boring logs document the material descriptions and thicknesses.

2. CCR and soil properties (including shear strengths).

    a. Sampling and testing followed relevant ASTM standards.

3.13. PARSONS (1999)

Table 13. Summary of Evaluation for Parsons (1999)

Reference:	Parsons Energy & Chemicals Group, Inc. (1999). "Fly Ash Pond Dike Slope Stability Evaluation, Phase One Report." Prepared for Tennessee Valley Authority. December 9.	
Purpose:	Evaluate the slope stability of the dike at select cross sections and propose alternatives for improving its stability in areas identified by analyses.	
CCR Unit(s):	Dry Fly Ash Stack	
Spatial coverage:	Slope stability evaluated along seven cross sections of the north dike - six sections between the northwest and northeast corners of Dry Fly Ash Stack, and one section on the east dike near the canal.	
Item	**Yes/No**	**Remarks**
Soil borings:	No	Analyses based on borings/subsurface data from Law (1999) and Law (1994)
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	N/A	
Data adequate to support three-dimensional model:	N/A	
Geometry at time of document representative of 2017 conditions:	No	Perimeter dike slopes flattened and toe drain constructed in 2000-2002; foundation geometry largely unchanged
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	Yes	Static drained strengths (soil fill, soft ash, alluvial clay, alluvial gravel, residuum, bedrock). Seismic strengths not developed
Static slope stability:	Yes	7 cross sections
Seismic slope stability:	Yes	7 cross sections
Information adequate to support stability evaluation:	Yes	
Other relevant analyses:	No	

3.13.1. Analysis

The referenced document relied on existing field and laboratory data to conduct slope stability analyses at seven cross sections along the north and east dikes of the Dry Fly Ash Stack. Principally, data from Law (1994) and Law (1999) were used to establish subsurface geometry and material parameters of the different soil layers at the evaluated cross sections. The various cross sections represented different reaches along the dike in areas with varying geometry (i.e., rip rap at the toe, slopes ranging from approximately 1.6:1 to 3:1).

Stability was evaluated using a limit equilibrium (Bishop's) method as implemented in the computer program PC STABL (version 5M). A program called STED (version "win 2.0") was also used to create the PC STABL data files based on graphical construction of the cross sections. Analyses were completed for static and pseudostatic loading for long-term, steady-state seepage conditions based on piezometer and well readings onsite. Additional analyses evaluated the potential for a perched groundwater level approximately ten feet higher than the observed water levels in the site instrumentation. The drained shear strength parameters for the CCR and soils used in the analyses were selected based on available boring and laboratory testing results, and the author's interpretation of the data. To account for variability of the CCR thickness in the profile, and to account for the assumed state of strain of the dike materials, the shear strengths were assigned conservatively. Specifically, the CCR in the dike was assumed to be in a residual rather than a peak state, therefore the triaxial tests were interpreted accordingly.

The stability analyses evaluated the selected cross sections with respect to circular failure surfaces. Based on the stability evaluation of the dike at the seven selected sections, the dike was categorized into three zones with respect to stability. The categorization approximately correlated to the existing slopes of the dike as follows;

- Critical (FS<1.0): existing slopes of 2.25:1 and steeper
- Marginal (1.0≤FS≤1.1): existing slopes between 2.25 and 2.75:1
- Acceptable (FS≥1.3): existing slope of 2.9:1 and flatter

Following the evaluation of the cross sections at the existing slopes, further static slope stability analyses were computed to support remediation concepts (regrading of slopes). Pseudostatic stability analyses were also conducted considering pore pressures based on instrumentation readings. The pseudostatic load cases used the static, drained shear strengths and a horizontal acceleration of 0.1g. Supporting derivations of the horizontal seismic coefficient were not documented in the report.

The surface geometry has changed since the referenced document was published; therefore, the stability results may no longer represent current conditions. Specifically, toe improvements have been added to the dike, the outslope has been flattened in several locations, a geomembrane liner was added to a portion of the interior of the Dry Fly Ash Stack, and final closure of the stack in 2016 altered the ground surface profiles at the evaluated cross sections.

3.13.2. 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. Some material parameters are representative of current.

    b. The subsurface geometry of the dike and top of rock elevations are substantially the same as present.

3.14. STANTEC (2010)

Table 14. Summary of Evaluation for Stantec (2010)

Reference:	Stantec (2010). "Report of Geotechnical Exploration: Dry Fly Ash Stack, Bottom Ash Disposal Area 2, Ash Disposal Area J." Prepared for Tennessee Valley Authority. February 8.	
Purpose:	Geotechnical exploration, seepage, and slope stability analyses of the referenced CCR units.	
CCR Unit(s):	Dry Fly Ash Stack, Ash Disposal Area J, Bottom Ash Pond	
Spatial coverage:	Perimeter of Ash Disposal Area J and Bottom Ash Pond. Perimeter and interior of Dry Fly Ash Stack.	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	88 borings
Rock coring:	No	
Other subsurface data:	Yes	5 CPT soundings
Boring locations surveyed:	Yes	Surveyed by TVA prior to drilling
Data adequate to support three-dimensional model:	Yes	Data to support dike geometry, CCR thickness, foundation soil stratigraphy, and top of rock elevation.
Geometry at time of document representative of 2017 conditions:	Yes	Ash Disposal Area J same as 2017, except for recommended repair to toe of perimeter dike. Dry Fly Ash Stack was undergoing closure. Bottom Ash Pond was active but was later modified significantly for closure.
Piezometer installation:	Yes	45 piezometers
In-situ testing:	Yes	SPT, CPT, Vane Shear testing, slope inclinometers
Laboratory testing:	Yes	Testing follows ASTM standards.
Shear strength parameters:	Yes	Static drained strengths (compacted fly ash, bottom ash, sluiced ash, clay fill, dike, alluvial clay, alluvial gravel, alluvial sand, residual clay)
Static slope stability:	Yes	4 Sections through Ash Disposal Area J perimeter (including proposed repair at one section), 1 Section through Bottom Ash Pond Perimeter, 7 sections through Dry Fly Ash Stack
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Substantial field and laboratory data, material parameter development. Some analyses representative of 2017 geometry.
Other relevant analyses:	Yes	Assessment of historical dike construction documents and sections

3.14.1. Field Activities

The geotechnical exploration program consisted of 88 borings (including offset borings) and five CPT soundings completed between March 23 and June 5, 2009. Boring locations were selected and staked by Stantec personnel (approximate boring locations are shown on the boring layouts in Exhibit 1, 2, and 3). The borings were performed using a drill rig equipped with hollow-stem augers. SPT sampling was performed at 1.5-foot intervals, in accordance with ASTM D1586. Undisturbed samples were obtained in accordance with ASTM D1587. Vane shear testing was performed in four borings in accordance with ASTM D 2573. An electronic cone penetrometer with pore pressure measurements was used for the CPT soundings.

Piezometers were installed in 45 borings and slope inclinometers were installed in 15 borings. Upon completion of the drilling and sampling procedures, the boreholes were either backfilled with auger cuttings (2 borings) or instrumentation backfill materials (cement, sand and/or bentonite) depending on the type of instrumentation the borehole received.

3.14.2. Laboratory Testing

Select disturbed (SPT) and undisturbed (Shelby tube) samples obtained during conventional drilling were subjected to the following laboratory tests according to ASTM standards: natural moisture content (D2216), Atterberg limits (D4318), specific gravity (D854), density (D2937), USCS classification (D2487), gradation (D422), and falling head hydraulic conductivity (D5084). Additionally, 47 CU triaxial compression (D4767) tests, nine UU triaxial compression (D2850) tests, and one unconfined compression test (D2166) were performed on undisturbed Shelby tube samples and remolded disturbed/bulk samples.

3.14.3. Analysis

Historical boring information and new data gathered from the referenced geotechnical exploration were used to establish existing subsurface geometry and material parameters at the section locations. The selection of the slope stability cross sections was based upon the steepness of slopes, the geometry of the sections, the piezometric surface, and the subsurface conditions. Based on these criteria, 13 cross sections (Sections A, B, C, D, E, F, G, H, I, J, K, M, O) were selected for slope stability analyses. Cross sections A through H represented various reaches of the Dry Fly Ash Stack, cross section I represented the Bottom Ash Pond, and cross sections J, K, M, and O represented Ash Disposal Area J. Seepage analyses were performed for one cross section (Section I) in the Bottom Ash Pond. Phreatic lines for cross sections in the Dry Fly Ash Stack and Ash Disposal Area J were developed using data from piezometers.

The stability of the existing dike slopes was evaluated using SLOPE/W software and two-dimensional limit equilibrium methods of analysis. Stability was assessed for static loading for long-term, steady-state seepage conditions. The drained shear strength parameters were derived using site-specific laboratory data and typical ash properties from other similar disposal sites.

The stability analyses focused on the potential for global failure and non-global failure along the exterior slopes of assessed CCR Units. Stability analyses of existing conditions along sections B-B', C-C', D-D', and E-E' within the Dry Fly Ash Stack produced factors of safety less that the 1.5 target for slip planes located within the river bank, immediately below the toe of the starter dike. The stability analysis for Ash Disposal Area J produced factors of safety less than 1.5 for the existing and high pool conditions for Section M-M'.

The report included recommendations to improve the stability of perimeter dike areas of the Dry Fly Ash Stack and Ash Disposal Area J that did not meet the recommended criteria for long term static stability.

3.14.4. 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. 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 (excluding the closed Bottom Ash Pond).
2. Piezometers
    a. Installation methods meet current standard of practice,
    b. Locations and elevations were surveyed.
    c. Active instruments are adequate to provide current water level readings.
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 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 to current.

d. Analysis methods meet current standard of practice.

3.15. URS (2010A)

Table 15. Summary of Evaluation for URS (2010a)

Reference:	URS (2010a). "Static Stability of the Perimeter Embankment of Ash Disposal Area J." Prepared for Tennessee Valley Authority. August 19.	
Purpose:	Complete a focused geotechnical assessment of areas of Ash Disposal Area J, where there was concern for less than acceptable slope stability.	
CCR Unit(s):	Ash Disposal Area J	
Spatial coverage:	Perimeter dikes	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	8 borings
Rock coring:	No	
Other subsurface data:	Yes	12 static CPT and 12 dilatometer (DMT) soundings
Boring locations surveyed:	Yes	Exploration cluster locations surveyed, not individual boring/CPT/DMT locations.
Data adequate to support three-dimensional model:	Yes	Data support dike geometry, foundation soil stratigraphy, and top of rock.
Geometry at time of document representative of 2017 conditions:	Yes	Geometry largely the same as 2017, except for recommended repair to toe of perimeter dike.
Piezometer installation:	No	
In-situ testing:	Yes	SPT, static CPT, DMT
Laboratory testing:	Yes	Testing follows ASTM standards. Laboratory data sheets included in report.
Shear strength parameters:	Yes	Static drained strengths (upper clay, lower clay, alluvial clay, alluvial sand, alluvial gravel)
Static slope stability:	Yes	4 cross sections
Seismic slope stability:	Yes	Pseudostatic with drained shear strength parameters
Information adequate to support stability evaluation:	Yes	Geometry, strengths, and laboratory data can support analyses.
Other relevant analyses:	No	

3.15.1. Field Activities

The field exploration program was conducted between May 25 and June 4, 2010. The program primarily focused on developing estimates of the strength of the soil that comprised the clay dike using static CPT soundings, HSA borings, Marchetti flat plate dilatometer (DMT) soundings, disturbed soil sampling, and undisturbed (thin-walled tube) soil sampling. Seventeen general locations were explored along approximately 2,700 feet of the north and west dikes of Ash Disposal Area J. Various combinations of borings, static CPT, and DMT soundings were clustered at the general locations. The multiple modes of exploration were undertaken to provide redundancy and improved reliability in the interpretation of stratigraphy and soil strength, and to provide a basis for calibration of in-situ testing with laboratory testing.

Exploration points were located by field personnel using a hand-held GPS device prior to advancement. The locations were marked after completion for subsequent surveying by TVA. A total of eight soil borings were completed. The borings were advanced using hollow stem auger techniques (ASTM D6151), and ranged in depth from 31 to 47 feet below existing grade. Both disturbed (SPT, ASTM D1586) and undisturbed (Shelby tube, ASTM D1587) samples were collected. Groundwater was not encountered in the borings at the time of drilling. After completion, the boreholes were grouted to the surface. The approximate locations for each boring are shown on the boring layout in Exhibit 3.

Twelve static cone penetrometer test (static CPT) soundings (ASTM D3441) were completed to depths ranging from 18 to 49 feet. The static CPT soundings were conducted with a cone equipped to record pore pressure measurements during advancement.

Twelve flat plate dilatometer (DMT) soundings were completed using a Marchetti dilatometer in general accordance with ASTM D6635. The soundings ranged in depth from 14 to 35 feet below existing grade. The increasing presence of gravel as the soundings were advanced limited the test depth as compared to the static CPT soundings. The DMT soundings were principally advanced to provide in-situ measurements of soil strength in the embankment (dike) clay, as well as provide indications of the state of stress of the in-situ soils.

3.15.2. Laboratory Testing

The samples obtained from the borings were visually described by the field geologist, recorded on boring logs, and transported to the laboratory. The testing program was designed to establish soil strengths by direct shear (ASTM D3080), laboratory vane shear (ASTM D4648), and consolidated-undrained (CU) triaxial shear (ASTM D4767) strength testing. Soil index properties were estimated by natural moisture content (ASTM D2216), Atterberg Limits (ASTM D4318), and particle size analyses (ASTM D422).

3.15.3. Analysis

Soil stratigraphy was developed from the borings and soundings described in Section 3.14.1, supplemented by available historical information. Four cross sections developed by Stantec (2010), sections J-J', K-K', M-M', and O-O', were analyzed again in the referenced document. The shear strength parameters and subsurface geometry were updated from Stantec (2010) based on new borings/soundings, in-situ testing, and laboratory testing.

The stability was evaluated using a limit equilibrium (Spencer's) method as implemented in the computer program SLIDE (version 5.0). The analysis sections were evaluated for two different river levels; normal river level (El. 1,067 feet) and high river water level (El. 1,073 feet). Analyses were completed for static (both river levels) and pseudostatic (high river level only) loading for long-term, steady-state seepage conditions. The drained shear strength parameters for the dike soils used in the analyses were selected based on in-situ and laboratory testing results. The clay soils modeled within the dike were assigned effective stress friction angles of zero degrees, and relatively high values of effective stress cohesion. Additionally, effective stress cohesion was modeled in the alluvial clay layer below the dike.

Results of the analyses indicated that the stability of the dike met target factors of safety for both static and pseudostatic conditions. The seismic load cases incorporated a horizontal acceleration of 0.1g. Supporting derivations of the horizontal seismic coefficient were not documented in the report. Based on the stability analysis results, no corrective (i.e., stabilization) measures were recommended for the dike at Ash Disposal Area J. Recommendations for scour protection of the dike toe were made, consistent with Stantec (2010).

3.15.4. 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. General 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. Soil properties (including shear strengths)
    a. Sampling and testing followed relevant ASTM standards.
    b. Surface and subsurface conditions are substantially the same as current.

3. 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 to current.

3.16. URS (2010B)

Table 16. Summary of Evaluation for URS (2010b)

Reference:	URS (2010b). "Static Stability of the Perimeter Dike of the Dry Fly Ash Stack, Rev. 1." Prepared for Tennessee Valley Authority. August 26.	
Purpose:	Field exploration, laboratory testing, and engineering analyses to support additional evaluation of static slope stability in targeted areas of concern identified by Stantec (2010).	
CCR Unit(s):	Dry Fly Ash Stack	
Spatial coverage:	Exploration and analysis of an area near the west end of the dry fly ash stack, along the upper and lower perimeter dike access roads.	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	8 borings
Rock coring:	No	
Other subsurface data:	Yes	18 static CPT and 13 DMT Soundings
Boring locations surveyed:	Yes	Exploration cluster locations surveyed, not individual boring/CPT/DMT locations.
Data adequate to support three-dimensional model:	Yes	Data support dike geometry, foundation soil stratigraphy, and top of rock.
Geometry at time of document representative of 2017 conditions:	Yes	Additional ash stacked after this exploration; however, foundation and dike geometry at boring locations has not been significantly changed.
Piezometer installation:	No	
In-situ testing:	Yes	Static CPT and DMT
Laboratory testing:	Yes	Testing follows ASTM standards. Laboratory data sheets included in report.
Shear strength parameters:	Yes	Static drained strengths (upper clay, lower clay, alluvial clay, alluvial sand, alluvial gravel)
Static slope stability:	Yes	3 cross sections
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Geometry, strengths, and laboratory data can support analyses.
Other relevant analyses:	No	

3.16.1. Field Activities

The field exploration program was conducted between May 22 and June 17, 2010. The program primarily focused on determining the occurrence and strength of soils in the area of concern using CPT soundings, HSA borings, Marchetti flat plate dilatometer (DMT) soundings, disturbed soil sampling, and undisturbed (thin-walled tube) soil sampling. Eighteen general locations were explored along approximately 800 feet of the north dike upper and lower perimeter roads of the dry fly ash stack. Various combinations of borings, static CPT, and DMT soundings were clustered at the general locations. The multiple modes of exploration were undertaken to provide redundancy and improved reliability in the interpretation of stratigraphy and soil strength, and to provide a basis for calibration of in-situ testing with laboratory testing.

Exploration points were located by field personnel using a hand-held GPS device prior to advancement. The locations were marked after completion for subsequent surveying by TVA. A total of eight soil borings were completed, four in each of the upper and lower perimeter roads. The borings were advanced using HSA techniques (ASTM D6151), and ranged in depth from 12 to 53 feet below existing grade. Both disturbed (SPT, ASTM D1586) and undisturbed (Shelby tube, ASTM D1587) samples were collected. Groundwater was measured in the eight borings approximately 24 hours after completion of drilling. The approximate locations for each boring are shown on the boring layout in Exhibit 1.

Eighteen static cone penetrometer test (CPT) soundings (ASTM D3441) were completed (nine in each of the upper and lower perimeter roads) to depths ranging from 6 to 47 feet. The static CPT soundings were conducted with a cone equipped to record pore pressure measurements during advancement.

Thirteen flat plate dilatometer (DMT) soundings were completed (seven in the upper road and six in the lower road) using a Marchetti dilatometer in general accordance with ASTM D6635. The soundings ranged in depth from 9 to 35 feet below existing grade. The increasing presence of gravel as the soundings were advanced limited the test depth as compared to the CPT soundings. The DMT soundings were principally advanced to provide in-situ measurements of soil strength in the embankment (dike) clay, as well as provide indications of the state of stress of the in-situ soils.

3.16.2. Laboratory Testing

The samples obtained from the borings were visually described by the field geologist, recorded on boring logs, and transported to the laboratory. The testing program was designed to establish soil strengths by direct shear (ASTM D3080), consolidated-undrained (CU) triaxial shear (ASTM D4767), and unconfined compression (ASTM D2166) strength testing. Soil index properties were estimated by natural moisture content (ASTM D2216), Atterberg Limits (ASTM D4318), and particle size analyses (ASTM D422).

3.16.3. Analysis

Soil stratigraphy was developed from the borings and soundings described in Section 3.15.1, supplemented by available historical information. Three cross sections developed by Stantec (2010), B-B', C-C', and D-D', were analyzed again in the referenced document. Select shear strength parameters and subsurface geometry were updated from Stantec (2010) based on new borings/soundings, in-situ testing, and laboratory testing.

The stability was evaluated using limit equilibrium (Spencer's) method as implemented in the computer program SLIDE (version 5.0). The analysis sections were evaluated at two river levels; normal river level (El. 1,067 feet) and high river water level (El. 1,073 feet). The piezometric surface modeled within the subsurface embankment and ash-fill areas was based on that used in Stantec (2010). Analyses were completed for static loading for long-term, steady-state seepage conditions at the two analyzed river levels. The drained shear strength parameters for the clay fill (perimeter dike), internal dike, and alluvial clay used in the analyses were selected based on in-situ and laboratory testing results of the subject program. In general, these materials were assigned slightly lower friction angles and higher cohesion values than those used in preliminary analyses reported in Stantec (2010). Note that Stantec (2010) did not assign effective stress cohesion to the subsurface materials. The remaining subsurface materials were assigned strengths similar to those used in Stantec (2010).

Both deterministic and probabilistic slope stability analyses were performed at the subject cross sections. In both cases, results of the analyses indicated that the stability of the dike met target factors of safety for the static conditions. Based on the analysis results, the rock buttress at the toe of the slope (recommended in Stantec (2010)) was not recommended by URS. However, URS recommended the construction of a subsurface drainage system, supporting a similar recommendation from Stantec (2010).

The surface geometry has changed since the referenced document was published; therefore, the stability results may no longer represent current conditions. Specifically, toe improvements have been added to the dike and final closure of the stack in 2016 and have altered the ground surface profiles at the evaluated cross sections.

3.16.4. 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. General 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. Soil properties (including shear strengths)

   a. Sampling and testing followed relevant ASTM standards.

   b. Foundation and perimeter subsurface conditions are substantially the same as current.

3. Static and seismic slope stability analyses

   a. Material parameters are representative of current.

   b. Foundation and perimeter subsurface geometry is substantially the same as present.

3.17. STANTEC (2012A)

Table 17. Summary of Evaluation for Stantec (2012a)

Reference:	Stantec (2012a). "JSF Bottom Ash Pond Closure – Volumetric Computations." Prepared for Tennessee Valley Authority. January 12.	
Purpose:	Perform drilling program to locate the top of clay/weathered shale in order to estimate the volume of ash in the Bottom Ash Pond.	
CCR Unit(s):	Bottom Ash Pond	
Spatial coverage:	East Pond, Stilling Pond, divider dike	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	53 borings
Rock coring:	No	
Other subsurface data:	Yes	Historical surfaces from surveys of Bottom Ash Pond.
Boring locations surveyed:	Yes	Surveyed at time of drilling using GPS equipment.
Data adequate to support three-dimensional model:	Yes	Survey establishes bottom of ash surface in Bottom Ash Pond.
Geometry at time of document representative of 2017 conditions:	No	Bottom Ash Pond currently undergoing closure. Perimeter dike and foundation stratigraphy largely unchanged
Piezometer installation:	No	
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	

3.17.1. Field Activities

A total of 53 borings were advanced between November and December 2011 in the Bottom Ash Pond, including 47 in the East Pond, four in the Stilling Pond, and two in the divider dike separating the Stilling Pond and East Pond. Boring locations were surveyed at time of drilling using GPS equipment (approximate boring locations are shown on the boring layout in Exhibit 2). The borings were performed using a drill rig equipped with hollow-stem augers. The borings in the Stilling Pond and 19 borings in the East Pond were drilled from a barge. SPT sampling was performed in accordance with ASTM D1586.

The drilling data indicated that there is a well-defined top of clay/weathered shale boundary beneath the Bottom Ash Pond. No ash was encountered in the borings in the divider dike.

3.17.2. 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.

3.18. STANTEC (2012B)

Table 18. Summary of Evaluation for Stantec (2012b)

Reference:	Stantec (2012b). "Results of Pseudostatic Slope Stability Analysis, Active CCP Disposal Sites." Prepared for Tennessee Valley Authority. February 15.	
Purpose:	Perform pseudostatic analysis of CCP facilities using existing data.	
CCR Unit(s):	Dry Fly Ash Stack, Bottom Ash Pond	
Spatial coverage:	West side of Dry Fly Ash Stack, Bottom Ash Pond Stilling Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	N/A	
Data adequate to support three-dimensional model:	No	
Geometry at time of document representative of 2017 conditions:	No	Dry Fly Ash Stack and Bottom Ash Pond were active; perimeter dikes and foundation geometry largely unchanged
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	Yes	
Static slope stability:	No	
Seismic slope stability:	Yes	Pseudostatic analysis of Section I in Bottom Ash Pond and Section C in Dry Fly Ash Stack using ground motions from AMEC 2011 seismic hazard study.
Information adequate to support stability evaluation:	Yes	Seismic undrained strengths (compacted fly ash, sluiced fly ash, clay fill, dike, residual clay, alluvial clay, alluvial sand)
Other relevant analyses:	No	

3.18.1. Analysis

Pseudostatic slope stability analyses were performed using a horizontal pseudostatic coefficient. The coefficient was selected to equal the total hazard peak ground acceleration (rock) for a 2,500-year return period. The analysis results indicate factors of safety greater than or equal to the target of 1.0.

3.18.2. 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. Seismic slope stability analyses

    a. Material parameters are representative of current.

    b. Surface and subsurface geometry (proposed design) is substantially the same at present.

    c. Pool elevations and phreatic conditions are similar or more conservative than current.

3.19. STANTEC (2012C)

Table 19. Summary of Evaluation for Stantec (2012c)

Reference:	Stantec (2012c). "Project Planning Document (PPD), John Sevier Fossil Plant, Bottom Ash Pond Discharge Re-Route." March 15.	
Purpose:	Design a re-route and/or reconfigure the discharge outfall of the Bottom Ash Pond to comply with new regulations.	
CCR Unit(s):	Bottom Ash Pond, Dry Fly Ash Stack	
Spatial coverage:	Areas west of Dry Fly Ash Stack West Stilling Pond and Bottom Ash Pond Stilling Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	20 Borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	As-drilled locations surveyed by TVA.
Data adequate to support three-dimensional model:	No	
Geometry at time of document representative of 2017 conditions:	Yes	No drilling in CCR units, but surrounding foundation stratigraphy unchanged
Piezometer installation:	No	
In-situ testing:	Yes	SPT
Laboratory testing:	Yes	Testing follows ASTM standards.
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Characterization of surrounding foundation soils and stratigraphy.
Other relevant analyses:	No	

3.19.1. Field Activities

Twenty borings were advanced in the vicinity of the proposed Bottom Ash Pond discharge reroute in January 2012. The borings are generally adjacent to the West Stilling Pond of the Dry Fly Ash Stack, the Stilling Pond of the Bottom Ash Pond, and the John Sevier Campground. Boring locations were selected by Stantec personnel and surveyed by TVA (approximate boring locations are shown on the boring layout in Exhibits 1 and 2). The borings were performed using a drill rig equipped with hollow-stem augers. SPT sampling was performed in accordance with ASTM D1586. Undisturbed samples were obtained in accordance with ASTM D1587. Augers were generally advanced through the upper layer of weathered bedrock until refusal was encountered in the harder, less-weathered shale.

Upon completion of the drilling and sampling procedures, the boreholes were backfilled with auger cuttings.

3.19.2. Laboratory Testing

Select disturbed (SPT, bulk) and undisturbed (Shelby tube) samples obtained during conventional drilling were subjected to the following laboratory tests according to ASTM standards: natural moisture content (D2216), Atterberg limits (D4318), specific gravity (D854), density (D2937), USCS classification (D2487), and gradation (D422).

3.19.3. 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 boring logs

    a. Boring locations and elevations were surveyed,

    b. Boring logs document material descriptions and thicknesses,

    c. Surrounding area foundation geometry is substantially the same as current.

3.20. STANTEC (2012D)

Table 20. Summary of Evaluation for Stantec (2012d)

Reference:	Stantec (2012d). "Letter for Additional & Replacement Instrumentation Installations, Dry Fly Ash Stack." Prepared for Tennessee Valley Authority. March 23.	
Purpose:	Replace instruments abandoned for the Dry Fly Ash Stack toe drain construction project and install additional instruments for the instrumentation monitoring program.	
CCR Unit(s):	Dry Fly Ash Stack	
Spatial coverage:	Upper and Lower Perimeter Roads	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	13 borings
Rock coring:	Yes	4 borings
Other subsurface data:	No	
Boring locations surveyed:	Yes	Surveyed by TVA prior to drilling
Data adequate to support three-dimensional model:	Yes	Data support dike geometry, foundation soil and rock stratigraphy.
Geometry at time of document representative of 2017 conditions:	Yes	Active unit, but perimeter dike and foundation largely unchanged.
Piezometer installation:	Yes	9 Piezometers
In-situ testing:	Yes	SPT, slope inclinometers
Laboratory testing:	Yes	Testing follows ASTM standards.
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	
Other relevant analyses:	No	

3.20.1. Field Activities

Between December 2011 and March 2012, 13 borings were drilled in the upper and lower perimeter roads of the Dry Fly Ash Stack. Boring locations were selected by Stantec personnel and staked by TVA (approximate boring locations are shown on the boring layout in Exhibit 1). The borings were performed using a drill rig equipped with hollow-stem augers. SPT sampling was performed in accordance with ASTM D1586.

Five piezometers and one slope inclinometer were installed as replacements of instruments abandoned for the toe drain construction project. In addition, four piezometers and three slope inclinometers were installed at new locations along the north slope. Upon completion of the drilling and sampling procedures, the boreholes were backfilled with instrument backfill materials (cement, sand and/or bentonite) depending on the type of instrumentation (piezometer versus slope inclinometer) the borehole received.

3.20.2. Laboratory Testing

Natural moisture content testing (ASTM D2216) was performed on select disturbed (SPT) samples.

3.20.3. 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 boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
    c. Dry Fly Ash Stack perimeter and foundation geometry is substantially the same as current.
2. Piezometers
    a. Installation methods meet current standard of practice,
    b. Locations and elevations were surveyed,
    c. Active 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.

3.21. STANTEC (2013A)

Table 21. Summary of Evaluation for Stantec (2013a)

Reference:	Stantec (2013a). "Basis of Design Report (Rev. 0), Dry Fly Ash Stack, Final Closure." Prepared for Tennessee Valley Authority. July 22.	
Purpose:	Support closure design for Dry Fly Ash Stack	
CCR Unit(s):	Dry Fly Ash Stack	
Spatial coverage:	Perimeter and interior	
Item	**Yes/No**	**Remarks**
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	N/A	
Data adequate to support three-dimensional model:	No	
Geometry at time of document representative of 2017 conditions:	Yes	Closed conditions
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	Yes	Static drained strengths (compacted fly ash, bottom ash, sluiced ash, clay fill, dike, alluvial clay, alluvial gravel, alluvial sand)
Static slope stability:	Yes	3 sections through Dry Fly Ash Stack
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Static stability analyses of Dry Fly Ash Stack under closed (2017) conditions. Static drained shear strength parameters.
Other relevant analyses:	No	

3.21.1. Analysis

Static stability analyses were performed to assess the global stability of the stack with the proposed cover system and the veneer stability of the proposed cover system. The sections (C, E, and F) were selected to represent typical conditions of the installed cover system. Long-term, drained strengths were modeled. The analyzed cross sections were found to meet applicable stability criteria for both global and veneer stability.

3.21.2. 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. CCR and soil properties (including shear strengths)
    a. Subsurface conditions are substantially the same as current.
2. Static 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 to current.
    d. Analysis methods meet current standard of practice.

3.22. STANTEC (2013B)

Table 22. Summary of Evaluation for Stantec (2013b)

Reference:	Stantec (2013b). "Additional Geotechnical Engineering Services, Exploratory Borings and Instrumentation Abandonment and Installation, Dry Fly Ash Stack Closure Project." Prepared for Tennessee Valley Authority. August 30.	
Purpose:	Gather information in support of the closure design for the Dry Fly Ash Stack. Install new instrumentation and abandon existing instrumentation in preparation for closure.	
CCR Unit(s):	Dry Fly Ash Stack	
Spatial coverage:	Interior, southeast perimeter dike, southeast limits of historical bathtub area	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	4 Borings
Rock coring:	No	
Other subsurface data:	Yes	6 CPTu soundings with pore pressure measurements, 5 vacuum-excavated holes
Boring locations surveyed:	Yes	Surveyed boring locations provided by TVA
Data adequate to support three-dimensional model:	Yes	Data support dike geometry, foundation soil stratigraphy, and top of rock.
Geometry at time of document representative of 2017 conditions:	Yes	Closure geometry
Piezometer installation:	Yes	4 sets of nested Vibrating Wire Piezometers, 5 Standpipe Piezometers
In-situ testing:	Yes	SPT, CPTu
Laboratory testing:	No	
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Subsurface and piezometer data representative of closed conditions
Other relevant analyses:	No	

3.22.1. Field Activities

The geotechnical exploration program included four traditional borings, six CPTu soundings, and five vacuum-excavated holes completed between March and July 2013. Boring locations were surveyed by TVA personnel (approximate boring locations are shown on the boring layout in Exhibit 1). The traditional borings were performed using a drill rig equipped with hollow-stem augers.

SPT sampling was performed in accordance with ASTM D1586. Undisturbed samples were obtained in accordance with ASTM D1587. An electronic cone penetrometer with pore pressure measurements was used for the CPT soundings. No sampling was performed in the vacuum-excavated holes.

Upon completion of drilling, vibrating wire piezometers and Sondex settlement systems were installed in the four HSA borings. The borings were fully grouted after the instrumentation was installed. Open standpipe piezometers were installed in the five vacuum-excavated holes, which were backfilled with a sand filter pack and hydrated bentonite pellets.

Four standpipe piezometers were removed and backfilled as part of the fieldwork. Bollards, concrete pads, and covers were removed with a skid-steer loader. The riser pipes were then removed either with the skid-steer loader or via over-drilling with hollow stem augers. Following removal, the boreholes were fully grouted with cement-bentonite grout, and the affected surfaces were restored with new grass vegetation.

3.22.2. 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. Dry Fly Ash Stack and foundation geometry is substantially the same as current (closure geometry).
2. Piezometers
   a. Installation methods meet current standard of practice,
   b. Locations and elevations were surveyed,
   c. Active instruments are adequate to provide current water level readings.

3.23. STANTEC (2016A)

Table 23. Summary of Evaluation for Stantec (2016a)

Reference:	Stantec (2016a). "Well Installations and Groundwater Closures, Groundwater Monitoring Optimization – Phase 3, John Sevier Fossil Plant." Prepared for Tennessee Valley Authority. May 4.	
Purpose:	Install new groundwater monitoring wells, close unnecessary wells, and redevelop existing wells to establish groundwater monitoring network	
CCR Unit(s):	Dry Fly Ash Stack, Bottom Ash Pond	
Spatial coverage:	Dry Fly Ash Stack Perimeter Dike, Areas adjacent to Dry Fly Ash Stack and Bottom Ash Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	10 borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	As-drilled locations surveyed by Stantec
Data adequate to support three-dimensional model:	Yes	Data support dike geometry, foundation soil stratigraphy, and top of rock.
Geometry at time of document representative of 2017 conditions:	Yes	Dry Fly Ash Stack closed, Bottom Ash Pond undergoing closure
Piezometer installation:	Yes	5 Monitoring Wells
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:	Yes	Subsurface and piezometer data representative of closed conditions
Other relevant analyses:	No	

3.23.1. Field Activities

The geotechnical exploration program included ten soil borings completed in October 2015. Five of the borings were located adjacent to existing instrumentation. The remaining borings were performed at various locations selected for the groundwater monitoring well network. Boring locations were surveyed by Stantec personnel (approximate boring locations are shown on the boring layout in Exhibits 1 and 2). The borings were performed using a drill rig equipped with hollow-stem augers. SPT sampling was performed in accordance with ASTM D1586. The soil borings were backfilled with bentonite grout.

Upon completion of drilling, monitoring wells were installed in the five soil borings at new locations. The holes were backfilled with well backfill materials (cement, sand and/or bentonite).

Additionally, seven existing monitoring wells were removed and backfilled as part of the field activities in October 2015. Surface features, casing, and annular backfill were removed with the instruments. The holes were tremie-backfilled with bentonite grout.

3.23.2. 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. Dry Fly Ash Stack and foundation geometry is substantially the same as current (closed).
2. Monitoring Wells
    a. Installation methods meet current standard of practice,
    b. Locations and elevations were surveyed,
    c. Active instruments are adequate to provide current water level readings.

