Attachment G

QA/QC Plan

Ash Pond 4 Final Closure QA/QC Plan by AECOM dated July 2016.

TENNESSEE VALLEY AUTHORITY
COLBERT FOSSIL PLANT
COLBERT COUNTY, ALABAMA

ASH POND 4 FINAL CLOSURE
QA/QC PLAN

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July 2016

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TABLE OF CONTENTS

TABLES AND FIGURES

APPENDICES

1. INTRODUCTION

The purpose of this Construction Quality Assurance/Quality Control (QA/QC) Plan is to outline the observation and testing requirements needed to document and verify that the Tennessee Valley Authority (TVA) Ash Pond 4 (Pond 4) is constructed in conformance with the approved construction documents. This QA/QC Plan details the material requirements, sampling and testing procedures, testing frequency, testing parameters and sampling locations, surveying requirements, required documentation and the procedures to follow in the case of a test failure.

The following sections address QA/QC activities associated with components of the project. These components will include some, but not necessarily all, of the following:

- Earth Materials;
- Aggregates;
- Geosynthetics;
- Concrete;
- Piping; and
- Survey

1.1 PROJECT DESCRIPTION

Pond 4, encompasses approximately 52 acres, and has a free water volume of approximately 330,000 CY. Pond 4 consists of a sluicing area for bottom ash management, a main pond, and adjoining stilling pond. Pond 4 receives Plant process water, gray water, and waters from the Coal Yard Runoff Pond (CYROP). Upon Plant closure and cleanout, the only remaining flows will be the Plant sumps, gray water, and waters from the CYROP. Plant sumps and gray water will be rerouted to the CYROP as part of a separate project.

As part of TVA's Programmatic Goals, Pond 4 will be closed and capped with geosynthetics and clay liner. Following Plant closure (March 23, 2016), Pond 4 will remain open for approximately three to six months to allow receipt of Plant clean-out/wash-down materials. Following Plant clean-out activities, the area will be filled/graded with the bottom ash and fly ash currently stacked in the southwestern portion of the pond footprint. The dike height will also be reduced and the existing clay dike used to fill portions of Pond 4 and for the construction of the cap system.

The project will address storm water management concerns present at Pond 4 including the modification of existing terraces and letdowns, as needed, to promote positive drainage and the sizing of storm water structures (terraces, letdowns, culverts, etc.) to handle the anticipated storm water flows after the closure of the Pond 4. The Pond 4 will have a final cover system consisting of a flexible membrane liner, geocomposite drainage layer, Cap Cover Soil, and vegetation.

2. QA / QC Program

2.1 Quality Assurance

Quality Assurance (QA) starts at the beginning of the project during preparation of the engineering plans and specifications. At this stage, the QA/QC plan outlines means and actions to be employed by the Owner through the Construction Quality Assurance (CQA) team to evaluate and measure conformity with the design, production (manufacture and fabrication), and installation of equipment and materials in accordance with this QA/QC plan as well as with the plans and specifications.

The objective of QA is to provide observations and tests that assist in evaluating whether the construction has been performed in accordance with the plans and specifications. Quality Assurance is defined as a process that assures that quality criteria are met. QA consists of many aspects including third party observation of construction activities and completing construction in conformance with the Contract Documents which includes the CQA Plan, and the review of Quality Control (QC) information provided by manufacturers, vendors, and contractors. QA also consists of working with the Owner to evaluate the experience of contractors, subcontractors, and inspectors, and obtaining quality materials. QC is provided by the manufacturers, vendors and contractors for their respective products and work, and QC documents are reviewed by the Project and/or Resident Engineer.

2.2 Quality Control

QC is inspection, analysis, and/or action required to ensure quality of output and includes actions taken by all parties including the designer, manufacturer, fabricator, and/or Contractor, to ensure that their methods, materials, and workmanship are accurate, correct, and meet the project requirements, in accordance with the approved plans and specifications. QC is provided by each party for its own work, product, or service.

2.3 Roles and Responsibilities

2.3.1 Owner and Operator

The plant and its ancillary functions are owned and operated by the Tennessee Valley Authority (Owner). The Owner will be responsible for overall management of construction activities including contracting and administration. The Owner will designate an on-site representative to serve as Construction Manager (CM).

2.3.1.1 Construction Manager

The role of the CM is solely dependent on the needs and preferences of the Owner. Comprehensive construction managers provide a wide range of services and can be involved in both the design and construction phases of a project. In general, a CM provides leadership to the construction team, and coordinates between the Owner, CQA Consultant, and Contractor to plan and oversee the completion of a project. Responsibilities of the Construction Manager may include managing the budget, construction progress, schedule, and settling any disagreements between the Project/Resident Engineer and the Contractor on issues that arise during CQA activities.

2.3.2 CONTRACTOR

The Contractor for this project will be selected by the Owner. The Contractor will be responsible for construction activities associated with this project including meeting all of the requirements for project quality as defined in the Contract Documents, Contract Drawings, construction schedule, plans, and specifications for his work as well as that of his Subcontractors.

2.3.3 CQA CONSULTANT

The CQA Consultant is responsible for making observations and performing field tests to provide written documentation that a facility is constructed in accordance with the applicable plans, including this QA/QC Plan, and specifications. The CQA Consultant may contract with third party testing firms to conduct on-site and laboratory testing, as necessary. The following section provides a description of the typical CQA Consultant team, including each member's roles and responsibilities.

2.3.3.1 Certifying Engineer

The CQA Certifying Engineer is responsible for certifying to the Owner and the regulatory agency that the facility has been constructed in accordance with the plans, drawings, and the approved QA/QC Plan. The Certifying Engineer serves as the Professional Engineer for the project and documents the as-built construction in a final certification report.

2.3.3.2 Project Engineer

The CQA Project Engineer is responsible for providing engineering and technical support to the field CQA team throughout the construction process. The Project Engineer works closely with the Construction Manager to assist with calculations and complete take-offs in support of as-built quantities for payment. The Project Engineer also reviews submittals and Requests For Information (RFI) from the Contractor, reviews and maintains QA/QC data, and coordinates all supplementary laboratory testing of geosynthetics and soils. The Project Engineer will provide the following on-site QA personnel as needed and as directed by the Construction Manager:

- Resident Engineer;
- CQA Inspector;
- Third party CQA testing firm; and
- Third party surveying firm.

2.3.3.3 Resident Engineer

The Resident Engineer (RE) will monitor work to evaluate conformance with the construction plans and specifications. Specific duties include:

- Coordinate submittal reviews with the Project Engineer for compliance with contract documents;
- Coordinate between the Construction Manager, Contractor and Project Engineer to resolve design issues;
- Coordinate responses to RFIs and other technical issues with the Project Engineer;
- Monitor construction progress and review Contractors Construction Quality Control (CQC) and as-built documentation on a daily basis;
- Represent the Project Engineer at on-site meetings;
- Plan, schedule and provide oversight of QA/QC testing and surveying Subcontractors;
- Document construction progress and QA/QC activities with daily reports and photographs; and,
- Notify the TVA Construction Manager and Project Engineer of any deficiencies or non-conformance observed.

The Resident Engineer will distribute copies of test reports and other QA/QC documentation as directed by the Construction Manager.

2.3.3.4 CQA Inspector

The CQA Inspector will observe and document construction activities for compliance with the contract documents. Specific duties of the CQA Inspector include:

- Observe and document construction related activities;
- Observe and document geosynthetic installation activities;
- Coordinate testing with CQA Subcontractor;
- Monitor delivery, handling, and on-site storage of construction materials;
- Evaluate conformance of borrow source materials;
- Observe material placement and testing;
- Observe the installation and testing of mechanical and electrical systems; and,
- Coordinate material sampling and shipping for laboratory testing.

Other duties and responsibilities of the CQA Inspector will be determined by the Resident Engineer and TVA Construction Manager as the work progresses.

2.3.3.5 CQA Subcontractors

The CQA Consultant will subcontract with a construction materials testing and inspection firm for field and laboratory testing as needed. The CQA Subcontractor will provide field technicians for on-site testing and observance including:

- Compaction testing of soils;
- Testing of concrete slump, temperature, and air content;
- Preparing concrete test specimens; and,

- Observation of laying of pipes.

Anticipated laboratory testing includes:

- Compressive strength testing of concrete cylinders;
- Pre-qualification testing of soils; and,
- Conformance testing of geosynthetic materials.

2.4 STOP WORK AUTHORITY

The CQA Consultant will advise the TVA Construction Manager that the Contractor should stop work in situations of recognizable stability issues, deviations from design and significant cost or schedule impacts. The TVA Construction Manager will obtain approval from the TVA Project Manager prior to stopping the Contractor's work. In situations where personnel safety is concerned, the CQA Consultant will advise the Contractor to stop work and notify the TVA Construction Manager as soon as possible of that action.

3. Preloading Program

3.1 Preloading

The following sections discuss the specific CQA requirements for the monitoring and construction of settlement plates and required monitoring procedures for the proposed preloading program.

3.1.1 Settlement Plates and Preloading Period

The project includes a minimum preload period for areas of the project where the proposed cap subgrades are to be higher than existing topographic or bathymetric grades. The purpose of the preload is to induce a proportion of the consolidation settlement expected to occur in the existing ash materials, prior to construction of the permanent cap. Preloading will include the following tasks:

- Installation of settlement plates and risers.
- Survey monitoring of settlement plates during filling activities and during the duration of the preloading period
- Recording and communicating the survey data
- Interpretation of data by the engineering team.

The minimum preload period is three weeks, and the preload shall be considered to begin at any location after all fill material has been placed and the grade at that location has been raised to the proposed subgrade elevation.

The Contractor shall document and report the date time grade has been raised to subgrade elevation at each settlement plate location to the Resident Engineer and CQA Inspector.

The Resident Engineer and CQA Inspector shall approve the start and stop of the preload period before subsequent construction processes begin.

The wait time between establishing cap subgrade and cap construction shall also be observed and reported to the Resident Engineer and CQA Inspector. The settlement shall also be monitored during fill placement; this data should be communicated to the Project Engineer.

3.1.2 Settlement Plates Installation & Fill Procedures

Prior to the start of fill construction and the specified preloading period, settlement plates shall be set at the locations shown on the Contract Drawings. The following items pertain to settlement plate construction:

- Each plate will be set to bear 12 inches below the existing grade elevation. Plates will be constructed such that they are level, and all riser extension will be installed plumb.

- The location of each plate will be surveyed (northing, easting, and elevation at the top of the plate). The coordinates will be provided to the Resident Engineer in a tabular format.
- Riser extensions will be added to the plates as filling is performed. Riser segments will be 4 ft. in length. The riser should extend a minimum of 3 ft. above grade at any time during fill placement activities and after fill placement is complete.
- The contractor will take care not to damage the settlement plates during construction activities. Barricades/cones or other clearly visible means will be used to demarcate the plates and corresponding risers. Heavy equipment tracks and compactors should not work within 3 ft. of any settlement plate riser.
- The Resident Engineer will monitor installation of settlement plates and risers.

3.1.3 Settlement Monitoring

Survey monitoring of settlement plate risers will be performed and promptly reported during grading operations and during the duration of the preloading period. The Contractor will perform and report all surveying.

The Contractor will identify, set, and maintain an appropriate number of fixed benchmarks to facilitate the surveying of settlement plates.

A fixed point (which will be clearly marked) will be established on each riser segment at each plate. This point will be used as a reference point, to be surveyed.

Survey events will then take place at the following intervals:

- During fill placement activities, a survey reading event will take place at each instance where a riser is extended. The reference point on the lower segment and on the new extension segment will be shot and recorded. The elevation of the ground surface 5 ft. away from the riser will also be shot and recorded.
- Upon reaching final subgrade elevation (and at the beginning of the specified preload period), the reference point on the final riser extension will be shot and recorded.
- During the preloading period, the reference point on the final riser extension will be shot and recorded on a twice-weekly basis.

3.1.4 Settlement Monitoring Communication

The Contractor will report all settlement plate survey data to the Resident Engineer on a weekly basis during fill placement activities, and within 2 days of each survey event during the preloading period.

The data will be communicated in tabular, Excel spreadsheet format and as a function of vertical deformation (defined as the reference elevation of the platform at the time of installation minus its current elevation) as a function of time.

3.1.5 Engineer's Interpretation Of Monitoring Results

The Project Engineer will review the measured settlement data on an ongoing basis. At the end of the specified preloading period, the Project Engineer will determine whether cap construction can begin or if the preloading period should be extended.

4. Earth Materials

The following section discusses the specific QA/QC requirements for the testing and construction of earth materials. Earth materials included in this project include:

- Structural Fill;
- Ash Fill;
- Cap Cover Soil;
- Trench Fill; and
- Anchor Trench Fill

4.1 Structural Fill

Structural fill will be used to modify terraces, fill trenches, fill anchor trenches, and to construct berms and roads. Excess or unsatisfactory material is to be removed and disposed of as directed by the Resident Engineer or CQA Inspector to the designated areas on-site stockpiles.

4.1.1 Material Specifications

Structural fill must consist of soil materials classified as SP, SM, SC, CL, CL-ML, or CH under the Unified Soils Classification System. Soils for construction of structural fill will be obtained from on-site and/or off-site borrow sources. The required prequalification testing for soil structural fill is summarized in Table A1. Soil material removed from excavations may be reused as fill provided it meets the requirements listed herein. Soil structural fill must consist of well-graded natural earth materials that are not excessively dry or saturated, and be free of organic materials, debris, waste, frozen materials, vegetation, roots, and other deleterious materials.

All soil structural fill must be free of cobbles, stones, rock, gravel, or boulders greater than 6-inches in diameter except the lift that is in direct contact with geosynthetics that must have a maximum particle size of less than 2 inches. Soil used as structural fill must have an organic content that does not exceed 5% by weight.

The Contractor must provide materials meeting the requirements of this plan and the specifications from on-site and/or off-site sources. TVA only approves of borrow sites that meet NEPA requirements for offsite borrow sources. Preconstruction testing for soil structural fill in accordance with Table A1 must be completed prior to delivery to the site.

4.1.2 Construction

Soil structural fill will be placed in loose-lifts and be compacted by a minimum of two passes (up and back over same area) of a compactor or as required to meet the minimum compaction requirements. The Contractor will overlap the passes so the entire area of structural fill placement is compacted. In addition, the Contractor will be required to key the structural fill into existing and/or constructed slopes with 2H:1V minimum benches.

4.1.2.1 Pipe Trenches

Structural fill used in pipe trench excavations will be placed only after the trench subgrade and pipe installation has been visually inspected and accepted by the Resident Engineer. Structural fill being placed shall be placed in accordance with the Contract Drawings in conveyance pipe trenches.

The structural fill used in pipe trench excavations shall be deposited, spread in uniform 6-inch loose lifts by the Contractor, satisfactorily compacting each lift after placement. Trench Fill shall be used to bring the trench excavation to the required subgrade and/or final grade elevations as shown in the Contract Drawings. In areas where topsoil and seeding is required the final lift of soil should be capable of supporting vegetative growth.

Structural Fill may be used to bring trench excavations to required subgrade/grade elevations. It should be noted: trench excavations shall have side slopes no steeper than 4H: 1V when cut in ash. Stability of trench sidewalls is the responsibility of the Contractor. The Contractor's Excavation Competent Person will determine safe excavation slopes, in accordance with OSHA requirements. Flatter slopes may be necessary to prevent cave-ins, especially during wet conditions, these potential hazards shall be mitigated by the Contractor. Contractor shall maintain access and egress to all excavations per governing agencies rules, regulations, and guidelines.

4.1.2.2 Anchor Trench

Structural fill shall be used in used to bring the anchor trench excavation to the required subgrade and/or final grade elevations as shown in the Contract Drawings. In areas where topsoil and seeding is required the soil should be capable of supporting vegetative growth.

Structural Fill being placed shall be placed in accordance with the Contract Drawings and shall only be placed and compacted after the geosynthetics and Anchor Trench subgrade have been correctly installed and accepted by the Resident Engineer.

4.1.3 Construction Testing

QA/QC activities include material source verification and inspection and testing during placement and grading. At completion, the layers will exhibit a thoroughly compacted, uniform and smooth surface, and be free from ruts, depressions, trash, and debris.

In-place moisture/density testing and/or proofrolls of structural fill will be conducted by the CQA Inspector or CQA Subconsultant in accordance with the requirements listed in Table A1.

4.2 Ash Fill

Ash fill will be used to bring the site to proposed top of subgrade elevations. Other ash material, sourced from elsewhere on property and at the direction of the Owner and with ADEM approval, may also be considered ash fill materials.

4.2.1 Material Specifications

The required prequalification testing for ash fill is summarized in Table A1. Ash fill must not be excessively dry or saturated, and be free of organic materials, debris, waste, frozen materials, vegetation, roots, and other deleterious materials. A large portion of the ash fill will require some moisture conditioning (i.e. drying).

Ash fill in direct contact with geosynthetics that must have a maximum particle size of less than 2 inches.

4.2.2 Construction

Ash fill will be placed in loose-lifts and be compacted by a minimum of four passes (up and back over same area) of a compactor or as required to meet the minimum compaction requirements. The Contractor will overlap the passes so the entire area of structural fill placement is compacted. In addition, the Contractor will be required to key the structural fill into existing and/or constructed slopes with 2 horizontal to 1 vertical minimum benches.

4.2.3 Construction Testing

In-place moisture/density testing and/or proofrolls of structural fill will be conducted by the CQA Inspector or CQA Subconsultant in accordance with the requirements listed in Table A1.

4.3 Cap Cover Soil

4.3.1 Material Specifications

The cap cover soil layer will be used to provide protection for the geosynthetic cap system; and, to support the establishment of vegetation. QA/QC activities include material source verification and inspection during placement and grading. At completion, the cap cover soil layer will exhibit a well-drained, uniform and smooth surface, and be free from ruts, depressions, and debris.

The cap cover soil must consist of soil materials classified as SC, CL, CL-ML, or CH under the Unified Soils Classification System. Soils may be obtained from on-site and/or off-site borrow sources. The required prequalification testing for the cap cover soil is summarized in Table A1. Soil material removed from dike excavations may be reused as fill provided it meets the requirements listed herein. The cap soil must consist of well-graded natural earth materials that are not excessively dry or saturated, and be free of organic materials, debris, waste, frozen materials, vegetation, roots, and other deleterious materials.

All cap cover soil must be free of cobbles, stones, rock, gravel, or boulders greater than 6-inches in diameter except the lift that is in direct contact with geosynthetics that must have a maximum particle size of less than 2 inches.

The Contractor must provide materials meeting the requirements of this plan and the specifications from on-site and/or off-site sources. Preconstruction testing for cap cover soil in accordance with Table A1 must be completed prior to delivery to the site.

4.3.2 CONSTRUCTION

The Contractor will place the cap cover soil layer only after the geosynthetics layers have been accepted in writing by the Project Engineer. The Cap Cover Soil must be deposited, spread in uniform lifts, and tracked in place using low ground pressure equipment.

If the soil to be used as the Cap Cover Soil layer complies with the requirements for the vegetative support, the Contractor may place the Cap Cover Soil layer in greater than or equal to 8-in. lifts, satisfactorily compacting each lift after placement. See Table A1 for additional acceptance criteria details regarding the Cap Cover Soil.

The material should be relatively free of debris, rock, plant materials, and other foreign matter. There shall be no material greater than 4-inch diameter except the lift in contact with the geosynthetics which shall not have any soil or aggregate greater than 2 inch in diameter.

4.3.3 CONSTRUCTION TESTING

The Cap Cover Soil layer should be visually inspected to evaluate conformance with the requirements of Table A1 and to ensure that the underlying geosynthetics were not damaged during placement.

5. Aggregate Fill and Rip-Rap

Durable crushed stone aggregate materials will be used for slope and channel protection (rip rap), bedding and stone backfill for structures, pipe bedding and initial backfill, access roads and haul roads.

5.1 Material, Construction, and Design Specifications

Material and construction requirements for aggregates are set forth in Table A1.

5.2 Material Specifications

Aggregate materials for use will be obtained from approved off-site borrow sources and must satisfy the requirements in the Contract Documents throughout delivery and use of the materials. The Contractor will submit certified laboratory test reports for each proposed borrow source material stating that the proposed material meets or exceeds the quality and durability requirements for aggregate as set forth in Table A1.

5.3 Construction

Bedding and backfill of structures: Place to the thickness and elevations shown on the Contract Drawings and compact in place to achieve required compaction.

Rip rap: Place in a manner that will produce a reasonably well-graded mass of stone with smaller stone fragments filling the space between the larger ones, so as to result in the minimum practicable percentage of voids. Distribute all material so that there will be no large accumulations of either the larger or smaller sizes of rock. Place the final section of stone filling in conformance with the lines, grades, and thicknesses as shown on the Construction Drawings. Do not place or drop material from a height greater than 24”.

Access roads: Spread in uniform loose lifts and compact with a compactor until the specified density is reached or until the material passes a proofroll as specified in Section 4.4.

5.4 Construction Testing

Observation of aggregate placement will document that the correct materials are utilized, aggregates are placed to the lines and grades as shown on the construction drawings and thicknesses of layers are attained to meet the design intent. For aggregate used in bedding and backfill of structures, the aggregate will be field inspected and verified to meet conformance. A proofroll will be utilized for determining the adequacy of compaction for roadway materials. All testing will be observed by the Resident Engineer or the CQA Inspector in accordance with the requirements listed in Table A1.

6. GEOSYNTHETICS

6.1 GEOMEMBRANE

The geomembrane material used for the Flexible Membrane Liner (FML) will be textured 40-mil linear low-density polyethylene (LLDPE) geomembrane for the cap system as set forth in the project specifications. The Closure Cap System geomembrane will be placed over the existing cover soils (Coal Combustion Products and Structural Fill). The geomembrane for the Closure Cap System will be textured as indicated in the Contract Drawings. Results of the quality control testing will be submitted to the Project Engineer for review and concurrence that the reported test results meet with project specifications. CQA inspection reports will be reviewed by the Resident Engineer.

6.1.1 MATERIAL, CONSTRUCTION, AND DESIGN SPECIFICATIONS

The textured geomembrane sheet for use in the Closure Cap System construction will be 40-mil, LLDPE containing no fillers or extenders. All LLDPE membrane to be installed will be textured.

Materials and methods must comply with the following applicable provisions and recommendations of the following, except as otherwise shown or specified:

- ASTM International – Standards Worldwide.
- Geosynthetic Institutes' GRI-GM9 "Cold Weather Seaming of Geomembranes".
- Geosynthetic Institutes' GRI-GM14 "Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes" specification.
- Geosynthetic Institutes' GRI-GM17 "Test Properties, Testing Frequency and Recommended Warranted for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes" specification.
- Geosynthetic Institutes' GRI-GM19 "Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes" specification.

It is the responsibility of the Contractor to verify that the most current version of the above referenced standards is adhered to. A summary of geomembrane material requirements is provided in Table A4 for the Closure Cap System geomembrane.

6.1.2 PRE-CONSTRUCTION MANUFACTURER / CONFORMANCE TESTING

The geomembrane manufacturer will perform quality control testing on the proposed geomembrane in accordance with Table A4. The complete textured sheet must demonstrate that it meets the properties listed in Table A4. Test reports documenting the results of the tests required in Table A4 must be submitted to the Project Engineer for review and verification that the reported test results meet with the project specifications at least 7 days prior to delivery of the geomembrane material to the job site. The material Manufacturer and Contractor must satisfy the Project Engineer that the material they propose to furnish and install will meet in every aspect the requirements set forth in these specifications and the requirements of Table

A4. The Contractor must transmit to the Project Engineer all information given to him or her by the manufacturer or supplier 7 days prior to delivery of the geomembrane material to the job site. The site specific soils and representative samples of the geomembrane materials that will be used at the site must be tested for interface shear strength for all overlying and underlying materials over the entire range of normal stresses that will develop at the facility as specified in Table A2. For the Closure Cap System construction, the 40-mil LLDPE geomembrane to underlying subgrade and 40-mil LLDPE geomembrane to geocomposite drainage layer must meet the requirements of Table A2 and Figure A2. For textured geomembrane, the manufacturer shall identify, if applicable, which side of the product is intended to be installed upward and which downward and the Contractor shall be made to confirm their intentions for installation. When agreed, the independent laboratory shall be instructed to arrange the test layers in the exact manner as intended to be installed.

6.1.3 DEPLOYMENT

Seams are to be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams must be minimized. If horizontal seams are deemed necessary and acceptable to the Resident Engineer or CQA Inspector, seams are to be staggered a minimum distance of ten feet between adjacent seams. Horizontal seams must not be within five (5) feet from the toe of slopes, or areas of potential stress concentration, unless otherwise approved by the Project Engineer.

Geomembrane placement will not proceed when the sheet temperature measured by placing a thermometer on the surface of the sheet is below 32°F or above 104°F for extrusion welding and 140°F for fusion welding. Deviations from these temperature criteria may only occur when authorized by the Owner and with the concurrence of the Project Engineer. Geomembrane placement will not be performed during any precipitation, fog, snow, in areas of ponded water, or in the presence of excessive winds.

During deployment of the geomembrane, ensure the following conditions are satisfied and documented for submittal to the CQA inspector:

- The double-sided, textured membrane is being deployed in the same manner as recommended by the manufacturer and as tested by the independent quality assurance testing laboratory and approved the engineer.
- The method and equipment used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil and the method used to place the panels minimizes wrinkles.
- For fusion seaming, a rub sheet may be required directly below each overlap of geomembrane to be seamed in order to prevent any moisture build-up between the sheets. The rub sheet should be removed after welding is completed.
- For extrusion seaming, the geomembrane is to be cleaned using a disc grinder or equivalent prior to seaming.

- Equipment utilized to deploy the geomembrane shall be rubber tired and shall not exceed a wheel contact pressure of 5 psi.

6.1.4 CONSTRUCTION TESTING

All geosynthetics field construction will be completed in accordance with the manufacturer's recommended installation procedures and the construction and testing specifications.

Construction QC Information

As the documentation is completed, the Contractor will provide the following QC information to the CQA Inspector or Resident Engineer for review, concurrence and project record-keeping:

- Panel placement map
- Subgrade acceptance forms
- Trial welds
- Panel placement logs
- Panel seaming logs (with the seamer identified)
- Non-destructive test results
- Destructive test results
- Repair logs (with the seamer identified)

The construction details for all deployed geomembrane will be recorded on individual forms acceptable to the Resident Engineer (see Appendix A – Forms and Logs). In addition to reviews of QC documentation, the CQA Inspector will visually observe installed geomembrane for damage and conformance with the construction and testing specifications.

Trial Welds

Trial welds will be made on pieces of geomembrane to verify that seaming conditions are adequate. Such trial seams will be performed once in the morning and once in the afternoon, when operators change, when an apparatus is turned off and restarted, or when the geomembrane temperature changes by 36 degrees Fahrenheit or more since the previous trial weld was performed. A passing trial seam will be made for each seaming device and technician. A change in technician or machine on a previously passed trial seam warrants the welding of a new passing trial seam. At least 5 peel tests and 5 shear tests shall be performed per trial weld.

Non-Destructive Testing

The Contractor will non-destructively test field seams over their full length using a vacuum test unit (for extrusion seams only), air pressure test, or other acceptable method. The testing will be completed to the accepted standards of the industry. Non-destructive testing will be completed on 100 percent of the seams as the seaming work progresses. The Contractor will complete any required repairs in accordance with industry standards.

Unless otherwise specified, air pressure testing of the seamed channel will include inflating the test channel, closing the valve, and observing initial pressure after approximate air temperature and pressure have stabilized. The initial pressure will be set appropriately as indicated in Table A4, and the test will last for 5 minutes after reading the initial test pressure. If pressure loss exceeds 3 psi, or if the pressure does not stabilize, locate the faulty area and repair. Flap welding is not an acceptable repair for a failing air channel test. For passing tests, at the end of the 5-minute period, the far end of the seam will be cut and the resultant pressure drop noted.

Vacuum testing will be required on all extrusion welded seams. To vacuum test, the Contractor will turn on the vacuum pump to reduce the vacuum box to approximately 5 psi. They will apply liquid soap and water solution to the area to be tested, place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" the seal strip against the geomembrane. Once a tight seal is created, the CQA Inspector will observe the seam through the window for a period of not less than 10 seconds. If no bubbles appear after 10 seconds, the Contractor may proceed to the next segment of seam to be tested. Non-passing tests will be marked and repaired in accordance with the specifications.

Destructive Testing

Destructive seam tests will be performed at locations selected by the CQA Inspector, at a minimum of one per every 500 feet of seam completed by a particular apparatus. The spacing for taking field seam samples for destructive testing is to be at a minimum of 1 per 500 feet of seam length, or as by directed by the CQA inspector. As the project continues and data is accumulated, however, this sampling interval may be varied according to the procedure set forth in GRI GM14 upon approval by the Resident Engineer. Following this procedure will result in three possible different situations:

- Good seaming with fewer rejected test results than the preset historic average can result in a sequential increase in the spacing interval, i.e., one per greater than 500 ft.
- Poor seaming with more rejected test results than the preset historic average can result in a sequential decrease in the spacing interval, i.e., one per less than 500 ft.
- Average seaming with approximately the same test results as the preset historic average will result in the spacing interval remaining the same, i.e., one per 500 ft.

All holes in the geomembrane resulting from destructive seam sampling will be immediately repaired. Samples will be cut by the Contractor as the seaming progresses and receives passing results prior to being covered by overlying materials. The CQA Inspector will:

- Select the locations for the destructive samples;
- Assign a number to each sample, and mark it accordingly;
- Observe sample cutting;
- Record the sample location on the layout drawing; and
- Record the reason for taking the sample at this location, if not taken due to statistical routine.

A specimen for field testing will be cut into three parts and distributed as follows:

- One for field testing by the Contractor,
- One for independent laboratory peel and shear testing, and
- One to the Owner for archive storage.

The field specimen will be tested in the field with a tensiometer for peel and shear (minimum 5 peel and 5 shear), and will meet the minimum requirements presented in Table A4. If any field or laboratory test sample fails to pass, then additional samples will be collected a minimum of ten feet on either side of the failing sample bounding the failing test until two bounding, passing tests are recorded. The failed section between two bounding, passing tests will be cap-stripped and tested by vacuum testing to the satisfaction of the CQA inspector Technician. The CQA Inspector will observe field tests and mark all samples.

Destructive test samples will be packaged and shipped by the Resident Engineer to an independent testing laboratory. Peel and shear destructive seam sample testing will be performed with a calibrated tensiometer. Collect destructive test samples once per every 500 lineal feet of seam length or at least one (1) sample per welder per day. If a sample fails, then additional samples will be collected bounding the failing test until two bounding, passing tests are recorded. The failed section between two bounding, passing tests will be cap-stripped and tested by vacuum testing to the satisfaction of the Resident Engineer. The CQA Inspector or Field Technician will observe field tests and mark all samples and portions with the corresponding identification number.

All testing will be performed in the manner and at the frequency identified in Table A4 at the end of this plan. Panel layout drawings (field sketches) of the deployed and tested geomembrane will be prepared by the Contractor and reviewed for conformance by the Resident Engineer. All field testing equipment must be calibrated in accordance with Table A3.

6.2 GEOCOMPOSITE

The QA/QC activities for the geocomposite drainage layer will include source verification (quality control testing), conformance testing, observation of delivered material, and documentation of geocomposite placement. The geocomposite layer will collect and convey liquid infiltrating from above to collection pipes located at specific intervals as located in the Contract drawings. At completion, the geocomposite layer will be smooth, without wrinkles, tears, or holes, and must cover the entire surface of the prepared subgrade. The geocomposite must be directly connected to the adjacent collection pipes such that liquid flows from the geocomposite unimpeded into the collection pipes.

6.2.1 MATERIAL DESIGN SPECIFICATIONS AND MANUFACTURER TESTING

The geocomposite to be used in the final Closure Cap System, as shown on the Contract Drawings, will include geotextile layers factory heat-bonded to both sides of an HDPE geonet, meeting the requirements of Table A5. Results of the manufacturer's quality control testing and inspection reports will be submitted to the Project Engineer for review and verification that the reported test results meet with project specifications at least 7 days prior to delivery of the geocomposite to the job site.

6.2.2 PRE-CONSTRUCTION AND CONFORMANCE TESTING

The geocomposite manufacturer will perform quality control testing on the proposed geocomposite in accordance with Table A5. The geocomposite must demonstrate that it meets the properties listed in Table A5. Test reports documenting the results of the conformance tests required in Table A5 must be submitted to the Project Engineer for review and verification that the reported test results meet with the project specifications at least 7 days prior to delivery of the geocomposite to the job site. The geocomposite material chosen by the Manufacturer and Contractor to supply and install will meet every aspect of the requirements set forth in these specifications, the requirements of Table A5, and satisfy the Project Engineer. The Contractor must transmit to the Project Engineer all information given to him by the manufacturer or supplier 7 days prior to delivery of the geocomposite to the job site. The specific soils and representative samples of the geocomposite materials that will be used at the site must be tested for interface shear strength over the entire range of normal stresses that will develop at the facility as specified in Table A2. For the closure cap system construction, the 40-mil LLDPE geomembrane to geocomposite drainage layer and geocomposite drainage layer to Cap Cover Soil must meet the requirements of Table A2 and Figure A2.

6.2.3 CONSTRUCTION

Panels shall be deployed with the machine direction in the predominate direction of flow, or as directed by the Engineer. Each component of the geocomposite (geotextile and geonet) will be secured or seamed to the like component at overlaps using visibly contrasting fasteners. Adjacent edges of geonet along the length of the geocomposite should be overlapped a minimum of 3 inches or in accordance with manufacturer's specifications. These overlaps will be joined by tying the geonet cores together with fasteners or polymeric braid. These ties will be spaced every 5 feet along the roll length. A complete interlocking of the two overlapped layers will occur. Adjoining geocomposite rolls (end to end) along the roll width should be shingled down in the direction of the slope, with the geonet portion of the top geocomposite overlapping the geonet portion of the bottom geocomposite a minimum of 12-inches across the roll width. Geonet should be tied every 12-inches across the roll width and every 6-inches in the anchor trench.

The bottom layer geotextile will be overlapped. The top layer of geotextile will be joined by sewing or heat bonding. Geotextiles must be overlapped a minimum of 4-inches prior to heat bonding or sewing or in accordance with manufacturer's specifications. If heat bonding is to be used, care must be taken to avoid burn through of the geotextile. If sewing of geotextiles seams is to be used, a flat (prayer) seam, "J" seam, or "butterfly-folded" seam with visibly contrasting thread is required unless an alternative method is approved by the Resident Engineer. The seam must be a two-thread, double-lock stitch, or a double row of single-thread, chain stitch. The Contractor will not leave tools, debris, or surplus materials on the surface.

6.2.4 CONSTRUCTION TESTING

Seams for the geocomposite will be 100% visually inspected, including inspection of the geonet seams, inspection of the lower geotextile overlaps, and inspection of the upper geotextile sewing or heat seaming to evaluate conformance with the requirements of Table A5.

6.3 GEOTEXTILES

Non-woven geotextile will consist of continuous filament needle punched non-woven polypropylene, polyethylene or polyamide fabric oriented into a stable network that retains its relative structure during handling, placement, and long-term service. Geotextiles will be used as a separation fabric in the construction of aggregate surfaced roads and will be installed prior to the placement of rip rap.

6.3.1 MATERIAL DESIGN SPECIFICATIONS AND MANUFACTURER TESTING

The geotextile to be used in the final Closure Cap System, as shown on the Contract Drawings, will include geotextile meeting the requirements of Table A6. Results of the manufacturer's quality control testing and inspection reports will be submitted to the Project Engineer for review and verification that the reported test results meet with project specifications at least 7 days prior to delivery of the geocomposite to the job site.

6.3.2 PRE-CONSTRUCTION AND CONFORMANCE TESTING

The geotextile manufacturer will perform quality control testing on the proposed geotextile in accordance with Table A6. The Contractor must demonstrate that the geotextile meets the properties listed in Table A6. Reports documenting the results of the tests required in Table A6 must be submitted to the Project Engineer for review and verification that the reported test results meet with the project specifications at least 7 days prior to delivery of the geotextile to the job site. The geotextile manufacturer and Contractor must satisfy the Project Engineer that the material they propose to furnish and install will meet in every aspect the requirements set forth in these specifications and the requirements in Table A6. The Contractor must transmit to the Project Engineer all information given to him by the manufacturer or supplier 7 days prior to delivery of the geotextile materials to the job site. The specific soils and representative samples of the geotextile materials that will be used at the site must be tested for interface shear strength over the entire range of normal stresses that will develop at the facility as specified in Table A2.

6.3.3 CONSTRUCTION

Nonwoven geotextiles will be placed at the locations shown on the Contract Drawings. All geotextile panels must have their seams overlapped a minimum of 24-inches. Other securing methods must be approved by the Project Engineer prior to use.

When placing aggregate over the geotextile, a minimum of 12-inches of the material must be placed onto the fabric in advance of either tracked or rubber-tired construction equipment operating on top of it, as specified. The aggregate must be placed in the same direction as the fabric is seamed and only pushed upslope, never downslope. Extreme care is required by the Contractor so that the equipment operator does not cause damage to the geotextiles. At no time will construction equipment be permitted to track directly on the fabric. Any damage to the geotextile fabrics must be repaired by the Contractor (using methods acceptable to the Resident Engineer) at no additional expense to the Owner.

6.3.4 Pre-Construction Interface Testing

The specific soils and representative samples of the geosynthetic materials that will be used at the site will be tested for interface shear strength over the entire range of normal stresses that will develop at the facility. Prior to the initial use of each specific geosynthetic material in the construction of engineered components including or adjacent to geosynthetic layers at the facility, the appropriate shear strengths for all soil to geosynthetic and geosynthetic to geosynthetic interfaces will be determined by direct shear testing in accordance with ASTM D5321.

6.3.4.1 Test Requirements

Testing will be performed for each interface and per the parameters specified in Table A2. The Contractor is responsible for providing representative samples in sufficient size of all soil and geosynthetic materials to be tested no less than three weeks prior to the start of geosynthetic material delivery. Every effort should be made to utilize actual soils proposed for construction.

The Contractor shall also state the manufacturer's recommendation, where applicable, regarding which side of the geosynthetic product is to be deployed upward and which downward, and also confirm that this is the installer's plan for deployment of the individual products. The Contractor shall also verify that the manufacturer has provided clear instructions regarding how to determine which side is which, when applicable, in the field such that the installer and CQA inspector can easily determine the correct deployment direction.

The Contractor is responsible for providing materials that exhibit sufficient interface strength to meet the requirements of this specification. The required peak interface shear strength with respect to deep failure of the geomembrane with all associated interfaces must be greater than the peak required by the "system residual shear strength value." The system residual value is defined as the residual shear strength value corresponding to the lowest peak strength for all materials and interfaces (i.e. weakest link design). The average asperity height of the sample from a passing interface shear test will become the new minimum average asperity height for all geomembrane rolls deployed for the project.

7. CONCRETE

The following sections discuss the specific CQA plan requirements for the testing and construction of concrete structures as well as the CQA plan requirements for grout.

7.1 CAST-IN-PLACE CONCRETE

Cast-in-place concrete is to be used for the construction of headwall and outlet structures.

7.1.1 MATERIAL, CONSTRUCTION, AND DESIGN SPECIFICATIONS

Material and construction specifications for cast-in-place concrete are set forth in the Contract Documents.

7.1.2 PRE-CONSTRUCTION CONFORMANCE TESTING

Cast-in-place concrete for use shall be obtained from approved concrete suppliers and shall satisfy the requirements in the Contract Documents throughout delivery and placement of the materials. The Contractor shall submit certified laboratory test reports for each proposed cast-in-place concrete supplier stating that the said material meets or exceeds the requirements set forth in the Contract Documents.

7.1.3 CONSTRUCTION

Place cast-in-place concrete at the locations, lines, grades, and dimensions shown on the Drawings. The subgrade for cast-in-place concrete structures shall be prepared as shown in the Contract Drawings. All formwork, rebar, anchors, and other embedded items for cast-in-place concrete shall be placed and constructed in accordance with the Contract Documents. Concrete shall be placed, consolidated, and cured in accordance with the Specifications. Concrete joints shall be located where shown on the Drawings and constructed in accordance with the Drawings and Specifications.

7.1.4 CONSTRUCTION TESTING

Observation of concrete placement should document that the correct materials are used and suitable construction procedures are being utilized. Onsite testing includes compressive strength test cylinders, slump, entrained air, concrete temperature, and unit weight.

Concrete properties shall meet requirements set forth in **Table A7**, unless explicit approval to deviate is given by the Engineer.

7.2 GROUT

Grout is to be used to abandon portions of the existing spillway pipes, and the CYROP discharge Pipe.

7.2.1 MATERIAL, CONSTRUCTION, AND DESIGN SPECIFICATIONS

Material and construction specifications for grout are set forth in Table A7.

7.2.2 Pre-Construction Conformance Testing

Grout for use shall be obtained from approved concrete suppliers and shall satisfy the requirements in the Contract Documents throughout delivery and placement of the materials. The Contractor shall submit certified laboratory test reports for each proposed ready-mix grout supplier stating that the said material meets or exceeds the requirements set forth in the Contract Documents.

7.2.3 Construction

Place grout at the locations, lines, and dimensions shown on the Drawings.

7.2.4 Construction Testing

Observation of grout placement should document that the correct materials are used and suitable construction procedures are being utilized. Onsite testing includes compressive strength test cylinders.

Grout properties shall meet requirements set forth in Table A7, unless explicit approval to deviate is given by the Project Engineer.

8. Piping

8.1 Piping Systems and Storm Water Structures

All piping and storm water structures used as part of the closure design will be to the sizes and installed in locations as shown on the Contract Drawings.

8.1.1 Material, Construction, and Design Specifications

A summary of piping material and construction requirements is provided in the Contract Documents.

8.1.2 Pre-Construction Conformance Testing

Contractor must submit shop drawings and material samples for each type of pipe and each structure intended for installation to the Resident Engineer for review and approval. The Resident Engineer will verify that the materials meet or exceed the minimum requirements of the Contract Documents.

8.1.3 Construction

Care will be taken during transportation of the pipe such that it will not be cut, kinked, or otherwise damaged. Pipes will be handled and stored in general accordance with the Manufacturer's recommendation. The handling of joined pipe will be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Slings for handling the pipe will not be positioned at joints. Sections of the pipes with deep cuts and gouges will be removed and the ends of the pipe rejoined.

Pipes and storm water structures shall be installed to the elevations, lines, and grades shown in the Contract Drawings. Pipes shall be bedded and backfilled as shown in the Contract Drawings.

The Resident Engineer or CQA Inspector will verify through delivery tickets and material bill of ladings that the material delivered to the site meets the project requirements.

8.1.4 Construction Inspection

The CQA Inspector will monitor and document the following:

- The pipe conforms to the requirements of the specifications and Contract Drawings.
- That pipe and fittings are joined by the methods indicated by the Manufacturer or in the specifications.
- That pipes are properly bedded and covered per the specifications.
- That marker/warning tape is installed in the trench above the pipe to mark its location.

9. SURVEY

9.1 CONTRACTOR'S SURVEYS

9.1.1 SURVEYING PROCEDURES

The purpose of the survey is to verify that actual thickness and grades of the construction components are in accordance with the plans and specifications. Surveying of lines and grades will be conducted during construction of the soil layers. Surveying will be performed to provide documentation for record plans, verify quantities of soils and geosynthetics, and assist the Contractor in complying with the required grades. Review of the surveys conducted at the site will be part of the Construction Quality Assurance program. The permanent benchmarks at the facility will be used for survey control. Surveying will be performed under the supervision of a qualified, professional Land Surveyor licensed in Alabama.

Based on the control points provided by the Owner, the Contractor is to provide all temporary and permanent benchmarks, monuments, and increments needed to control work. If during the work, control points set by the Owner are disturbed by the Contractor, the Contractor will replace the control points.

The following surfaces will be surveyed to determine the lines and grades achieved during cap system construction:

- Top of CCP/Subgrade limits and elevations;
- Limits of geosynthetics, locations of anchor trenches, geomembrane panel limits, repair locations, and destruct locations;
- Top of the Cap Cover layer;
- Final Site Conditions- including alignment, inverts, structures, and termination points of piping; and Profiles, cross sections, inverts for additional swales, benches, ditches, and roads.

9.1.2 ACCURACY REQUIREMENTS & MEASUREMENT SPECIFICATIONS

For the first facility survey mark established from the known control point, the minimum horizontal distance accuracy will be 1 foot horizontal to 2500 feet horizontal. For each facility survey mark established from the first facility survey mark, the minimum horizontal accuracy will be 1 foot horizontal distance to 5000 horizontal. For the first facility survey mark established from the known control point and for each facility survey mark established from the first facility survey mark, the minimum vertical accuracy will be 1 inch to 5000 feet horizontal. The coordinate system will match the system used on the Contract Drawings. The following vertical tolerances apply to each of the following components as they are constructed:

Top of CCR material (geosynthetics subgrade)	0 to - 0.1 feet
Top of soil cover (cap cover soil) =	0 to + 0.2 feet
Invert of pipes =	-0.1 to + 0.1 feet

Note: These tolerances are meant to assure that the required layer thickness and design intent can be met upon final certification. A Professional Surveyor registered in Alabama must certify results of the survey. Survey results for all components shall be provided to the Engineer for approval prior to continuation of subsequent layers. Results of each survey will be included in the certification report provided to the Owner.

9.1.3 As-Built Surveys

The Contractor will complete as-built surveys in order to document the following:

- Top of CCP/Subgrade limits and elevations;
- Limits of geosynthetics, locations of anchor trenches, geomembrane panel limits, repair locations, and destruct locations;
- Top of the Cap Cover layer;
- Final Site Conditions- including alignment, inverts, structures, and termination points of piping; and Profiles, cross sections, inverts for additional swales, benches, ditches, and roads.

A minimum of one cross-section and one profile for every 200 linear feet of the area will be surveyed. At a minimum, survey points will be established at the top, mid-point, and bottom of each slope.

9.2 Surveys by Owner or Engineer

The Owner or Project Engineer may request additional surveys to monitor, verify, or document the work.

TABLES AND FIGURES

TVA COLBERT FOSSIL PLANT
ASH POND 4
TABLE A1
SOIL AND AGGREGATE REQUIREMENTS

COMPONENT	REQUIRED TEST OR OBSERVATION	TEST METHOD	MINIMUM FREQUENCY	SAMPLE SIZE	ACCEPTANCE CRITERIA	RESPONSIBLE PARTY
Structural Fill – Soil	Visual inspection of soil type	ASTM D 2488	Full-time on-site inspection.		Structural fill must consist of soil materials classified as SP, SM, SC, CL-ML, CH, or CL under the Unified Soils Classification System. Relatively free of debris, rock, plant materials, and other foreign matter. 100% ≤ 4-inches except the lift in contact with the geosynthetics shall be 100% < 2-inches	CQA Consultant
	Standard Proctor Density	ASTM D 698	1 test per 10,000 cy	60 lbs.	Capable of producing a maximum dry density of > 100 pcf using Standard Proctor Effort.	CQA Consultant
	Nuclear Densiometer In-Place Moisture Content and Density	ASTM D 6938	In-place density and moisture content per ASTM 6938 at a frequency of 1 test per lift per 100 lineal feet along roadways or subgrades (at least one test per lift); 1 test per lift per ½ acre of structural fill area elsewhere.	N/A	General Structural Fill and Trench Fill shall be compacted ≥ 95% of maximum Standard Proctor dry density and within -3 and +2% of the Optimum Moisture Content.	CQA Consultant
	Proof roll with a fully loaded tandem-axle dump truck or other equivalent equipment with a minimum weight of 25 tons.	N/A	Entire Surface of permanent access roads	N/A	No observed pumping or rutting in excess of 2 inches maximum.	Performed by Contractor CQA Consultant to interpret and approve all proofrolls.

TVA COLBERT FOSSIL PLANT
ASH POND 4
TABLE A1
SOIL AND AGGREGATE REQUIREMENTS

COMPONENT	REQUIRED TEST OR OBSERVATION	TEST METHOD	MINIMUM FREQUENCY	SAMPLE SIZE	ACCEPTANCE CRITERIA	RESPONSIBLE PARTY
	Lift thickness by Observation	N/A	Full-time site inspection observation	N/A	General Structural Fill: < 8-inch loose lift thickness, if using full-size equipment; <4 inch loose lifts if compaction will be with miniature, manual, or walk-behind equipment. Trench Fills: < 6-inch loose lift thickness	CQA Consultant
	Final Lift by Registered Survey	N/A	Survey on 100-foot grid plus all changes in grade.	N/A	Per design, 0 to - 0.1 feet below design grade in all areas of fill placement	Contractor
Ash Fill	Visual inspection of soil type	ASTM D 2488	Full-time on-site inspection.		Ash fill consists of materials classified as SP, SM, SW, ML, CH under the Unified Soils Classification System. Relatively free of debris, rock, plant materials, and other foreign matter. 100% ≤ 4-inches except the lift in contact with the geosynthetics shall be 100% < 2-inches	CQA Consultant
	Standard Proctor Density	ASTM D 698	1 test per 10,000 cy	60 lbs.	To be performed if in place density testing is to be used for material. Or proof roll as discussed below	CQA Consultant
	Drive Cylinder Method	ASTM D 2937	1 test per lift per 1 acre of ash fill placement.	N/A	Be compacted ≥ 90% of maximum Standard Proctor dry density	CQA Consultant
	Lift thickness by Observation	N/A	Full-time site inspection observation	N/A	≤ 8-inch loose lift thickness	CQA Consultant
	Final Lift by Registered Survey	N/A	Survey on 100-foot grid plus all changes in grade.	N/A	Per design, 0 to - 0.1 feet above or below design grade in all areas of fill placement	Contractor

TVA COLBERT FOSSIL PLANT
ASH POND 4
TABLE A1
SOIL AND AGGREGATE REQUIREMENTS

COMPONENT	REQUIRED TEST OR OBSERVATION	TEST METHOD	MINIMUM FREQUENCY	SAMPLE SIZE	ACCEPTANCE CRITERIA	RESPONSIBLE PARTY
Cap Cover Soil	Visual inspection of soil type	ASTM D 2488	Full-time on-site inspection.		Structural fill must consist of soil materials classified as SP, SM, SC, CL-ML, CH, or CL under the Unified Soils Classification System. Relatively free of debris, rock, plant materials, and other foreign matter. 100% ≤ 6-inches except the lift in contact with the geosynthetics shall be 100% < 2-inches	CQA Consultant
	Lift Depth (Visual Inspection)	N/A	In-Place material	N/A	Observed to be ≥ 8 inch loose lifts. Top 6 inches must be able to support vegetation. Relatively free of debris, rock, plant materials, and other foreign matter. 100% ≤ 4-inches except the lift in contact with the geosynthetics shall be 100% < 2-inches	CQA Consultant
	Vegetative Cover Soil Analysis		1 per Borrow Source	50 lbs.	Able to support vegetative growth	Contractor
	Final Lift by Registered Survey		In-Place material	N/A	Per design, 0 to +0.1 feet above design grade in all areas of soil layer placement.	Contractor
Rip Rap	Lift thickness by Observation	N/A	Full-time site inspection observation	N/A	Per the Contract Documents	CQA Consultant
Bedding and Backfill (structures and pipes**)**	Lift thickness by Observation	N/A	Full-time site inspection observation	N/A	Per the Contract Documents	CQA Consultant
	Sieve Analysis	ASTM D422	1 per Borrow Source	60 lbs.	ALDOT #57 stone per Contract Documents	Contractor / Supplier

TVA COLBERT FOSSIL PLANT

ASH POND 4

TABLE A1

SOIL AND AGGREGATE REQUIREMENTS

COMPONENT	REQUIRED TEST OR OBSERVATION	TEST METHOD	MINIMUM FREQUENCY	SAMPLE SIZE	ACCEPTANCE CRITERIA	RESPONSIBLE PARTY
Aggregate Road Surface	Lift thickness by Observation	N/A	Full-time site inspection observation	N/A	Per the Contract Documents	CQA Consultant
	Sieve Analysis	ASTM D422	1 per Borrow Source	60 lbs.	ALDOT Crushed Aggregate 100% passing the 1" sieve and less than 10% passing the #200 sieve.	Contractor / Supplier
	Proof roll with a fully loaded tandem-axle dump truck or other equivalent equipment with a minimum weight of 25 tons.	N/A	Entire Surface.	N/A	No observed pumping or rutting in excess of 2 inches maximum.	Performed by Contractor CQA Consultant to determine adequate strength to satisfy bearing capacity.

TVA COLBERT FOSSIL PLANT

ASH POND 4

TABLE A2

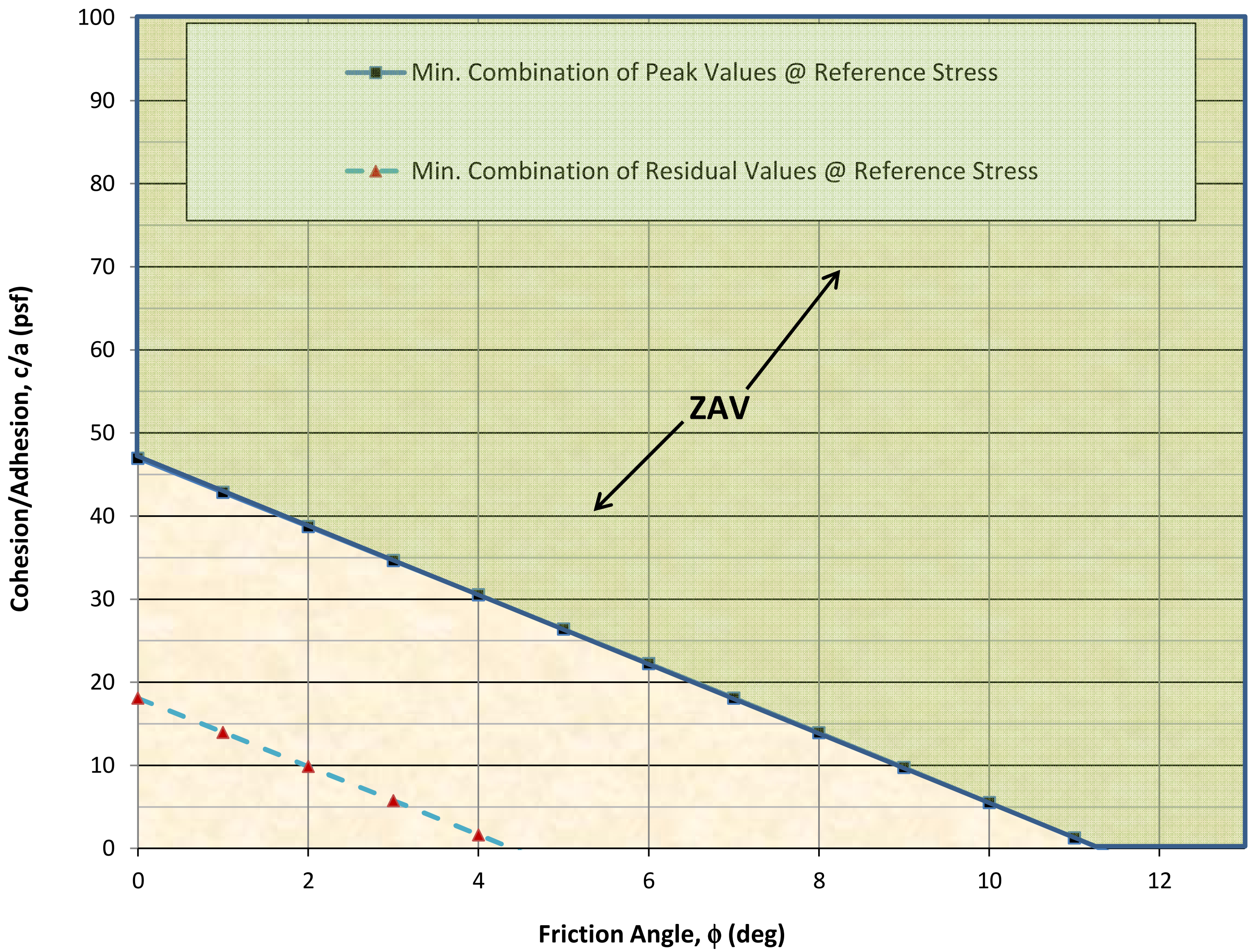
PRE-CONSTRUCTION INTERFACE TESTING

MINIMUM PEAK INTERFACE SHEAR STRENGTHS

System	Interface	Direct Shear Test Parameters					Acceptance Criteria
		Normal Stress (psf)			Min. Seat Time (hrs)	Max. Strain Rate (in/min)	
		Low	Medium	High			
Cap	Cap Cover Soil / Geocomposite	120	240	360	24	0.04	With the ZAV criteria shown in Figure A2-A (8% slope, peak and residual strength)and Figure A2-B (short length 33% slope, peak and residual strength)
	Geocomposite / 40mil FML				1	0.2	
	40mil FML / Subgrade				24	0.04	

Testing to be conducted for all soil-geosynthetic and all geosynthetic-geosynthetic interfaces. For textured geomembrane, the manufacturer shall identify, if applicable, which side of the product is intended to be installed upward and which downward and the contractor shall be made to confirm their intentions for installation. When agreed, the independent laboratory shall be instructed to arrange the test layers in the exact manner as intended to be installed.