3.24. STANTEC (2016B)

Table 24. Summary of Evaluation for Stantec (2016b)

Reference:	Stantec (2016b). "Basis of Design Report, Bottom Ash Pond, Final Closure." Prepared for Tennessee Valley Authority. December 22.	
Purpose:	Support closure design for Bottom Ash Pond	
CCR Unit(s):	Bottom Ash Pond	
Spatial coverage:	Perimeter and interior	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	10 Borings
Rock coring:	No	
Other subsurface data:	Yes	Bulk samples from Sanders Property Borrow Area
Boring locations surveyed:	Yes	Coordinates are documented, but source of survey data is not reported
Data adequate to support three-dimensional model:	Yes	Borings can contribute to ash volume calculations.
Geometry at time of document representative of 2017 conditions:	Yes	Closed conditions
Piezometer installation:	Yes	1 standpipe piezometer 6 vibrating wire piezometers
In-situ testing:	Yes	SPT
Laboratory testing:	Yes	Testing follows ASTM standards.
Shear strength parameters:	Yes	Static drained strengths (cover soil, stacked ash, sluiced ash, constructed berm, dike, residual clay/silt)
Static slope stability:	Yes	4 Sections for global stability; typical section for veneer stability
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Static stability analyses under closed (2017) conditions. Shear strength parameters.
Other relevant analyses:	No	

3.24.1. Field Activities

The geotechnical exploration program consisted of ten borings. The program included drilling five borings along the existing perimeter dike and four borings in the proposed ash stacking area in August 2016. In November 2015, a single boring was drilled in the divider dike separating the Stilling Pond from the Intermediate Pond, which was used to support closure construction. Bulk samples were also collected from the Sanders Property Borrow Area to confirm soil properties used in stability analyses. Approximate boring locations are shown on the boring layout in Exhibit 2.

The borings were performed using a drill rig equipped with hollow-stem augers. SPT sampling was performed in accordance with ASTM D1586. Undisturbed samples were obtained in accordance with ASTM D1587.

Upon completion of drilling, vibrating wire piezometers were installed in six borings. Two of the six borings also had extensometers installed. A standpipe piezometer was installed in the divider dike boring. The boreholes were either backfilled with grout or well backfill materials (cement, sand and/or bentonite) depending on the type of instrumentation the borehole received.

3.24.2. Laboratory Testing

Select disturbed (SPT) and undisturbed (Shelby tube) samples obtained during conventional drilling were subjected to the following laboratory tests following ASTM standards: natural moisture content (D2216), Atterberg limits (D4318), specific gravity (D854), density (D2937), USCS classification (D2487), gradation (D422), falling head hydraulic conductivity (D5084), and standard proctor compaction (D698B). Additionally, CU triaxial compression (D4767) tests were performed on undisturbed Shelby tube samples.

3.24.3. Analysis

Historical boring information along with the new data gathered from this geotechnical exploration were used to establish existing subsurface geometry and material parameters of the different soils at each section location. Stability of the structure was assessed using SLOPE/W software and two-dimensional limit equilibrium methods of analysis. The analyses included stability evaluations of the exterior perimeter dike slopes, new constructed berm, and ash stack interior under static, long-term (drained) conditions. Four typical cross sections were analyzed, including one section through the ash stack and constructed berm (Q) and three sections though the perimeter dike (R, S, and T). The factor of safety results met the criteria of greater than or equal to 1.5 for post-construction, long-term conditions.

Static, veneer stability analyses were performed for a typical cross section of the proposed cap system. A spreadsheet was used to develop minimum required interface shear strength parameters necessary to meet the acceptance criteria.

3.24.4. 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. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,

   c. Closure geometry for Bottom Ash Pond.

2. Piezometers

   a. Installation methods meet current standard of practice,

   b. Locations and elevations were surveyed,

   c. Active instruments are adequate to provide current water level readings.

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 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 to current.

   d. Analysis methods meet current standard of practice.

4.0. ADDITIONAL DISCUSSION OF SELECTED INFORMATION REQUESTS

4.1. TDEC INFORMATION REQUEST NO. 9

The TVA shall provide, in the JSF site EIP, a description of the process it plans to use to determine if dike construction at the TVA JSF site is susceptible to failure. While TVA may have historic data for dike construction, TVA shall perform proposed additional on-site activities to definitively determine dike construction materials and the location and relative amount of the different materials in the dikes. The JSF Site EAR shall contain this information as well as data that confirm CCR materials used to raise the dikes and a determination if the use of CCR materials contributed to the North Dike Failure in 1973. TVA shall describe the repairs made to the North Dike Failure after the 1973 repair and if any additional repair work is anticipated.

TVA Response

Introduction

TVA understands the information request is to comprehend the stability of perimeter dike systems for the CCR units. Emphasis is placed on the possible presence of CCR in the existing dikes, and whether factors that contributed to the 1973 North Dike failure may still be present.

TVA will use existing data to respond to the information request. Sufficient data exists to characterize the dike materials, construction methods, and material locations without additional field work. The adequacy of existing data to support this response is presented below. The response includes a description of dike construction for each unit, an explanation of the 1973 failure and subsequent repair, and a review of the existing perimeter dike stability with respect to the major factors of the 1973 failure.

JSF Study Area Dike Evaluation

Dry Fly Ash Stack

The Dry Fly Ash Stack area was originally developed as a sluiced ash disposal area located on the floodplain of the Holston River. The principal feature of the disposal area was an approximately 17-foot tall, 4,375-foot long earthen perimeter dike (i.e., starter dike) constructed along the south bank of the river. TVA Drawing 10N410 shows the top of the dike at elevation 1,087± feet. Beginning in 1955, the disposal area was subdivided into a series of ponds (Area A through Area I) separated by interior divider dikes. See Exhibit 4 for a layout of the historical ponds within the footprint of the Dry Fly Ash Stack.

Drawing 10N410 also shows that a raised ash dike would be constructed within the area impounded by the starter dike (Figure 1). The raised ash dike would be constructed to a crest elevation of 1,110 feet as part of future expansion. However, construction records of the expansion are not available. Drawing 10N290 (labeled Ash Disposal Area E Dike Repair, dated July 26, 1973) shows as-built geometry of the raised ash dike that extended both inboard and outboard of the crest of the starter dike in Area E. Also, the as-built crest of the raised dike was above elevation 1,110 feet in Area E. The 1973 drawing indicates that the sluiced ash reached an elevation above 1,100 feet, and this is supported by boring data in Stantec (2010). Sluiced ash was encountered in borings located in the interior of the stack at elevations as high as 1,100 feet.

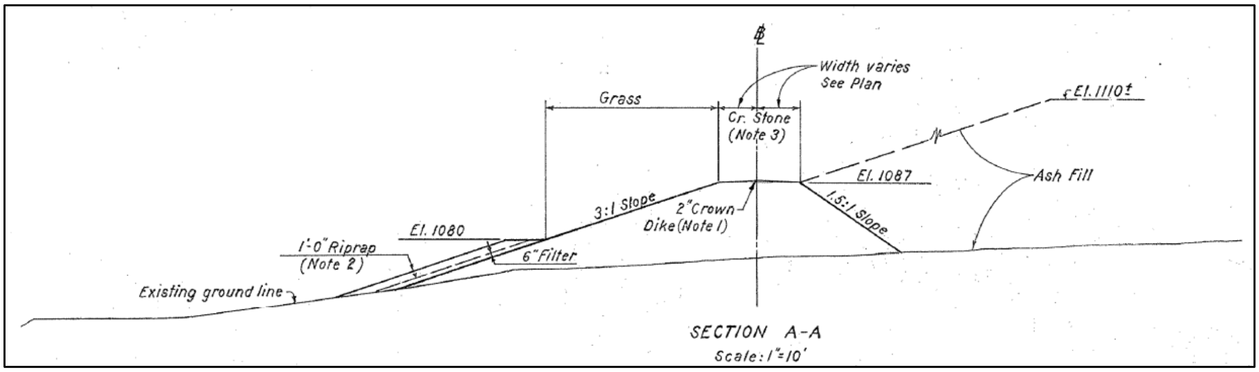

Figure 1. TVA Drawing 10N410 - Starter Dike with Future Interior Raised Ash Dike

The annual inspection report from 1968 states that the perimeter containment was originally built by constructing an earth starter dike around the disposal area. Subsequently, the perimeter dike system was raised by constructing an ash dike along the inside, overlying previously sluiced ash. Several inspection reports (1967, 1968, 1969, 1973) mention that the dikes were steeper than designed, with approximately 1.5:1 outslopes, compared to the 3:1 or 2:1 outslopes shown on design drawings (TVA 1967; TVA 1968; TVA 1969; TVA 1973). The steep slopes were associated with shallow surface slides, or sloughing, on the slopes of the dike in 1969, 1989, 1990, 1995, and 1999 (TVA 1969; TVA 1990; TVA 1995; TVA 1999). A more significant slope failure occurred in 1973, and is discussed later. In general, the shallow slides were repaired with compacted earth by plant personnel prior to the next year's annual inspection. However, after multiple reports in 1995 and 1999 (TVA 1995; TVA 1999), a slope stability evaluation was completed which resulted in a remediation program to flatten the steep slopes. Work in 2002-2004 (TVA 2002; TVA 2004) was completed to flatten the outside slopes of the perimeter dike to 4:1, improving stability in areas where shallow sloughing had occurred. Additionally, rip rap was added as toe stabilization. Plans and details of the improvements are provided on TVA Drawings 10W206-1 through 10W206-11.

The starter dike for the Dry Fly Ash Stack was constructed from clay soil. Based on observations from borings and analysis cross sections in Stantec (2010), there is an additional clay fill on the outslope of the Dry Fly Ash Stack that was likely a component of the 2002-2004 slope flattening project.

The additional clay fill was encountered on the outslope of both the starter dike and the raised dike. The repaired raised dike in Area E (following the 1973 failure) was constructed of clay. According to the 1975 annual inspection report, the raised dike in Area G was constructed of clay to a crest elevation of approximately 1,100 feet.

In the remaining areas of the Dry Fly Ash Stack, boring records from Stantec (2010) suggest that the perimeter raised dike was constructed inside of the starter dike. The raised dikes were constructed, at least in part, with compacted fly ash. Where raised ash dikes were constructed with compacted fly ash, the exploration results from Stantec (2010) indicate that the clay fill veneer was encountered on the outslope. This clay fill veneer protects the compacted fly ash from erosion.

The boring logs published in Stantec (2012b) document material lithology based on borings near the perimeter dike of the Dry Fly Ash Stack, and support the above conclusions based on the information published in Stantec (2010). Similarly, the study of the Dry Fly Ash Stack by URS (2010b) included additional borings that reinforce the findings of Stantec (2010). Earlier borings by Law (1999) are also consistent with the above-mentioned explorations. Refer to Exhibit 1 in Attachment A for boring locations.

Ash Disposal Area J

The dikes forming Ash Disposal Area J were constructed with clayey soil excavated from within the pond footprint and from a borrow area located southeast of the disposal area. Historical drilling and testing programs characterized the borrow materials (TVA 1981). The dike soils are documented by the boring logs published in Stantec (2010). All seven borings in the dike encountered lean clay fill overlying alluvial soils.

Eight additional borings were performed by URS (2010a). Those boring logs also recorded clayey fill soils overlying alluvial foundation materials. Together, the two exploration programs advanced fifteen (15) borings through the dike of Ash Disposal Area J, which encountered consistent materials along the alignment. Refer to Exhibit 3 in Attachment A for boring locations.

Bottom Ash Pond

Historical drilling and testing programs characterized the borrow materials used to construct the Bottom Ash Pond (TVA 1976). Subsurface explorations by Stantec (2010, 2016b) advanced a total of 15 borings from the top of the bottom ash pond perimeter dike. The borings encountered small amounts of bottom ash and gravel as a roadway base on the crest, underlain by clay fill soils above residual silt and clay. Refer to Exhibit 2 in Attachment A for boring locations.

Summary

The above review of available design and construction documents, inspection reports, and subsurface exploration reports demonstrates that portions of the raised perimeter dike of the Dry Fly Ash Stack were constructed using compacted fly ash. In contrast, the perimeter dike systems of Ash Disposal Area J and the Bottom Ash Pond do not appear to contain CCR. Given the emphasis of this information request regarding dike stability as it relates to the presence of CCR in the dikes, only the Dry Fly Ash Stack is discussed in the remainder of this response.

Refer to the Stability SAP and related information requests that explain how TVA will use existing and proposed analyses to demonstrate perimeter slope stability of each CCR unit.

1973 North Dike Failure, Evaluation, and Repair

According to the 1973 inspection report (TVA 1973), a slope failure occurred along a 200 to 300-foot long segment of the outslope of the North Dike (i.e., perimeter dike) in Area E, near the divider dike between Areas E and F. The base of the failure wedge was at approximate elevation 1,085 feet, roughly coinciding with the original crest of the starter dike.

To support the response to this information request, TVA reviewed record construction drawings, annual inspection reports, and geotechnical reports. Many of these documents were provided to TDEC in the Investigation Conference data transmittal.

Record drawings and annual inspections provided the historical perspective on the failure and repair. TVA Drawing 10N290 (Rev 0) (Figure 2) documents the pre-failure, post-failure, and repair conditions to the 1973 North Dike Failure area. This drawing also lists repair construction specifications.

The 1973 Annual Inspection Report (TVA 1973) details the investigation and immediate response to the 1973 North Dike Failure. The 1974 Annual Inspection Report (TVA 1974) details the repair as it progressed. Stantec (2010) included a drilling and sampling program through the perimeter dike, including the repaired slide area, to evaluate the dike materials and geometry. Slope stability analyses completed as part of Stantec (2010), URS (2010b), and Stantec (2013a) evaluated the current perimeter dike geometry.

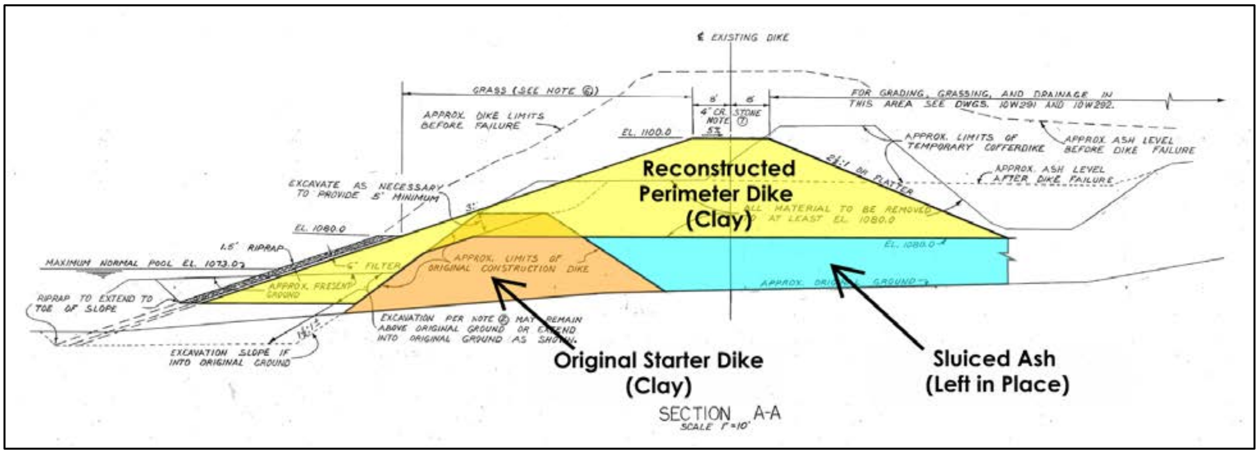

Figure 2. Dry Fly Ash Stack - 1973 North Dike Repair (from TVA Drawing 10N290)

The 1973 inspection report indicated that the following factors contributed to the failure:

- Steep outslopes of the perimeter dike: At time of failure, the dike slopes were as steep as 1.5:1 (H:V), whereas design drawings specified 3:1 slopes or benched 2:1 slopes.

- Ash used to raise the perimeter dike: The top of ash material used in the raised dike appeared to be at approximately elevation 1,115 feet. Ash was used, despite a recommendation from the TVA Department of Engineering Design (DED) that ash not be used in dikes at JSF. DED stated that a significant portion of the ash was assumed to not be stable when wet and could be easily eroded.

- Dikes were raised without compaction control: The ash used to raise the dike was placed by dumping and blading material into place, with limited compaction accomplished by equipment tracking only.

- The toe of the dike was saturated due to elevated river levels: The river/reservoir was at approximate elevation 1,074 feet for an extended period of time. There was no evidence of riprap at the toe as shown on the design drawing; however, rip rap may have been covered by material that was bladed down the steep slope during dike raising.

- The operating pool in the ash pond was assumed to have been elevated: A new flow-through pipe had been installed through the divider dike between Areas E and F at a higher elevation, and some of the Area E dikes had been raised. There is no record of the invert elevation of the new pipe, but the invert noted on the design drawing for the original, lower flow-through pipe is 1,079.69 feet. Based on Figure 2, prior to the failure the sluiced ash inside the raised dike had accumulated to approximately elevation 1,100 feet or slightly higher.

The 1974 inspection report indicated that the permanent repair had been completed according to design. The design of the repair addressed the contributing factors listed above as follows:

- The outslope of the repaired clay dike was constructed at a 3:1 slope.

- Ash was not used in constructing the repaired section of the dike. Existing dike material was removed down to at least elevation 1,080 feet, and was replaced with rolled earthfill up to the raised dike crest elevation of 1,100 feet.

- Specifications on Drawing 10N290 required construction in six-inch lifts, compacted with sheepsfoot rollers.

- Per Drawing 10N290, a two-foot thick layer of riprap and filter material was constructed along the outboard slope of the starter dike, for scour and wave protection in the river.

- Slide material was removed from the outboard side and directly above the starter dike.

- TVA (1973) indicated that after the failure, the operating pool in Area D and E was lowered approximately 20 feet. Additionally, by the time of the 1974 annual inspection (TVA 1974), sluicing was discontinued in Areas D and E.

It should also be noted that TVA (1974) states that Area G had been completed following the 1973 failure. Accordingly, DED contributed input to the construction, and the Area G dike was constructed with rolled earthfill.

Recent geotechnical explorations support evaluation of the failure area and repaired condition. Previously described reports (Stantec 2010, Stantec 2012d, and URS 2010b) present borings, in-situ testing, and instrumentation in the 1973 North Dike Failure repair area. These explorations were focused on the dikes, with consideration of the 1973 failure. Law Engineering (1999) also studied the North Dike. Data from these explorations was used to describe the dike materials and repairs.

Based on the description in TVA (1973), only the Area E dike had been raised to approximately elevation 1,115 feet; raised dikes in other areas were reported to be constructed to lower crest elevations. Between 2002 and 2004, further repair work was done on the steeper outslopes of the perimeter dike, flattening the slopes to 4:1 (TVA 2002; TVA 2004). To accomplish this, some areas of the existing raised ash dike were cut, removing materials to achieve a flatter slope. Other areas required the addition of rolled earthfill to achieve the desired geometry. In either cut or fill situation, a minimum of 18 inches of rolled earthfill veneer was added to the outslope. Evidence from subsequent subsurface explorations indicates that most areas have more than 18 inches of earthfill veneer (Stantec 2010; URS 2010b; Stantec 2013a). A typical section of the closure geometry for the perimeter dike system is shown in Figure 3.

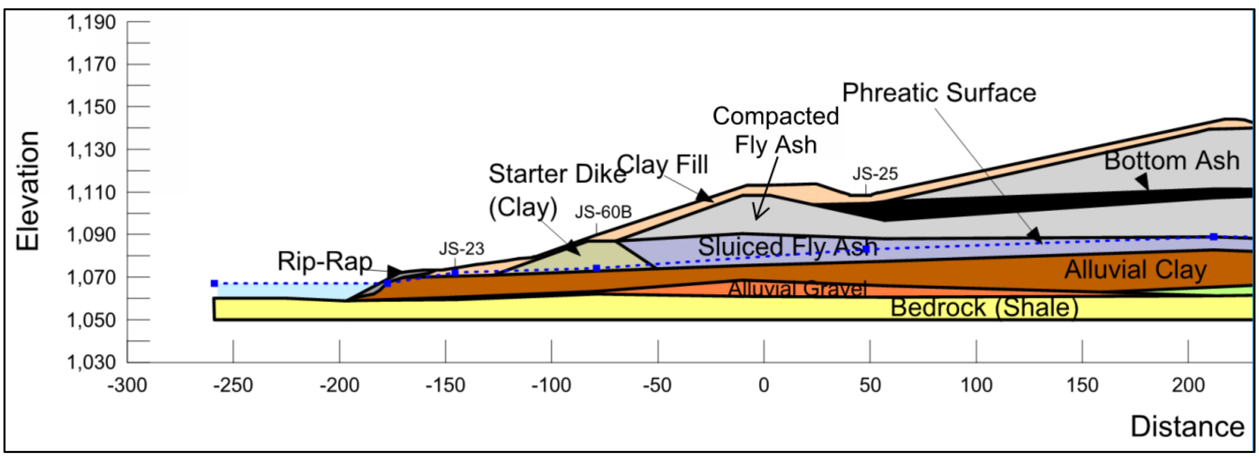

Figure 3. Typical Section - Dry Fly Ash Stack Closure Geometry (Stantec 2013a)

Slope stability Section C-C' was evaluated in Stantec (2010), which included the North Dike of Area E, in the vicinity of the 1973 failure and subsequent repair. The cross section is shown in Figure 4. Boring JS-44 encountered clay fill at the ground surface (elevation 1,103 feet). A small interval of sluiced fly ash was encountered below the repaired clay dike in Boring JS-44, between elevations 1,072 and 1,076 feet.

This is likely a remnant of the sluiced ash that was beneath the original raised dike. Sluiced fly ash was not encountered beneath the repaired clay dike in other borings along the same section (JS-43, JS-62A, and JS-65A).

Because of the failure and repair of this area, the repaired dike appears to be constructed of clay as designed, and not CCR materials. Static slope stability analyses were completed for multiple cross sections (including the 1973 repair area, and areas outside the repair) in Stantec (2010) and URS (2010b), incorporating the geometry and conditions following the 2002-2004 slope flattening improvements. The analyses resulted in acceptable factors of safety, but also included further recommendations for improvements. In February 2012, construction was completed for additional slope flattening and toe drain system installation near the west end of the north dike (Stantec 2012e). Stantec (2013a) included static slope stability analyses for the Dry Fly Ash Stack in the final, closed condition. These analyses resulted in acceptable factors of safety for the perimeter dike.

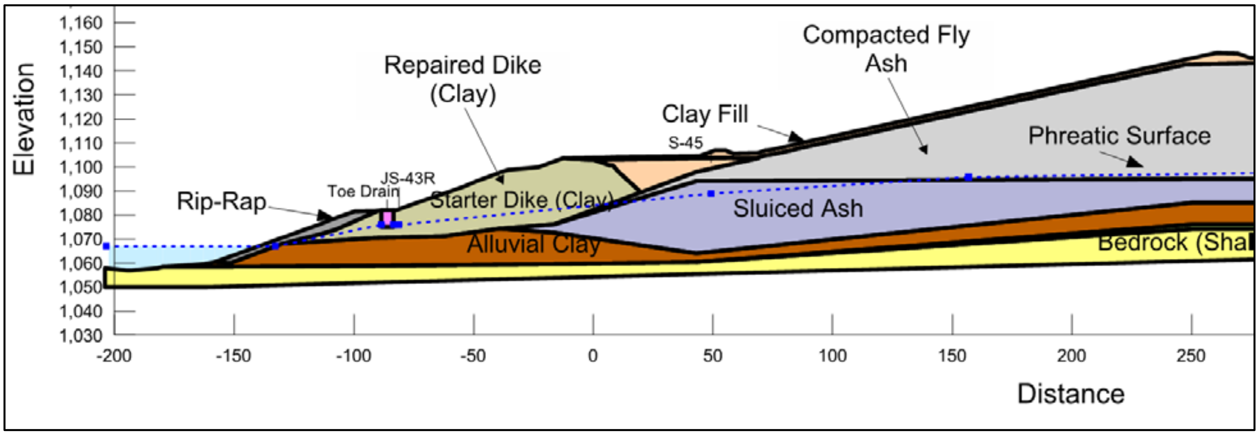

Figure 4. Section C-C' (Final Closure Geometry per Stantec 2013a)

Conclusions

Based on the data presented above, the following conclusions can be made:

- The footprint of the Dry Fly Ash Stack was originally constructed and operated as a surface impoundment for sluiced ash disposal. Design and construction records and borings demonstrate that the starter perimeter dike consisted of clay, while portions of the raised perimeter dike originally included some CCR.
- For the Ash Disposal Area J and the Bottom Ash Pond, design and construction records and borings demonstrate that the perimeter dikes consist of clay, and do not include CCR.
- In 1973, a slope failure occurred along a segment of the raised perimeter dike of the present-day Dry Fly Ash Stack. An evaluation of the failure indicated that several factors

contributed to the failure, including overly steep outslopes, use of poorly compacted ash in the raised dike, saturated outslopes (due to elevated river levels), and elevated operating pool levels.

- The slope failure was repaired by flattening the perimeter dike outslopes, reconstructing the raised dike using compacted clay fill, and installing scour protection along the starter dike outslope. Operational improvements were also made by lowering the operating pool and ultimately discontinuing sluicing and converting the unit to a Dry Fly Ash Stack.

- More recently, additional perimeter improvements have been made to the Dry Fly Ash Stack, including flattening of perimeter outslopes and improving subsurface drainage. The final closure of the unit also improves stability by reducing infiltration, leading to long-term reductions in pore water pressures.

- Borings confirm that portions of the raised perimeter dike consist of compacted fly ash, although it is beneath a clay veneer placed as part of the 2002-2004 slope flattening project. The presence of the CCR is accounted for in recent slope stability modeling of the closed conditions, and adequate factors of safety have been achieved. Similarly, proposed slope stability analyses (refer to the Stability SAP) to be performed as part of the TDEC Order Investigation will also account for the CCR.

- As part of TVA's instrumentation monitoring program, piezometers and slope inclinometers are routinely monitored to provide information regarding dike condition/performance and slope stability.

- Based on the above information, adequate data is available to assess the stability of the perimeter dikes of the CCR units in the JSF study area. No additional field work is necessary to address this information request, and no additional modifications or repairs are anticipated at this time. The presence of CCR in the raised perimeter dike of the Dry Fly Ash Stack has been adequately characterized and is accounted for in slope stability analyses.

4.2. PIEZOMETER DATA IN THE DRY FLY ASH STACK

During the John Sevier EIP Preview Meeting on November 14, 2017, TVA provided a cross section with piezometer data, as an example of phreatic levels at the Dry Fly Ash Stack before, during, and after closure. TDEC requested more recent supplemental data at this cross section; the data and supporting discussion are provided herein.

Figure 5 is the typical section (with piezometer locations shown) through the Dry Fly Ash Stack that was presented at the EIP Preview Meeting. Data for the instruments shown in Figure 5 is presented in Figure 6 and Table 24. The instruments continue to be regularly monitored under TVA's instrumentation and monitoring program.

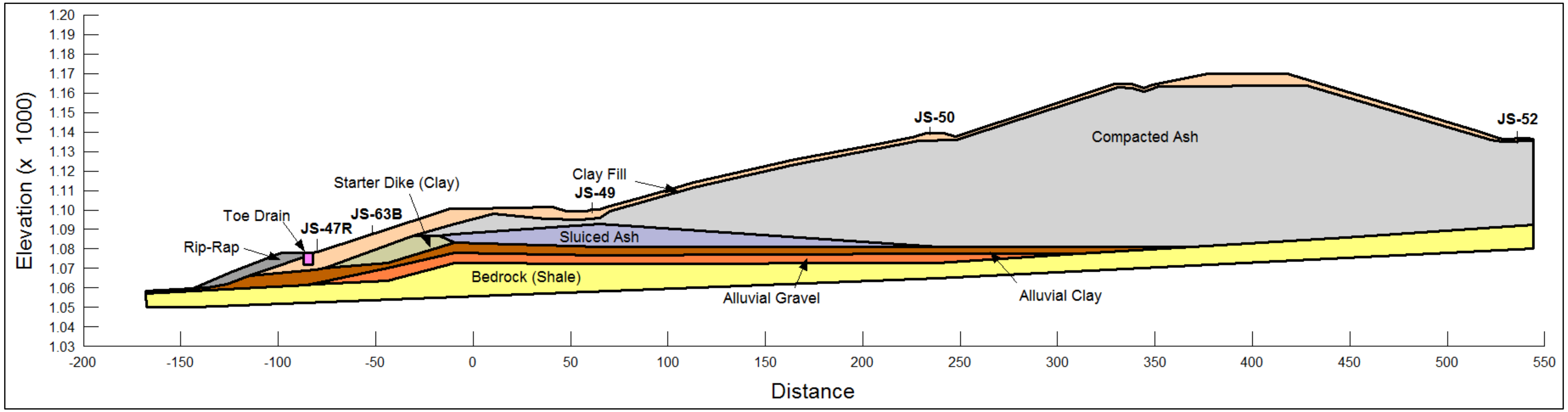

Figure 5. Typical Section through Dry Fly Ash Stack with approximate piezometer locations

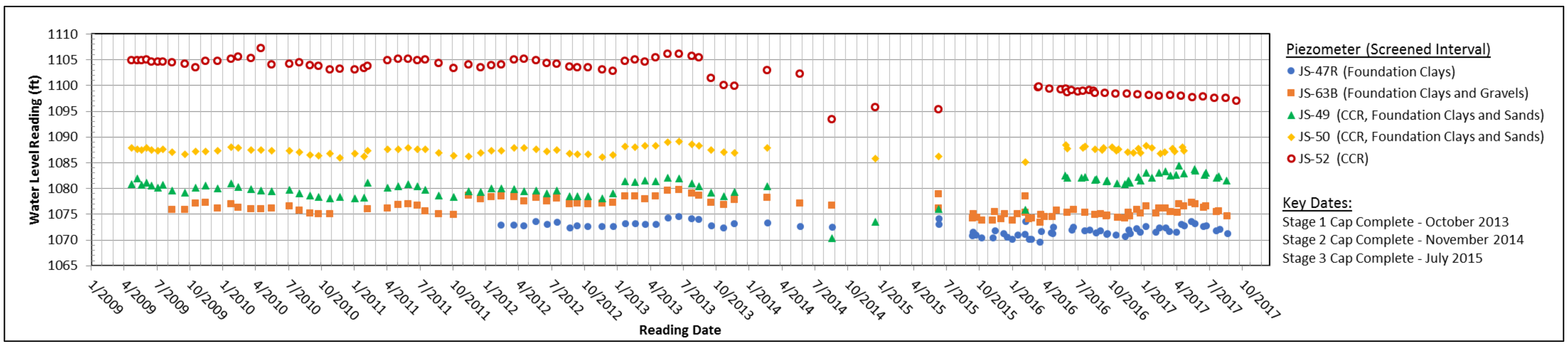

Figure 6. Piezometer readings (i.e, water levels) at the Dry Fly Ash Stack typical section

Table 25. Piezometer readings (i.e., water levels) at the Dry Fly Ash Stack typical section (Geocomp 2017)

Date	Piezometer Readings (elevation, feet)				
	JS-47R	JS-63B	JS-49	JS-50	JS-52
5/19/2009	---	---	1080.8	1087.9	1104.8
6/3/2009	---	---	1082.0	1087.7	1104.8
6/16/2009	---	---	1080.7	1087.5	1104.9
6/29/2009	---	---	1081.1	1087.9	1105.0
7/13/2009	---	---	1080.6	1087.5	1104.6
7/30/2009	---	---	1080.1	1087.3	1104.7
8/13/2009	---	---	1080.8	1087.7	1104.7
9/8/2009	---	1075.8	1079.7	1087.0	1104.5
10/13/2009	---	1075.9	1079.2	1086.7	1104.2
11/12/2009	---	1077.1	1080.2	1087.2	1103.6
12/9/2009	---	1077.3	1080.5	1087.2	1104.7
1/13/2010	---	1076.2	1080.1	1087.3	1104.7
2/18/2010	---	1077.0	1081.0	1088.1	1105.1
3/10/2010	---	1076.3	1080.4	1087.9	1105.6
4/14/2010	---	1076.0	1079.8	1087.5	1105.3
5/13/2010	---	1076.0	1079.6	1087.5	1107.2
6/11/2010	---	1076.2	1079.5	1087.3	1104.1
7/30/2010	---	1076.6	1079.7	1087.4	1104.2
8/26/2010	---	1075.7	1079.1	1087.1	1104.4
9/24/2010	---	1075.2	1078.6	1086.6	1103.9
10/19/2010	---	1075.0	1078.4	1086.4	1103.7
11/18/2010	---	1075.0	1078.1	1086.8	1103.0
12/17/2010	---	---	1078.4	1086.0	1103.2
1/27/2011	---	---	1078.1	1086.8	1103.0
2/22/2011	---	---	1078.3	1086.3	1103.4
3/3/2011	---	1076.0	1081.2	1087.4	1103.8
4/27/2011	---	1076.2	1080.1	1087.6	1104.9
5/27/2011	---	1076.8	1080.4	1087.7	1105.1
6/24/2011	---	1077.0	1080.8	1088.0	1105.1
7/19/2011	---	1076.7	1080.5	1087.7	1104.9
8/10/2011	---	1075.6	1079.7	1087.7	1105.0
9/15/2011	---	1075.0	1078.7	1087.0	1104.3
10/27/2011	---	1074.9	1078.4	1086.3	1103.4
12/8/2011	---	1078.6	1079.4	1086.3	1104.1

Date	Piezometer Readings (elevation, feet)				
	JS-47R	JS-63B	JS-49	JS-50	JS-52
1/10/2012	---	1078.0	1079.3	1087.0	1103.5
2/8/2012	---	1078.4	1080.0	1087.3	1104.0
3/6/2012	1072.9	1078.5	1080.0	1087.4	1104.1
4/11/2012	1072.9	1078.4	1079.9	1087.9	1105.1
5/8/2012	1072.8	1077.6	1079.5	1087.9	1105.2
6/11/2012	1073.6	1078.2	1079.6	1087.7	1104.9
7/11/2012	1073.1	1077.6	1079.1	1087.2	1104.3
8/8/2012	1073.4	1078.0	1079.6	1087.5	1104.2
9/12/2012	1072.4	1076.9	1078.5	1086.8	1103.6
10/3/2012	1072.7	1077.2	1078.5	1086.7	1103.5
11/1/2012	1072.6	1077.0	1078.5	1086.7	1103.5
12/11/2012	1072.7	1077.1	1078.0	1086.1	1103.0
1/10/2013	1072.6	1077.3	1079.0	1086.5	1102.9
2/13/2013	1073.2	1078.5	1081.5	1088.2	1104.7
3/12/2013	1073.2	1078.5	1081.2	1088.0	1105.0
4/9/2013	1073.1	1078.0	1081.5	1088.4	1104.6
5/8/2013	1073.0	1078.6	1081.4	1088.3	1105.4
6/11/2013	1074.3	1079.7	1082.1	1089.0	1106.1
7/11/2013	1074.6	1079.7	1082.0	1089.1	1106.1
8/15/2013	1074.2	1079.0	1081.0	1088.6	1105.8
9/4/2013	1074.0	1078.6	1080.5	1088.3	1105.5
10/9/2013	1072.7	1077.3	1079.2	1087.5	1101.5
11/12/2013	1072.4	1076.9	1078.5	1087.1	1100.0
12/11/2013	1073.1	1077.8	1079.3	1086.9	1099.9
3/13/2014	1073.3	1078.2	1080.5	1087.9	1103.0
6/11/2014	1072.6	1077.2	---	---	1102.2
9/8/2014	1072.4	1076.8	1070.4	---	1093.5
1/5/2015	---	---	1073.5	1085.8	1095.7
6/30/2015	1074.2	1078.9	1076.0	1086.2	1095.4
6/30/2015	1073.0	1076.2	---	---	---
10/1/2015	1070.9	1074.2	---	---	---
10/2/2015	1071.5	---	---	---	---
10/3/2015	---	1075.0	---	---	---
10/10/2015	1071.0	---	---	---	---
10/13/2015	---	1074.3	---	---	---
10/27/2015	1070.5	1073.8	---	---	---

Date	Piezometer Readings (elevation, feet)				
	JS-47R	JS-63B	JS-49	JS-50	JS-52
11/26/2015	1070.4	1073.8	---	---	---
12/2/2015	1071.8	1075.5	---	---	---
12/20/2015	---	1074.1	---	---	---
12/26/2015	1071.3	---	---	---	---
12/29/2015	---	1075.0	---	---	---
1/5/2016	1070.5	---	---	---	---
1/19/2016	1070.2	1073.8	---	---	---
2/3/2016	1071.0	1075.0	---	---	---
2/24/2016	1071.1	1075.3	---	---	---
2/25/2016	1073.6	1078.5	1075.8	1085.2	---
3/6/2016	1070.1	1074.0	---	---	---
3/13/2016	1070.2	1074.2	---	---	---
3/31/2016	---	---	---	---	1099.7
4/1/2016	---	---	---	---	1099.7
4/5/2016	1069.5	1073.4	---	---	---
4/8/2016	1071.7	1074.9	---	---	---
4/17/2016	---	1074.5	---	---	---
5/1/2016	---	---	---	---	1099.3
5/6/2016	1071.4	---	---	---	---
5/10/2016	1071.3	1074.5	---	---	---
5/13/2016	1072.5	---	---	---	---
5/21/2016	---	1075.8	---	---	---
6/1/2016	---	---	---	---	1099.2
6/13/2016	---	---	1082.6	---	---
6/16/2016	---	---	---	1088.5	1099.4
6/19/2016	---	1075.4	1082.1	1087.8	1098.7
7/1/2016	---	---	---	---	1099.1
7/3/2016	1072.0	---	---	---	---
7/6/2016	1072.5	---	---	---	---
7/7/2016	---	1075.8	---	---	---
7/18/2016	---	---	---	---	1098.8
7/29/2016	---	---	1082.2	---	---
8/1/2016	---	---		1087.9	1098.9
8/7/2016	1071.8	1075.3			---
8/8/2016	---	1075.3	1082.3	1088.1	---
8/20/2016	---	---	---	---	1099.1

Date	Piezometer Readings (elevation, feet)				
	JS-47R	JS-63B	JS-49	JS-50	JS-52
8/21/2016	1071.9	---	---	---	---
9/1/2016		---	---	---	1099.0
9/4/2016		---	1081.6	1087.6	---
9/5/2016		1074.9	---	---	1098.5
9/7/2016	1071.4	---	---	---	---
9/8/2016	---	---	1081.8	---	---
9/19/2016	1071.7	1075.1	---	---	---
9/24/2016	---	---	---	1087.5	---
9/28/2016	---	---	---	1087.9	---
10/1/2016	---	---	---	---	1098.6
10/5/2016	---	---	1081.3	---	---
10/6/2016	1071.2	1074.7	---	---	---
10/8/2016	1071.3	1074.8	1081.5	---	---
10/21/2016	---	---	---	1088.0	---
11/1/2016	---	---	---	---	1098.5
11/2/2016	1070.9	---	---	1087.3	---
11/5/2016	---	---	1081.0	---	---
11/7/2016	---	1074.4	---	---	---
11/9/2016	---	---	---	1087.7	---
11/26/2016	1070.7	1074.2	1080.8	---	---
12/1/2016	---	---	---	---	1098.5
12/3/2016	---	---	---	1087.0	---
12/6/2016	1072.0	1075.4	1081.6	---	---
12/10/2016		1074.7	1081.1	---	---
12/11/2016	1071.3	---	---	---	---
12/19/2016	---	---	---	1086.9	---
12/29/2016	1072.2	1075.8	---	---	---
1/1/2017	---	---	---	---	1098.3
1/3/2017	---	---	1082.2	1087.8	---
1/8/2017	1071.6	1075.1	1081.5	1086.9	---
1/23/2017	1072.6	1076.5	1083.1	1088.4	---
2/1/2017	---	---	---	---	1098.1
2/8/2017	---	---	---	1087.9	---
2/9/2017	---	---	1082.1	---	---
2/20/2017	1071.6	1075.2	---	---	---
3/1/2017	1072.3	1076.1	1083.0	---	1098.0

Date	Piezometer Readings (elevation, feet)				
	JS-47R	JS-63B	JS-49	JS-50	JS-52
3/4/2017	---	---	---	1086.8	---
3/16/2017	---	---	---	1087.1	---
3/18/2017	1072.3	1076.2	1083.4	---	---
3/29/2017	1071.6	---	---	---	---
4/1/2017	---	1075.4	1082.5	---	1098.2
4/6/2017	---	---	---	1087.8	---
4/12/2017	---	---	---	1087.1	---
4/17/2017	1071.6	---	1082.6	---	---
4/20/2017	---	1075.4	---	---	---
4/24/2017	---	---	1084.5	---	---
4/25/2017		1077.0	---	---	---
5/1/2017	1073.1	---	---	---	1098.0
5/5/2017	---	---	---	1088.0	---
5/8/2017	1072.8	1076.5	1083.0	1087.3	---
5/29/2017	1073.6	1077.2	---	---	---
6/1/2017	---	---	---	---	1097.8
6/6/2017	---	---	1083.7	---	---
6/8/2017	1073.2	1077.0	1083.5	---	---
7/1/2017	---	---	---	---	1097.8
7/2/2017	1072.7	1076.3	---	---	---
7/5/2017	---	---	1082.6	---	---
7/8/2017	1072.8	1076.5	1083.0	---	---
8/1/2017	---	---	---	---	1097.5
8/6/2017	1071.8	1075.5	1082.1	---	---
8/12/2017	---	1075.6	1082.4	---	---
8/15/2017	1072.1	---	---	---	---
9/1/2017	---	---	---	---	1097.5
9/3/2017	---	---	1081.6	---	---
9/4/2017		1074.7	---	---	---
9/5/2017	1071.2	---	---	---	---
10/1/2017	---	---	---	---	1097.1

5.0. 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.