FIGURE A2-A - Cap System ZAV (8% Slope)



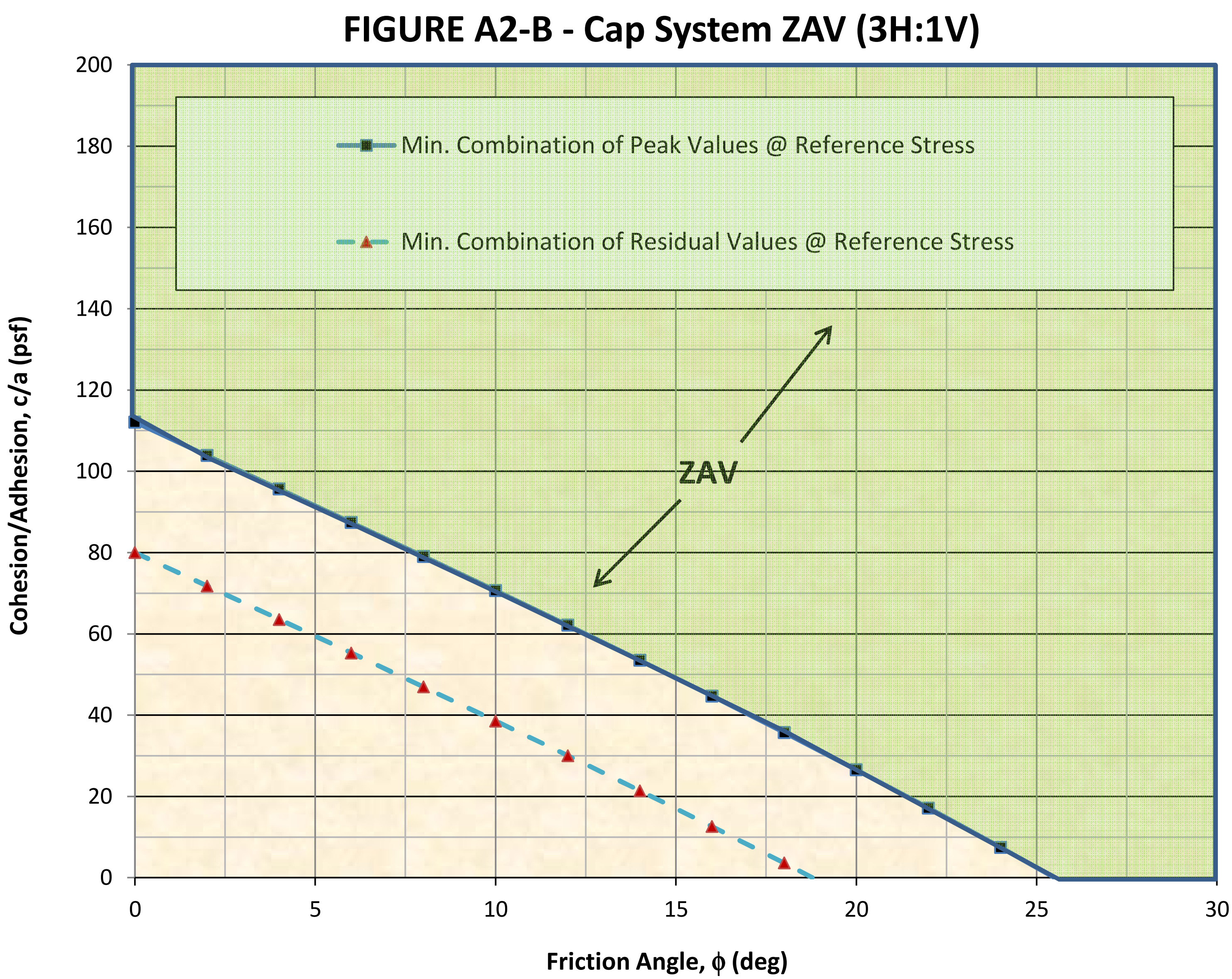


FIGURE A2-B - Cap System ZAV (3H:1V)
Min. Combination of Peak Values @ Reference Stress
Min. Combination of Residual Values @ Reference Stress
ZAV
Cohesion/Adhesion, c/a (psf)
Friction Angle, ϕ (deg)
200
180
160
140
120
100
80
60
40
20
0
0
5
10
15
20
25
30

TVA COLBERT FOSSIL PLANT
ASH POND 4
TABLE A3
CALIBRATION OF TESTING EQUIPMENT

EQUIPMENT	REQUIRED TEST	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Nuclear Density Gauge	Radioactive Source Wipe Testing and Systems Electronics Check	Annually by Manufacturer or Specialty Testing firm qualified to inspect and calibrate nuclear source equipment	Certificate of Calibration and Safety by Testing Firm
Tensiometer	Tensile strength calibration to standard	Prior to arrival to project site. Tensionmeter to be field verified at the discretion of the Engineer	+/- 3 ppi
Air Pressure Gauges	Pressure in psi compared to standard	Prior to arrival to project site or documentation that the product is new	+/- 1 psi
Other	As Determined by the Engineer	As Recommended by the Manufacturer, or Required by State Auditor of Measurement Devices	As Guaranteed by the Manufacturer

TVA COLBERT FOSSIL PLANT
ASH POND 4
TABLE A4
MINIMUM TESTING FOR GEOMEMBRANE
40-MIL TEXTURED LINEAR LOW DENSITY POLYETHYLENE

Unless otherwise noted, the liner material will possess the following minimum average roll values:

PARAMETER[(2)]	TEST METHOD	TEST FREQUENCY		ACCEPTANCE CRITERIA
		QC Testing	QA Testing	
Thickness (mils)	ASTM D-5994 GRI-GM8	Each roll	1 per 100,000 sf	38 minimum average 34 minimum individual 36 minimum for at least 8 of 10 individual
Asperity Height (mils)	GRI-GM12	Each roll	1 per 100,000 sf	All results must meet or exceed minimum average asperity height of material as determined by the direct shear testing
Density (g/cm^3)	ASTM D1505/ D792	1 per 200,000 lb.	1 per 100,000 sf	0.939 (max.)
Strength at Break (ppi) Elongation at Break (%)	ASTM D 6693	1 per 20,000 lb	1 per 100,000 sf	≥ 60 ≥ 250%
Carbon Black Content Carbon Black Dispersion Oxidative Induction Time (OIT)	ASTM D 1603 ASTM D 5596 ASTM D3895 or D5885	1 per 45,000 lb. 1 per 45,000 lb. 1 per 200,000 lb.	1 per 100,000 sf 1 per 100,000 sf NA	2% to 3% 9 in Category 1 or 2 and 1 in Category 3 100 min. (ASTM D3895) or 400 min. (ASTM D5885)
Oven Aging at 85°C	ASTM D5721	Per each formulation	NA	35% (standard) or 60% (high pressure)
UV Resistance	ASTM D5885	Per each formulation	NA	35%
Pre-Construction Interface Testing	ASTM D 6243-98	NA	Once per construction event	See Table A2
Seam Shear Strength (PPI) [(1)] Seam Peel Strength (PPI) [(1)]	ASTM D 6392 ASTM D 6392	1 per welder per machine prior to each seaming period 1 per welder per machine prior to each seaming period	1 every 500 feet of seam length 1 every 500 feet of seam length	60 ppi and all tests film tear bond. 50 (fusion) and 44 (extrusion) ppi and all tests film tear bond.
Air Pressure Vacuum Box Testing	ASTM D 5820 ASTM D 5641	All fusion welds All extrusion welds	NA	Pressurize to 25 psi (min.) for 5 minutes, ≤ 3 psi loss, note pressure drop when far seam is cut Examine weld for 10 seconds through window of vacuum box at min. 3 psi

(1) For reduction in the frequency of destructive testing, see CQA Plan Section 5.1.4.

(2) Geomembrane manufacturers will provide QC certification test results for all parameters listed in this table except for interface friction, seam shear strength and peel strength.

TVA COLBERT FOSSIL PLANT
ASH POND 4
TABLE A5
MINIMUM TESTING FOR DOUBLE-SIDED GEOCOMPOSITE

PARAMETER	TEST METHOD	TEST FREQUENCY		ACCEPTANCE CRITERIA
		QC Testing	QA Testing	
Geonet				
Thickness (mils)	ASTM D 5199	See Note 2	NA	250 (min. or as required to achieve required transmissivity)
Density (g/cm^3)	ASTM D 1505	See Note 2	NA	≥ 0.94 (min. avg.)
Creep Reduction Factor	GRI GC8	Certify	NA	1.1 @ 1,000 psf
Geotextile				
Apparent Opening Size	ASTM D 4751	See Note 2	1 per 250,000 sq. ft.	80 (sieve no.)
Grab Tensile Strength	ASTM D 4632	See Note 2	1 per 250,000 sq. ft.	225 lb (min.)
Mass per unit area	ASTM D5261	See Note 2	1 per 250,000 sq. ft.	8 oz./s.y.
Permittivity	ASTM D4491	See Note 2	1 per 250,000 sq. ft.	1.2 sec^{-1} (min.)
CBR Puncture Strength	ASTM D6241	See Note 2	1 per 250,000 sq. ft.	520 lb (min.)
UV resistance	ASTM D4355	Certify	N/A	70% (min.)
Geocomposite				
Transmissivity [(1)] (@ 240 psf normal load, gradient = 0.33	ASTM D 4716	See Note 2	1 per 100,000 sq. ft.	5 x 10^{-4} m^2/sec
Ply Adhesion	GRI-GC7	See Note 2	1 per 250,000 sq. ft.	1 ppi (minimum)

Notes
1) Transmissivity shall be measured under the same boundary conditions (soil/geosynthetics) as those to be constructed.
2) At the manufacturer's recommended frequency unless noted otherwise.

TVA COLBERT FOSSIL PLANT
ASH POND 4
TABLE A6
MINIMUM TESTING FOR NON-WOVEN GEOTEXTILE

PARAMETER	TEST METHOD(1)	TEST FREQUENCY		ACCEPTANCE CRITERIA
		QC Testing	QA Testing	
Apparent Opening Size	ASTM D 4751	See Note 1	1 per 250,000 sq. ft.	80 U.S. Sieve (min)
Grab Tensile Strength	ASTM D 4632	See Note 1	1 per 250,000 sq. ft.	220 lbs (min.)
Mass per unit area	ASTM D5261	See Note 1	1 per 250,000 sq. ft.	8 oz/sy (min.)
Permittivity	ASTM D4491	See Note 1	1 per 250,000 sq. ft.	1.30 sec^{-1} (min.)
CBR Puncture Strength	ASTM D6241	See Note 1	1 per 250,000 sq. ft.	535 lbs (min.)
UV resistance	ASTM D4355	Certify	N/A	70% (min.)

Notes
1) At the manufacturer's recommended frequency unless noted otherwise.

TVA COLBERT FOSSIL PLANT
ASH POND 4
TABLE A7
MINIMUM TESTING FOR CONCRETE AND GROUT

COMPONENT	REQUIRED TEST OR OBSERVATION	TEST METHOD	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA	RESPONSIBLE PARTY
Cast-In-Place Concrete	Mix Design	N/A	1 per mix	Submit for Review	Contractor/Supplier
	Concrete Cylinders	ASTM C 31	One set of 4 cylinders per placement and one additional set each 50 CY of concrete thereafter	N/A	Sample collection by CQA Consultant Testing by CQA Consultant
	Compressive Strength	ASTM C 39	1 break at 7 days 2 breaks at 28 days 1 spare	4,000 psi (28 day)	
	Slump	ASTM C 143	Each set of cylinders	<u><8</u> inches	
	Entrained Air	ASTM C 231	Each set of cylinders	4.5% to 7.5%	
	Temperature	ASTM C 1064	Each set of cylinders	50 to 95 °F	
	Unit Weight	ASTM C 138	Each set of cylinders	N/A	
	Rebar	Visual Inspection	Each structure	Per Contract Drawings and Shop Drawings	CQA Consultant
Grout	Mix Design	N/A	1 per mix	ALDOT Section 260 Cement Mortar Flowable Backfill Mix 2, or approved equal	Contractor/Supplier
	Cylinders	ASTM D 5971 ASTM D 4832	One set of 4 cylinders per placement and one additional set each 50 CY thereafter	N/A	Sample collection by CQA Consultant Testing by CQA Consultant
	Compressive Strength	ASTM D 4832	1 break at 3 days 1 break at 7 days 1 break at 28 days 1 spare	70 psi (3 day) 130 psi (7 day) 150 psi (28 day)	

APPENDIX A1

FORMS AND LOGS

AECOM

FIELD COMPACTION TESTING

Project: ______________________________ Report No.: ____________

______________________________ Date: ____________

AECOM Personnel: ____________

Project No. ____________________

Client: ____________________

Field Test Equipment: Troxler : ____________________________

Standard Counts: Moisture __________________ Density ______________________

Lift Thickness, in.: __" loose

Laboratory Reference Compaction: ___ pcf @ ___%

Placement Area: ____

TEST DATA

Lift Test No.	Location	Lift No.	Percent Water Content	In Place Dry Density/ PCF	Percent Compaction	Pass/ Fail	Type of Material	Comments
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

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BY: ______________________

RESIDENT REPRESENTATIVE

AECOM
1300 E. 9th Street
Cleveland, Ohio 44115
(216)622-2400

AECOM

CONCRETE TESTING LOG

Project: ____________________
Contractor: ____________________
Owner: ____________________
Job No. ____________________

Specified Slump: __________
Specified Entrained Air: __________
Specified Compressive Strength: __________

Set Number	Sample Date	Ticket Number	Entrained Air (%)	Slump (inches)	Compressive Strength (psi)				Comments
					7 Day	28 Day	28 Day	56 Day	

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Construction Progress Report

Report No. 1

Project:
Contractor:
Owner:
Job No.

Date	**Cal. Day** 1
Day:	
AM Temp. & Weather	**PM Temp. & Weather**

Contractor	Work Force	Equipment

Description of Work in Progress:

Item	Description	Quantity	Location

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FIRM: AECOM

Destructive Test Log

Project: ____________________ **Product:** ______________________________

Contractor: ____________________ ______________________________

Owner: ____________________ ______________________________

Job No. ____________________ ______________________________

Date Welded	Date Pulled	Sample ID #	Seam Number	Mach. Number	Seamer Initials	Test Mode	Test Results in LBS/IN					Pass Fail
							Sample Number					
							1	2	3	4	5	
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
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						PEEL						
						SHEAR						

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AECOM

Non Destructive Testing Log

Project: ______________________

Contractor: ______________________

Owner: ______________________

Job No. ______________________

Product: ______________________

Date	Seam Segment	Tester Initials	Pressure PSI Start	Pressure PSI End	Test Time Start	Test Time End	Pass Fail	V-Box Pass	Comments

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Panel Placement

Project: ______________________ **Product:** ______________________
Contractor: ______________________ ______________________
Owner: ______________________ ______________________
Job No ______________________ ______________________

Date	Panel Number	Roll Number	Panel Length	Panel Width	Square Footage	Comments
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	
					0.0	

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Panel Seaming Form

Project: ______________________ **Product:** ______________________

Contractor: ______________________ ______________________

Owner: ______________________ ______________________

Job No. ______________________ ______________________

Date	Seam Number	Time	Seamer Initials	Machine Number	Seam Length (ft)	Comments

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BY: ______________________

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AECOM

Pipe Test Log

Project: ____________________

Contractor: ____________________

Owner: ____________________

AECOM Job No. ____________________

Date	Test Section	Length (feet)	Pipe Dia (inches)	Min Test Time (sec.)	Start Time	Start Press (psi)	End Time	End Press (psi)	Test length (sec)	Press Drop (psi)	Pass / Fail

time for 1 psi pressure drop: $T = 0.085\ DK / 0.0015$

$K = 0.000419\ DL$, but not < 1

D = Diameter in inches

L = Length in feet

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BY: ____________________

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REPAIR LOG

Project: ____________________ **Product:** ____________________

Contractor: ____________________ ____________________

Owner: ____________________ ____________________

Job No. ____________________ ____________________

Repair Number	Repair Date	Time of Repair	Location of Repair	Size of Repair	Repair Tech	Machine Number	V-Box Test	COMMENTS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
13								
14								
23								
24								
25								
26								
27								
28								
29								
30								

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____________________ RESIDENT REPRESENTATIVE

AECOM

SHOP DRAWING / SUBMITTAL LOG

Project: ____________________
Contractor: ____________________
Owner: ____________________
Job No. ____________________

Original Submittal				Re-submittal			
Transmittal Number	Date Received	Date Returned	Status	Date Received	Date Returned	Status	Description

COPIES ____________________
____

BY: ____________________
RESIDENT REPRESENTATIVE

AECOM

Trial Weld Log

Contractor: ____________________

Owner: ____________________

Job No. ____________________

Product: ______________________________

Date	Time	Mach. Number	Seamer Initials	Fusion Welder Wedge Temp	Fusion Welder Speed Ft/Min	Test Mode	Test Results in LBS/IN Sample Number 1	2	3	4	5	Pass Fail
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
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						PEEL						
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						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						

Date	Time	Mach. Number	Seamer Initials	Extrusion Welder Barrel Temp	Extrusion Welder Preheat Setting	Test Mode	Test Results in LBS/IN Sample Number 1	2	3	4	5	Pass Fail
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						
						PEEL						
						SHEAR						

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BY: ____________________

RESIDENT REPRESENTATIVE

Attachment H

Operation Plans

CCR Fugitive Dust Control Plan, Revision 2 by TVA dated December 13, 2019.

Periodic Inflow Design Flood Control System Plan Ash Disposal Area 4 by Stantec dated October 12, 2021.

Ash Pond 4 Groundwater Monitoring Plan by Stantec dated November 3, 2021.

CCR FUGITIVE DUST CONTROL PLAN

COLBERT FOSSIL PLANT
COAL COMBUSTION PRODUCTS
TUSCUMBIA, ALABAMA

Prepared by:

TENNESSEE VALLEY AUTHORITY
1101 Market Street
Chattanooga, TN 37402-2801

December 13, 2019 (Amended)

Revision or Change Number	Date Placed in Operating Record	Affected Page Numbers	Description of Revision/Change
0	10/19/15	All	Initial Plan
1	12/15/17	1	Facility updates in Section 1.1, Updated Dust Control Measures in Section 2.0.
2	12/13/19	1, 2	Facility updates in Section 1.1, Updated Dust Control Measures in Section 2.0, Updated Section 3.2 with maintenance activities documentation.

Table of Contents

Page

CERTIFICATION

I certify that this plan meets the requirements of 40 CFR 257.80, Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities.

Signature

December 13, 2019
Date

ALABAMA
LICENSED
No. 36540
PROFESSIONAL
ENGINEER
JASON CURTSINGER
12/13/19

1.0 OVERVIEW

This CCR Fugitive Dust Control Plan (Plan) provides a program for minimizing fugitive dust events originating from day-to-day operations for Coal Combustion Residuals (CCR) management at the Colbert Fossil Plant (COF or Site) of the Tennessee Valley Authority (TVA), located in Tuscumbia, Alabama. This document provides measures to effectively minimize CCR from becoming airborne from CCR units, CCR piles, roads, and other CCR management activities. This plan has been developed in accordance with 40 CFR 257.80, Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities.

1.1 Facility Description

COF was a fossil-fueled, steam-electric generating plant operated by TVA that had five coal-fired generating units. Power production ceased at the facility on March 24, 2016. Closure construction of Ash Disposal Area 4, consisting of installation of a geomembrane cap system with soil cover, is complete. The facility is covered with vegetation.

2.0 FUGITIVE DUST CONTROL MEASURES

All of the CCR material at the unit is capped, therefore, CCR dust cannot originate from the facility. Construction activities have ceased and vegetation has been established on the facility. If needed, dust control measures that may be utilitized include:

- Berms constructed as wind breaks
- Interim soil cover
- Chemical dust suppressants
- Mobilization and use of water trucks

3.0 RECORD KEEPING

This Plan and the following associated documents will be placed in the Site's operating record once completed, and proper notification will be provided to the State Director. The following documents will also be made publically available on the Site's "CCR Rule Compliance Data and Information" website.

3.1 Citizen Input

Citizens can provide input and submit complaints/concerns relative to fugitive dust by calling 1-844-TVA-DUST (882-3878). Comments will be logged and submitted to TVA's Coal Combustion Product Management (CCPM) Group for review and response. Upon receipt, appropriate CCPM Management personnel will investigate the complaint/concern and implement any additional dust control measures required. Examples of additional dust control measures which may be considered for implementation are described in Section 2.0. Upon completion, the results of the investigation and a description of any associated corrective measures employed by the site will be added to the log.

3.2 Annual CCR Fugitive Dust Control Report

The Ash Disposal Area 4 at COF is capped and closed. TVA continues to perform maintenance activities and routine inspections of the cap system. Should the cap system be removed and CCR exposed for any reason, applicable best management practices described above will be implemented and will be documented on this CCR website as prescribed in the record-keeping requirements of 40 C.F.R. §257.105, 40 C.F.R. §257.106, and 40 C.F.R. §257.107.

4.0 ASSESSMENT OF CCR FUGITIVE DUST CONTROL PLAN

This Plan will be evaluated annually in conjunction with preparation of the annual CCR Fugitive Dust Control Report. Operating personnel at the Site have been instructed to record any evidence of fugitive dust events or deficiencies in the current fugitive dust control measures as well as report such issues to the TVA Field Supervisor. Evaluation of plan effectiveness will include a review of the Construction Contractor/TVA observation reports and any reported public complaints/concerns. Any necessary amendments or revisions required to rectify noted issues will be incorporated into the updated Plan.

Stantec Consulting Services Inc.
3052 Beaumont Centre Circle, Lexington, KY 40513
Address

October 12, 2021
File: rpt_014_let_175568465
Revision 0

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

RE: Periodic Inflow Design Flood Control System Plan
Ash Disposal Area 4
EPA CCR Rule
TVA Colbert Fossil Plant
Tuscumbia, Alabama

1.0 PURPOSE

This letter documents Stantec's certification of the inflow design flood control system plan in accordance with 40 CFR 257.82(a)&(b) of the EPA CCR Rule for Ash Disposal Area 4 at the TVA Colbert Fossil Plant. The EPA CCR Rule requires periodic inflow design flood control assessments, certified by a qualified professional engineer, every five years. The initial certification of the inflow design flood control system plan was placed in the operating record on October 12, 2016.

2.0 INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN ASSESSMENT

The initial inflow design flood control plan, performed in 2016, found that Active Ash Pond 2 met the requirements of 40 CFR 257.82(a)&(b).

3.0 CURRENT INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN ASSESSMENT

Stantec reviewed the initial assessment and the changes in site conditions that have occurred in the past five years. The following changes have occurred that affect the initial assessment:

1. Ash Disposal Area 4 has been capped and closed and the area is no longer designed to impound surface water. The site is graded to convey stormwater to the north and south of the impoundment. Stormwater discharges through a 30-inch diameter HDPE culvert (north) and a 36-inch diameter HDPE culvert (south).

Because of these changes, an updated inflow design flood control plan was prepared and is attached to this letter. The updated plan shows that the culverts are capable of conveying the 1,000-year, 6-hour storm without overtopping the crest of the surrounding dike.

Re: **Periodic Inflow Design Flood Control System Plan**
Ash Disposal Area 4
EPA CCR Rule
TVA Colbert Fossil Plant
Tuscumbia, Alabama

4.0 SUMMARY OF FINDINGS

The attached plan presents the analysis of the inflow design flood control system for Ash Disposal Area 4. The resulting water surface elevations are shown in the following table. The plan and results show that the impoundment meets the requirements set forth in 40 CFR 257.82(a) and (b).

Plant	Facility	Inflow Design Storm	Water Surface Elevation (feet)	Minimum Embankment Elevation (feet)
COF	Ash Disposal Area 4	1000-year storm	446.6 (South)	447
			446.2 (North)	447

5.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Robert D. Fuller, being a Professional Engineer in good standing in the State of Alabama, do hereby certify, to the best of my knowledge, information, and belief:

1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;

2. that the information contained herein is accurate as of the date of my signature below; and

3. that the inflow design flood control system plan for the TVA Colbert Fossil Plant's Ash Disposal Area 4 meets the requirements specified in 40 CFR 257.82(a), (b), and (c)(1).

SIGNATURE Robert D. Fuller DATE 10/12/2021

ADDRESS: Stantec Consulting Services Inc.
3052 Beaumont Centre Circle
Lexington, Kentucky 40513

ALABAMA LICENSED No. 30931 PROFESSIONAL ENGINEER ROBERT DANIEL FULLER

Re: **Periodic Inflow Design Flood Control System Plan**
Ash Disposal Area 4
EPA CCR Rule
TVA Colbert Fossil Plant
Tuscumbia, Alabama

TELEPHONE: (859) 422-3000

ATTACHMENTS: Periodic Inflow Design Flood Control System Plan

Inflow Design Flood Control System Plan

Colbert Fossil Plant – Ash Disposal
Area 4
Tuscumbia, Alabama

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 11, 2021
Revision A

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 BACKGROUND

On April 17, 2015 the "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals (CCR) from Electric Utilities (RIN-2050-AE81;FRL-9149-4)" (EPA Final CCR Rule) was published in the Federal Register. Stantec Consulting Services, Inc. (Stantec) was contracted by the Tennessee Valley Authority (TVA) to analyze the inflow design flood for Colbert Fossil Plant (COF) Ash Disposal Area 4 and evaluate compliance with section §257.82 of the EPA Final CCR Rule.

COF is a former coal-fired, electric generating plant located in Colbert County, Alabama, on Pickwick Lake, a reservoir along the Tennessee River. TVA has determined that Ash Disposal Area 4 is a CCR Surface Impoundment and therefore subject to the CCR rule. A figure showing the location of COF in relation to the surrounding hydrologic features is included as Appendix A. Figure 1 below shows the location of Ash Disposal Area 4 in relation to the other plant features.

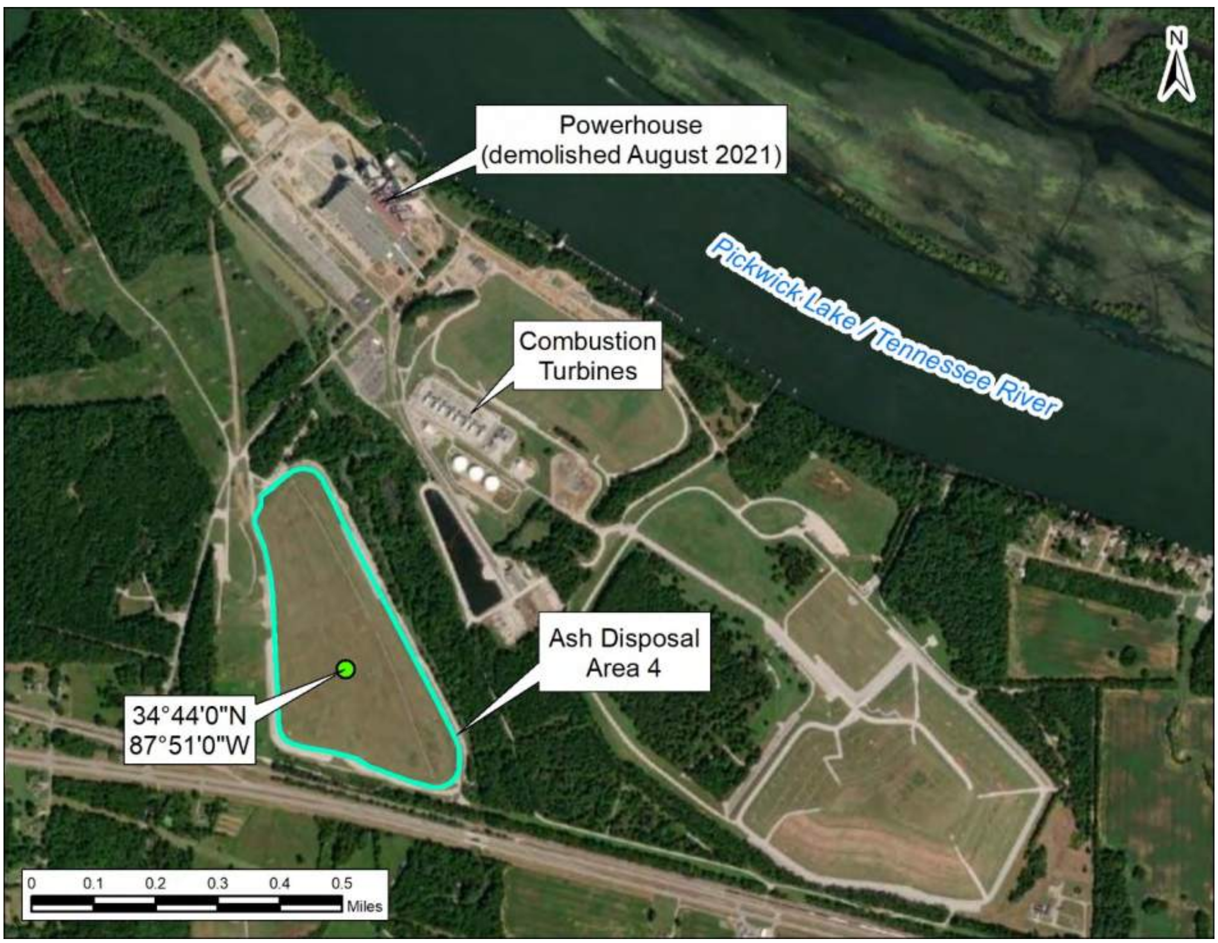


Figure 1 Colbert Fossil Plant Map

2.0 EXISTING CONDITIONS

Ash Disposal Area 4 is located south of the former powerhouse. Rainfall is the only source of inflow received by Ash Disposal Area 4, which is conveyed through two culverts: one at the southeast end of the drainage area and another at the north end. Both culverts drain into Cane Creek just upstream of its confluence with Pickwick Lake.

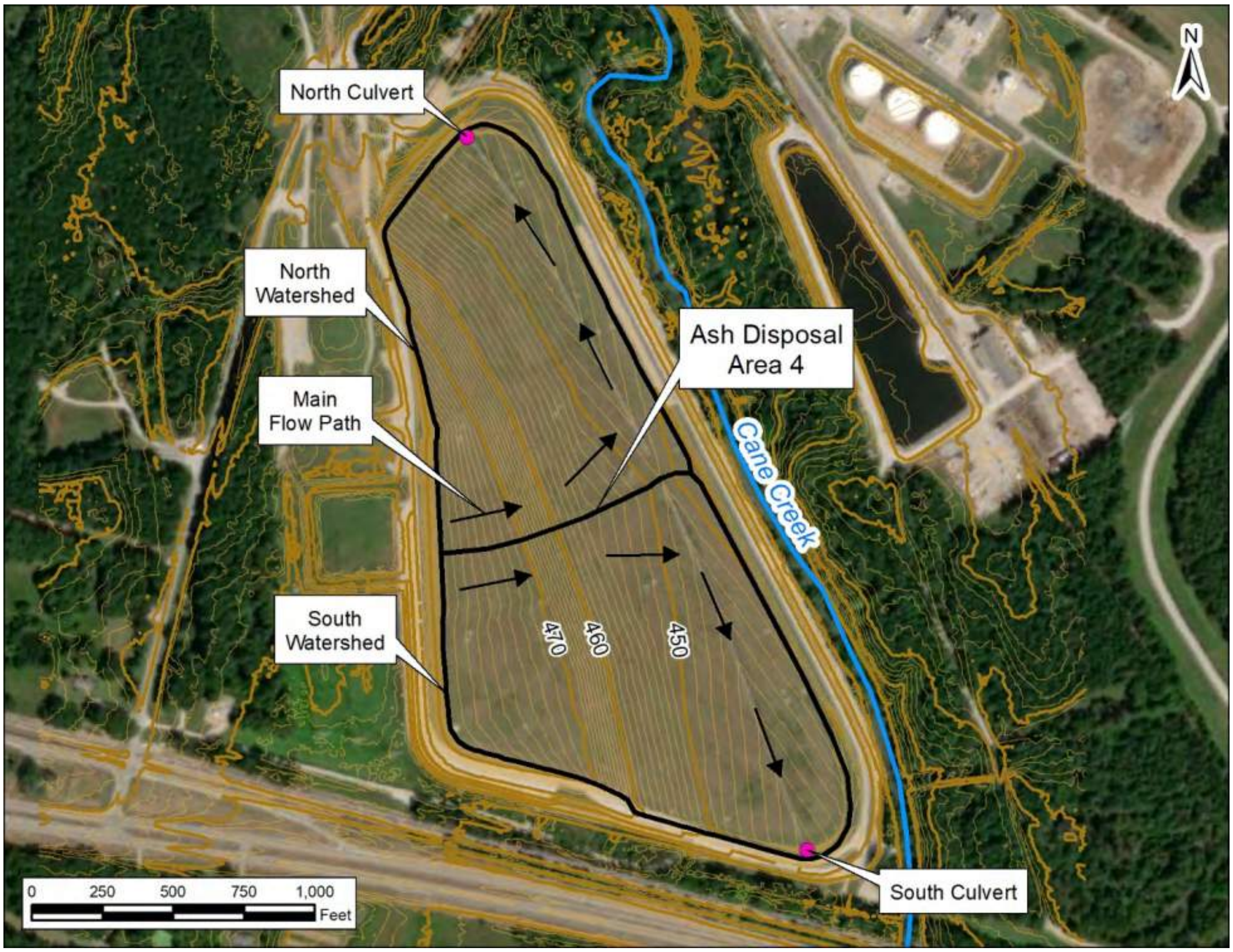


Figure 2 Map of Hydraulic Structures

3.0 METHODS / DESIGN CRITERIA

This Inflow Design Flood Control System Plan has been developed to document how the inflow design flood control system has been designed and constructed to meet the requirements of §257.82. The East Ash Disposal Area is currently classified as a significant hazard structure. This plan has been developed based on that classification and the following CCR rule criteria apply:

1. The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood. (Ref. §257.82(a)(1))
2. The inflow design flood control system must collect and control flow from the CCR unit during and following the peak discharge of the inflow design flood. (Ref. §257.82(a)(2))
3. The inflow design flood for a significant hazard potential CCR surface impoundment is the 1000-year flood. (Ref. §257.82(a)(3)(ii))
4. Discharge from the CCR Unit must be handled in accordance with the surface water requirements under §257.3-3
5. The owner or operator must prepare an initial inflow design flood control system plan for its existing surface impoundments by October 17, 2016. (Ref. §257.82(c)(3)(i))
6. The plan must be revised every 5 years, and amendments must be made whenever there is a change in condition(s) that would substantially affect the written plan in effect. (Ref. §257.82)(c)(4) & (2))
7. This plan will be considered complete upon its placement in the facility's operating record. (Ref. §257.82(c)(1))
8. The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic inflow design flood control system plans meet the requirements of §257.82.

Hydrologic calculations were performed based on Soil Conservation Service Technical Release 55 (TR-55) methods in U.S. Army Corps of Engineers' Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) software to analyze the performance of the impoundments for the 1000-year storm. The CCR rule does not specify the storm duration for the inflow design flood. For this analysis, a duration of 6-hours was chosen based on recommendations from TVA. This duration is reasonable given the size of the watershed and the travel time to the watershed outlet.

The following sections describe the hydrologic parameter inputs to the HEC-HMS model, including curve number and lag times, in addition to the channel hydraulics.

3.1 MODELING ASSUMPTIONS

1. Pipes are assumed to be flowing freely and not clogged or leaking.
2. Natural Resources Conservation Service (NRCS) TR-55 methods were used for hydrologic run-off computations.
3. Ash Disposal Area 4 storage was included in the model.
4. The north and south culverts contain three pipe segments. These pipe segments consist of the same pipe diameter and material, but the lengths and slope vary. In HEC-HMS, only the initial pipe segment was modeled. The results were checked to confirm that shallower pipe slopes (in other segments of the pipe) would not adversely affect the results.
5. Effects of tailwater were not included in the modeling; it was assumed tailwater would not limit the capacity of the culverts due to the large elevation difference (approx. 20 feet) between the inlet and outlet inverts.

3.2 HYDROLOGY INPUTS

3.2.1 Watershed Parameters

Watersheds were delineated using topographic data included in as-built drawings dated September 4, 2018, provided by TVA. The estimated watershed parameters are summarized in Table 1. A figure showing the watershed delineations is included in Appendix B.

Table 1 Watershed Parameters

Watershed	Drainage Area (acres)	Composite Curve Number	Estimated Lag Time (min)
South Culvert	28.9	74	12.4
North Culvert	22.1	74	12.6

3.2.1.1 Curve Number (CN)

The curve number for each watershed was calculated using the approach outlined in NRCS's TR-55. From the as-built drawings provided by TVA, Ash Disposal Area 4 was capped with soil and grass cover corresponding to Hydrologic Soil Group C with grass cover in good condition. Therefore, both watersheds were assigned a curve number of 74.

3.2.1.2 Lag Time

The time of concentration for each watershed was calculated using the NRCS segmental approach described in TR-55. The longest hydraulic flow path in each watershed was delineated with contour data dated September 4, 2018, provided to Stantec by TVA. The flow paths were subdivided into sheet, shallow-concentrated, and open channel components. The following methods were used to calculate flow velocities (time of concentration was then found by dividing flow length by velocity) for each flow component:

- Sheet Flow: Sheet flow velocity was computed based on the equation presented in TR-55. This equation calculates time of concentration based on Manning's roughness coefficient for sheet flow, flow length (up to a maximum distance of 100 feet, unless the area is paved), slope, and the 2-year 24-hour rainfall depth.
- Shallow Concentrated Flow: Shallow Concentrated Flow was computed based on equations presented in TR-55. The travel time is computed based on the flow length and average velocity. The equations used to calculate average velocity are dependent upon the watercourse slope and whether the surface is "Paved" or "Unpaved". The equations were derived from the graph "Average velocities for estimating travel time for shallow concentrated flow" presented in TR-55.
- Open Channel Flow: Open channel flow was computed based on Manning's equation as presented in TR-55. Manning's equation calculates the velocity using the channel's hydraulic radius, slope, and Manning's roughness coefficient. Each channel within the ash disposal area was analyzed as a triangular ditch with side slopes of 50H:1V based on the existing topographic data.

Lag time calculations are included in Appendix D.

3.2.2 Spillway Data

As described in Section 2, there are two single-pipe outlets within Ash Disposal Area 4 which discharge to Cane Creek.

Dimensions and elevations for the two outlet structures were obtained from TVA Drawing 10W396-21. This drawing is included in Appendix E. The geometry for both structures is summarized in Table 2.

Table 2 Ash Disposal Area 4 Spillway Data

Outlet Structure	Outlet Pipe Diameter (inches)	Pipe Inlet Invert (ft)	Pipe Outlet Invert (ft)	Pipe Length (ft)
South	36	442.25	439.75	22.04
		439.75	435.33	160.33
		435.33	422.40	106.64
North	30	442.00	435.65	21.00
		435.65	425.47	144.45

As shown in Table 2, the south culvert contains three pipe segments and the north culvert contains two pipe segments. These pipe segments consist of the same pipe diameter and material, but the lengths and slope vary. In HEC-HMS, the initial pipe segment was entered as an outlet structure.

3.2.3 Precipitation Data

The rainfall depth for the 1000-yr, 6-hour storm is 7.3 inches based on NOAA Atlas 14 at COF. "Early", "Middle" and "Late Peak" hyetographs were obtained from HydroCAD for a 6-hr storm duration assuming an SCS Type II shape. The modeled distributions are included in Appendix G.

3.2.4 Stage-Storage Data

Storage volumes computed at 1-foot increments for Ash Disposal Area 4 are included as Appendix H. This information was generated from topographic data for the closed condition included in as-built drawings dated September 4, 2018, provided by TVA.

The embankment crest elevations for the Ash Disposal Area 4's north and south watersheds are both 447 ft, based on the provided topographic data.

3.2.5 Starting Water Surface Elevations

Both outlet structures are located at the approximate low point of each watershed, so Ash Disposal Area 4 holds water only when inflows from precipitation exceed outflows. The starting water surface elevations for Ash Disposal Area 4 were assumed to be at the invert of the culverts.

3.3 HYDROLOGIC AND HYDRAULIC MODELING

Hydrologic and hydraulic modeling was performed using HEC-HMS 4.6.1 based on the model inputs summarized in Section 3.2. A model schematic is included in Figure 3.

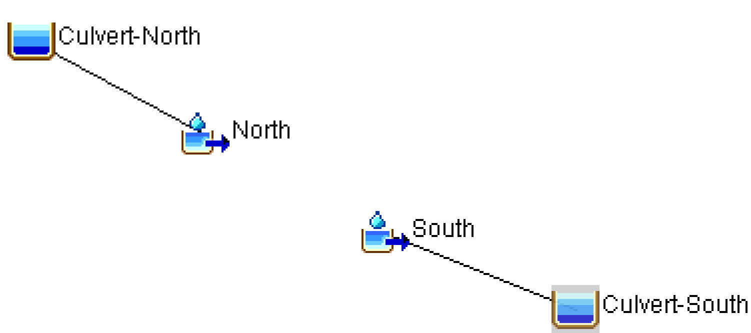


Figure 3 HEC-HMS Model Schematic

Simulations were run with the assumption that precipitation is the only inflow source.

The model scenarios analyzed are summarized in Table 3.

Table 3 Summary of Hydrologic/Hydraulic Modeling Scenarios

Scenario Number	Rainfall Hyetograph Type
1	SCS 6-hour “Early” Peak
2	SCS 6-hour “Middle” Peak
3	SCS 6-hour “Late” Peak

4.0 CALCULATION RESULTS

The hydrologic modeling results were reviewed to determine the performance of Ash Disposal Area 4 for the 1000-year, 6-hour storm for the three precipitation events described in Section 3.2.3.

4.1 CAPACITY AND FREEBOARD RESULTS

The peak pool elevation, inflow and outflow for Ash Disposal Area 4 is summarized in Table 4. The results showed that Ash Disposal Area 4 can convey the flow from the 1000-year 6-hour scenarios modeled without overtopping.

Table 4 Hydrologic and Hydraulic Modeling Results for Ash Disposal Area 4

Scenario	Pond	Storm	Peak Water Surface Elevation (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)	Minimum Embankment Elevation (ft)	Freeboard (ft)
1	South Ash Disposal Area 4	SCS Type II "Early Peak"	445.6	103.2	36.3	447.0	1.4
2	South Ash Disposal Area 4	SCS Type II "Middle Peak"	446.3	190.5	48.6	447.0	0.7
3	South Ash Disposal Area 4	SCS Type II "Late Peak"	446.6	218.7	52.6	447.0	0.4
1	North Ash Disposal Area 4	SCS Type II "Early Peak"	445.2	78.4	27.8	447.0	1.8
2	North Ash Disposal Area 4	SCS Type II "Middle Peak"	446.0	144.5	37.3	447.0	1.0
3	North Ash Disposal Area 4	SCS Type II "Late Peak"	446.2	166.1	40.5	447.0	0.8

5.0 CONCLUSIONS

The calculations included in this report demonstrate that the inflow design flood control system adequately manages flow into and from the CCR unit during and following the peak discharge of the inflow design flood (1000-year flood). In addition, the CCR unit is capped and covered and therefore surface water is handled in accordance with the surface water requirements under §257.3-2. Therefore, Ash Disposal Area 4 meets the requirements of §257.82 of the EPA Final CCR Rule.

6.0 REFERENCES

1. AECOM, As-Built Drawings, “Ash Disposal Area 4 Closure”, TVA Project #204316, Colbert Fossil Plant, September 4, 2018.

2. Bonnin G. M. et all, NOAA Atlas 14, Precipitation Frequency Atlas of the United States, Volume 2, Version 3, 2006.

3. Environmental Protection Agency, “Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities”, Federal Register, April 17, 2015.

4. United States Army Corps of Engineers, Hydrologic Modeling System (HEC-HMS), Version 4.0, December 31, 2013.

5. United States Department of Agriculture, “Technical Release 55: Urban Hydrology for Small Watersheds”, June 1986.

APPENDIX A
HYDROLOGIC OVERVIEW MAP

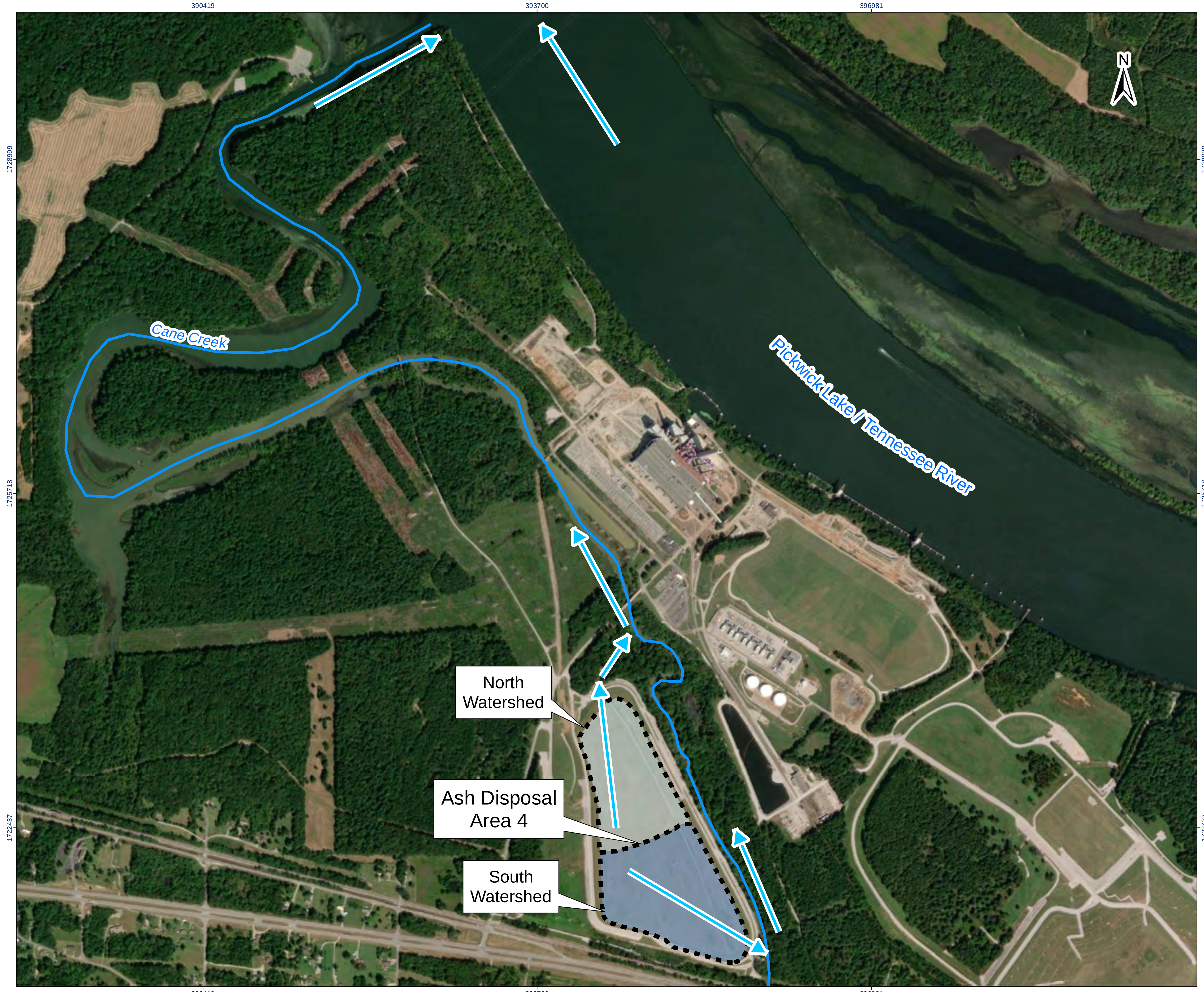


Figure No.
1

Title
HYDROLOGIC OVERVIEW MAP
ASH DISPOSAL AREA 4

Client/Project
Tennessee Valley Authority
Inflow Design Flood Control Plan
175568465

Project Location:
Tuscumbia, AL

Prepared by CCC on 9-24-21
Technical Review by MMM on 9-27-21
Independent Review by TGC on 9-29-21

175568465

0 1,250 2,500 Feet

1:12,000 (At Original document size of 11x17)

Legend

Flow Direction

Watersheds

North Watershed

South Watershed

Notes
1. Coordinate System: NAD 1927 StatePlane Alabama West FIPS 0102

Stantec

APPENDIX B
WATERSHED MAP

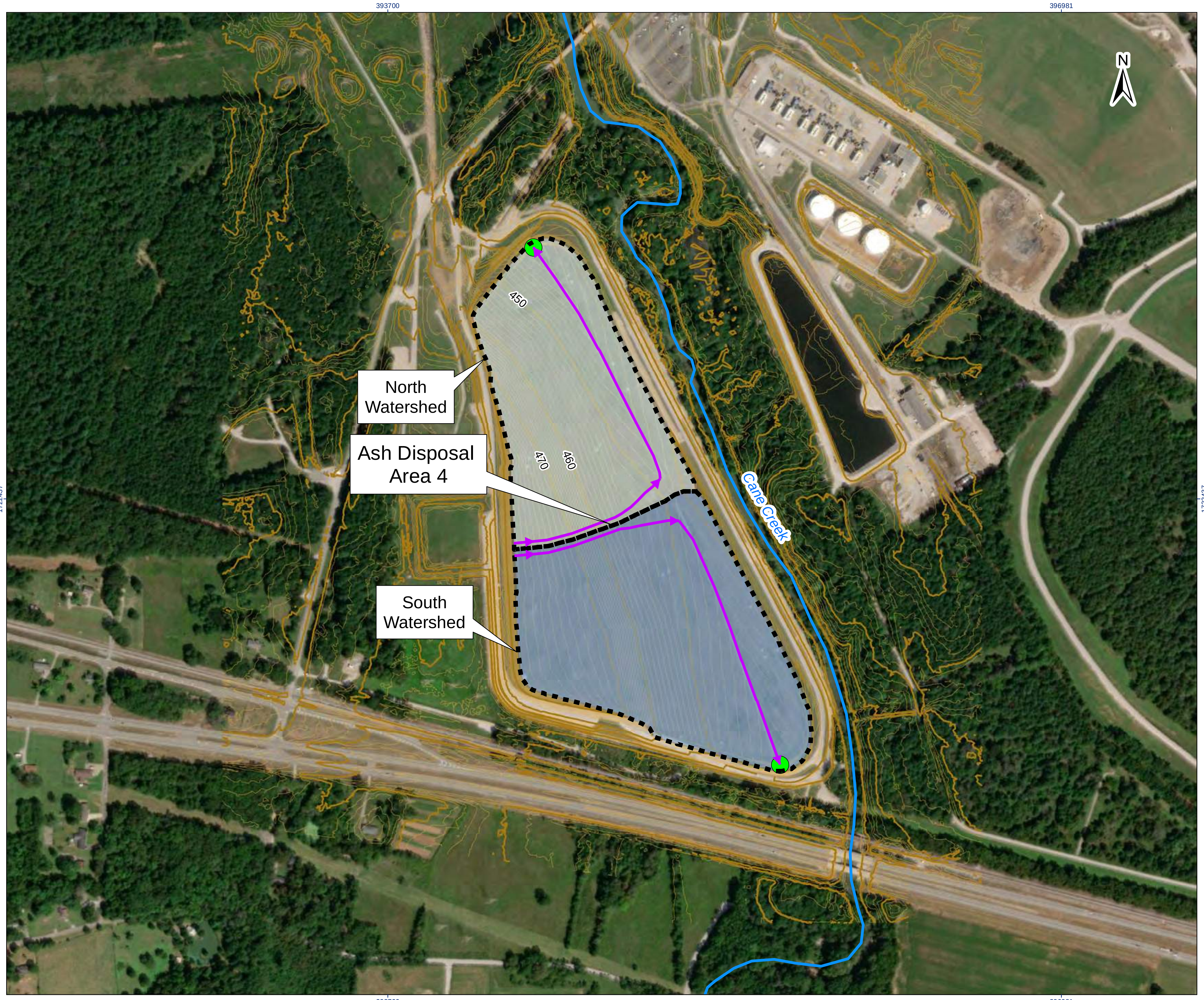


Figure No.
1

Title

WATERSHED MAP
ASH DISPOSAL AREA 4

Client/Project
Tennessee Valley Authority
Inflow Design Flood Control Plan
175568465

Project Location:
Tuscumbia, AL

Prepared by CCC on 9-24-21
Technical Review by MMM on 9-27-21
Independent Review by TGC on 9-29-21

175568465

0 600 1,200 Feet
1:6,000 (At Original document size of 11x17)

Watershed	Area (Acres)
South	28.9
North	22.1

Legend

- Outlet Structure
- Flow Paths
- Topographic Mapping

Watersheds

- North Watershed
- South Watershed

Notes
1. Coordinate System: NAD 1927 StatePlane Alabama West FIPS 0102
2. Topographic mapping was developed from as-built drawings dated September 4, 2018, provided by TVA.

Stantec

V:\1755\active\175568465\technical_production\analysis\Colbert\mxds\watershed map.mxd Revised: 2021-09-29 By: ccrankshaw

APPENDIX C
LAG TIME COMPUTATIONS

Stantec

Lag Time Calculation
TVA CCR Rule Periodic Assessment Updates
Ash Disposal Area 4 Closure, Colbert Fossil Plant
Project Number: 175568465
Calculation Performed by: CCC   Calculation Date: 9/20/2021
Checked by: MMM   Checked By Date: 9/22/2021

Watershed ID: South Culvert

Sheet Flow	Units	Segment ID 1	Segment ID 2		Total
1. Surface description		Grass, short prairi	Grass, short prairie		
2. Manning's roughness coef., n		0.15			
3. Flow length, L (Total L less than 300/100 f	ft	100			
4. 2-year, 24-hour Rainfall, P2	in	4.04			
5a. Upstream elevation	ft	479			
5b. Downstream elevation	ft	476			
5. Land slope, S	ft / ft	0.030			
6. Tt = $[0.007(nL)^{0.8}]/[\text{sqrt}(P2)\ S^{0.4}]$	hr	0.12		=	0.12 hr

Shallow Concentrated Flow	Units	Segment ID 1	Segment ID 2		Total
7. Surface description (paved or unpaved)		Unpaved			
8. Flow length, L	ft	724			
9a. Upstream elevation	ft	476			
9b. Downstream elevation	ft	449			
9. Watercourse slope, S	ft / ft	0.037			
10. Average velocity, V	ft / s	3.1			
11. Tt = L / 3600V	hr	0.06		=	0.06 hr

Open Channel Flow	Units	Segment ID 1	Segment ID 2		Total
12. Pipe or Open Channel		Open-channel			
13. Diam (pipe) or depth (open)	ft	1.03			
14. Base width (open)	ft	0			
15. Channel side slope	XH:1V	50			
16. Cross sectional flow area	ft2	53.05			
17. Wetted perimeter, Pw	ft	103.02			
18. Hydraulic radius, r = a/Pw	ft	0.51			
19a. Upstream elevation	ft	449			
19b. Downstream elevation	ft	442			
19. Channel slope, S	ft / ft	0.005			
20. Runoff surface / pipe material		earth, winding, grass weeds			
21. Manning's roughness coef., n		0.03			
22. V= (1.49 r2/3 S1/2 / n)	ft / s	2.31			
23. Flow length, L	ft	1290			
24. Tt = L / 3600V	hr	0.16		=	0.16 hr

25. Watershed Tc (sum Tt from 6, 11, 24) — 0.34 hr

26. Watershed lag time, TL (=0.6 x Tc) — 0.206 hr

Lag Time Calculation
TVA CCR Rule Periodic Assessment Updates
Ash Disposal Area 4 Closure, Colbert Fossil Plant
Project Number: 175568465
Calculation Performed by: CCC   Calculation Date: 9/20/2021
Checked by: MMM   Checked By Date: 9/22/2021

Watershed ID: North Culvert

Sheet Flow	Units	Segment ID 1	Segment ID 2		Total	
1. Surface description		Grass, short prairi	Grass, short prairie			
2. Manning's roughness coef., n		0.15				
3. Flow length, L (Total L less than 300/100 f	ft	100				
4. 2-year, 24-hour Rainfall, P2	in	4.04				
5a. Upstream elevation	ft	479				
5b. Downstream elevation	ft	476				
5. Land slope, S	ft / ft	0.030				
6. $Tt = [0.007(nL)^{0.8}]/[sqrt(P2)\ S^{0.4}]$	hr	0.12		=	0.12	hr

Shallow Concentrated Flow	Units	Segment ID 1	Segment ID 2		Total	
7. Surface description (paved or unpaved)		Unpaved				
8. Flow length, L	ft	703				
9a. Upstream elevation	ft	476				
9b. Downstream elevation	ft	449				
9. Watercourse slope, S	ft / ft	0.038				
10. Average velocity, V	ft / s	3.2				
11. Tt = L / 3600V	hr	0.06		=	0.06	hr

Open Channel Flow	Units	Segment ID	Segment ID		Total	
12. Pipe or Open Channel		Open-channel				
13. Diam (pipe) or depth (open)	ft	0.93				
14. Base width (open)	ft	0				
15. Channel side slope	XH:1V	50				
16. Cross sectional flow area	ft2	43.25				
17. Wetted perimeter, Pw	ft	93.02				
18. Hydraulic radius, r = a/Pw	ft	0.46				
19a. Upstream elevation	ft	449				
19b. Downstream elevation	ft	442				
19. Channel slope, S	ft / ft	0.005				
20. Runoff surface / pipe material		earth, winding, grass weeds				
21. Manning's roughness coef., n		0.03				
22. V= (1.49 r2/3 S1/2 / n)	ft / s	2.19				
23. Flow length, L	ft	1291				
24. Tt = L / 3600V	hr	0.16		=	0.16	hr

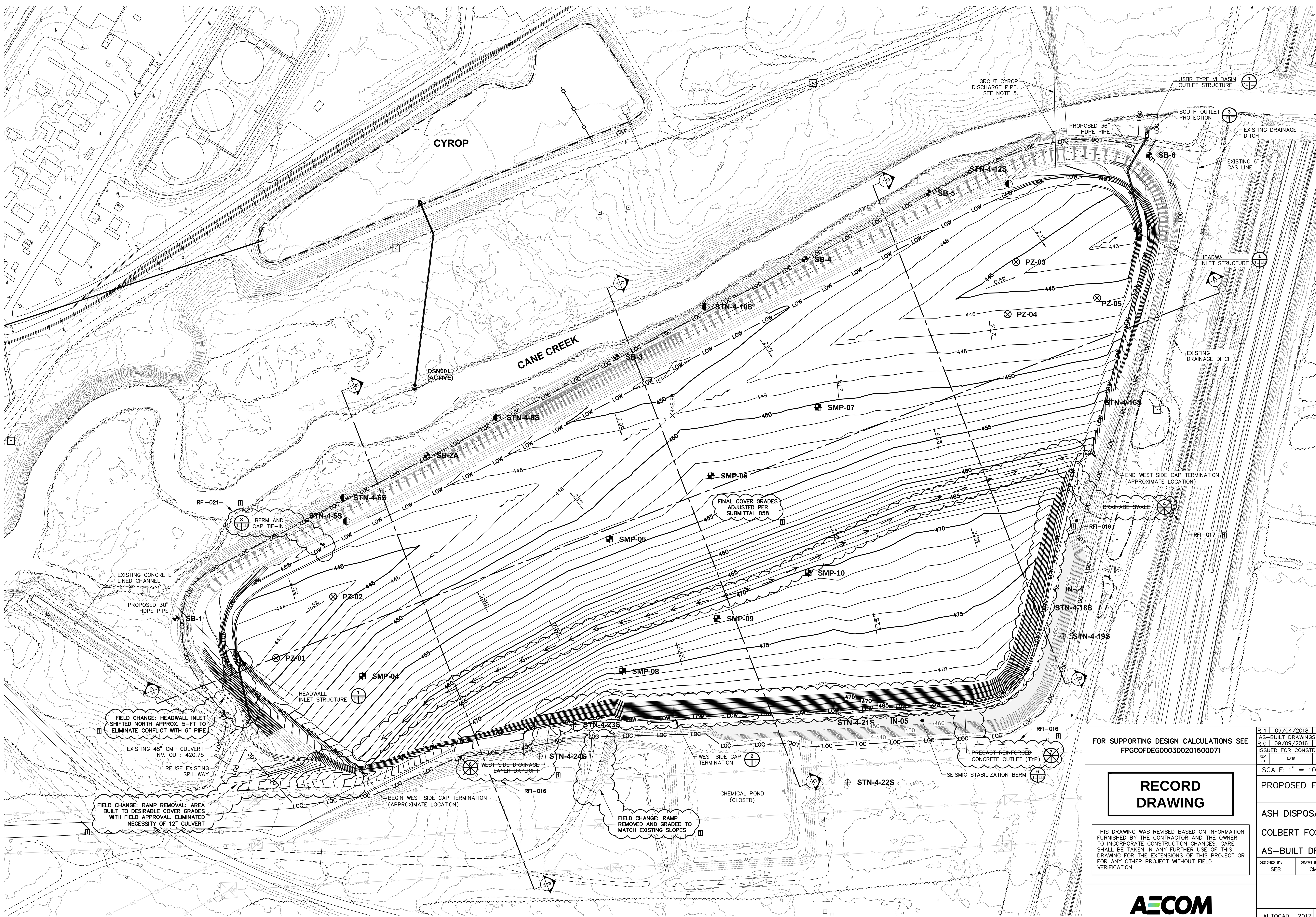
25. Watershed Tc (sum Tt from 6, 11, 24) 0.35 hr

26. Watershed lag time, TL (=0.6 x Tc) 0.209 hr

Lag Time Calculation
TVA CCR Rule Periodic Assessment Updates
Ash Disposal Area 4 Closure, Colbert Fossil Plant
Project Number: 175568465
Calculation Performed by: CCC   Calculation Date: 9/20/2021
Checked by: MMM   Checked By Date: 9/22/2021

Lag Time Summary			
	T_L(hr)	T_L(hr) Used	T_L(min) Used
S_Culvert	0.206	0.206	12.4
N_Culvert	0.209	0.209	12.6

APPENDIX D
REFERENCE DRAWINGS



LEGEND

(symbol)	EXISTING VEGETATION
—460—	EXISTING MAJOR CONTOURS
(symbol)	EXISTING MINOR CONTOURS
—460—	FINAL MAJOR CONTOURS
(symbol)	FINAL MINOR CONTOURS
— LOC —	LIMIT OF CONSTRUCTION AND GRADING
— LOW —	LIMIT OF WASTE
(symbol)	TACK ON TERRACE
(symbol)	FLOW DIRECTION
(symbol)	PROPOSED WELL
DS (symbol)	EXISTING DISCHARGE POINTS
(symbol)	WEST DIKE SEISMIC STABILIZATION BERM
(symbol)	EXISTING INCLINOMETER WITH VIBRATING WIRE PIEZOMETER
(symbol)	EXISTING SETTLEMENT MONITORING POINT
(symbol)	EXISTING VIBRATING WIRE PIEZOMETER
(symbol)	EXISTING OPEN STANDPIPE
(symbol)	EXISTING OPEN STANDPIPE
(symbol)	PROPOSED PIEZOMETER
(symbol)	PROPOSED SETTLEMENT MONITORING POINT

NOTES

1. EXACT LOCATION OF EXISTING UTILITIES TO BE VERIFIED.
2. CONTRACTOR TO COORDINATE HAUL ROUTES AND ACCESS WITH NEEDS OF OTHER PROJECTS.
3. ANY EXISTING PIEZOMETERS OR MONITORING WELLS IN THE LIMITS OF WORK SHALL BE PROTECTED. INSTRUMENTATION MODIFICATION OR REMOVAL SHALL BE COORDINATED WITH TVA INSTRUMENTATION.
4. AFTER ABANDONING EXISTING DSN001 (NORTH SIDE OF ASH DISPOSAL AREA 4), NO CONTACT WATER WILL BE PERMITTED TO DISCHARGE FROM OUTLET STRUCTURES. CONTACT WATER MUST BE ROUTED TO THE COAL YARD RUNOFF POND.
5. AFTER THE CAP SYSTEM HAS BEEN INSTALLED, AND ALL REMAINING CONTACT WATER HAS BEEN PUMPED TO THE CYROP, THE CONTRACTOR SHALL GROUT THE CYROP DISCHARGE PIPE FULL.
6. FINAL GRADE CONTOURS WERE PROVIDED BY PHILLIPS & JORDAN, INC. ON 10/18/2017.