6.0. REFERENCES

References are provided in the summary table for each document discussed herein.

Additional references are as follows:

Geocomp (2017). *iSite Central™ GIS Database*. Prepared for Tennessee Valley Authority. (Nov. 30, 2017).

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Tennessee Valley Authority (2002). "John Sevier Fossil Plant – Stability Inspection of the Waste Disposal Areas." March 29.

Tennessee Valley Authority (2004). "John Sevier Fossil Plant – Annual Stability Inspection of Waste Disposal Areas." June 10.

ATTACHMENT A
EXHIBITS

Exhibit No.
1

Title
Existing Borings
Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-21
Technical Review by RAA on 2017-11-21

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Existing Boring
- Existing CPT
- 2011 Test Pit
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Exhibit No.

2

Title

Existing Borings
Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-21
Technical Review by RAA on 2017-11-21

0 200 400 600 800
Feet

1:2,400 (At original document size of 22x34)

Legend

- Existing Boring
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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TVA

U:\TVA-EP\175566338\gis\mxds\JSF_Ex_Borings_BottomAsh.mxd Revised: 2017-11-21 By: mbough

Exhibit No.
3

Title
Existing Borings
Ash Disposal Area J

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-16
Technical Review by RAA on 2018-05-16

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

Legend

- ● Existing Boring
- ▲ Existing CPT
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec

TVA

Exhibit No.
4

Title
Historical Ash Disposal Ponds
Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-09
Technical Review by RAA on 2017-11-09

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Limit of Historical Ash Disposal Ponds (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. The limits of the Historical Ash Disposal Ponds were approximated using drawing 10N295 and previous inspection reports per note 4 on drawing 10W507-01.

APPENDIX L
BACKGROUND SOIL SAP

Background Soil
Sampling and Analysis Plan
John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

BACKGROUND SOIL
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Background Soil
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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: 10/17/18

TVA Investigation Field Lead — Date: 10/17/18

Health, Safety, and Environmental (HSE) Manager — Date: 10/17/18

Kip Anderson
Investigation Project Manager — Date: 10-08-18

Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.10.17 10:01:16 -04'00'
QA Oversight Manager — Date

Laboratory Project Manager — Date: 10/16/18

Charles L. Head
Charles L. Head
TDEC Senior Advisor — Date: 2018/10/31

Robert Wilkinson
TDEC CCR Technical Manager — Date: 10/31/18

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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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 JSF 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). Figure 1 additionally depicts the locations of proposed background groundwater monitoring wells JSF-106 and JSF-110. During installation of these wells, soil samples will be collected through the well screen intervals. 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, as were areas that were directly impacted by the 1973 ash spill. 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 Hawkins County, Tennessee. The presence of metallic ore deposits, including barium, copper, and zinc, in the area could naturally increase the concentrations of these 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-08.80.01 *Planning Sampling* Events, conducted according to TVA TI ENV-TI-08.80.50, *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.

- 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-08.80.50, *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 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.)
- 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 (ºC) 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 <6º C	4 oz. glass	180 days
Mercury	SW-846 7471B	Cool to <6º C	4 oz. glass	28 days
Radium 226	SW-846 901.1	Cool to <6º C	8 oz. glass	180 days
Radium 228	SW-846 901.1	Cool to <6º C	8 oz. glass	180 days
Chloride	SW-846 9056A Modified	Cool to <6º C	4 oz. glass	28 days
Fluoride	SW-846 9056A Modified	Cool to <6º C	4 oz. glass	28 days
Sulfate	SW-846 9056A Modified	Cool to <6º C	4 oz. glass	28 days
pH	SW-846 9045D Modified	Cool to <6º 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
- 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 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 1995.

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

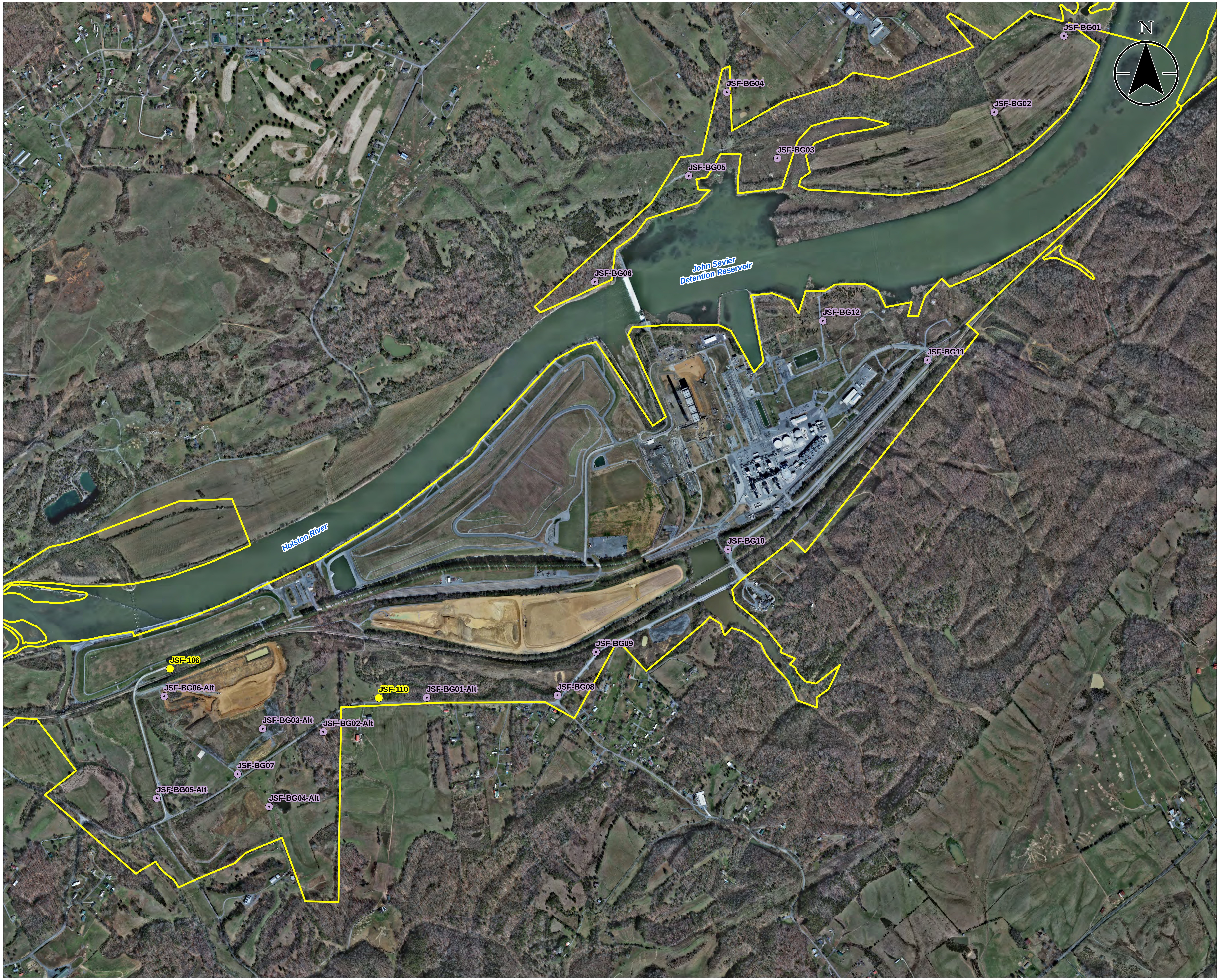

Figure No.
1

Title
Proposed Soil Sampling Locations

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 600 1,200 1,800 2,400 Feet

1:7,200 (At original document size of 22x34)

Legend

- Proposed Background Soil Sample Location
- Proposed Groundwater Monitoring Well
- TVA Property Boundary

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec

TVA

\\us1269-f01\shared_projects\TVA\EIP\175568225_JSF_Phase2\gis\mxd\JSF_Proposed_Soil_Sampling.mxd Revised: 2018-10-18 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 M
CCR MATERIAL CHARACTERISTICS SAP

CCR Material Characteristics Sampling and Analysis Plan John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

REVISION LOG

Revision	Description	Date
2	Issued for TDEC Review	May 25, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

CCR MATERIAL CHARACTERISTICS
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: CCR Material Characteristics
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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 10/17/18

TVA Investigation Field Lead — Date 10/17/18

Health, Safety, and Environmental (HSE) Manager — Date 10/17/18

Investigation Project Manager — Date 10-08-18

Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.10.17 10:01:34 -04'00'
QA Oversight Manager — Date

Laboratory Project Manager — Date 10/16/18

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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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 sampling plan to determine the leachability of CCR constituents (listed in 40 CFR Part 257, Appendix III and IV of the CCR Rule) from material in surface impoundments, landfills, and non-registered CCR units at the JSF Plant (Plant). TDEC's comments also included a request for a Pore Water Sampling and Analysis Plan (SAP) for the Plant. The submittal of this CCR Material Characteristics SAP addresses both requests.

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.

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 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 Material Characteristics SAP consists of the Dry Fly Ash Stack, Ash Disposal Area J, Bottom Ash Pond, and Highway 70 Borrow 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). Twelve sample locations were selected based on TDEC's request to characterize the leachability of constituents from the material in the Study Area and are described in Table 1. 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.

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 proposed pore water/CCR material sampling locations is provided as Figures 1-3 in Attachment A. Installation and construction specifications for the temporary wells are provided in the JSF 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.

Sampling Locations
October 19, 2018

Table 1. Proposed Sample Locations

Sample Location ID	Description
TW01	Dry Fly Ash Stack – western-most TW*
TW02	Dry Fly Ash Stack – adjacent and east of TW02
TW03	Dry Fly Ash Stack – southern-most TW* in ammoniated ash
TW04	Dry Fly Ash Stack – northern-most TW* in ammoniated ash
TW05	Dry Fly Ash Stack – northern-most TW*
TW06	Bottom Ash Pond – western-most TW*
TW07	Bottom Ash Pond – between TW06 and TW08
TW08	Bottom Ash Pond – eastern-most TW*
TW09	Ash Disposal Area J – western-most TW*
TW10	Ash Disposal Area J – between TW09 and TW11
TW11	Ash Disposal Area J - eastern-most TW*
TW12	Highway 70 Borrow Area

*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. As an Appendix IV constituent, arsenic will be speciated into arsenate and arsenite. Sample analyses are described in greater detail in Section 5.2.6.

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% µS/cm
- Dissolved oxygen (DO) - ±10% for > 0.5 mg/L or <0.5 mg/L
- Turbidity - below 10 Nephelometric Turbidity Unit (NTU) 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 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. 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 the 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 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 (ºC) 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 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. As an Appendix IV constituent, arsenic will be speciated into arsenate and arsenite. 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; 8-oz glass (CCR)	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; 8-oz glass (CCR)	180 days
Arsenic species, aqueous - unfiltered	SW-846 6020A	Disodium EDTA, Acetic Acid Cool to <6°C	250-mL HDPE	21 days
Arsenic species, aqueous - filtered	SW-846 6020A	Disodium EDTA, Acetic Acid Cool to <6°C	250-mL HDPE	21 days
Arsenic species, SPLP leachates	SW-846 6020A	Disodium EDTA, Acetic Acid Cool to <6°C	100-mL HDPE	21 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 (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

Table 6. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
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
- Personnel Protection 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
FIGURES

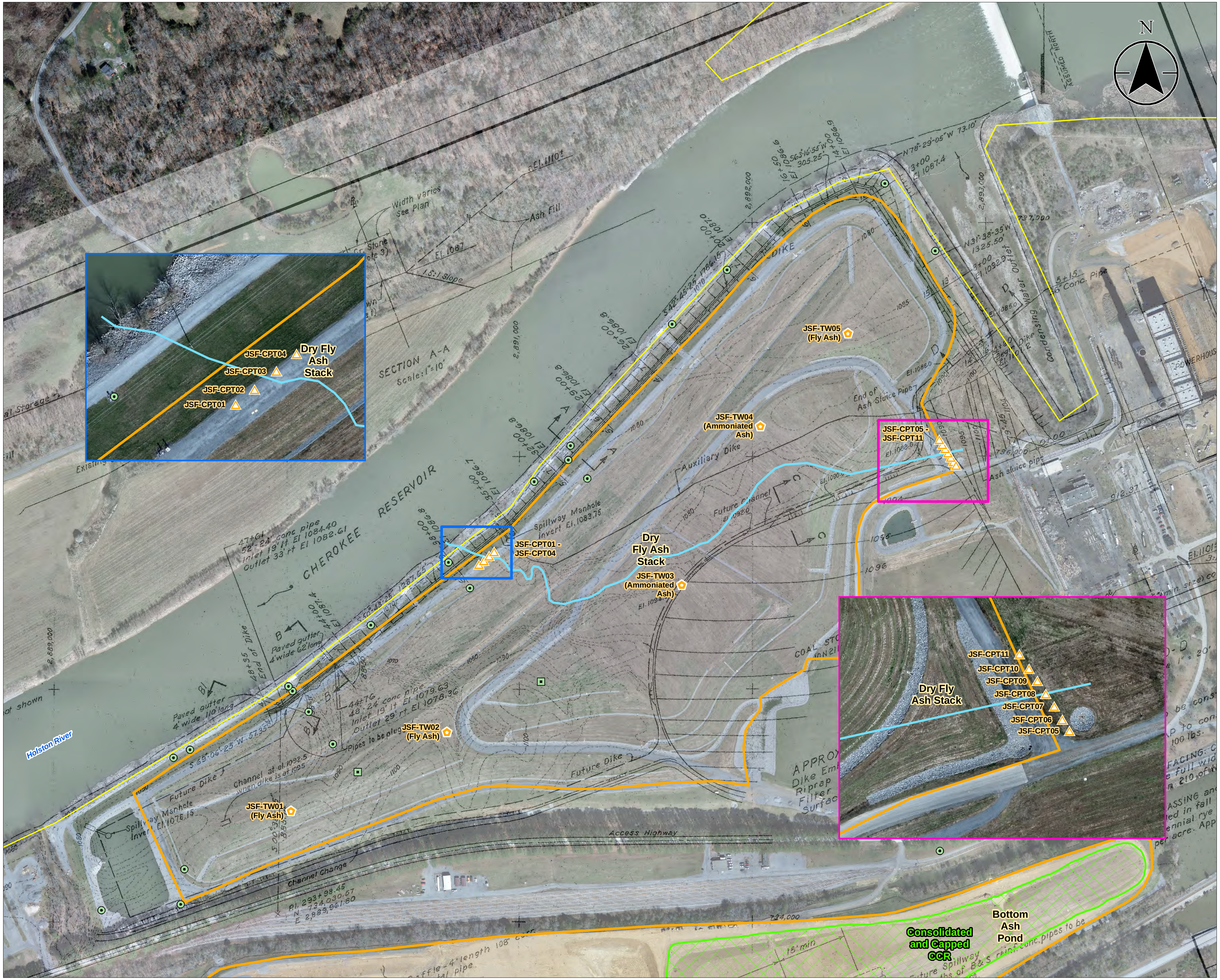

Figure No.
1

Title
Proposed Borings
Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- Existing Piezometer Open Standpipe
- Existing Piezometer Vibrating Wire
- Historical Stream Channel (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Based on historical mapping (TVA Dwg. 10N410), the pre-construction stream was approximately 40 feet wide. CPT borings will be advanced along the perimeter dike on 20-foot spacing within 60 feet of the historical stream centerline.
4. Fewer CPT borings are proposed at the historical stream channel on the northwest side of the DFAS than the southeast side because of the spatial coverage provided by existing borings.
5. Overlay and Stream Alignment: Historical TVA Drawing 10N410, 1958

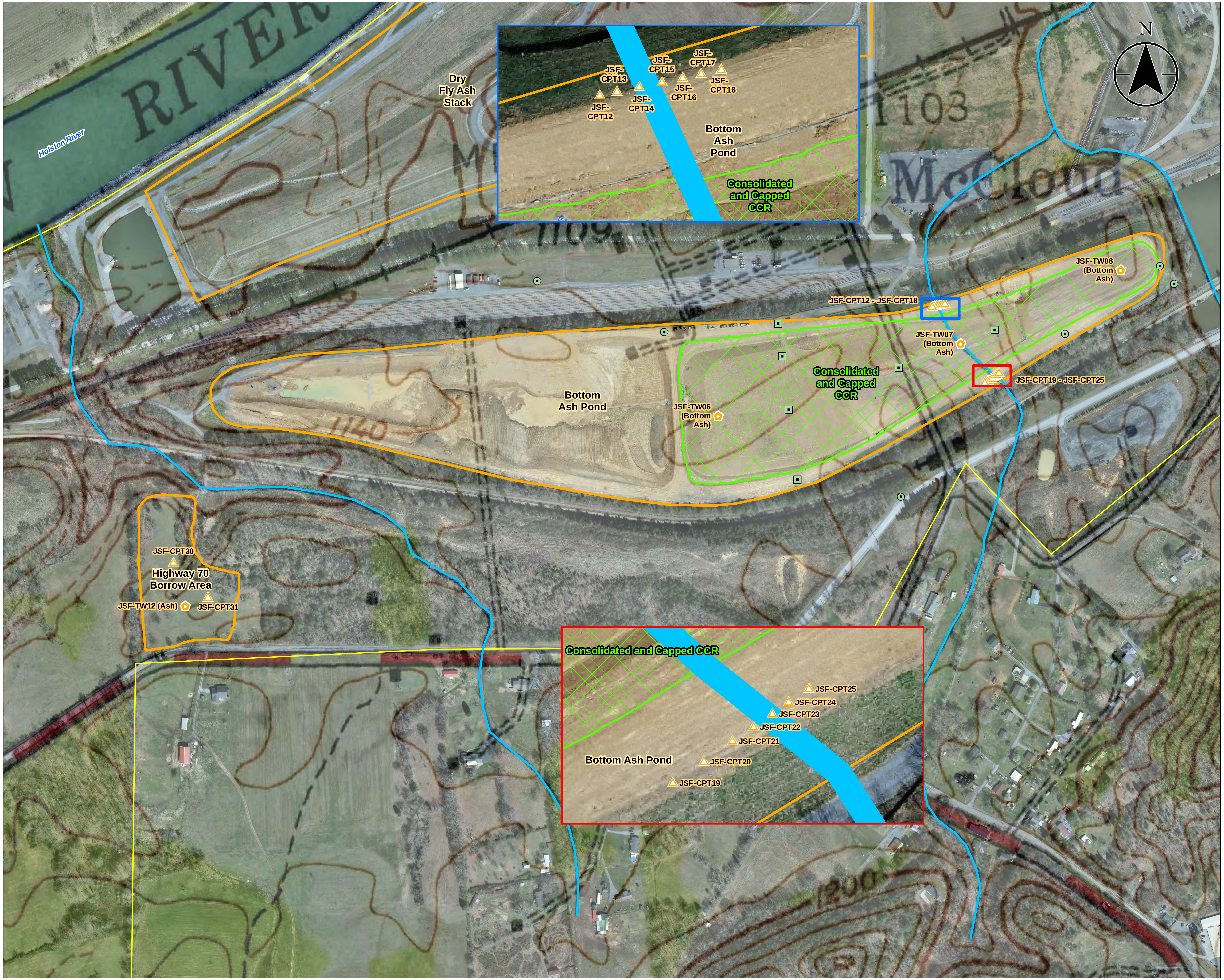

Figure No.
2

Title
Proposed Borings
Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- Existing Piezometer Open Standpipe
- Existing Piezometer Vibrating Wire
- Historical Stream Channel (approximate)
- TVA Property Boundary (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. The width of the pre-construction channel is unclear from historical mapping. CPTs will be advanced through the perimeter dike at 10-foot spacing near the approximate centerline of the pre-construction channel.
4. Topographic Map and Stream Alignment: USGS McCloud and Burem, Tennessee Quadrangles, 1940

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TVA

Figure No.

3

Title

Proposed Borings
Ash Disposal Area J

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175568225

Prepared by DMB on 2018-10-03
Technical Review by KRB on 2018-10-03

0 150 300 450 600 Feet

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

Legend

- Existing Piezometer Open Standpipe
- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- TVA Property Boundary (Approximate)
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec

TVA

U:\TVA-EIP\175568225_JSF_Phase2\gis\mxd\JSF_Proposed_Borings_AreaJ_CEC.mxd Revised: 2018-10-03 By: mbough

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 N
EXPLORATORY DRILLING SAP

Exploratory Drilling
Sampling and Analysis Plan
John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Public Comments, TDEC EIP Rev2 Comments, Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

EXPLORATORY DRILLING
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Exploratory Drilling
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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	10/17/18 Date
TVA Investigation Field Lead	10/17/18 Date
Health, Safety, and Environmental (HSE) Manager	10/17/18 Date
Kip Anderson Investigation Project Manager	10-08-18 Date
Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.10.17 10:01:50 -04'00' QA Oversight Manager	Date
K. Ryan R. Jones Laboratory Project Manager	10-08-18 Date
Charles L. Head Charles L. Head TDEC Senior Advisor	2018/10/31 Date
Robert Wilkinson TDEC CCR Technical Manager	10/31/18 Date

Stantec

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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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 JSF (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 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 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 JSF. Rationale for individual cone penetration test (CPT) and borings with temporary well locations are discussed below. Refer to Figures 1 through 3 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 borings with temporary well installations at locations shown on Figures 1 through 3 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 31 CPTs and 12 borings with temporary well installations are proposed. Table 1 provides the number of CPTs and borings with temporary well installations proposed in each CCR unit. Table 2 lists the borings and more detail about the purpose of each.

Table 1. Exploratory Drilling Proposed in each CCR Unit

CCR Unit	No. of Proposed CPT	No. of Borings with Temporary Wells
Dry Fly Ash Stack	11	5
Bottom Ash Pond	14	3
Ash Disposal Area J	4	3
Highway 70 Borrow Area	2	1
Total	**31**	**12**

Table 2. Detailed Boring and CPT Descriptions

Boring No.	CCR Unit	Deepest Material Encountered	Temporary Well Screen Location	Boring Purpose[1]
TW01	Dry Fly Ash Stack	Foundation Soil	Fly Ash	PZ, PW, Geo
TW02	Dry Fly Ash Stack	Foundation Soil	Fly Ash	PZ, PW, Geo
TW03	Dry Fly Ash Stack	Ammoniated Fly Ash (above liner)	Ammoniated Fly Ash	PZ, PW, Geo
TW04	Dry Fly Ash Stack	Ammoniated Fly Ash (above liner)	Ammoniated Fly Ash	PZ, PW, Geo
TW05	Dry Fly Ash Stack	Foundation Soil	Fly Ash	PZ, PW, Geo
CPT01	Dry Fly Ash Stack	Bedrock	--	Geo
CPT02	Dry Fly Ash Stack	Bedrock	--	Geo
CPT03	Dry Fly Ash Stack	Bedrock	--	Geo
CPT04	Dry Fly Ash Stack	Bedrock	--	Geo
CPT05	Dry Fly Ash Stack	Bedrock	--	Geo
CPT06	Dry Fly Ash Stack	Bedrock	--	Geo
CPT07	Dry Fly Ash Stack	Bedrock	--	Geo
CPT08	Dry Fly Ash Stack	Bedrock	--	Geo
CPT09	Dry Fly Ash Stack	Bedrock	--	Geo
CPT10	Dry Fly Ash Stack	Bedrock	--	Geo
CPT11	Dry Fly Ash Stack	Bedrock	--	Geo
TW06	Bottom Ash Pond	Foundation Soil	Bottom Ash	PZ, PW, Geo
TW07	Bottom Ash Pond	Foundation Soil	Bottom Ash	PZ, PW, Geo
TW08	Bottom Ash Pond	Foundation Soil	Bottom Ash	PZ, PW, Geo
CPT12	Bottom Ash Pond	Bedrock	--	Geo
CPT13	Bottom Ash Pond	Bedrock	--	Geo
CPT14	Bottom Ash Pond	Bedrock	--	Geo
CPT15	Bottom Ash Pond	Bedrock	--	Geo
CPT16	Bottom Ash Pond	Bedrock	--	Geo
CPT17	Bottom Ash Pond	Bedrock	--	Geo

Table 2. Detailed Boring and CPT Descriptions

Boring No.	CCR Unit	Deepest Material Encountered	Temporary Well Screen Location	Boring Purpose[1]
CPT18	Bottom Ash Pond	Bedrock	--	Geo
CPT19	Bottom Ash Pond	Bedrock	--	Geo
CPT20	Bottom Ash Pond	Bedrock	--	Geo
CPT21	Bottom Ash Pond	Bedrock	--	Geo
CPT22	Bottom Ash Pond	Bedrock	--	Geo
CPT23	Bottom Ash Pond	Bedrock	--	Geo
CPT24	Bottom Ash Pond	Bedrock	--	Geo
CPT25	Bottom Ash Pond	Bedrock	--	Geo
TW09	Ash Disposal Area J	Foundation Soil	Ash	PZ, PW, Geo
TW10	Ash Disposal Area J	Foundation Soil	Ash	PZ, PW, Geo
TW11	Ash Disposal Area J	Foundation Soil	Ash	PZ, PW, Geo
CPT26	Ash Disposal Area J	Bedrock	--	Geo
CPT27	Ash Disposal Area J	Bedrock	--	Geo
CPT28	Ash Disposal Area J	Bedrock	--	Geo
CPT29	Ash Disposal Area J	Bedrock	--	Geo
TW12	Highway 70 Borrow Area	Foundation Soil	Ash	PZ, PW, Geo
CPT30	Highway 70 Borrow Area	Bedrock	--	Geo
CPT31	Highway 70 Borrow Area	Bedrock	--	Geo

[1] PZ = Piezometric (Water) Levels in CCR; PW = Pore Water Sampling; Geo = Geotechnical Data

As shown in Figures 1 through 3, a total of twelve (12) borings with temporary wells (labeled TW01 through TW12) are proposed within the footprints of the Dry Fly Ash Stack (5 temporary wells), Bottom Ash Pond (3 temporary wells), Ash Disposal Area J (3 temporary wells), and the Highway 70 Borrow Area (1 temporary well). 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 and pore water sampling. At the Highway 70 Borrow Area, the temporary well boring will also provide samples for laboratory testing to support slope stability analyses. Two temporary well installations are proposed within the limits of the Phase I and II liner system installed in the Dry Fly Ash Stack. The borings will target the ammoniated ash for CCR and pore water sample collection (if water is observed in the boring) and will be terminated/screened at an elevation above the liner system.

The remaining temporary wells (TW01, TW02, and TW05 through TW12) 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 need for the three temporary wells proposed for the Bottom Ash Pond will be re-evaluated prior to initiation of fieldwork. If readings of the existing piezometers (Figure 2) indicate that the CCR is unsaturated and above the expected phreatic surface, the borings will not be performed and the temporary wells will not be installed.

Borings will be advanced using a conventional rotary drill rig with standard penetration test (SPT) and undisturbed (Shelby) tube sampling. SPT samples will be collected for general soil and CCR characterization. Undisturbed tube samples will be collected for laboratory testing. No rock coring or downhole testing in rock is proposed for the units at JSF.

Also shown in Figures 1 and 2, 25 CPT soundings (CPT01 through CPT25) are proposed along the perimeters of the Dry Fly Ash Stack and Bottom Ash Pond. These CPTs are proposed to better characterize the uppermost foundation soils in the immediate vicinity of the mapped, pre-construction stream channels. At the stream crossing locations 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. 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.

As shown in Figure 3, four CPT soundings (CPT26 through CPT29) are proposed in the interiors of Ash Disposal Area J, primarily to support material quantity estimates. Figure 2 shows the proposed locations for two CPT soundings (CPT30 and CPT31) in the interior of the Highway 70 Borrow Area, primarily to support slope stability analyses. The in-situ penetration resistance measured by the CPT will be used to estimate CCR and soil strengths, differentiate CCR from foundation soil, and estimate pore water pressures. This data will support material quantity estimating and slope stability analyses. Additional companion borings may be performed after select CPT soundings if subsurface conditions encountered differ significantly from anticipated conditions, or if supplemental samples are needed for laboratory testing.

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 into the annular space of the drill tooling.

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 4. A drawing of the wellhead construction is shown in Figure 5.