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGCOFDEG000300201600071

RECORD DRAWING

THIS DRAWING WAS REVISED BASED ON INFORMATION FURNISHED BY THE CONTRACTOR AND THE OWNER TO INCORPORATE CONSTRUCTION CHANGES. CARE SHALL BE TAKEN IN ANY FURTHER USE OF THIS DRAWING FOR THE EXTENSIONS OF THIS PROJECT OR FOR ANY OTHER PROJECT WITHOUT FIELD VERIFICATION

AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 1	09/04/2018	SEB	MJT	SEB	MJS	RSH	MST	JCK	204316		J
AS-BUILT DRAWINGS											
R 0	09/09/2016	SEB	CMA	MJS	MJS	RSH	MST	JCK	204316		D
ISSUED FOR CONSTRUCTION											

DISCIPLINE INTERFACE

SCALE: 1" = 100' EXCEPT AS NOTED

PROPOSED FINAL COVER GRADES

ASH DISPOSAL AREA 4 CLOSURE

COLBERT FOSSIL PLANT

AS-BUILT DRAWINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	CMA	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2017 | DATE 09/04/18 | 47 | C | 10W396-10 | R 1

47 C 10W396-10

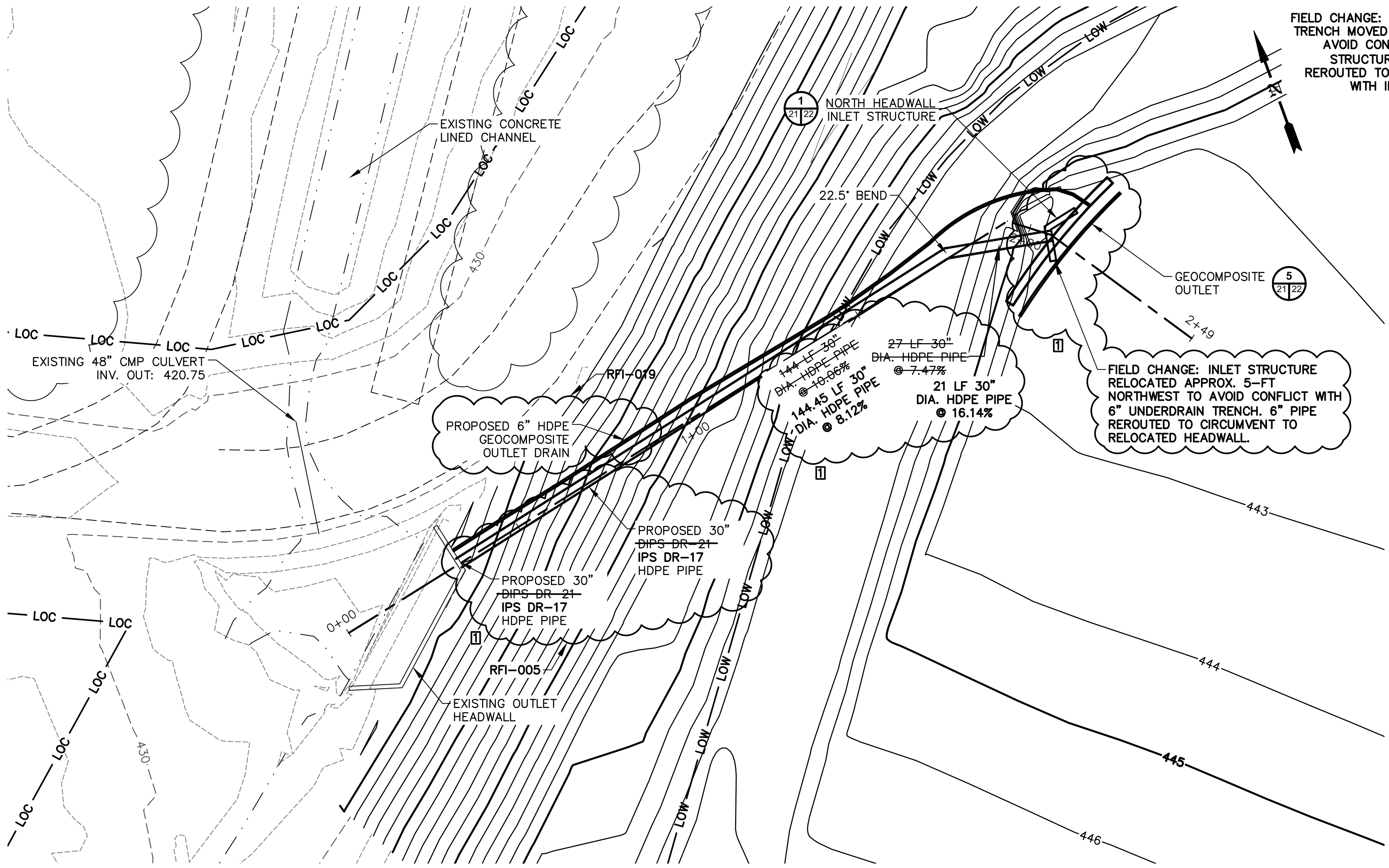
AECOM 1
TASK COMPLETED BY: REV. NO.

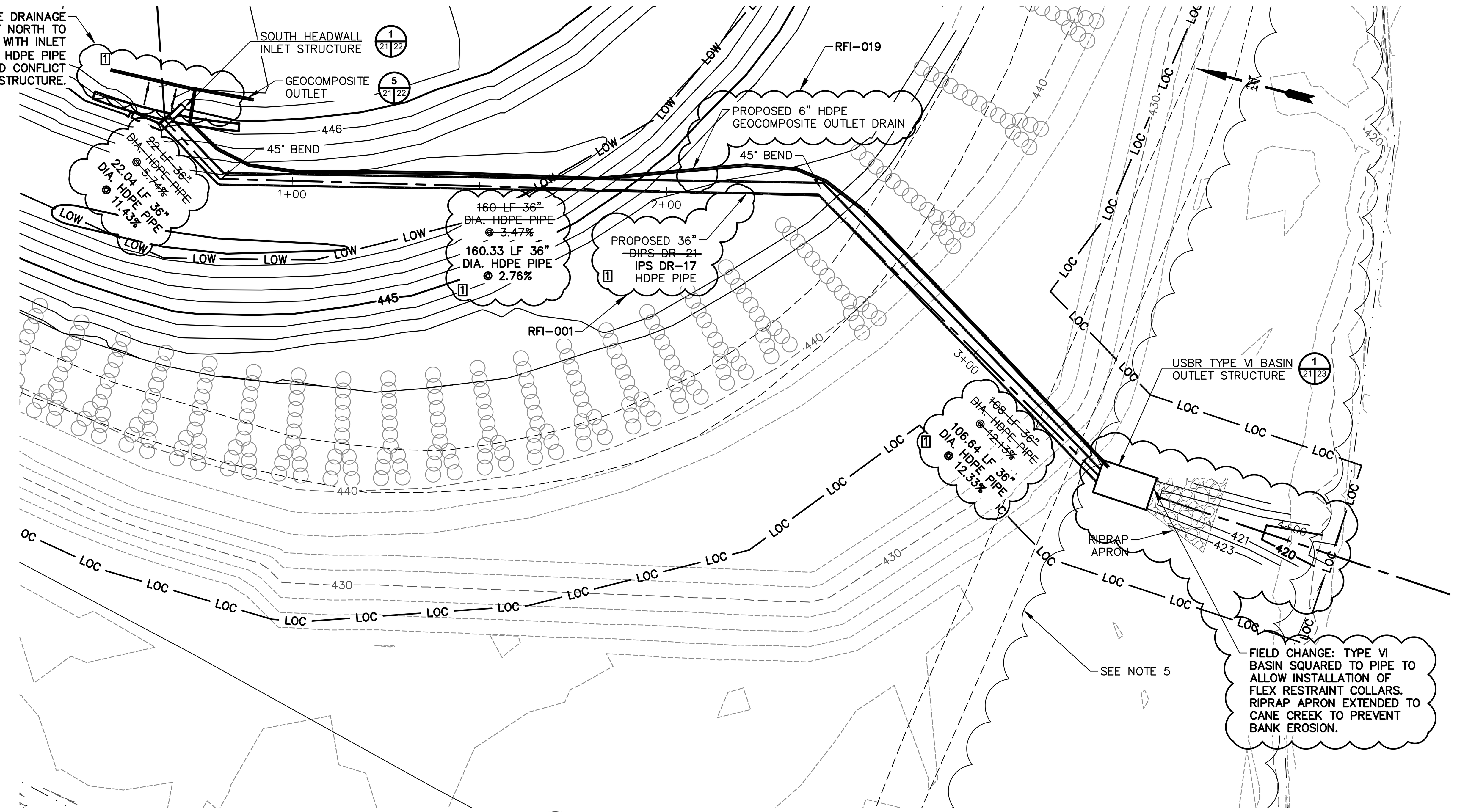
PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

G:\Akron\DCS\Projects_Legacy\TVA-COF\60520225_A4 Stabilization Ph3\900-CAD-GIS\910-CAD\20-SHEETS\10-11-12-32289 TC_R2.dwg User:Mcavinewa Sep 11, 2018 - 8:37am

47 C 10W396-21





SCALE IN FEET (0 20 40)

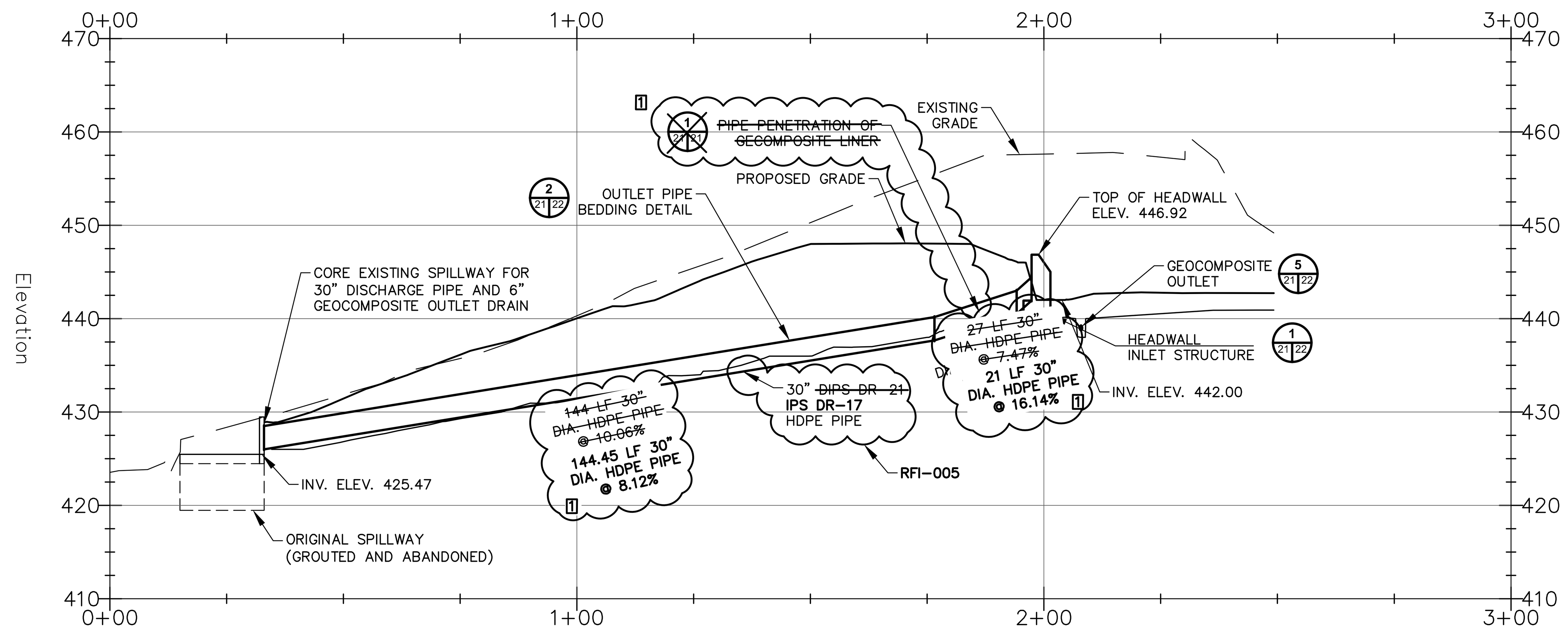
SCALE IN FEET (0 10 20)

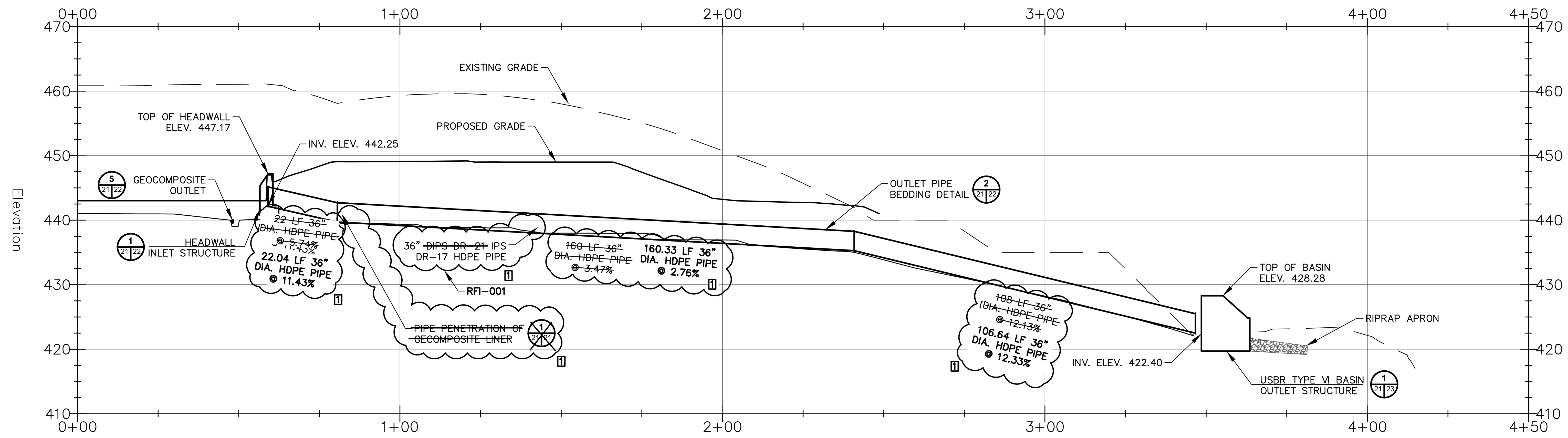
LEGEND

- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING VEGETATION
- EXISTING HAUL ROAD
- EXISTING CREEK
- EXISTING LIGHT POLE
- EXISTING DMM WALL
- PROPOSED STORM WATER LINE
- LOW — LIMIT OF WASTE
- LOC — LIMIT OF CONSTRUCTION & GRADING

NOTES

1. EXACT LOCATION OF EXISTING UTILITIES TO BE VERIFIED.
2. ALL HORIZONTAL COORDINATES GIVEN ON THESE DRAWINGS ARE IN COLBERT PLANT COORDINATES. ELEVATION DATA ARE IN NGVD 29. EXISTING GRADES ARE BASED ON SURVEY PROVIDED BY TVA FROM TUCK MAPPING SOLUTIONS, INC. DATED AUGUST 12, 2014.
3. BATHYMETRIC CONTOURS ARE FROM "POND 4 HYDROGRAPHIC SURVEY" BY THE R.L.S. GROUP DATED JUNE 2, 2015.
4. BENCHMARK COORDINATES TO BE PROVIDED BY TVA.
5. CONTRACTOR TO COORDINATE PROTECTION AND/OR REMOVAL OF ANY BAT HABITAT TREES WITH TVA ENVIRONMENTAL.

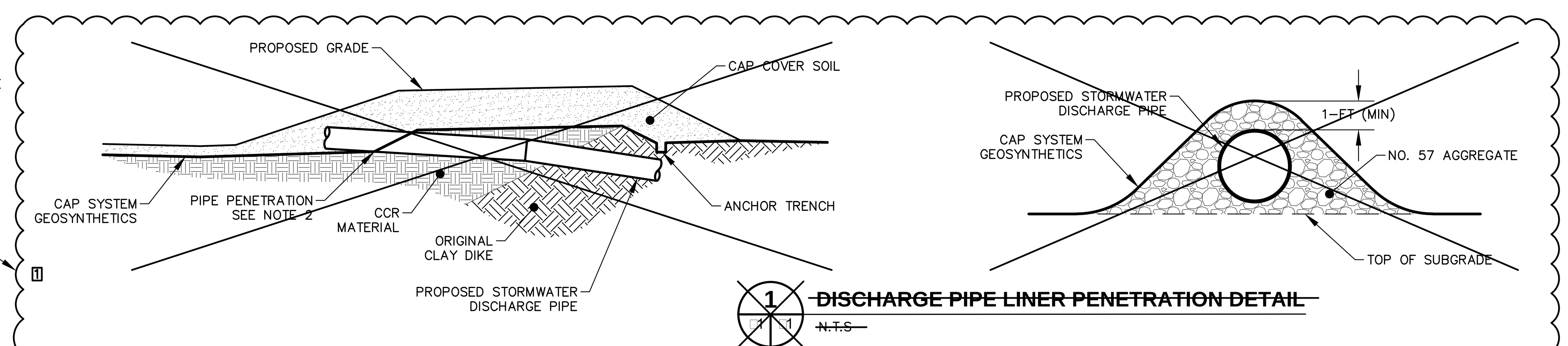




NOTES

1. GEOCOMPOSITE OUTLET DRAIN NOT SHOWN ON PROFILE FOR CLARITY.
2. ALL PIPE PENETRATIONS OF THE GEOCOMPOSITE LINER SHALL BE SEALED WITH A PIPE BOOT.

FIELD CHANGE: LINER PENETRATION ELIMINATED BY LINING THE BOTTOM OF PIPE TRENCHES PRIOR TO BACKFILLING. ANCHOR TRENCHES TERMINATE AT EDGES OF PIPE TRENCH.



FOR SUPPORTING DESIGN CALCULATIONS SEE FPGCOFDEG000300201600071

RECORD DRAWING

THIS DRAWING WAS REVISED BASED ON INFORMATION FURNISHED BY THE CONTRACTOR AND THE OWNER TO INCORPORATE CONSTRUCTION CHANGES. CARE SHALL BE TAKEN IN ANY FURTHER USE OF THIS DRAWING FOR THE EXTENSIONS OF THIS PROJECT OR FOR ANY OTHER PROJECT WITHOUT FIELD VERIFICATION

AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 1	09/04/2018	SEB	MJT	SEB	MJS	RSH	MST	JCK	204316	J
AS-BUILT DRAWINGS										
R 0	09/09/2016	SEB	CMA	MJS	MJS	RSH	MST	JCK	204316	D
ISSUED FOR CONSTRUCTION										

DISCIPLINE INTERFACE

SCALE: NONE — EXCEPT AS NOTED

DISCHARGE PIPES PLAN & PROFILE

ASH DISPOSAL AREA 4 CLOSURE

COLBERT FOSSIL PLANT

AS-BUILT DRAWINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	CMA	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2017 | DATE 09/04/18 | 47 | C | 10W396-21 | R 1

AECOM | 1
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

G:\Akron\DCS\Projects_Legacy\TVA-COF\60520225_A4 Stabilization Ph3\900-CAD-GIS\910-CAD\20-SHEETS\21-32289 STPP_R1.dwg User:Mcovinewa Sep 11, 2018 - 8:45am

APPENDIX E
PRECIPITATION DATA

Stantec

Rainfall Distribution
Inflow Design Flow Control System Plan
Ash Disposal Area 4, Colbert Fossil Plant
Project Number: 175568465
Calculation Performed by: CCC Calculation Date: 9/21/2021
Checked by: MMM Checked By Date: 9/22/2021

1000-year, 6-hour Rainfall Depth equals 7.30 inches
From NOAA Atlas 14

1000-year 6-hour SCS Type II "Late Peak" Hydrograph

Time	Incremental Depth	Cumulative Depth
0.00	0.00	0.00
0.10	0.03	0.03
0.20	0.03	0.06
0.30	0.03	0.10
0.40	0.03	0.13
0.50	0.03	0.16
0.60	0.03	0.20
0.70	0.03	0.23
0.80	0.03	0.26
0.90	0.03	0.30
1.00	0.03	0.33
1.10	0.03	0.37
1.20	0.04	0.40
1.30	0.04	0.44
1.40	0.04	0.47
1.50	0.04	0.51
1.60	0.04	0.54
1.70	0.04	0.58
1.80	0.04	0.62
1.90	0.04	0.66
2.00	0.04	0.70
2.10	0.04	0.74
2.20	0.04	0.78
2.30	0.04	0.82
2.40	0.04	0.87
2.50	0.05	0.91
2.60	0.05	0.96
2.70	0.05	1.00
2.80	0.05	1.05
2.90	0.05	1.10
3.00	0.05	1.15
3.10	0.05	1.20
3.20	0.05	1.26
3.30	0.06	1.31
3.40	0.06	1.37
3.50	0.06	1.43
3.60	0.06	1.49
3.70	0.06	1.55
3.80	0.06	1.61
3.90	0.07	1.68
4.00	0.07	1.75
4.10	0.07	1.82
4.20	0.07	1.89
4.30	0.08	1.97
4.40	0.08	2.04
4.50	0.08	2.13
4.60	0.09	2.21
4.70	0.09	2.30
4.80	0.10	2.40
4.90	0.10	2.50
5.00	0.11	2.61
5.10	0.12	2.73
5.20	0.13	2.86
5.30	0.15	3.01
5.40	0.17	3.18
5.50	0.20	3.37
5.60	0.25	3.62
5.70	0.49	4.11
5.80	0.79	4.90
5.90	0.98	5.88
6.00	1.42	7.30

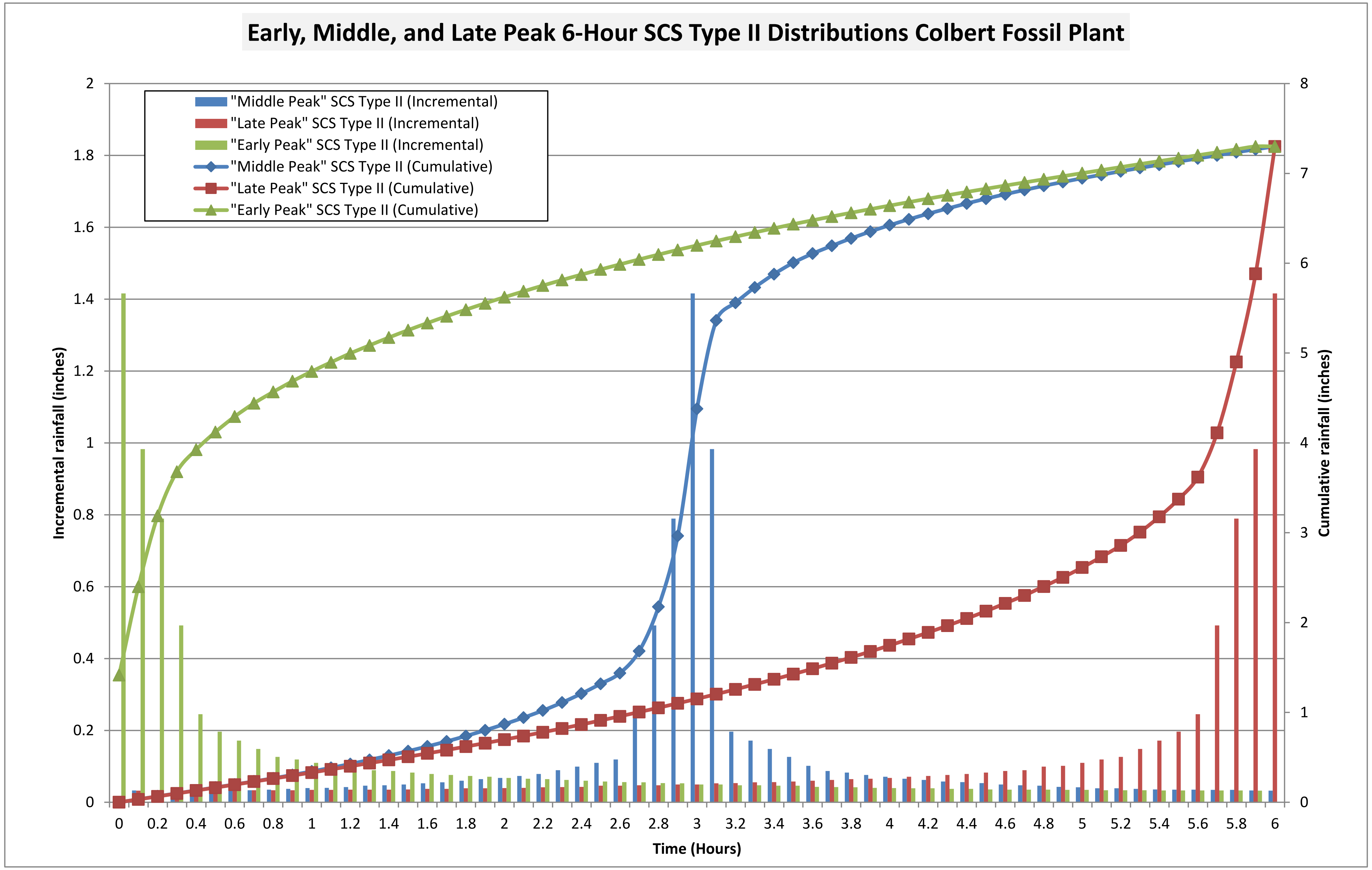
1000-year 6-hour SCS Type II "Middle Peak" Hydrograph

Time	Incremental Depth	Cumulative Depth
0.00	0.00	0.00
0.10	0.03	0.03
0.20	0.03	0.07
0.30	0.03	0.10
0.40	0.03	0.13
0.50	0.03	0.16
0.60	0.03	0.20
0.70	0.03	0.23
0.80	0.04	0.27
0.90	0.04	0.30
1.00	0.04	0.34
1.10	0.04	0.38
1.20	0.04	0.43
1.30	0.05	0.47
1.40	0.05	0.52
1.50	0.05	0.57
1.60	0.05	0.62
1.70	0.06	0.68
1.80	0.06	0.74
1.90	0.06	0.80
2.00	0.07	0.87
2.10	0.07	0.94
2.20	0.08	1.02
2.30	0.09	1.11
2.40	0.10	1.21
2.50	0.11	1.32
2.60	0.12	1.44
2.70	0.25	1.68
2.80	0.49	2.18
2.90	0.79	2.96
3.00	1.42	4.38
3.10	0.98	5.36
3.20	0.20	5.56
3.30	0.17	5.73
3.40	0.15	5.88
3.50	0.13	6.01
3.60	0.10	6.11
3.70	0.09	6.19
3.80	0.08	6.28
3.90	0.08	6.35
4.00	0.07	6.42
4.10	0.07	6.49
4.20	0.06	6.55
4.30	0.06	6.61
4.40	0.06	6.66
4.50	0.05	6.72
4.60	0.05	6.77
4.70	0.05	6.82
4.80	0.05	6.86
4.90	0.04	6.90
5.00	0.04	6.95
5.10	0.04	6.98
5.20	0.04	7.02
5.30	0.04	7.06
5.40	0.04	7.10
5.50	0.04	7.13
5.60	0.04	7.17
5.70	0.03	7.20
5.80	0.03	7.24
5.90	0.03	7.27
6.00	0.03	7.30

1000-year 6-hour SCS Type II "Early Peak" Hydrograph

Time	Incremental Depth	Cumulative Depth
0.00	1.42	1.42
0.10	0.98	2.40
0.20	0.79	3.19
0.30	0.49	3.68
0.40	0.25	3.93
0.50	0.20	4.12
0.60	0.17	4.29
0.70	0.15	4.44
0.80	0.13	4.57
0.90	0.12	4.69
1.00	0.11	4.80
1.10	0.10	4.90
1.20	0.10	5.00
1.30	0.09	5.09
1.40	0.09	5.17
1.50	0.08	5.26
1.60	0.08	5.33
1.70	0.08	5.41
1.80	0.07	5.48
1.90	0.07	5.55
2.00	0.07	5.62
2.10	0.07	5.69
2.20	0.06	5.75
2.30	0.06	5.81
2.40	0.06	5.87
2.50	0.06	5.93
2.60	0.06	5.99
2.70	0.06	6.04
2.80	0.05	6.10
2.90	0.05	6.15
3.00	0.05	6.20
3.10	0.05	6.25
3.20	0.05	6.30
3.30	0.05	6.34
3.40	0.05	6.39
3.50	0.05	6.43
3.60	0.04	6.48
3.70	0.04	6.52
3.80	0.04	6.56
3.90	0.04	6.60
4.00	0.04	6.64
4.10	0.04	6.68
4.20	0.04	6.72
4.30	0.04	6.76
4.40	0.04	6.79
4.50	0.04	6.83
4.60	0.04	6.86
4.70	0.04	6.90
4.80	0.04	6.93
4.90	0.03	6.97
5.00	0.03	7.00
5.10	0.03	7.04
5.20	0.03	7.07
5.30	0.03	7.10
5.40	0.03	7.14
5.50	0.03	7.17
5.60	0.03	7.20
5.70	0.03	7.24
5.80	0.03	7.27
5.90	0.03	7.30
6.00	0.00	7.30

Rainfall Distribution - Hydrograph
Inflow Design Flow Control System Plan
Ash Disposal Area 4, Colbert Fossil Plant
Project Number: 175568465
Calculation Performed by: CCC   Calculation Date: 9/21/2021
Checked by: MMM   Checked By Date: 9/22/2021



NOAA Atlas 14, Volume 9, Version 2
Location name: Tuscumbia, Alabama, USA*
Latitude: 34.7336°, Longitude: -87.8501°
Elevation: 465.72 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

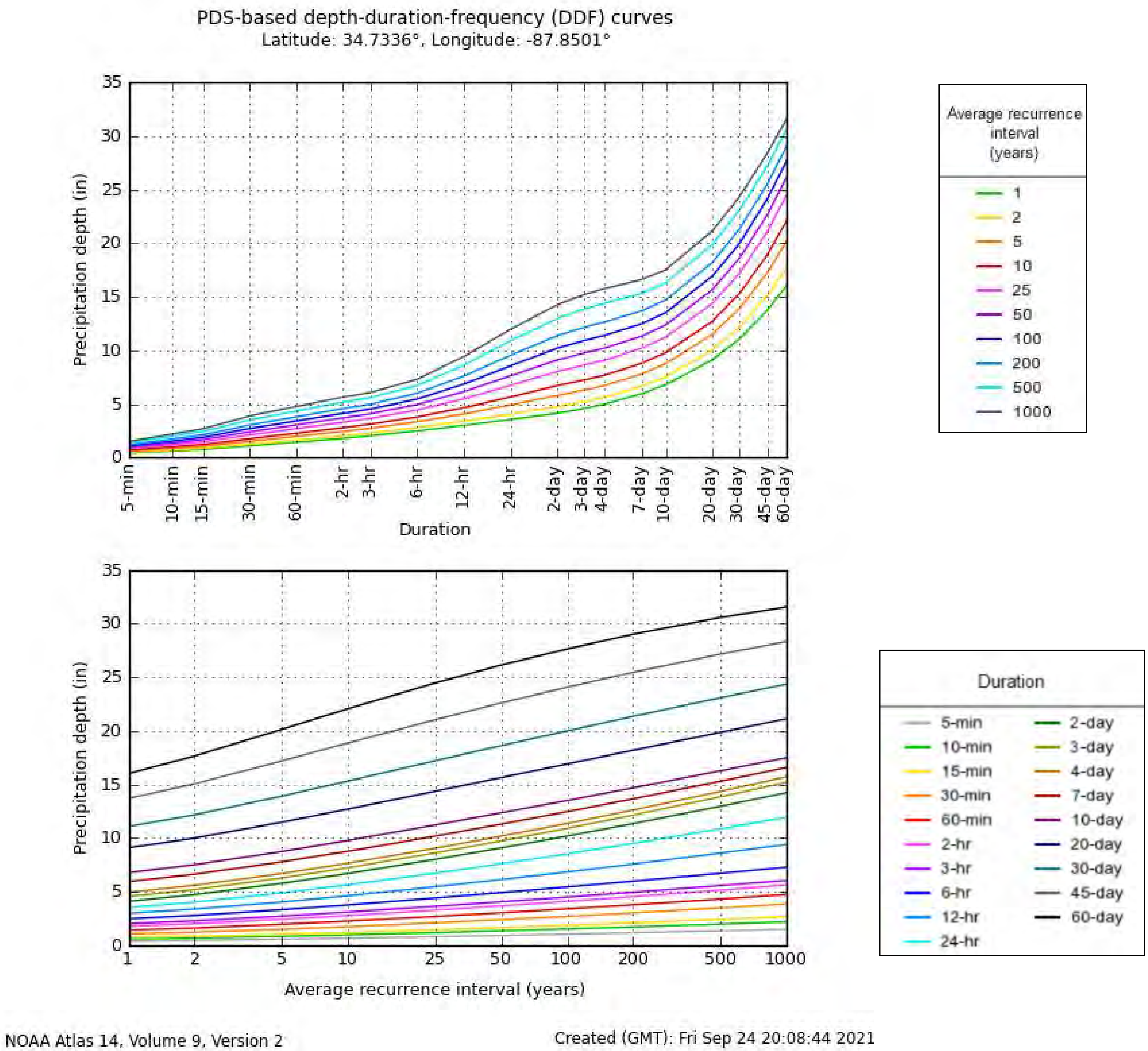
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.414** (0.335-0.521)	**0.475** (0.384-0.599)	**0.583** (0.470-0.736)	**0.677** (0.543-0.857)	**0.816** (0.636-1.06)	**0.931** (0.707-1.22)	**1.05** (0.771-1.39)	**1.18** (0.829-1.58)	**1.36** (0.918-1.85)	**1.50** (0.985-2.05)
10-min	**0.606** (0.490-0.763)	**0.696** (0.563-0.878)	**0.853** (0.688-1.08)	**0.992** (0.795-1.25)	**1.20** (0.932-1.55)	**1.36** (1.03-1.78)	**1.54** (1.13-2.04)	**1.73** (1.21-2.32)	**1.99** (1.34-2.71)	**2.20** (1.44-3.00)
15-min	**0.739** (0.598-0.931)	**0.849** (0.687-1.07)	**1.04** (0.838-1.31)	**1.21** (0.969-1.53)	**1.46** (1.14-1.89)	**1.66** (1.26-2.17)	**1.88** (1.38-2.48)	**2.11** (1.48-2.82)	**2.42** (1.64-3.30)	**2.68** (1.76-3.66)
30-min	**1.08** (0.872-1.36)	**1.23** (0.997-1.56)	**1.51** (1.21-1.90)	**1.75** (1.40-2.21)	**2.10** (1.64-2.73)	**2.40** (1.82-3.13)	**2.71** (1.99-3.58)	**3.04** (2.14-4.07)	**3.50** (2.37-4.76)	**3.87** (2.54-5.28)
60-min	**1.43** (1.16-1.81)	**1.63** (1.32-2.06)	**1.97** (1.59-2.49)	**2.27** (1.82-2.87)	**2.70** (2.10-3.49)	**3.05** (2.31-3.97)	**3.41** (2.50-4.50)	**3.80** (2.67-5.08)	**4.33** (2.92-5.88)	**4.75** (3.12-6.49)
2-hr	**1.79** (1.45-2.24)	**2.03** (1.65-2.54)	**2.43** (1.97-3.05)	**2.79** (2.24-3.50)	**3.29** (2.57-4.23)	**3.70** (2.82-4.78)	**4.11** (3.03-5.39)	**4.55** (3.22-6.05)	**5.16** (3.51-6.95)	**5.63** (3.72-7.64)
3-hr	**2.03** (1.65-2.53)	**2.29** (1.87-2.86)	**2.73** (2.22-3.42)	**3.11** (2.51-3.90)	**3.65** (2.86-4.66)	**4.07** (3.12-5.24)	**4.51** (3.34-5.88)	**4.96** (3.52-6.56)	**5.58** (3.81-7.48)	**6.06** (4.03-8.19)
6-hr	**2.48** (2.03-3.07)	**2.80** (2.29-3.47)	**3.33** (2.72-4.13)	**3.78** (3.07-4.70)	**4.42** (3.48-5.61)	**4.93** (3.79-6.29)	**5.45** (4.06-7.05)	**5.99** (4.28-7.86)	**6.73** (4.62-8.96)	**7.30** (4.89-9.79)
12-hr	**3.00** (2.47-3.69)	**3.39** (2.79-4.17)	**4.05** (3.33-5.00)	**4.63** (3.78-5.72)	**5.47** (4.34-6.91)	**6.15** (4.76-7.81)	**6.85** (5.14-8.82)	**7.59** (5.47-9.91)	**8.61** (5.97-11.4)	**9.42** (6.36-12.6)
24-hr	**3.54** (2.93-4.33)	**4.04** (3.34-4.94)	**4.90** (4.04-5.99)	**5.65** (4.63-6.93)	**6.73** (5.38-8.47)	**7.62** (5.95-9.63)	**8.55** (6.45-10.9)	**9.53** (6.91-12.4)	**10.9** (7.61-14.3)	**12.0** (8.13-15.8)
2-day	**4.12** (3.43-5.00)	**4.74** (3.94-5.75)	**5.79** (4.80-7.04)	**6.70** (5.53-8.17)	**8.02** (6.44-10.0)	**9.09** (7.13-11.4)	**10.2** (7.75-13.0)	**11.4** (8.30-14.6)	**13.0** (9.13-17.0)	**14.2** (9.76-18.7)
3-day	**4.57** (3.81-5.52)	**5.20** (4.34-6.29)	**6.29** (5.23-7.62)	**7.25** (6.00-8.79)	**8.63** (6.95-10.7)	**9.75** (7.68-12.2)	**10.9** (8.33-13.8)	**12.2** (8.92-15.6)	**13.9** (9.81-18.1)	**15.2** (10.5-19.9)
4-day	**4.96** (4.15-5.98)	**5.60** (4.68-6.75)	**6.70** (5.59-8.09)	**7.66** (6.36-9.27)	**9.06** (7.32-11.2)	**10.2** (8.05-12.7)	**11.4** (8.70-14.4)	**12.6** (9.30-16.2)	**14.4** (10.2-18.7)	**15.7** (10.9-20.5)
7-day	**5.95** (5.00-7.13)	**6.64** (5.58-7.96)	**7.79** (6.52-9.36)	**8.78** (7.32-10.6)	**10.2** (8.26-12.5)	**11.3** (8.97-14.0)	**12.5** (9.58-15.6)	**13.7** (10.1-17.4)	**15.3** (10.9-19.7)	**16.6** (11.5-21.5)
10-day	**6.79** (5.72-8.11)	**7.53** (6.34-9.00)	**8.76** (7.35-10.5)	**9.79** (8.17-11.7)	**11.2** (9.11-13.7)	**12.4** (9.82-15.2)	**13.5** (10.4-16.8)	**14.7** (10.9-18.6)	**16.3** (11.7-20.9)	**17.5** (12.2-22.6)
20-day	**9.11** (7.71-10.8)	**10.0** (8.48-11.9)	**11.5** (9.70-13.7)	**12.7** (10.7-15.1)	**14.4** (11.7-17.4)	**15.7** (12.5-19.1)	**16.9** (13.1-20.9)	**18.2** (13.6-22.8)	**19.9** (14.3-25.3)	**21.1** (14.9-27.2)
30-day	**11.1** (9.42-13.1)	**12.2** (10.3-14.4)	**13.9** (11.8-16.5)	**15.3** (12.9-18.2)	**17.2** (14.0-20.7)	**18.6** (14.9-22.5)	**20.0** (15.5-24.5)	**21.4** (16.0-26.6)	**23.1** (16.7-29.2)	**24.4** (17.2-31.2)
45-day	**13.7** (11.7-16.1)	**15.1** (12.8-17.7)	**17.2** (14.6-20.3)	**18.9** (15.9-22.3)	**21.0** (17.2-25.1)	**22.6** (18.1-27.2)	**24.1** (18.7-29.3)	**25.5** (19.1-31.5)	**27.2** (19.7-34.1)	**28.3** (20.2-36.1)
60-day	**16.0** (13.7-18.8)	**17.7** (15.1-20.7)	**20.2** (17.1-23.7)	**22.1** (18.7-26.0)	**24.5** (20.0-29.0)	**26.1** (21.0-31.2)	**27.7** (21.6-33.5)	**29.0** (21.8-35.7)	**30.6** (22.2-38.2)	**31.6** (22.5-40.1)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
Please refer to NOAA Atlas 14 document for more information.

Back to Top

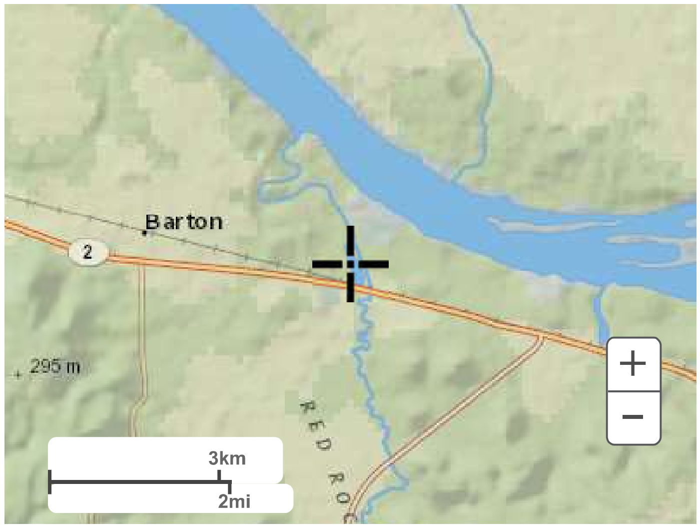
PF graphical



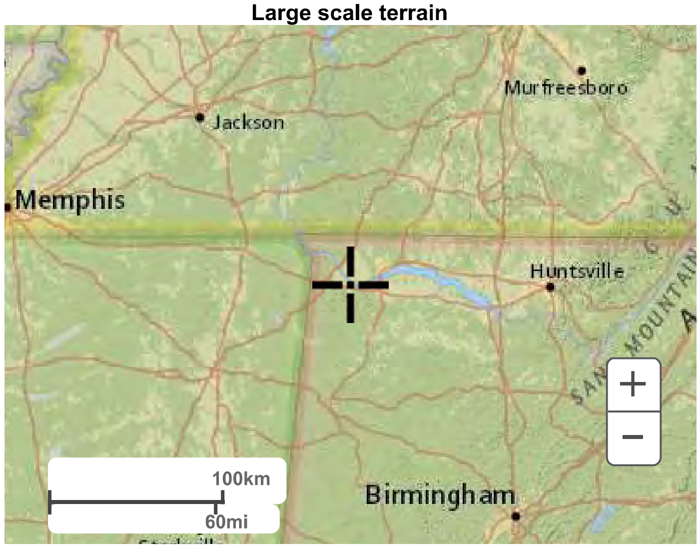
Back to Top

Maps & aerials

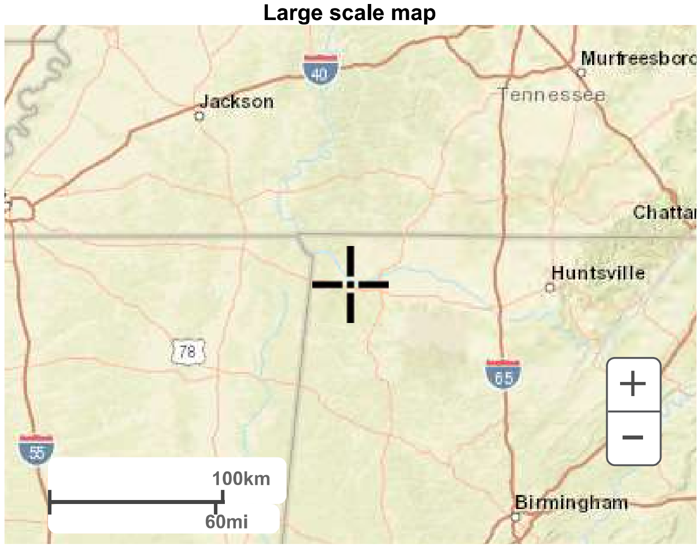
Small scale terrain



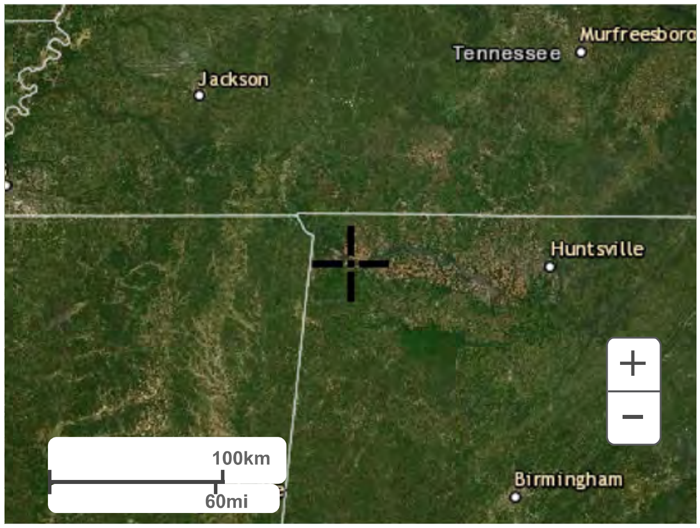
Large scale terrain



Large scale map



Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX F
STAGE-STORAGE DATA

Stage -Storage Data
Inflow Design Flow Control System Plan
Ash Disposal Area 4 South Watershed, Colbert Fossil Plant
Project Number: 175568465
Calculation Performed by: CCC   Calculation Date: 9/17/2021
Checked by: MMM   Checked By Date: 9/22/2021

South Watershed Stage-Storage

Item No.	Basin Elevation (ft)	Height (ft)	Cumulative Storage (ac-ft)	Cumulative Storage (cu. yds)	Cumulative Storage (cu. ft)
1	442.25	0.0	0.00	0.00	0
2	443	0.75	0.04	60.67	1,638
3	444	1.75	0.39	630.41	17,021
4	445	2.75	1.46	2,354.02	63,559
5	446	3.75	3.66	5,904.81	159,430
6	447	4.75	7.39	11,924.88	321,972

ft = feet; ac-ft = acre feet; cu. yds = cubic yards; cu. ft = cubic feet.

North Watershed Stage-Storage

Item No.	Basin Elevation (ft)	Height (ft)	Cumulative Storage (ac-ft)	Cumulative Storage (cu. yds)	Cumulative Storage (cu. ft)
1	442	0.0	0.00	0.00	0
2	443	1.0	0.10	160.56	4,335
3	444	2.0	0.59	953.19	25,736
4	445	3.0	1.78	2,874.95	77,624
5	446	4.0	3.88	6,256.82	168,934
6	447	5.0	7.03	11,348.34	306,405

ft = feet; ac-ft = acre feet; cu. yds = cubic yards; cu. ft = cubic feet.

TVA TENNESSEE VALLEY AUTHORITY

Received: 6/10/2022

1101 Market Street, BR 2C, Chattanooga, Tennessee 37402

Sent Via Electronic Transmittal

June 10, 2022

Mr. S. Scott Story, P.E. (e-mail: SSS@adem.alabama.gov)
Chief, Solid Waste Engineering Section
Division of Solid Waste Management
Alabama Department of Environmental Management (ADEM)
1400 Coliseum Boulevard
Montogomery, AL 36110

Dear Mr. Story:

TENNESSEE VALLEY AUTHORITY (TVA) – COLBERT FOSSIL PLANT (COF) – UPDATED GROUNDWATER MONITORING PLAN (GWMP) FOR THE ASH DISPOSAL AREA 4 PERMIT APPLICATION

TVA is submitting an updated Groundwater Monitoring Plan (GWMP) for the Ash Disposal Area 4 (Ash Pond 4). The enclosed GWMP supersedes the version *(Attachment H Operation Plans)* submitted to ADEM on December 10, 2021, as part of the Solid Waste Permit Application Package (Form 439) for Ash Disposal Pond 4.

Changes requested by ADEM during the issuance of the Ash Pond 4 draft permit on April 8, 2022 and a subsequent follow-up meeting on May 11, 2022 were incorporated in the enclosure.

If you have any questions, please contact Suama Bolden at 901-319-8787 or by email at snbolden@tva.gov.

Sincerely,

Anna Fisher
Manager, Ash and Groundwater
Waste Permits, Compliance, and Monitoring

Enclosure

Enclosures
cc (Electronic Distribution w/ Enclosures):

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Ash Disposal Area 4 Groundwater Monitoring Plan

TVA Colbert Fossil Plant

Tuscumbia, Colbert Co., Alabama

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.

June 10, 2022

ASH DISPOSAL AREA 4 GROUNDWATER MONITORING PLAN
Colbert Fossil Plant
Tuscumbia, Alabama

This document entitled Ash Disposal Area 4 Groundwater Monitoring Plan was prepared by Stantec Consulting Services Inc. ("Stantec") for the Tennessee Valley Authority (the "Client"). The material in this report reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document. The opinions in the document are based on conditions and information existing at the time of publication and do not take into account any subsequent changes. In preparing the report, Stantec relied in part upon data and information supplied to it by the Client.

Prepared by ______________________

Erin Diven, PE
Environmental Engineer

Prepared by ______________________

John W. Jengo, PG
Principal

Reviewed by______________________

Kim Kesler-Arnold, PG
Vice President, Alabama PG #1510

Approved by ______________________

Benjamin D. Grove Jr., PG, PE
Vice President, Alabama PG #1343, Alabama PE #26234

Document Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate 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, including the possibility of fine and imprisonment for knowing violations.

Benjamin D. Grove, Jr.
Alabama Professional Geologist License No. 1343
Alabama Professional Engineer License No. 26234
Stantec Consulting Services Inc., Alpharetta, GA

June 10, 2022

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

This TVA Colbert Fossil Plan Ash Disposal Area 4 Groundwater Monitoring Plan (GWMP) describes the groundwater program for Ash Disposal Area 4, a coal combustion residuals (CCR) management unit, in compliance with ADEM Admin Code r. 335-13-15-.09(1)(a)1. The unit is located at the Tennessee Valley Authority (TVA) Colbert Fossil Plant (COF) in Tuscumbia, Alabama.

Groundwater monitoring at Ash Disposal Area 4 is required by the Alabama Department of Environmental Management (ADEM or the Department), ADEM Admin Code r. 335-13-15-.06, to detect potential downgradient changes in groundwater quality at Ash Disposal Area 4. This GWMP meets the requirements set forth for groundwater monitoring systems as described by ADEM Admin Code r. 335-13-15-.06(2) and the United States Environmental Protection Agency (EPA) CCR Rule [Title 40, Code of Federal Regulations (Federal or EPA CFR) Part 257, Subpart D].

This GWMP includes a description of the geologic setting and hydrogeology, the groundwater monitoring well system, groundwater sampling and analysis program, reporting, statistical evaluation protocols, well installation and abandonment procedures and recordkeeping.

1.1 SITE DESCRIPTION

TVA COF is located at 900 Colbert Steam Plant Road in Tuscumbia, Colbert County, Alabama (**Figure 1**). The facility occupies 1,354 acres between the south shore of the Tennessee River / Pickwick Reservoir and U.S. Highway 72 in Colbert County, Alabama. Cane Creek, a tributary of the Tennessee River, flows through the COF property (**Figure 2**).

Cane Creek, a tributary of the Tennessee River, enters the COF property south of U.S. Highway 72 and flows northwest through the property before crossing under Colbert Steam Plant Road. From there, the creek meanders for approximately 2.85 miles past the decommissioned power plant and around Horseshoe Bend before reaching the Tennessee River, as shown on **Figure 2**.

1.2 BACKGROUND

The COF facility operated as a coal-fired power generation station commencing in 1955. COF was retired in 2016 and is no longer used to generate electricity. Two capped and closed CCR units, Ash Disposal Area 4 and Ash Stack 5, are located within the eastern portion of COF. Ash Disposal Area 4 is a CCR Rule unit, regulated under both the Federal CCR Rule and the ADEM CCR Rule (ADEM Admin. Code r. 335-13-15). Ash Stack 5 is regulated under the ADEM Solid Waste Program [ADEM Admin Code r. 335-13-4] and is monitored in accordance with an ADEM-approved Closure/Post-closure Plan.

Ash Disposal Area 4 is located approximately 3,000 feet south of the plant powerhouse and was constructed in 1972. Ash Disposal Area 4 was capped and substantially complete by December

2017 as documented in the September 2018 "Closure Certification Report Final Closure – Ash Disposal Area 4" report (AECOM, 2018).

The groundwater near Ash Disposal Area 4 has been routinely monitored as required by the EPA's CCR rule and the Ash Disposal Area 4 Closure Plan for this unit. A certified groundwater monitoring system was established for Ash Disposal Area 4, which includes six wells[1] installed at the downgradient waste boundary within the uppermost aquifer (a shallow alluvial aquifer). Routine groundwater monitoring and reporting is regularly conducted in accordance with Federal/state requirements (Stantec, 2022b).