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	80 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
FIGURES

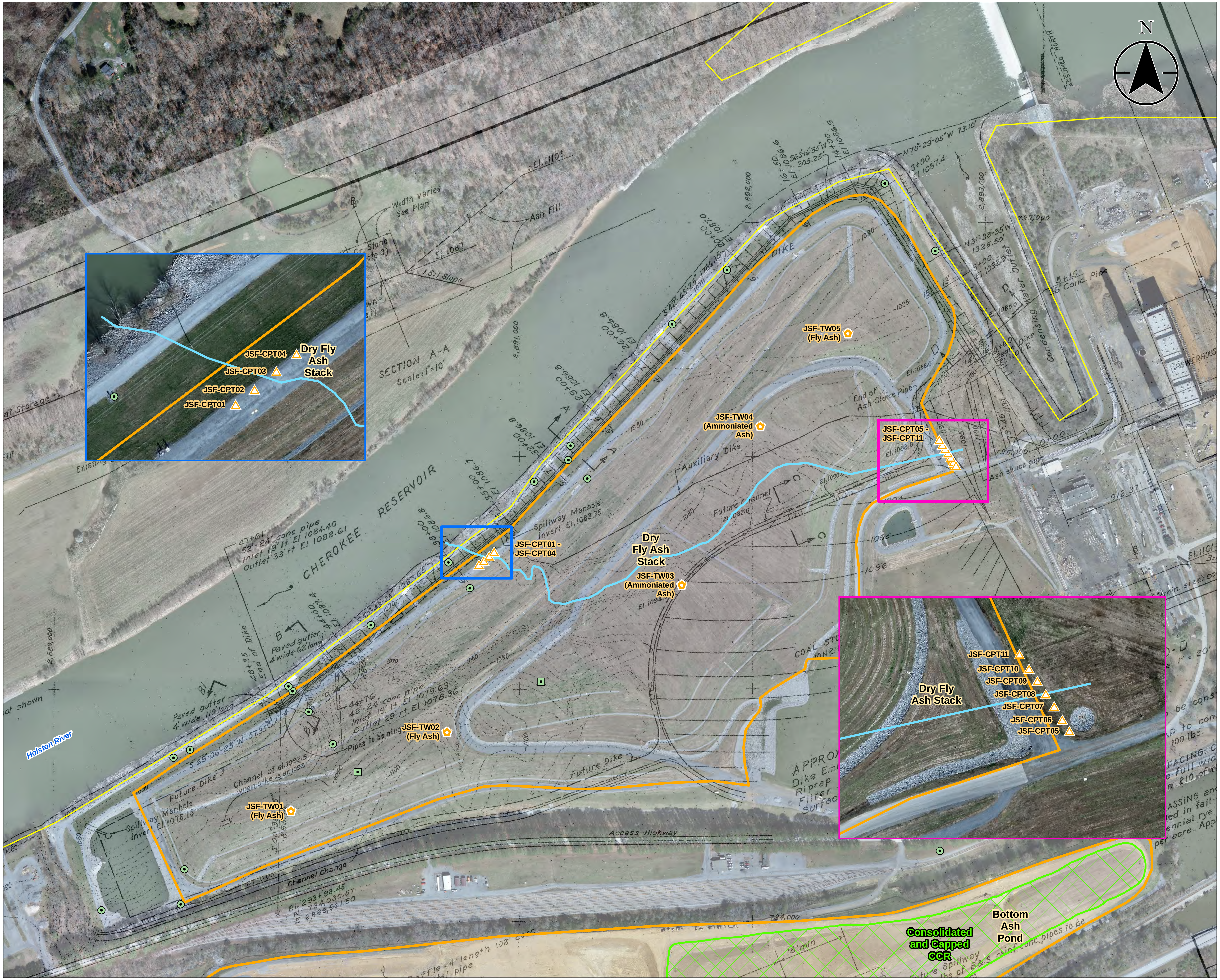

Figure No.
1

Title
Proposed Borings Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- Existing Piezometer Open Standpipe
- Existing Piezometer Vibrating Wire
- Historical Stream Channel (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Based on historical mapping (TVA Dwg. 10N410), the pre-construction stream was approximately 40 feet wide. CPT borings will be advanced along the perimeter dike on 20-foot spacing within 60 feet of the historical stream centerline.
4. Fewer CPT borings are proposed at the historical stream channel on the northwest side of the DFAS than the southeast side because of the spatial coverage provided by existing borings.
5. Overlay and Stream Alignment: Historical TVA Drawing 10N410, 1958

Stantec TVA

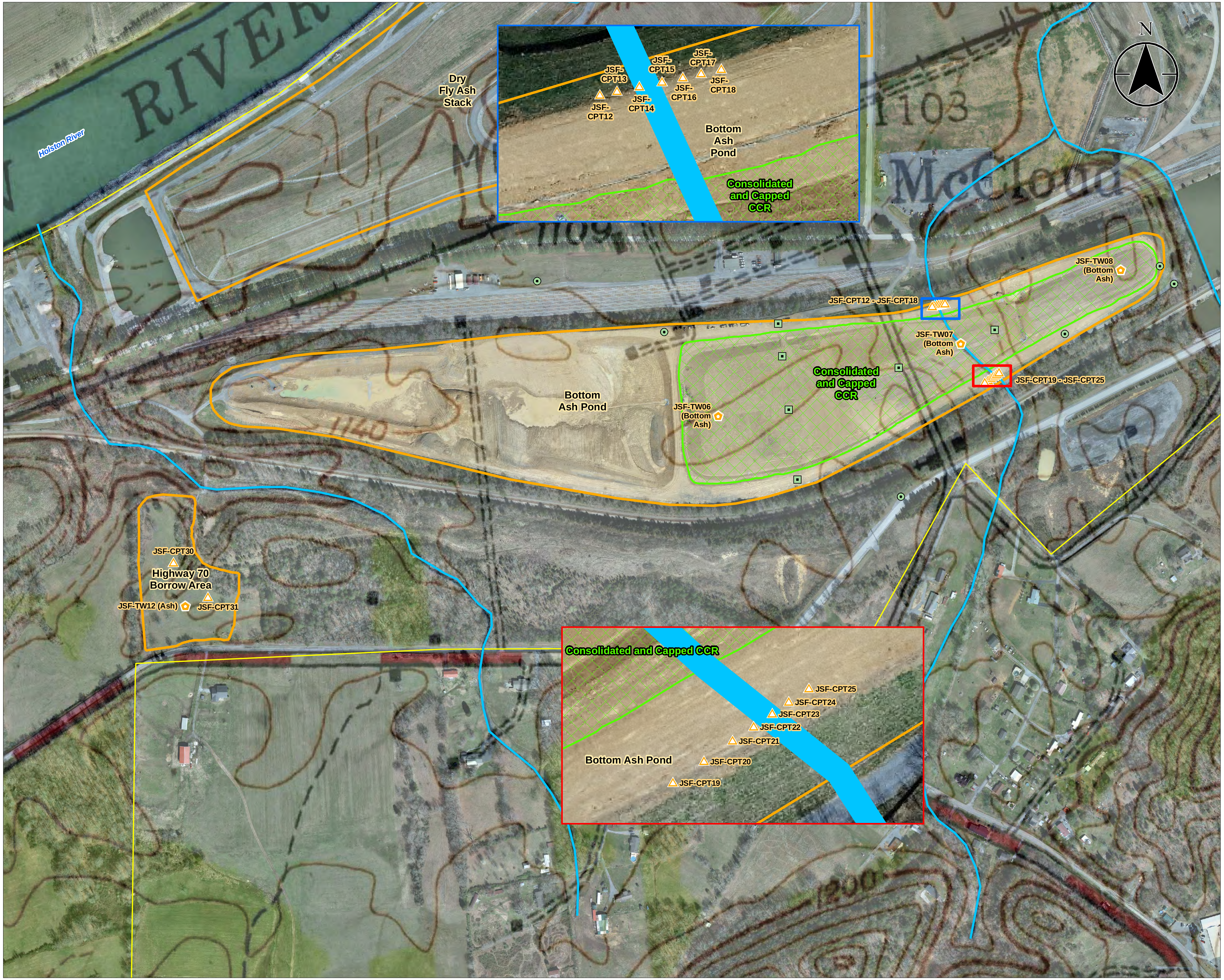

Figure No.

2

Title

Proposed Borings
Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175568225

Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- Existing Piezometer Open Standpipe
- Existing Piezometer Vibrating Wire
- Historical Stream Channel (approximate)
- TVA Property Boundary (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. The width of the pre-construction channel is unclear from historical mapping. CPTs will be advanced through the perimeter dike at 10-foot spacing near the approximate centerline of the pre-construction channel.
4. Topographic Map and Stream Alignment: USGS McCloud and Burem, Tennessee Quadrangles, 1940

Stantec

TVA

Figure No.
3

Title
Proposed Borings
Ash Disposal Area J

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-03
Technical Review by KRB on 2018-10-03

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

Legend

- Existing Piezometer Open Standpipe
- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- TVA Property Boundary (Approximate)
- CCR Unit Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec

TVA

U:\TVA-EIP\175568225_JSF_Phase2\gis\mxd\JSF_Proposed_Borings_AreaJ_CEC.mxd Revised: 2018-10-03 By: mbough

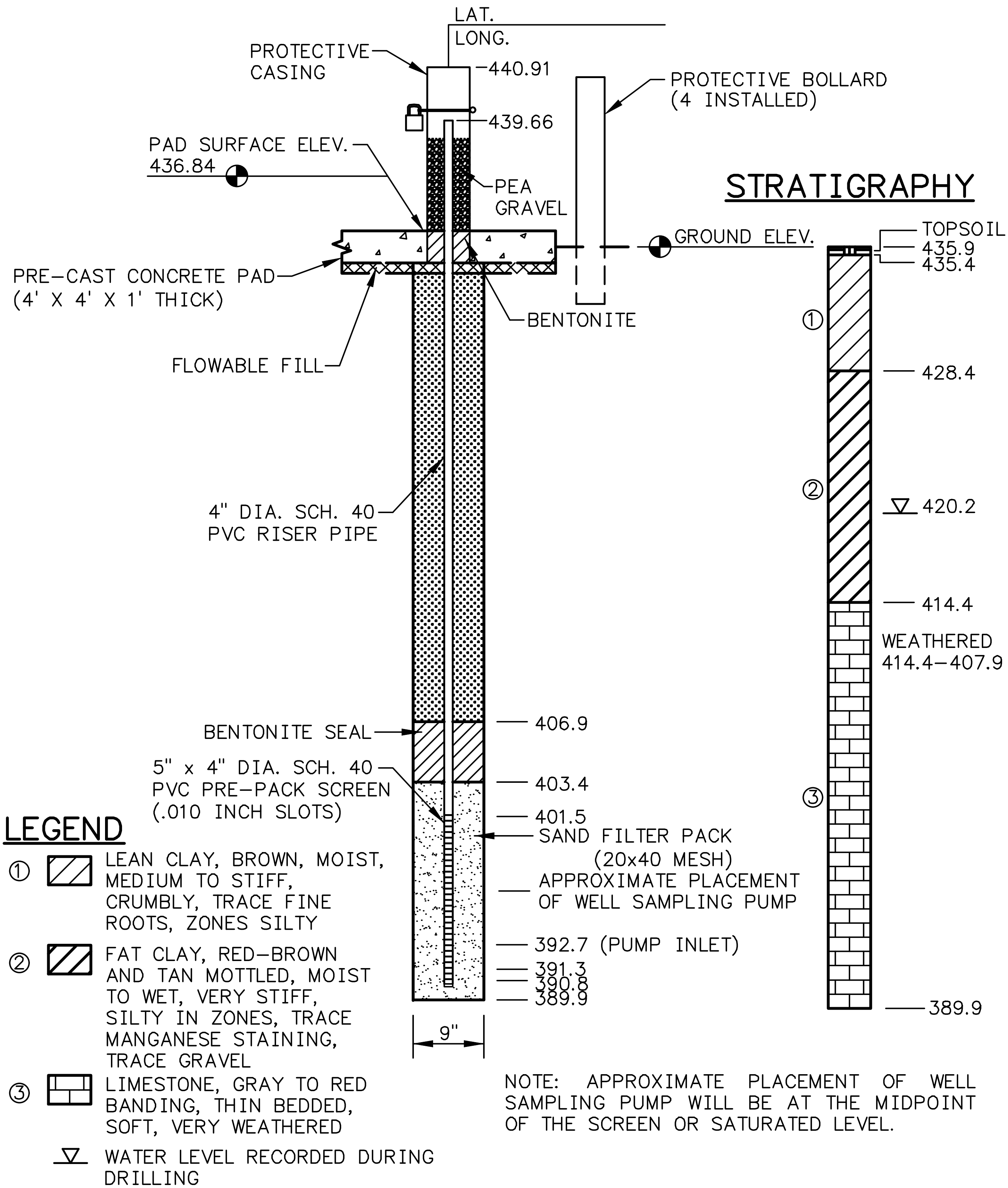

Figure 4. Temporary Well Installation Schematic

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
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 O
MATERIAL QUANTITY SAP

Material Quantity
Sampling and Analysis Plan
John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

Material Quantity
Sampling and Analysis Plan
John Sevier Fossil Plant

TITLE AND REVIEW PAGE

Title of Plan: Material Quantity
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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: 10/17/18

TVA Investigation Field Lead — Date: 10/17/18

Health, Safety, and Environmental (HSE) Manager — Date: 10/17/18

Kip Anderson
Investigation Project Manager — Date: 10-08-18

Rock J. Vitale
Digitally signed by Rock J. Vitale
DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US
Date: 2018.10.17 10:02:06 -04'00'
QA Oversight Manager — Date

K. Ryan R. Jones
Laboratory Project Manager — Date: 10-08-18

Charles L. Head
TDEC Senior Advisor — Date: 2018/10/31

Robert Wilkinson
TDEC CCR Technical Manager — Date: 10/31/18

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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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 Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area (Study Area Units) at the JSF Plant (Plant).

2.0 OBJECTIVES

The purpose of this Material Quantity SAP is 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 EXPLORATION PLAN

4.1.1 Proposed TDEC Order CPT Soundings

The proposed soil 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 JSF. Rationale for individual cone penetration test (CPT) and borings with temporary well installation locations are discussed below. Refer to Figures 1 through 3 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 borings with temporary well installations at locations shown on Figures 1 through 3 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 31 CPTs and 12 borings with temporary well installations are proposed. Table 1 provides the number of CPTs and borings with temporary well installations proposed in each CCR unit.

Table 1. Exploratory Drilling Proposed in each CCR Unit

CCR Unit	No. of Proposed CPT	No. of Borings with Temporary Wells
Dry Fly Ash Stack	11	5
Bottom Ash Pond	14	3
Ash Disposal Area J	4	3
Highway 70 Borrow Area	2	1
Total	**31**	**12**

Additionally, as described in the Hydrogeological Investigation SAP, TVA plans to install groundwater monitoring wells at the locations shown in Figure 4.

4.1.2 Data Analysis

Data from the proposed CPTs and borings will be compared to the existing boring data and pre-construction topographic information available for each 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 a minimum of six months to estimate and monitor levels in each CCR unit. TVA proposes using temporary wells, estimated pore water pressures from CPT sounding data, manual readings from existing piezometers, and automated readings from existing automated vibrating wire transducer piezometers shown on Figures 5, 6 and 7 to estimate saturation levels in CCR. Details regarding water level monitoring field activities are provided in the CCR Material Characteristics SAP. Monitoring and/or sampling of temporary wells is not addressed in this 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. The three-dimensional models of the Dry Fly Ash Stack will be expanded outside of the Dry Fly Ash Stack footprint to include two Chemical Treatment Ponds and an Intermediate Stilling Pond that were constructed in portions of Area H outside of the Dry Fly Ash Stack footprint as shown in Figure 8. The models will be developed using the data summarized below which includes data from the proposed exploratory borings as well as other relevant data collected during the Investigation.

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

2. Recent aerial surveys, as-built closure surveys and borings shown on Figures 1, 2, 3, 9, 10, and 11 will be used to model the upper CCR surface.

3. Pre-construction topographic information from the 1940 McCloud and Burem Quadrangles, TVA Drawings 10N410 "Ash Disposal Area," 10W293 "Ash Disposal Area No. 2 Plan," 10N295 "Fly Ash Disposal Area G-Plan" and 10W286-1 "Fly Ash Disposal Area J (Attachment B), and data from borings that penetrated the CCR surface shown on Figures 1, 2, 3, 9, 10, and 11 will be used to model the lower CCR surface at the Dry Fly Ash Stack, Bottom Ash Pond, Highway 70 Borrow Area, and Ash Disposal Area J.

4. Data from borings shown on Figures 1, 2, 3, 12, 13, and 14 will be used to model the foundation soils underlying each site.
5. Data from borings that encountered top of bedrock shown on Figures 1, 2, 3, 15, 16, and 17 will be used to model the top of bedrock surface.
6. Estimated piezometric levels of saturation discussed in Section 4.1.3 will be incorporated into the models.
7. Groundwater levels estimated as part of the Investigation will be incorporated into the models.
8. TVA surveyed slopes, embankments, and benches to develop stability cross-sections. TVA will use this topographic data with the most recent aerial survey data to model the geometry of the dikes and benches.

The three-dimensional models 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 models 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
- Volume of CCR below the highest recorded groundwater surface

The combined total volume of CCR for all Study Area Units at JSF 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 Environmental Assessment Report (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 CPTs and 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

Tennessee Valley Authority (TVA). 1958. “Ash Disposal Area.” TVA Drawing No. 10N410, Rev. 3.

Tennessee Valley Authority (TVA). 1980a. “Ash Disposal Area No. 2 Plan.” TVA Drawing No. 10W293-1, Rev. 2.

Tennessee Valley Authority (TVA). 1980b. “Fly Ash Disposal Area G-Plan.” TVA Drawing No. 10N295, Rev. 3.

Tennessee Valley Authority (TVA). 1984. “Fly Ash Disposal Area J.” TVA Drawing No. 10W286-1, Rev. 3.

United States Geological Survey (USGS). 1940. “USGS Topographic Map of the McCloud Quadrangle.”

United States Geological Survey (USGS). 1940. “USGS Topographic Map of the Burem Quadrangle.”

ATTACHMENT A
FIGURES

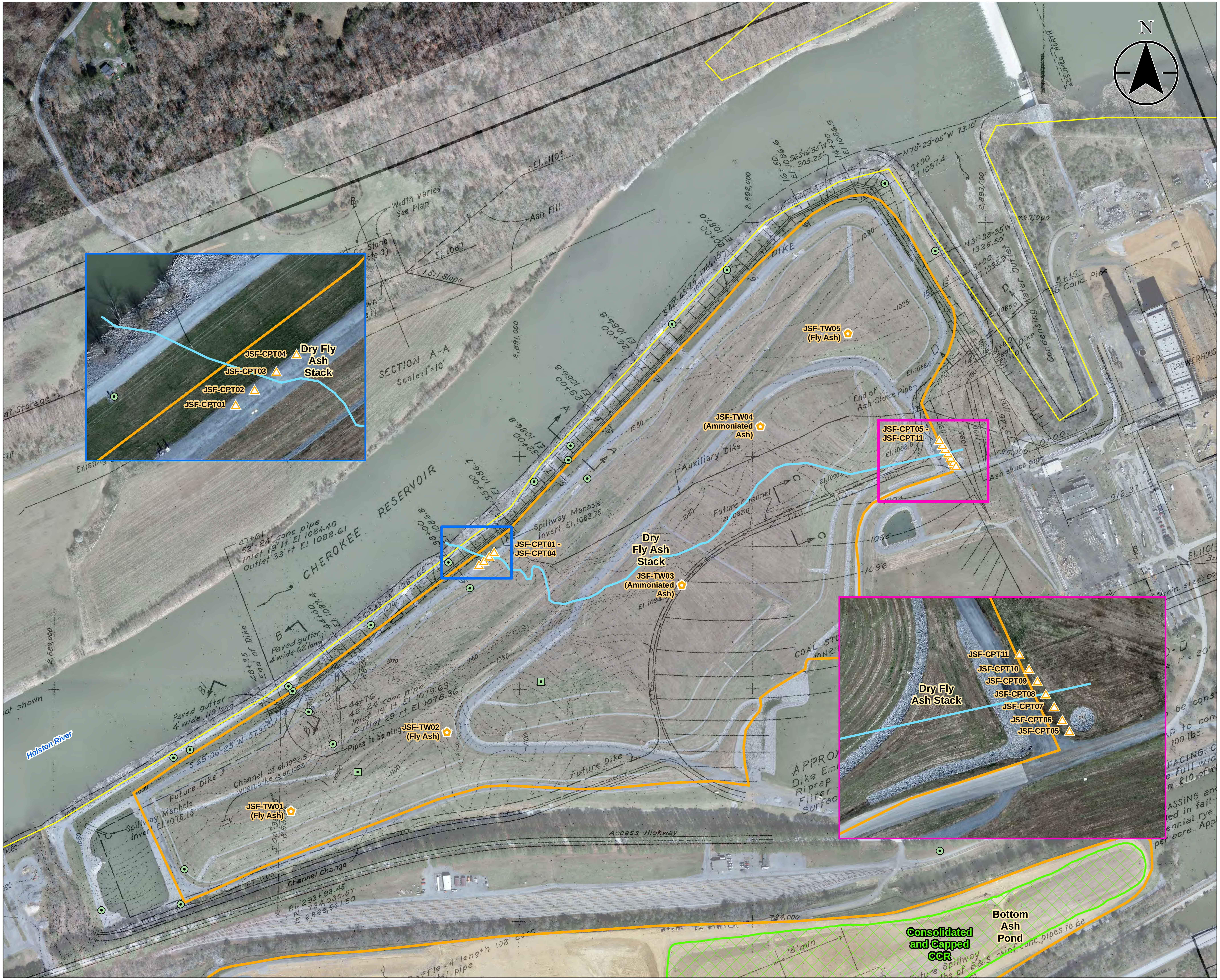

Figure No.
1

Title
Proposed Borings
Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- Existing Piezometer Open Standpipe
- Existing Piezometer Vibrating Wire
- Historical Stream Channel (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Based on historical mapping (TVA Dwg. 10N410), the pre-construction stream was approximately 40 feet wide. CPT borings will be advanced along the perimeter dike on 20-foot spacing within 60 feet of the historical stream centerline.
4. Fewer CPT borings are proposed at the historical stream channel on the northwest side of the DFAS than the southeast side because of the spatial coverage provided by existing borings.
5. Overlay and Stream Alignment: Historical TVA Drawing 10N410, 1958

Stantec
TVA

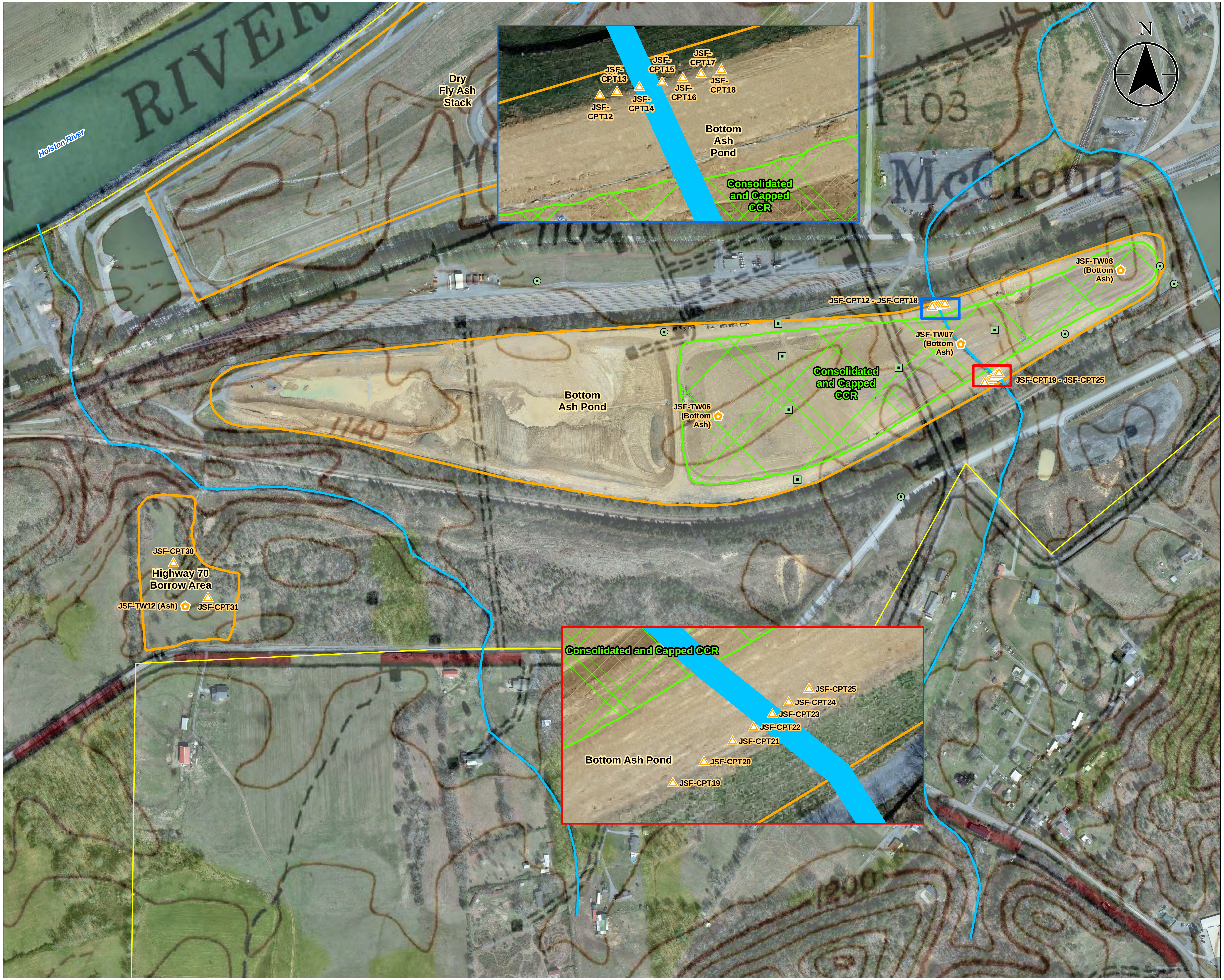

Figure No.
2

Title
Proposed Borings
Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- Existing Piezometer Open Standpipe
- Existing Piezometer Vibrating Wire
- Historical Stream Channel (approximate)
- TVA Property Boundary (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. The width of the pre-construction channel is unclear from historical mapping. CPTs will be advanced through the perimeter dike at 10-foot spacing near the approximate centerline of the pre-construction channel.
4. Topographic Map and Stream Alignment: USGS McCloud and Burem, Tennessee Quadrangles, 1940

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TVA

Figure No.
3

Title
Proposed Borings Ash Disposal Area J

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-03
Technical Review by KRB on 2018-10-03

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

Legend

- Existing Piezometer Open Standpipe
- Proposed Cone Penetration Test
- Proposed Temporary Well (Screened Material)
- TVA Property Boundary (Approximate)
- CCR Unit Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec
TVA

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Figure No.
4

Title
John Sevier Fossil Plant
Proposed Groundwater Well Locations

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175568225
Prepared by DMB on 2018-10-18
Technical Review by KRB on 2018-10-18

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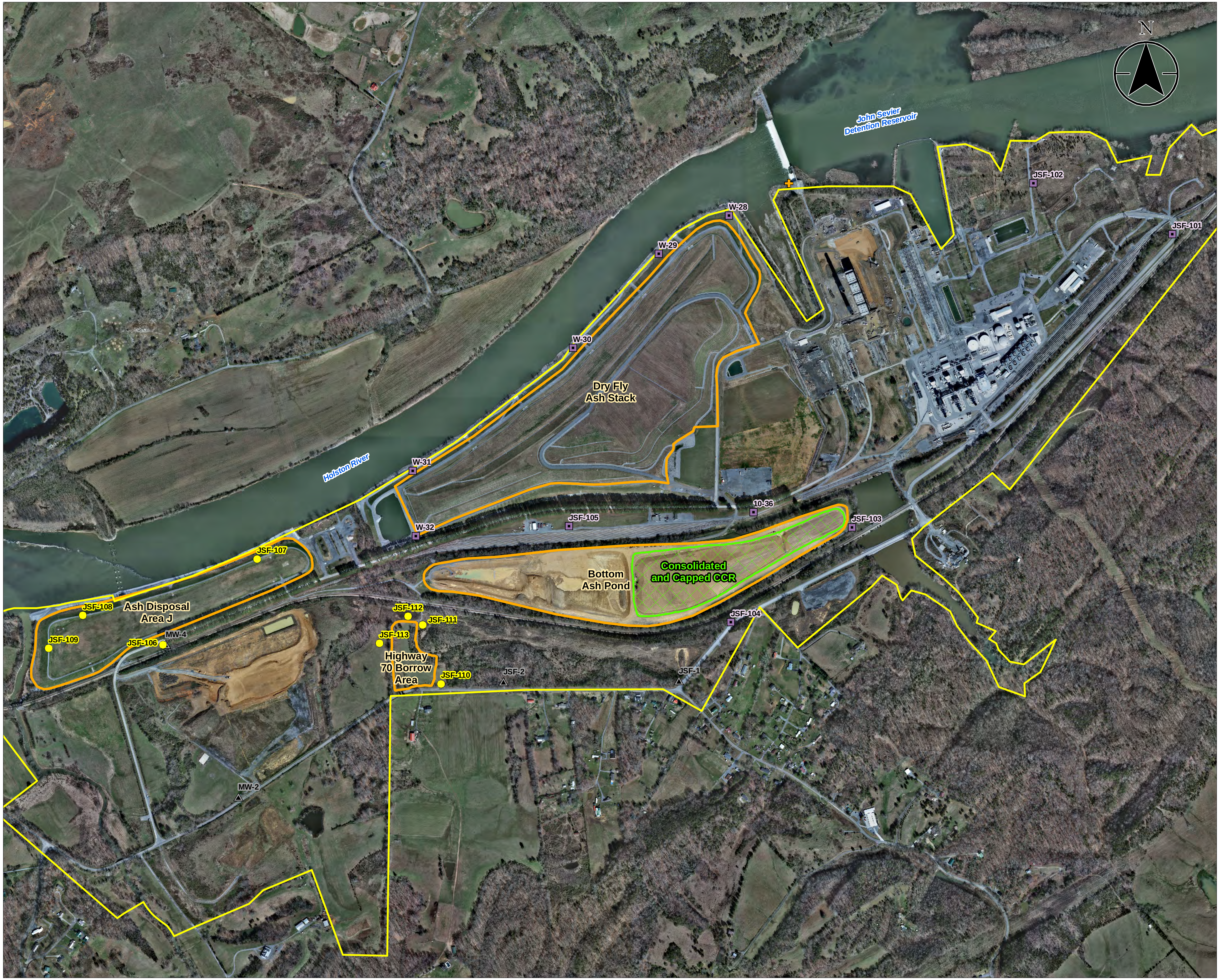

Legend

- River Gauge
- Existing Groundwater Monitoring Well
- Existing Observation Well
- Proposed Groundwater Monitoring Well
- TVA Property Boundary
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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TVA

Figure No.
5

Title
Existing Instrumentation
Ash Disposal Area J

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-20
Technical Review by RAA on 2017-11-20

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

Legend

Existing Piezometer Open Standpipe (Screened Interval)

CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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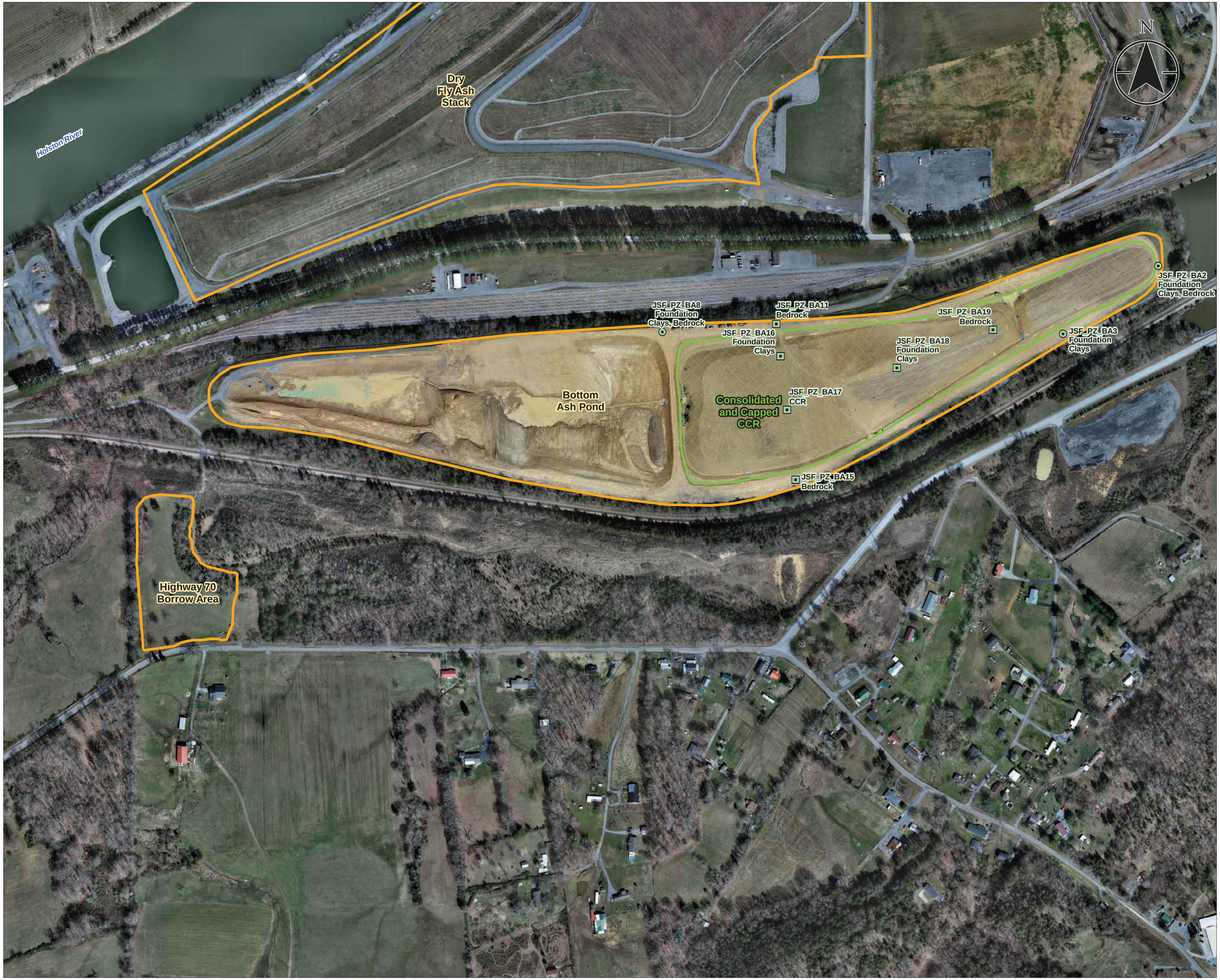

Figure No.
6

Title

Existing Instrumentation
Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-03
Technical Review by RAA on 2018-05-03

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- Existing Piezometer Open Standpipe (Screened Interval)
- Existing Piezometer Vibrating Wire (Tip Interval)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec TVA

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Figure No.
7

Title
Existing Instrumentation
Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-20
Technical Review by RAA on 2017-11-20

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Existing Piezometer Open Standpipe (Screened Interval)
- Existing Piezometer Vibrating Wire (Tip Interval)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec TVA

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Figure No.
8

Title
John Sevier Fossil Plant
Site Map

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-09
Technical Review by RAA on 2017-11-09

0 450 900 1,350 1,800 Feet
1:5,400 (At original document size of 22x34)

Legend

- TVA Property Boundary
- Limit of Historical Ash Disposal Ponds (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec TVA

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Figure No.
9

Title
Existing CCR Thickness Boring Data Ash Disposal Area J

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-17
Technical Review by RAA on 2018-05-17

0 200 400 600 800 Feet
1:1,800 (At original document size of 22x34)

Legend

- Boring with CCR Thickness Data
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec TVA

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Figure No.
10

Title
Existing CCR Thickness Boring Data
Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-09
Technical Review by RAA on 2017-11-09

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Boring with CCR Thickness Data
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec
TVA

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Figure No.
11

Title
Existing CCR Thickness Boring Data
Dry Fly Ash Stack

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-13
Technical Review by RAA on 2017-11-13

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Boring with CCR Thickness Data
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec TVA

U:\TVA-EP\175566338\gis\mxds\JSF_CCR_DryFly.mxd Revised: 2017-11-13 By: mbough

Figure No.

12

Title

Uppermost Foundation Soil Data
Ash Disposal Area J

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175566338

Prepared by TKR on 2018-05-17
Technical Review by RAA on 2018-05-17

0 150 300 450 600 Feet

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

Legend

- Alluvial Clay/Silt
- Alluvial Gravel
- Alluvial Sand
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec TVA

U:\1VA-EP\175566338\gis\mxds\USF_Foundation_Soils_AreaJ.mxd Revised: 2018-05-17 By: tmk

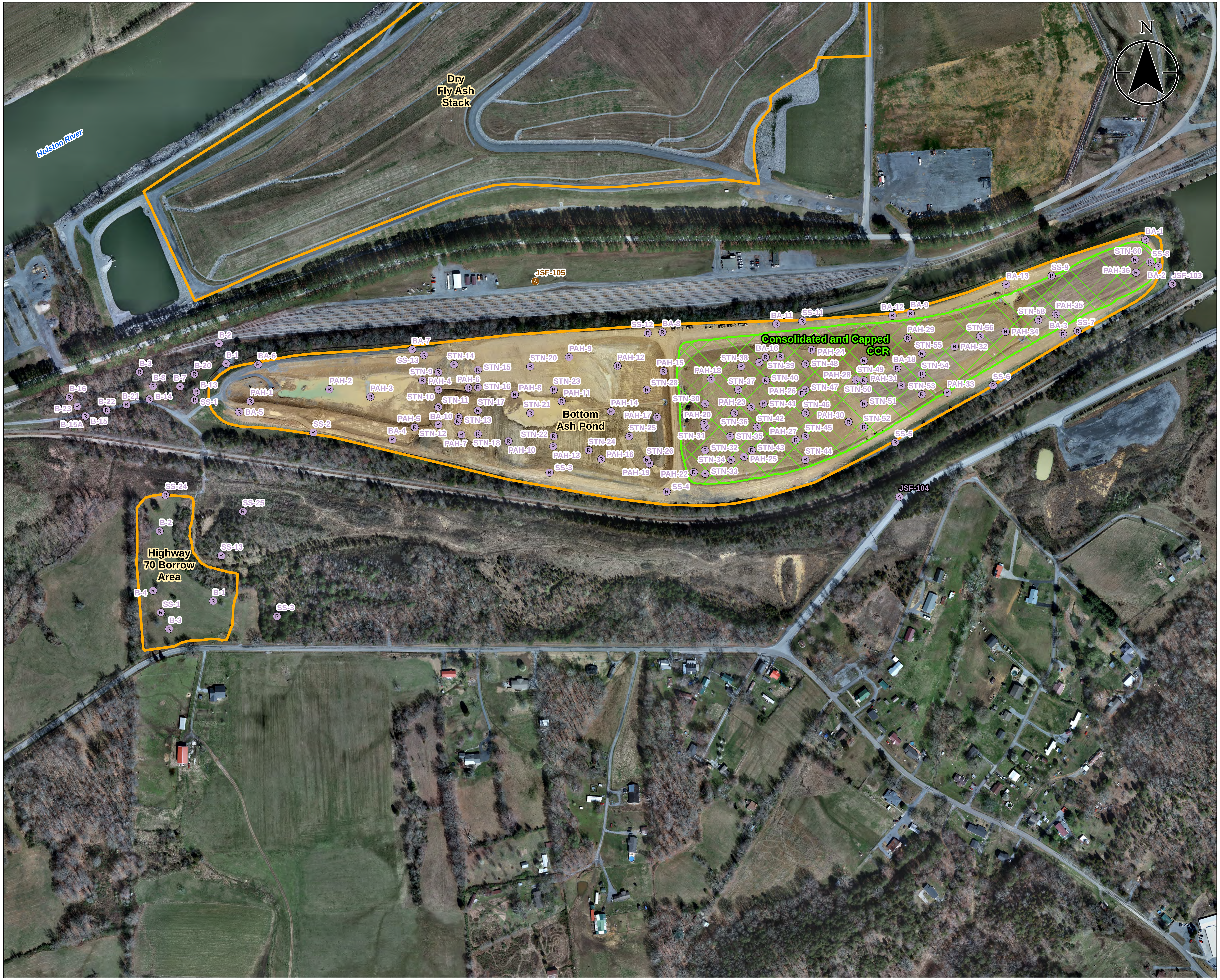


Figure No.
13

Title

Uppermost Foundation Soil Data
Bottom Ash Pond & Hwy 70 Borrow Area

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-21
Technical Review by RAA on 2017-11-21

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- Alluvial Clay/Silt
- Alluvial Sand
- Residual Clay/Silt
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

Stantec TVA

U:\TVA-EP\175566338\gis\mxds\JSF_Foundation_Soils_BottomAsh.mxd Revised: 2017-11-21 By: mbough

Figure No.
14

Title

Uppermost Foundation Soil Data Dry Fly Ash Stack

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-21
Technical Review by RAA on 2017-11-21

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Alluvial Clay/Silt
- Alluvial Gravel
- Alluvial Sand
- Residual Clay/Silt
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. The limits of the Historical Ash Disposal Ponds were approximated using drawing 10N295 and previous inspection reports per note 4 on drawing 10W507-01.

U:\175566338\gis\mxds\JSF_Foundation_Soils_DryFly.mxd Revised: 2017-11-21 By: mbough

Figure No.
15

Title
Existing Top of Rock Elevation Boring Data Ash Disposal Area J

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-17
Technical Review by RAA on 2018-05-17

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

Legend

- Boring without Rock Core Data [ID, TOR Elevation]
- Fault Line
- CCR Unit Area (Approximate)
- Omb - Martinsburg Shale, including Reedsville Shale and Unnamed Limestone Unit
- On - Newala Formation, including Mascot Dolomite and Kingsport Formation
- Osv - Sevier Shale

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Geologic data downloaded from https://mrdata.usgs.gov/geology/state/state.php?state=TN

Stantec TVA

Figure No.
16

Title

Existing Top of Rock Elevation Boring Data Bottom Ash Pond & Hwy 70 Borrow Area

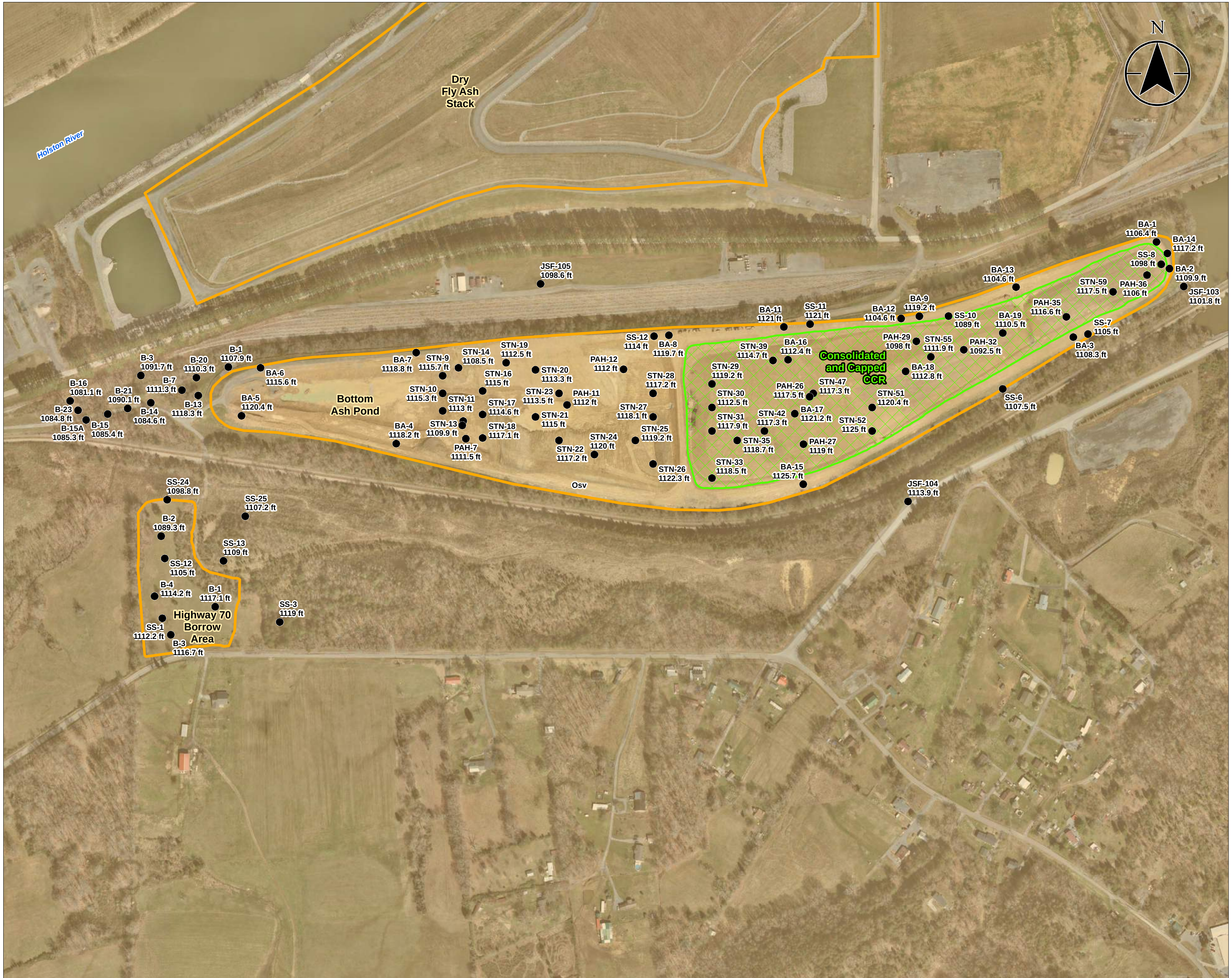
Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-09
Technical Review by RAA on 2017-11-09

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)



Legend

- Boring without Rock Core Data [ID, TOR Elevation]
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- Osv - Sevier Shale

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Geologic data downloaded from https://mrdata.usgs.gov/geology/state/state.php?state=TN

Stantec

TVA

V:\1754\EP\175566338\gis\mxds\JSF_TOR_BottomAsh.mxd Revised: 2017-11-09 By: mbough

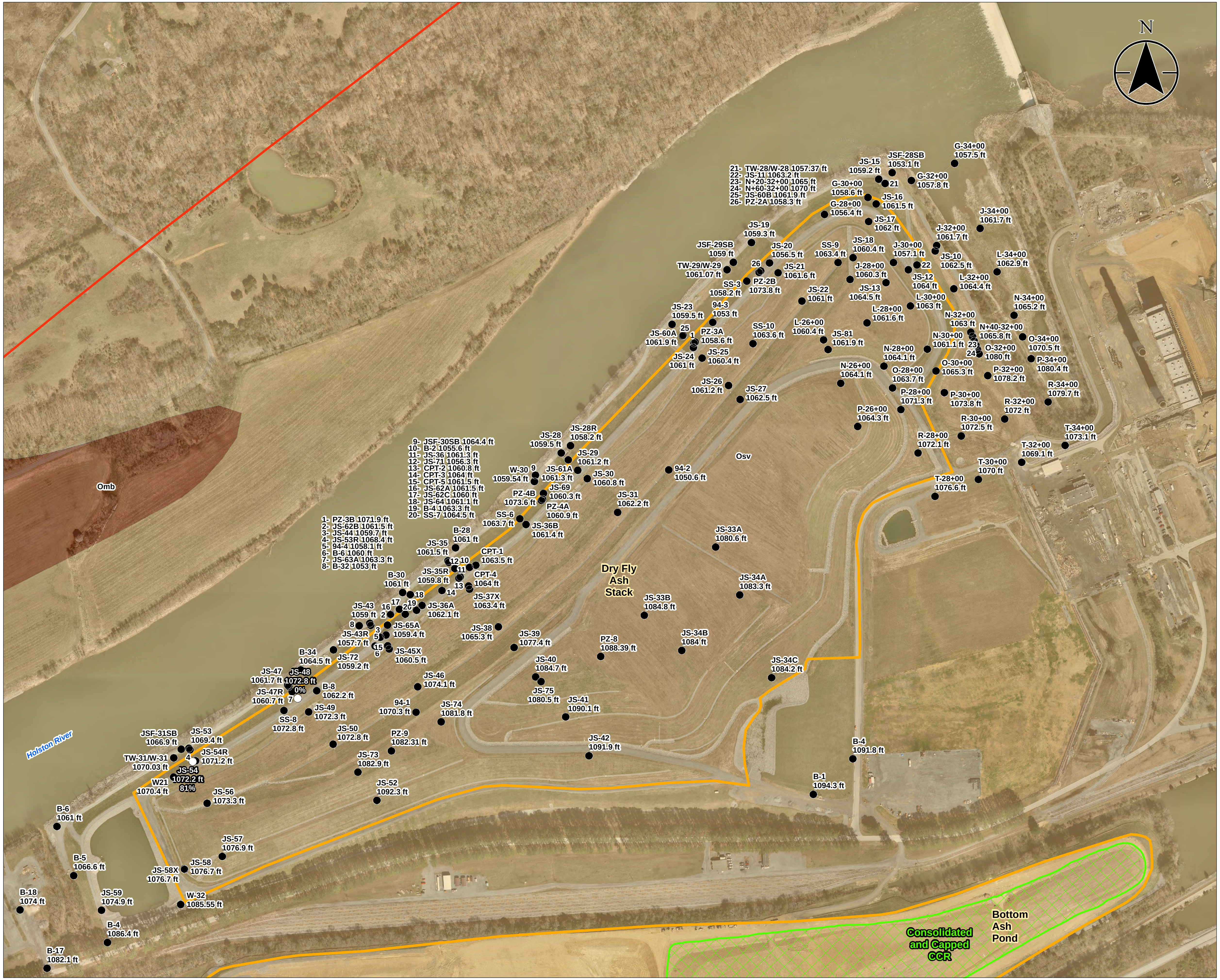


Figure No.
17

Title

Existing Top of Rock Elevation Boring Data Dry Fly Ash Stack

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-11-13
Technical Review by RAA on 2017-11-13

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- Boring without Rock Core Data [ID, TOR Elevation]
- Boring with Rock Core Data [ID, TOR Elevation, RQD]
- Fault Line
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- Omb - Martinsburg Shale, including Reedsville Shale and Unnamed Limestone Unit
- Osv - Sevier Shale

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)
3. Geologic data downloaded from https://mrdata.usgs.gov/geology/state/state.php?state=TN
4. RQD value corresponds to upper 20 feet of rock core.

Stantec

TVA

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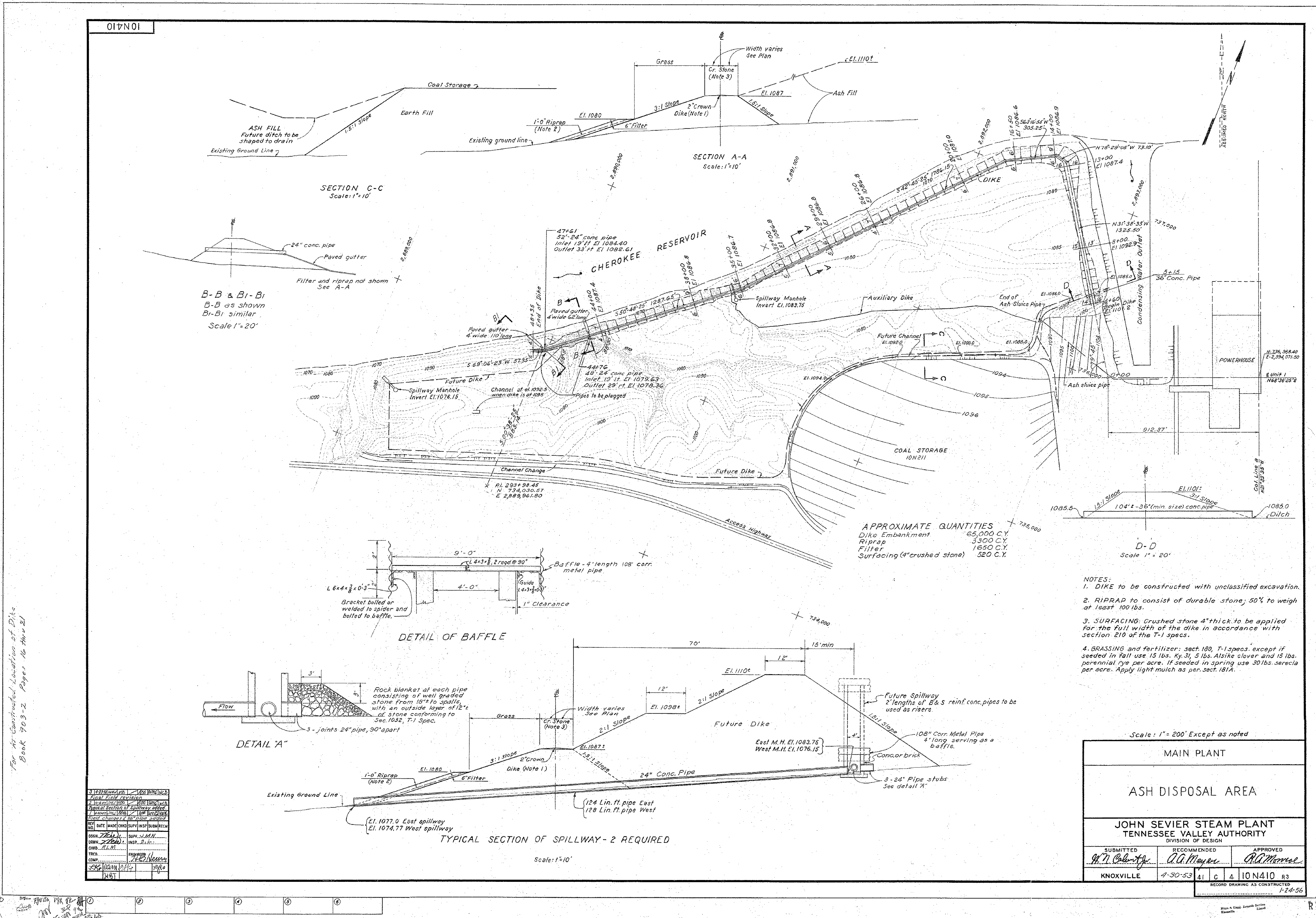
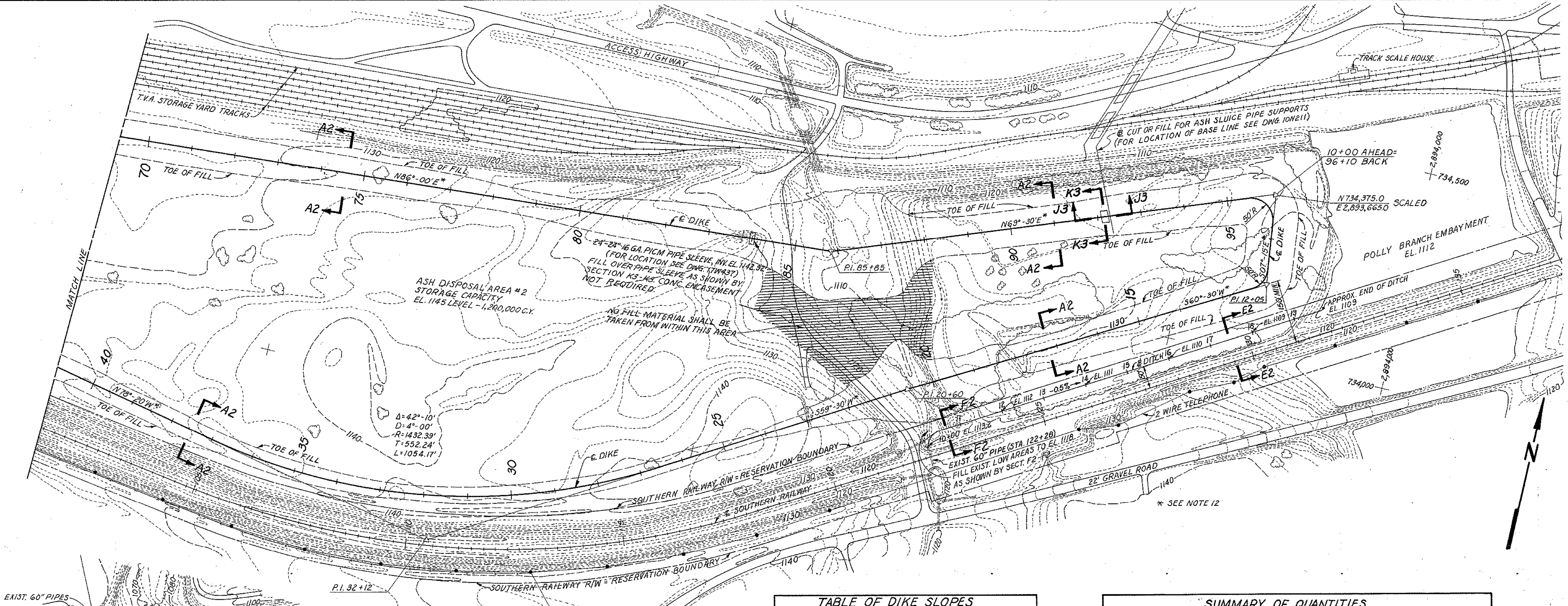
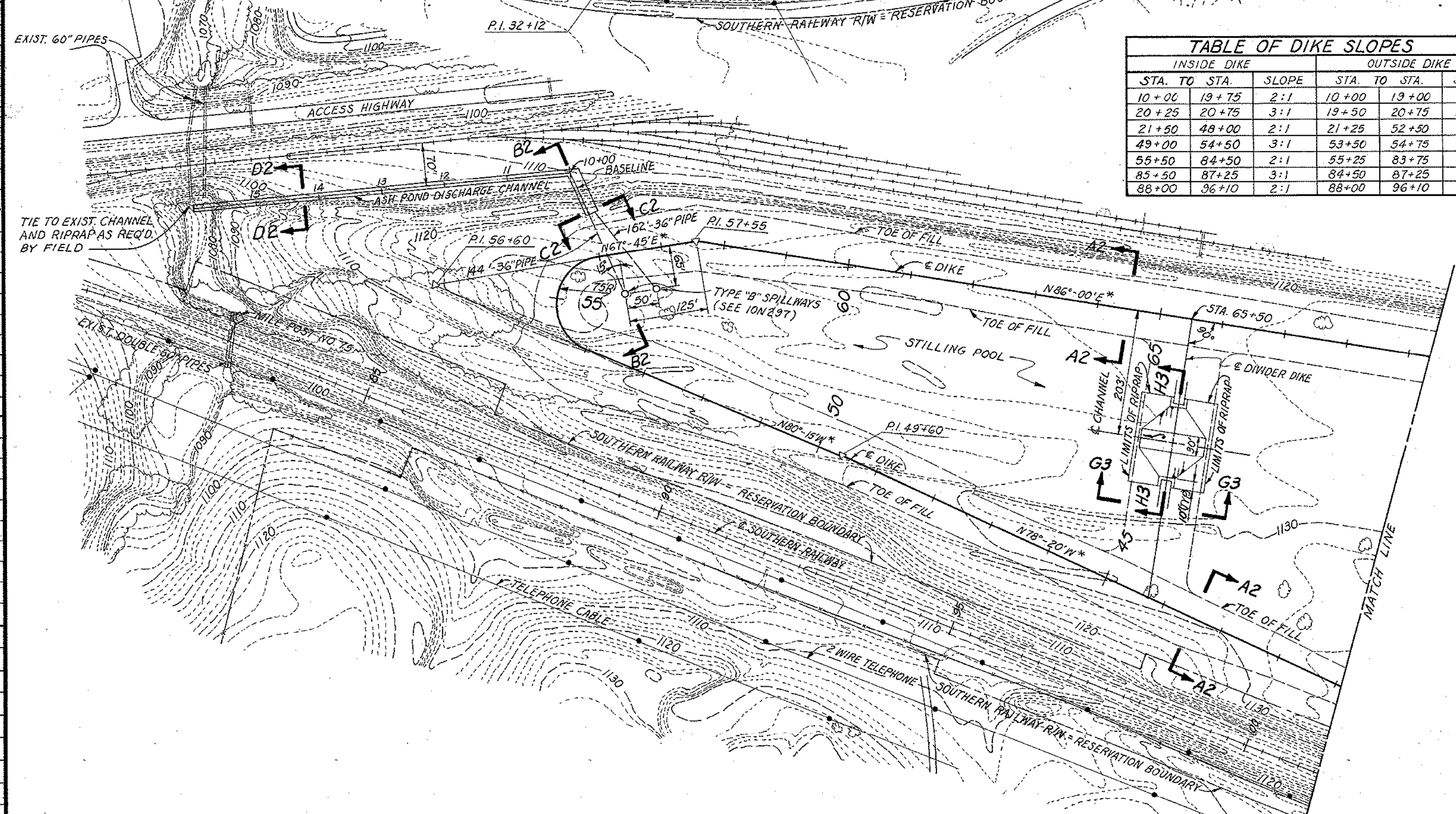
ATTACHMENT B
HISTORIC DRAWINGS


10N410
SECTION C-C
Scale: 1"=10'
Coal Storage
Earth Fill
ASH FILL
Future ditch to be shaped to drain
Existing Ground Line
1.5:1 Slope
SECTION A-A
Scale: 1"=10'
Grass
Cr. Stone (Note 3)
Width varies See Plan
El. 1110±
Ash Fill
El. 1087
3:1 Slope
2" Crown
Dike (Note 1)
1.5:1 Slope
1'-0" Riprap (Note 2)
El. 1080
6" Filter
Existing ground line
24" conc. pipe
Paved gutter
Filter and riprap not shown See A-A
B-B & B1-B1
B-B as shown
B1-B1 similar
Scale 1"=20'
CHEROKEE RESERVOIR
47+61
52'-24" conc pipe
Inlet 19' lt El. 1084.40
Outlet 33' rt El. 1082.61
44+76
48'-24" conc pipe
Inlet 19' lt. El. 1079.63
Outlet 29' rt. El. 1078.36
Pipes to be plugged
Paved gutter 4' wide 62' long
Paved gutter 4' wide 110' long
S 69°-06'-23" W 575.53'
S 50°-48'-25" 1287.65'
S 42°-45'-25" 1786.15'
N 78°-29'-05" W 73.10'
N 31°-38'-35" W 1325.50'
DIKE
Spillway Manhole Invert El. 1083.75
Spillway Manhole Invert El. 1076.15
Auxiliary Dike
Future Dike
Future Channel
Channel at el. 1092.5 when dike is at 1095
Channel Change
Future Dike
Access Highway
P.I. 293+98.45
N 734,030.57
E 2,889,961.80
End of Ash Sluice Pipe
Ash sluice pipe
36" Conc. Pipe
Condensing Water Outlet
POWERHOUSE
COAL STORAGE 10N211
912.37'
ASSUMED NORTH
APPROXIMATE QUANTITIES
Dike Embankment 65,000 C.Y.
Riprap 3300 C.Y.
Filter 1650 C.Y.
Surfacing (4" crushed stone) 520 C.Y.
D-D
Scale 1" = 20'
El. 1101±
1.5:1 Slope
3:1 Slope
104'± - 36" (min. size) conc. pipe
1085.5
1085.0
Ditch
NOTES:
1. DIKE to be constructed with unclassified excavation.
2. RIPRAP to consist of durable stone; 50% to weigh at least 100 lbs.
3. SURFACING: Crushed stone 4" thick to be applied for the full width of the dike in accordance with section 210 of the T-1 specs.
4. GRASSING and fertilizer: sect. 180, T-1 specs. except if seeded in fall use 15 lbs. Ky. 31, 5 lbs. Alsike clover and 15 lbs. perennial rye per acre. If seeded in spring use 30 lbs. serecia per acre. Apply light mulch as per sect. 181A.
9'-0"
4'-0"
Baffle - 4' length 108" corr. metal pipe
Bracket bolted or welded to spider and bolted to baffle.
1" Clearance
DETAIL OF BAFFLE
Rock blanket at each pipe consisting of well graded stone from 18" to spalls, with an outside layer of 12"± of stone conforming to Sec. 1032, T-1 Spec.
Flow
3 - joints 24" pipe, 90° apart
DETAIL "A"
70'
15' min
12'
El. 1110±
El. 1098±
2:1 Slope
Future Dike
Future Spillway 2' lengths of B & S reinf. conc. pipes to be used as risers.
108" Corr. Metal Pipe 4' long serving as a baffle.
East M.H. El. 1083.75
West M.H. El. 1076.15
Conc. or brick
3 - 24" Pipe stubs See detail "A"
24" Conc. Pipe
124 Lin. ft. pipe East
128 Lin. ft. pipe West
El. 1077.0 East spillway
El. 1074.77 West spillway
TYPICAL SECTION OF SPILLWAY - 2 REQUIRED
Scale: 1"=10'
For As Constructed Location of Dike Book 903-2 Pages 16 thru 21
Final field revision
Typical Section of Spillway added
Scale: 1" = 200' Except as noted
MAIN PLANT
ASH DISPOSAL AREA
JOHN SEVIER STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN
SUBMITTED
RECOMMENDED
APPROVED
KNOXVILLE
4-30-53
41 C 4 10N410 R3
RECORD DRAWING AS CONSTRUCTED
1-24-56
R3

10W293-1 | C | 41





NOTES:

1. ALL CONSTRUCTION, EXCEPT ROLLED EARTHFILL, SHALL BE IN ACCORDANCE WITH T-1 SPEC.
2. THE RESULTS OF THE SOIL INVESTIGATION FOR THE CONSTRUCTION OF THE ASH DISPOSAL AREA DIKES ARE REPORTED IN A MEMO FROM GENE FARMER TO G.L. BUCHANAN DATED DECEMBER 10, 1976, JOHN SEVIER STEAM PLANT-NEW ASH DISPOSAL AREA-SOILS INVESTIGATION, EN. DES. SOIL SCHEDULE NO. 6.
3. ALL ROLLED EARTHFILL SHALL BE IN ACCORDANCE WITH CONSTRUCTION SPEC. G-9, ROLLED EARTHFILL FOR DAMS AND POWER PLANTS. ROLLED EARTHFILL SHALL CONSIST OF SOIL PLACED IN LAYERS NOT EXCEEDING 6" AFTER COMPACTION AND SHALL BE UNIFORMLY COMPACTED TO AT LEAST 95% OF STD. MAX. DRY DENSITY AS DETERMINED BY ASTM D-698 PROCEDURES (STANDARD PROCTOR). MOISTURE CONTENT OF EARTHFILL SHALL BE WITHIN ±3% OF OPTIMUM MOISTURE CONTENT.
4. FROM STA. 19+50 TO STA. 21+50 AND FROM STA. 84+00 TO STA. 88+00 (APPROXIMATELY BETWEEN EL. 1125 CONTOURS), A NARROW INSPECTION TRENCH SHALL BE EXCAVATED TO A DEPTH OF 10'. IN ANY AREA WHERE GRAVEL STRATUM IS EXPOSED, A CUTOFF TRENCH IS TO BE EXCAVATED THROUGH THE PERVIOUS STRATUM AND BACKFILLED WITH COMPACTED IMPERVIOUS EARTHFILL MATERIAL AS SHOWN BY SECT. A2-A2. WHERE A CUTOFF TRENCH IS NOT REQUIRED, THE INSPECTION TRENCH IS TO BE IMMEDIATELY BACKFILLED, AFTER INSPECTION, WITH THE EXCAVATED MATERIALS AND THOROUGHLY COMPACTED.
5. BORROW MATERIAL SHALL BE EXCAVATED TO A DEPTH OF 10' BENEATH THE EXISTING GROUND SURFACE OR 2' MINIMUM BENEATH GRAVEL STRATUM WHERE ENCOUNTERED, EXCEPT AT LOCATIONS WHERE INSPECTION TRENCH IS REQUIRED. WHERE GRAVEL STRATUM IS EXPOSED, THE EXCAVATED SLOPE SHALL BE BLANKETED WITH COMPACTED IMPERVIOUS EARTHFILL MATERIAL AS SHOWN BY SECTION A2-A2.
6. WHERE A CUTOFF TRENCH IS REQUIRED ADJACENT TO BLANKETED EXCAVATION SLOPE, THE CUTOFF TRENCH SHALL BE EXTENDED ACROSS THE WIDTH OF THE DIKE TO TIE INTO THE BLANKETED EXCAVATION SLOPE.
7. EARTHFILL FOR DIKE CONSTRUCTION SHALL CONSIST OF MATERIAL EXCAVATED FROM INSIDE ASH DISPOSAL AREA NO. 2. PERVIOUS GRANULAR SOILS COMPARABLE TO BORROW SOIL CLASS VII, AS DEFINED BY THE MEMO PER NOTE 2, SHALL NOT BE USED AS EARTHFILL FOR DIKE CONSTRUCTION. CUT SLOPES FOR BORROW MATERIAL ADJACENT TO THE DIKE SHALL BE 3:1 OR FLATTER, AND THE TOP OF CUT SHALL BE A MINIMUM OF 25' FROM THE TOE OF DIKE SLOPE.
8. THE MINIMUM FACTOR OF SAFETY FOR ALL LOADING CONDITIONS INVESTIGATED BY STABILITY ANALYSIS FOR THE ASH DISPOSAL DIKES IS 1.21. THIS FACTOR OF SAFETY IS FOR THE SUDDEN DRAWDOWN CONDITION.
9. CRUSHED STONE OR GRAVEL SURFACING, 4" THICK, SHALL BE APPLIED FOR THE FULL WIDTH OF THE TOP OF DIKE IN ACCORDANCE WITH SECTION 210.
10. ALL CUT AND FILL SLOPES AND OTHER DISTURBED AREAS SHALL BE SEEDED WITH TYPE 6, MIXTURE E, IN ACCORDANCE WITH SECTION 180. DEPENDING ON THE TIME OF CONSTRUCTION, IT MAY BE NECESSARY TO PROVIDE A TEMPORARY COVER ON THE DIKE SLOPES. ALL GRASSED AREAS SHALL BE FERTILIZED AND MULCHED IN ACCORDANCE WITH SECTIONS 180 AND 182 RESPECTIVELY.
11. RIPRAP SHALL BE PLACED AS SHOWN ON THE DRAWINGS WITH A MINIMUM OF 50%, BY WEIGHT, CONSISTING OF STONES OF AT LEAST 150 LB. EACH. RIPRAP SHALL CONFORM TO SECTION 830.
12. FILTER SHALL CONFORM TO SECTION 836.
13. ALL CENTERLINE BEARINGS ARE APPROXIMATE SCALED BEARINGS.

TABLE OF DIKE SLOPES

INSIDE DIKE			OUTSIDE DIKE		
STA. TO	STA.	SLOPE	STA. TO	STA.	SLOPE
10+00	19+75	2:1	10+00	19+00	2:1
20+25	20+75	3:1	19+50	20+75	2.5:1
21+50	48+00	2:1	21+25	52+50	2:1
49+00	54+50	3:1	53+50	54+75	2.5:1
55+50	84+50	2:1	55+25	83+75	2:1
85+50	87+25	3:1	84+50	87+25	3:1
88+00	96+10	2:1	88+00	96+10	2:1

SUMMARY OF QUANTITIES

ITEM	DESCRIPTION	QUANTITY	UNIT
120	UNCLASSIFIED EXCAVATION	42,600	C.Y.
123	EARTH BORROW EXCAVATION	340,400	C.Y.
125	STRUCTURAL EXCAVATION	365	C.Y.
180	SEEDING	89,000	S.Y.
182	MULCHING	89,000	S.Y.
210	CRUSHED STONE SURFACING	3,150	TONS
661	18" PICM PIPE SLEEVE	78	L.F.
661	24" PICM PIPE SLEEVE	128	L.F.
830	DUMPED RIPRAP	2200	C.Y.
836	FILTER BLANKET	1075	TONS

COMPANION DRAWINGS: 10W293-2, -3

REV NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPD
2		8-20-80	GRD	TAC	JLG	JLG	KWB	RJB	RJB	FDS	GLB
RECORD AS CONSTRUCTED; P.A. 3312											
1		4-25-78	RDP	B.S.W.	RDP	AEH	KWB	—	RJB	JDE	GLB
REV. NOTES, TABLE OF DIKE SLOPES, & EXCAV. QUANTITIES; MINOR REVISIONS; P.A. 3312.											

DSGN R.D. POWELL
DRWN B.S. WAYCASTER
CHKD R.D. POWELL
SUPV J.L. GLOVER
INSP
ENGINEER K.W. Burnett

SCALE: 1" = 100' EXCEPT AS NOTED

MAIN PLANT

ASH DISPOSAL AREA NO. 2
PLAN

JOHN SEVIER STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
Robert J. Bowman	[illegible]	[illegible]

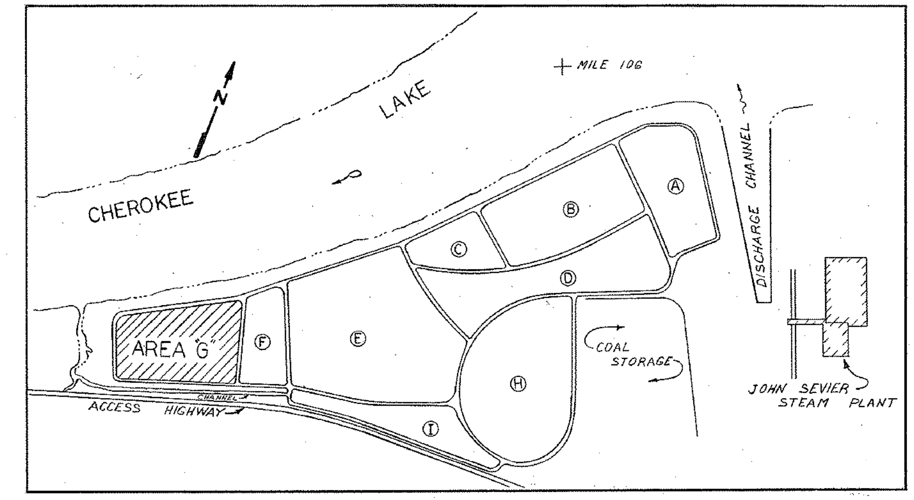
INSPECTED AND APPROVED FOR ISSUE
W.M. Bowen

KNOXVILLE 8-18-77 | 41 | C | 10W293-1 R2

RECORD DRAWING AS-CONSTRUCTED 1-20-80
Frank Van Meter R2

PRINT H 4
SIZE F
BR OR PROJ ME EE CE AD CD ED MD SW BL PA
PRINTS REQD-R 0

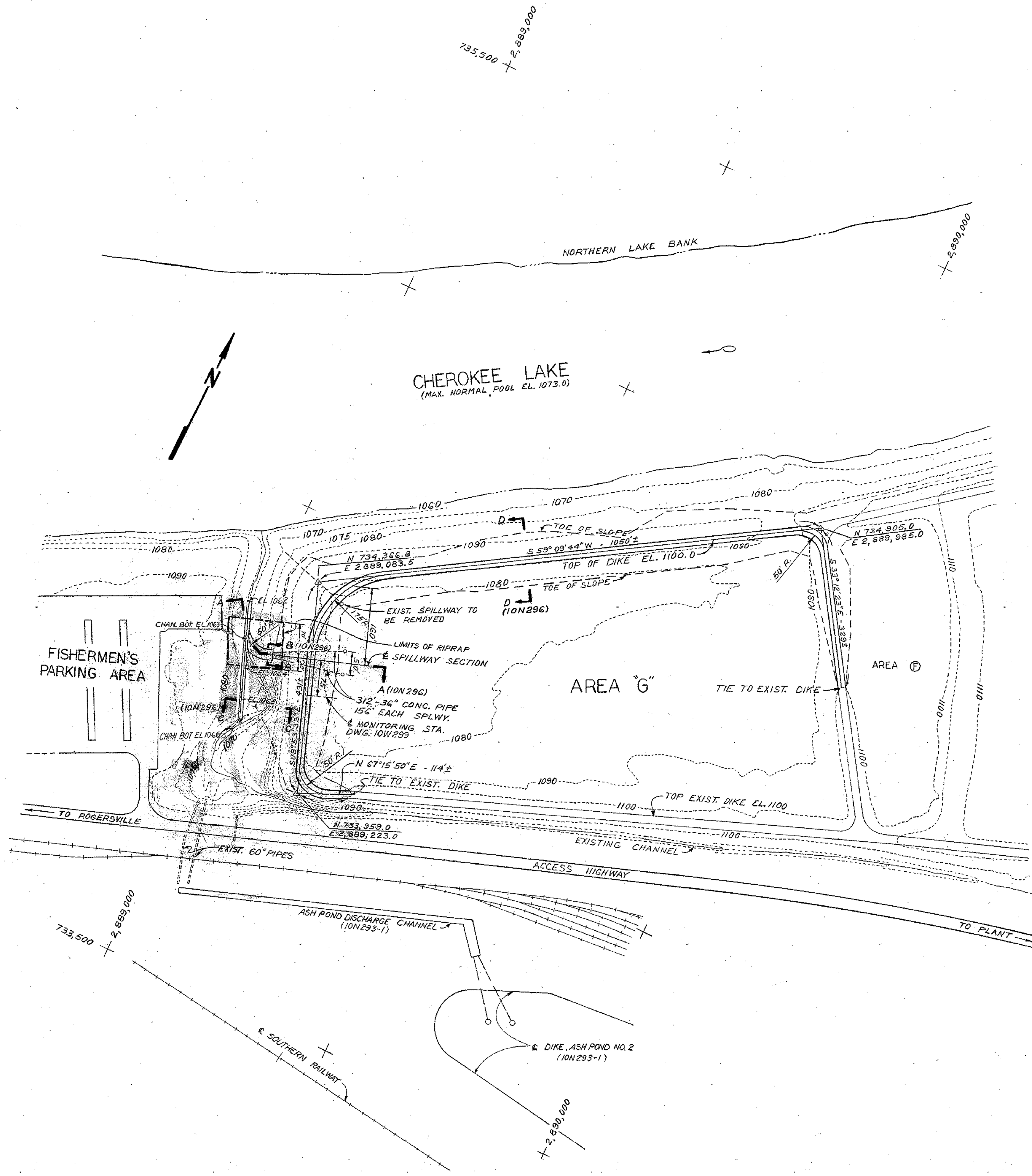
41 C 10N295



KEY PLAN

200 0 400 SCALE

SUMMARY OF QUANTITIES		
ITEM NO.	DESCRIPTION	QUANTITY
101	CLEARING & GRUBBING	15.2 AC.
110	REMOVE EXIST. SPWLY.	L.S.
120	CHANNEL EXCAVATION	3490 C.Y.
123	EARTH BORROW	37,650 C.Y.
129	STRUCTURAL EXCAVATION	545 C.Y.
180	GRASSING	15,720 S.Y.
210	SURFACING (4" CR. STONE)	740 TONS
830	RIPRAP	690 C.Y.
836	FILTER	310 TONS
FOR BILL OF MATERIALS FOR SPLWY. SEE DWG. 10N297		



PLAN
SCALE 1"= 100'

W.O.# P23-544-82-31401-J10

NOTES:
FOR NOTES SEE 10N296

COMPANION DWGS: 10N296, 297, 298

INSPECTED AND APPROVED FOR ISSUE
B.M. Montgomery
DESIGN PROJECT MANAGER

REV NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPR
3		8-20-80	GRO	TAC	JLG	JLG	KWB	RJB	RJB	FDS	GLB
Revised to remove Ash Pond Discharge Channel & Relocated Polly Br. of R2; PA 3076											
2		4-25-78	RDP		RDP		KWB		RJB		GLB
ADDED ASH POND DISCHARGE CHANNEL & RELOCATION POLLY BR.; PA 3076.											
1	-	2-7-75	DEC	DEC	PDH	PDH	PDH		RJB	JOB	GLB
REV. MONITORING STA. DWG. NO.											