In 2018, TVA and ADEM executed the First Amended Consent Decree (ADEM 2018) which required a comprehensive groundwater investigation (CGWI) associated with the area of Ash Disposal Area 4 and Ash Stack 5. The CGWI was conducted from December 2018 through April 2019, to understand groundwater flow regimes and groundwater quality of the alluvial aquifer and the underlying bedrock aquifer. The results were published in the CGWI Report dated May 17, 2019 (Stantec, 2019). An update of recent groundwater sampling analytical results and additional downgradient monitoring well installations can be found in the 2019, 2020, and 2021 First Amended Consent Decree Annual Groundwater Monitoring and Corrective Action reports (Stantec, 2020; Stantec, 2021; Stantec, 2022a).

[1] Five alluvial aquifer wells (CA5, COF-102, COF-104, COF-105 and COF-106) were certified in October 2017, and a sixth well (COF-111) was added to the certified groundwater monitoring system in 2021.

2.0 ASH DISPOSAL AREA 4 CONCEPTUAL SITE MODEL

The following sections discuss the geologic setting and hydrogeology of the COF facility, including a description of the units pertinent to this GWMP, the presence of groundwater and aquifers, and groundwater flow patterns.

2.1 GEOLOGY

COF is within the Highland Rim section of the Interior Low Plateaus Physiographic Province and is underlain by bedrock composed of limestones, shales and sandstones of Mississippian age (Bossong and Harris, 1987; Szabo et al., 1988). This province is characterized by moderate relief on a low plateau adjacent to the Tennessee River. The river is a major drainage feature within the province and composes the northern property boundary of COF.

The local geologic setting of COF has been determined through the interpretation of lithologic logs associated with groundwater monitoring well borings and geotechnical borings. Three lithologic units of importance to this GWMP have been identified at COF and each is described below. **Figure 3** provides a map showing the site geologic setting.

2.1.1 RESIDUUM

A surficial chert-rich clay residuum composed of silt, clay, and chert materials is present at COF, formed by the in-situ weathering of limestone bedrock (see **Figure 4**). Near Ash Disposal Area 4, this lithologic unit is more evident in locations away from Cane Creek near the western edge of Ash Disposal Area 4. The residuum is relatively impermeable and can inhibit the vertical flow of groundwater creating localized perched pockets of groundwater. Horizontal flow through the residuum might occur locally but is typically of minimal volumetric flow. Although water is occasionally present in wells screened within the clay residuum, the residuum is not considered to be an aquifer at COF because of its sporadic saturated condition and the very low yields.

2.1.2 ALLUVIUM

Adjacent and parallel to Cane Creek in the Ash Disposal Area 4 area, alluvium deposits composed primarily of sands and gravels were deposited in the valley of Cane Creek (the hatched area depicted on **Figure 3**). Alluvium is a general term for clay, silt, sand, gravel, or similar unconsolidated detrital material, deposited during comparatively recent geologic time by a stream or other body of running water, as a sorted or semi-sorted unconsolidated sediment. Based on the geologic mapping depicted on **Figure 3** and evaluation of geotechnical borings at Ash Disposal Area 4, the alluvial aquifer underlies most of the Ash Disposal Area 4 management unit. A cross-sectional view of the alluvial aquifer along the eastern (downgradient) boundary of Ash Disposal Area 4 is provided as **Figure 5**.

2.1.3 BEDROCK

The Tuscumbia Limestone is the predominant bedrock unit underlying most of the COF facility (including Ash Disposal Area 4 and Ash Stack 5), with the Pride Mountain Formation overlying the Tuscumbia Limestone over a small area southwest of Ash Disposal Area 4, as shown on **Figure 3**. The Tuscumbia Limestone bedrock has an irregular contact between bedrock and the overlying residuum and alluvium due to weathering. The Tuscumbia Limestone is characterized by light to medium gray, fine- to medium-grained fossiliferous (primarily crinoid stems), cherty limestone. Chert occurs as light gray to dark bluish gray, sub-rounded nodules in layers throughout the unit (URS, 2014). A southwest to northeast cross-sectional view of the bedrock aquifer is provided as **Figure 4.**

2.2 HYDROGEOLOGY

COF is underlain by the Tuscumbia Limestone, and surface clay (residuum) from weathered limestone overlies the Tuscumbia Limestone in some areas. Alluvial sediments are present above the Tuscumbia Limestone along Cane Creek in the vicinity of Ash Disposal Area 4. The geologic materials in which groundwater is observed are described below.

2.2.1 ALLUVIAL AQUIFER

Adjacent to Cane Creek, alluvium deposits (unconsolidated silts, sands, and gravels) overlie bedrock that compose a surficial alluvial aquifer of limited horizontal extent. The alluvium adjacent and parallel to Cane Creek and underlying most of the Ash Disposal Area 4 area compose a discrete Alluvial aquifer that directs groundwater on both sides of the creek valley toward the creek throughout the year. Cane Creek flows north and northwest through TVA property, and eventually discharges into the Tennessee River more than two miles downstream of the former COF powerhouse. The Alluvial aquifer contains adequate quantities of groundwater and has sufficient yields to be classified as the uppermost aquifer in this area downgradient of Ash Disposal Area 4.

Alluvial aquifer groundwater elevation maps from 2020 to 2021 dry and wet seasons are included in **Appendix A** to illustrate the consistent groundwater flow regime of the alluvial aquifer. To develop these maps, alluvial aquifer and residuum monitoring wells were gauged for water levels prior to quarterly groundwater sampling events, and groundwater elevations were calculated using the National Geodetic Vertical Datum of 1929 (NGVD 29). Although the residuum is not a water-bearing unit, groundwater elevations in the residuum wells west of Ash Disposal Area 4 were gauged because the alluvial aquifer does not extend that far west. The residuum wells serve as a proxy for the upgradient water table elevation.

Groundwater flow at Ash Disposal Area 4 is a subdued replica of the natural valley topography, flowing from higher topographic elevations toward the creek on both sides of the valley. The horizontal gradient fluctuates throughout the year at variable magnitudes and durations depending on precipitation, groundwater flow trends in the bedrock aquifer, and other hydraulic factors in adjacent water bodies.

Testing for hydraulic conductivity at downgradient groundwater monitoring wells was conducted during a 2018 hydrogeologic evaluation (Terracon, 2018). Testing data indicates the uppermost saturated zone within the alluvial deposits has a geometric mean hydraulic conductivity of 3.4 x 10^{-3} centimeters per second (cm/sec). Linear groundwater flow velocity was calculated for the uppermost aquifer (alluvial aquifer) using:

- The geometric mean hydraulic conductivity calculated from hydraulic testing (3.4 x 10^{-3} cm/sec);
- Horizontal hydraulic gradients calculated from gauging data measured during the implementation of the groundwater sampling and analysis program, ranging from 0.0016 to 0.0073 feet per foot; and,
- An effective porosity of 20% (assumed effective porosity value in silty clayey sand and lean clay with sand type materials in the alluvial aquifer).

The average linear flow velocity in the uppermost aquifer ranges from approximately 28 to 130 feet per year.

2.2.2 BEDROCK AQUIFER

The Tuscumbia Limestone bedrock aquifer (technically referred to as the Tuscumbia-Fort Payne aquifer) underlying COF is composed of limestone and dolomite rocks with a permeability distribution spanning many orders of magnitude. The aquifer is composed of a complex, mesh-like, multiple-channel network of secondary porosity enhanced by limestone dissolution processes immersed in a low permeability, non-fractured to sparsely fractured limestone matrix.

Bedrock aquifer groundwater elevation maps from 2020 to 2021 dry and wet seasons are included in **Appendix A** to illustrate the groundwater flow patterns of this unit. Groundwater in the bedrock aquifer generally flows northeast toward the Tennessee River, similar to regional groundwater flow patterns.

Data necessary to provide a reliable estimate of groundwater flow velocity through the COF fracture system are not available; however, it is postulated that groundwater flow is relatively unimpeded through the open and interconnected fractures underlying the site. It is presumed that groundwater flow is maximized when there is a significant head differential (driving force), whereas under static conditions (during periods of light or no rainfall for several days to weeks), groundwater flow lessens considerably. Groundwater flow through partially filled fractures (which is likely the case through the majority of the site) is considered negligible.

3.0 GROUNDWATER MONITORING SYSTEM

Groundwater monitoring at the Ash Disposal Area 4 is required by ADEM Admin Code r. 335-13-15-.06 to detect potential downgradient changes in groundwater quality. The Ash Disposal Area 4 groundwater monitoring system is summarized below in **Table 1**, and well locations are depicted on **Figure 6**. TVA's groundwater monitoring system for Ash Disposal Area 4 was designed to meet the requirements of ADEM Admin Code r. 335-13-15-.06, as summarized below.

The groundwater monitoring system includes 19 wells at the appropriate depths and locations to provide groundwater samples that accurately represent the quality of background groundwater that has not been affected by the unit, and the quality of groundwater passing the waste boundary in accordance with ADEM Admin Code r. 335-13-15-.06(2)(a). The system is comprised of three background wells, four upgradient wells, two cross-gradient wells, and ten downgradient wells (five each located within the alluvial aquifer and the bedrock aquifer).

The number, spacing and depths of groundwater monitoring wells selected for inclusion in the system were determined based on the performance standards set in ADEM's administrative code; site-specific technical information collected during the Comprehensive Groundwater Investigation (2018-2019); semiannual groundwater data (uppermost alluvial aquifer) collected in accordance with the Federal CCR Rule (2016 to present); quarterly groundwater data (alluvial and bedrock aquifers) collected in accordance with the 1st Amended Consent Decree (2019 to present); and historical hydrogeological data and information. As discussed in Section 2 (above), the conceptual site model for COF is based on an understanding of aquifer thicknesses, groundwater flow rate and direction, and seasonal groundwater elevation fluctuations.

The groundwater monitoring system for Ash Disposal Area 4 meets the performance standard set forth in the rules. Further technical discussion is provided in the following sections.

3.1 WELL CONSTRUCTION

Wells completed in the alluvial aquifer (and two wells screened in residuum) were installed in general accordance with the "*Design and Installation of Groundwater Monitoring Wells in Aquifers*" (ASTM D5092) standard, per Division 13 regulation [335-13-15-.06 Groundwater Monitoring and Corrective Action] regarding the proper construction of monitoring wells. Wells within the bedrock aquifer were also installed in general accordance with the "*Design and Installation of Groundwater Monitoring Wells in Aquifers*" (ASTM D5092) standard. Per ASTM D5092 and USEPA Region 4 guidance for the Design and Installation of Monitoring Wells (USEPA, 2018), open hole bedrock completions are warranted in the limestone bedrock conditions prevalent at COF. Therefore, the designated unconsolidated aquifer and open hole bedrock aquifer background and compliance monitoring wells at Ash Disposal Area 4 were installed in accordance with ADEM regulations and USEPA guidance and compose a suitable and representative groundwater monitoring system.

Boring logs and well construction diagrams for the wells listed in **Table 1** are included in **Appendix B.** Well construction details are summarized in **Table B-1**, and **Table B-2** provides an index of logs and diagrams for reference.

Table 1: Ash Disposal Area 4 Groundwater Monitoring System

Monitoring Well Number	Top of Casing (feet NGVD29)	Unit Monitoring	Geologic Unit
Background Wells			
CA5	428.56	Ash Disposal Area 4	Alluvium
CA6	428.22	Ash Disposal Area 4	Bedrock
COF-116BR	427.26	Ash Disposal Area 4	Bedrock
Compliance Wells			
COF-102	426.27	Ash Disposal Area 4	Alluvium
COF-104	423.74	Ash Disposal Area 4	Alluvium
COF-105	426.83	Ash Disposal Area 4	Alluvium
COF-108	429.36	Ash Disposal Area 4	Alluvium
COF-111	425.32	Ash Disposal Area 4	Alluvium
MC4 (a)	447.21	Ash Disposal Area 4	Residuum
MC5A (a)	444.20	Ash Disposal Area 4	Residuum
COF-111BR (b)	425.38	Ash Disposal Area 4	Bedrock
COF-112BR	448.59	Ash Disposal Area 4	Bedrock
COF-113BR (c)	438.98	Ash Disposal Area 4	Bedrock
COF-114BR (c)	429.18	Ash Disposal Area 4	Bedrock
CA17B	439.71	Ash Disposal Area 4	Bedrock
CA30B	442.57	Ash Disposal Area 4	Bedrock
MC1 (a)	446.86	Ash Disposal Area 4	Bedrock
MC5C (a)	442.67	Ash Disposal Area 4	Bedrock
COF-108BR (d)	Future Installation	Ash Disposal Area 4	Bedrock
COF-111BRR (d)	Future Installation	Ash Disposal Area 4	Bedrock
Delineation Wells (RESERVED)			
Pending Final Assessment of Corrective Measures			

Notes:

(a) Located hydraulically upgradient of Ash Disposal Area 4.
(b) Planned for abandonment due to onsite construction activities.
(c) Located hydraulically cross-gradient of Ash Disposal Area 4.
(d) Future installations.

3.2 WELL TYPES

The groundwater monitoring network is subdivided into background and compliance locations per the ADEM CCR Facility Permit. Background and compliance locations are further defined below as upgradient, downgradient or cross-gradient. These designations are based upon assessment of potentiometric contours and aquifer interpretations by a qualified geologist where upgradient refers to the direction of increasing hydraulic head with respect to Ash Disposal Area 4; downgradient refers to the direction of decreasing hydraulic head with respect to Ash Disposal Area 4; and, cross-gradient is used to describe locations that are not directly hydraulically upgradient or downgradient relative to Ash Disposal Area 4. Further discussion of the well types is provided below.

3.2.1 BACKGROUND MONITORING WELLS

Background groundwater is the baseline quality of groundwater that is representative of the aquifer being monitored but has not been affected by CCR. Background groundwater monitoring wells for both the uppermost alluvial aquifer and the underlying bedrock aquifer have been identified at COF based on groundwater flow conditions, groundwater quality, and statistical screening of the data in accordance with the Unified Guidance (Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance, March 2009, USEPA 530/R-09-007).

For Ash Disposal Area 4, one background well is located within the alluvial aquifer (CA5), and two (CA6 and COF-116BR) are located within the bedrock aquifer (see **Figure 6** for well locations). Further discussion of the background wells is provided below.

Alluvial Aquifer

Monitoring well CA5 is included in the proposed groundwater monitoring system to provide groundwater samples that represent the quality of background groundwater in the alluvial aquifer. Based on review of alluvial aquifer groundwater elevations and flow patterns, monitoring well CA5, screened in the alluvial aquifer, is upgradient of Ash Disposal Area 4 at a location approximately 1,600 feet south of the waste boundary. Installed in 1982, CA5 has been sampled more than 45 times, providing data that represents seasonal fluctuations over several years. Groundwater quality data indicates reasonably consistent concentrations of constituents and stable trends over time. CA5 is included as a background well in the certified monitoring systems for both federal and state CCR groundwater monitoring programs.

Bedrock Aquifer

Monitoring well CA6 is included in the proposed groundwater monitoring system to provide groundwater samples that represent the quality of background groundwater in the limestone bedrock aquifer. Based on review of bedrock aquifer groundwater elevations and flow patterns, open hole monitoring well CA6 is located approximately 1,600 feet south of the waste boundary. CA6 has been determined to be moderately connected to the limestone aquifer which enables collection of groundwater samples that are representative of bedrock groundwater quality. Installed in 1982, CA6 has been sampled more than 47 times, providing groundwater data that represents seasonal fluctuations over several years. The data appear representative of a natural limestone aquifer and indicates reasonably consistent concentrations of constituents and stable trends over time.

Monitoring well COF-116BR is included in the proposed groundwater monitoring system to provide groundwater samples that represent the quality of background groundwater in the limestone bedrock aquifer. Based on review of bedrock aquifer groundwater elevations and flow patterns, open hole monitoring well COF-116BR is located approximately 800 feet south of the waste boundary. Similar to CA6, well COF-116BR has been determined to be moderately connected to the limestone aquifer which enables collection of groundwater samples that are representative of bedrock groundwater quality. Installed in 2019, CA6 has been sampled 10 times from 2019 through 2022, providing groundwater data that characterizes seasonal fluctuations and groundwater quality at this location. The data appear representative of a natural limestone aquifer and indicates reasonably consistent concentrations of constituents and stable trends over time.

3.2.2 COMPLIANCE MONITORING WELLS

Alluvial aquifer compliance wells are screened within the uppermost aquifer at Ash Disposal Area 4 within the saturated interval down to the interface with underlying bedrock and are used to assess potential impacts to the uppermost or first "aquifer" in the event of a release. Bedrock aquifer compliance wells (with one exception) are open hole constructed wells that monitor the uppermost interval of bedrock in the vicinity of Ash Disposal Area 4.

Compliance monitoring wells are located downgradient, upgradient and cross-gradient of Ash Disposal Area 4, enabling monitoring of groundwater quality around the perimeter of Ash Disposal Area 4. Groundwater monitoring at Ash Disposal Area 4 is required in accordance with ADEM Admin Code r. 335-13-15-.06, to detect potential downgradient changes in groundwater quality.

The following compliance wells have been identified for inclusion in the Ash Disposal Area 4 groundwater monitoring system:

- Ten wells are located <u>downgradient</u>: alluvial wells COF-102, COF-104, COF-105, COF-108, COF-111, and bedrock wells COF-108BR[2], COF-111BRR[3], COF-112BR, CA17B, CA30B.
- Four wells are located <u>upgradient</u>: residuum wells MC1, MC5A and bedrock wells MC1 and MC5C.
- Two wells are located <u>cross-gradient</u>: bedrock wells COF-113BR and COF-114BR.

Each compliance well type is discussed below. See **Figure 6** for well locations.

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[2] Future new well installation.
[3] Future installation as replacement for COF-111BR.

3.2.2.1 Compliance Wells – Downgradient

There are two sets of downgradient compliance wells at Ash Disposal Area 4: a network of five wells screened within the uppermost alluvial aquifer that are used to assess potential impacts to the uppermost "aquifer" in the event of a release, and a network of five wells completed in the underlying bedrock aquifer.

Alluvial Aquifer

Monitoring wells COF-102, COF-104, COF-105, COF-111, and COF-108 have been designated as the downgradient compliance uppermost alluvial aquifer wells at Ash Disposal Area 4. Well depths range between 10.9 to 39.0 feet below ground surface (bgs). Except for COF-108, these wells were installed and screened across the entire saturated aquifer thickness of the uppermost alluvial aquifer. Well COF-108 is screened in the basal 10 feet of the alluvial aquifer and was selected as a compliance well in lieu of COF-106, which was screened in the upper portion of the alluvial aquifer saturated interval. Based on review of groundwater elevations, these wells occupy a consistent downgradient position relative to Ash Disposal Area 4 and are properly located to detect potential impacts from the unit.

Bedrock Aquifer

Monitoring wells COF-108BR, COF-111BRR, CA17B, CA30B, and COF-112BR have been designated as the downgradient bedrock compliance bedrock wells at Ash Disposal Area 4. Each well has been constructed (or will be constructed, in the case of COF-108BR and COF-111BRR) as an open hole well. Based on review of groundwater elevations, these wells occupy downgradient positions relative to Ash Disposal Area 4 along or directly adjacent to preferential groundwater flow pathways. Existing wells CA17B, CA30B, COF-111BR and COF-112BR have total well depths between 52 to 126 feet bgs.

Due to impacts related to upcoming site activities, COF-111BR will be abandoned and later replaced with COF-111BRR after construction activities are complete. COF-111BR will continue to be monitored until the well is abandoned. COF-111 will be protected during construction, but if damage occurs, this well will also be replaced.

Well COF-108BR, a new downgradient bedrock compliance well, will be installed following ADEM approval. The locations of both COF-111BRR and COF-108BR will be dependent on field conditions, construction activities, and the results of pre-installation geophysical surveys.

3.2.2.2 Compliance Wells - Upgradient

Four compliance wells are located upgradient of Ash Disposal Area 4: MC4, MC5A, MC1 and MC5C. All four of these wells were installed prior to 2005 to monitor potential influences from the former Metal Cleaning Pond (MCP), also referred to as the Iron Pond. The Iron Pond was located west of Ash Disposal Area 4, ceased operation by 2007, and was closed in 2011-2012 in accordance with ADEM requirements.

<u>Residuum</u>

Monitoring wells MC4 and MC5A are screened in residuum, which is not considered to be an aquifer, although water is sometimes present in the wells. When enough water is present in the wells, the elevations indicate these well are nominally upgradient of Ash Disposal Area 4. MC4 and MC5A are screened between 9.7 to 24.6 feet bgs and 8.5 to 23.4 feet bgs, respectively, just above the top of bedrock.

<u>Bedrock Aquifer</u>

Based on their location and the interpreted direction of groundwater flow, wells MC1 and MC5C are both considered to be upgradient of Ash Disposal Area 4. MC1 is an open hole well, with a total depth of 73.6 feet bgs. MC5C is a screened bedrock well (the only screened bedrock well in the system), constructed with a 10-foot-long screen between 142.5 to 152.1 feet bgs. MC5C is approximately 50 feet deeper than other nearby open hole bedrock wells and monitors a much deeper zone of bedrock groundwater than other Ash Disposal Area 4 compliance wells.

3.2.2.3 Compliance Wells – Cross-gradient

Two cross-gradient bedrock wells are included in the groundwater monitoring system.

<u>Bedrock Aquifer</u>

Based on their location and the interpreted direction of groundwater flow, COF-113BR and COF-114BR are cross-gradient of Ash Disposal Area 4, based on groundwater elevation maps (**Appendix A**). Both wells are open hole, with total depths of 100 and 120 feet bgs, respectively.

4.0 GROUNDWATER SAMPLING AND ANALYSIS

In accordance with ADEM Admin Code 335-13-15-.06(4), groundwater monitoring will be performed in accordance with sampling and analysis procedures to ensure an accurate representation of groundwater quality. The sampling and analysis procedures, including sample collection, sample preservation and shipment, analytical procedures, chain of custody control, and quality assurance and quality control measures are summarized below.

4.1 GROUNDWATER SAMPLING FREQUENCY

Groundwater monitoring events will be conducted on a semiannual basis. All wells identified in the groundwater monitoring system will be sampled, based on the existing wells at the time. To coincide with wet and dry periods, sampling will be scheduled during the February-March and August-September timeframe each year. The time periods may be adjusted in the future depending on observed weather conditions.

4.2 GROUNDWATER MEASUREMENTS AND PURGING PROTOCOL

4.2.1 GROUNDWATER LEVEL MEASUREMENTS

Prior to groundwater sampling, the depth from top of casing (or surveyed reference point) to groundwater surface in each monitoring well will be measured using an electronic water-level indicator. Well gauging data will be measured and recorded to the nearest 0.01 foot. To the extent possible, the field team will minimize the time between collecting the first and last water level measurements for the monitoring well network. At a minimum, all wells will be gauged within a 24-hour period. The water level indicator will be decontaminated after gauging each well by following the decontamination procedures provided below in Section 4.6.

In the event of a moderate to heavy rainfall, well gauging will stop and TVA will estimate the length of time needed for water levels to equilibrate. All water levels may need to be measured again.

4.2.2 WELL PURGING

Following the round of well gauging, monitoring wells will be purged using either dedicated (if present) or non-dedicated pumps in each well. Purging will continue until field measurements of water quality parameters have stabilized during three consecutive readings at three- to five-minute intervals. The stabilization criteria are as follows:

- pH: ±0.1 standard units
- specific conductance: ±3% in microsiemens/centimeter (μS/cm)
- dissolved oxygen (DO): Below 0.5 milligrams per liter (mg/L) or ± 10% for values greater than 0.5 mg/L

- turbidity: Below 5 Nephelometric Turbidity Units (NTUs) or ±10% for values above 5 NTUs and stable

With the intended goal of collecting a groundwater sample with a turbidity value below 5 NTUs, the following scenarios will be followed, as applicable, provided the water quality parameters have met stabilization criteria:

- If turbidity is below 5 NTUs for three consecutive readings, purging will be deemed complete and sampling shall proceed.

- If turbidity is greater than 5 NTUs and is continuing to decrease, purging should continue for a total of up to 2 hours or until other conditions listed herein are met. After two hours, sampling will proceed.

- If turbidity is greater than 5 NTUs and there are three consecutive increasing turbidity measurements after decreasing values have been observed, sample collection will proceed.

- If turbidity is greater than 5 NTUs but is within plus or minus 10% of the previous reading for three consecutive readings, and historic purge logs for the well have shown that the well has consistently stabilized above 5 NTUs, purging will be deemed complete and sampling shall proceed.

Field measurements, including pH, specific conductance, DO, oxidation reduction potential (ORP), temperature, and turbidity, will be measured during purging using a flow-through cell complemented by other field parameter measurement devices, if necessary. Once the field measurements of water quality parameters have stabilized after three consecutive readings, groundwater samples will be collected. For low-yield wells, field measurements might be performed at the time of sample collection in an open sample container using a multi-parameter probe. If after two hours of well purging the field measurements of water quality parameters have not stabilized, then groundwater samples will be collected and the efforts to stabilize the water quality parameters will be recorded in the field logbook and field data sheet.

Purging beginning and end times, pumping rates, field measurements of water quality parameters, and groundwater gauging data will be recorded throughout the purging procedure 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 formation, 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 historical purge pumping rates 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 sufficient water returns within the well bore to obtain the necessary sample volume, but no later than 24 hours after the well purge.

4.3 COLLECTION OF GROUNDWATER SAMPLES

4.3.1 GROUNDWATER SAMPLING

The final measurement 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 laboratory-provided, pre-preserved sample containers. Groundwater samples will be collected directly from the pump discharge line at the same flow rate used for stabilization during purging. 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 set of sample containers. When filling sample containers, 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.

Filtered (dissolved) inorganic constituent samples may need to be collected, in addition to unfiltered (total) inorganic constituent samples, <u>if the final turbidity value before sampling exceeds 5 NTUs</u>. Issues that could affect the quality of samples will be recorded on the field data sheet or in the logbook 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.

Once sample collection is complete, a post-sampling confirmation turbidity and depth-to-water measurement will be collected and recorded, and a final set of indicator parameter readings will be collected.

4.3.2 SAMPLE PRESERVATION AND HANDLING

Once each sample container has been filled, the rim and threads will be cleaned by wiping with a clean paper towel and then the sample bottle cap will be secured. Each sample container will be checked to ensure that it is sealed, legibly labeled, and externally clean. A signed and dated custody seal will be applied to each sample container. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment 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, if requested, and provided by the analytical laboratory. Loose ice will be placed around and among the sample containers to ensure that the samples remain less than 6 degrees Celsius (°C) during shipment. The cooler will be filled with additional packing material to ensure that the containers are secure.

4.3.3 CHAIN OF CUSTODY (COC) CONTROL

Custody of each sample container will be maintained by Field Sampling Personnel during the sampling events until relinquished via COC to the analytical laboratory. A custody seal with the date and signature of the sampler is to be placed on each sample container.

COC records will be prefilled to the extent practical using TVA's fillable PDF forms or the EQuIS® Collect software to ease transcription in the field. COC records will be completed electronically at the time of sample collection by field sampling personnel. If electronic means are not available, then COC records will be completed on paper in blue or black waterproof ink. The COC record will accompany the samples at all times until samples are relinquished. Individuals who subsequently take possession of the samples will also sign and include the date and time on the COC record, except for common carriers (i.e., FedEx). The shipping document provided by FedEx will serve as an appropriate custody record during sample shipment.

Unique COC identification (ID) numbers are to be recorded in the Daily Activity Log or field logbook. Accurate COC identification is critical for maintaining traceability from field collection to laboratory delivery, as well as for association with results.

COC identification will be in the format of XXZZZMMDDYYYY_TC_LOC as follows:

- XX – Sampling Program Code (GW = Groundwater Monitoring)
- ZZZ – Three-character facility identification code (COF)
- MMDDYYYY – Day of Sample Collection in mmddyyyy format
- T = Sampling Team Number
- C – COC Identification code for analysis requested (A = Chemical Constituents)
- LOC – Specific Location (i.e., LF) only used for facilities with multiple networks to ensure that all COC numbers are unique.

The original COC form will be placed in a resealable 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 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 each 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" line on each COC form. The laboratory will verify that the custody seals have not been broken. The laboratory will note the condition and temperature of the samples upon receipt and will identify any discrepancies between the contents of the cooler and the COC form. If discrepancies are found, 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 manager and investigation/consultant project manager.

4.4 ANALYTICAL PARAMETERS

Groundwater samples will be analyzed for the constituents listed in Appendix III and Appendix IV of the ADEM CCR Rule. The groundwater monitoring constituents are listed below:

Table 2 : Ash Disposal Area 4 Groundwater Monitoring Constituents

Appendix III Parameters	Appendix IV Parameters
Boron	Antimony
Calcium	Arsenic
Chloride	Barium
Fluoride	Beryllium
pH	Cadmium
Sulfate	Chromium (Total)
Total Dissolved Solids (TDS)	Cobalt
	Fluoride [already included]
	Lead
	Lithium
	Mercury
	Molybdenum
	Selenium
	Thallium
	Ra-226 &228

Analytical methods, preservation requirements, container size, and holding times for each chemical analysis are presented in **Table 3**.

Table 3: Analytical Methods, Preservatives, Containers and Holding Times

Parameter	Analytical Methods	Reporting Limits	Preservative(s)	Container(s)	Holding Times
Metals, total	SW-846 6020B	Varies	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	180 days
Mercury, total	SW-846 7470A	2.0 µg/L			28 days
Metals, dissolved	SW-846 6020B	Varies	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	180 days
Mercury, dissolved	SW-846 7470A	2.0 µg/L			28 days
Radium 226	EPA 903.0	2.5 pCi/L	HNO_3 to pH < 2 Cool to <6°C	1-L HDPE	180 days
Radium 228	EPA 904.0	2.5 pCi/L	HNO_3 to pH < 2 Cool to <6°C	2x1-L HDPE	180 days
Anions (chloride, fluoride, sulfate)	SW-846 9056	Varies	Cool to <6°C	500-mL HDPE	28 days
Total Dissolved Solids (TDS)	SM 2540C	10.0 mg/L			7 days
Alkalinity (Total, Carbonate, and Bicarbonate)	SM2320B	5.00 mg/L			14 days
pH	SW-846 9040C (laboratory measurement)	±0.1 SU			24 hours
pH	SW-846 9040C (field measurement)	±0.05 SU	NA	NA	15 minutes

<u>Notes:</u>

Varies: Reporting limits for metals (total and/or dissolved) and anions vary per analyte; laboratory reporting limits will be in accordance with the QAPP

µg/L: micrograms per liter

mg/L: milligrams per liter

4.5 FIELD EQUIPMENT TESTING/INSPECTION AND MAINTENANCE

Field equipment will be inspected, tested, and calibrated (as applicable) prior to initiation of fieldwork by the field team members. 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.

For instruments requiring field calibration, documented calibrations will be conducted at the frequency recommended by the manufacturer. Personnel performing instrument calibrations/standardizations shall be trained in its proper operation and calibration. Records of instrument calibration/standardization will be maintained in the project files.

4.6 EQUIPMENT DECONTAMINATION PROCEDURES

Documented decontamination will be performed to prevent cross-contamination. Decontamination fluids will be containerized, if required, and disposed of in accordance with COF waste disposal policies. If collection and containerization of decontamination fluids is required, 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 and transportation, and, ultimately, disposal in accordance with COF waste disposal policies. Decontamination 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® and/or other appropriate non-phosphatic detergent in five-gallon buckets. Decontamination of sampling equipment and instruments (e.g., water level meters, pumps for well development, etc.) will be performed before use and between sampling locations. Decontamination will be documented in the logbook field notes.

4.7 QUALITY CONTROL AND QUALITY ASSURANCE

The accuracy of the water level measurements and groundwater sampling will be maintained during each sampling event throughout the program. Field personnel will be responsible for performing checks to confirm that the procedures in the GWMP have been followed. This will consist of completing applicable field forms and documentation of field activities.

Field quality assurance and quality control (QA/QC) samples will be collected during sampling: field-duplicate samples, matrix-spike/matrix-spike-duplicate (MS/MSD) samples, equipment blanks, and field blanks. Filter blanks and tubing blanks will be collected if required.

Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below.

Duplicate Samples—One duplicate sample will be collected for every 20 groundwater 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. Sample bottles will be filled in one-third increments across the duplicate-sample containers. The primary and duplicate samples will be labeled according to standard procedure (i.e., sample identifier information will not be used to identify 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 groundwater will be collected for use as the MS/MSD. MS/MSD sample containers will be filled in one-third increments across the triplicate-sample containers. MS/MSD samples will be collected to allow matrix-spike samples to be run by the laboratory 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 chain-of-custody records and sample labels. The location of sample collection will be noted in the logbook. The MS/MSD sample will be analyzed for the same analytes as the primary sample, except for parameters that are not amenable to MS/MSD. A laboratory duplicate (LD) will be performed for analytes that are not amenable to spiking.

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 logbook. The sample will be analyzed for the same analytes as the sample collected from the monitoring well location where the equipment blank is prepared except for pH.

Field Blanks—Each sample team will prepare one field-blank sample per day per team using laboratory-supplied deionized water. Field blanks will be prepared in the field by pouring laboratory-supplied deionized water into sample containers. The field blanks will be preserved, packaged, and sealed in the manner used for environmental samples. The blanks will be labeled in accordance with standard procedure and shipped to the analytical laboratory with the investigative samples. The sample will be analyzed for the same analytes as the groundwater samples and equipment blanks.

Filter Blanks (if required) —Filter blanks will be collected at a frequency of one per event and one per lot number of filters used 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 an unused disposable in-line filter of the same brand and lot as used in the collection of dissolved metals (or other analytes) and collecting the filtered water into the appropriate sample containers. The time and location of collecting the filter blank will be noted in the daily field notes. The sample will be analyzed for the same dissolved analytes as the sample collected from the location where the filter blank is prepared.

Tubing Blanks (if required) —At least one tubing blank will be collected during each groundwater sampling or surface water event when non-certified clean or non-dedicated tubing is used for sample collection or when dedicated tubing from the monitoring well is replaced. The tubing blank will be collected at a groundwater sampling location by passing laboratory-supplied deionized water through sample tubing used. The time and location of collecting the tubing blank will be noted in the logbook. The sample will be analyzed for the same analytes as the sample collected from the location where the tubing blank is prepared.

5.0 REPORTING

5.1 Semiannual Reports

In accordance with ADEM Admin. Code 335-13-15-.06(1)(f), a semiannual report will be prepared that coincides with each semiannual sampling event. Statistical evaluations of groundwater data will be conducted semiannually. The semiannual reports will provide the following at a minimum:

- A scaled facility map showing the monitoring well locations.
- A summary of any monitoring well installations or well decommissioning that occurred during the reporting period.
- A summary of the sampling activities.
- Tabular laboratory analytical groundwater data.
- A conclusion section that summarizes the results of the groundwater sampling event and provides a discussion of results and sampling monitoring program transitions, if any. The conclusion shall also summarize constituents that exceed a Groundwater Protection Standard.

5.2 Annual Report

In accordance with ADEM Admin. Code 335-13-15-.06(1)(e), an annual groundwater and corrective action report will be prepared and submitted no later than January 31 of the following year. Statistical evaluations of the groundwater data will be conducted semiannually, and background threshold values will be developed at least every five years. See Section 6 below for further details.

The annual report will include the following:

- A summary of the status of the groundwater monitoring and corrective action program including key actions completed, problems encountered and resolutions, and key activities for the upcoming year.
- A scaled facility map showing the monitoring well locations.
- A summary of any monitoring well installations or well decommissioning that occurred during the reporting period.
- A summary of the sampling activities.

- Groundwater potentiometric maps to illustrate groundwater flow direction for each sampling event.

- Estimated groundwater flow rate ranges.

- Table summarizing depth-to-water measurements and groundwater elevations for each monitoring well.

- Tabular groundwater sampling field parameter data.

- Tabular laboratory analytical groundwater data.

- The results of the statistical evaluation to identify if there has been a statistically significant increase above background values for naturally occurring parameters/constituents monitored.

- An overview of the status of the groundwater monitoring and corrective action programs, including transitions between groundwater monitoring programs (detection versus assessment monitoring), identification of statistically significant increases for any constituents, details related to the assessment of corrective measures and remedy selection activities.

- A conclusion section that summarizes the results of the groundwater sampling event and provides a discussion of results and sampling monitoring program transitions, if any. The conclusion shall also summarize constituents that exceed a Groundwater Protection Standard.

The following additional information will be provided to ADEM under separate cover:

- Groundwater sampling field data sheets and chain of custodies.

- Electronic pdf versions of the chain-of-custody (COC) forms and the analytical laboratory data reports.

- Quality assurance and quality control (QA/QC) documentation.

6.0 STATISTICAL EVALUATION

A statistical methods certification for compliance with the EPA CCR Rule (40 CFR §257.93) for Ash Disposal Area 4 is provided in **Appendix C**. This appendix describes the statistical methodology applicable to evaluating groundwater monitoring data at Ash Disposal Area 4 to support compliance with requirements outlined in Sections 257.93(f) and 257.93(g) of the EPA CCR Rule, thus meeting the requirements of the ADEM CCR Rule (ADEM Admin. Code r. 335-13-15). As such, **Appendix C** describes statistical methods applicable to detection monitoring, assessment monitoring, and corrective action at Ash Disposal Area 4.

For detection monitoring, a prediction limits method is described that is consistent with method/paragraph (3) of Section 257.93(f). For assessment monitoring and corrective action, a confidence interval or confidence band method is described that is also justified under method/paragraph (5) of Section 257.93(f), namely "Another statistical method that meets the performance standards of paragraph (g) of this section."

Statistical methods that will be applied to establish site-specific background threshold values are also described in **Appendix C**.

7.0 WELL INSTALLATION AND ABANDONMENT PROCEDURES

The following sections describe all monitoring well installation and abandonment procedures at Ash Disposal Area 4 during the permit period.

7.1 NEW MONITORING WELL INSTALLATIONS

Prior to drilling, utility clearances, National Environmental Policy Act (NEPA) evaluations, and approvals/permits will be obtained in accordance with site-specific protocols and local requirements. For bedrock wells, downhole geophysical investigations will be required to identify preferential flow paths in the area that are desirable for bedrock well installation.

Borings in unconsolidated geologic materials (e.g., alluvium) will be installed using hollow-stem auger (HSA) techniques (ASTM D6151), or by rotosonic drilling (or equivalent). Continuous soil sampling will be performed using either Standard Penetration Test (SPT) sampling (HSA drilling technique) or continuous coring (rotosonic drilling technique) to allow for visual logging of the soil intervals encountered. Drilling methods and well construction methods/materials may be modified if deemed necessary due to site conditions.

In the event that additional wells are warranted in the alluvial aquifer, groundwater monitoring wells will be constructed using 4-inch diameter Schedule 40 Polyvinyl Chloride (PVC) well casing and screens with 0.010-inch machined slots, and 20-40 sand filter pack, or equivalent. The screen and riser will consist of flush-joint, threaded PVC pipe. The screen lengths will be selected based on the lithology that is encountered, including the thickness of the aquifer interval, but 10-foot-long screens are anticipated. Approximately 0.5-feet of sand will be placed in the bottom of the boring as a foundation for the PVC screen and riser. A sand filter pack will be placed in the PVC-boring annular space from bottom of boring to approximately 2 feet above the screen. A 2-foot-thick bentonite seal placed on top of the sand filter pack will be hydrated with potable water in accordance with manufacturers recommendations. The PVC riser for the monitoring wells will extend above (2.5 feet minimum) the ground surface and will be capped with a temporary plug or slip cap. This riser will be protected by an above-grade, steel, locking protective cover anchored to a concrete surface pad.

Borings for bedrock monitoring wells will be advanced using rotosonic or air hammer drilling techniques until 3 to 5 feet of competent bedrock is encountered. Once 3 to 5 feet of bedrock is encountered, a flush-threaded Schedule 40 PVC surface casing will be installed and seated by installing cement-bentonite grout in the borehole-casing annular space. The purpose of the surface casing is to isolate the bedrock from the overburden and to direct drilling fluid and cuttings to the surface that are generated as the boring is advanced into bedrock.

After the surface casing grout has cured for a minimum of 24-hours, the boring for the monitoring well installation will be advanced into bedrock using either rotosonic or air rotary drilling techniques to the target termination depth. A target termination depth for bedrock wells will be selected based on results of the conceptual site model. The actual termination depth may vary from the target termination depth depending on conditions encountered as the boring is advanced. The bedrock wells will be completed as an open hole.

The field geologist will prepare a written field log for each boring that includes descriptions of recovered soil samples in general accordance with the Unified Soil Classification System (USCS), ASTM D2488, and the Munsell Soil Color Book. Descriptions of recovered rock core samples will be logged in general accordance with the Midwest Geosciences Group Field Guide for Rock Core Logging and Fracture Analysis. Each boring log will include the boring location, drilling personnel, tooling/equipment used, drilling performance and response, depth at which groundwater is encountered, sample numbers, sample recovery, SPT blow counts (in the unconsolidated geologic materials only), and other relevant observations.

New monitoring wells will not be developed until at least 24 hours after installation. Development of new monitoring wells will be performed using a combination of surging and either bailing or pumping to remove residual materials (fines) remaining in the well after installation and to re-establish the natural flow conditions of the formation that may have been disturbed by the drilling process. Development will continue until the column of water in the well is free of visible sediment and the pH, temperature, turbidity, and specific conductance have stabilized in accordance with ADEM guidance (ADEM 2017).

The monitoring wells will be completed with concrete pads (approximately 6-inches thick) surrounding the well (i.e., 3 ft x 3 ft x 0.5 ft) and sloping away from the well. Each well will be capped and enclosed in a lockable above-ground metal protective cover with weep holes to prevent build-up of water within the protective casing. Wells located in areas with potential traffic will have a minimum of three surface protection bumper guards (bollards) installed. All wells will have identification including the well identification number, total depth, and installation date.

Once construction of the monitoring wells is completed, newly installed wells will be surveyed for horizontal and vertical control by a licensed surveyor relative to the Alabama State Plane coordinate system and NGVD29. The survey data will be added to the final well construction logs once available.

7.2 MONITORING WELL ABANDONMENT

If a permitted monitoring well should be abandoned, the abandonment procedures will be followed in accordance with ADEM Admin Code r. 335-13-15-.06(2)(g) and 335-13-4-.27(2)(e). The objectives of abandoning a well are to: 1) eliminate physical hazards; 2) prevent groundwater contamination; 3) conserve aquifer head and hydrostatic head; and 4) prevent intermixing of subsurface water. The purpose of sealing an abandoned well is to prevent further disturbance to the pre-existing hydrogeologic conditions that exist within the subsurface. The sealing plug shall prevent the vertical movement within the borehole and confine water to the original zone of occurrence.

A notification letter and abandonment plan will be sent to ADEM with the name of each well to be abandoned. Abandonment will be performed in accordance with the following procedures unless field conditions warrant a modified approach. Approval will be received from ADEM prior to implementing abandonment of any well.

The actual total depth of each well to be abandoned will be measured and compared to as-built records to verify there are no obstructions that may interfere with the sealing operations.

Where possible wells will be completely filled with neat cement-bentonite grout. If the well cannot be completely filled with grout, the sealing material for the top 20-feet will be a neat cement-bentonite grout and no material that could impart taste, odor, or toxic components to water may be used in the sealing process.

Tremie grouting will be performed from the bottom of the well or from a plug set within casing or competent borehole, upwards with a cement-bentonite grout as primary sealing material, defined as a mixture of not more than 8.3 gallons of clear, potable water, 5-pounds of sodium-based bentonite to one 94-pound bag of Portland cement. All water used for the mixing of grout shall be of potable quality. The grout shall be pumped through a tremie pipe installed in the well in one continuous operation from the well bottom (or top of plug) to the top of the well. The tremie pipe shall be slowly raised as the grout is being placed, keeping the discharge end of the pipe always submerged in the grout until sealing of the well is complete. The grout mixture shall be brought up to ground level to displace all water and materials in the well.

The driller shall return to the well no sooner than 24 hours nor no later than 72 hours to inspect the well for grout settlement and implement activities to top off the well with additional grout. Regrouting of a well by the tremie pressure method is acceptable and shall be performed if the settlement of the grout was more than 10 feet bgs. Settling of less than 10 feet can be addressed by the emplacement of properly hydrated sodium-based bentonite chips or pellets. Additionally, a concrete seal may be placed at the ground surface, or the top two feet of the borehole will be poured with concrete, to insure a secure surface seal (plug).

Records of well abandonment activities will be kept for each well abandoned. The records will include the date(s) the well was abandoned, the property owner's name and address, the facility and location information where the well was located, local well identification number (COF-111BR), the as built total well depth, the static water level, the well depth measured at the start of abandonment, well diameter, and surface casing material (PVC), the method (pressure tremie), description of the type and amount of materials used to abandon the well, the depth or intervals in which each abandonment material was placed, the licensed drilling company name and address, the name and either the license or registration number of the driller who abandoned the well, and any changes to the planned abandonment process. A copy of these records will be provided to ADEM, and a copy placed in the operating record.

7.3 MONITORING WELL DOCUMENTATION

Pursuant to ADEM Admin Code r. 335-13-15-.06(2)(e)4), TVA will document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells associated with Ash Disposal Area 4.

8.0 RECORD KEEPING

TVA will maintain its publicly accessible internet site to include information for Ash Disposal Area 4 required by the EPA and ADEM CCR Rule to be posted on the site, and the information posted to this website will be made available to the public for at least five years following the date the information was first posted to the website.

9.0 REFERENCES

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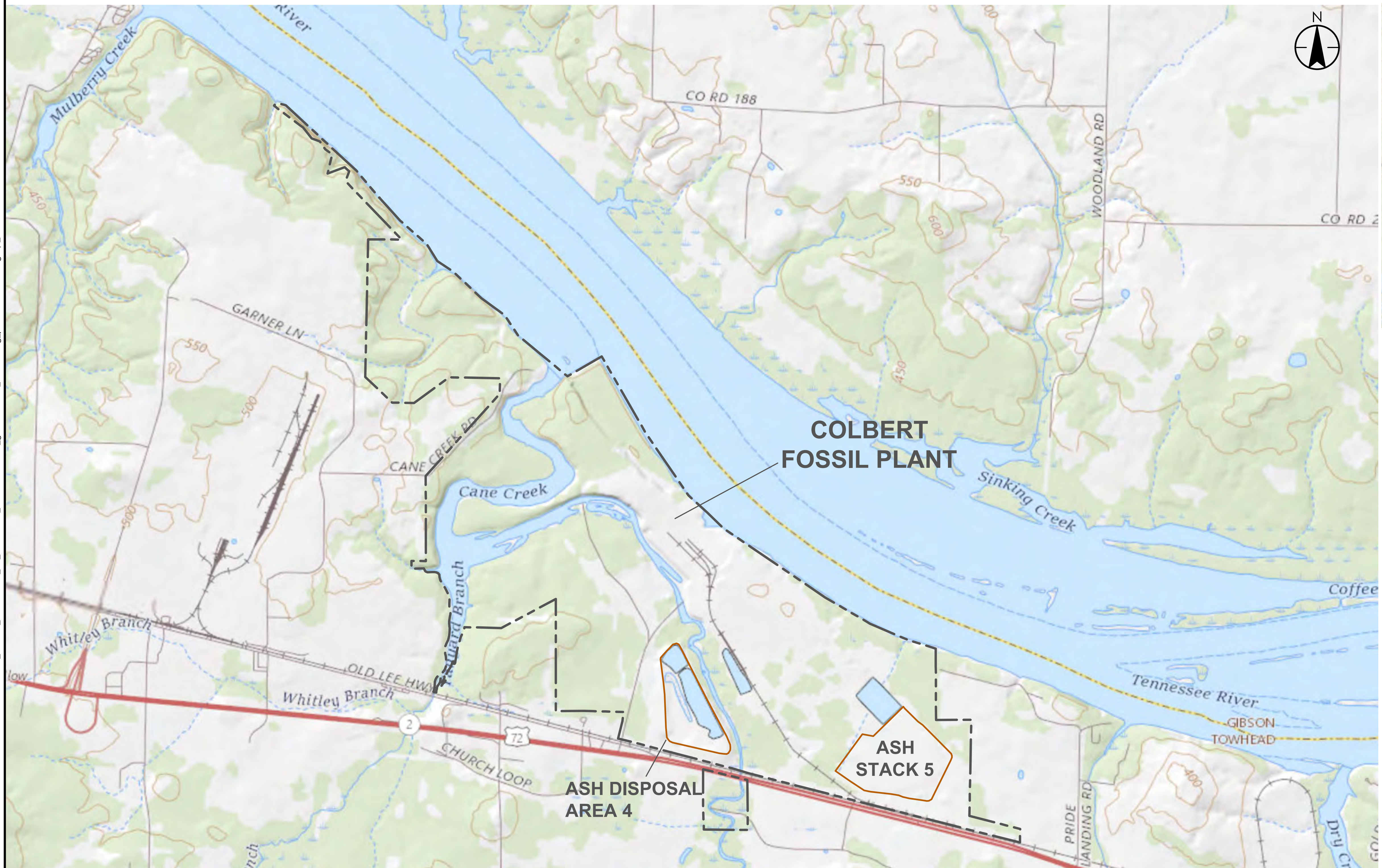
FIGURES



SITE LOCATION INSET

SCALE: N.T.S.

0 2500' 5000'

MAP COMPOSED OF THE CHEROKEE, BARTON, SINKING CREEK, AND PRIDE 7.5 MINUTE SERIES QUADRANGLE MAPS.

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LEGEND

TVA PROPERTY BOUNDARY

CCR MANAGEMENT UNIT

Client/Project

Tennessee Valley Authority
Colbert Fossil Plant

Ash Disposal Area 4 Groundwater Monitoring Plan

Project No.
172699205

Title

SITE LOCATION ON USGS TOPOGRAPHIC MAP

Figure No.
1

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TVA PROPERTY BOUNDARY

CCR MANAGEMENT UNIT

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Client/Project

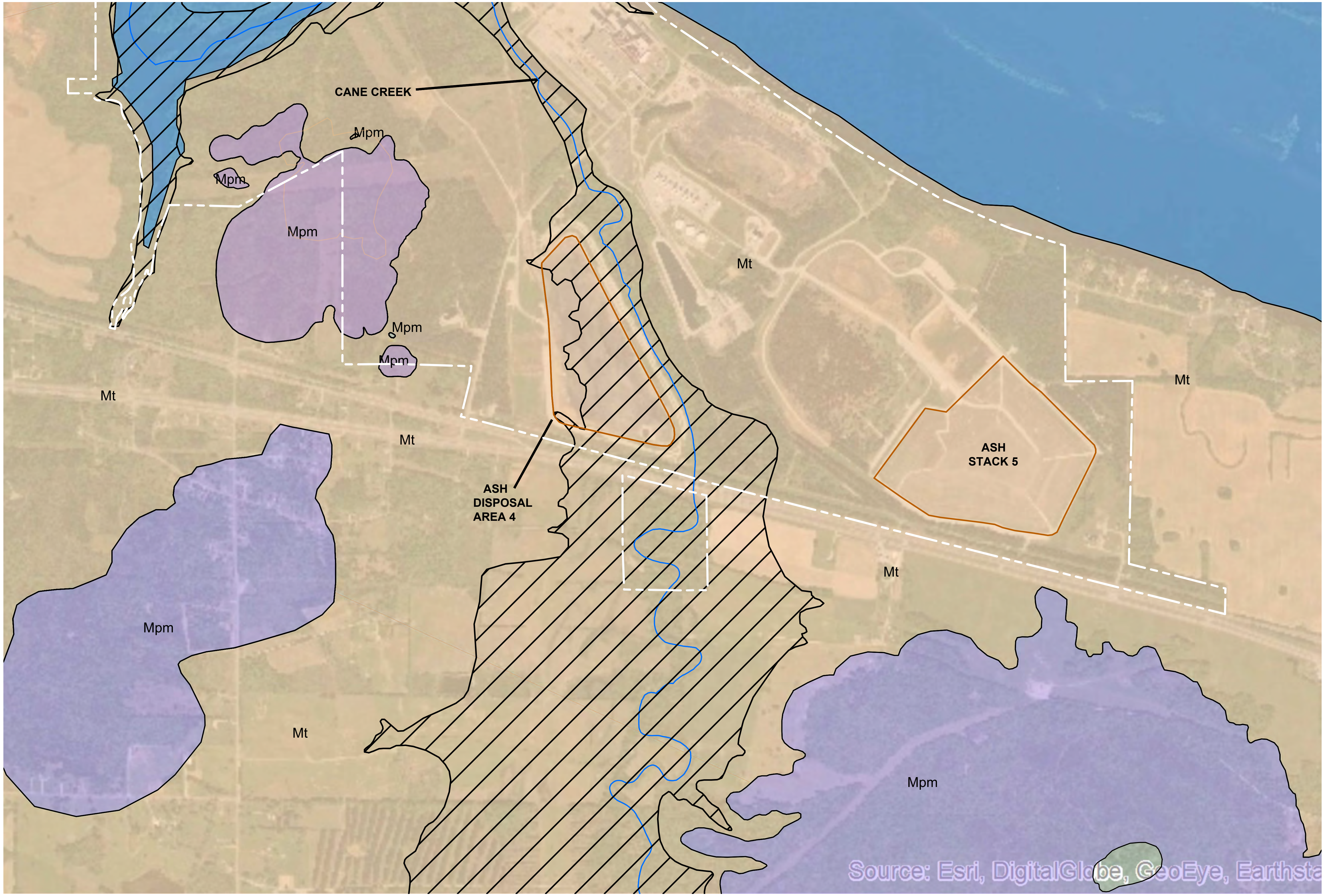
Tennessee Valley Authority
Colbert Fossil Plant
Ash Pond 4 Groundwater Monitoring Plan

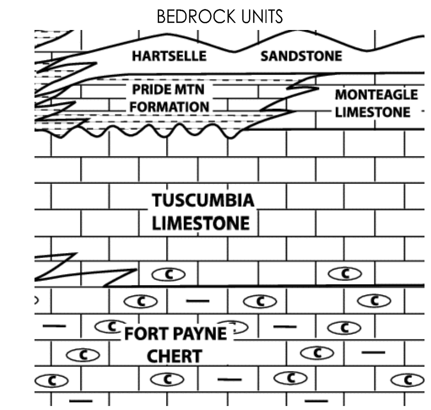
Project No.
172699205

Title

COF FACILITY AND
SURROUNDING PROPERTIES

Figure No.
2





STRATIGRAPHIC CHART FROM MANN, ET AL (2013)

NOTE:

EXTENT OF RESIDUUM SOILS DERIVED FROM WEATHERED TUSCUMBIA LIMESTONE IS NOT DEPICTED.

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LEGEND

TVA PROPERTY BOUNDARY

CCR MANAGEMENT UNIT

Mt (TUSCUMBIA LIMESTONE)

Mpm (PRIDE MOUNTAIN FORMATION)

SURFICIAL ALLUVIAL DEPOSITS

MAPPING SOURCES: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND GIS USER COMMUNITY

Client/Project

Tennessee Valley Authority
Colbert Fossil Plant

Ash Disposal Area 4 Groundwater Monitoring Plan

Project No.
172699205

Title

SITE GEOLOGIC SETTING

Figure No.
3

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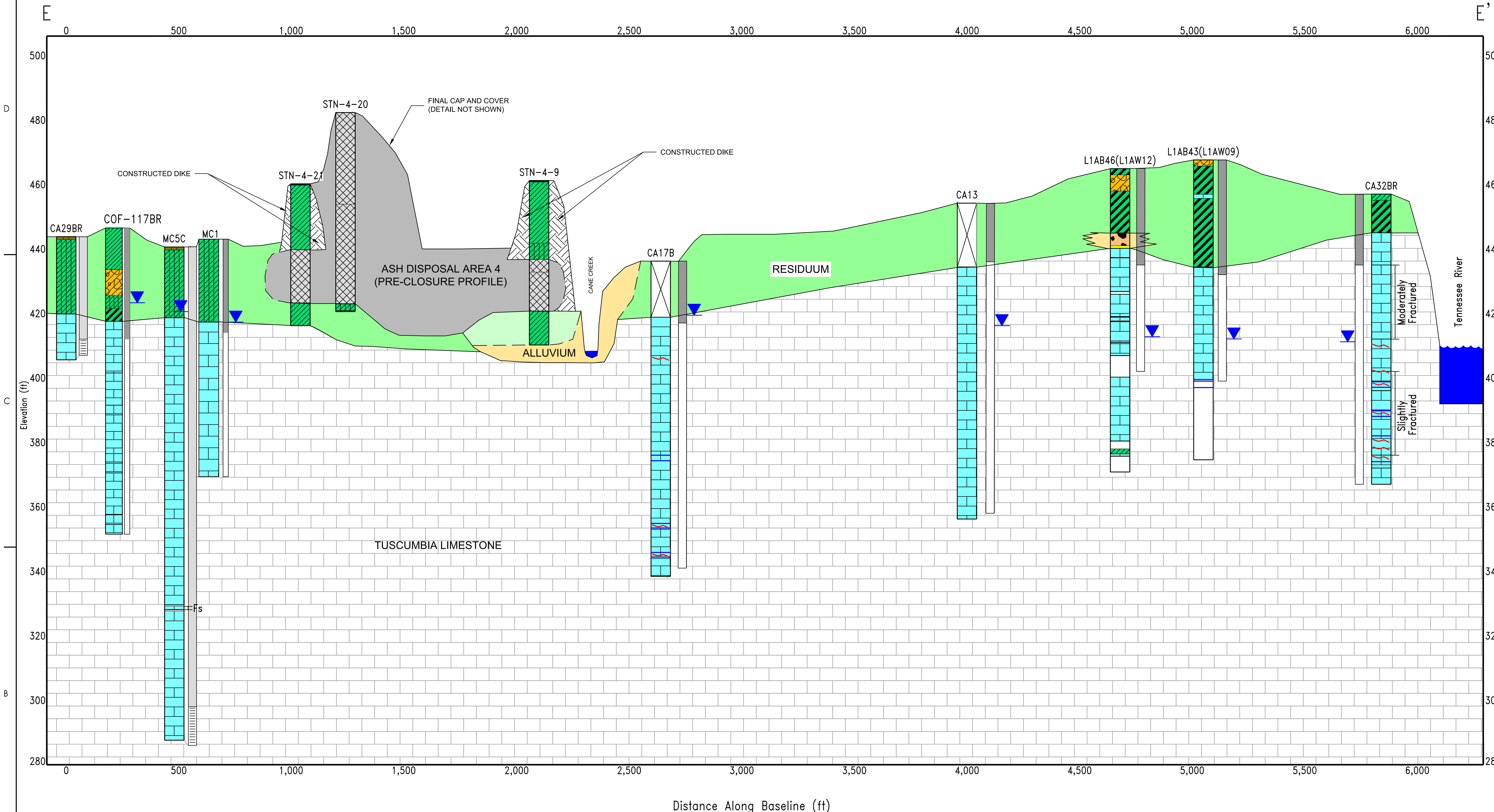

LEGEND

- ALLUVIUM / ALLUVIAL AQUIFER
- RESIDUUM
- TUSCUMBIA LIMESTONE BEDROCK AQUIFER
- LOW PERMEABILITY SOILS
- WELL CASING
- WELL SCREEN INTERVAL
- HEAVILY FRACTURED
- PRODUCES WATER AS PER HPFM LOG
- POTENTIAL PREFERENTIAL GROUNDWATER FLOW HORIZON
- ALLUVIAL AQUIFER / RESIDUUM GROUNDWATER ELEVATION IN FEET NGVD 29 (NOVEMBER 2021)
- TUSCUMBIA LIMESTONE BEDROCK AQUIFER GROUNDWATER ELEVATION IN FEET NGVD 29 (NOVEMBER 2021)
- SURFACE CASING
- OPEN BOREHOLE WELL

LITHOLOGY GRAPHICS

- Limestone
- Topsoil
- Low Plasticity Silty Clay
- Low Plasticity Clay
- High Plasticity Clay
- Clayey Gravel
- Void
- Well-graded Gravel
- Poorly-graded Sand
- Ash
- Asphalt
- Lithologic Description Not Available
- Fs Fractures

NOTE

1. A PREVIOUS VERSION OF THIS CROSS-SECTION WAS PUBLISHED IN THE TVA COLBERT FOSSIL PLANT COMPREHENSIVE GROUNDWATER INVESTIGATION REPORT, MAY 17, 2019 (STANTEC, 2019)
2. UNCONSOLIDATED LITHOLOGIC DESCRIPTIONS BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

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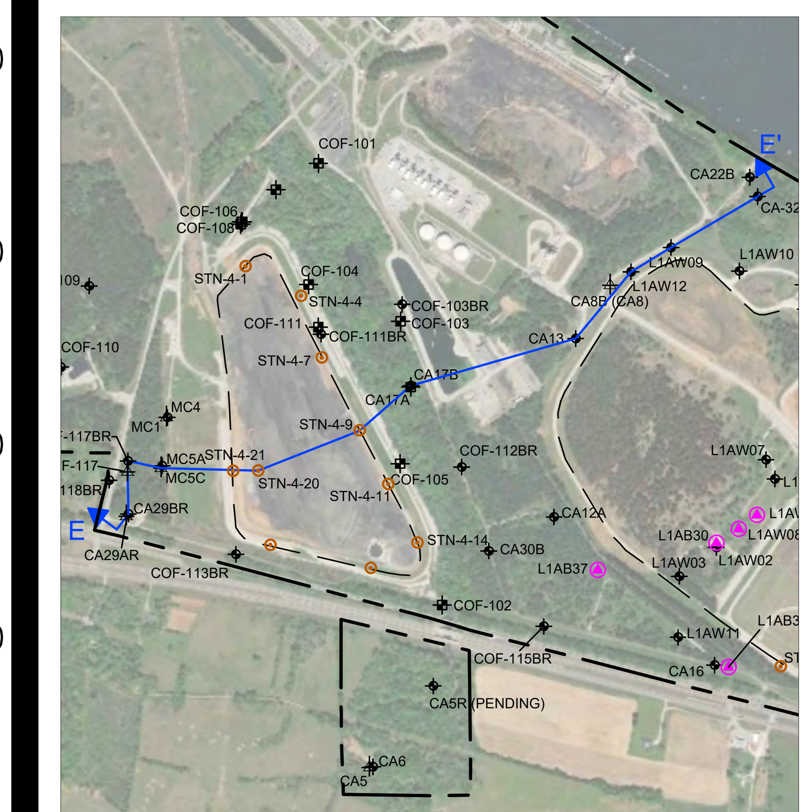


CROSS-SECTION LOCATION MAP

Revision | By | Appd | YYYY.MM.DD

File Name: 172607623R-STRATAGRAPHIC CROSS-SECTION E-E_FIG4 | VEN/KEF | JJ | | YYYY.MM.DD
Dwn. | Dsgn. | Chkd. | YYYY.MM.DD

Client/Project
Tennessee Valley Authority

Colbert Fossil Plant

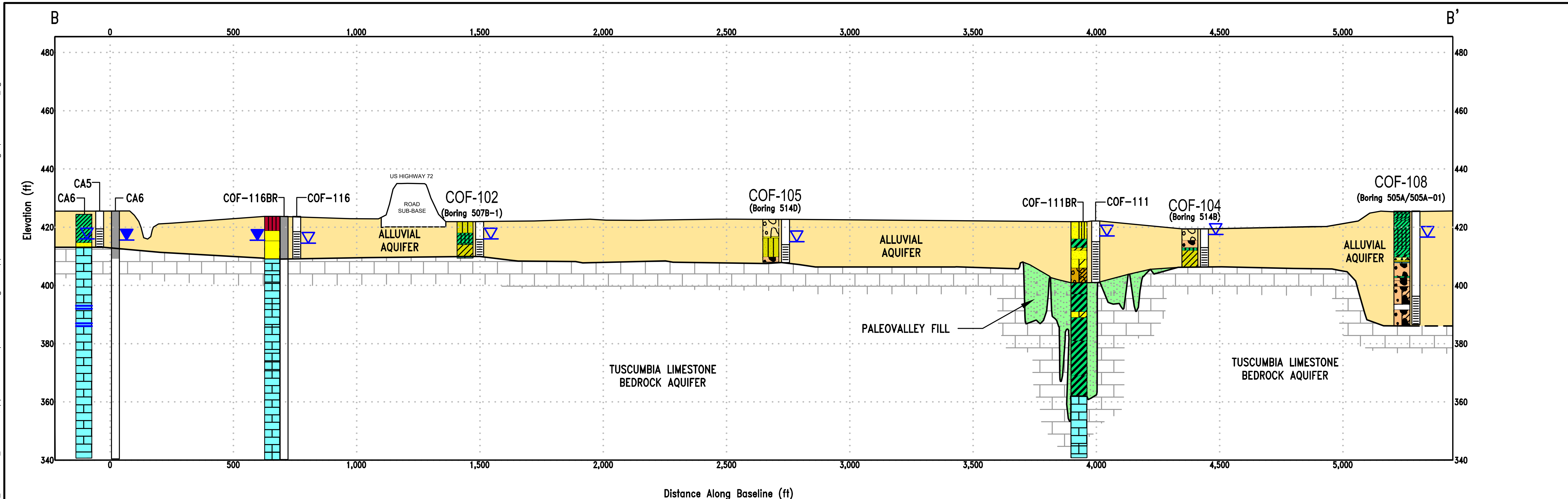
Title
ASH DISPOSAL AREA 4
MONITORING WELL
STRATIGRAPHIC CROSS-SECTION E-E'

Project No.
172607623

Scale
AS SHOWN

Drawing No.
4

ORIGINAL SHEET - ARCH D

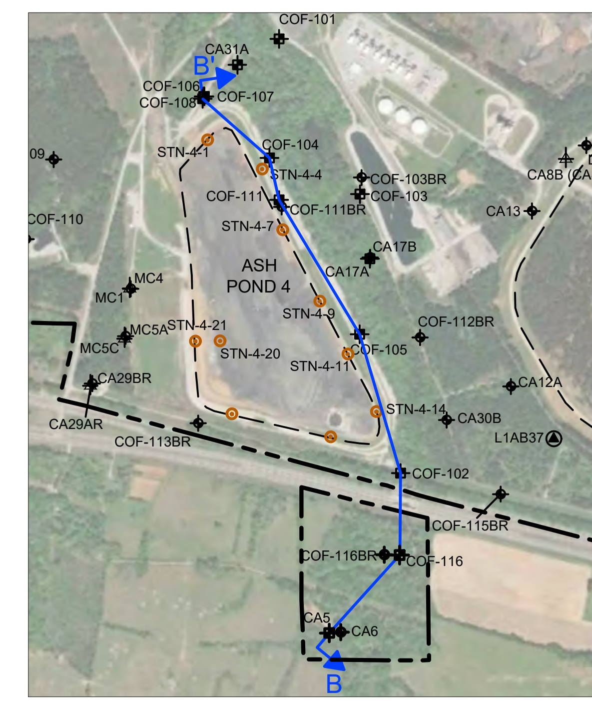


LEGEND

- BEDROCK MONITORING WELL LOCATION
- ALLUVIUM MONITORING WELL LOCATION
- RESIDUUM MONITORING WELL LOCATION
- ALLUVIUM / ALLUVIAL AQUIFER
- PALEOVALLEY FILL
- TUSCUMBIA LIMESTONE BEDROCK AQUIFER
- WELL CASING
- WELL SCREEN INTERVAL
- PRODUCES WATER AS PER HPFM LOG
- SURFACE CASING
- OPEN BOREHOLE WELL
- ALLUVIAL AQUIFER / RESIDUUM GROUNDWATER ELEVATION IN FEET NGVD 29 (AUGUST 2020)
- TUSCUMBIA LIMESTONE BEDROCK AQUIFER GROUNDWATER ELEVATION IN FEET NGVD 29 (AUGUST 2020)

NOTE

1. UNCONSOLIDATED LITHOLOGIC DESCRIPTIONS BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
2. UPPER SECTION OF ALLUVIAL AQUIFER MAY INCLUDE SURFICIAL SOILS AND/OR ANTHROPOGENIC FILL SUCH AS ACCESS ROAD GRADING MATERIAL.
3. THE CA6 LITHOLOGY HAS BEEN SHIFTED TO ALLOW FOR PLACEMENT ON THE CROSS-SECTION FOR VIEWING.
4. A PREVIOUS VERSION OF THIS CROSS-SECTION WAS PUBLISHED IN THE TVA COLBERT FOSSIL PLANT COMPREHENSIVE GROUNDWATER INVESTIGATION REPORT, MAY 17, 2019 (STANTEC, 2019)



CROSS-SECTION LOCATION MAP

LITHOLOGY GRAPHICS

- Graphic – Topsoil
- Poorly-graded Sand
- Poorly-graded Sand with Silt
- Limestone
- Silty Sand
- Silt
- Well-graded Gravel
- Clayey Sand
- Well-graded Sandy Gravel
- Road Sub-base
- Low Plasticity Silty Clay
- Well-graded Gravel with Clay
- Low Plasticity Sandy Clay
- Ash
- Fs Fractures
- Well-graded Sand with Clay
- High Plasticity Clay
- Low Plasticity Clay
- Void

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Client/Project
Tennessee Valley Authority
Colbert Fossil Plant

Project No.
182603655

Title
ASH DISPOSAL AREA 4 MONITORING WELL STRATIGRAPHIC CROSS-SECTION B-B'

Figure No.
5

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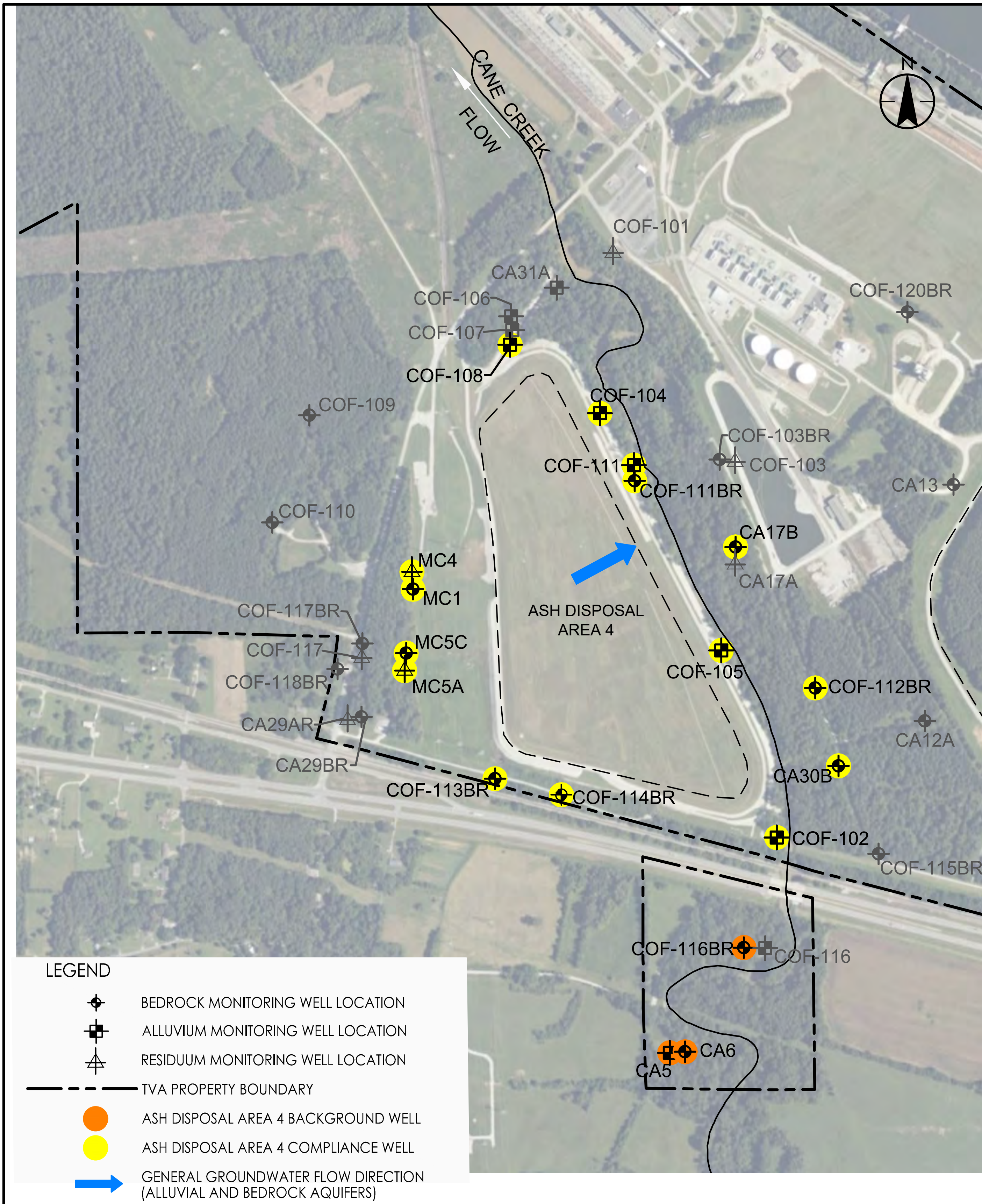

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Stantec

0 800' 1600'

Client/Project

Tennessee Valley Authority
Colbert Fossil Plant
Ash Disposal Area 4
Groundwater Monitoring Plan

Project No.
172699205

Title

ASH DISPOSAL AREA 4
GROUNDWATER MONITORING
SYSTEM

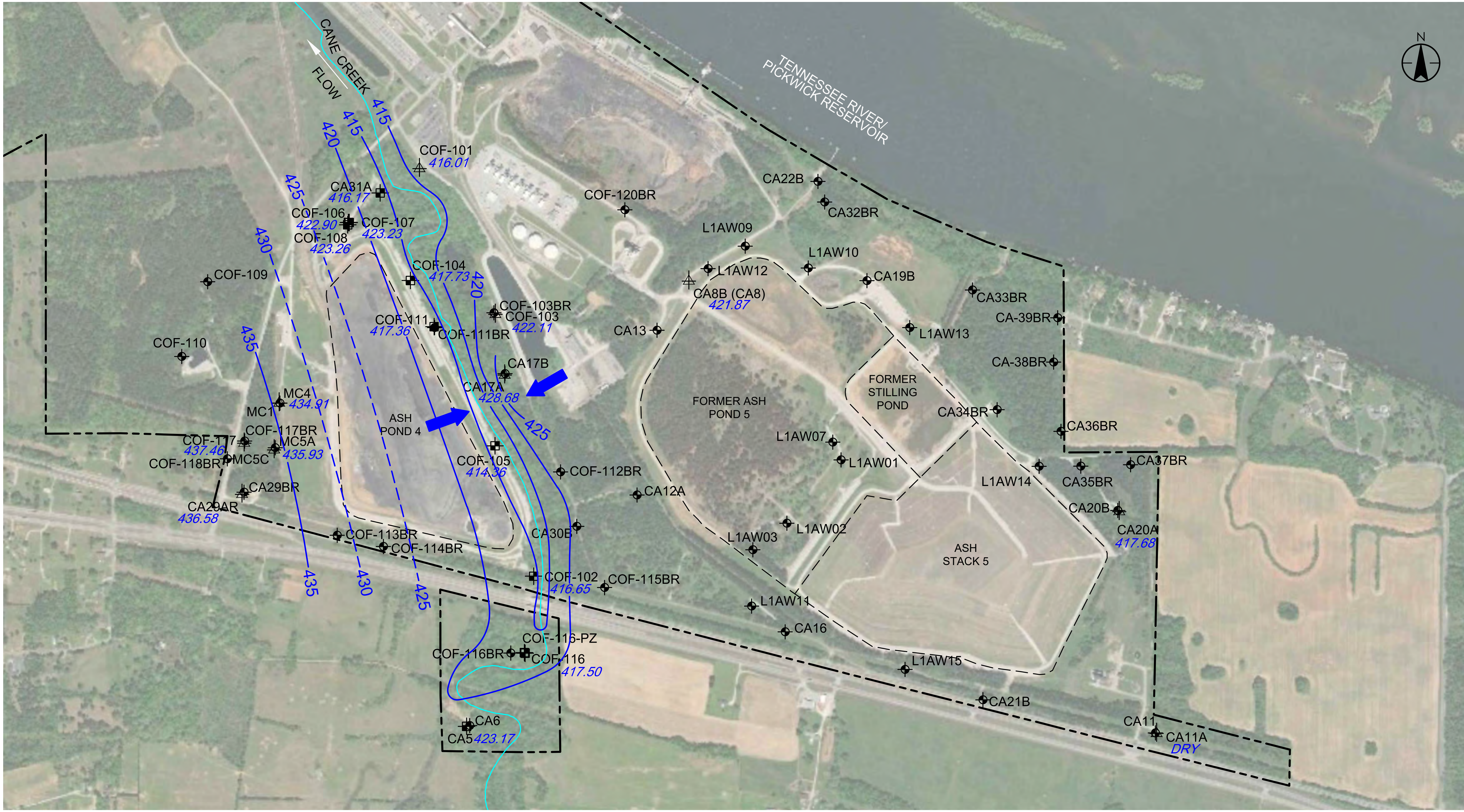
Figure No.
6

APPENDIX A

Groundwater Elevation Maps (2020 to 2021) – Alluvial and Bedrock Aquifer

Table A-1
Ash Disposal Area 4
Groundwater Elevation Map Index
TVA Colbert Fossil Plant, Tuscumbia, Alabama

Figure Number	Aquifer	Date	Report Reference	Page No.
A-1	Alluvial	February 27, 2020	2020 *First Amended Consent Decree Annual Groundwater Monitoring and Corrective Action Report*, January 29, 2021	1
A-2	Alluvial	August 10, 2020		2
A-3	Alluvial	February 22, 2021	*2021 First Amended Consent Decree Annual Groundwater Monitoring and Corrective Action Report*, January 31, 2022	3
A-4	Alluvial	August 23, 2021		4
A-5	Bedrock	February 27, 2020	2020 *First Amended Consent Decree Annual Groundwater Monitoring and Corrective Action Report*, January 29, 2021	5
A-6	Bedrock	August 10, 2020		6
A-7	Bedrock	February 22, 2021	*2021 First Amended Consent Decree Annual Groundwater Monitoring and Corrective Action Report*, January 31, 2022	7
A-8	Bedrock	August 23, 2021		8



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Stantec

LEGEND

- BEDROCK MONITORING WELL LOCATION
- ALLUVIUM MONITORING WELL LOCATION
- RESIDUUM MONITORING WELL LOCATION
- 423.17 GROUNDWATER ELEVATION (FT NGVD 29)
- GROUNDWATER ELEVATION CONTOUR (FT NGVD 29)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- TVA PROPERTY BOUNDARY

Client/Project

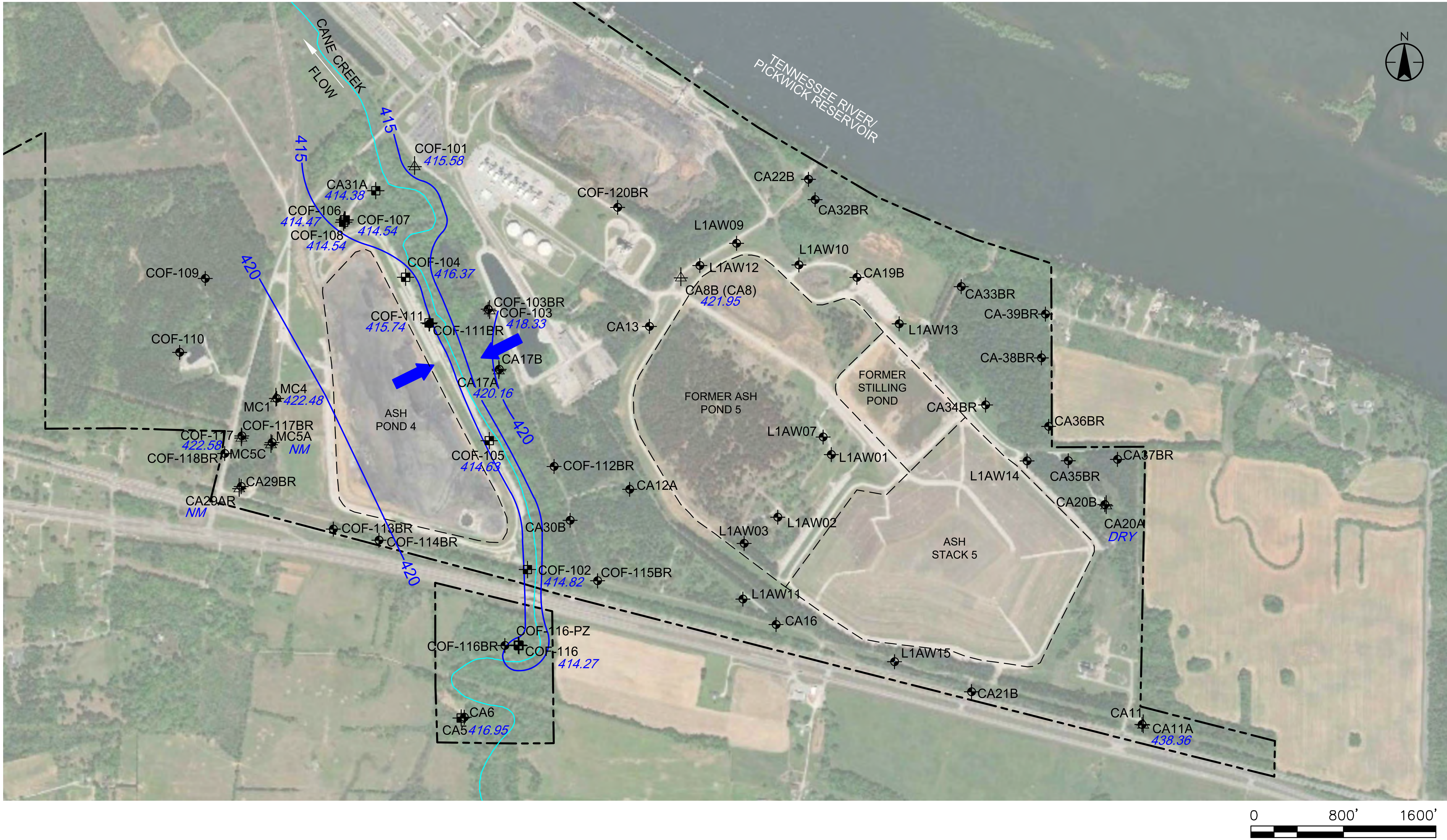
Tennessee Valley Authority
Colbert Fossil Plant

Project No.
172607623

Title

GROUNDWATER ELEVATION MAP - ALLUVIAL AQUIFER / RESIDUUM (FEBRUARY 27, 2020)

Figure No.
A-1



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Stantec

LEGEND

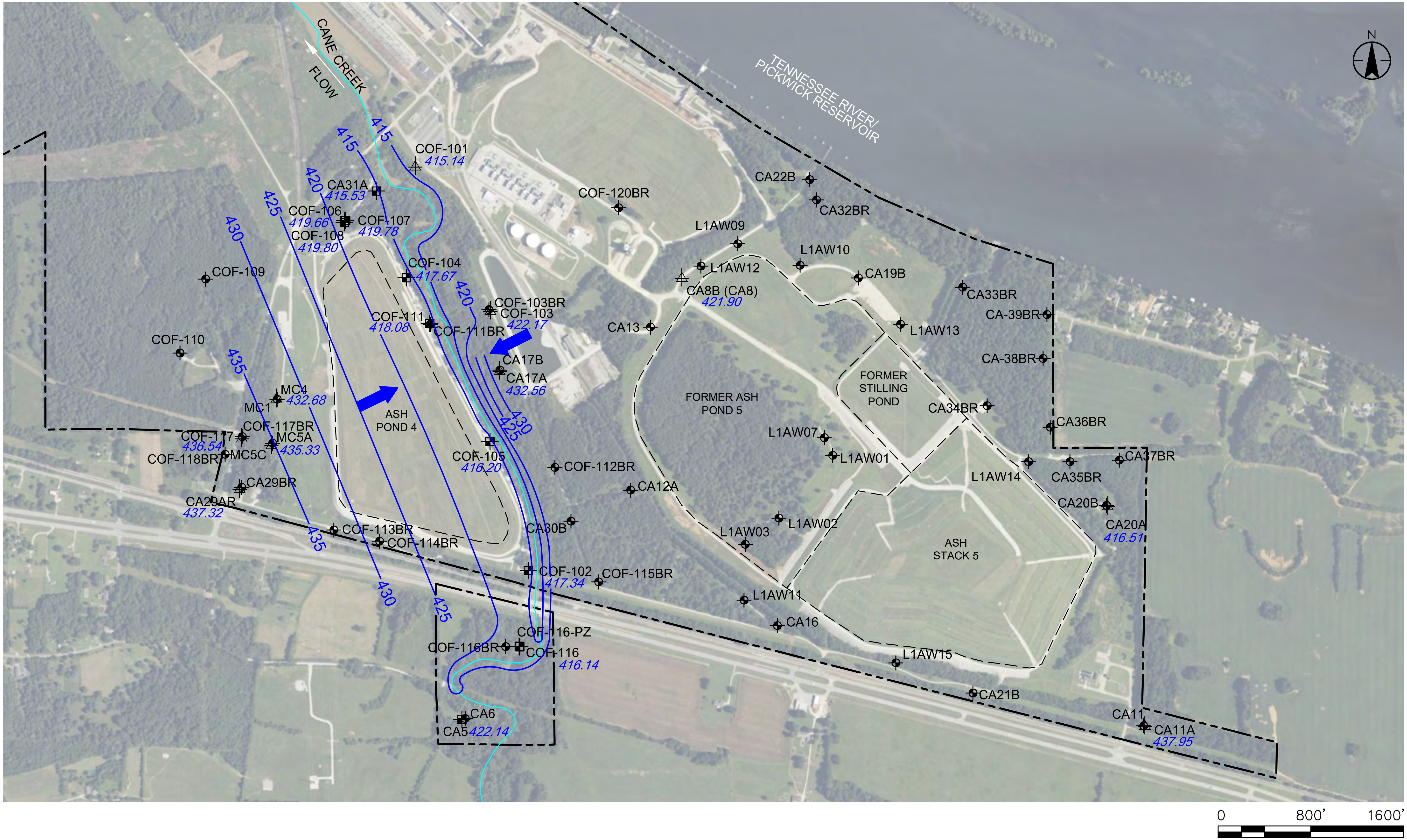
- BEDROCK MONITORING WELL LOCATION
- ALLUVIUM MONITORING WELL LOCATION
- RESIDUUM MONITORING WELL LOCATION
- 416.95 GROUNDWATER ELEVATION (FT NGVD 29)
- GROUNDWATER ELEVATION CONTOUR (FT NGVD 29)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- TVA PROPERTY BOUNDARY
- NM NOT MEASURED

Client/Project
Tennessee Valley Authority
Colbert Fossil Plant

Project No.
172607623

Title
GROUNDWATER ELEVATION MAP - ALLUVIAL AQUIFER / RESIDUUM (AUGUST 10, 2020)

Figure No.
A-2



Stantec

LEGEND

- BEDROCK MONITORING WELL LOCATION
- ALLUVIUM MONITORING WELL LOCATION
- RESIDUUM MONITORING WELL LOCATION
- 422.14 GROUNDWATER ELEVATION (FT NGVD 29)
- GROUNDWATER ELEVATION CONTOUR (FT NGVD 29)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- TVA PROPERTY BOUNDARY

Client/Project

Tennessee Valley Authority
Colbert Fossil Plant

Project No.
172607623

Title

GROUNDWATER ELEVATION MAP - ALLUVIAL AQUIFER / RESIDUUM (FEBRUARY 22, 2021)

Figure No.
A-3

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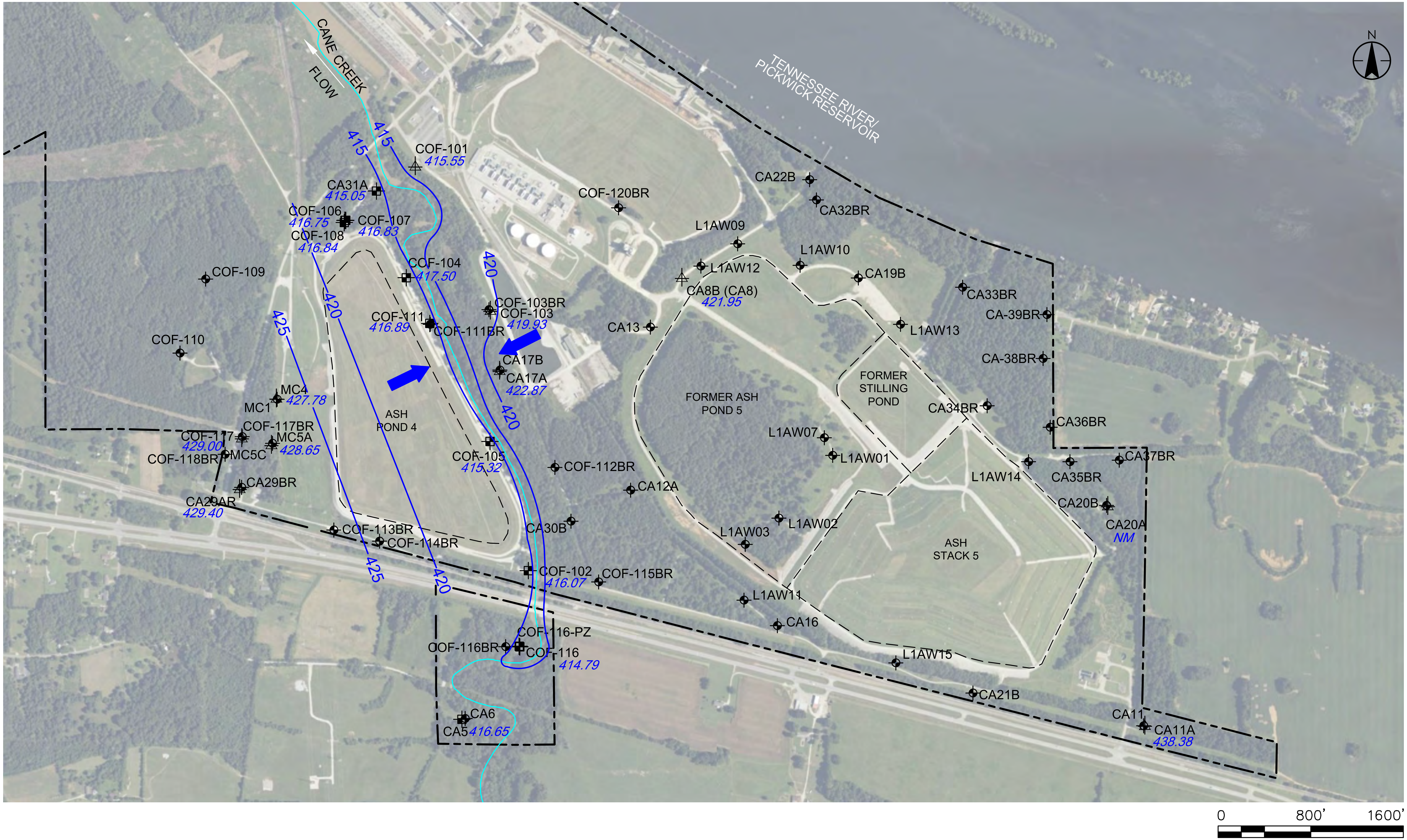

LEGEND

- BEDROCK MONITORING WELL LOCATION
- ALLUVIUM MONITORING WELL LOCATION
- RESIDUUM MONITORING WELL LOCATION
- 416.65 GROUNDWATER ELEVATION (FT NGVD 29)
- NM NOT MONITORED
- GROUNDWATER ELEVATION CONTOUR (FT NGVD 29)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- TVA PROPERTY BOUNDARY

Stantec

Client/Project
Tennessee Valley Authority
Colbert Fossil Plant

Project No.
172607623

Title
GROUNDWATER ELEVATION MAP - ALLUVIAL AQUIFER / RESIDUUM (AUGUST 23, 2021)

Figure No.
A-4

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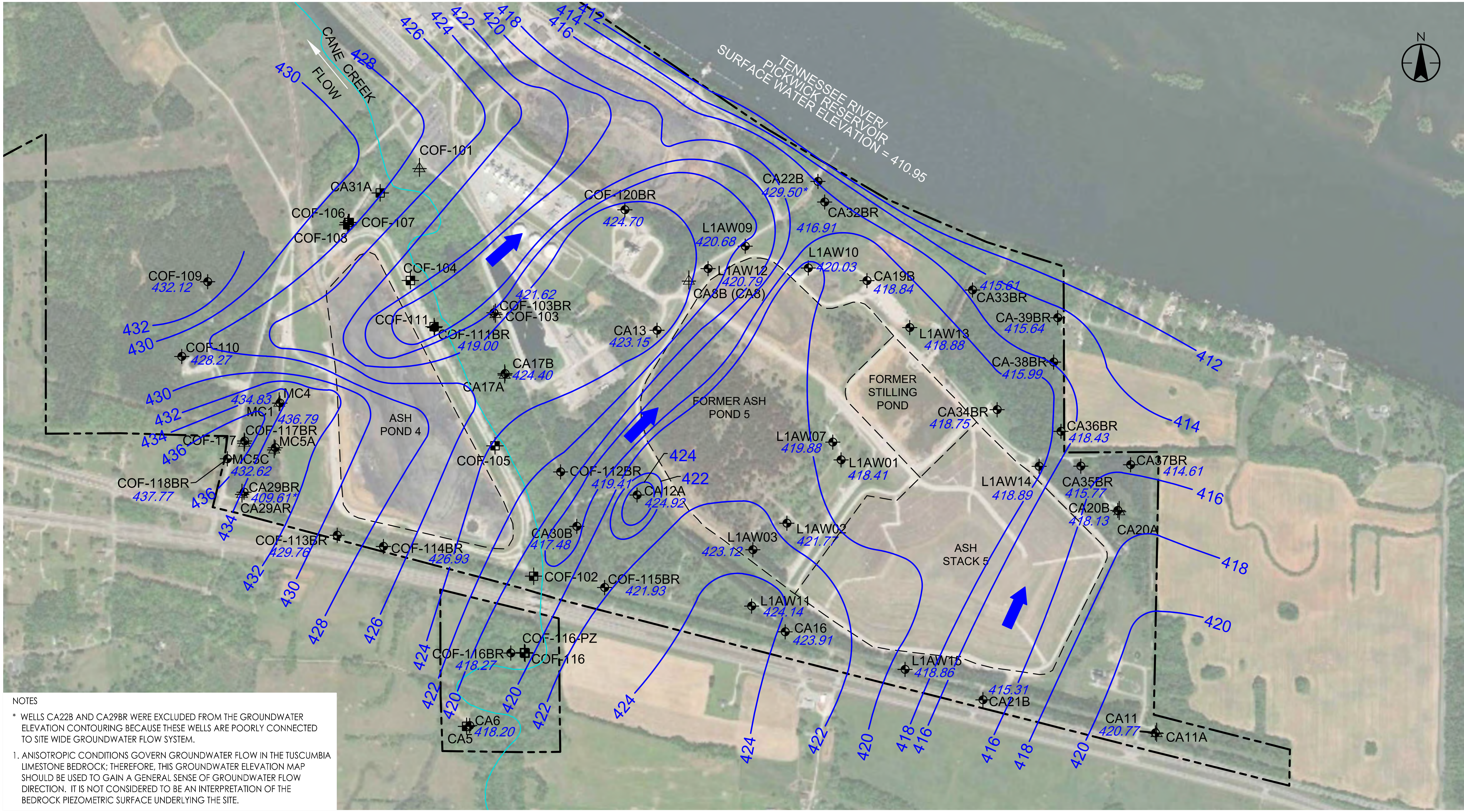

NOTES

* WELLS CA22B AND CA29BR WERE EXCLUDED FROM THE GROUNDWATER ELEVATION CONTOURING BECAUSE THESE WELLS ARE POORLY CONNECTED TO SITE WIDE GROUNDWATER FLOW SYSTEM.

1. ANISOTROPIC CONDITIONS GOVERN GROUNDWATER FLOW IN THE TUSCUMBIA LIMESTONE BEDROCK; THEREFORE, THIS GROUNDWATER ELEVATION MAP SHOULD BE USED TO GAIN A GENERAL SENSE OF GROUNDWATER FLOW DIRECTION. IT IS NOT CONSIDERED TO BE AN INTERPRETATION OF THE BEDROCK PIEZOMETRIC SURFACE UNDERLYING THE SITE.

Stantec

LEGEND

- BEDROCK MONITORING WELL LOCATION
- ALLUVIUM MONITORING WELL LOCATION
- RESIDUUM MONITORING WELL LOCATION
- 418.20 GROUNDWATER ELEVATION (FT NGVD 29)
- GROUNDWATER ELEVATION CONTOUR (FT NGVD 29)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- TVA PROPERTY BOUNDARY

Client/Project

Tennessee Valley Authority
Colbert Fossil Plant

Project No.
172607623

Title

GROUNDWATER ELEVATION MAP - TUSCUMBIA LIMESTONE BEDROCK AQUIFER (FEBRUARY 27, 2020)

Figure No.
A-5

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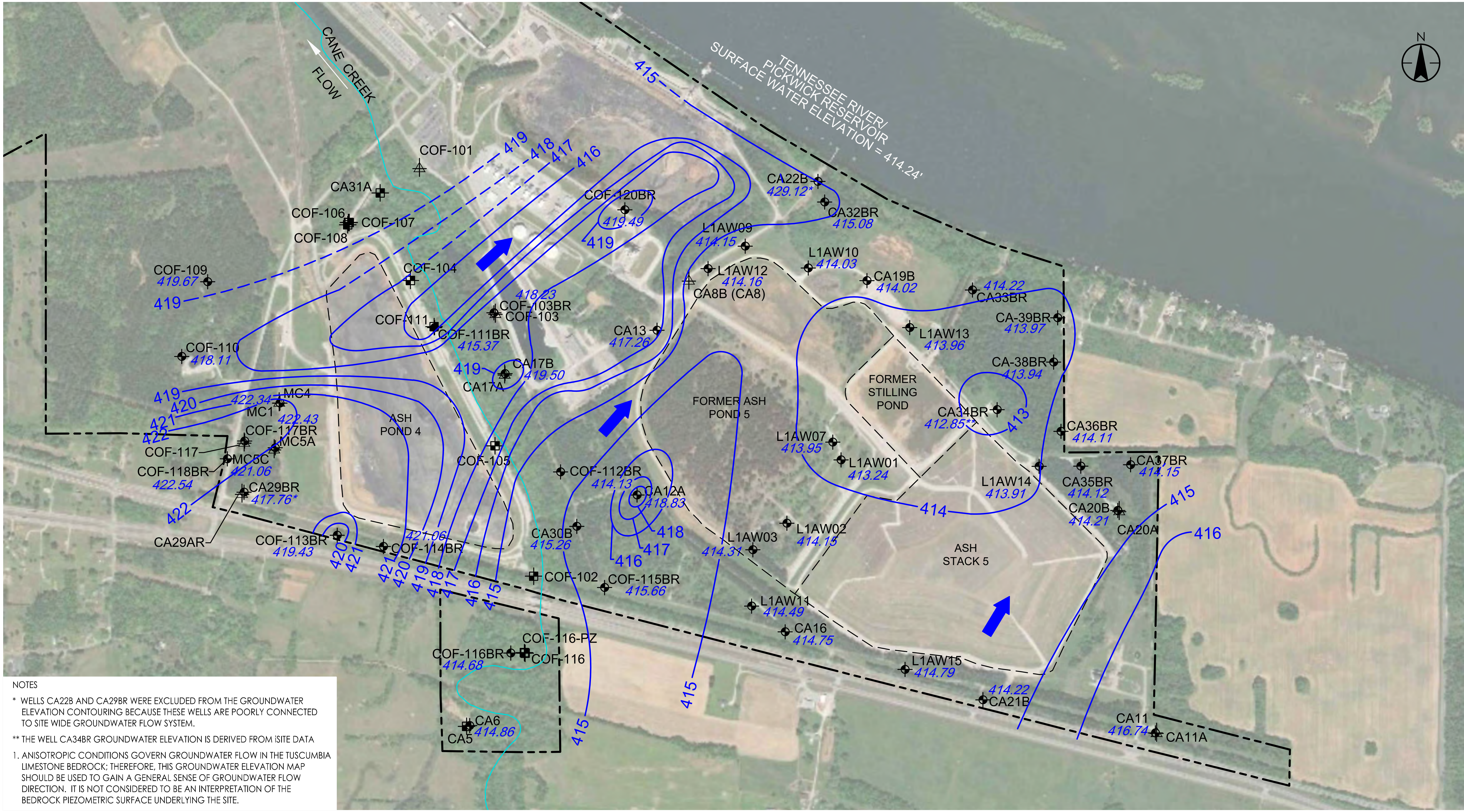

NOTES

* WELLS CA22B AND CA29BR WERE EXCLUDED FROM THE GROUNDWATER ELEVATION CONTOURING BECAUSE THESE WELLS ARE POORLY CONNECTED TO SITE WIDE GROUNDWATER FLOW SYSTEM.

** THE WELL CA34BR GROUNDWATER ELEVATION IS DERIVED FROM iSITE DATA

1. ANISOTROPIC CONDITIONS GOVERN GROUNDWATER FLOW IN THE TUSCUMBIA LIMESTONE BEDROCK; THEREFORE, THIS GROUNDWATER ELEVATION MAP SHOULD BE USED TO GAIN A GENERAL SENSE OF GROUNDWATER FLOW DIRECTION. IT IS NOT CONSIDERED TO BE AN INTERPRETATION OF THE BEDROCK PIEZOMETRIC SURFACE UNDERLYING THE SITE.

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Stantec

LEGEND

- BEDROCK MONITORING WELL LOCATION
- ALLUVIUM MONITORING WELL LOCATION
- RESIDUUM MONITORING WELL LOCATION
- 414.68 GROUNDWATER ELEVATION (FT NGVD 29)
- GROUNDWATER ELEVATION CONTOUR (FT NGVD 29)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- TVA PROPERTY BOUNDARY
- * ELEVATION NOT USED IN CONTOURING
- ** I-SITE DATA

Client/Project

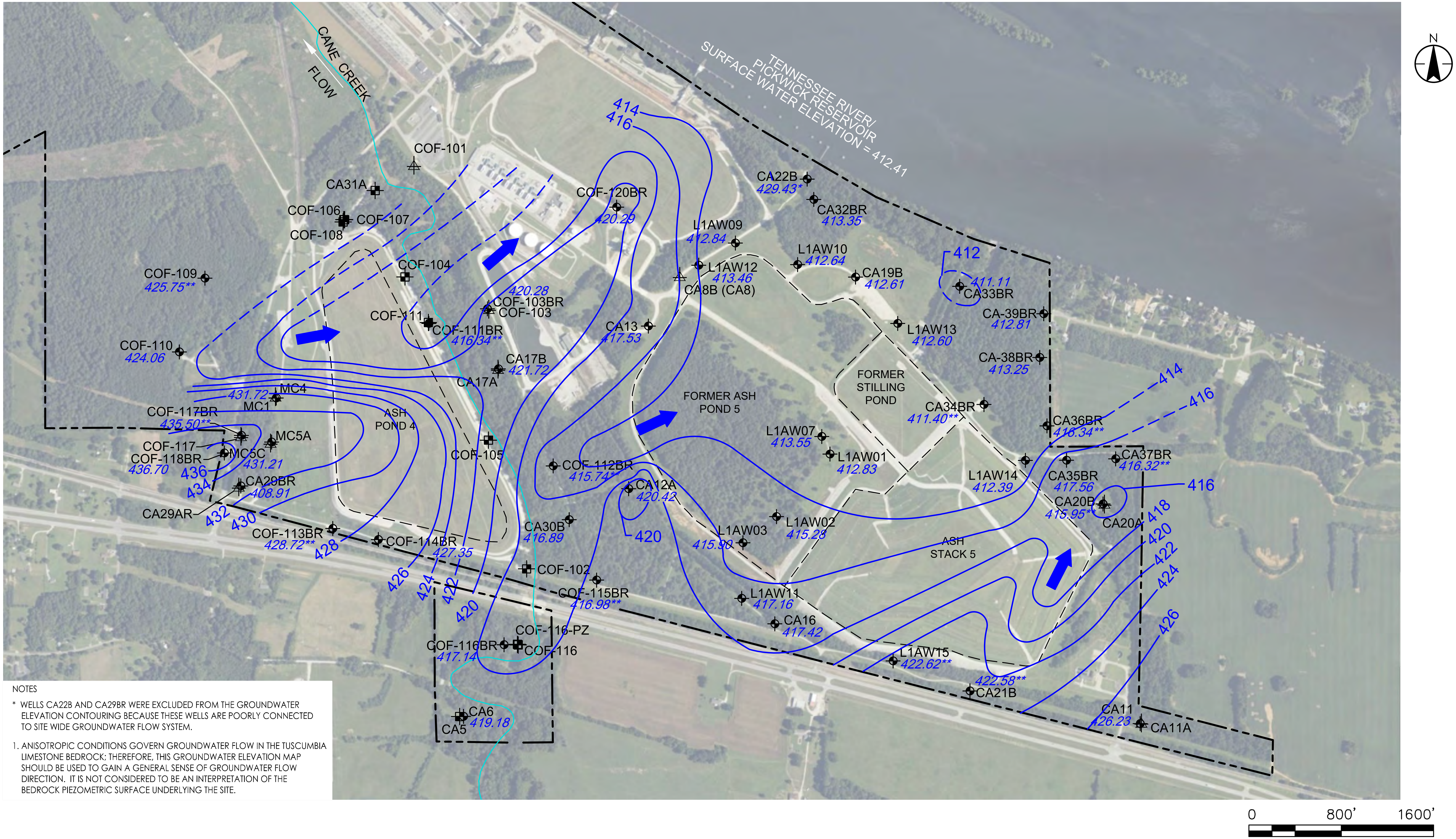
Tennessee Valley Authority
Colbert Fossil Plant

Project No.
172607623

Title

GROUNDWATER ELEVATION MAP - TUSCUMBIA LIMESTONE BEDROCK AQUIFER
(AUGUST 10, 2020)

Figure No.
A-6



NOTES

* WELLS CA22B AND CA29BR WERE EXCLUDED FROM THE GROUNDWATER ELEVATION CONTOURING BECAUSE THESE WELLS ARE POORLY CONNECTED TO SITE WIDE GROUNDWATER FLOW SYSTEM.

1. ANISOTROPIC CONDITIONS GOVERN GROUNDWATER FLOW IN THE TUSCUMBIA LIMESTONE BEDROCK; THEREFORE, THIS GROUNDWATER ELEVATION MAP SHOULD BE USED TO GAIN A GENERAL SENSE OF GROUNDWATER FLOW DIRECTION. IT IS NOT CONSIDERED TO BE AN INTERPRETATION OF THE BEDROCK PIEZOMETRIC SURFACE UNDERLYING THE SITE.

Stantec

LEGEND

- BEDROCK MONITORING WELL LOCATION
- ALLUVIUM MONITORING WELL LOCATION
- RESIDUUM MONITORING WELL LOCATION
- 419.18 GROUNDWATER ELEVATION (FT NGVD 29)
- GROUNDWATER ELEVATION CONTOUR (FT NGVD 29)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- TVA PROPERTY BOUNDARY
- * ELEVATION NOT USED IN CONTOURING
- ** I-SITE DATA

Client/Project

Tennessee Valley Authority
Colbert Fossil Plant

Project No.
172607623

Title

GROUNDWATER ELEVATION MAP - TUSCUMBIA LIMESTONE BEDROCK AQUIFER (FEBRUARY 22, 2021)

Figure No.
A-7

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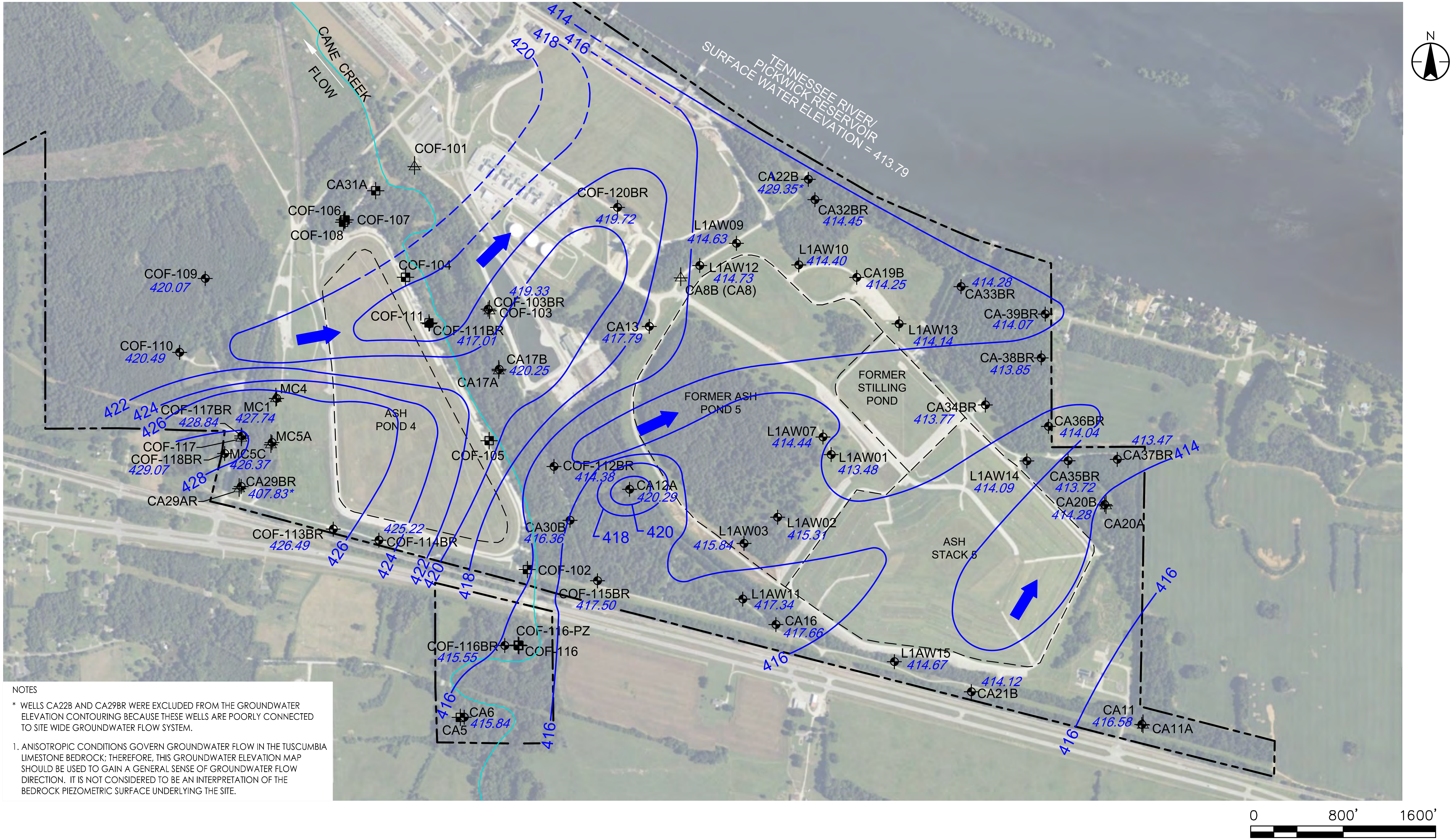

NOTES

* WELLS CA22B AND CA29BR WERE EXCLUDED FROM THE GROUNDWATER ELEVATION CONTOURING BECAUSE THESE WELLS ARE POORLY CONNECTED TO SITE WIDE GROUNDWATER FLOW SYSTEM.

1. ANISOTROPIC CONDITIONS GOVERN GROUNDWATER FLOW IN THE TUSCUMBIA LIMESTONE BEDROCK; THEREFORE, THIS GROUNDWATER ELEVATION MAP SHOULD BE USED TO GAIN A GENERAL SENSE OF GROUNDWATER FLOW DIRECTION. IT IS NOT CONSIDERED TO BE AN INTERPRETATION OF THE BEDROCK PIEZOMETRIC SURFACE UNDERLYING THE SITE.