DSGN D.E. CALLOWAY
DRWN D.E. CALLOWAY
CHKD J.B. CHAPMAN
SUPV J.M. HELMS
INSP
OHB
ENGINEER
Paul D. Herald

MAIN PLANT

FLY ASH DISPOSAL AREA "G" - PLAN

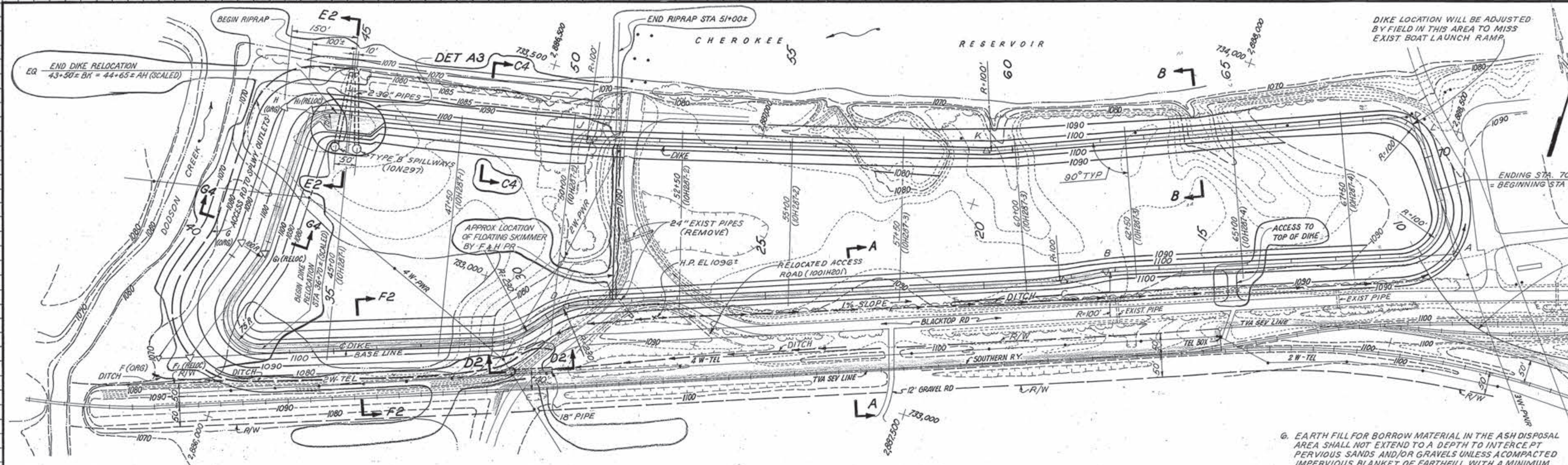
JOHN SEVIER STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
R.J. Bowman	[illegible]	W.W. Engle

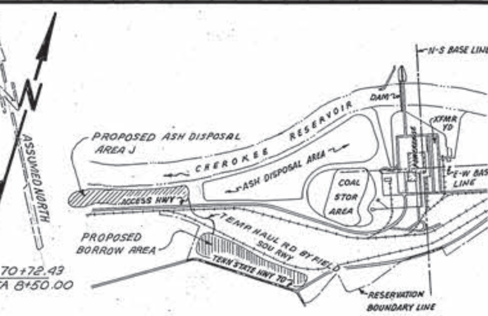
KNOXVILLE 2-1-74 | 41 | C | 10N295R3

RECORD DRAWING AS CONSTRUCTED
Gene Farmer 3/3/75 R1

25833R2
35330 R3



PLAN

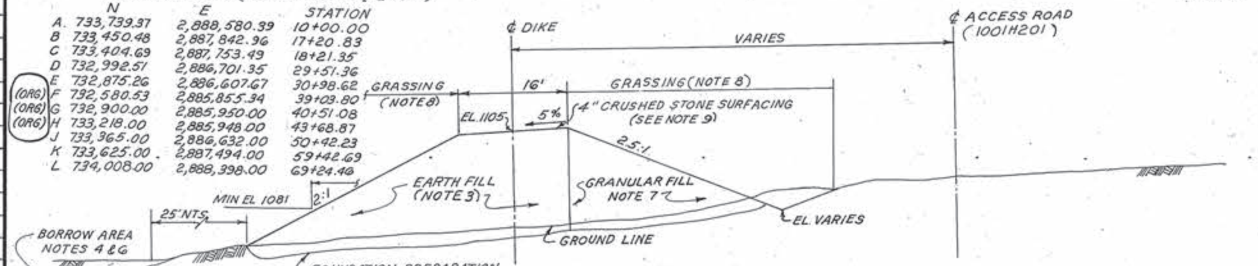


KEY PLAN
NTS

TEMPORARY HAUL ROAD FROM BORROW AREA BY FIELD

PI COORDINATES (℄ DIKE EXCEPT & E TO F)

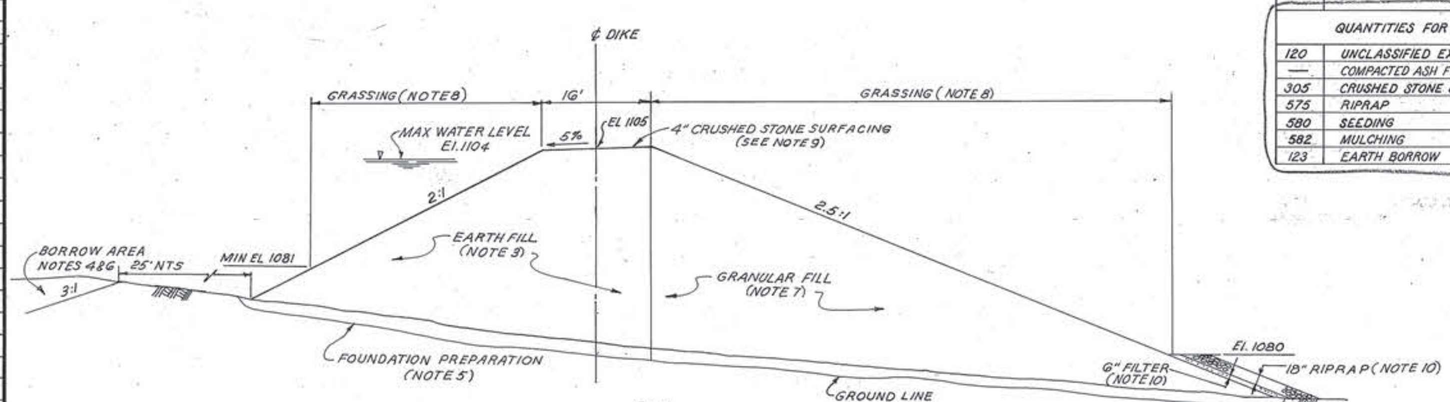
	N	E	STATION
A.	733,739.37	2,888,580.39	10+00.00
B	733,450.48	2,887,842.96	17+20.83
C	733,404.69	2,887,753.49	18+21.35
D	732,992.51	2,886,701.35	29+51.36
E	732,875.26	2,886,607.67	30+98.62
(ORG) F	732,580.53	2,885,855.34	39+03.80
(ORG) G	732,900.00	2,885,950.00	40+51.08
(ORG) H	733,218.00	2,885,948.00	43+68.87
J	733,365.00	2,886,632.00	50+42.23
K	733,625.00	2,887,494.00	59+42.69
L	734,008.00	2,888,398.00	69+24.40



A-A
TYPICAL SECTION
STA. 69+00± FORWARD TO STA. 31+00±
1" = 10'

PI COORDINATES

	N	E	STATION
(RELOC) F1	732,606.88	2,885,922.60	38+25±
(RELOC) G1	732,891.91	2,886,007.05	39+75±
(RELOC) H1	733,230.23	2,886,004.92	43+15±



B-B
TYPICAL SECTION
STA. 50+00± TO STA. 69+00±
1" = 10'

SUMMARY OF QUANTITIES

ITEM	DESCRIPTION	QUANTITY	UNIT
101	CLEARING & GRUBBING	35	AC.
123	EARTH BORROW	471,000	CY
125	EXCAVATION FOR STRUCTURES	303	CY
305	CRUSHED STONE SURFACING	1855	TON
570	FILTER BLANKET	1500	TON
575	RIPRAP	2650	CY
580	SEEDING	72,000	SY
582	MULCHING	72,000	SY
510	STONE GUTTER	100	LF
	FOUNDATION PREPARATION	55,000	CY
463 481 491	18" PIPE CULVERT	86	LF
464	36" CONC PIPE CLASS IV "O" RING	340	LF

QUANTITIES FOR REVISION 3

ITEM	DESCRIPTION	QUANTITY	UNIT
120	UNCLASSIFIED EXCAVATION	17,000	CY
—	COMPACTED ASH FILL	21,200	CY
305	CRUSHED STONE SURFACING	1,500	TON
575	RIPRAP	44,000	TON
580	SEEDING	13,500	SY
582	MULCHING	13,500	SY
123	EARTH BORROW	1,000	CY

STORAGE CAPACITY *

ELEVATION	QUANTITY	ACCUM QUANTITY
1071 & BELOW	10,600 CY	10,600 CY
1076 TO 1071	59,200 CY	69,800 CY
1081 TO 1076	107,600 CY	177,400 CY
1086 TO 1081	127,800 CY	305,200 CY
1091 TO 1086	137,600 CY	442,800 CY
1096 TO 1091	147,400 CY	590,200 CY
1101 TO 1096	157,200 CY	747,000 CY ‡

* ASSUME ASH LEVEL
‡ RELOCATION OF THE WEST DIKE REDUCED THE ASH STORAGE CAPACITY BY 27,000 CY±.

NOTES:

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE T-1 SPECIFICATIONS, UNLESS OTHERWISE NOTED.
2. THE SOLID CONTOURS REPRESENT FINISHED GRADE; DASHED CONTOURS INDICATE EXISTING GROUND.
3. THE RESULTS OF THE SOIL INVESTIGATION FOR THE ASH DISPOSAL AREA DIKES ARE REPORTED IN A MEMO FROM FRANK VANMETER TO G.L. BUCHANAN DATED JULY 22, 1981 (CSB 810724 301), JOHN SEVIER STEAM PLANT, ASH DISPOSAL AREA, SOIL EXPLORATION AND TESTING, EN DES SOIL SCHEDULE NO. 6.2. ALL ROLLED EARTH FILL SHALL BE IN ACCORDANCE WITH CONSTRUCTION SPECIFICATION G-9, ROLLED EARTH FILL FOR DAMS AND POWER PLANTS. ROLLED EARTHFILL SHALL CONSIST OF SOIL PLACED IN LAYERS NOT EXCEEDING 6" AFTER COMPACTION AND SHALL BE UNIFORMLY COMPACTED TO AT LEAST 95% OF STANDARD MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D-698 PROCEDURES. MOISTURE CONTENT OF EARTHFILL SHALL BE WITHIN ±3% OF OPTIMUM MOISTURE CONTENT.
4. BORROW MATERIAL AS MUCH AS PRACTICAL FOR THE DIKE SHALL BE OBTAINED FROM INSIDE THE DISPOSAL AREA. CUT SLOPES ADJACENT TO EMBANKMENTS SHALL NOT BE EXCAVATED STEEPER THAN 3:1 AND TOP OF CUT SHALL BE A MINIMUM OF 25 FEET FROM TOE OF EMBANKMENT. REMAINING BORROW MATERIAL SHALL BE OBTAINED FROM DESIGNATED BORROW AREA LOCATED SE OF DIKE AND BETWEEN SOUTHERN RAILWAY AND TENNESSEE HIGHWAY 70.
5. FOUNDATION PREPARATION FOR EARTH EMBANKMENTS SHALL CONSIST OF CLEARING AND REMOVING ALL ROOTS. VEGETATION, AND ORGANIC TOPSOIL. FOUNDATION AREA SHALL BE COMPACTED BY USING SHEEP'S FOOT ROLLER FOLLOWED BY A FLAT WHEELED ROLLER UNTIL DISTURBED AREA WILL SUPPORT HEAVY EQUIPMENT WITHOUT RUTTING INTO THE GROUND SO AS TO REDUCE ITS STABILITY. PRIOR TO PLACING FILL THE FOUNDATION MUST BE SCARIFIED SO THERE WILL BE GOOD BOND BETWEEN FOUNDATION AND FILL. THE SOIL INVESTIGATION PROGRAM INDICATED THE PRESENCE OF SOFT SOILS DIRECTLY BENEATH THE TOPSOIL AT STATION 9+50± AND STATION 34+00± IN THE DIKE FOUNDATION. SUCH SOFT AND SHALLOW SOILS DETECTED DURING THE FOUNDATION PREPARATION AT THESE LOCATIONS OR ANY OTHER LOCATION IN THE DIKE AREA SHALL BE REMOVED AND REPLACED BY IMPERVIOUS EARTHFILL COMPACTED IN LAYERS.
6. EARTH FILL FOR BORROW MATERIAL IN THE ASH DISPOSAL AREA SHALL NOT EXTEND TO A DEPTH TO INTERCEPT PERVIOUS SANDS AND/OR GRAVELS UNLESS A COMPACTED IMPERVIOUS BLANKET OF EARTHFILL WITH A MINIMUM THICKNESS OF 3FT. IS PLACED OVER EXPOSED SANDS AND/OR GRAVELS. IF THIN LAYERS OR POCKETS OF SAND AND/OR GRAVEL, ENCOUNTERED WITHIN FINE-GRAINED BORROW SOILS, ARE EXPOSED ON THE EXCAVATED SLOPE, THEY SHOULD BE BLANKETED WITH COMPACTED IMPERVIOUS EARTHFILL WITH A MINIMUM WIDTH OF 3FT.
7. IN VIEW OF A POTENTIAL FOR BORROW SHORTAGE, SAND AND GRAVEL MATERIALS, IF ENCOUNTERED DURING BORROW EXCAVATION OR DIKE FOUNDATION PREPARATION, SHALL NOT BE WASTED. IF SHORTAGE OF FINE-GRAINED BORROW SOIL OCCURS, SANDS AND GRAVELS MAY BE USED BENEATH THE OUTER SLOPE OF THE DIKE. GRANULAR FILL WITH LESS THAN 20% FINES SHALL BE COMPACTED TO AN AVERAGE RELATIVE DENSITY OF 85% OR GREATER WITH A MINIMUM RELATIVE DENSITY OF 80% AS DETERMINED BY ASTM D2049 PROCEDURES. GRANULAR MATERIAL WITH MORE THAN 20% FINES SHALL BE COMPACTED TO AT LEAST 95% OF STANDARD MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D698 (METHOD D) PROCEDURES.
8. DIKE SLOPES SHALL BE SEEDED WITH TYPE 6 MIXTURE 5 SEEDED AREAS ARE TO BE FERTILIZED AND MULCHED IN CONFORMENCE WITH SECTIONS 580 AND 582.
9. CRUSHED STONE SURFACING, 4 INCHES THICK, SHALL BE APPLIED FOR THE FULL WIDTH OF THE TOP OF THE DIKE IN ACCORDANCE WITH SECTION 305.
10. RIPRAP SHALL BE SOUND, DURABLE STONE, 18 INCHES THICK, WITH A MINIMUN OF 50% BY WEIGHT CONSISTING OF STONES AT LEAST 100 LBS EACH. RIPRAP SHALL CONFORM TO SECTION 575. FILTER BLANKET, 6 INCHES THICK, SHALL CONFORM TO SECTION 570.
11. THE ASH DISPOSAL AREA SHALL BE CLEARED IN ACCORDANCE WITH SECTION 101. NO GRUBBING IS REQUIRED EXCEPT FOR AREAS OF DIKE FOUNDATIONS.
12. STONE GUTTER SHALL BE CONSTRUCTED IN ACCORDANCE WITH SECTION 510.
13. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185 PLAIN FINISH AND SHALL HAVE A MINIMUM LAP DISTANCE OF 8 INCHES.
14. FAMILY OF COMPACTION CURVES DEVELOPED FOR BORROW AREAS A AND B BY SME AS PER EN DES SOIL SCHEDULE NO. 6.2 (CSB 810724 301) SHALL BE USED TO CONTROL THE EARTHFILL COMPACTION. IN-PLACE DENSITY TESTS USING THE SAND CONE (ASTM D1556) OR RUBBER BALLOON (ASTM D2167) TEST METHODS SHALL BE MADE AT A RATE OF AT LEAST 1 TEST FOR EACH 2000 CUBIC YARDS OF EARTHFILL PLACED (IN-PLACE VOLUME), OR A MINIMUM OF 1 PER DAY.
15. COMPACTED ASH FILL SHALL BE CONSTRUCTED THE SAME WAY THE EARTHFILL IS CONSTRUCTED. THE FAMILY-OF-COMPACT CURVES DEVELOPED FOR THE ASH FILL BY SME PER EN DES SOIL SCHEDULE NO. 6.4 (SME 841127 002) SHALL BE USED TO CONTROL THE COMPACTED ASH FILL. COMPACTION OF ASH FILL SHALL BE DONE WITH SMOOTH SURFACE STEEL WHEEL VIBRATORY ROLLERS.

FIRST ISSUE FOR
W.O. 544-30-31401-J0084

COMPANION DWG: 10N297, 298
10W286-2, -3, -4

REV NO.	DESCRIPTION
3	WO # 20636 12/24/84 — RELOC WEST DIKE. ADD NOTES, FLOAT SKIM, AND ACCESS RD & RAMP.
2	12/6/83 — ADDED SECTIONS & STORAGE CAPACITY - WO 544-30-31401-J0084
1	9/28/83 — ADD DET A3 & REV SUMMARY OF QUANTITIES - WO 544-30-31401-J0084

REV NO. | PA NO. | DATE | DSGN | DRWN | CHKD | SUPV | ENGR | INSP | SUBM | RECM | APPD | DPM

DSGN R. D. MARONEY
DRWN V.R. LEE - A.H. SPEBBER
CHKD J. L. GLOVER
SUPV J. L. GLOVER
INSP J.R. Fox
ENGINEER K. W. Burnett

SCALE 1" = 100' EXCEPT AS NOTED

MAIN PLANT

FLY ASH DISPOSAL AREA "J" SHEET 1

JOHN SEVIER STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED Robert J. Bowman
RECOMMENDED
APPROVED

INSPECTED AND APPROVED FOR ISSUE

KNOXVILLE 7-28-82 41 C 10W286-1 R3

RECORD DRAWING AS CONSTRUCTED

PRINT H
SIZE F
BR OR PROJ NE EE CE AD CD ED MD SW BL FDP
PRINTS REQD - R 2

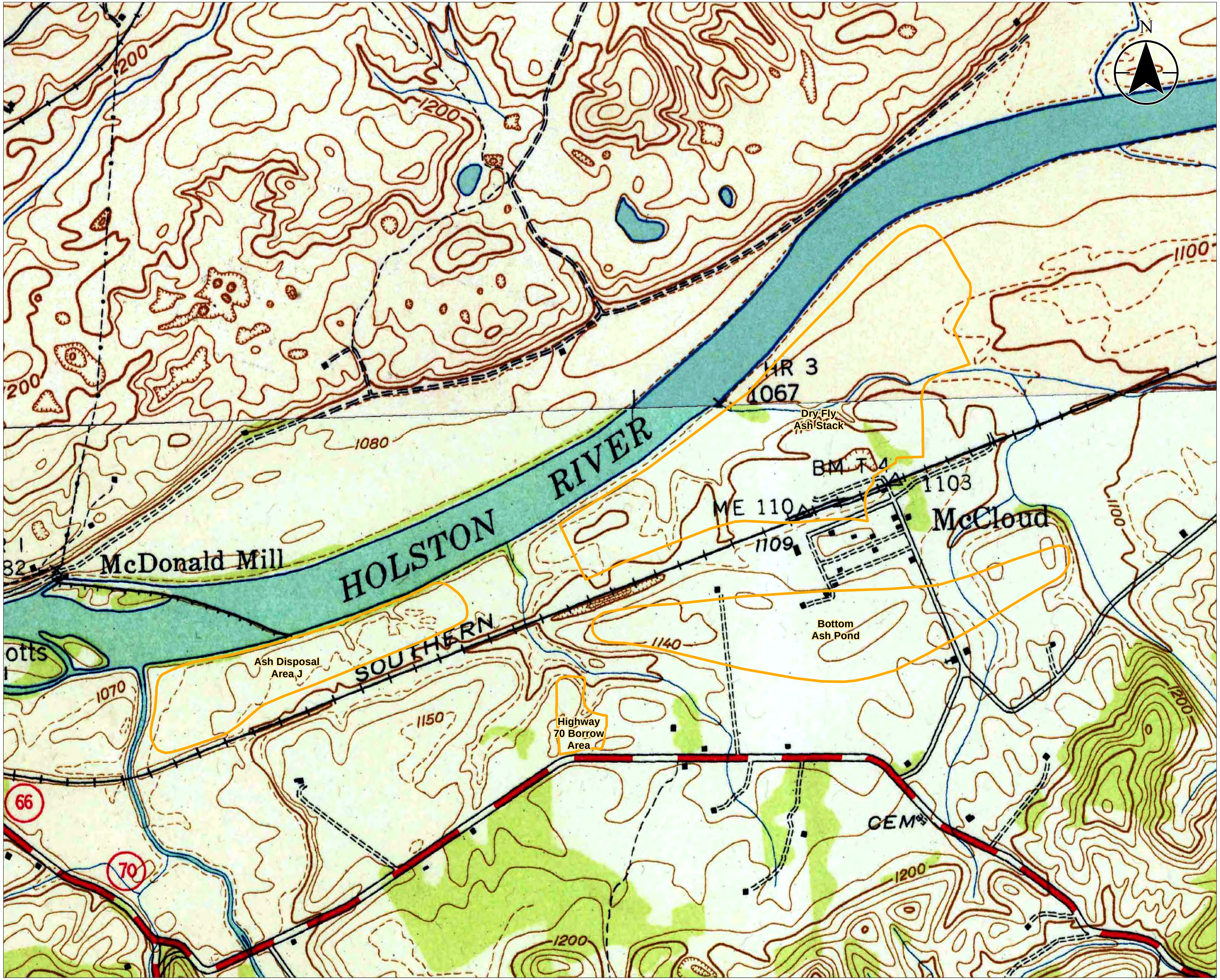


Figure No.
1

Title
John Sevier Fossil Plant
Pre-Construction Topographic Map

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-12-11
Technical Review by RAA on 2017-12-11

0 400 800 1,200 1,600 Feet
1:4,800 (At original document size of 22x34)

Legend

CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Topographic Map: USGS McCloud and Burem, Tennessee Quadrangles, 1940

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TVA

APPENDIX P
WATER USE SURVEY SAP

Water Use Survey
Sampling and Analysis Plan
John Sevier Fossil Plant

Revision 0 Draft

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

REVISION LOG

Revision	Description	Date
1	Addresses Public Comments and Issued for TDEC Approval	October 19, 2018

WATER USE SURVEY
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Water Use Survey
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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 10/12/18

TVA Investigation Field Lead — Date 10/11/18

Health, Safety, and Environmental (HSE) Manager — Date 10/17/18

Kip Anderson
Investigation Consultant Project Manager — Date 10-08-18

Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.10.17 10:03:16 -04'00'
QA Oversight Manager — Date

Laboratory Project Manager — Date 10/16/18

Charles L. Head
Charles L. Head
TDEC Senior Advisor — Date 2018/10/31

Robert Wilkinson
TDEC CCR Technical Manager — Date 10/31/18

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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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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.

On September 7, 2018, the public comment period for the JSF EIP ended. In response to the public's comments, TVA has developed this Water Use Survey Sampling and Analysis Plan (SAP) to conduct a water use survey and sampling of groundwater and surface water supplies within ½ mile of the boundary of the JSF Plant (Plant). This SAP includes a schedule and procedures for identifying the locations and owner of each water source, soliciting permission to collect groundwater or surface water samples, and reviewing and reporting the gathered information.

2.0 OBJECTIVES

The objectives of this Water Use Survey SAP are to establish procedures for identifying and sampling usable water supply wells and surface water sources being used for domestic purposes located within the Survey Area (defined in Section 4.0). Sampling will assist in the evaluation of constituents that may be related to coal ash in water supply wells or surface water supplies within the survey area. TVA defines a usable water well to be one that will house a pump (even if a pump is not currently present) and does not contain an obstruction or defective construction that would prevent the insertion or operation of a pump.

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Site Health and Safety Plan (SHSP). This SHSP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the SHSP. 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 SHSP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment requirements and safety, security, health, and environmental procedures are defined in the SHSP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Investigation Consultant will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks. The designated Safety Officer 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 SAMPLE LOCATIONS

TVA will conduct a survey of water supplies within a one-half-mile radius of the Plant. TVA owned property will be included in the survey. Usable water supply wells and surface water sources being used for domestic purposes will be sampled if access is granted. A map showing properties within a one-half mile radius of the Plant is provided in Attachment A. A final map displaying surveyed and sampled wells will be provided in the EAR.

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to prepare for field activities, identify locations of domestic water supply and collect water samples, and assist in providing scientifically defensible results.

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 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
- 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
- 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 TI ENV-TI-05.80.03, *Field Record Keeping* and TVA TI ENV-TI-05.80.02, *Sample Labeling and Custody*
- Obtain ice daily prior to beginning work for sample preservation

5.2 PROPERTY AND OWNER IDENTIFICATION

Sources of information on the potential presence of private water supplies in the survey area include:

- Water supply well locations within the local quadrangle(s) provided by TVA
- Public utilities water service maps
- County water well inventory records on file with TDEC
- Existing reports with information regarding water well and surface water supply locations. TVA will compile information from county tax maps on properties and cross-reference sources of information to create a map of potential water supplies within the survey boundary. This map will be used to guide door-to-door surveys that seek to confirm ownership and locations of groundwater supply wells or surface water sources, identify previously unknown water sources, and evaluate whether the water source is now or in the future could be used as a source of water supply.

A template for the properties identified through this data comparison process is provided as Table 1 in Attachment B. This master table will list potential properties identified via this survey where a private water supply is present and whether the supply is located within the survey area. Each property will be assigned an identification number to preserve the owner's privacy. The identification numbers will begin with "Plant specific three letter acronym-PV-00#" (or similar designation) and will be assigned sequentially as the property appears on the list, beginning with "-001". Key data relating to each property identification number (i.e. property owner, resident name and address) will be stored and managed on a secure server.

5.3 DOOR-TO-DOOR SURVEY

This section provides a generic access agreement letter (Attachment C), example survey form (Attachment D), and procedure to be used by TVA to conduct the survey.

5.3.1 Survey Description

This survey will allow TVA to identify persons either currently using groundwater or surface water as a drinking water source or if persons have usable water wells. The updated list of survey properties will be visited by TVA personnel or their contractors to gather information using the same or similar questions to those in the example survey form (Attachment D) The door-to-door survey will be conducted between the hours of 8 am and 8 pm (to be staggered to cover a general 8-hour work day each day) to increase the likelihood that someone will be present.

Locations where contact is not made will be revisited as needed, including weekend contact attempts if necessary.

TVA or their contractors will discuss the access agreement letter with each property owner to determine if access will be granted to allow sampling of their well or water supply source at a later date. In the event that access is not initially granted, TDEC will be contacted to assist in gaining access. Two copies of the access agreement letter (example in Attachment C) will be left with the property owner, one for the owner's records, and one to be signed and returned to TVA if an immediate signature is not obtained during the initial visit. If the occupant is not the property owner, then TVA will work with the occupant to contact the property owner for access.

Contact information for appropriate TVA personnel will be provided in the access agreement letter.

The survey team will consist of at least two people. To the extent possible, at least one member will be a TVA employee.

5.3.2 Well-Owner Questionnaire

Personnel conducting the door-to-door survey will complete a Water Supply Well Survey Form (Attachment D) for each property owner. If necessary, the information will be supplemented with the following information if it is known by the owner:

- Well construction information, including construction material and date drilled
- Septic system type and location (if present) relative to well location
- Which taps receive treated vs untreated water
- Typical use of water (irrigation, residential water source, etc.)
- Determine if the well or source has ever gone dry or if water supply is a concern
- Water quality concerns or complaints, if any
- Number of occupants living at the location

5.3.3 Survey Information Management

Information forms will be compiled in an electronic format, such as Microsoft Excel and key data relating to each property (i.e. property owner, resident name, and address) will be stored and managed on a secure server. The information will be used to finalize a map showing homes and businesses within the survey area that TVA contacted, wells within the survey area, and locations of water sources that are used as a drinking water source or have usable water wells. The final map will indicate one of the following for each property:

- Water supply well or surface water source used as primary drinking water source
- Water supply well present and usable, is not used as primary drinking water source, but is used for other activities (e.g., irrigation)
- Water supply well present and usable, but is not currently being used
- Water supply well present but not in a usable condition (i.e., no pump is present and the field team is unable to sample the well with field pumps)
- No water supply well or surface water supply present
- Information not available

This map will be provided to TDEC and will be used to prepare for a water supply sampling event.

5.4 SAMPLE LOCATIONS

TVA will collect samples from locations identified during the door-to-door survey that are using groundwater or surface water as a drinking water source or have useable wells and where permission has been obtained from the owner/operator.

If sampling reveals CCR constituents present above maximum contaminant levels within the initial survey boundary, TVA will promptly report the information to TDEC. In the event of an emergency related to elevated CCR constituents in groundwater associated with Plant operations, TVA will work with TDEC to implement a contingency plan. As part of the contingency plan, TVA will work with TDEC to notify appropriate parties, implement necessary safety measures, and provide an alternative source of potable water.

5.5 SAMPLING METHODS AND PROTOCOL

Water supply sample collection will adhere to applicable EPA (EPA 2001) and TVA TI documents. The related TVA TIs follow:

- ENV-GAF-PW.01 *Potable Water Sampling*
- 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*
- ENV-TI-05.80.42 *Groundwater Sampling*
- ENV-TI-05.80.46 *Field Measurement Using a Multi-Parameter Sonde*

5.5.1 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment E. A final list of equipment will be prepared by the Investigation Consultant, 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 JSF Quality Assurance Project Plan (QAPP).

5.5.2 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/global positioning system documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.5.2.1 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 Quality Assurance (QA) Oversight Manager or designee will approve deviations before they occur.

5.5.2.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks.

5.5.2.3 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 Consultant 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.

5.5.2.4 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.

5.5.3 Collection of Samples

5.5.3.1 GENERAL SAMPLING PROCEDURES

Prior to sampling, a multi-parameter meter will be used to record conventional water parameters at the tap. Water quality measurement instrumentation will be calibrated and used in accordance with the QAPP. Conventional field parameters to be measured include:

- Dissolved Oxygen
- Oxidation Reduction Potential
- pH
- Specific Conductance (measured and recorded in microsiemens per centimeter [µS/cm] in accordance with ENV-TI-05.80.42
- Temperature
- Turbidity

The sampling point will be selected from within the system as close to the well as possible but prior to the addition of water softeners, filters, and treatment systems when possible. If a sample cannot be collected prior to a water treatment device, then the type of treatment device will be documented in the field logbook. Aerators and screens/fixtures attached to the faucet will be removed prior to sampling. The system will be purged by allowing cold water to run for at least 15 minutes. If there is an inline tank prior to the sampling tap, enough water will be purged to complete a full exchange of water in the tank after the 15-minute purge has been completed. During purging, field parameters will be measured every 3-5 minutes to assess stability. If water quality parameters have not stabilized after purging, then TVA will note that they have not stabilized, record the final field parameter values, and collect a sample.

5.5.3.2 WATER SUPPLY SAMPLING FROM A TAP

TVA and its contractors will collect samples in accordance with the procedures provided in the QAPP. Water samples will be collected directly from a faucet or pipe valve with any screens/fixtures removed directly into laboratory-supplied bottleware or will be collected from the screenless/fixtureless faucet into laboratory-supplied bottleware utilizing new, clean sample tubing connected to the tap/faucet. The tubing will be connected to the tap/faucet via a properly decontaminated adapter with a ribbed nipple that will be screwed on the faucet outlet. The tubing will be flushed for at least three minutes prior to sampling. The sample will be collected at the indoor or outdoor tap closest to the wellhead, prior to any water treatment devices. If a sample cannot be collected prior to a water treatment device, then the type of treatment device will be documented in the field logbook.

5.5.3.3 WATER SUPPLY WELL SAMPLING WHERE THERE IS NO TAP

Water supply wells that do not have a tap will be sampled in a manner that allows collection of samples that will be representative of ambient groundwater quality. This typically requires that the well is purged to remove stagnant water prior to sample collection. For wells that have existing pumps, purging will be conducted in a manner to minimize disturbance of water in the well bore by pumping at low rates. If wells without functioning pumps installed are identified during the initial sampling event, then a second visit to the property may be required for sample collection. Available information regarding the condition of the well and the equipment needed to collect a sample will be will be recorded in the field logbook during the initial visit to the property.

The methods to be used for sample collection are provided in the TIs and ENV-GAF-PW.01, *Potable Water Sampling* which describes use of bailers, peristaltic, or submersible pumps for sample collection at wells where there is no tap or existing pump. Water samples will be collected directly from a pump discharge point directly into laboratory-supplied bottleware or will be collected from the pump into laboratory-supplied bottleware utilizing new, clean sample tubing which has been connected to the pump and flushed for three minutes.

5.5.4 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-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. 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 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 Consultant Project Manager.

5.5.5 Sample Analyses

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 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, 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 magnesium, potassium, sodium, carbonate and bicarbonate.

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

Appendix IV Constituents
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. Additional Geochemical Parameters

Major Cations/Anions**
Bicarbonate
Carbonate
Magnesium
Potassium
Sodium

** Constituents not included in the CCR Parameters

Table 5. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Metals, dissolved	EPA 200.8	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	180 days
Metals, total	EPA 200.8	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	180 days
Mercury, dissolved	EPA 245.1	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	28 days
Mercury, total	EPA 245.1	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
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.

5.5.6 Equipment Decontamination Procedures

Documented decontamination will be performed for non-dedicated sampling equipment and instruments that 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.

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 disposal in accordance with Section 5.5.7

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.

5.5.7 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 QA/QC requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to the Water Use Survey 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 Consultant 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 field 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 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.

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 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 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 Water Use Survey Activities

Project Schedule		
Task	**Duration**	**Notes**
Water Use Survey SAP Submittal		Completed
Field Activities Preparation	30 Days	Following EIP Approval
Field Activities Implementation	65 Days	Following Field Preparation
Lab Analysis	30 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Private water sources will only be sampled and measured when access is granted. The Investigation Consultant will record the address and information provided by the owner when access is not granted.

- This scope of work does not include the repair of wells or pumps. Wells or pumps in a condition that will not allow sampling will be noted in the field logbook.

9.0 REFERENCES

Environmental Protection Agency (EPA) Region 4. 2001. "Environmental Investigations Standard Operating Procedures and Quality Assurance Manual." November.

Tennessee Valley Authority (TVA). 2016. "Potable Water Sampling." Technical Instruction ENV-GAF-PW.01, Revision 0. August 29.

Tennessee Valley Authority (TVA). 2017a. "Planning Sampling Events." Technical Instruction ENV-TI-05.80.01, Revision 0001 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. "Field Measurement Using a Multi-Parameter Sonde." Technical Instruction ENV-TI-05.80.46, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017h. "Groundwater Sampling" Technical Instruction ENV-TI-05.80.42, Revision 0001, effective date 3/31/2017.

ATTACHMENT A
½ MILE RADIUS MAP

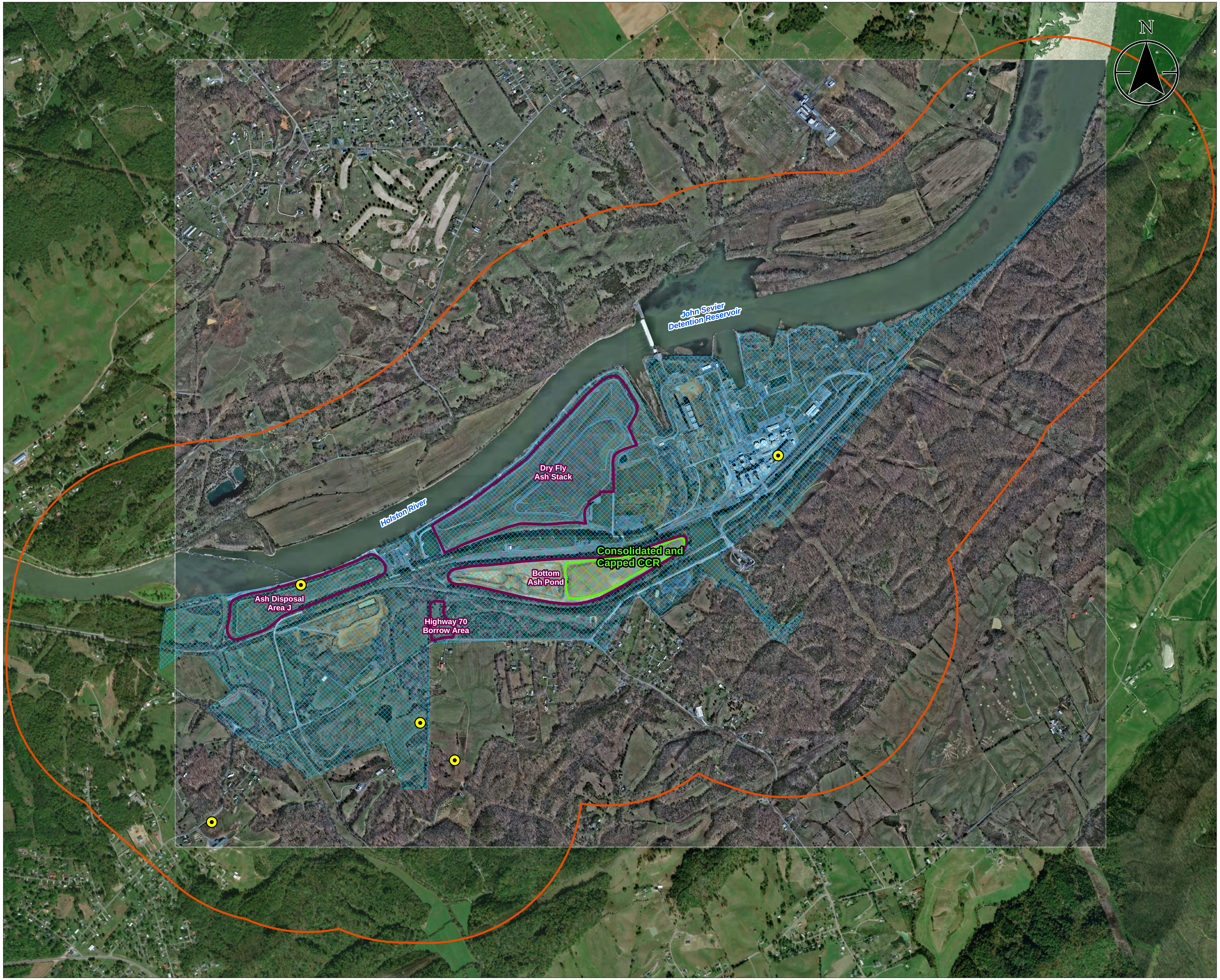

Figure No.
1

DRAFT

Title
John Sevier Fossil Plant
Water Supply Wells

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-07-06
Technical Review by RAA on 2018-07-06

0 800 1,600 2,400 3,200 Feet
1:9,600 (At original document size of 22x34)

Legend

- Water Supply Wells to be Verified
- JSF Parcel 1/2 Mile Buffer
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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ATTACHMENT B
PRIVATE WATER WELL LIST TEMPLATE

Table 1
Water Supply Survey List
Template

JSFID No.	JSFPV-001	JSFPV-002	JSFPV-003
Owners Name			
Property Address			
Alt. Property Address			
Mailng Address			
Stewart County Tax Assessor's Map No.			
Dwelling/Building Present? Y/N			
Data Source			
Municiple Water at This Location? Y/N			
Door-to- Door Survey? Y/N			
Comments			

ATTACHMENT C
GENERIC ACCESS AGREEMENT LETTER

Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

Date: ____________________

Address:

____
____
____

SUBJECT: Access for Water Supply Survey

Dear Well Owner,

The Tennessee Valley Authority (TVA) is working with the Tennessee Department of Environment and Conservation (TDEC) to evaluate environmental conditions in and around the John Sevier Fossil Plant. One of these activities is to conduct sampling of private well water. TVA would like to sample your well, and to do so, we need your written permission.

The purpose of this letter is to ask your permission, as the property owner, to allow TVA, its contractor, and their respective subcontractors and agents to conduct a water supply survey at your property located at [insert address]. A signed access agreement will allow TVA and its contractor to survey your well. An access agreement is provided at the end of this letter. If you are renting or leasing the property and/or are not the legal property owner, please let TVA know and we will work to contact the owner for this permission.

TVA would coordinate the timing of this work with you to minimize any inconvenience. The work would be conducted on weekdays, during normal business hours, and you would need to be present. However, we will work with you to schedule the work for a day when you are available. We hope to complete this work during June or July 2017 or as soon as we can schedule it with you; additional sampling may be requested for later dates, and this access agreement is also meant to cover future sampling.

The field staff will ask you about the location of the water supply entering your home and if your home has a water treatment system. Should water sampling be necessary they will try to collect a sample between the water well and the water treatment system, if you have one. Otherwise they will try to sample closest to the water entry point. In many cases, this will be a tap on the exterior of your home. The sampling activity involves filling sample bottles with tap water and will take approximately 30 minutes.

All TVA and contractor field staff would be identifiable by bright yellow safety vests and/or identification badges. No work would be performed at your property without your permission. Our field staff may need to go into your home, and they will be instructed to provide you with an

ID and a phone number should you wish to confirm with TVA that they are authorized personnel. The field staff would be available to answer any questions you may have during the well sampling.

You can also contact the following person if you have any questions:

If you agree to allow TVA, its contractor, and their respective subcontractors and agents access to your property to survey and/or sample your well water as described above, we ask that you sign this letter where indicated below and return it to TVA. So that you may also keep a copy for your records, we have provided a duplicate of this letter.

Thank you for considering participation in this well sampling program. Yours

sincerely,

CC:

As the owner(s) of the property located at, ________________ I/we hereby agree to allow TVA its contractor, and their subcontractors and agents the access described above.

Owner(s) Signature: ____

Owner(s) Printed Name: ____

Date(s) Signed by Owner(s): ____

Contact Phone Number: ____
(To be used only to coordinate sampling activities)

Contact email: ____

ATTACHMENT D
EXAMPLE DOOR-TO-DOOR SURVEY

Survey Team No.	Property Identification No.
	JSF-SW-

GPS Coordinates: ____________________

Date: ___________________

Name:	
Property Address:	
Mailing Address:	
E-mail Address:	
Telephone Number:	
1	Is there a well or surface water supply on the property?
2	If any, how many wells or surface water supplies are on the property?
3	Is this a drinking water or irrigation water supply (circle one)?
4	When was the last time water from the water supply was used?
5	Does the water supply on the property have a pump and is it operational?
6	How deep is the well or wells?
7	Do you have a septic system on the property?
8	Do you have municipal water and/or sewer? (circle all that apply)
9	Have any odors from the water been detected?
10	Has any discoloration in the water or staining in the sinks, tubs, ect. been observed?
11	Where on the property is the water supply located?
12	Can we walk over and see the well or surface water supply?
13	Can we return and take a sample of your water supply?
14	Do you treat your well or surface water supply water? Do you use a treatment system such as reverse osmosis system, filtration, or water softening unit?
15	Was Access Agreement provided to the water supply owner?
16	Was Access Agreement signed by water supply owner and provided to survey team?

Key Observations for Surveyor to Note: -Mark the well(s)/surface water supply and/or septic system location on the property map, or draw a diagram of these locations relative to the dwelling and other buildings.
-Describe the location(s) where the water supply can be accessed for sampling. Make sure you note if there is a sampling location located up flow of (before) any water treatment unit (if present).
-Is there a spigot at the wellhead that can be used for sampling?
-Provide a business card with TVA contact information for follow-up questions from the property owner.

Survey Complete (Circle One)	Y	N

General Notes or Drawing:

ATTACHMENT E
FIELD EQUIPMENT LIST

Field Equipment List
Water Use Survey

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
Field Equipment[1]
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Flow measurement supplies (for example: graduated cylinder and stop watch)
Multiparameter Sonde with flow-through cell
Turbidity 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 Q
BENTHIC SAP

Benthic
Sampling and Analysis Plan
John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Public Comments, Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

Benthic
Sampling and Analysis Plan
John Sevier Fossil Plant

TITLE AND REVIEW PAGE

Title of Plan: Benthic
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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	10/18/18 Date
TVA Investigation Field Lead	10/19/18 Date
Health, Safety, and Environmental (HSE) Manager	10/17/18 Date
Investigation Project Manager	10-08-18 Date
Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.10.17 10:02:25 -04'00' QA Oversight Manager	Date
Tod Noltemeyer Laboratory Project Manager	10/16/2018 10/16/18 Date
Charles L. Head TDEC Senior Advisor	2018/10/31 Date
Robert Wilkinson TDEC CCR Technical Manager	10/31/18 Date

Stantec

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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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 JSF 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

Nine sediment sample transects in the Holston River and two sediment sample transects in the Polly Branch 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. Seven sediment sample points (versus transects) in the Polly Branch are also planned for the Phase 1 investigation due to the narrowness of the channel at the proposed locations. The sediment sample points will become transects if the Polly Branch is sufficiently wide based on conditions encountered in the field.

The Phase 1 investigation will include areas subject to potential past releases from the facility into surface streams on or adjacent to the Plant, areas bordering surface streams on or adjacent to the Plant where mitigated or potentially active seeps are located, and areas downstream from the Plant. Due to concerns regarding the history of sediment contamination related to off-site industrial sources upstream of the Plant, sediment sample transects on the Holston River upstream from the detention dam are not being proposed during Phase 1. See Table 1 below for a summary of transect and sample point locations and Figure 1 for proposed sediment sampling locations.

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.

Table 1. Proposed Sediment Sample Locations

Transect ID	Description
SED-HR01	Holston River Adjacent to the Detention Dam
SED-HR02	Holston River Adjacent to Dry Fly Ash Stack
SED-HR03	Holston River Adjacent to Dry Fly Ash Stack at Location of 1973 Dike Failure
SED-HR04	Holston River Adjacent to Dry Fly Ash Stack
SED-HR05	Holston River Downstream of Polly Branch Discharge
SED-HR06	Holston River Adjacent to Ash Disposal Area J
SED-HR07	Holston River Downstream from Plant
SED-HR08	Holston River Downstream from Plant
SED-HR09	Holston River Downstream from Plant
SED-PB01*	Polly Branch Upstream of Plant (background)
SED-PB02*	Polly Branch Upstream of Plant (background)
SED-PB03	Polly Branch Upstream of Plant (background)
SED-PB04	Polly Branch Upstream of Plant (background)
SED-PB05*	Polly Branch Adjacent to Bottom Ash Pond
SED-PB06*	Polly Branch Adjacent to Bottom Ash Pond
SED-PB07*	Polly Branch Adjacent to Bottom Ash Pond
SED-PB08*	Polly Branch at Former Bottom Ash Pond Spillway
SED-PB09*	Polly Branch at Former Bottom Ash Pond Spillway Discharge

*Sediment sample point (versus transect)

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 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-HR01*	Holston River Upstream of Plant
MAC-HR02*	Holston River Upstream of Plant
MAC-HR03	Holston River Downstream from Plant Outfall No. 002
MAC-HR04	Holston River Adjacent to Dry Fly Ash Stack at Location of 1973 Dike Failure
MAC-HR05*	Holston River Adjacent to Dry Fly Ash Stack
MAC-HR06	Holston River Downstream of Polly Branch Discharge
MAC-HR07	Holston River Adjacent to Ash Disposal Area J
MAC-HR08	Holston River Downstream from Plant
MAC-HR09*	Holston River Downstream from Plant
MAC-HR010	Holston River Downstream from Plant
MAC-HR11*	Holston River Downstream from Plant

* Coincides with historical benthic macroinvertebrate sample transect 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

Transect ID	Description
HRU	Holston River Upstream of Plant
HRA1	Holston River Adjacent to Plant
HRA2	Holston River Adjacent to Plant
HRD	Holston River Downstream from Plant

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. JSF Environmental Corresponding Sample Locations Matrix

Surface Stream Sample Location	Sediment Sample Location	Benthic Sampling Location	Mayfly Sampling Location	Fish Tissue Sampling Location
NA	NA	MAC-HR01	HRU	HRU
NA	NA	MAC-HR02	NA	NA
STR-HR01	SED-HR01	NA	NA	NA
STR-HR02	SED-HR02	MAC-HR03		
STR-HR03	SED-HR03	MAC-HR04		
STR-HR04	SED-TR04	MAC-HR05	HRA1	HRA1
STR-HR05	SED-HR05	MAC-HR06		
STR-HR06	SED-HR06	MAC-HR07		
STR-HR07	SED-HR07	MAC-HR08	NA	NA
STR-HR08	SED-HR08	MAC-HR09	HRA2	HRA2
STR-HR09	SED-HR09	MAC-HR10		
STR-PB01	SED-PB01	NA	NA	NA
STR-PB02	SED-PB02	NA	NA	NA
STR-PB03	SED-PB03	NA	NA	NA
STR-PB04	SED-PB04	NA	NA	NA
STR-PB05	SED-PB05	NA	NA	NA
STR-PB06	SED-PB06	NA	NA	NA
STR-PB07	SED-PB07	NA	NA	NA
STR-PB08	SED-PB08	NA	NA	NA
STR-PB09	SED-PB09	NA	NA	NA
NA	NA	NA	HRD	HRD

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*. Collection of sediment samples will be conducted according to TVA TI ENV-TI-08.80.50, *Soil and Sediment Sampling*.

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™ 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*
- TI-05.80.50 *Soil and Sediment Sampling*

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. This sampling sequence will prevent sediment disturbance from affecting the surface stream sample.

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 that sediment sample collection using the 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	8 oz. glass jar	180 days
Radium 228	SW-846 901.1	Cool to < 6° C	8 oz. glass jar	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/7473	Cool to < 6° C	4 oz. glass jar	24 hours**
Depurated Mayfly Nymphs	SW-846 6020A/7473	Surface water, cool to < 6° C	32 oz. glass jar	24 hours**
Adult Mayflies	SW-846 6020A/7473	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 sample preparation required.

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

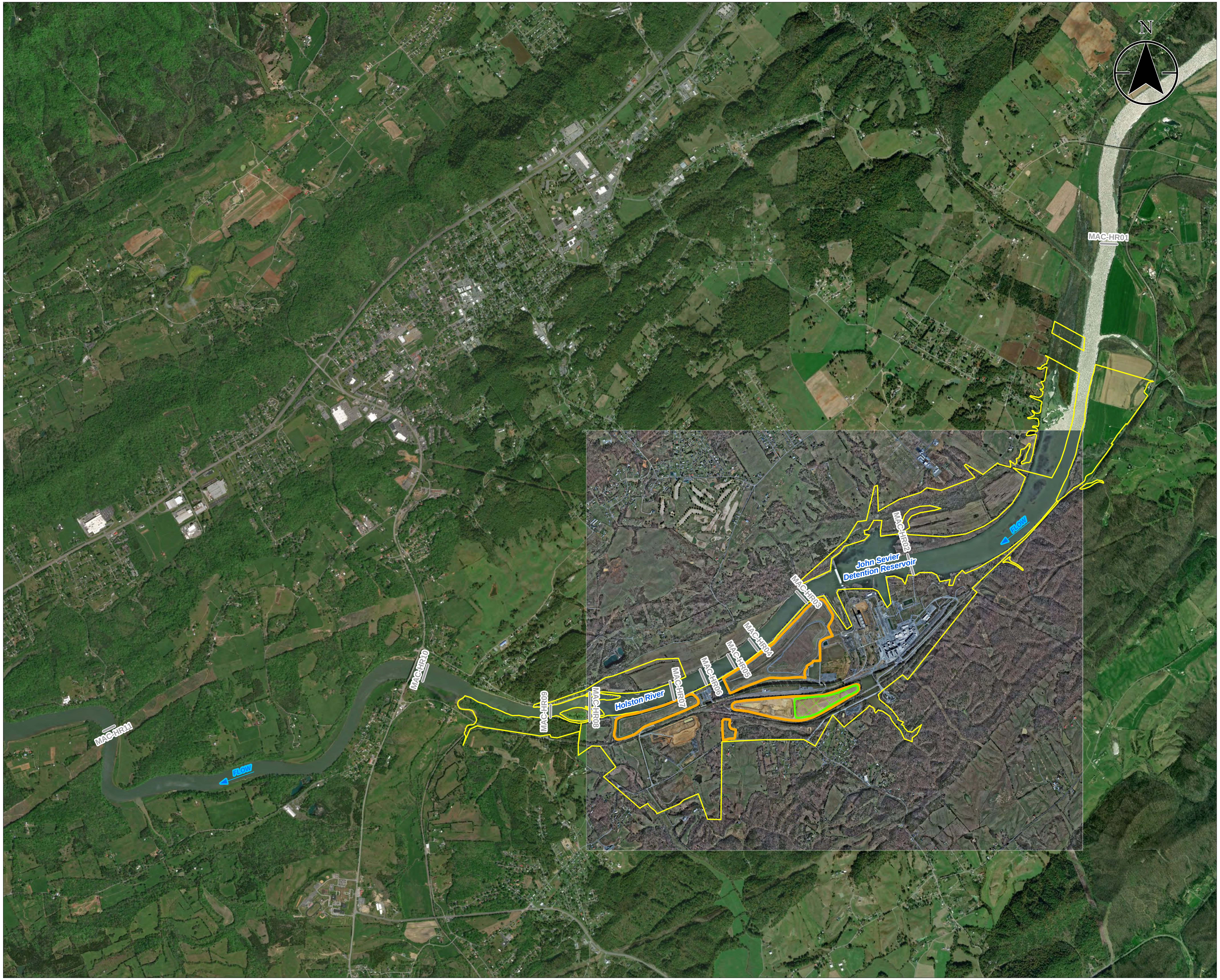

Figure No.
1

Title

Benthic Macroinvertebrates Sampling

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location

Rogersville, Tennessee

175566338
Prepared by LMB on 2018-07-25
Technical Review by RAA on 2018-07-25

0 1,500 3,000 4,500 6,000 Feet

1:18,000 (At original document size of 22x34)

Legend

- Benthic Transect
- Consolidated & Capped CCR Area (Approximate)
- CCR Unit Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08) and ESRI Basemaps (NAIP 2016)

Stantec

TVA

U:\TVA-EP\175566338\gis\mxds\JSF_Benthic_Transects.mxd Revised: 2018-07-25 By: lblackman

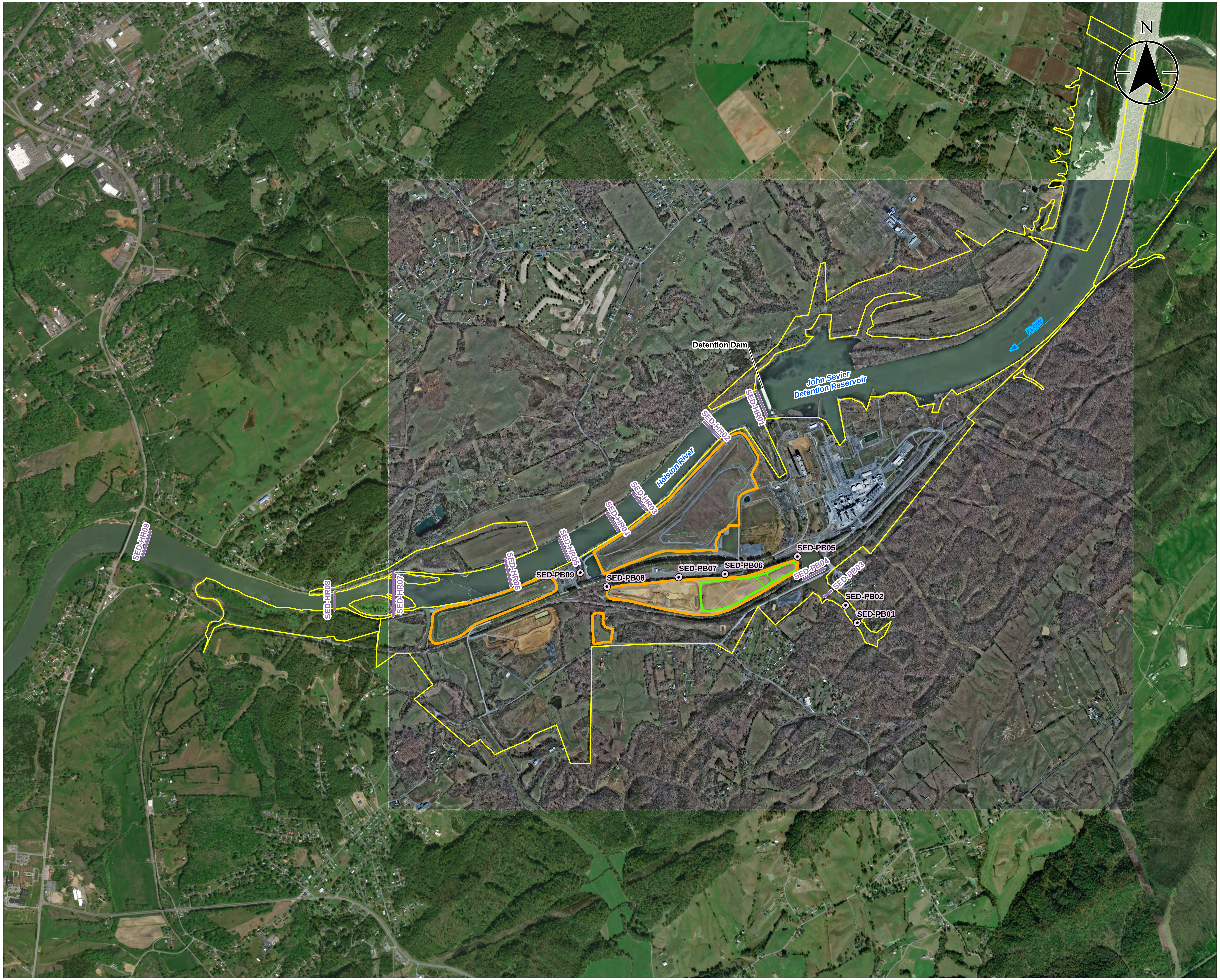

Figure No.
1

Title

Sediment Sampling

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by LMB on 2018-07-25
Technical Review by RAA on 2018-07-25

0 1,000 2,000 3,000 4,000 Feet

1:12,000 (At original document size of 22x34)

Legend

- Sediment Sampling Point
- Sediment Sampling Location
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08) and ESRI Basemaps (NAIP 2016)

Stantec

TVA

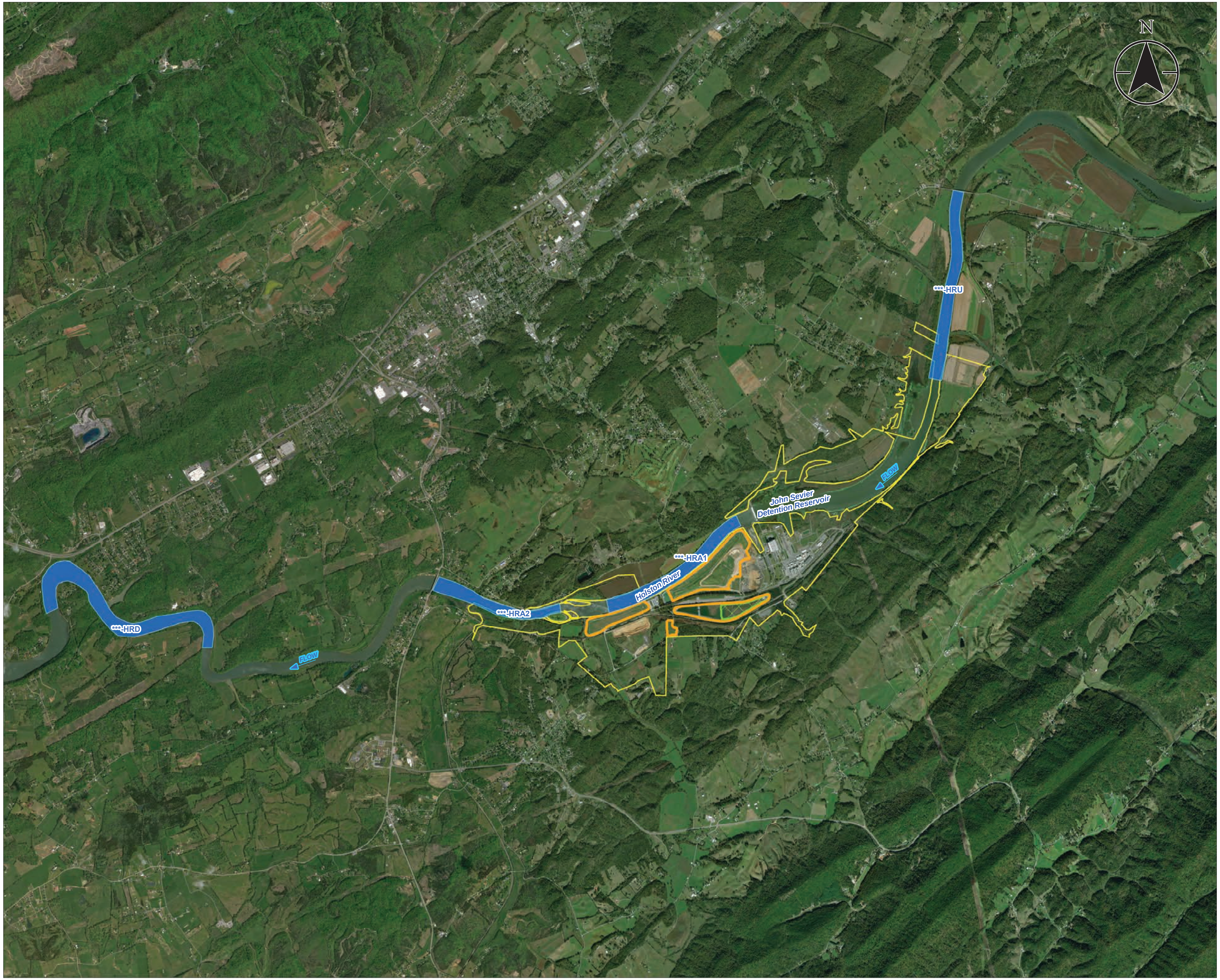

Figure No.
3

Title
Mayfly Sampling
Adult Mayflies, Purated Mayfly Nymphs, & Non-Purated Mayfly Nymphs

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-05-16
Technical Review by RAA on 2018-05-16

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)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

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 Basemaps (NAIP 2016)

Stantec TVA

U:\TVA-EP\175566338\gis\mxds\JSF_Mayfly_Sampling.mxd Revised: 2018-05-16 By: tmk

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
Boat
Boat Motor
Paddles
Anchor
Marine Engine Oil
Boat Gas Tank
PFDs
Marine VHF Radio
Wildco™ Ponar Dredge
Prepared board containing a graduated six-foot scale
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
10% buffered formalin solution
Integrated Spout Wash Bottle
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
SURFACE STREAM SAP

Surface Stream Sampling and Analysis Plan John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

SURFACE STREAM
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Public Comments, Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

Stantec

SURFACE STREAM
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Surface Stream
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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.

[signature]	10/18/18
TVA Investigation Project Manager	Date
[signature]	10-19-18
TVA Investigation Field Lead	Date
[signature]	10/17/18
Health, Safety, and Environmental (HSE) Manager	Date
Kip Anderson	10-08-18
Investigation Project Manager	Date
Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=[illegible], c=US Date: 2018.10.17 10:02:42 -04'00'	
QA Oversight Manager	Date
[signature]	10/16/18
Laboratory Project Manager	Date
Charles L Head	2018/10/31
Charles L. Head TDEC Senior Advisor	Date
[signature]	10/31/18
Robert Wilkinson TDEC CCR Technical Manager	Date

Stantec

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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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 JSF 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.

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 Holston River and Polly Branch illustrated on Figure 1 (Attachment A) were selected to evaluate whether ash processing at the plant has had or is having adverse effects on water quality.

Eighteen 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. Nine sampling locations are proposed in the Holston River to capture water quality in areas subject to potential past releases from the facility into the Holston River, areas bordering the Holston River where mitigated or potentially active seeps are located, and downstream of the CCR Units. Note that the TVA NEPA process identified a cultural concern in the vicinity of STR-HR06. Due to the presence of a historical Native American fish ladder, sampling will be performed upstream of the structure to reduce risk of disturbance of the resource. Nine sampling locations are proposed along Polly Branch, four of which will serve as background samples upstream of the CCR Units on Polly Branch to provide a baseline of CCR Parameters concentrations. The number and/or location of the proposed surface stream samples may be modified based on conditions encountered in the field. 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 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 contamination. 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-HR01	Holston River Just Downstream of the John Sevier Detention Dam (sampling team to exercise extreme caution when working near the dam)
STR-HR02	Holston River Adjacent to Dry Fly Ash Stack Upstream of 1973 Dike Failure
STR-HR03	Holston River Adjacent to Dry Fly Ash Stack Upstream of 1973 Dike Failure
STR-HR04	Holston River Adjacent to Dry Fly Ash Stack at Location of 1973 Dike Failure
STR-HR05	Holston River Adjacent to Ash Disposal Area J Downstream from Location of 1973 Dike Failure
STR-HR06	Holston River Adjacent to Ash Disposal Area J Downstream from Location of 1973 Dike Failure, Upstream of historical Native American fish ladder
STR-HR07	Holston River Downstream from JSF
STR-HR08	Holston River Downstream from JSF
STR-HR09	Holston River Downstream from JSF
STR-PB01	Polly Branch Upstream of JSF (Background)
STR-PB02	Polly Branch Upstream of JSF (Background)
STR-PB03	Polly Branch Upstream of JSF (Background)
STR-PB04	Polly Branch at Old McCloud Rd. just upstream of JSF (Background)
STR-PB05	Polly Branch at the Upstream end of Bottom Ash Pond
STR-PB06	Polly Branch adjacent to the Bottom Ash Pond
STR-PB07	Polly Branch adjacent to the Bottom Ash Pond
STR-PB08	Polly Branch at the Downstream end of Bottom Ash Pond
STR-PB09	Polly Branch just upstream of confluence with the Holston River

Several of the surface stream sample locations coincide with sample locations of other environmental SAPs. Table 2 summarizes the corresponding samples for the surface stream, benthic, and fish tissue SAPs.

Table 2. JSF Environmental Corresponding Sample Locations Matrix

<table>
<tr><th>Surface Stream Sample Location</th><th>Corresponding Sediment Sample Location</th><th>Corresponding Benthic Sampling Location</th><th>Corresponding Mayfly Sampling Location</th><th>Corresponding Fish Tissue Sampling Location</th></tr>
<tr><td>NA</td><td>NA</td><td>MAC-HR01</td><td>HRU</td><td>HRU</td></tr>
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<tr><td>STR-HR09</td><td>SED-HR09</td><td>MAC-HR10</td></tr>
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<tr><td>NA</td><td>NA</td><td>NA</td><td>HRD</td><td>HRD</td></tr>
</table>

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 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 is observed, the depth interval will be adjusted to better define the thermocline. 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 (mg/L)

- Specific Conductivity (µS/cm)
- Oxidation Reduction Potential (mV)
- pH (Standard Units)
- Turbidity (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 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 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. 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-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, and one during winter pool). Flow during sampling events will be in greater than the 25th percentile and less than the 75th percentile based on analysis of the mean daily flows of the nearest United States Geological Survey (USGS) gage.

- Surface stream samples are to be collected from downstream to upstream locations to prevent the disturbance of bottom sediments from impacting further downstream sample locations.

- 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 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 m above the bottom.

    5. Allow the Hydrolab® approximately 30 seconds to equilibrate at each depth increment, or until otherwise observed stable with Hydroplus GPS software. Observe the parameter readings for 5-7 seconds to ensure stable readings before recording values. If readings are unstable, allow them to stabilize before recording the value.

    6. Record the temperature measured from each depth location.

    7. Evaluate the recorded data for evidence of stratification (specifically temperature).

       <u>A temperature change of greater than 1° C per meter indicates that there is a thermocline and that the location is stratified.</u> 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.

8. 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.

- Where applicable, surface water samples will be collected prior to collection of sediment samples. 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. Surface stream samples will be collected away from and upstream of the boat and motor to reduce potential for contamination.

  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 the three transect stations (thalweg, left bank, and right bank) at various depths: epibenthic (near bottom) sample within 0.5 m of the streambed, mid-hypolimnion sample midway between the bottom of thermocline and the streambed, mid-epilimnion sample midway between top of the thermocline and water surface, and near-surface sample collected at 0.5 m 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, three samples will be collected at each of the three transect stations at various depths: near-surface, mid-depth, and epibenthic. 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, 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. 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. 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

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 will be calculated based on 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).

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	SM2540C	Cool to <6°C	250-mL HDPE	7 days
Total Suspended Solids	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 to 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 and 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*	50 Days	Following EIP Approval
Conduct Field Activities*	16 Days	Following Field Preparation
Laboratory Analysis	50 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

* Two Sampling Events (winter and summer)

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.