Stantec

LEGEND

- BEDROCK MONITORING WELL LOCATION
- ALLUVIUM MONITORING WELL LOCATION
- RESIDUUM MONITORING WELL LOCATION
- 415.84 GROUNDWATER ELEVATION (FT NGVD 29)
- GROUNDWATER ELEVATION CONTOUR (FT NGVD 29)
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- TVA PROPERTY BOUNDARY
- * ELEVATION NOT USED IN CONTOURING

Client/Project

Tennessee Valley Authority
Colbert Fossil Plant

Project No.
172607623

Title

GROUNDWATER ELEVATION MAP - TUSCUMBIA LIMESTONE BEDROCK AQUIFER
(AUGUST 23, 2021)

Figure No.
A-8

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APPENDIX B

Ash Disposal Area 4 Boring and Well Construction Logs

Table B-1
Ash Disposal Area 4 Monitoring Well Specifications
TVA Colbert Fossil Plant, Tuscumbia, Alabama

Well ID	Screened Formation	Monitoring Well Location Relative to CCR Unit AP4	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Bottom of Open Hole Surface Casing (ft bgs)	Well Depth (ft bgs)	Well Inside Diameter (in)	Top of Casing Elevation (ft NGVD 29)	Ground Surface Elevation (ft NGVD 29)	Top of Screen or "*Top of Open Hole*" (ft NGVD 29)	Bottom of Screen or "*Bottom of Open Hole*" (ft NGVD 29)	Bottom of Well Elevation (ft NGVD 29)
CA5	Alluvium	Background	5.9	11.5	NA	11.5	3.8	428.56	425.6	419.7	414.1	414.1
CA6	Bedrock	Background	NA	NA	14.6	96.6	4.0	428.22	424.4	*"409.8"*	*"327.8"*	327.8
COF-116BR	Bedrock	Background	NA	NA	18.0	95.0	7.25	427.26	423.7	*"405.7"*	*"328.7"*	328.7
CA17B	Bedrock	Downgradient	NA	NA	18.8	95.4	4.0	439.71	436.2	*"417.4"*	*"340.8"*	340.8
CA30B	Bedrock	Downgradient	31.3	51.1	NA	52.0	2.0	442.57	439.1	407.8	388.0	387.1
COF-102	Alluvium	Downgradient	6.0	10.8	NA	10.9	4.0	426.27	421.9	415.9	411.1	411.0
COF-104	Alluvium	Downgradient	6.7	11.6	NA	11.6	4.0	423.74	419.4	412.7	407.8	407.8
COF-105	Alluvium	Downgradient	8.8	13.8	NA	13.8	4.0	426.83	422.7	413.9	408.9	408.9
COF-108	Alluvium	Downgradient	28.7	38.6	NA	39.0	2.0	429.36	425.8	397.1	387.2	386.8
COF-111	Alluvium	Downgradient	9.0	19.0	NA	19.0	4.0	425.32	421.9	412.9	402.9	402.9
COF-111BR	Bedrock	Downgradient	NA	NA	76.0	126.0	7.25	425.38	421.9	*"345.9"*	*"295.99"*	295.9
COF-112BR	Bedrock	Downgradient	NA	NA	32.0	110.0	7.25	448.59	445.1	*"413.1"*	*"335.1"*	335.1
COF-113BR	Bedrock	Cross-Gradient	NA	NA	21.0	100.0	7.25	438.98	435.5	*"414.5"*	*"335.5"*	335.5
COF-114BR	Bedrock	Cross-Gradient	NA	NA	20.0	120.0	7.25	429.18	429.5	*"409.5"*	*"309.5"*	309.5
MC1	Bedrock	Upgradient	NA	NA	29.3	73.6	4.0	446.86	443.0	*"413.7"*	*"369.4"*	369.4
MC4	Residuum	Upgradient	9.7	24.6	NA	26.5	4.0	447.21	443.0	433.3	418.4	416.5
MC5A	Residuum	Upgradient	8.5	23.4	NA	23.4	2.0	444.20	440.1	431.6	416.7	416.7
MC5C	Bedrock	Upgradient	142.5	152.1	NA	154.1	2.0	442.67	440.6	298.1	288.5	286.5

NOTES:

ft: feet

ft bgs: feet below ground surface

NA: not applicable

Table B-2
Ash Disposal Area 4 Monitoring Well Index
TVA Colbert Fossil Plant, Tuscumbia, Alabama

Monitoring Well Number	Well Diagram Designation	Boring Log Designation	Page No.
CA5	5	CA5	1
CA6	6	CA6	3
CA17B	17B	CA17B	5
CA30B	CA30B	CA30B	7
COF-102	507B-1/COF-102	507B	8
COF-104	514B/COF-104	514B/COF-104	11
COF-105	514D/COF-105	514D/COF-105	12
COF-108	505A-12/COF-108	505A/505A-01	13
COF-111	COF-111	COF-111	18
COF-111BR	COF-111BR	COF-111BR	20
COF-112BR	COF-112BR	COF-112BR	21
COF-113BR	COF-113BR	COF-113BR	22
COF-114BR	COF-114BR	COF-114BR	23
COF-116BR	COF-116BR	COF-116BR	24
MC1	MC1	MC-1	25
MC4	MC-4	MC-4	27
MC5A	MC-5A	MC-5A	28
MC5C	MC-5C	MC-5C	30

MONITORING WELL INSTALLATION RECORD

PROJECT COLBERT

WELL NUMBER 5

INSTALLATION DATE 1982

PLANT COORDINATES EAST 4416.6 FT

NORTH -4019.2 FT

GROUND SURFACE ELEVATION 424.9 FT-MSL

TOP OF INNER CASING 427.2 FT MSL

GRANULAR BACKFILL MATERIAL SAND/GRAVEL

SLOT SIZE ______

CASING MATERIAL SCH 80 PVC

CASING DIAMETER 4"

DRILLING TECHNIQUE AUGER

DRILLING CONTRACTOR ______

BOREHOLE DIAMETER 12"

FIELD REPRESENTATIVE ______

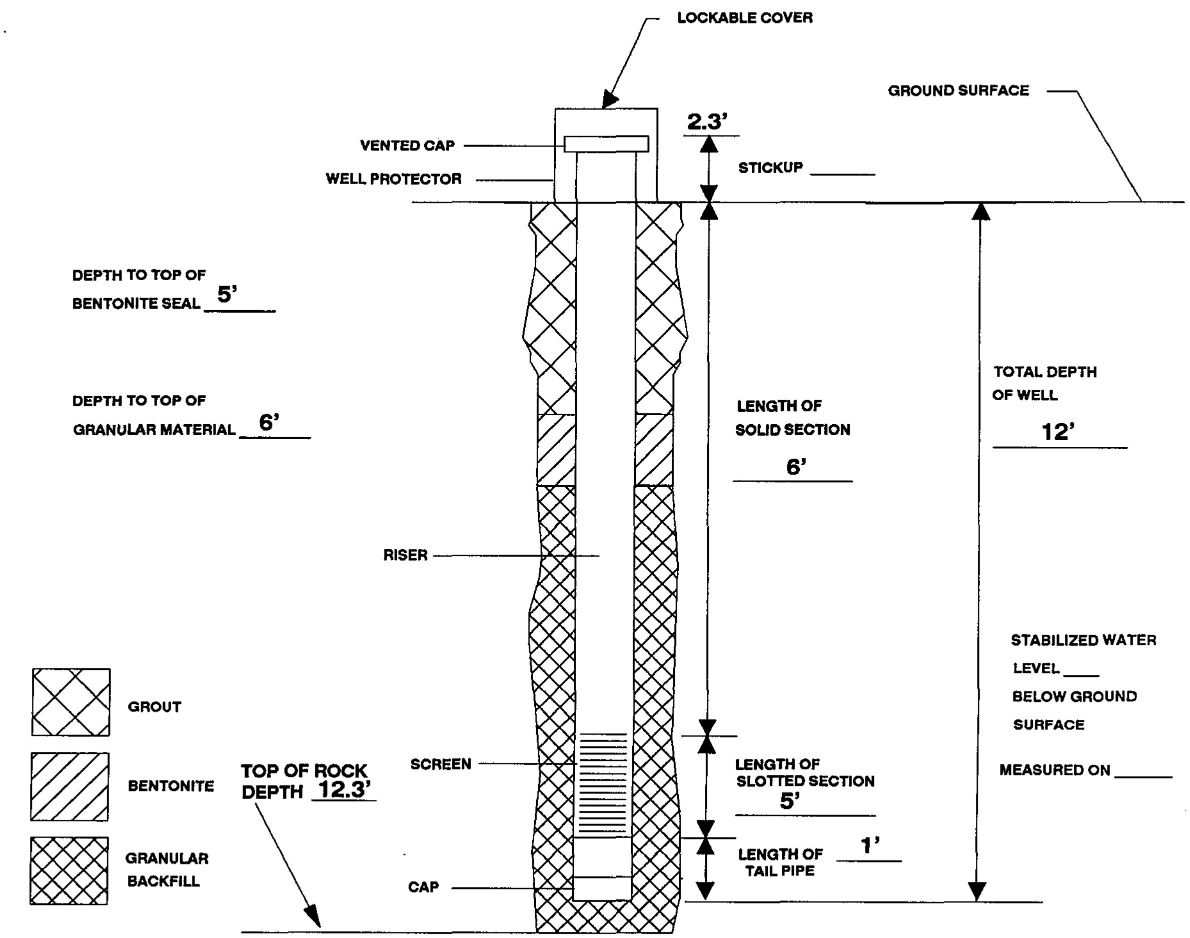
LOCKABLE COVER ? YES

FILTER CLOTH AROUND SCREEN ? ______

DRILLING FLUID ______

COMMENTS ______

(NOT TO SCALE)



ENG LAB 3/23/89

Tennessee Valley Authority

LOG OF BORING Well CA5

BLOWS/M	FID (ppm)	ELEV. (m-msl)	DEPTH (m)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION
						Clay w/weathered chert
						Gray sand
						Auger refusal Bottom of Hole
			5			

PROJECT Colbert Fossil Plant
DRILLING COMPANY Law-Tillery
LOCATION Tuscumbia, AL
DATE DRILLED 1/16/82
DRILL RIG Hollow Stem Auger
SURFACE ELEVATION 129.57 meters-msl
LOGGER/ENGINEER Mink-Pedin-Hamilton
TOTAL DEPTH OF HOLE 3.8 meters
WATER LEVEL (INITIAL) 3.8meters
WATER LEVEL (24-HOUR) 3.57meters

ROCK MONITORING WELL INSTALLATION RECORD

PROJECT: COLBERT

WELL NUMBER: 6

INSTALLATION DATE: 10/14/82

PLANT COORDINATES EAST: 4431.5 FT

NORTH: -3995.4 FT

GROUND SURFACE ELEVATION: 424.7 FT MSL

TOP OF INNER CASING: 427.1 FT MSL

BACKFILL MATERIAL: ONSITE MATERIAL

CASING DIAMETER: 4"

CASING MATERIAL: SCH 40 PVC

DRILLING TECHNIQUE IN ROCK: ______

DRILLING TECHNIQUE IN SOIL: ______

DRILLING CONTRACTOR: TVA

OUTER BOREHOLE DIAMETER: 6"

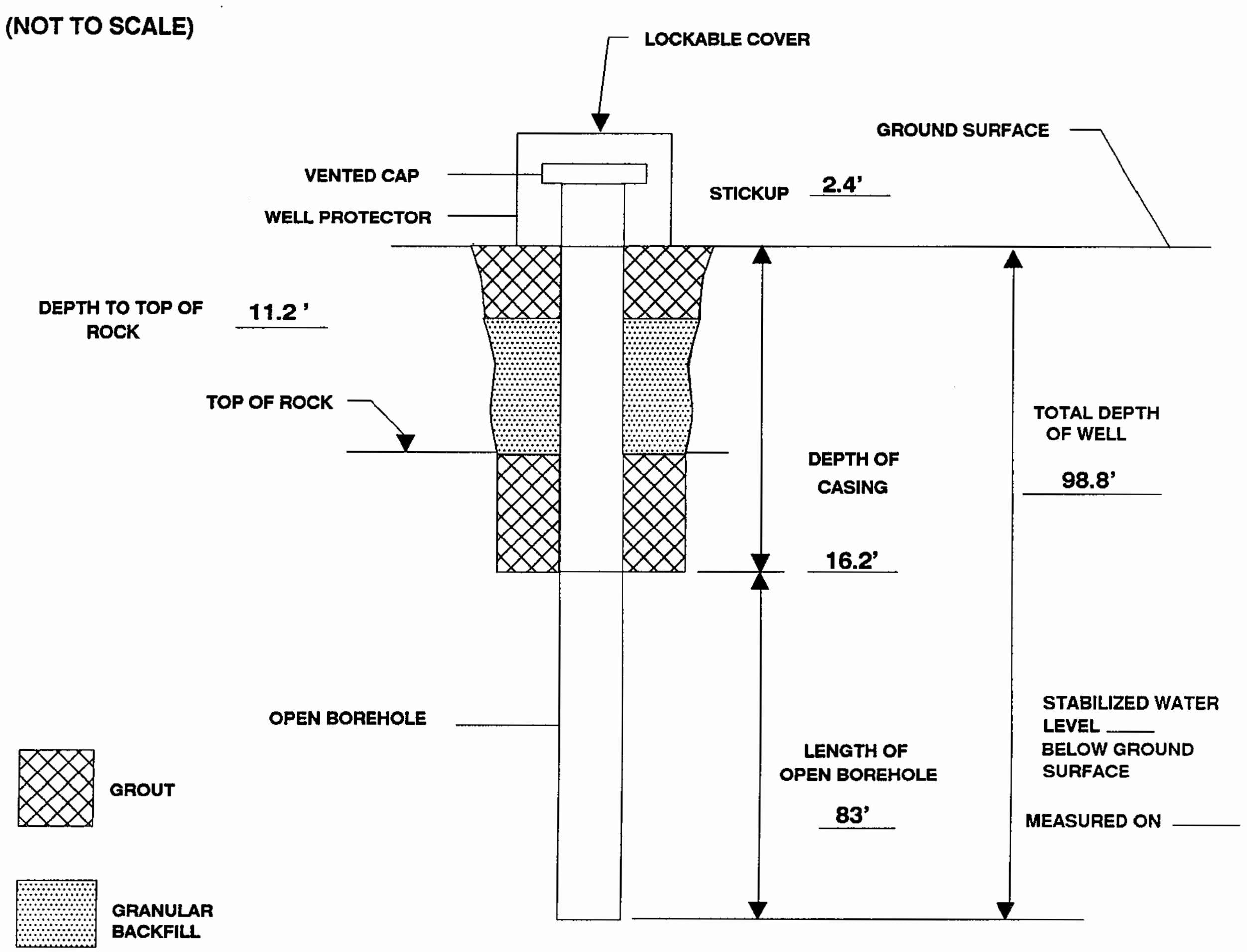
OPEN BOREHOLE DIAMETER: 4"

LOCKABLE COVER ? ______

FIELD REPRESENTATIVE: ______

DRILLING FLUID: ______

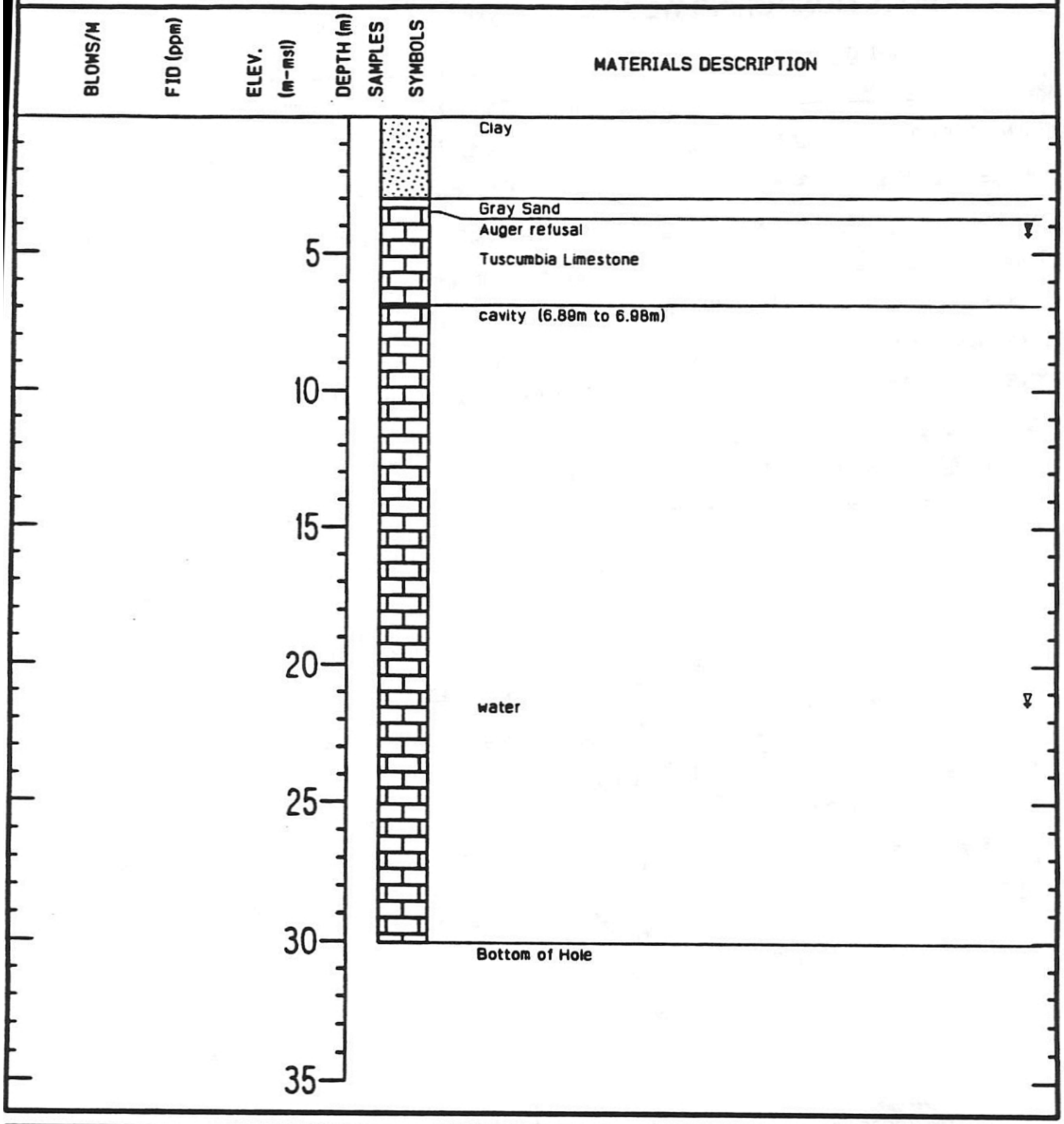
COMMENTS: ______



ENG LAB 3/22/89

Tennessee Valley Authority

LOG OF BORING Well CA6



PROJECT Colbert Fossil Plant
LOCATION Tuscumbia, AL
DRILL RIG Hollow Stem Auger
LOGGER/ENGINEER Mink-Pedin-Hamilton
WATER LEVEL (INITIAL) 21.33meters
DRILLING COMPANY Law-Tillery
DATE DRILLED 1/16/82
SURFACE ELEVATION 129.39 meters-msl
TOTAL DEPTH OF HOLE 30.05 meters
WATER LEVEL (24-HOUR) 4.27meters

ROCK MONITORING WELL INSTALLATION RECORD

PROJECT COLBERT

WELL NUMBER CA17B

INSTALLATION DATE APRIL-MAY 1986

PLANT COORDINATES EAST 766.90m

NORTH -506.16m

GROUND SURFACE ELEVATION 132.82mmsl

TOP OF INNER CASING 133.16mmsl

BACKFILL MATERIAL CEMENT GROUT

CASING DIAMETER 10cm

CASING MATERIAL SCH 40 PVC

DRILLING TECHNIQUE IN ROCK PERCUSSION

DRILLING TECHNIQUE IN SOIL HOLLOW STEM AUGER

DRILLING CONTRACTOR TVA

OUTER BOREHOLE DIAMETER 15cm

OPEN BOREHOLE DIAMETER 10cm

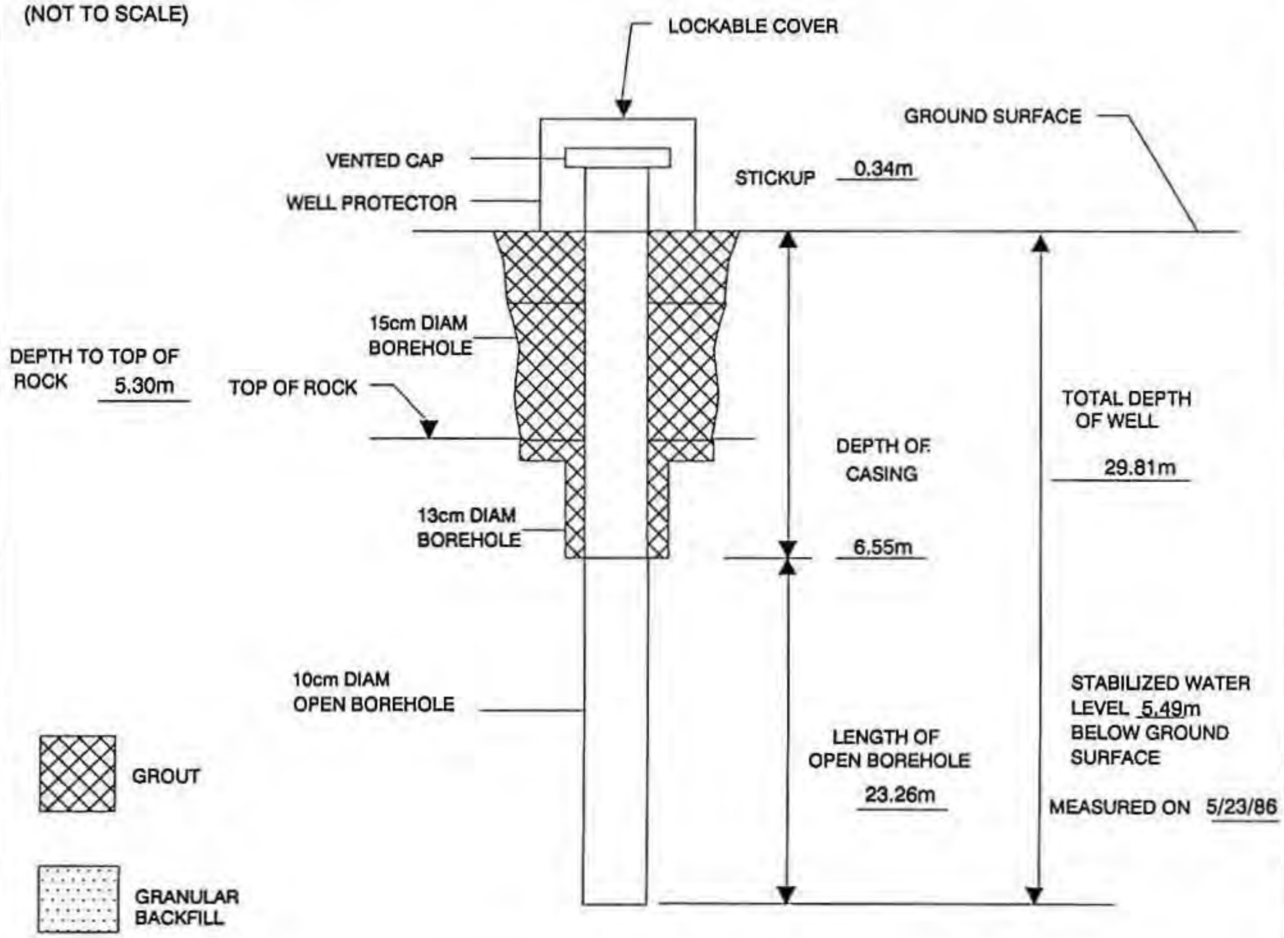
LOCKABLE COVER ? YES

FIELD REPRESENTATIVE HAL ROBINSON

DRILLING FLUID NONE

COMMENTS LOW YIELD.

(NOT TO SCALE)



ENG LAB 3/22/89

ROCK MONITORING WELL INSTALLATION RECORD

PROJECT COLBERT

WELL NUMBER 17B

INSTALLATION DATE APRIL-MAY 1986

PLANT COORDINATES EAST 2516.2 FT

NORTH -1660.7 FT

GROUND SURFACE ELEVATION 435.2 FT MSL

TOP OF INNER CASING 436.9 FT MSL

BACKFILL MATERIAL CEMENT GROUT

CASING DIAMETER 4"

CASING MATERIAL SCH 40 PVC

DRILLING TECHNIQUE IN ROCK PERCUSSION

DRILLING TECHNIQUE IN SOIL HOLLOW STEM AUGER

DRILLING CONTRACTOR TVA

OUTER BOREHOLE DIAMETER 6"

OPEN BOREHOLE DIAMETER 4"

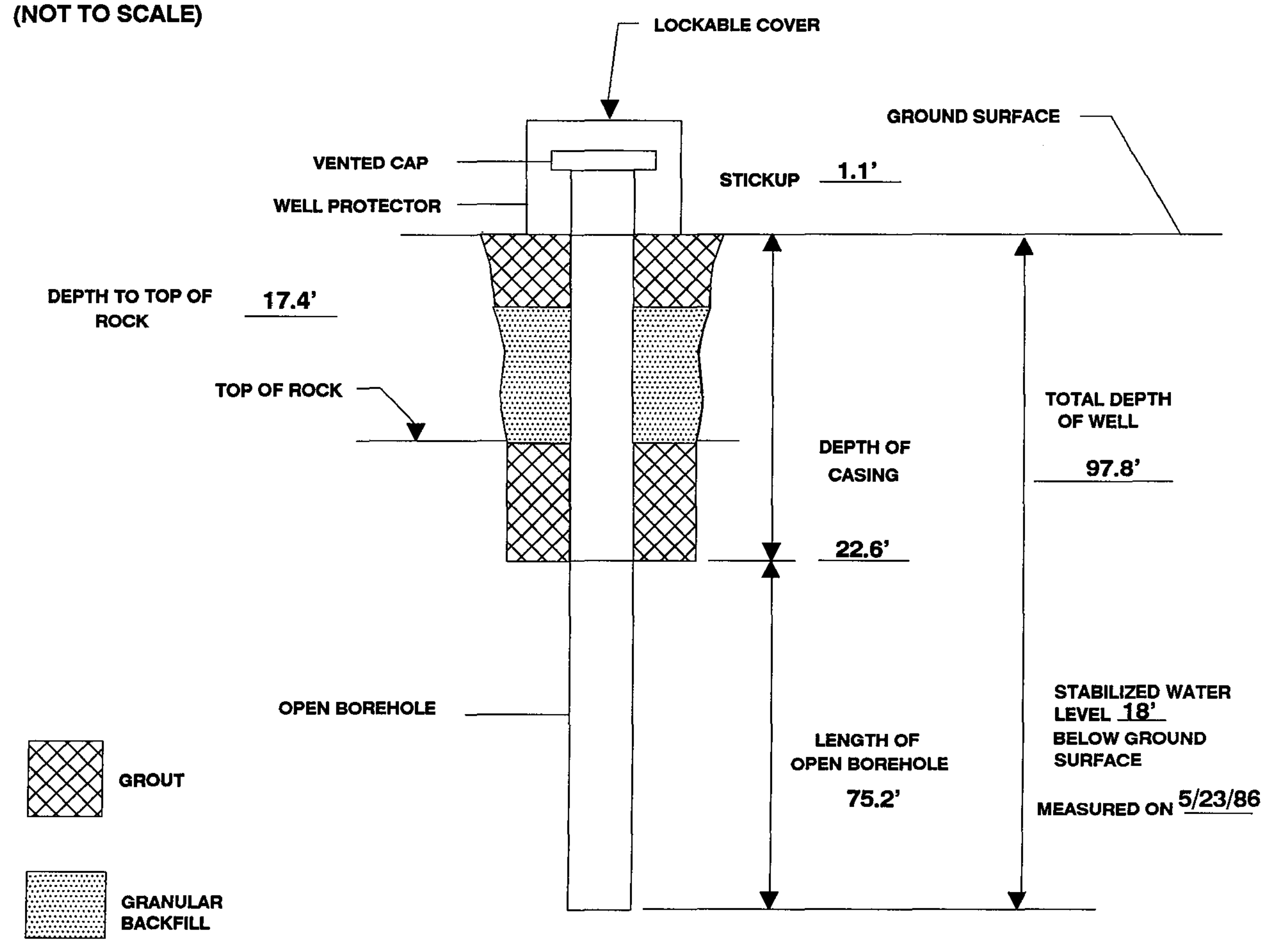
LOCKABLE COVER ? YES

FIELD REPRESENTATIVE HAL ROBINSON

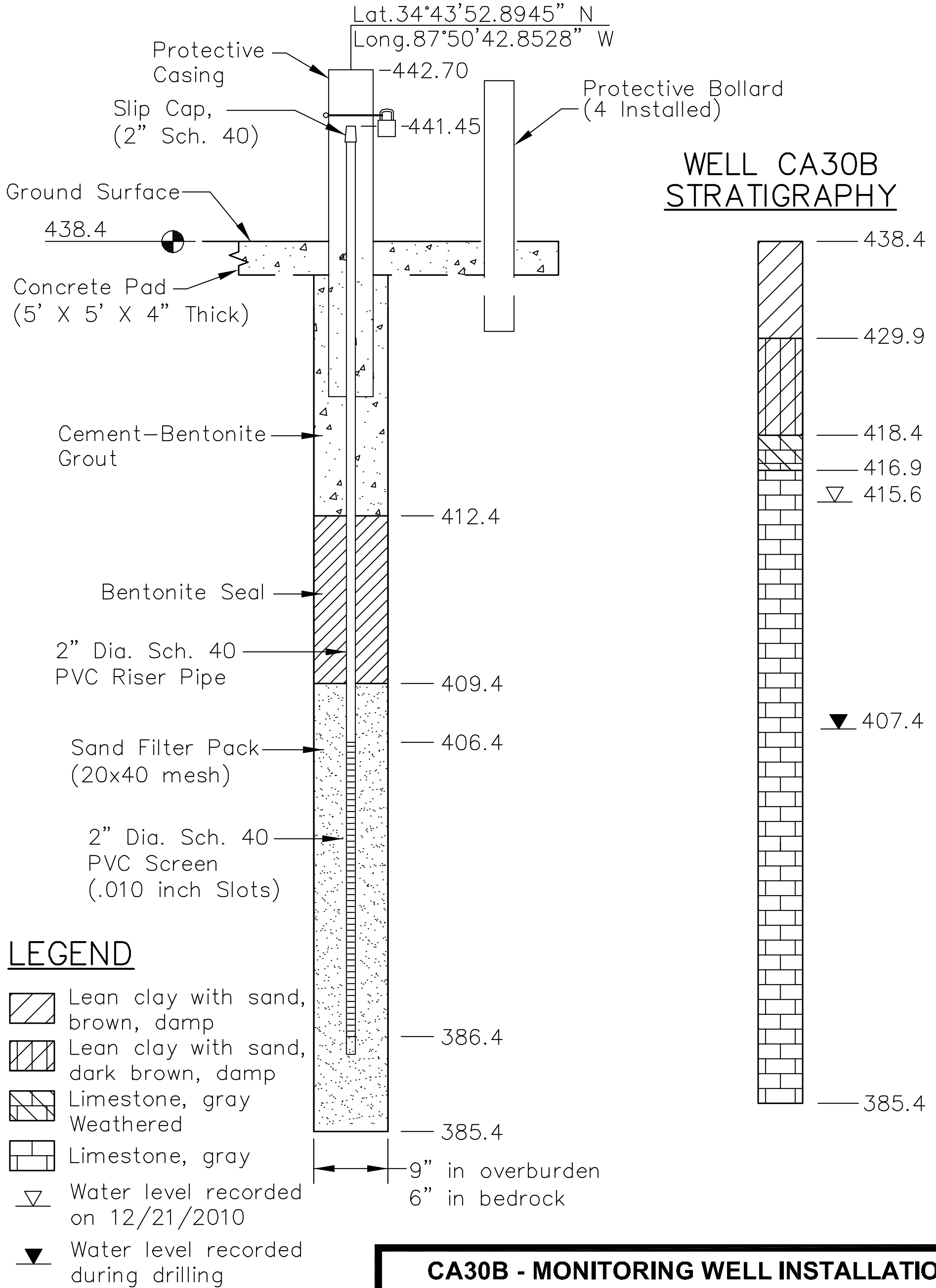
DRILLING FLUID NONE

COMMENTS

(NOT TO SCALE)



ENG LAB 3/22/89



NOTES:

1. Soil stratigraphy based on SPT samples obtained during the drilling process.
2. Survey information provided by TVA Surveying.
3. Well installed on 10/08/10.

CA30B - MONITORING WELL INSTALLATION DETAIL
USWAG GROUND WATER MONITORING NETWORK
TVA COLBERT FOSSIL PLANT

Stantec

Stantec Consulting Services Inc.
11687 Lebanon Rd.
Cincinnati, Ohio
45241-2012
513-842-8200
www.stantec.com

DRAWN BY	MJ	DATE JAN. 21, 2011	REVISED		SHEET
CHECKED BY	JM	PROJ. NO. 175560058	1.	3.	1 OF 1
CHECKED BY	BB	SCALE NTS	2.	4.	

Project: COF Pond 4 CCR Drilling
Project Location: Colbert Fossil Plant; Tuscumbia, AL
Project Number: 60439420

Log of Boring/Well 507B-1/COF-102
Sheet 1 of 1

Date(s) Drilled	5/20/2016-5/23/2016	Logged By	C. Musial	Checked By	N. Pagano
Drilling Method	HSA	Drill Bit Size/Type	4.25" HSA, 10.25" HSA HQ diamond bit	Total Depth of Borehole	12.5 ft bgs
Drill Rig Type	CME 550x	Drilling Contractor	Tri-State Drilling, LLC	Surface Elevation	422.4 est. ft above msl
Borehole Backfill	4" monitoring well	Sampling Method(s)	NA	Hammer Data	NA
Boring Location	Toe of Ash Disposal Area 4 dike	Groundwater Level(s)	12.5' bgs during drilling		

Elevation, feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Sampling Resist. Blows/6" OR CORE% RQD	SAMPLES: Recovery, %	SAMPLES: Pocket Penetrometer (tsf)	Graphic Log	MATERIAL DESCRIPTION	Well details	REMARKS AND OTHER DETAILS
425	0							Offset. Refer to Boring Log 507B for soil description from 0.0'-12.5' For lithologic information for well COF-102, refer to the following Boring 507B boring log.		Bentonite plug (medium chips from 0.0' to 4.5' bgs)
420	5									4" Schedule 40 PVC pipe
415	10									4" Schedule 40 PVC screen (0.010" slotted from 7.0' to 12.0' bgs) Sand pack (GP#2 from 4.5' to 12.5' bgs)
	12.5							End of Boring at 12.5´ bgs		
410	15									
405	20									
400	25									
	30									

Report: GEO_CR_WELL; File T:\PROJECTS\31850000_TVA\TVA COF\LOGISTICS_60439420_COMBINED FIELD LOGS\GINT FILES\PROJECT\COF_POND_4_CCR_DRILLING.GPJ; 8/10/2016 2:33:17 PM

AECOM

Project: COF Pond 4 CCR Drilling

Project Location: Colbert Fossil Plant; Tuscumbia, AL

Project Number: 60439420

Log of Boring 507B

Sheet 1 of 2

Date(s) Drilled	5/20/2016-5/23/2016	Logged By	C. Musial	Checked By	N. Pagano
Drilling Method	HSA, HQ	Drill Bit Size/Type	3.25" HSA, HQ diamond bit	Total Depth of Borehole	33.2 ft bgs
Drill Rig Type	CME 550x	Drilling Contractor	Tri-State Drilling, LLC	Surface Elevation	422.4 est. ft above msl
Borehole Backfill	Abandoned with portland/bentonite grout	Sampling Method(s)	2' continous split-spoon/HQ	Hammer Data	140# 30" drop auto
Boring Location	Toe of Ash Disposal Area 4 dike	Groundwater Level(s)	12.5' bgs during drilling		

Depth, feet	SAMPLES: Number	Sampling Resist. Blows/6" OR CORE% RQD	Recovery, %	Pocket Penetrometer (tsf)	MATERIAL DESCRIPTION	No well	REMARKS AND OTHER DETAILS
0	SS-1	2 6 5 5	65	NM	Brown with black, silty SAND (SM), dry, soft, very fine to medium grained		
	SS-2	3 4 6 6	65	NM	grades with more silt		
5	SS-3	2 3 3 3	65	NM	Brown with gray, clayey SILT (CL-ML), dry, soft, with trace very fine to medium sand		Abandoned with portland/bentonite grout
	SS-4	2 3 2 2	75	1.0	grades with medium to coarse sand, with chert fragments		
	SS-5	2 2 3 3	100	0.75 0.5	Gray and orange, silty clayey SAND (SC-SM), moist, soft, medium to coarse grained sand		
10	SS-6	2 2 3 3	65	0.25	grades to gray		
	SS-7	50/1	100	0.25	sand appears to be crushed limestone		
	Run-1	14	75		Gray to light gray, LIMESTONE, fossiliferous, macrocrystalline, massive, no chert		*13.0' PQ Casing set 1' into rock*
15	Run-2	100	98		light gray		
20	Run-3	100	100		20.75'-21.25' - thin gray, seam along side		
25	Run-4	100	100				
30							

Report: GEO_CR_WELL; File T:\PROJECTS\31850000_TVA\TVA COF\LOGISTICS_60439420_COMBINED FIELD LOGS\GINT FILES\PROJECT\COF_POND_4_CCR_DRILLING.GPJ; 8/10/2016 12:40:41 PM

AECOM

Log of Boring 507B

Depth, feet	Type	Number	Sampling Resist. Blows/6" OR CORE% RQD	Recovery, %	Pocket Penetrometer (tsf)	Graphic Log	MATERIAL DESCRIPTION	No well	REMARKS AND OTHER DETAILS
30		Run-5	60	97			hard, medium gray blue-gray, chert nodules, crystalline		
							End of Boring at 33.2´ bgs		
35									
40									
45									
50									
55									
60									
65									

Project: COF Pond 4 CCR Drilling
Project Location: Colbert Fossil Plant; Tuscumbia, AL
Project Number: 60439420

Log of Boring/Well 514B/COF-104

Sheet 1 of 1

Date(s) Drilled	**7/7/2016**	Logged By	**P. Van Winkle**	Checked By	**N. Pagano**
Drilling Method	**HSA**	Drill Bit Size/Type	**3.25" HSA, 8.25" HSA**	Total Depth of Borehole	**13.1 ft bgs**
Drill Rig Type	**CME 550x**	Drilling Contractor	**Tri-State Drilling, LLC**	Surface Elevation	**421.4 est. ft above msl**
Borehole Backfill	**4" monitoring well**	Sampling Method(s)	**2' continous split-spoon**	Hammer Data	**140# 30" drop auto**
Boring Location	**Toe of Ash Disposal Area 4 dike**	Groundwater Level(s)	**4.0' bgs at 16:20 on 07/08/16**		

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resist. Blows/6" OR CORE% RQD	Recovery, %	Pocket Penetrometer (tsf)	Graphic Log	MATERIAL DESCRIPTION	Well details	REMARKS AND OTHER DETAILS
	0							Rip-Rap road sub base, toe of dike		**Bentonite chips (medium from 0.0' to 3.6'bgs)**
420	5		SS-1	5 8 8 4	30	NA		Gray, fine to coarse limestone GRAVEL (GW), wet		**4" Schedule 40 PVC pipe**; **Bentonite plug (3/8" coated pellets from 3.6' to 5.7' bgs)**
			SS-2	3 2 1 1	60	0.25		Dark gray, silty CLAY (CL-ML), wet, with organic odor, some sand Gray with orange mottling, sandy CLAY (CL-SP), wet, low plasticity		**Sand pack (GP#2 from 5.7' to 13.1' bgs)**
415			SS-3	1 3 5 4	20	0.0		Gray, clayey SAND (SC), wet, fine grained, organic odor		
	10		SS-4	3 2 2 3	80	NA		trace orange mottling, some black organic lenses, trace wood fragments		**4" Schedule 40 PVC screen (0.010" slotted from 7.9' to 12.9' bgs)**
			SS-5	0 0 50/1	75	NA		medium to coarse grained sand, trace brown fine sand, limestone in shoe		
								End of Boring at 13.1´ bgs		*Splitspoon refusal at 13.1' bgs Bottom of hole*
410	15									
405	20									
400	25									
395	30									

AECOM

Report: GEO_CR_WELL; File T:\PROJECTS\31850000_TVA\TVA COF\LOGISTICS_60439420_COMBINED FIELD LOGS\GINT FILES\PROJECT\COF_POND_4_CCR_DRILLING.GPJ; 8/10/2016 12:40:43 PM

Project: COF Pond 4 CCR Drilling
Project Location: Colbert Fossil Plant; Tuscumbia, AL
Project Number: 60439420

Log of Boring/Well 514D/COF-105

Date(s) Drilled	7/8/2016	Logged By	P. Van Winkle	Checked By	N. Pagano
Drilling Method	HSA	Drill Bit Size/Type	3.25" HSA, 8.25" HSA	Total Depth of Borehole	14.7 ft bgs
Drill Rig Type	CME 550x	Drilling Contractor	Tri-State Drilling, LLC	Surface Elevation	421.9 est. ft above msl
Borehole Backfill	4" monitoring well	Sampling Method(s)	2' continous split-spoon	Hammer Data	140# 30" drop auto
Boring Location	Toe of Ash Disposal Area 4 dike	Groundwater Level(s)	8.35' bgs during drilling		

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resist. Blows/6" OR CORE% RQD	Recovery, %	Pocket Penetrometer (tsf)	Graphic Log	MATERIAL DESCRIPTION	Well details	REMARKS AND OTHER DETAILS
	0							Rip-Rap road sub-surface, toe of dike		Bentonite chips (medium from 0.0' to 4.7'bgs)
420	5									Bentonite plug (3/8" coated pellets from 4.7' to 7.0' bgs)
			SS-1	1 2 1 1	20	NA		Gray, sandy CLAY (SP-SC), wet, soft, with angular limestone gravel Brown, poorly graded, fine, silty SAND (SM), wet, loose		4" Schedule 40 PVC pipe
			SS-2	0 1 1 1	90	NA				
415	10		SS-3	0 2 2 2	70	NA		grades to gray with brown mottling		4" Schedule 40 PVC screen (0.010" slotted from 9.1' to 14.1' bgs)
			SS-4	2 3 5 5	55	NA		Brownish-gray, sandy GRAVEL (GW-SW), wet, sub-rounded to rounded, coarse, well graded		Sand Pack (GP#2 from 7.0' to 14.7' bgs)
			SS-5	2 50/2	40	NA		gray, with some clay		
410	15							End of Boring at 14.7´ bgs		
405	20									
400	25									
395	30									

AECOM

Sampling Resist. Blows/6" OR CORE% RQD	Pocket Pene-trometer (tsf)

For lithologic information for well COF-108, refer to the following Boring 505A and 505A-1 boring log.

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AECOM

Sampling Resist. Blows/6" OR CORE% RQD	Pocket Penetrometer (tsf)	Remarks
		Hard drilling. Sample from 16-18' recovered but auger unable to advance to 18ft. Pulled augers blocked with large limestone plug and sand.
		Auger having difficulty advancing starting to dog leg.

AECOM

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/							QAADEĀ+A0ĀE4L43B GĀ4GĀ" "; ĀA9ĀDEĀ10D7BFE4B DĀA43 . S)*&. S		*Auger down to 23' with 4.25" flight augers then switch to 3.25" HSA*
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			WQY Ä	Ā			ĀĀĀĀ(49CF806Ā4Ā0374H03		*Heaving gravel 1' up into augers*
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O/		(( )Ä	WQ+ WQ+ WQ+ WQ+	Ā"	<;		=93TĀG9:ĀEĀBKEĀ9:6ĀD91: ĀL+; aOI ĀL W@ĀBEKĀ9- G, 893 8C0DE4 0ĀĀ9C0- E06ĀC1B, CĀEĀ7493D06ĀBKEĀ45 - ĀĀ9Ā78ĀBĀDK40		*Weight of rods dropped from 46' to 52'bgs* *Offset and redrill hole*
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AECOM

Client Borehole ID: COF-111
Stantec Boring No.: **COF-111**
Client: Tennessee Valley Authority
Boring Location: 1723061.1 N; 395060.2 E
Project Number: 172607623
Surface Elevation: 421.9 ft
Elevation Datum: NAD27
Project Name: Comprehensive Groundwater Investigation
Date Started: 2/1/19
Completed: 2/2/19
Project Location: Colbert Steam Plant
Depth to Water: 2.84 ft
Date/Time: 2/1/19
Inspector: W. Padgett
Logger: W. Padgett
Depth to Water: 6.65 ft
Date/Time: 2/2/19
Drilling Contractor: Cascade
Drill Rig Type and ID: BLY LS 600
Overburden Drilling and Sampling Tools (Type and Size): 6" core barrel, 12" casing 0-21'
Rock Drilling and Sampling Tools (Type and Size): N/A
Overdrill Tooling (Type and Size): N/A
Overdrill Depth: N/A
Sampler Hammer Type: N/A
Weight: N/A
Drop: N/A
Efficiency: N/A
Borehole Azimuth: N/A (Vertical)
Borehole Inclination (from Vertical): N/A
Reviewed By: W. Padgett
Approved By: B. Grove, Jr.

Lithology Depth	Lithology Elevation	Graphic	Description	Overburden Sonic Core Sample ID	Depth Ft. / Run Ft.	Rec. Ft.	Rec. %
0.0	421.9		Ground Surface				
6.0	415.9		SAND WITH SILT, SP-SM, brown, fine to medium grained, moist, alluvium	RS1	0.0 - 6.0	2.0	33
9.0	412.9		FAT CLAY, CH, brown to gray, dry to moist, alluvium	RS2	6.0 - 16.0	9.0	90
10.0	411.9		CLAYEY SAND, SC, brown to gray, fine to medium grained, moist				
13.0	408.9		SAND, SP, gray, fine to medium grained, moist, alluvium				
16.0	405.9		SAND WITH GRAVEL AND CLAY, SP-SC, gray, fine to medium grained, wet, alluvium				
21.0	400.9		GRAVEL WITH SAND AND CLAY, GP-GC, gray, fine to coarse grained, wet, alluvium	RS3	16.0 - 21.0	5.0	100

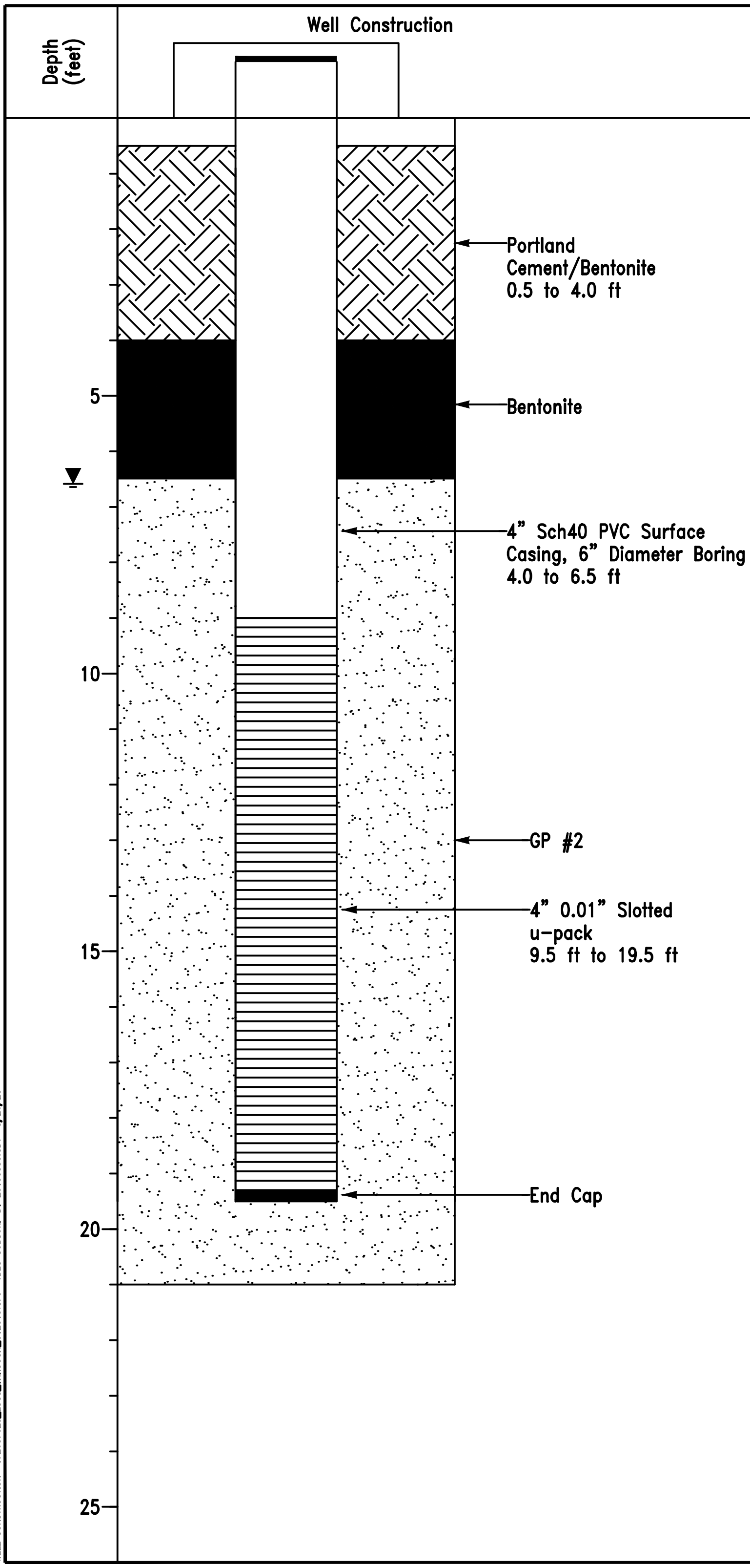
No Refusal/Bottom of Hole at 21 Ft.

TVA EIP SONIC BORING LOG 172607623_LOGS_THROUGH_062020.GPJ TDEC SUBSURF DT 1-24-19.GDT 8/11/20

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: COF-111	PAGE 1 OF 1

PROJECT: Comprehensive Groundwater Investigation	LOCATION: Directly NE of Ash Pond 4 adjacent to Cane Creek
PROJECT NUMBER: 172607623	INSTALLATION: STARTED: 2/1/19 COMPLETED: 2/2/19
DRILLING COMPANY: Cascade	NORTHING (ft): 1723061.06 EASTING (ft): 395060.18
DRILLING EQUIPMENT: BLY LS 600	LATITUDE: N34°44'09.42" LONGITUDE: W87°50'57.40"
DRILLING METHOD: Rotary Sonic - See Drilling Schedule	GROUND ELEV (ft): 421.9 TOC ELEV (ft): 425.32
SAMPLING METHOD: Standard Core Barrel	LOCATION DATUM: NAD27 ELEVATION DATUM: NAD27
LOGGED BY: W. Padgett	BOREHOLE DEPTH (ft): 21.0 WELL DEPTH (ft): 19.5
REVIEWED BY: WDP	DTW AT COMPLETION (ft, bgs): 6.65 CONCRETE PAD ELEV. (ft): 422.09
APPROVED BY: BDGJ	BOREHOLE DIA. (in): 12.0 WELL DIA. (in): 4.0



Materials Inventory

RISER TYPE: 4" Sch 40 PVC Riser	
RISER: TOP (BGS): 0.0 ft	BOTTOM (BGS): 9.5 ft
SCREEN TYPE: U-Pak - Factory Machine Slotted	
SCREEN SLOT SIZE (in): 0.010	
SCREEN: TOP (BGS): 9.5 ft	BOTTOM (BGS): 19.5 ft
END CAP: TOP (BGS): 19.5 ft	BOTTOM (BGS): 20.5 ft
GROUT QUANTITY: 25 gal	
GROUT TYPE: Portland Cement/Bentonite	
GROUT: TOP (BGS): 0.5 ft	BOTTOM (BGS): 4.0 ft
INITIAL (lbs/gal):	RETURN (lbs/gal):
BENTONITE TOP (BGS): 4.0 ft	BOTTOM (BGS): 6.5 ft
FILTER PACK TYPE: Pre-pack and annular space TYPE: 20/40 mesh (Global #7)	
FILTER PACK: TOP (BGS): 6.5 ft	BOTTOM (BGS): 21.0 ft
NOTES: Monitoring Well completed with stick-up enclosure. Refer to COF-111 Boring Log for lithology information	

DRILLING SCHEDULE

INTERVAL	METHOD
0-21 ft	6" Core Barrel, 12" Drill Casing

WELL CONSTRUCTION 172607623_LOGS_THROUGH_112019.GPJ TDEC SUBSURF DT 20190530.GDT 3/26/20

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

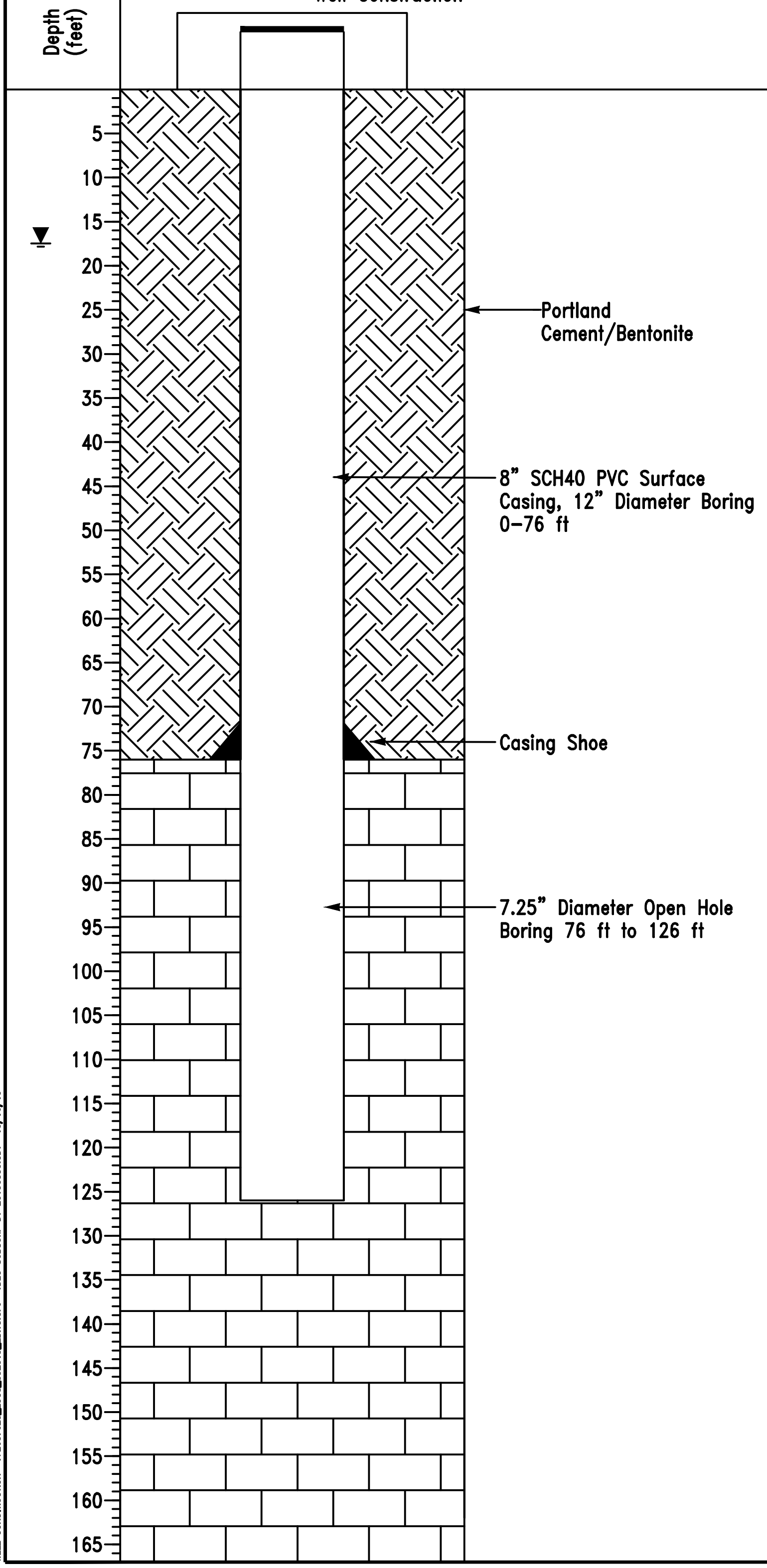
WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: COF-111BR

PROJECT: Comprehensive Groundwater Investigation
PROJECT NUMBER: 172607623
DRILLING COMPANY: Cascade
DRILLING EQUIPMENT: BLY LS 600
DRILLING METHOD: Rotary Sonic - See Drilling Schedule
SAMPLING METHOD: Standard Core Barrel
LOGGED BY: W. Padgett
REVIEWED BY: WDP
APPROVED BY: BDGJ

LOCATION: Directly NE of Ash Pond 4 adjacent to Cane Creek
INSTALLATION: STARTED: 1/31/19 COMPLETED: 2/2/19
NORTHING (ft): 1723052.75 EASTING (ft): 395065.06
LATITUDE: N34°44'09.34" LONGITUDE: W87°50'57.34"
GROUND ELEV (ft): 421.9 TOC ELEV (ft): 425.38
LOCATION DATUM: NAD27 ELEVATION DATUM: NAD27
BOREHOLE DEPTH (ft): 126.0 WELL DEPTH (ft): 126.0
DTW AT COMPLETION (ft, bgs): 17.48 CONCRETE PAD ELEV (ft): 422.08
BOREHOLE DIA. (in): 12.0/7.25 WELL DIA. (in): 7.25

Depth (feet) | Well Construction



Materials Inventory

Casing Type: 8" Sch 40 PVC Casing

CASING: TOP (BGS): 0.0 ft BOTTOM (BGS): 76 ft

SCREEN TYPE: None - Open Hole Completion to 126 ft

GROUT QUANTITY: 500 gallons

GROUT TYPE: Portland Cement/Bentonite

GROUT: TOP (BGS): 0.0 ft BOTTOM (BGS): 76 ft

NOTES: Monitoring Well completed with stick-up enclosure
Refer to COF-111BR Boring Log for lithology information

DRILLING SCHEDULE

INTERVAL	METHOD
0-60 ft	6" Core Barrel, 12" Drill Casing
0-76 ft	10" Core Barrel
76-126 ft	6" Core Barrel, 7" Drill Casing

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

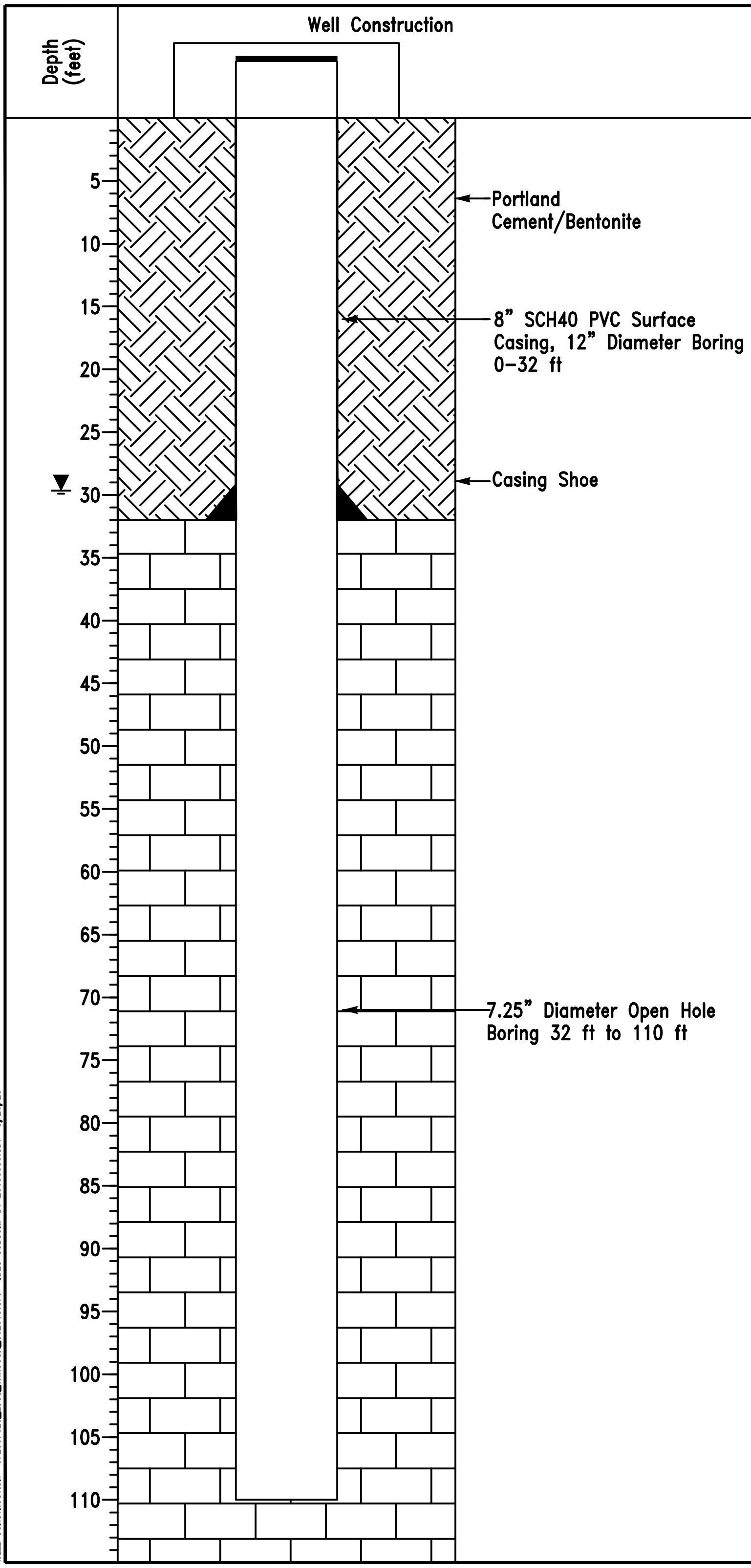
WELL CONSTRUCTION 172607623_LOGS_092019_EXITS.GPJ TDEC SUBSURF DT 20190530.GDT 10/16/19

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **COF–112BR**

PROJECT: Comprehensive Groundwater Investigation	LOCATION: South of Former CYRP
PROJECT NUMBER: 172607623	INSTALLATION: STARTED: 1/30/19 COMPLETED: 2/2/19
DRILLING COMPANY: Cascade	NORTHING (ft): 1721819.25 EASTING (ft): 396140.84
DRILLING EQUIPMENT: BLY LS 600	LATITUDE: N34°43'57.17" LONGITUDE: W87°50'44.40"
DRILLING METHOD: Rotary Sonic – See Drilling Schedule	GROUND ELEV (ft): 445.1 TOC ELEV (ft): 448.59
SAMPLING METHOD: Standard Core Barrel	LOCATION DATUM: NAD27 ELEVATION DATUM: NAD27
LOGGED BY: W. Padgett	BOREHOLE DEPTH (ft): 110.0 WELL DEPTH (ft): 110.0
REVIEWED BY: WDP	DTW AT COMPLETION (ft, bgs): 29.75 CONCRETE PAD ELEV. (ft): 445.33
APPROVED BY: BDGJ	BOREHOLE DIA. (in): 12.0/7.25 WELL DIA. (in): 7.25

Well Construction



Materials Inventory

Casing Type: 8" Sch 40 PVC Casing

CASING: TOP (BGS): 0.0 ft BOTTOM (BGS): 32 ft

SCREEN TYPE: None – Open Hole Completion to 110 ft

GROUT QUANTITY: 220 gallons

GROUT TYPE: Portland Cement/Bentonite

GROUT: TOP (BGS): 0.0 ft BOTTOM (BGS): 32 ft

NOTES: Monitoring Well completed with stick-up enclosure
Refer to COF–112BR Boring Log for lithology information

DRILLING SCHEDULE

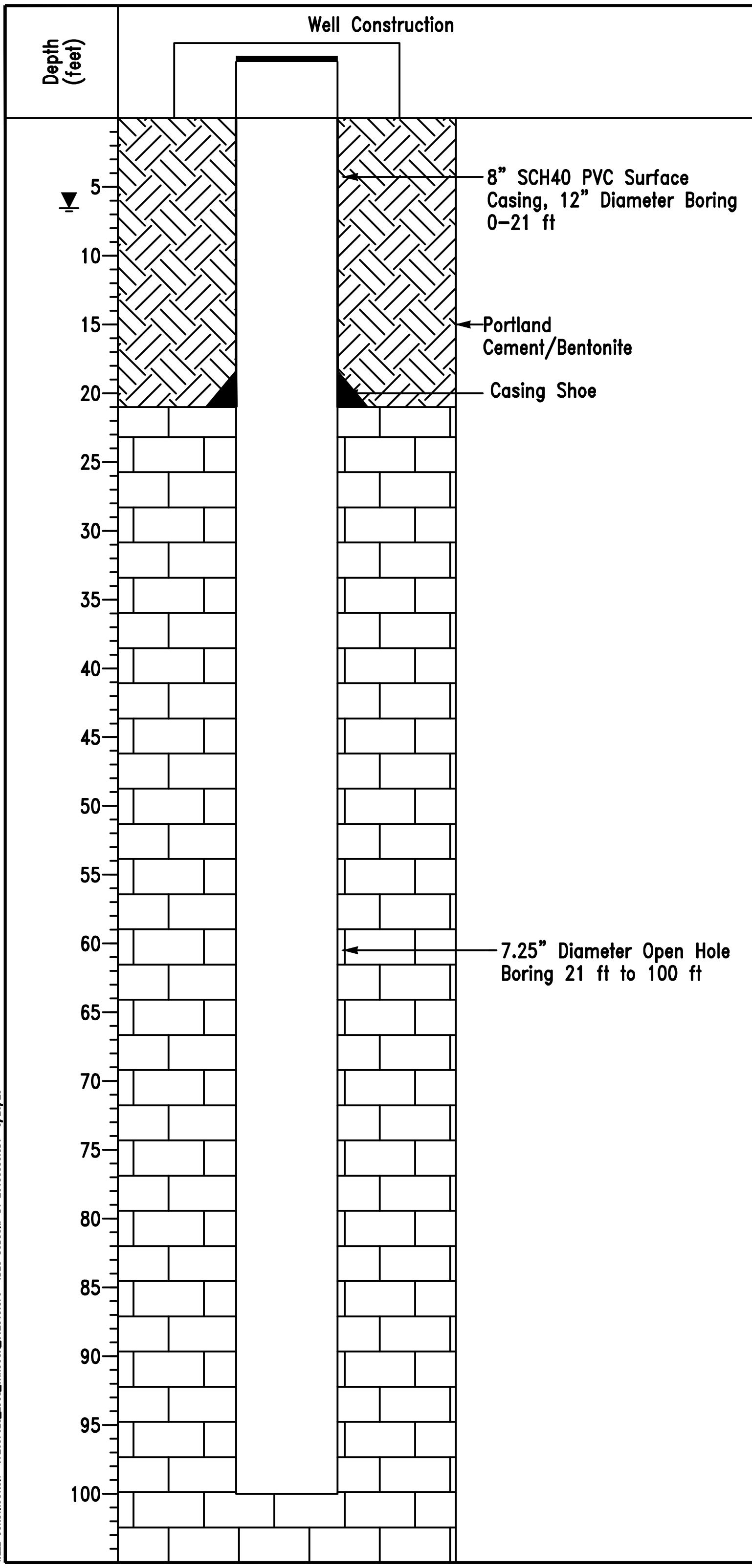
INTERVAL	METHOD
0–25 ft	6" Core Barrel, 12" Drill Casing
0–32 ft	10" Core Barrel
32–110 ft	6" Core Barrel, 7" Drill Casing

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

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **COF-113BR**

PROJECT: Comprehensive Groundwater Investigation	LOCATION: Southwest of Ash Pond 4 near TVA Property Line
PROJECT NUMBER: 172607623	INSTALLATION: STARTED: 2/3/19 COMPLETED: 2/5/19
DRILLING COMPANY: Cascade	NORTHING (ft): 1721278.66 EASTING (ft): 394232.07
DRILLING EQUIPMENT: BLY LS 600	LATITUDE: N34°43'51.76" LONGITUDE: W87°51'07.24"
DRILLING METHOD: Rotary Sonic - See Drilling Schedule	GROUND ELEV (ft): 435.5 TOC ELEV (ft): 438.98
SAMPLING METHOD: Standard Core Barrel	LOCATION DATUM: NAD27 ELEVATION DATUM: NAD27
LOGGED BY: W. Padgett	BOREHOLE DEPTH (ft): 100.0 WELL DEPTH (ft): 100.0
REVIEWED BY: WDP	DTW AT COMPLETION (ft, bgs): 6.65 CONCRETE PAD ELEV. (ft): 435.71
APPROVED BY: BDGJ	BOREHOLE DIA. (in): 12.0/7.25 WELL DIA. (in): 7.25



Materials Inventory

Casing Type: 8" Sch 40 PVC Casing

CASING: TOP (BGS): 0.0 ft BOTTOM (BGS): 21 ft

SCREEN TYPE: None - Open Hole Completion to 100 ft

GROUT QUANTITY: 170 gallons

GROUT TYPE: Portland Cement/Bentonite

GROUT: TOP (BGS): 0.0 ft BOTTOM (BGS): 21 ft

NOTES: Monitoring Well completed with stick-up enclosure
Refer to COF-113BR Boring Log for lithology information

DRILLING SCHEDULE

INTERVAL	METHOD
0-16 ft	6" Core Barrel, 12" Drill Casing
0-21 ft	10" Core Barrel
21-100 ft	6" Core Barrel, 7" Drill Casing

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

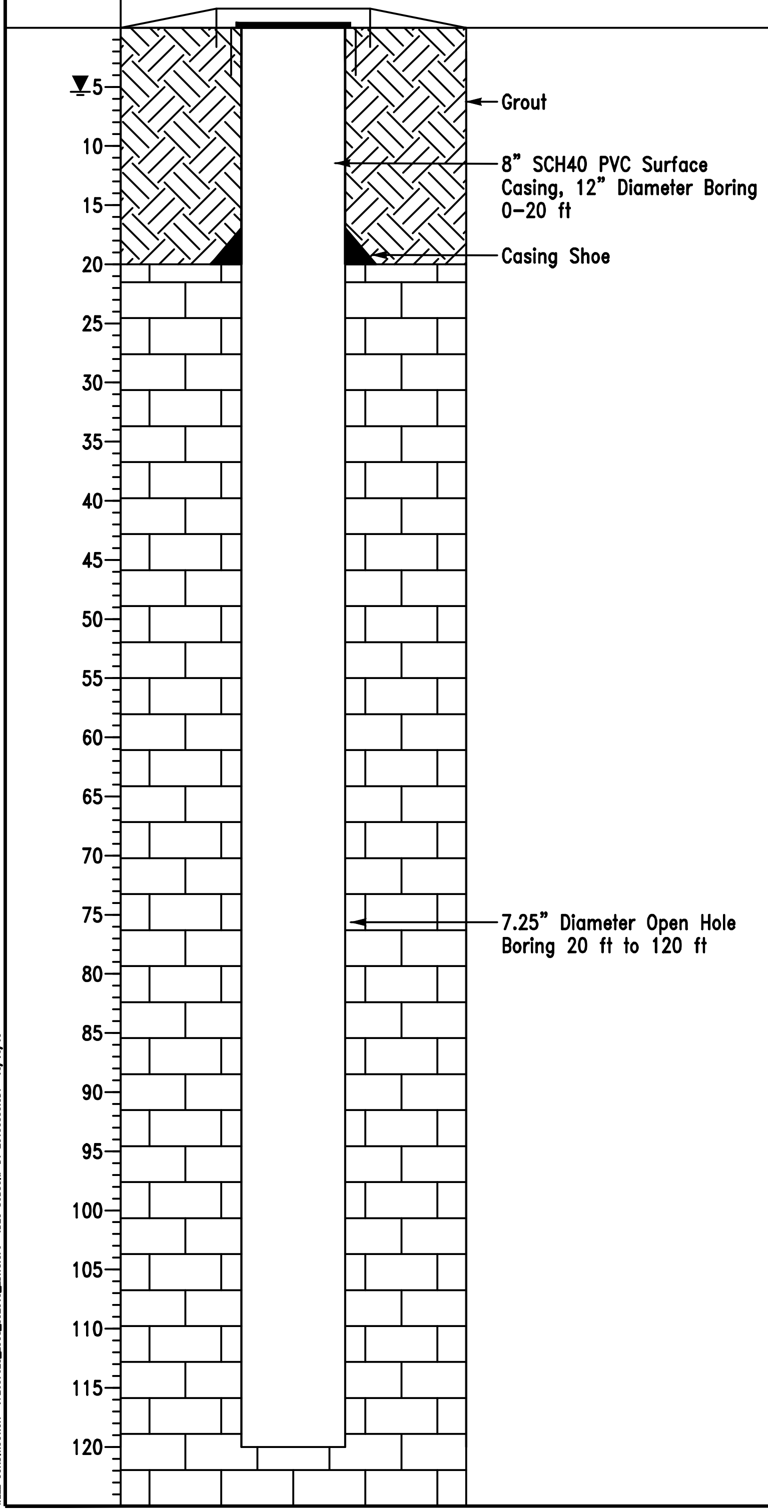
WELL CONSTRUCTION 172607623_LOGS_THROUGH_112019.GPJ TDEC SUBSURF DT 20190530.GDT 3/26/20

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **COF-114BR**

PROJECT: Comprehensive Groundwater Investigation	LOCATION: South of Ash Pond 4 near TVA Property Line
PROJECT NUMBER: 172607623	INSTALLATION: STARTED: 8/1/19 COMPLETED: 8/19/19
DRILLING COMPANY: Cascade	NORTHING (ft): 1721182.88 EASTING (ft): 394627.74
DRILLING EQUIPMENT: Compact Crawler CC1185	LATITUDE: N34°43'50.826" LONGITUDE: W87°51'02.504"
DRILLING METHOD: Rotary Sonic - See Drilling Schedule	GROUND ELEV (ft): 429.5 TOC ELEV (ft): 429.18
SAMPLING METHOD: Standard Core Barrel	LOCATION DATUM: NAD27 ELEVATION DATUM: NAD27
LOGGED BY: S. Ward	BOREHOLE DEPTH (ft): 120.0 WELL DEPTH (ft): 120.0
REVIEWED BY: WDP	DTW AT COMPLETION (ft, bgs): 5.42 CONCRETE PAD ELEV. (ft): 429.72
APPROVED BY: BDGJ	BOREHOLE DIA. (in): 12.0/7.25' WELL DIA. (in): 7.25

Well Construction



Materials Inventory

Casing Type: 8" Sch 40 PVC Casing

CASING: TOP (BGS): 0.0 ft BOTTOM (BGS): 20.0 ft

SCREEN TYPE: None - Open Hole Completion to 120 ft

GROUT QUANTITY: 75 gallons

GROUT TYPE: Portland Cement/Bentonite

GROUT: TOP (BGS): 2.0 ft BOTTOM (BGS): 20.0 ft

NOTES: Monitoring Well completed with flush mount enclosure
Refer to COF-114BR Boring Log for lithology information

DRILLING SCHEDULE

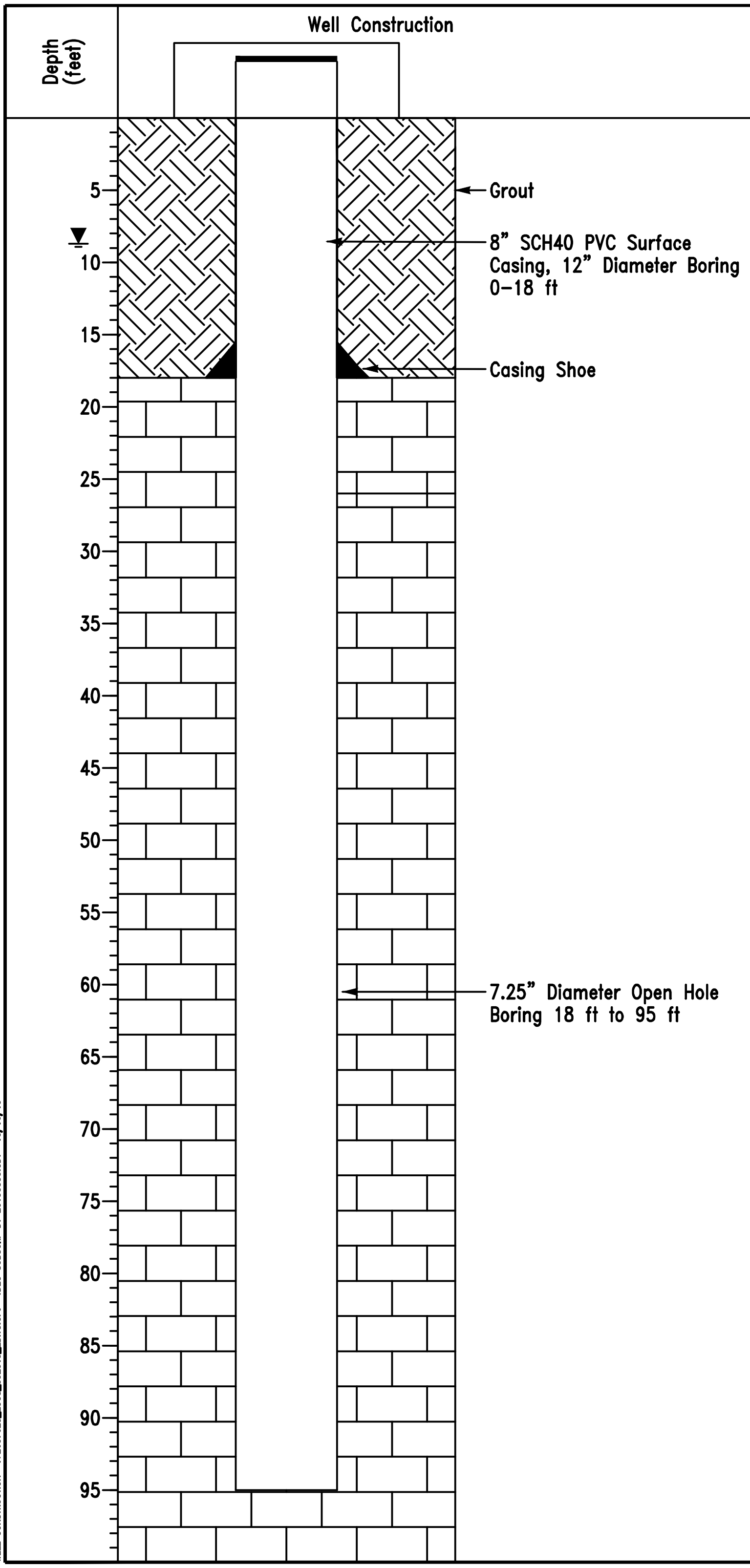
INTERVAL	METHOD
0-20 ft	4" Core Barrel, 6" Drill Casing
0-20 ft	10" Core Barrel, 12" Drill Casing
20-120 ft	6" Core Barrel, 7" Drill Casing

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

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **COF-116BR**

PROJECT:	Comprehensive Groundwater Investigation	LOCATION:	TVA Property South of Hwy 72
PROJECT NUMBER:	172607623	INSTALLATION:	STARTED: 8/6/19 COMPLETED: 8/15/19
DRILLING COMPANY:	Cascade	NORTHING (ft): 1720272.63	EASTING (ft): 395715.49
DRILLING EQUIPMENT:	Compact Crawler CC1185	LATITUDE: N34°43'41.859"	LONGITUDE: W87°50'49.434"
DRILLING METHOD:	Rotary Sonic - See Drilling Schedule	GROUND ELEV (ft): 423.7	TOC ELEV (ft): 427.26
SAMPLING METHOD:	Standard Core Barrel	LOCATION DATUM: NAD27	ELEVATION DATUM: NAD27
LOGGED BY:	S. Ward	BOREHOLE DEPTH (ft): 95.0	WELL DEPTH (ft): 95.0
REVIEWED BY:	WDP	DTW AT COMPLETION (ft, bgs): 8.7	CONCRETE PAD ELEV. (ft): 424.06
APPROVED BY:	BDGJ	BOREHOLE DIA. (in): 12.0/7.25	WELL DIA. (in): 7.25



Materials Inventory

Casing Type: 8" Sch 40 PVC Casing

CASING: TOP (BGS): 0.0 ft BOTTOM (BGS): 18.0 ft

SCREEN TYPE: None - Open Hole Completion to 95 ft

GROUT QUANTITY: 75 gallons

GROUT TYPE: Portland Cement/Bentonite

GROUT: TOP (BGS): 2.0 ft BOTTOM (BGS): 18.0 ft

NOTES: Monitoring Well completed with stick-up enclosure
Refer to COF-116BR Boring Log for lithology information

DRILLING SCHEDULE

INTERVAL	METHOD
0-18 ft	4" Core Barrel, 6" Drill Casing
0-18 ft	10" Core Barrel, 12" Drill Casing
18-95 ft	6" Core Barrel, 7" Drill Casing

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

WELL CONSTRUCTION 172607623_LOGS_092019_EXITS.GPJ TDEC SUBSURF DT 20190530.GDT 10/16/19

ROCK MONITORING WELL INSTALLATION RECORD

PROJECT COLBERT

WELL NUMBER MC1

INSTALLATION DATE NOVEMBER 1981

PLANT COORDINATES EAST 405.94m

NORTH -974.73m

GROUND SURFACE ELEVATION 134.83mmsl

TOP OF INNER CASING 135.23mmsl

BACKFILL MATERIAL CEMENT GROUT

CASING DIAMETER 10cm

CASING MATERIAL SCH 40 PVC

DRILLING TECHNIQUE IN ROCK PERCUSSION

DRILLING TECHNIQUE IN SOIL HOLLOW STEM AUGER

DRILLING CONTRACTOR TVA

OUTER BOREHOLE DIAMETER 30cm

OPEN BOREHOLE DIAMETER 10cm

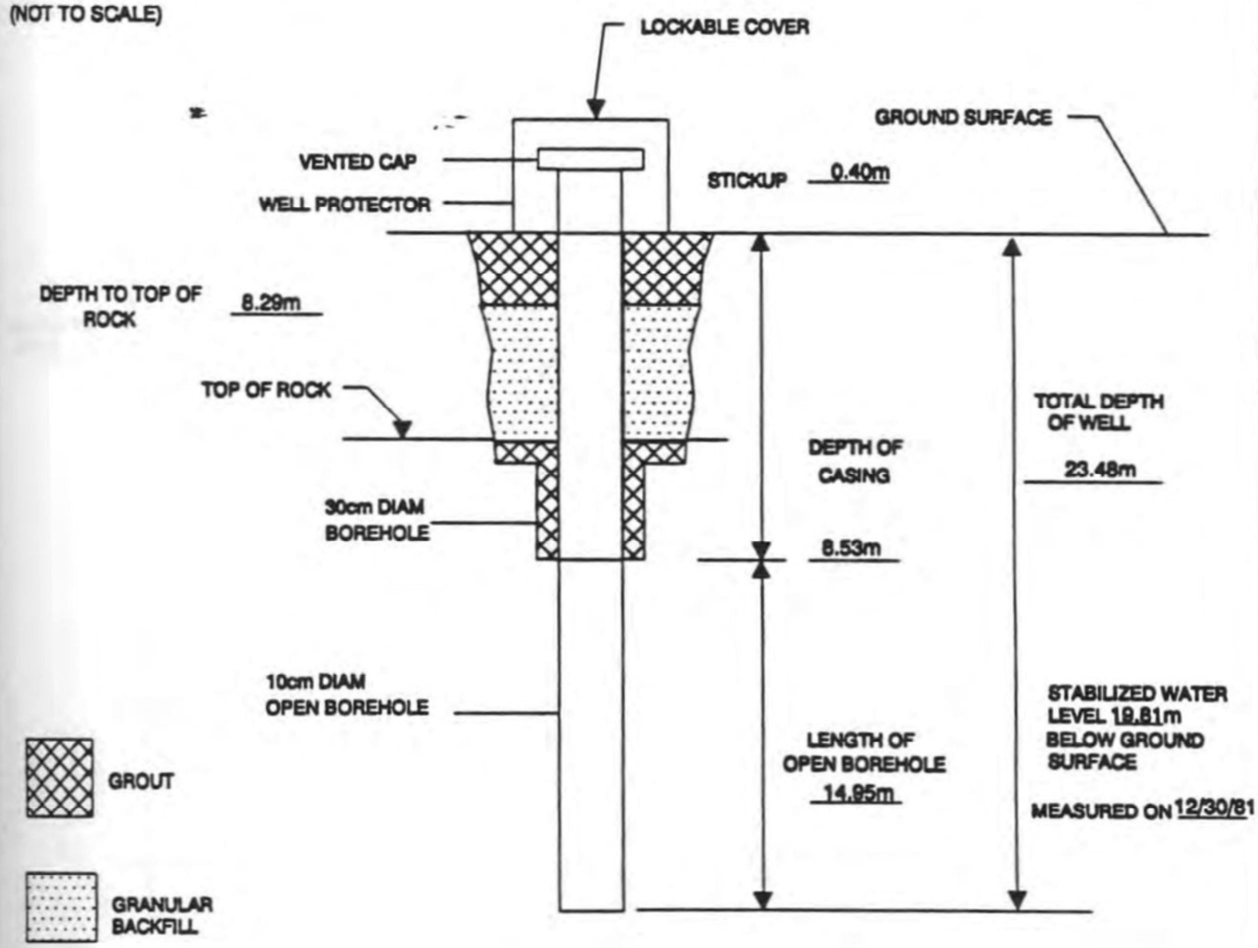
LOCKABLE COVER ? YES

FIELD REPRESENTATIVE HAL ROBINSON

DRILLING FLUID

COMMENTS SECTIONS GLUED. CAVITY 19.81m. 19.87m WEATHERED ZONE AT 22.86m.
GROUT - 207kg PORTLAND CEMENT: 352kg SAND: 23L WATER: 1.1kg INTRAPLAST N

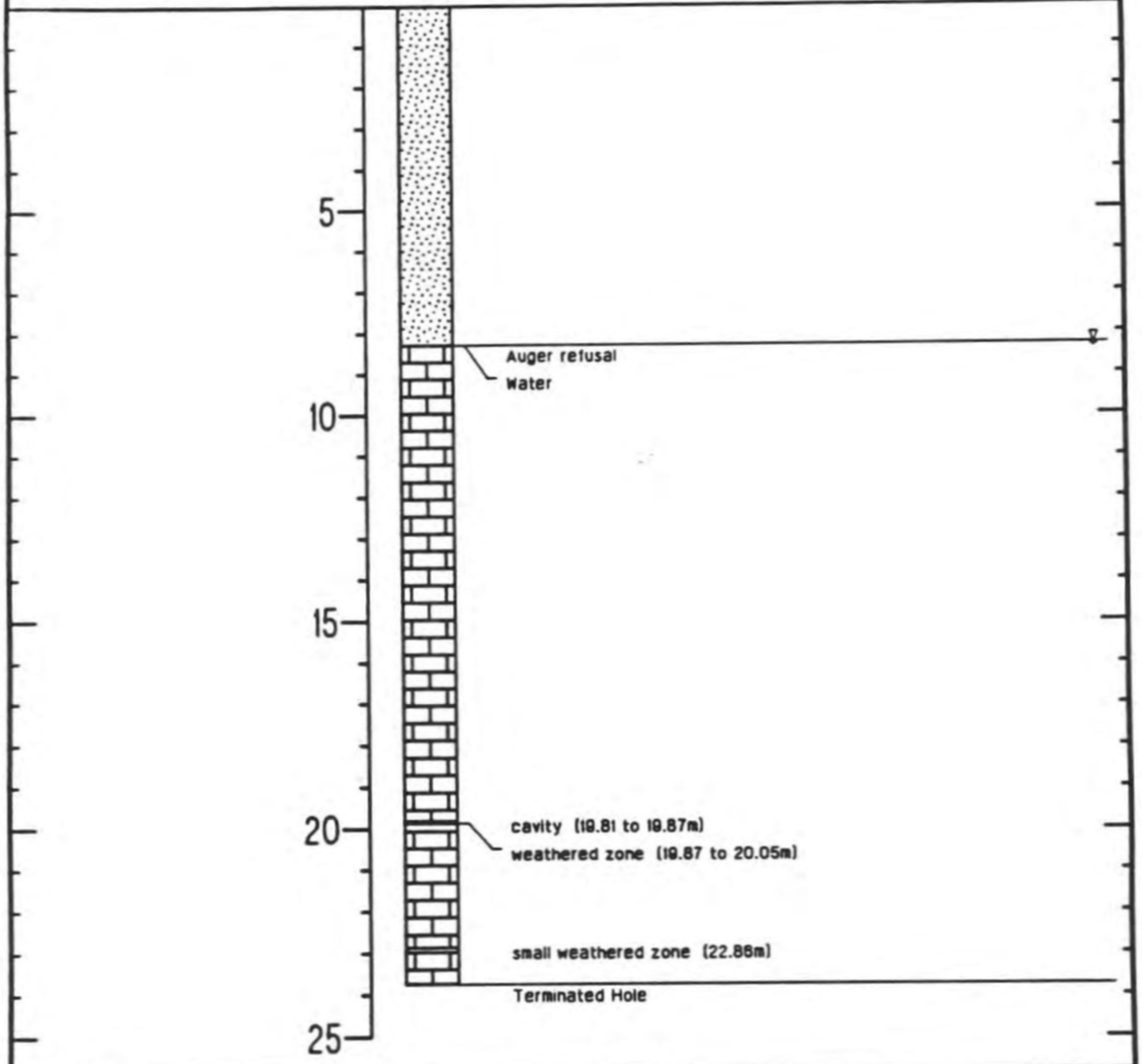
(NOT TO SCALE)



Tennessee Valley Authority

LOG OF BORING MC-1

BLOWS/M	FID (ppm)	ELEV. (m-msl)	DEPTH (m)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION



PROJECT Colbert Fossil Plant

DRILLING COMPANY Maynor

LOCATION Tuscumbia, AL

DATE DRILLED 11/25/81

DRILL RIG Hollow Stem Auger

SURFACE ELEVATION meters-msl

LOGGER/ENGINEER H. W. Robinson

TOTAL DEPTH OF HOLE 23.74 meters

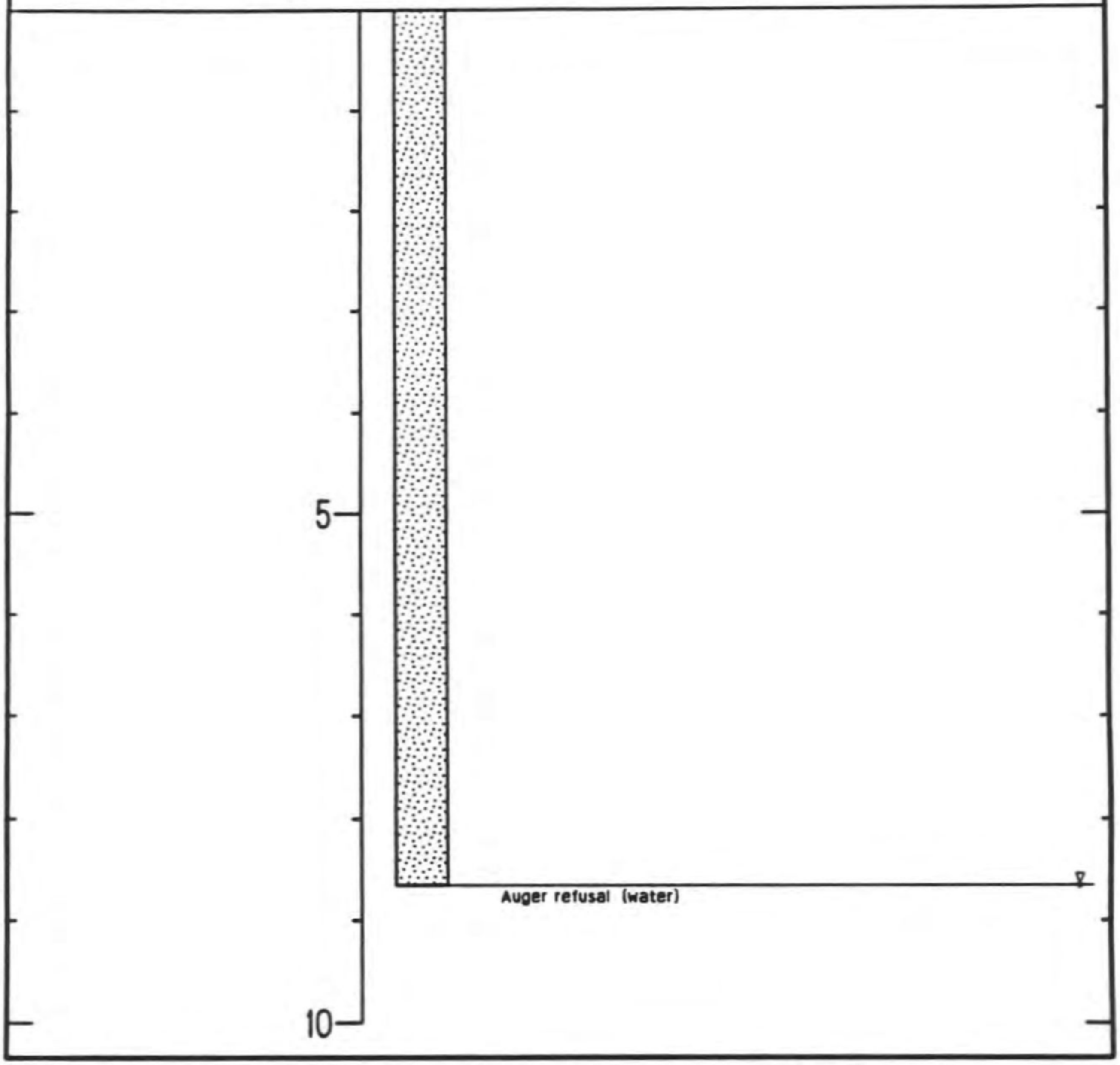
WATER LEVEL (INITIAL) 8.32meters

WATER LEVEL (24-HOUR) meters

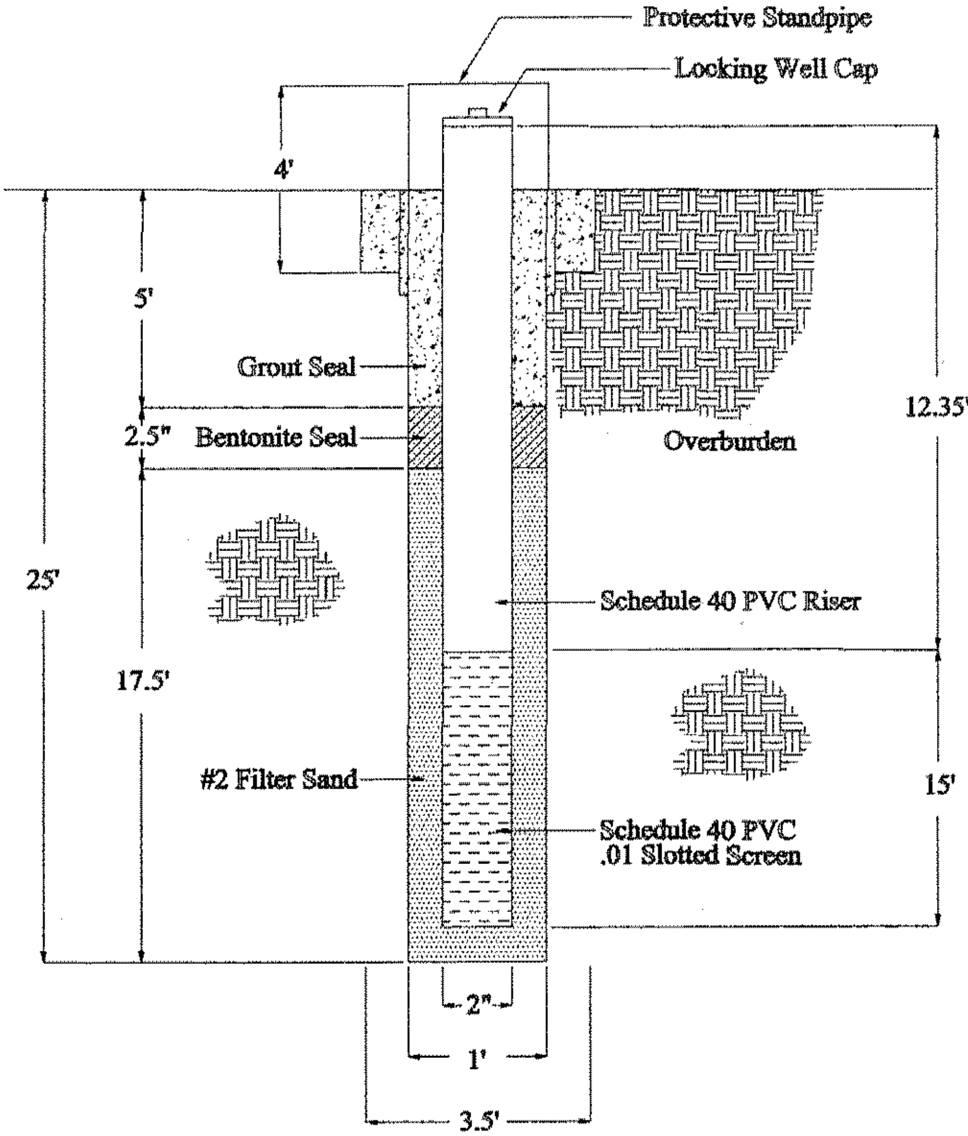
Tennessee Valley Authority

LOG OF BORING MC-4

BLOWS/M	FID (ppm)	ELEV. (m-msl)	DEPTH (m)	SAMPLES	SYMBOLS	MATERIALS DESCRIPTION



PROJECT Colbert Fossil Plant	DRILLING COMPANY Maynor
LOCATION Tuscumbia, AL	DATE DRILLED 12/01/81
DRILL RIG Hollow Stem Auger	SURFACE ELEVATION meters-msl
LOGGER/ENGINEER H. W. Robinson	TOTAL DEPTH OF HOLE 8.65 meters
WATER LEVEL (INITIAL) 8.65meters	WATER LEVEL (24-HOUR) meters



Date Constructed	10-15-03	Ground Surface Elev.	NA
Boring Depth	25 feet	Boring Terminated Elev.	NA
Casing	NA	Total Well Length	27.35 feet
Length of Screen	15 feet	Length of Riser	12.35 feet
Top of Sand	7.5 feet bgs	Vol./Wt. of Sand	800 lbs
Top of Bentonite	5 feet bgs	Vol./Wt. of Bentonite	100 lbs
Top of Grout	Ground Surface	Vol./Wt. of Grout	100 lbs

S&ME ENVIRONMENTAL SERVICES ENGINEERING · TESTING

Well Construction Figure			
Boring No.: MC-5A			
Project Name: TVA Colbert Fossil Plant			Project No.: 1432-03-502
Scale: NTS	Drawn By: DJH	Checked By: BRS	Date: 10-15-03

PROJECT: TVA - Colbert Fossil Plant Colbert County, Alabama S&ME Project No. 1432-03-502	BORING LOG MC-5A

DATE DRILLED: 10/15/03	ELEVATION:	NOTES. Soil descriptions based on visual observation of cuttings during drilling.
DRILLING METHOD: CME 550-X, 6¼" H.S.A.	BORING DEPTH: 25.0 feet	
LOGGED BY: M. Pannell	WATER LEVEL @ TOB: 15 feet	
DRILLER: D. Hedges	REVIEWED BY.	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO. SAMPLE TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
0		Topsoil - (12 inches)					
		Clay to Silty Clay - reddish tan; very moist					
5							
10							
		Clay to Silty Clay - reddish tan; wet					
15			∇				
20							
25		Clay to Silty Clay with fractured weathered rock - reddish tan; very moist					
		Boring Terminated at 25 feet					

BORING LOG NEW 03-502.GPJ S&ME.GDT 4/22/04

NOTES:

1. *THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.*
2. *BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.*
3. *STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.*
4. *WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.*

Page 1 of 1

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ENVIRONMENTAL SERVICES

PROJECT: TVA-Colbert Fossil Plant, Colbert, Alabama, S&ME Project No. 1432-03-502A	BORING LOG	MC-5C

DATE DRILLED: **11/21/04**	ELEVATION:	NOTES:
DRILLING METHOD: **Air Rotary/HQ Wireline**	BORING DEPTH: **153.0** feet	
LOGGED BY: **M. Pannell**	WATER LEVEL @ TOB: **3 ft**	
DRILLER: **T. Hall**	WATER LEVEL @ 24 hrs:	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO. SAMPLE TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
0–2		Topsoil					
2–20		Clay to Silty Clay - With Some Pebbles, Reddish Tan, Very Moist to Wet	▽ (3 ft)				
20–22		Clay to Silty Clay - With Fractured Weathered Rock, Reddish Tan, Very Moist to Wet					
22–35		Limestone - Gray, With Chert					

BORING LOG NEW 03-502A.GPJ S&ME.GDT 12/22/04

NOTES:

1. *THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.*
2. *BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.*
3. *STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.*
4. *WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.*

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ENVIRONMENTAL SERVICES

PROJECT: TVA-Colbert Fossil Plant Colbert, Alabama S&ME Project No. 1432-03-502A	BORING LOG MC-5C

DATE DRILLED: 11/21/04	ELEVATION:	NOTES:
DRILLING METHOD: Air Rotary/HQ Wireline	BORING DEPTH: 153.0 feet	
LOGGED BY: M. Pannell	WATER LEVEL @ TOB: 3 ft	
DRILLER: T. Hall	WATER LEVEL @ 24 hrs:	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO. SAMPLE TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
40							
45							
50							
		Limestone - Gray					
55							
60							
65							

BORING LOG NEW 03-502A.GPJ S&ME.GDT 12/22/04

NOTES:

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2. ***BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.***
3. ***STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.***
4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES

PROJECT: TVA-Colbert Fossil Plant Colbert, Alabama S&ME Project No. 1432-03-502A	BORING LOG MC-5C

DATE DRILLED: 11/21/04	ELEVATION:	NOTES:
DRILLING METHOD: Air Rotary/HQ Wireline	BORING DEPTH: 153.0 feet	
LOGGED BY: M. Pannell	WATER LEVEL @ TOB: 3 ft	
DRILLER: T. Hall	WATER LEVEL @ 24 hrs:	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO. SAMPLE TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
75							
80							
85							
		Limestone - Gray *(continued)*					
90							
95							
100							

NOTES:

1. ***THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.***
2. ***BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.***
3. ***STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.***
4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

S&ME
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ENVIRONMENTAL SERVICES

PROJECT: TVA-Colbert Fossil Plant Colbert, Alabama S&ME Project No. 1432-03-502A	BORING LOG	MC-5C

		NOTES:
DATE DRILLED: **11/21/04**	ELEVATION:	
DRILLING METHOD: **Air Rotary/HQ Wireline**	BORING DEPTH: **153.0** feet	
LOGGED BY: **M. Pannell**	WATER LEVEL @ TOB: **3 ft**	
DRILLER: **T. Hall**	WATER LEVEL @ 24 hrs:	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO. SAMPLE TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
		Fractured Rock with Mud Seam					
		Limestone - Gray					
110		Air Rotary Drilling Terminated at 109 feet					
		Begin HQ Core					
		Numerous Weathered Fragments of Limestone/Dolostone - Crystalline, with Calcite Particles Throughout; Chert Present in Very Small Pieces Within Limestone Matrix					
115		Void					
		Fractured Rock					
		Void					
120		Run No. 1 (109 ft - 113 ft) Rec. = 85% RQD = 65%					
125							
130							
135							

BORING LOG NEW 03-502A.GPJ S&ME.GDT 12/22/04

NOTES:

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2. *BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.*
3. *STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.*
4. *WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.*

S&ME
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ENVIRONMENTAL SERVICES

PROJECT: TVA-Colbert Fossil Plant Colbert, Alabama S&ME Project No. 1432-03-502A	BORING LOG	MC-5C

DATE DRILLED: **11/21/04**	ELEVATION:	NOTES:
DRILLING METHOD: **Air Rotary/HQ Wireline**	BORING DEPTH: **153.0** feet	
LOGGED BY: **M. Pannell**	WATER LEVEL @ TOB: **3 ft**	
DRILLER: **T. Hall**	WATER LEVEL @ 24 hrs:	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO. SAMPLE TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
		Limestone/Dolostone - light gray to darker gray Run No. 2 (113 ft - 118 ft) Rec. = 100% RQD = 100%					
145		Fossiliferous limestone, gray Run No. 3 (118 ft - 123 ft) Rec. = 100% RQD = 100%					
		Run No. 4 (123 ft - 128 ft) Rec. = 100% RQD = 100%					
150		Fossiliferous limestone, medium gray, coarse crystalline Run No. 5 (128 ft - 133 ft) Rec. = 100% RQD = 100%					
		Run No. 6 (133 ft - 138 ft) Rec. = 100% RQD = 100%					
		Run No. 7 (138 ft - 143 ft) Rec. = 100% RQD = 100%					
		Limestone, light gray, fine-grained Run No. 8 (143 ft - 148 ft) Rec. = 100% RQD = 94% *(continued)*					
		Limestone - coarse; fossil-bearing; light gray 148 ft - 150.6 ft Extensive Vertical Fractures Filled with Calcite 150.6 ft - 151.1 ft Weathered and multiple vertical fractures Limestone, light gray, fine-grained, crystalline Run No. 9 (148 ft - 153 ft) Rec. = 100% RQD = 100%					
		Coring Terminated at 153 feet					

BORING LOG NEW 03-502A.GPJ S&ME.GDT 12/22/04

NOTES:

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3. ***STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.***
4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

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APPENDIX C

Statistical Methods Certification

Stantec Consulting Services, Inc.
3157 Royal Drive Suite 250
Alpharetta, GA US 30022-2487

October 1, 2021
File: 182603597

Attention: Tennessee Valley Authority
Generation Construction Projects
1101 Market Street
Chattanooga, TN 37402

Reference: Statistical Methods Re-certification
TVA CCR Rule and Groundwater Quality Monitoring Program
Colbert Fossil Plant
Ash Disposal Area 4 CCR Unit
Tuscumbia, Colbert County, Alabama

To Whom it May Concern:

Stantec Consulting Services, Inc. (Stantec) has reviewed the *Statistical Methods Certification for Compliance with the Final Coal Combustion Residuals Rule (40 CFR §257.93)* prepared by Dr. Kirk Cameron, MacStat Consulting Ltd., for application at the above referenced facility and monitored unit. Based upon our review of this document, it is our opinion that, to the best of our knowledge, information, and belief:

1. The information contained in this certification is prepared in accordance with the accepted practice of engineering.

2. The information contained therein is accurate as of the date of my signature below.

3. The selected statistical methods are appropriate for evaluating the groundwater monitoring data for the referenced coal combustion residuals (CCR) unit at the Colbert Fossil Plant in Tuscumbia, Colbert County, Alabama and that the reference methods meet the requirements described in 40 CFR §257.93.

Reference: Statistical Methods Re-certification – Ash Disposal Area 4 CCR Unit Tuscumbia, Colbert County, Alabama

We appreciate this opportunity to be of service to TVA. If we can be of further assistance, please contact us.

Regards,

Stantec Consulting Services, Inc.

Benjamin D. Grove PE, PG
Vice President
Phone: 678 327 2963
Benjamin.Grove@stantec.com

10/1/2021

10/10Attachment: Statistical Methods Re-certification for Compliance with the Final Coal Combustion Residuals Rule (40 CFR 257.93)

dm document2

Statistical Methods Certification for Compliance with the Final Coal Combustion Residuals Rule (40 CFR §257.93)

Colbert Fossil Plant

CCR Groundwater Monitoring Network: Ash Disposal Area 4 CCR Unit

1. Introduction

The U.S. Environmental Protection Agency's (USEPA's) final Coal Combustion Residuals (CCR) Rule establishes a comprehensive set of requirements for the management and disposal of coal ash in landfills and surface impoundments by electric utilities. The Tennessee Valley Authority (TVA) Colbert Fossil Plant (COF), located in Tuscumbia, Colbert County, Alabama, has a closed CCR surface impoundment (Ash Disposal Area 4 CCR Unit, also referred to as Ash Pond 4) that is subject to the CCR Rule.

This report includes a summary of the statistical methodology selected for evaluating groundwater monitoring data at the above mentioned CCR unit and supports compliance with requirements outlined in Sections 257.93(f) and 257.93(g) of the CCR Rule. To develop the most appropriate methods to validate assumptions, evaluate groundwater data, and develop background concentrations, the statistical methodology is based on USEPA's *Unified Guidance* (2009). This Statistical Methods Certification will replace the prior version dated October 16, 2017, prepared by HDR (HDR, 2017).

Groundwater monitoring activities commenced in December 2016 and, at the time of this report, TVA contractors obtained more than the minimally prescribed number of samples (i.e., "eight independent samples for each background and downgradient well") to comply with the initial baseline requirements included in §257.90(b) of the CCR Rule. Detection monitoring was initiated in September 2017 and Ash Disposal Area 4 CCR Unit transitioned to assessment monitoring in July 2018.

Regardless of the current status of the Ash Disposal Area 4 CCR Unit monitoring program, this Statistical Methods Certification describes statistical methods applicable to detection monitoring, assessment monitoring, and corrective action. The statistical method for evaluating groundwater data in detection monitoring described in **Section 3** of this document – prediction limits – is consistent with method/paragraph (3) of Section 257.93(f), which includes a prediction interval procedure. In assessment monitoring or corrective action, the method described in **Section 4** of this document — confidence intervals (and its variant confidence bands) — is consistent with Unified Guidance recommendations and is also justified under method/paragraph (5) of Section 257.93(f), namely "Another statistical method that meets the performance standards of paragraph (g) of this section."

2. Development of Background

2.1 Interwell vs. Intrawell

When data from multiple upgradient, background wells are available, a determination will be made as to whether the upgradient data appear to come from the same population or whether there is evidence of statistically significant spatial variation at the facility. Data for each constituent will be plotted using box plots to assist in this determination, allowing concentrations within and across wells to be visualized. Analysis of Variance (ANOVA) will be utilized to statistically evaluate whether or not spatial variation is statistically significant.

Conventionally, interwell statistical tests are used to evaluate whether compliance wells are consistent with, and in the expected range of, background. These tests are generally appropriate when there is no significant spatial variation at the site, and the natural groundwater gradient flows from the upgradient, background wells to the compliance locations. In the event of significant spatial variation among the background wells, it may be reasonable to assume similar variation among the compliance wells, independent of any groundwater contamination. Under such conditions, it may be difficult to make valid interwell comparisons between compliance wells and upgradient, background locations, since apparent differences may reflect natural spatial variability rather than evidence of groundwater contamination.

As an alternative, USEPA's *Unified Guidance* recommends switching from interwell methods to *intrawell* methods when it can be reasonably demonstrated that no pre-existing contamination from current practices or waste management at the regulated facility is present. More generally, intrawell methods may also be needed when there is insufficient data from upgradient background wells or when interwell methods will not adequately address the question of a change in groundwater quality at compliance locations. The latter can occur, for instance, when the uppermost aquifer underlying a site is discontinuous, or when compliance wells are screened in different hydrostratigraphic units.

Intrawell tests compare the most recent sample(s) from a given well to historical measurements at the same well, rapidly detecting changes over time at a given location. When appropriate, intrawell methods remove the confounding factors of spatial variation in well-to-well concentration levels. In these cases, EPA recommends intrawell methods, such as intrawell prediction limits with retesting, as an acceptable alternative to interwell testing.

The overarching goals in selecting either interwell or intrawell testing will be to:

- Ensure that statistical comparisons will be adequately sensitive to detecting a facility release;
- Ensure that data used in testing reflect current background conditions; and
- Avoid confusing an impact caused by a release from the facility with a difference between wells caused by heterogeneous subsurface conditions.

2.2 Background Screening

Credible and adequate background data is the most important aspect to developing accurate and sensitive statistical limits. Standard parametric prediction and control chart limits for groundwater assume that the background data (1) are representative of current background conditions; (2) are statistically stable over time (i.e., not trending); (3) do not include (extreme) outliers; (4) include a sufficient number of samples to accurately estimate the variability in the underlying groundwater population, and thus be sensitive to a persistent change in groundwater concentrations; and (5) can be normalized, possibly via transformation. Non-parametric prediction limits — including rank-based and bootstrap methods — also rely on assumptions 1-4, but do not require that the data can be normalized (assumption 5).

To test these assumptions, any proposed background data will be screened prior to constructing statistical limits. Time series plots and formal trend tests will be used to check stability. The statistical pattern of the data along with the history and hydrogeology of the site will be used to gauge how well the data mimic current background conditions.

To handle potential outliers, one of two basic approaches will be utilized: (1) the **standard** method involves box plots and formal parametric outlier tests to identify, check for, and exclude any confirmed outliers, while (2) the **robust** method involves down-weighting of any potential outliers and the use of weighted, robust versions of standard statistical estimates (e.g., robust prediction limits) to curtail the influence of outlying values even when not formally excluded from the analysis. Robust methods have the advantage of bypassing sometimes uncertain judgments about whether specific observations are indeed outliers and can be adapted to cases where formal outlier testing is difficult, for instance, when the detection rate is low.

If average background concentration levels are changing over time (i.e., trending), the prospective background data may need to be truncated, removing older data to ensure that the resulting limits continue to represent current natural conditions. Confirmed outliers will either be flagged and de-selected from prospective background data prior to establishing statistical limits or will be down-weighted using alternate techniques robust to the presence of possible outliers, as discussed above. Any values flagged as outliers will be summarized in periodic reporting.

Probability plots and normality tests, adjusted for the presence of non-detects (Cameron, 2017), if any, will be used to identify and test best-fitting distributional models for the background data. If the data can be closely fit to a normal distribution (i.e., 'normalized') — possibly via mathematical transformation — then a parametric prediction limit or control chart will be constructed. If the data cannot be normalized, a nonparametric rank-based or bootstrap prediction limit will be constructed instead. Non-parametric methods will also be considered when the skewness and pattern of the background data result in unrealistic and likely inaccurate parametric estimates.

The size of the background dataset impacts both the accuracy (false positive rate) and sensitivity (statistical power) associated with a prediction limit or control chart comparison. The CCR rule requires at least 8 baseline samples prior to the start of statistical analysis and evaluations, but often more background data is needed to meet EPA performance requirements for groundwater tests, especially at larger well networks. These requirements are discussed below (**Section 3.1**).

2.3 Periodic Updating of Background

Background data will be updated for interwell statistical limits by consolidating more recent sampling observations with historical background data at least every five years. Any new outliers in the combined background data will be either (1) flagged and removed, or (2) down-weighted prior to construction of statistical limits. This updating process will not only increase the background sample size but will also reduce the incidence of false positives when using nonparametric prediction limits and increase the statistical power of parametric prediction or control chart limits.

For intrawell statistical limits, a similar consolidation of the site-specific intrawell background data will be done after every four new sampling events, with a similar inspection for new outliers. Since subtle trends or changes in the intrawell background observations can additionally impact the accuracy and potential bias of the updated statistical limits, two-sample tests and trend tests of the current background vs. the new candidate background observations will be run to ensure the older and newer data are comparable and can be combined prior to any statistical update. If the enlarged background data pool shows a significant trend or a significant difference in the newer measurements, the intrawell background will be re-examined and reconfigured as necessary to ensure it reflects current, but uncontaminated, conditions at the well.

3. Detection Monitoring Tests

Prediction limits are recommended by USEPA as a primary technique for detection monitoring. The detection monitoring methods described herein are in accordance with 40 CFR § 257.93(f)(3). Prediction limits are statistical thresholds estimated from background. If any new compliance observation exceeds the upper prediction limit, a potential statistical exceedance will be flagged. Retesting will then be conducted by collecting one or more independent resamples of the same well-constituent pair to confirm or disconfirm the initial exceedance. Any confirmed exceedance will be recorded as a statistically significant increase (SSI).

To conduct retesting, the pass one-of-m method, as described in the *Unified Guidance* (Chapter 19), allows for an efficient plan to confirm or disconfirm a potential SSI over background identified during detection monitoring. Depending on the background sample size, the target site-wide false positive rate, and the available time period in which to collect independent resamples, either a 1-of-2 or 1-of-3 method will be used when retesting is needed.

Under the CCR rule, prediction limit tests will initially be implemented for all detected Appendix III parameters. Note that one parameter, pH, will require both upper and lower prediction limits. In that case, a potential SSI will be flagged whenever a new compliance measurement is either less than the lower statistical limit or higher than the upper statistical limit.

Parameters with all non-detects in background do not require formal testing but will be evaluated using USEPA's Double Quantification Rule (DQR). The DQR assumes that a significant change in groundwater quality has occurred whenever two consecutive detections of a parameter are observed after no previous detections. It is similar in nature to a nonparametric prediction limit with a single retest (1-of-2).

3.1 Statistical Performance Requirements

The Unified Guidance recommends two general criteria when designing a statistical detection monitoring program in order to meet Resource, Conservation and Recovery Act (RCRA) (and, by reference, the CCR Rule) statistical performance requirements: (1) an annual site-wide false positive rate (SWFPR) of no more than 10%, and (2) statistical power of a site's 'weakest' test greater than or equal to the minimum benchmark power represented by the EPA reference power curves.

The first criterion informs the accuracy of statistical testing, limiting the occurrence of spurious (false) SSIs. The second criterion guides the sensitivity of testing, ensuring an adequate chance of identifying real changes in groundwater quality. In practical terms, the annual SWFPR is distributed evenly among the total number of well-constituent pairs and among the total number of statistical evaluations per year. Statistical limits will be constructed with sufficient background size and retesting in order not to exceed the per-pair portion of the overall false positive risk. Similarly, site-specific power curves associated with each distinct type of test will be constructed and compared to the EPA reference power curves to ensure adequate statistical power.

The CCR Rule indicates that if an SSI over background is confirmed for one or more Appendix III constituents during detection monitoring (that is, after all necessary retesting has been conducted), then the owner or operator of the CCR unit must, within 90 days: 1) establish an assessment monitoring program, 2) demonstrate that a source other than the CCR unit caused the SSI over background, or 3) demonstrate that the SSI over background resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Note that one parameter, pH, will require both upper and lower prediction limits. In that case, a potential SSI will be flagged whenever a new compliance measurement is either less than the lower statistical limit or higher than the upper statistical limit. Written documentation must also be completed and certified by a qualified professional engineer within the 90-day timeframe.

4. Assessment Monitoring and Corrective Action

The methods described herein for assessment monitoring or corrective action — confidence intervals (and its variant confidence bands) — are consistent with Unified Guidance recommendations and are also justified under method/paragraph (5) of Section 257.93(f), namely “Another statistical method that meets the performance standards of paragraph (g) of this section.”

To implement assessment monitoring, the CCR rule requires that all Appendix IV constituents be sampled, with any detected parameters added to the list of parameters sampled semiannually. To statistically evaluate these parameters for the CCR Unit, concentration data will be compared to Groundwater Protection Standards (GWPS) through the use of confidence intervals or their variant, confidence bands. A confidence interval is recommended and appropriate when the monitoring data do not exhibit a statistically significant trend. A confidence band is more appropriate when a trend is present. The GWPS for each constituent will be established as either the Maximum Contaminant Level (MCL) or as a statistical limit based on background if either no MCL is available or background concentrations are higher in concentration than the established MCL. On an annual basis, all Appendix IV parameters must be sampled and newly detected parameters added to the list of parameters sampled semiannually.

4.1 Confidence Intervals

For each well-constituent pair, a trend test will be run to determine whether there is evidence of a significant trend. If not, a parametric confidence interval around the population mean may be constructed at the 99% confidence level when the compliance data follow a normal distribution. Alternatively, a confidence band approach, as described in Section 4.2, below, may be applied.