United States Geological Survey (USGS). 2006. “Techniques of Water-Resources Investigations Book 9, National Field Manual for the Collection of Water Quality Data, Chapter A4. Collection of Water Samples.”

ATTACHMENT A
FIGURE

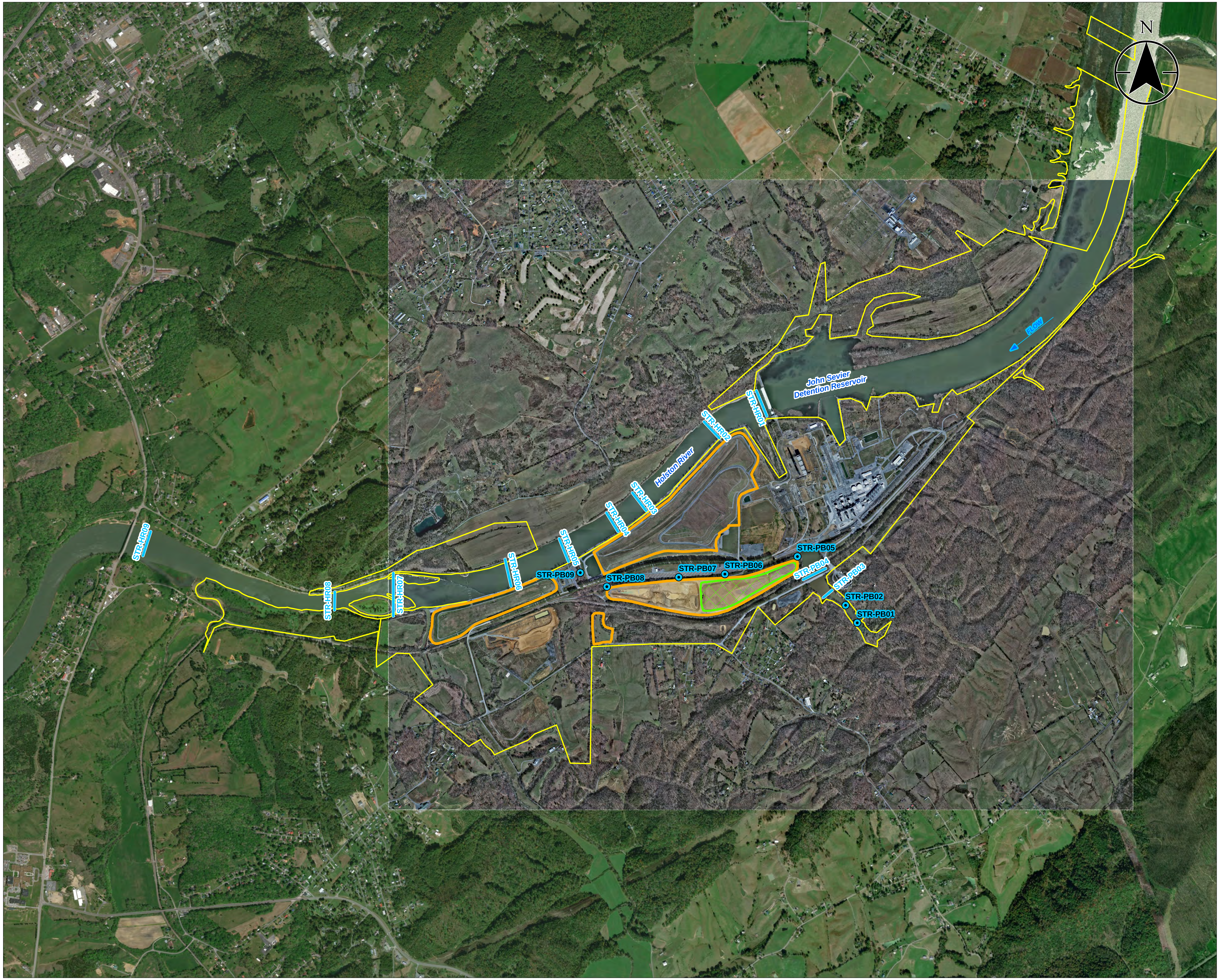

Figure No.
1

DRAFT

Title

Stream Sampling

Client/Project

Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-07-25
Technical Review by RAA on 2018-07-25

0 1,000 2,000 3,000 4,000 Feet

1:12,000 (At original document size of 22x34)

Legend

- Stream Sampling Point
- Stream Sampling Transect
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08) and ESRI Basemaps (NAIP 2016)

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ATTACHMENT B
FIELD EQUIPMENT 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 S
SEEPAGE HISTORY SUMMARY

Seepage History Summary

TVA has conducted annual dike inspections at JSF since 1967. These inspections focused on stability issues pertaining to seeps. NPDES Permit No. TN0005436 was issued by TDEC to the TVA John Sevier Plant. Under the NPDES permit, TVA visually inspects the dikes and toe areas at least quarterly for seepage and submits an annual report to the TDEC Johnson City Environmental Field Office documenting the findings of the inspections and remedial activities implemented.

Remedial activities include the construction of a seepage interception and collection system at the Dry Fly Ash Stack in 2001 - 2002 shown in TVA Drawing Series 17W445. The purpose of the system was to intercept and collect seepage and generally lower the phreatic surface in the vicinity of the Bathtub area. In 2011, TVA installed an additional seepage collection system (shown in TVA Drawing Series 10W511) at the Dry Fly Ash Stack to supplement and improve the system installed in 2001-2002.

TVA maintains a Seepage Action Plan (Stantec 2010) which identifies areas of concern (AOC) by a unique number and documents the date of discovery, description, size, mitigation status, and current status. A map depicting historic seepage areas is shown on Figure 1. A summary of the seep history for JSF is provided in Table 1.

Table 1. Seepage History Summary

Map ID	Seepage Action Plan AOC No.	CCR Unit	Description
A	1	Dry Fly Ash Stack	This AOC was reported in TVA (1995). TVA continued to monitor this area as documented in subsequent annual inspection reports. TVA constructed a seepage interception and collection system shown in TVA Drawing Series 17W445 to intercept and collect seepage from this area (TVA 1999). This system pumped effluent to the Coal Yard Drainage Basin and eventually the Bottom Ash Pond. Subsequent annual inspection reports noted the system appeared to be functioning correctly and wet areas noted in previous inspection reports were not observed. TVA later expanded this system (TVA 2002). This AOC is classified as Action Level 1 (Non-Flowing) and inactive.
NA	NA	Dry Fly Ash Stack	Wet areas were noted along Polly Branch south of the discharge pipes formerly identified as Outfall 003 in TVA (1996). The inspection report noted "there is no flow from these areas to Polly Branch." A second area located "approximately 300 feet east of Polly Branch along the gravel walkway" was also reported in TVA (1996). These areas were not reported in subsequent inspection reports.
B	NA	Dry Fly Ash Stack	This seep was located around an abandoned concrete pipe as reported in TVA (2000). TVA continued to monitor this area as documented in subsequent annual inspection reports. The inspection reports did not indicate whether the seep was flowing. TVA constructed a toe drain system (shown in TVA Drawing Series 10W511) in this area in 2011. The toe drain system collected seepage and pumped it to the Coal Yard Runoff Pond.

Table 1. Seepage History Summary

Map ID	Seepage Action Plan AOC No.	CCR Unit	Description
C	NA	Dry Fly Ash Stack	These two seeps were reported in TVA (2000). TVA continued to monitor this area as documented in subsequent annual inspection reports. The inspection reports did not indicate if the seeps were flowing. TVA constructed a toe drain system (shown in TVA Drawing Series 10W511) in this area in 2011. The toe drain system collected seepage and pumped it to the Coal Yard Runoff Pond.
P	NA	Dry Fly Ash Stack	Seep reported in TVA (2002) along the length of the Stilling Pond. TVA completed a slope stabilization project in this area that involved grading the perimeter dike slopes and stabilizing the toe with riprap per recommendations documented in Parsons (1999). Plans and details of the project are shown in TVA Drawing Series 10W206.
D	2	Dry Fly Ash Stack	Seep observed by TVA in 2006. TVA constructed a toe drain system (shown in TVA Drawing Series 10W511) in 2011 to address this seep. The toe drain system collected seepage and pumped it to the Coal Yard Runoff Pond. This AOC is classified as Action Level 1 (Non-Flowing) and has been remediated by the toe drain system.
E	3	Dry Fly Ash Stack	Seep observed by TVA in 2009. TVA constructed a toe drain system (shown in TVA Drawing Series 10W511) in 2011 to address this seep. The toe drain system collected seepage and pumped it to the Coal Yard Runoff Pond. This AOC is classified as Action Level 1 (Non-Flowing) and has been remediated by the toe drain system.
F	4	Dry Fly Ash Stack	Seep observed by TVA in 2008. This AOC is classified as Action Level 1 (Non-Flowing) and inactive.
G	5	Dry Fly Ash Stack	Potential seep observed by TVA in 2002. Non-flowing seep/stain reported west of Stilling Pond in 2004-2006 during February inspections only. This AOC is classified as Action Level 1 (Non-

Table 1. Seepage History Summary

Map ID	Seepage Action Plan AOC No.	CCR Unit	Description
			Flowing) and inactive. Inspections conducted in 2007-2008 did not observe potential seep/staining.
H	6	Dry Fly Ash Stack	Seep observed by TVA in 2002. This AOC is classified as Action Level 1 (Non-Flowing) and inactive.
I	NA	Dry Fly Ash Stack	Potential seep observed during 2013 Annual Inspection. Not reported in subsequent annual inspection reports.
J	NA	Dry Fly Ash Stack	Repaired wet area discussed in TVA (2014).
K		Bottom Ash Pond	Two seeps in this area were reported in TVA (1996) TVA continued to monitor this area as documented in subsequent annual inspections. TVA (2004) noted the seepage water at this location was "analyzed and the results indicate that it does not originate from within the ash pond." Subsequent inspection reports noted seepage was not observed in this area during the inspections.
L	7	Bottom Ash Pond	Potential seep observed by TVA in 2009. This AOC is classified as Action Level 1 (Non-Flowing) and inactive.
M	8	Bottom Ash Pond	Seep observed by Stantec/TVA in July 2009 during maintenance and tree removal activities. This AOC is classified as Action Level 1 (Non-Flowing) and inactive.
N	9	Bottom Ash Pond	Potential seep observed by TVA prior to 2008. This AOC is classified as Action Level 1 (Non-Flowing) and inactive.
O	NA	Bottom Ash Pond	Repaired area discussed in TVA (2014).
Q	NA	Bottom Ash Pond	Small, non-flowing seeps/stains observed on divider dike periodically from 2003-2005. Inspections conducted from 2006-2008 did not observe seep/stain.

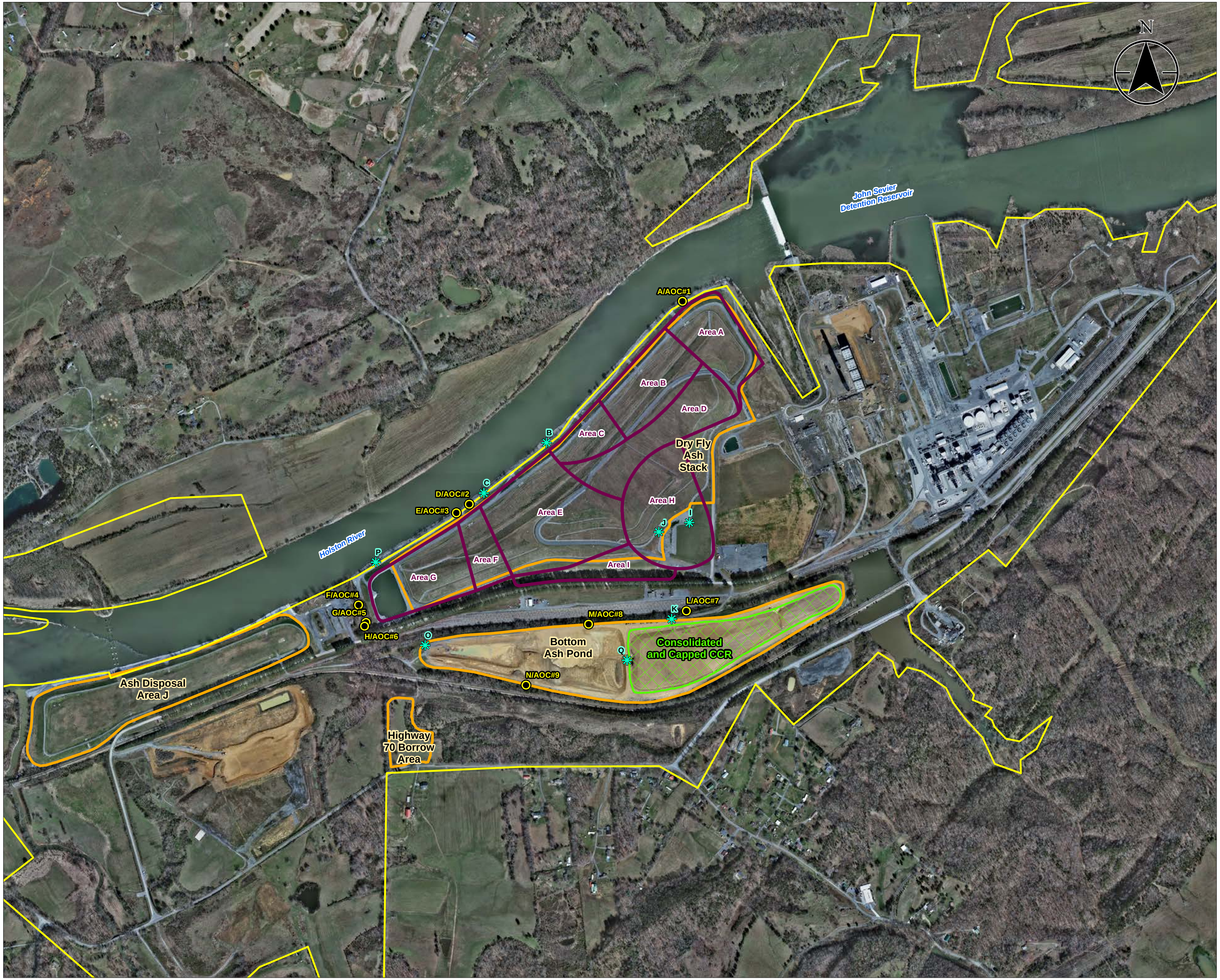

Figure No.
1

Title
John Sevier Fossil Plant
Historic Seep Locations

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2017-12-14
Technical Review by RAA on 2017-12-14

0 450 900 1,350 1,800
Feet
1:5,400 (At original document size of 22x34)

Legend

- Area of Concern (AOC) (Map ID/AOC #)
- Other Historic Area of Concern (Map ID)
- TVA Property Boundary
- Limit of Historical Ash Disposal Ponds (Approximate)
- CCR Unit Area (Approximate)
- Consolidated & Capped CCR Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (2017-03-08)

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APPENDIX T
FISH TISSUE SAP

Fish Tissue
Sampling and Analysis Plan
John Sevier Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
John Sevier Fossil Plant
Rogersville, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 19, 2018

FISH TISSUE
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 15, 2017
2	Addresses March 27, 2018 TDEC Review Comments and Issued for TDEC Review	May 25, 2018
3	Addresses Public Comments, Applicable Programmatic Revisions and Issued for TDEC Approval	October 19, 2018

FISH TISSUE
SAMPLING AND ANALYSIS PLAN
JOHN SEVIER FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Fish Tissue
Sampling and Analysis Plan
John Sevier Fossil Plant
Tennessee Valley Authority
Rogersville, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: October 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	10/18/18 Date
Tyler Baker TVA Investigation Field Lead	10/19/18 Date
Health, Safety, and Environmental (HSE) Manager	10/17/18 Date
Kip Anderson Investigation Project Manager	10-08-18 Date
Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.10.17 10:02:59 -04'00' 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: 2018.10.16 15:26:34 -05'00' Laboratory Project Manager	10/16/2018 Date
Charles L. Head Charles L. Head TDEC Senior Advisor	2018/10/31 Date
Robert Wilkinson TDEC CCR Technical Manager	10/31/18 Date

Stantec

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 the John Sevier Fossil Plant (JSF) on June 8 and 9, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management plans at JSF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On August 3, 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 November 3, 2016, TVA submitted JSF 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 JSF have higher concentrations of CCR-related constituents than fish from reference locations not adjacent to or downstream from the JSF 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

Four sites have been selected for the collection of fish and associated fish tissues as shown in Figure 1 (Attachment A) and Table 1. These sites are strategically located based on access, current hydrogeologic knowledge, historical TVA sampling locations, and the greatest expectation of successfully capturing target fish species. Note that the TVA NEPA process identified a cultural concern between HRA-1 and HRA-2. Due to the presence of a historical Native American fish ladder, sampling will be performed upstream and downstream of the structure to reduce risk of disturbance of the resource. The sites are located in the Holston River. HRA1 and HRA2 are located adjacent to JSF and are associated with the CCR units. HRA1 is located downstream of the detention dam and extends approximately 1.2 miles. HRA2 is located downstream of Ash Disposal Area J and extends approximately one mile. The downstream most sample site on the Holston River, HRD, is approximately 1.5 miles and is approximately 2 miles downstream from the HRA2 sampling reach. The upstream site, HRU, extends for approximately 1.5 miles and is approximately 2 miles upstream from the HRA1 sampling reach; 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 JSF, Rogersville, Hawkins County, Tennessee.

Sampling Reach Name	Drainage	Approximate River/Creek Mile	Latitude	Longitude
HRU	Holston River	109.9 – 108.4	36.418228	82.934444
			36.396214	82.938889
HRA1	Holston River	106.4 – 105.2	36.380169	82.968056
			36.370736	82.987500
HRA2	Holston River	104.8 – 103.8	36.370397	82.994444
			36.373842	83.012500
HRD	Holston River	101.8 – 100.3	36.367158	83.046389
			36.375994	83.064722

Table 2. Corresponding Sample Locations at JSF, Rogersville, Hawkins County, Tennessee.

<table>
<tr><th>Surface Stream Sample Location</th><th>Corresponding Sediment Sample Location</th><th>Corresponding Benthic Sampling Location</th><th>Corresponding Mayfly Sampling Location</th><th>Corresponding Fish Tissue Sampling Location</th></tr>
<tr><td>NA</td><td>NA</td><td>MAC-HR01</td><td>HRU</td><td>HRU</td></tr>
<tr><td>NA</td><td>NA</td><td>MAC-HR02</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-HR01</td><td>SED-HR01</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-HR02</td><td>SED-HR02</td><td>MAC-HR03</td><td rowspan="5">HRA1</td><td rowspan="5">HRA1</td></tr>
<tr><td>STR-HR03</td><td>SED-HR03</td><td>MAC-HR04</td></tr>
<tr><td>STR-HR04</td><td>SED-TR04</td><td>MAC-HR05</td></tr>
<tr><td>STR-HR05</td><td>SED-HR05</td><td>MAC-HR06</td></tr>
<tr><td>STR-HR06</td><td>SED-HR06</td><td>MAC-HR07</td></tr>
<tr><td>STR-HR07</td><td>SED-HR07</td><td>MAC-HR08</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-HR08</td><td>SED-HR08</td><td>MAC-HR09</td><td rowspan="2">HRA2</td><td rowspan="2">HRA2</td></tr>
<tr><td>STR-HR09</td><td>SED-HR09</td><td>MAC-HR10</td></tr>
<tr><td>STR-PB01</td><td>SED-PB01</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-PB02</td><td>SED-PB02</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-PB03</td><td>SED-PB03</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-PB04</td><td>SED-PB04</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-PB05</td><td>SED-PB05</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-PB06</td><td>SED-PB06</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-PB07</td><td>SED-PB07</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-PB08</td><td>SED-PB08</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>STR-PB09</td><td>SED-PB09</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>NA</td><td>NA</td><td>NA</td><td>HRD</td><td>HRD</td></tr>
</table>

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 frozen 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.

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

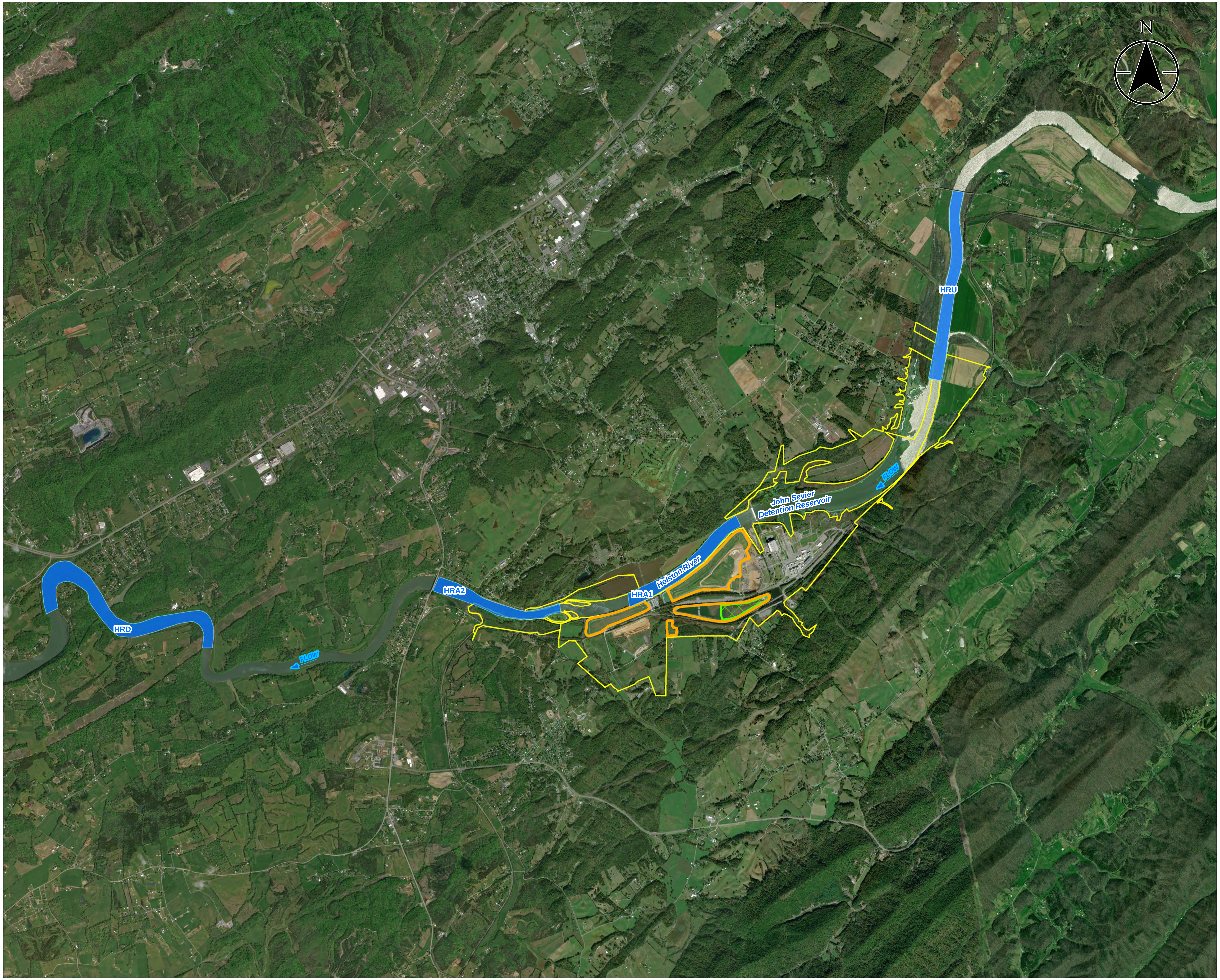

Figure No.
1

Title
Fish Sampling

Client/Project
Tennessee Valley Authority
John Sevier Fossil Plant

Project Location
Rogersville, Tennessee

175566338
Prepared by TKR on 2018-07-25
Technical Review by RAA on 2018-07-25

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)
- Consolidated & Capped CCR Area (Approximate)
- TVA Property Boundary (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by ESRI Basemaps (NAIP 2016)

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 U
PUBLIC COMMENTS

Table 1
TVA John Sevier EIP Rev 3
Summary of Public Comments & TVA Responses
October 5, 2018

Comment Number	Section Number	Section Title	Page	Paragraph	Line	Comment	Date	Source	TVA Response (09/28/2018)
1	General	All	NA	NA	NA	The primary recommendation we have is that you have a comprehensive technical peer review of your plan with nationally respected peers in your community.	8/17/18	Dave and Leona Toll Cherokee Lake Users Association 410-279-9799	This comment is noted. As part of the Tennessee Department of Environment and Conservation (TDEC) Order process, the Tennessee Valley Authority (TVA) will be conducting an Environmental Investigation (EI) as outlined in the Environmental Investigation Plan (EIP) and assessing potential risks that may result from the management and disposal of coal combustion residuals (CCR) at the John Sevier Fossil Plant (JSF). The results of the EI will be summarized in the Environmental Assessment Report (EAR) for review and approval by TDEC. The EIP was prepared by credentialed professionals (engineers and geologists) licensed in the State of Tennessee. TDEC staff are also Tennessee-licensed professionals that will review the EAR independently. Data collected during the EI will be verified and validated by a third-party consultant under contract to TVA.
2	General	All	NA	NA	NA	A second recommendation is for TVA to have its own water quality and reduced contaminant program.	8/17/18	Dave and Leona Toll	In addition to groundwater monitoring for State permitting, Federal CCR Rule requirements and groundwater investigations for the TDEC Order, TVA has conducted numerous studies at JSF and has plans underway for program commitments, normal site operations, inspections, and maintenance to monitor groundwater quality at the plant.
3	General	All	NA	NA	NA	Please think more at the watershed level, since non-point source pollution is so critical.	8/17/18	Dave and Leona Toll	TVA has developed the EIP to include investigation of the portion of the watershed that could be affected by the John Sevier Fossil Plant. This includes investigation of upgradient and downgradient groundwater. In addition, the EIP includes plans to investigate surface water, sediments, fish and benthic organisms upstream and downstream of the plant.
4	General	All	NA	NA	NA	I am extremely concerned about the maintenance and monitoring of the coal ash stored at the John Sevier facility. I live across the river from the site and we cannot have a well because of contamination from an old landfill on the north side of the river. Persia water system that serves this area has wells just south of the river that are most likely at risk of contamination from both the landfill and the coal ash site. This site should be monitored forever.	8/13/18	Emil Prisco	The EIP includes plans to investigate groundwater quality near the John Sevier Fossil plant. If CCR-impacted groundwater is detected, additional investigations to characterize the extent of the impact will be conducted. TVA has worked with TDEC over the years to develop a groundwater monitoring plan for State compliance and is also following the Federal CCR Groundwater Rule.
5	General	All	NA	NA	NA	See attached letter. 1. Water sampling method a. Use of filtered and unfiltered samples b. Decisions based on filtered or unfiltered samples c. Determinations of water quality conditions must be based on unfiltered results	9/7/18	Barry Sulkin for Tennessee Clean Water Network	The sampling method for groundwater is based on collecting unfiltered samples. In some cases, both unfiltered and filtered samples may be collected. The results of both unfiltered and filtered samples will be evaluated and summarized in the EAR.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	Comment	Date	Source	TVA Response (09/28/2018)
6	General	All	NA	NA	NA	2. Sample locations (continued) a. Unclear where samples for water, sediment and aquatic organisms are to be taken. b. Any sampling of the adjacent river must include locations right along the shoreline – where any leaks or impacts are most likely to be detected. All samples should be evaluated and presented individually, and not diluted by averaging with mid-channel, mid-depth, or other such samples.	9/7/18	Barry Sulkin for Tennessee Clean Water Network	2a. As described in the Surface Stream SAP, water samples will be collected from right bank, left bank, and the deepest part of the channel at each transect location. No averaging of samples is proposed. 2b. The sample transects are shown on site figures. Observed active seeps will be subjected to soil and water sampling, with analyses conducted for the CCR parameters As described in the Benthic Investigation SAP, sediment sampling consists of taking three vibracore borings along transects 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) to 6-ft depth or refusal. Grab samples will be collected from the top six inches of sediment at each sampling location. Grab samples shall be taken of the remainder of each sediment core, segregated by strata types - native soils will not be collected. Transect locations are shown on areal figures. Samples will be analyzed for the CCR parameters and water quality parameters. Benthic sampling shall be collected during the sediment sampling along the same transects, with 5 samples obtained per transect from the upper 6" of sediment. The benthic sampling will consist of a quantitative sampling evaluation to assess the diversity of the benthic community. Fish tissue and mayfly samples will be taken from geographical areas in the surface streams and rivers to evaluate CCR contaminant bioaccumulation. These sampling areas are shown on JSF site figures.

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October 5, 2018

Comment Number	Section Number	Section Title	Page	Paragraph	Line	Comment	Date	Source	TVA Response (09/28/2018)
7	General	All	NA	NA	NA	2. Historic geography considerations a. Take into account the landscape prior to alteration by the power plant and ash ponds now present. The most likely pathways for migration of contaminants is along historic stream channels and flow contours. i. Streams once flowed through the site where the plant and ash are now located ii. One apparent sink hole in or near the present ash pond Such stream and karst features must be explicitly and seriously considered as part of any EIP as the present likely pathways of migration.	9/7/18	Barry Sulkin for Tennessee Clean Water Network	The EIP includes plans to investigate historical stream channels at the perimeter of the CCR units and their potential to act as migration pathways via cone penetrometer test (CPT) borings. The investigation will be a phased approach to first locate and evaluate the stream channels. There is no evidence of karst, dissolution of limestone beds or sinkhole development at JSF. JSF is underlain by the Sevier shale. A report prepared by TVA in 2009 concluded the following: • Interbedded limestone layers are typically less than 0.3 foot in thickness and show no evidence of dissolution cavity development. • No evidence of sinkhole development was observed. • The potential for cavity development in the Sevier Shale is negligible due to the prevalence of thinly-bedded, shaley limestones.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	Comment	Date	Source	TVA Response (09/28/2018)
8	General	All	NA	NA	NA	We know already that the W31 well, near the river has had high levels of toxic cadmium appearing in tests from 2007 to 2011. These results appear to have been dismissed with hypothesis of agitation and of errors in testing procedures. Multiple explanations are often a red flag and multiple results over years should not be so easily dismissed.	9/5/18	Jeff Scott	TVA will review concentrations of cadmium from previous and future sampling activities and evaluate if and where concentrations exceeded the Maximum Contaminant Level (MCL). Previous evaluation of the exceedances observed between 2007 and 2011 indicated that they were the result of a laboratory interference. The laboratory method was modified, which eliminated the interference. Sampling has continued since 2011 with no cadmium exceedances. The sampling locations, analytical results, comparison to the MCL and discussion of the laboratory interference evaluation will be included in the EAR.
9	General	All	NA	NA	NA	See attached email on multiple topics paraphrased below: Requests long term plan to test and monitor private residential wells as part of TVA environmental stewardship plan.	9/5/18	Jeff Scott	A Water Use Survey SAP will be prepared and included in the EIP. The Water Use Survey SAP will include a plan to conduct a search for private water supplies within ½ mile of the CCR units. A door-to-door survey will be conducted to locate water supply wells. TVA will collect water samples from the water supplies in accordance with the SAP. If water samples indicate the presence of CCR constituents from the John Sevier Fossil plant, then TVA will work with TDEC to address this as part of the Corrective Action/Risk Assessment (CARA) Plan.
10	General	All	NA	NA	NA	Believes 30-year post-closure care period is insufficient.	9/5/18	Jeff Scott	The need for additional post-closure care monitoring will be evaluated upon completion of the regulatory 30-year post-closure care monitoring period.

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October 5, 2018

Comment Number	Section Number	Section Title	Page	Paragraph	Line	Comment	Date	Source	TVA Response (09/28/2018)
11	General	All	NA	NA	NA	Shallow wells (30-ft. deep) used to determine GW flow direction – concern for deep flow direction and migration of impacts to deeper private wells	9/5/18	Jeff Scott	TVA proposes to implement the proposed plan, evaluate the data collected, and assess the suitability of the proposed wells. If additional monitoring wells are required, then the data collected as part of the initial investigation phase will be reviewed to identify alternative monitoring well 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.
12	General	All	NA	NA	NA	Test all private wells within a ½ mile perimeter of the TVA property line.	9/5/18	Jeff Scott	A Water Use Survey SAP will be prepared and included in the EIP. The Water Use Survey SAP will include a plan to conduct a search for private water supplies within ½ mile of the CCR units. A door-to-door survey will be conducted to locate water supply wells. TVA will collect water samples from the water supplies in accordance with the SAP. If water samples indicate the presence of CCR constituents from the John Sevier Fossil plant, then TVA will work with TDEC to address this as part of the CARA Plan.
13	General	All	NA	NA	NA	Conduct full door-to-door survey of neighborhood. Monitor well water during 30-yr post-closure period and beyond.	9/5/18	Jeff Scott	A Water Use Survey SAP will be prepared and included in the EIP. The Water Use Survey SAP will include a plan to conduct a search for private water supplies within ½ mile of the CCR units. A door-to-door survey will be conducted to locate water supply wells. TVA will collect water samples from the water supplies in accordance with the SAP. If water samples indicate the presence of CCR constituents from the John Sevier Fossil plant, then TVA will work with TDEC to address this as part of the CARA Plan.
14	General	All	NA	NA	NA	Groundwater quality testing in 1960s part of a program that led to the establishment of the Persia Utility District. Where wells on the south side of Old Hwy 70 part of the testing program.	9/5/18	Jeff Scott	Refer Mr. Scott to the Persia Utility District for more information.
15	General	All	NA	NA	NA	State Assessment Records of private water wells not accurate for many of the properties. State Assessment Data should not be used to find wells.	9/5/18	Jeff Scott	The state database is used as one source of information. Other sources of information, such as city and county records will be researched, and a door-to-door survey will be conducted to locate water supply wells.

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October 5, 2018

Comment Number	Section Number	Section Title	Page	Paragraph	Line	Comment	Date	Source	TVA Response (09/28/2018)
16	General	All	NA	NA	NA	No one was aware of the plan involving the ½ mile proposed testing perimeter around the TVA property line. Message has not gotten out about the EIP or TDEC. More public education and engagement may be helpful.	9/5/18	Jeff Scott	In an effort to inform residents about the EIP, TVA sent postcards and provided advertisements/news releases to the local media in advance of the 45-day comment period and public information meeting. Information is still available on the EIP and the public presentations at www.TVA.com. In addition, TVA is developing an ongoing information and outreach plan for the local residents and community near the former plant site. TVA will develop information about the proposed sampling activities and make it available to the residents as they are contacted as part of the door-to-door notifications. Information about the sampling activities will also be made available online at www.tva.com. While the investigation is technical in nature, every effort will be made to include common terms/usage in its explanations, as well as providing additional available resources, including TVA contact information for additional questions and information requests.
17	General	All	NA	NA	NA	Consider monitoring the health of frogs, which are another aquatic indicator species in the area.	9/5/18	Jeff Scott	The sampling and analysis plans approved in the EIP address key trophic level species and indicators representing the aquatic-terrestrial food chains at JSF.
18	General	All	NA	NA	NA	A detailed single document that is accessible and understandable to and by the public explaining the full life cycle processing of the ash, and the concerns and remediations regarding geology and hydrology issues involving bedrock, fractures and aquifers, would be appreciated.	9/5/18	Jeff Scott	As part of the TDEC Order process, TVA will be conducting an EI as outlined in the EIP and assessing potential risks that may result from the management and disposal of CCR at the John Sevier Fossil Plant. The results of the EI will be summarized in the EAR for review and approval by TDEC. Documents containing remediation measures performed at the site will be summarized and included in the EAR. TVA will also develop a Corrective Action/Risk Assessment (CARA) Plan to establish why no further action is warranted or to specify the remedial actions TVA will take at the site and the basis for those actions.
19	General	All	NA	NA	NA	The public should be allowed access to the area (former fossil plant), and there should be some long-term ability for residents of the area and others to be able to ask questions and understand issues involved with the long-term maintenance and monitoring of the CCRs in these landfills.	9/5/18	Jeff Scott	The former fossil plant is located next to TVA's John Sevier combined cycle natural gas plant, which is considered critical infrastructure and is secured following federal and industry standards, as are other generating sites at TVA and nationwide. TVA will continue to provide an opportunity for residents to ask questions and obtain information on the maintenance and monitoring of CCR on its website, as well as contact information at TVA in writing and by phone.