If using a confidence interval approach, non-parametric bootstrap confidence intervals may be constructed if the data do not pass a normality test, due to skewness or other reasons. The accuracy of non-parametric intervals, including the bootstrap, depends in part on the number of observations used to construct the interval. When a well-constituent pair does not have sufficient sample size to ensure high statistical accuracy, a confidence interval with potentially less accuracy will be constructed but updated after each new sampling event until the desired accuracy is reached. The pair will also continue to be reported and tracked using time series plots and/or trend tests until enough data are available.

In assessment monitoring, a well is determined to be out of compliance, and has a statistically significant level (SSL), when the lower confidence limit (LCL), and thus the entire interval, exceeds the GWPS, as discussed in USEPA’s *Unified Guidance*. Assessment of corrective measures is initiated within 90 days, with remediation efforts evaluated through the continuing use of confidence intervals and confidence bands to determine remedial effectiveness.

4.2 Confidence Bands

If the compliance data at a given well-constituent pair show evidence of a significant trend, a linear regression line will be fit to the data and a confidence band with 99% confidence will be constructed around the trend line. Confidence bands will only be constructed on pairs with at least four independent samples. This approach may also be applied in the absence of a significant trend.

To evaluate compliance with regulatory standards, the lower edge of the confidence band at the most recent sampling event will be compared to the GWPS. If the lower edge exceeds the GWPS at that point in time (thus guaranteeing the entire vertical cross-section of the band also exceeds the GWPS at that point), an SSL will be recorded. If the lower edge of the band does not exceed the GWPS, no SSL will have occurred. As new sampling events are collected, the trend estimate will be updated along with the confidence band.

4.3 Corrective Action

If and when the assessment of corrective measures is initiated, this information will be placed in the operating record and, if possible, an alternate source demonstration (ASD) will be made. If there is evidence of an SSL above GWPS or if an ASD is not made regarding any SSL above GWPS, efforts will be made to characterize the nature and extent of the release.

Once remediation activities begin, semiannual sampling will continue and confidence intervals and/or confidence bands will monitor the progress of remediation efforts. Confidence intervals and bands are compared to GWPS or other risk-based criteria to determine when clean-up levels are achieved.

Although in corrective action the same statistical techniques are used, the manner of the comparison is different from that in assessment monitoring. In corrective action a well-constituent pair is declared ‘clean’ when the entire confidence interval or cross-section of the confidence band at the most recent sampling event falls *below* a specified clean-up limit or GWPS (i.e., the upper confidence limit [UCL] or upper confidence band [UCB] falls below the regulatory limit). Alternatively, compliance is achieved when the lower confidence limit (LCL) or lower confidence band (LCB) for every Appendix IV parameter does not exceed the GWPS for a period of three consecutive years.

5. Bibliography

Cameron, K (2017) ‘On-the-fly ’goodness of fit and outlier testing for left-censored data. In JSM Proceedings, Section on Statistics and the Environment, Alexandria, VA, American Statistical Association, 3445-53.

HDR (2017) Statistical Methods Certification for Compliance with the Final Coal Combustion Residuals Rule (40 CFR §257.93). October 16, 2017. 6 pp.

U.S. Environmental Protection Agency (2009) Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. USEPA Office of Solid Waste, EPA 530-R-09-007.

Attachment I

Closure/Post Closure Plan

ADEM Approval Letter – Ash Pond 4 Closure Plan Cap, August 2017

Closure/Post-Closure Plan for Ash Pond 4 by AECOM dated February 2017

Lance R. LeFleur
Director

Kay Ivey
Governor

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adem.alabama.gov
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Montgomery, Alabama 36130-1463
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August 22, 2017

Ms. Abigail Bowen
Waste, Permits, and Marketing
Tennessee Valley Authority
1101 Market Street, BR4A-C
Chattanooga, TN 37402

RE: Closure Plan
Ash Pond 4 – TVA Colbert Fossil Plant
Colbert County, Alabama

Dear Ms. Bowen:

On July 11, 2017, the Department received your revisions to the closure plan for Ash Pond 4. After review, the Department approves the closure plan for Ash Pond 4. Please note, this approval is only for the Ash Pond 4 final cap. At this time, the Department has not completed the review of the groundwater monitoring plan for Ash Pond 4. The Department will notify you when the review of the groundwater plan has been completed. After the final cap for Ash Pond 4 has been completed, please submit the cap certification to the Department for review and approval.

Sincerely,

S. Scott Story, Chief
Solid Waste Engineering Section
Land Division

CC: Ms. Rhonda Hooper, Tennessee Valley Authority

SSS/jc

COLBERT FOSSIL PLANT
TUSCUMBIA, ALABAMA

CLOSURE/ POST-CLOSURE PLAN FOR ASH POND 4

Prepared for

TVA

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

ALABAMA LICENSED No. 30571 PROFESSIONAL ENGINEER MICHAEL J. STEPIC

2/20/17

February 2017

Prepared by

AECOM

Project No. 60432289

TABLE OF CONTENTS

The Groundwater Monitoring Plan for Ash Pond 4 has been removed from this document.
The updated Groundwater Monitoring Plan is provided in Attachment G - Operations Plans

and

The Ash Pond 4 Final Closure QA/QC Plan is included in Attachment F - QA/QC Plan

1. INTRODUCTION

1.1 BACKGROUND

The following Closure/Post Closure Plan has been developed for Ash Pond 4, located at the Tennessee Valley Authority (TVA) Colbert Fossil Plant (COF) in Tuscumbia, Alabama to aid in meeting the requirements of the Alabama Department of Environmental Management (ADEM) Consent Decree (May 13, 2013) related to the Alabama Water Pollution Control Act. As discussed on September 16, 2015, during a meeting with ADEM, as part of the corrective action for groundwater, Ash Pond 4 will be closed. Installation of the closure cap system at Ash Pond 4 is anticipated to improve groundwater once fully implemented.

The purpose of this document is to: (i) describe necessary activities associated with the closure of Ash Pond 4, and (ii) describe the monitoring and maintenance activities for the facility during the post-closure period. A copy of the Closure/Post-Closure Plan will be kept in the operating record.

1.2 SITE DESCRIPTION

Ash Pond 4, shown in Figure 1, is enclosed by a 1.2 mile long perimeter dike, encompasses approximately 52 acres, and has a free water volume of approximately 330,000 cy. Ash pond 4 is bordered on the east by Cane Creek and State Route 72 to the South. This area has been used for many years as a wastewater treatment pond for both fly and bottom ash from plant operations. The pond also receives Plant process water, gray water, and waters from the Coal Yard Runoff Pond (CYROP). Ash Pond 4 consists of a sluicing area for bottom ash management, a Staging Area for bottom ash and fly ash, a Main Pond and an adjoining Stilling Pond. Existing conditions are shown on Sheet 10WXXX-02.

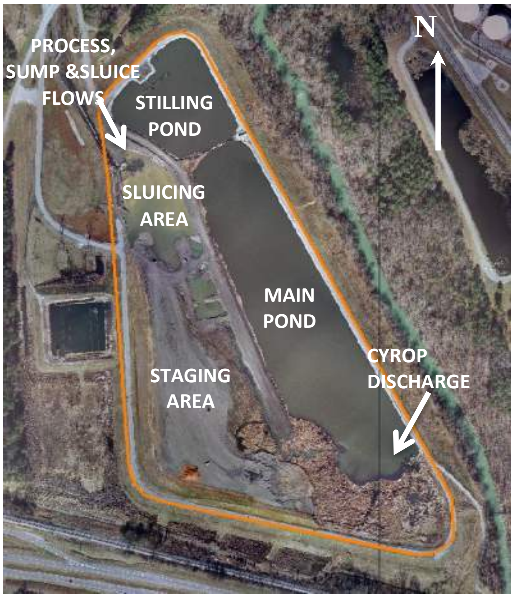


Figure 1. Ash Pond 4 Plan View (Not to Scale)

The pond was originally constructed in 1972 with dikes that were approximately 20 feet high on the north, east and south sides, and somewhat shorter at the west side of the pond. The crest elevation was nominally El. 440. In 1984, the dikes were raised approximately 20 feet using the upstream method, with fill material being placed on the inboard side on top of ash deposits, resulting in an average crest elevation of El. 460.

Currently waters are discharged from a spillway structure on the north side of Ash Pond 4 to NPDES monitoring point DSN 001 (Permit No. AL 0003867).

2. GENERAL CONSIDERATIONS

2.1 CHARACTERISTICS OF CONTENTS

Ash Pond 4 was originally used as a wastewater treatment area for both fly ash and bottom ash from Plant operations. Since 1994, the area has only received sluiced bottom ash due to the installation of a bag house and the management of the fly ash in a dry manner at Ash Stack 5. However, since the placement of production ash in Ash Stack 5 was discontinued on October 17, 2015, dry fly ash has been placed in the Staging Area within the footprint of Ash Pond 4 to use for cap contouring during closure

2.2 SITE IMPROVEMENTS

Modifications to the existing dike height and spillway structure at Ash Pond 4 were performed in 2010 and 2011. Portions of the dike crest were lowered two feet from elevation 460 to 458. The four original spillway riser structures were removed and the discharge pipes grouted full. A new concrete spillway structure was installed. The new spillway allows for adjustments in water level with the use of plastic stop logs, which can be lifted and moved with a davit crane mounted to the concrete structure. Additionally, siphons were installed to draw down the water level to facilitate construction of the new spillway. The siphons remain in place for emergency and operational usage. Upon completion of these projects, the operational water level in the Main Pond and Stilling Pond was lowered to elevation 453.

In 2013, a seepage remediation system consisting of a seepage collection drain, lateral piping, conveyance line, and stone buttress to mitigate seepage along the eastern and southern sides of the Ash Pond 4 dikes was installed. Seepage is carried via lateral pipes to the seepage conveyance line, which conveys seepage flows to the new headwall structure to the north of Pond 4 (seepage from the east dike), and to the treatment wetlands to the south of Pond 4 (seepage from the south dike). The stone buttress provided a working surface for construction of the conveyance line, and remains in place.

In 2015, construction of Seismic Improvements began along the eastern dike of Ash Pond 4. The improvements consist of installation of a Deep Mix Method (DMM) wall and associated working platform/buttress. As part of the Seismic Improvements, the water level in the Main Pond was lowered to elevation 452, and the Stilling Pond was lowered to elevation 451. The construction of the DMM wall is ongoing at the time of this document.

Prior to and throughout the aforementioned improvements, instrumentation has been added to Ash Pond 4, primarily in the perimeter dikes and the Staging Area. The instrumentation is used to regularly monitor water levels, slopes, and settlement of the Staging Area.

2.3 CLOSURE DESIGN

COF will cease burning coal in April of 2016. As a result, Plant process flows to Ash Pond 4 will be discontinued, aside from the sump and grey water flows. Prior to the start of the closure of Ash Pond 4, the remaining sump and grey water flows from the Plant will be rerouted to the CYROP as part of a separate project. Final Closure of the Ash Pond 4 requires following general tasks:

- Installing erosion and sediment controls.
- Installing turbidity curtains as needed.

- Begin decanting the Ash Pond 4 using pumps and existing siphons. Discharged water will be monitored throughout decanting operations to maintain compliance with NPDES permitted limits.
- Regrading of materials from the existing Staging Area (within Ash Pond 4) as necessary to achieve positive drainage and fill in decanted portions of the pond.
- Remove existing structures (including spillway and associated appurtenances) to 2 feet below proposed top of ash.
- Final grading of in-place CCRs and portions of clay dike to achieve design Top of Ash/Top of Subgrade elevations.
- Constructing a cover system by installing the final cover system components, which includes lowering the existing dike to design grades. The existing dike materials may be reused for the cap system cover soil. The cover system is detailed in Section 3.1.
- Install permanent stormwater control structures.
- Vegetating the surface of the cover via seeding and/or stabilization and fertilizing the surface to promote germination and growth.

3. Closure Components

3.1 Cover System

The cap system for the facility consists of a layer of cover soil and flexible membrane liner (FML). The components include the following, listed from top to bottom:

- Vegetative cover;
- A minimum 18-inch-thick layer of cover soil, of which the upper 6 inches will be capable of supporting native plant growth;
- A drainage layer consisting of a geocomposite material;
- A 40-mil Linear Low Density Polyethylene (LLDPE) Flexible Membrane Liner (FML) barrier; and,

Details of the closure cap system are illustrated on Sheet 10WXXX-11. Sheet 10WXXX-11 also provides details regarding geosynthetic cap terminations in anchor trench locations along the perimeter of the Ash Pond 4 closure.

The geosynthetic components will be installed in accordance with the manufacturer's instructions. To ensure that installation of the final cover is properly installed, independent third party construction quality assurance (CQA) will be provided in accordance with the plan approved for the site. Pre-construction and construction testing will be performed on integral materials for final cover construction. Upon completion of the final cover system, a registered professional engineer will certify that the construction has been performed in accordance with the applicable plans and specifications, and as-built drawings will be prepared and submitted to ADEM.

3.2 Grading and Surface Water Management

The final cover grades will be designed to maintain positive drainage while minimizing erosion. The side slopes will be constructed at a maximum 3H:1V (33.33%) final grade. Tack-on berms/terraces for Ash Pond 4 will be located on the side slopes at intervals of approximately every 20-feet of rise, and will be graded with minimum slopes of 1%. The majority of the top area of Ash Pond 4 will be closed with slopes ranging between 2% and 4%. Ditches will be graded with minimum slopes of 0.5%. Final Top of Ash grades, and Final Cover Grades are shown on Sheet 10WXXX-03 and 10WXXX-04, respectively.

Storm water structures are shown on Sheets 10WXXX-04 and 10WXXX-10. Storm water details are provided on Sheet 10WXXX-12 through 10WXXX-14. The system is designed to convey water via pipes, terraces and letdowns. Storm water will be conveyed to the north and to the south of the closed Ash Pond 4 to existing NPDES discharge points DSN 001 and DSN 013. Permanent and temporary surface water control structures, storm water diversion terraces, rock channel letdowns, culverts and proposed catch basins were designed to accommodate the peak flow from the 25-year/24-hour storm event.

3.3 Erosion and Sediment Control

Temporary and permanent seeding of the exposed final cover system will occur as soon as practicable. Temporary best management practices over disturbed areas of the site will be used prior to final grading or in a season not suitable for planting the desired species of grasses, as prescribed in the most recent edition of the *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Area*s (Alabama E&S Handbook).

Permanent seeding will occur prior to the completion of closure activities. Permanent vegetation will be established and maintained to provide long-term erosion control and prevent sediment from leaving the site. Preparation of a vegetative cover shall include seeding, mulching, and any necessary fertilization at a minimum, and may include additional activities such as sodding of steeper slopes and drainage ways if necessary. Application rates for seeding and fertilizing of vegetation will be adjusted appropriately. Temporary erosion control blankets may be used if necessary to provide seedbed protection and prevent wash-out of seed and fertilizer during vegetation establishment. No deep rooted vegetation capable of growth below the 6-inch erosion layer shall be used. Commonly used plants for permanent covering, as provided by the Alabama E&S Handbook, are summarized in the following table. Note that alternative seed mixtures may be utilized during closure should they be deemed more appropriate, so long as they are compatible with the soil and climate at the site. Commonly used plants for cover in the area of the site have been summarized in Table 1 below.

Table 1. Suitable Cover Plants

Species	**Planting Dates and Application Rates** (lbs/acre)			
	Jan 1 to Feb 29	Mar 1 to Aug 15	Aug 16 to Nov 15	Nov 16 to Dec 31
Annual Ryegrass	25			25
Hulled Bermudagrass		15		
Unhulled Bermudagrass	45	30	45	45
Tall Fescue	45	45	45	45
Total lbs/acre	115	90	90	115

4. CLOSURE SCHEDULE

Construction of the closure of Ash Pond 4 began during Fall 2016. Completion of closure is anticipated to be during Fall 2017.

Upon completion of all closure activities, TVA will provide certification by a registered professional engineer, certifying closure was completed in accordance with the closure plan. Certifications for the closure activities will document all construction activities related to the closure. A Closure Certification Report including as-built drawings will be provided to ADEM during within 90 days following completion of closure.

5. Post Closure Care

Post-Closure care activities will be implemented for a minimum period of 30 years. The Post-Closure activities will include groundwater monitoring, inspections and maintenance activities of the final closure cap system.

Regular inspections of the site will be performed for the duration of the post-closure care period. Inspection frequency is described in Section 5.3. Maintenance or other corrective measures needed to prevent the deterioration of the final cover system will be identified during the inspections. Features to be inspected include the visible final cover components and stormwater control features. Each inspection will be documented and will include, at a minimum, the following information:

- Date and time of the inspection;
- Name of inspector;
- Notation of observations made;
- Nature of any remedial actions to be taken, and;
- Recommendation for corrective measures.

The final cover system will be inspected for erosion and sediment control. Areas showing evidence of rills, surface cracks, and settlement will be repaired with suitable soil cover, compacted, graded, and have appropriate vegetative cover established. Grading will be performed so that surface water does not pond over the unit and may be kept at the final approved contours, unless approved by ADEM. Appropriate vegetative cover shall be re-established following the repairs.

The vegetative cover will be inspected on a regular basis to maintain a healthy stand of vegetation. Areas containing distressed vegetation will be reseeded. The vegetative cover over the site will be maintained by mowing or selective herbicide use on a regular schedule. Deep rooted vegetation will be prohibited as vegetative cover. If an area has less than approximately 70 percent coverage by grass based on visual inspections, the area will be reworked and reseeded. Fertilizer or other soil amendments may be applied, as necessary, to promote the re-establishment of a self-sustaining vegetative cover.

All monitoring devices including groundwater wells, erosion and surface water control structures, and leachate facilities will be inspected and maintained throughout the active life and post-closure period. Groundwater monitoring will be performed in accordance with the Groundwater Monitoring Plan provided in Appendix B.

5.1 Material Restrictions and Access

No ash materials will be placed at the site following closure. Any ash or waste shall be transported to a landfill approved by TVA.

Ash Pond 4 is located on contiguous TVA property. Access is controlled by an existing gate, natural features, and other controls. Use of Ash Pond 4 is limited and exclusive to COF therefore, all access is controlled by TVA. No new access control structures will be constructed.

5.2 FUTURE USE

The planned use for this portion of the TVA property during the post-closure period is as open space. There are no anticipated activities associated with this end use that would disturb the integrity of the final cover, liners, or any other component of the containment system, or the function of the monitoring system.

Any other future end use of the property will be approved by ADEM.

5.3 POST-CLOSURE INSPECTION FREQUENCIES

Table 2 summarizes TVA's proposed frequencies of post-closure inspection. Frequencies of inspection will be adjusted, as necessary, based on the performance of the closure system and storm water control structures.

Table 2. Inspection Frequencies

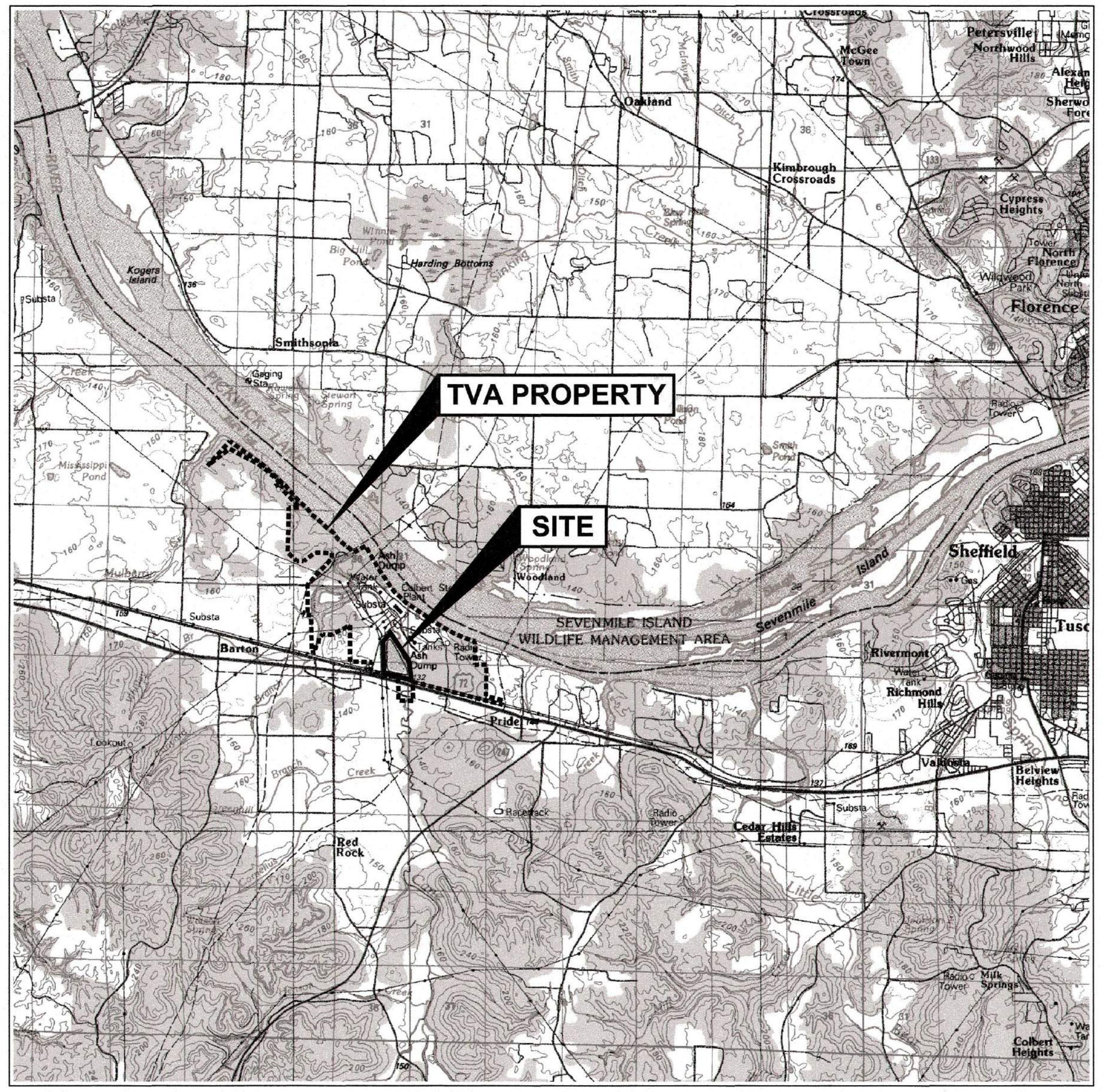
Visual Inspection Frequencies	
First Year (Starting after vegetative establishment)	Monthly and after major storm events
Years 2 – 5	Quarterly
Years 5 – 30	Annually

5.4 POST-CLOSURE CERTIFICATION

A certification signed by an independent registered professional engineer verifying that post-closure care has been completed in accordance with the post-closure plan shall be provided to ADEM and a copy shall be placed in the operating record.

APPENDIX A

TENNESSEE VALLEY AUTHORITY
COLBERT FOSSIL PLANT
ASH POND 4 CLOSURE
TVA PROJECT NO. 204316



N
W E

SITE VICINITY MAP

0 6000 12000
SCALE: 1"=6000'

COLBERT COUNTY, ALABAMA
SEPTEMBER 2016

DWG. NO.	DWG. DESCRIPTION
10WXXX–01	TITLE SHEET
10WXXX–02	EXISTING CONDITIONS
10WXXX–03	TOP OF ASH/TOP OF SUBGRADE
10WXXX–04	PROPOSED FINAL COVER GRADES
10WXXX–05	CUT / FILL PLAN
10WXXX–06	SECTIONS A–A & B–B
10WXXX–07	SECTIONS C–C & D–D
10WXXX–08	SHEET PILE CUTOFF WALL DEMOLITION PLAN
10WXXX–09	SPILLWAY DEMOLITION PLAN
10WXXX–10	DISCHARGE PIPES PLAN & PROFILE
10WXXX–11	MISCELLANEOUS DETAILS
10WXXX–12	STORM WATER DETAILS I
10WXXX–13	STORM WATER DETAILS II
10WXXX–14	STORM WATER DETAILS III

2 WORKING DAYS
BEFORE YOU DIG
205–353–2636
ALABAMA UTILITIES PROTECTION SERVICE

PREPARED FOR:

TENNESSEE VALLEY AUTHORITY
1101 MARKET STREET
CHATTANOOGA, TN 37402-2801

PREPARED BY:

AECOM
564 WHITE POND DRIVE
AKRON, OH 44320
PHONE (330) 836-9111
ATTN: MICHAEL STEPIC, P.E.

ALABAMA LICENSED No. 30571 PROFESSIONAL ENGINEER MICHAEL J. STEPIC

ISSUED FOR ADEM

DRAFT

ISSUED FOR APPROVAL NOT FOR CONSTRUCTION

AECOM

R #												
R 0	09/02/2016	SEB	CMA	MJS	MJS	RSH	MST	JCK	204316		D	DISCIPLINE INTERFACE
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD	1 2 3 4

SCALE: NONE EXCEPT AS NOTED

TITLE SHEET

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	CMA	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX–01 | R 0

AECOM	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

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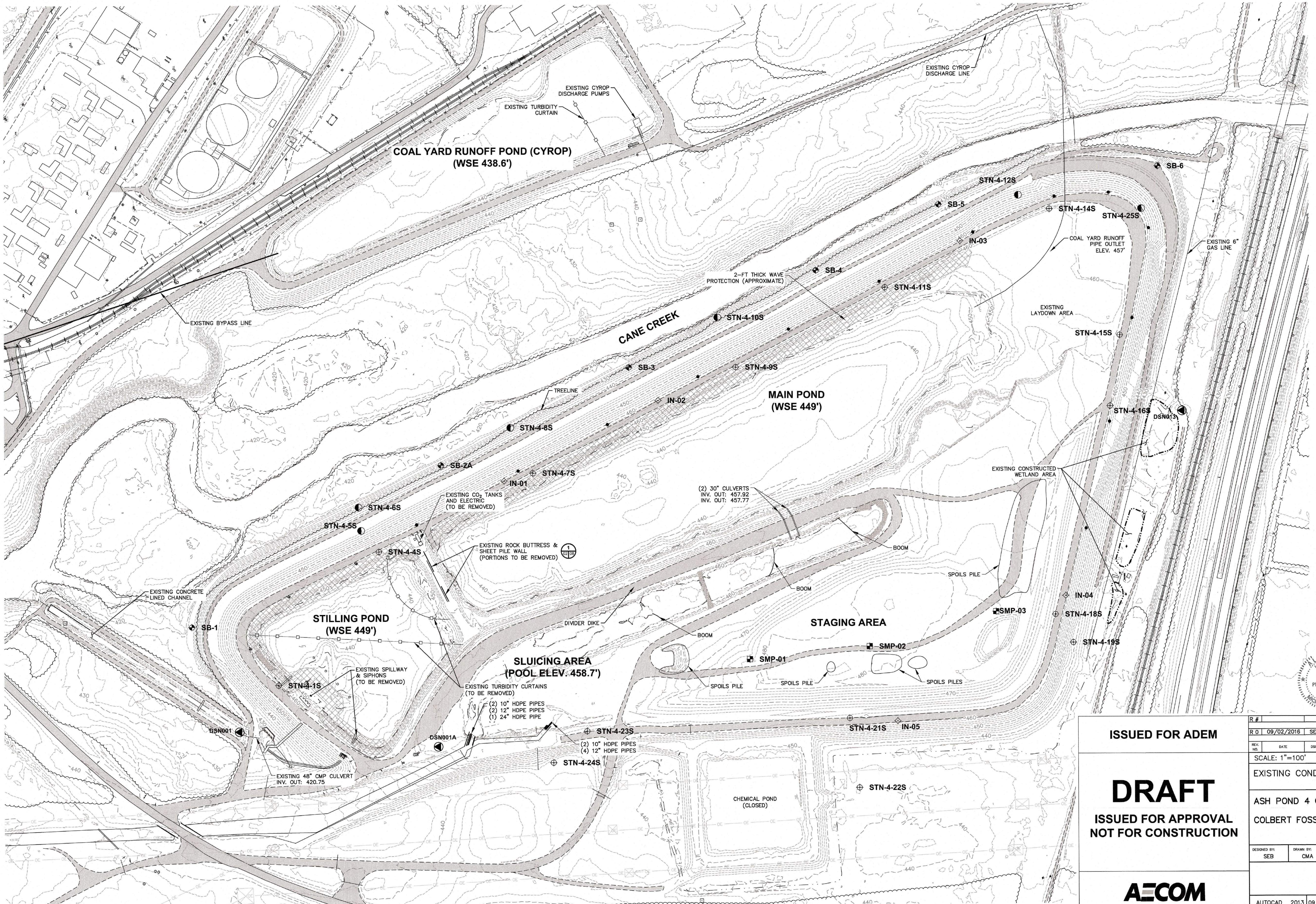

LEGEND

— — 450 — —	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR
	EXISTING VEGETATION
——x——	EXISTING FENCE
— OE —	EXISTING OVERHEAD ELECTRIC LINE
	EXISTING HAUL ROAD
	EXISTING CREEK
	EXISTING WETLANDS
	EXISTING TURBIDITY CURTAIN
	EXISTING DRAINAGE PIPE
	EXISTING DISCHARGE POINT
	EXISTING POWER POLES (TO BE REMOVED)
	EXISTING INCLINOMETER WITH VIBRATING WIRE PIEZOMETER
	EXISTING SETTLEMENT MONITORING POINT
	EXISTING VIBRATING WIRE PIEZOMETER
	EXISTING OPEN STANDPIPE
	SOIL BORING
	EXISTING OPEN STANDPIPE
	WAVE PROTECTION

NOTES

1. EXACT LOCATION OF EXISTING UTILITIES TO BE VERIFIED.
2. ALL HORIZONTAL COORDINATES GIVEN ON THESE DRAWINGS ARE IN COLBERT PLANT COORDINATES. ELEVATION DATA ARE IN NGVD 29. EXISTING GRADES ARE BASED ON SURVEY PROVIDED BY TVA FROM TUCK MAPPING SOLUTIONS, INC. DATED AUGUST 12, 2014.
3. BATHYMETRIC CONTOURS ARE FROM "POND 4 HYDROGRAPHIC SURVEY" BY THE R.L.S. GROUP DATED JUNE 2, 2015.
4. ADDITIONAL SURVEY IN THE BOTTOM ASH AND SLUICING AREA ARE FROM "ASH AREA #4 DREDGE CELL" BY THE R.L.S GROUP DATED JUNE 01, 2016.
5. BENCHMARK COORDINATES TO BE PROVIDED BY TVA.
6. EXISTING CONTOURS REFLECT THE COMPLETION OF SEISMIC REMEDIATION PROJECT CONSTRUCTION. CONSTRUCTION IS IN PROGRESS AT THE TIME OF THESE DRAWINGS.
7. ANY EXISTING PIEZOMETERS OR MONITORING WELLS IN THE LIMITS OF WORK SHALL BE PROTECTED. INSTRUMENTATION MODIFICATION OR REMOVAL SHALL BE COORDINATED WITH TVA INSTRUMENTATION.
8. EXISTING CYROP DISCHARGE LINE LOCATION TAKEN FROM COORDINATES PROVIDED IN HISTORICAL DRAWING 17W412-02 R2 AND FROM POINTS SURVEYED DURING THE RELOCATION OF THE COAL YARD RUNOFF DISCHARGE LINE AT ASH POND 4 IN DECEMBER 2015.
9. THE LOCATIONS OF THE EXISTING SETTLEMENT MONITORING PLATES WERE PROVIDED BY GEI CONSULTANTS, INC. IN JANUARY 2016.
10. EXISTING PIEZOMETER LOCATIONS ARE TAKEN FROM STANTEC'S "REPORT OF GEOTECHNICAL EXPLORATION AND SLOPE STABILITY EVALUATION, 2010" FOR ASH POND 4.
11. EXISTING SOIL BORINGS (SB) PERFORMED BY TRISTATE DRILLING, LLC DURING JANUARY 2016.

ALABAMA LICENSED No. 30571 PROFESSIONAL ENGINEER

ISSUED FOR ADEM

DRAFT

ISSUED FOR APPROVAL NOT FOR CONSTRUCTION

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	09/02/2016	SEB	CMA	MJS	MJS	RSH	MST	JCK	204316	0

SCALE: 1"=100' EXCEPT AS NOTED

EXISTING CONDITIONS

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	CMA	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AECOM

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX-02 | R 0

PLOT FACTOR:XX W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

AECOM | 0
TASK COMPLETED BY: | REV NO.

47 | C | 10WXXX-02

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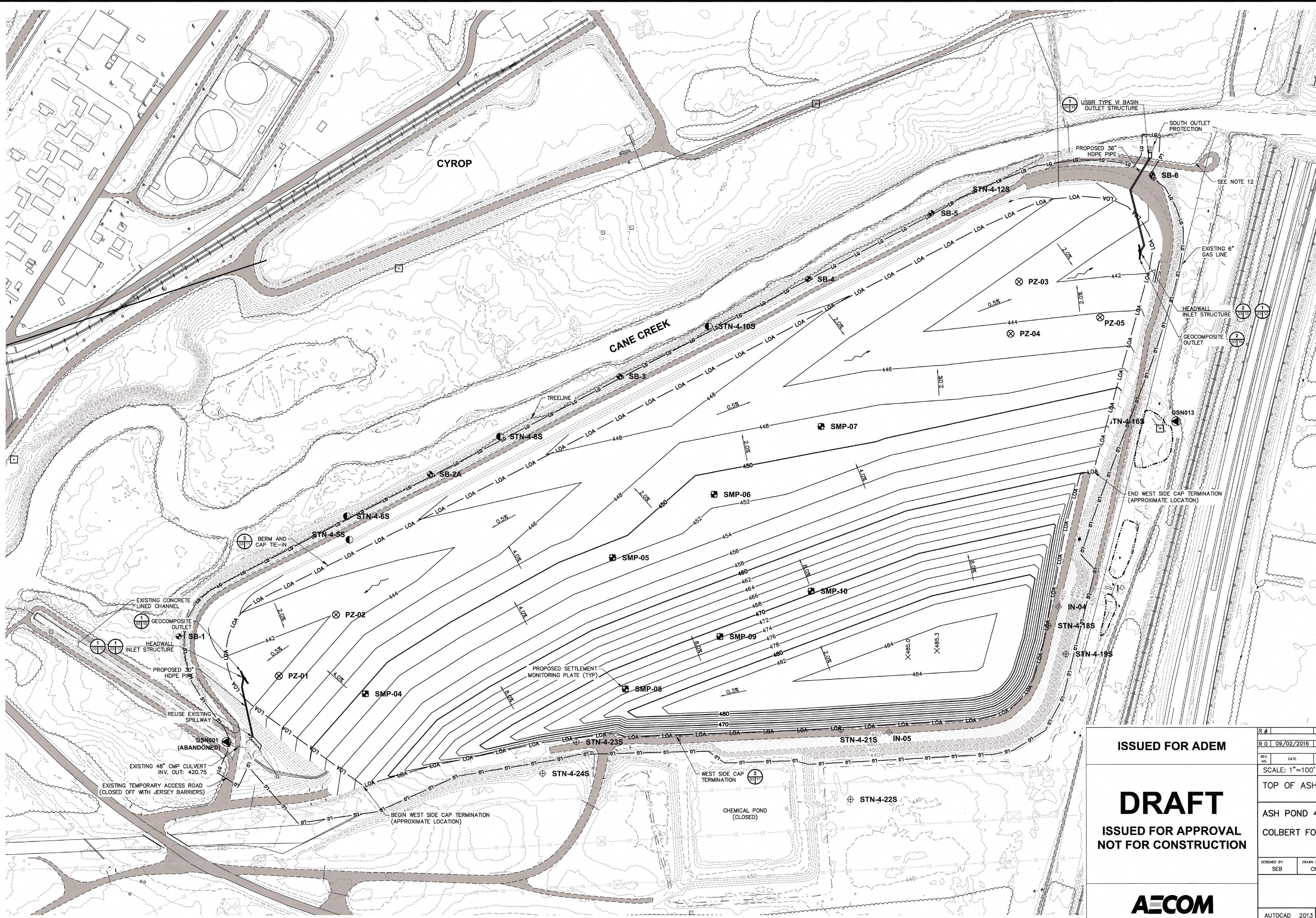

SCALE IN FEET 0 100 200

LEGEND

- EXISTING VEGETATION
- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- TOP OF ASH/SUBGRADE MAJOR CONTOURS
- TOP OF ASH/SUBGRADE MINOR CONTOURS
- LIMIT OF GRADING
- LIMIT OF ASH
- PROPOSED WELL
- DSN013 EXISTING DISCHARGE POINTS
- WEST DIKE SEISMIC STABILIZATION BERM
- EXISTING INCLINOMETER WITH VIBRATING WIRE PIEZOMETER
- EXISTING VIBRATING WIRE PIEZOMETER
- EXISTING OPEN STANDPIPE
- EXISTING OPEN STANDPIPE
- PROPOSED PIEZOMETER
- PROPOSED SETTLEMENT MONITORING POINT

NOTES

1. EXACT LOCATION OF EXISTING UTILITIES TO BE VERIFIED.
2. CONTRACTOR TO COORDINATE HAUL ROUTES AND ACCESS WITH NEEDS OF OTHER PROJECTS.
3. ALL HORIZONTAL COORDINATES GIVEN ON THESE DRAWINGS ARE IN COLBERT PLANT COORDINATES. ELEVATION DATA ARE IN NGVD 29. EXISTING GRADES ARE BASED ON SURVEY PROVIDED BY TVA FROM TUCK MAPPING SOLUTIONS, INC. DATED AUGUST 12, 2014.
4. BATHYMETRIC CONTOURS ARE FROM "POND 4 HYDROGRAPHIC SURVEY" BY THE R.L.S. GROUP DATED JUNE 2, 2015.
5. ADDITIONAL SURVEY IN THE BOTTOM ASH AND SLUICING AREA ARE FROM "ASH AREA #4 DREDGE CELL" BY THE R.L.S GROUP DATED JUNE 01, 2016.
6. ANY EXISTING PIEZOMETERS OR MONITORING WELLS IN THE LIMITS OF WORK SHALL BE PROTECTED. INSTRUMENTATION MODIFICATION OR REMOVAL SHALL BE COORDINATED WITH TVA INSTRUMENTATION.
7. THE LIMIT OF ASH IS BASED ON HISTORICAL INFORMATION PROVIDED BY TVA. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE ACTUAL LIMITS OF ASH.
8. CONSTRUCT THE NEW OUTLET STRUCTURES AT THE NORTH AND SOUTH ENDS OF THE POND.
9. AFTER ABANDONING EXISTING DSN001 (NORTH SIDE OF ASH POND 4), NO CONTACT WATER WILL BE PERMITTED TO DISCHARGE FROM OUTLET STRUCTURES. CONTACT WATER MUST BE ROUTED TO THE COAL YARD RUNOFF POND.
10. SETTLEMENT TO BE MONITORED DURING GRADING OPERATIONS. FILL SHOULD PLACED IN 1-FT LIFTS. AFTER 5-FT OF FILL PLACEMENT, SETTLEMENT SHOULD BE EVALUATED BY THE ENGINEER.
11. COORDINATE INSTALLATION OF SETTLEMENT MONITORING PLATES WITH TVA INSTRUMENTATION.
12. CONTRACTOR TO COORDINATE PROTECTION AND/OR REMOVAL OF ANY BAT HABITAT TREES WITH TVA ENVIRONMENTAL.

ALABAMA LICENSED No. 30571 PROFESSIONAL ENGINEER MICHAEL J. STEPIC

ISSUED FOR ADEM

DRAFT

ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION

AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R #											
R 0	09/02/2016	SEB	CMA	MJS	MJS	RSH	MST	JCK	204316		D

DISCIPLINE INTERFACE 1 2 3 4

SCALE: 1"=100' EXCEPT AS NOTED

TOP OF ASH/TOP OF SUBGRADE

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	CMA	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX–03 | R 0

AECOM	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
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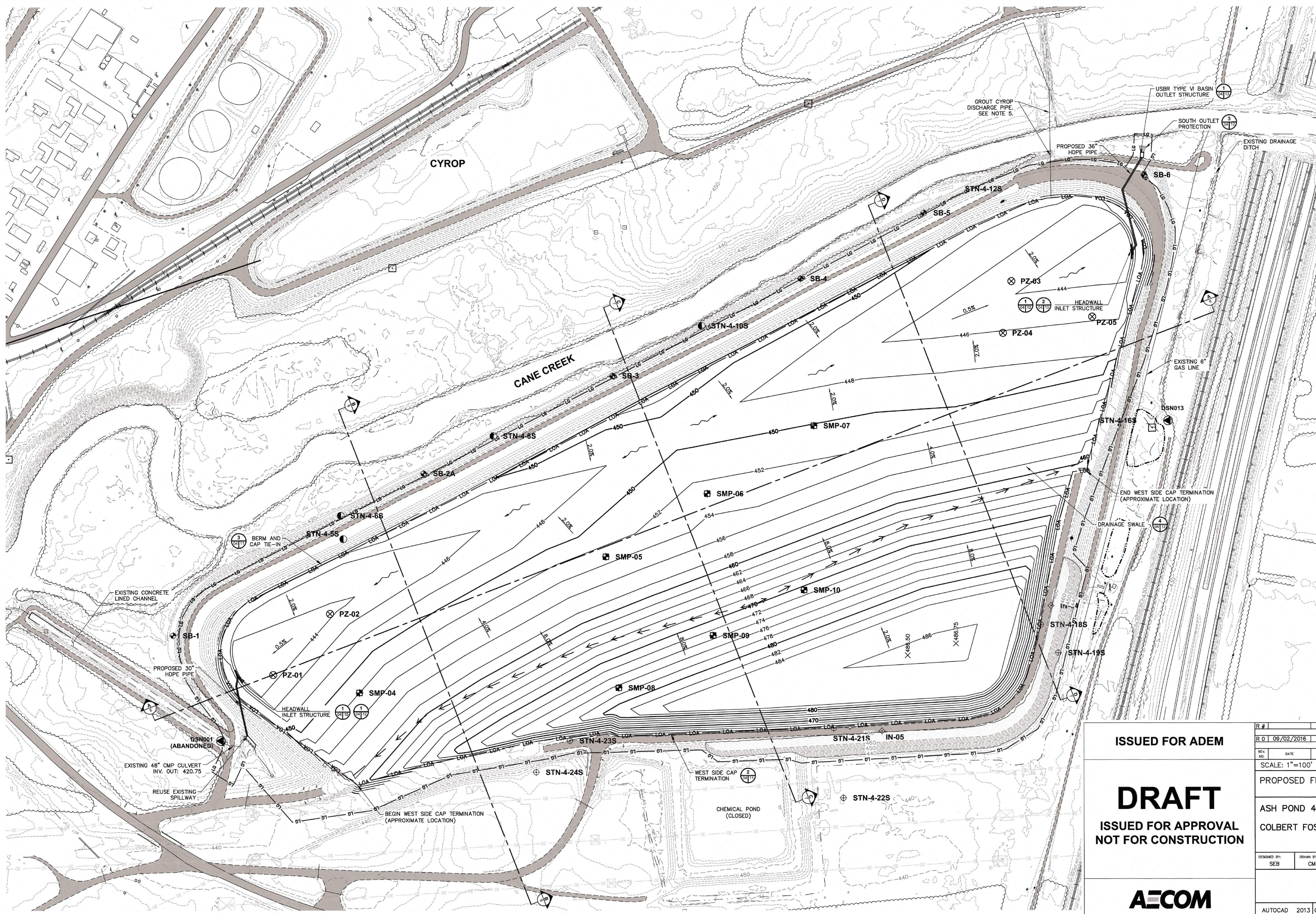


0 100 200
SCALE IN FEET

LEGEND

	EXISTING VEGETATION
—460—	EXISTING MAJOR CONTOURS
	EXISTING MINOR CONTOURS
—460—	FINAL MAJOR CONTOURS
	FINAL MINOR CONTOURS
— LG —	LIMIT OF GRADING
— LOA —	LIMIT OF ASH
	DRAINAGE SWALE
	PROPOSED WELL
DSN013	EXISTING DISCHARGE POINTS
	WEST DIKE SEISMIC STABILIZATION BERM
	EXISTING INCLINOMETER WITH VIBRATING WIRE PIEZOMETER
	EXISTING SETTLEMENT MONITORING POINT
	EXISTING VIBRATING WIRE PIEZOMETER
	EXISTING OPEN STANDPIPE
	EXISTING OPEN STANDPIPE
	PROPOSED PIEZOMETER
	PROPOSED SETTLEMENT MONITORING POINT

NOTES

1. EXACT LOCATION OF EXISTING UTILITIES TO BE VERIFIED.
2. CONTRACTOR TO COORDINATE HAUL ROUTES AND ACCESS WITH NEEDS OF OTHER PROJECTS.
3. ANY EXISTING PIEZOMETERS OR MONITORING WELLS IN THE LIMITS OF WORK SHALL BE PROTECTED. INSTRUMENTATION MODIFICATION OR REMOVAL SHALL BE COORDINATED WITH TVA INSTRUMENTATION.
4. AFTER ABANDONING EXISTING DSN001 (NORTH SIDE OF ASH POND 4), NO CONTACT WATER WILL BE PERMITTED TO DISCHARGE FROM OUTLET STRUCTURES. CONTACT WATER MUST BE ROUTED TO THE COAL YARD RUNOFF POND.
5. AFTER THE CAP SYSTEM HAS BEEN INSTALLED, AND ALL REMAINING CONTACT WATER HAS BEEN PUMPED TO THE CYROP, THE CONTRACTOR SHALL GROUT THE CYROP DISCHARGE PIPE FULL.

ISSUED FOR ADEM

DRAFT

ISSUED FOR APPROVAL NOT FOR CONSTRUCTION

AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R #											
R 0	09/02/2016	SEB	CMA	MJS	MJS	RSH	MST	JCK	204316		D

DISCIPLINE INTERFACE 1 2 3 4

SCALE: 1"=100' EXCEPT AS NOTED

PROPOSED FINAL COVER GRADES

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	CMA	MJS	MJS	RSH	MST	JCK

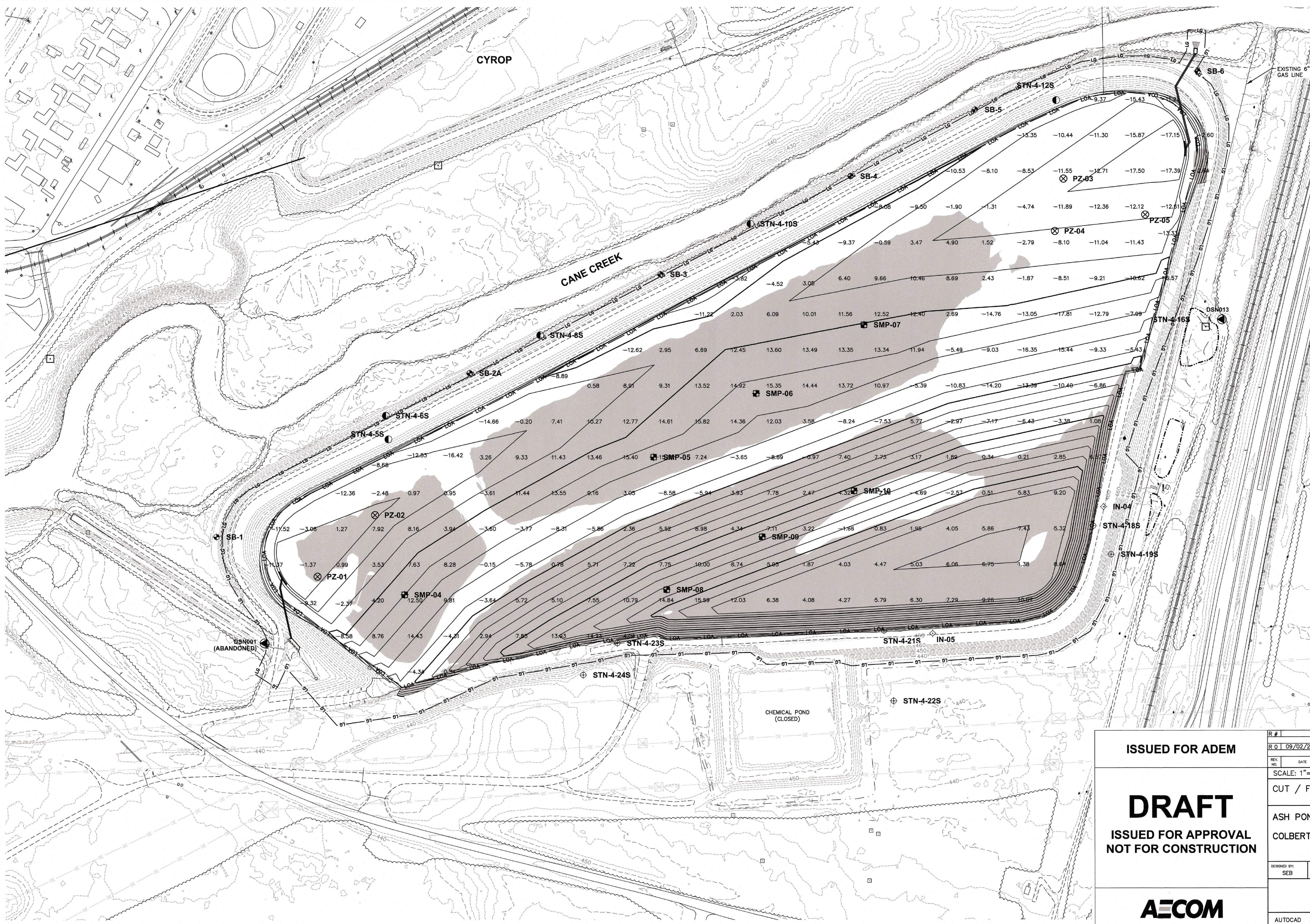
COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX−04 | R 0

AECOM	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



0 100 200
SCALE IN FEET

LEGEND

	EXISTING VEGETATION
—460—	EXISTING MAJOR CONTOURS
	EXISTING MINOR CONTOURS
—460—	FINAL MAJOR CONTOURS
	FINAL MINOR CONTOURS
	AREA REQUIRES FILL (SEE NOTE 1)
—LG—	LIMIT OF GRADING
—LOA—	LIMIT OF ASH
	PROPOSED WELL
DSN013	EXISTING DISCHARGE POINTS
	WEST DIKE SEISMIC STABILIZATION BERM
	EXISTING INCLINOMETER WITH VIBRATING WIRE PIEZOMETER
	EXISTING VIBRATING WIRE PIEZOMETER
	EXISTING OPEN STANDPIPE
	EXISTING OPEN STANDPIPE
	PROPOSED PIEZOMETER
	PROPOSED SETTLEMENT MONITORING POINT

NOTES

1. SPOT ELEVATIONS REPRESENT THE CUT OR FILL DEPTH BETWEEN THE PROPOSED FINAL COVER AND THE EXISTING GRADE. POSITIVE VALUES INDICATE FILL DEPTH, WHILE NEGATIVE VALUES INDICATE CUT DEPTH.

ISSUED FOR ADEM

DRAFT

ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION

AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT	AS CONST
R 0	09/02/2016	SEB	CMA	MJS	MJS	RSH	MST	JCK	204316	0

SCALE: 1"=100' EXCEPT AS NOTED

CUT / FILL PLAN

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	CMA	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX-05 | R 0

AECOM | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

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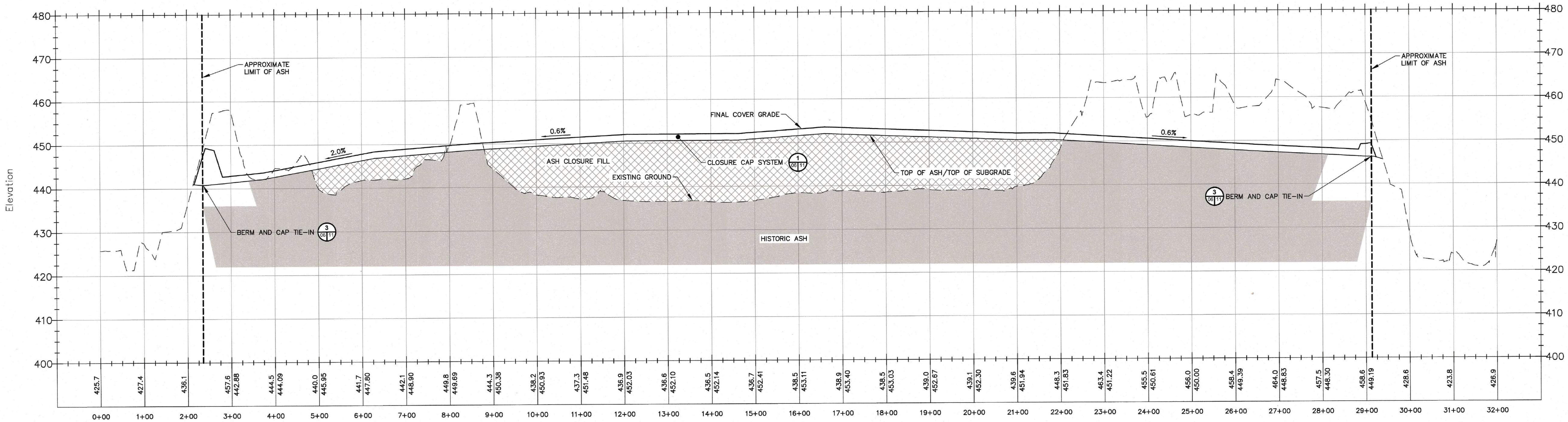
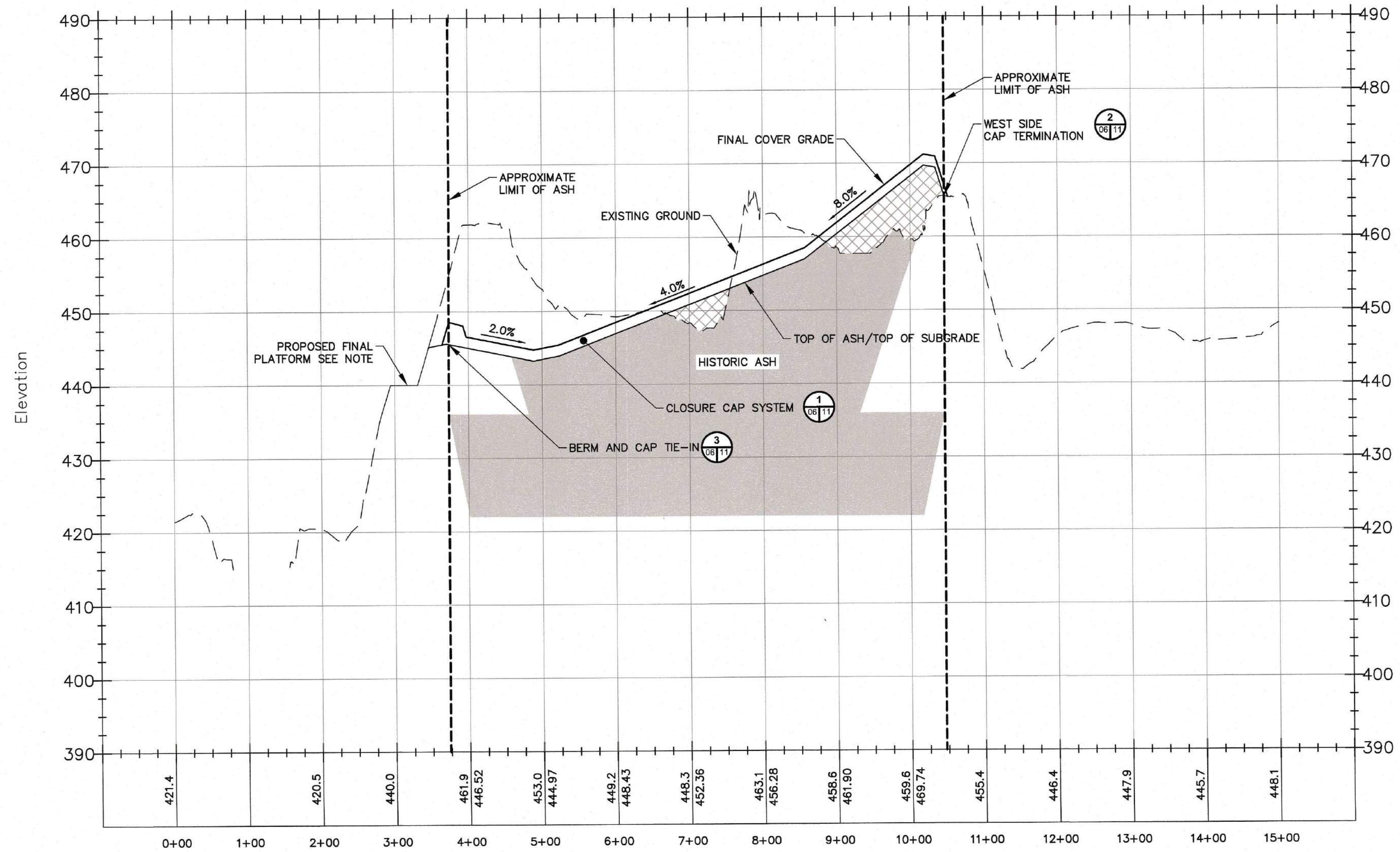


SECTION A - A
HORIZONTAL SCALE: 1"=100'
VERTICAL SCALE: 1"=10'



SECTION B - B
HORIZONTAL SCALE: 1"=100'
VERTICAL SCALE: 1"=10'

LEGEND

HISTORIC ASH

ASH CLOSURE FILL

NOTES:
1. LIMIT OF ASH IS BASED ON AVAILABLE HISTORIC INFORMATION.
2. PROPOSED FINAL PLATFORM CONSTRUCTION IN PROGRESS AS PART OF SEISMIC REMEDIATION PROJECT.

ISSUED FOR ADEM

DRAFT

ISSUED FOR APPROVAL NOT FOR CONSTRUCTION

AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID
R 0	09/02/2016	SEB	CMA	MJS	MJS	RSH	MST	JCK	204316

SCALE: AS SHOWN EXCEPT AS NOTED

SECTIONS A-A & B-B

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	CMA	MJS	MJS	RSH	MST	JCK

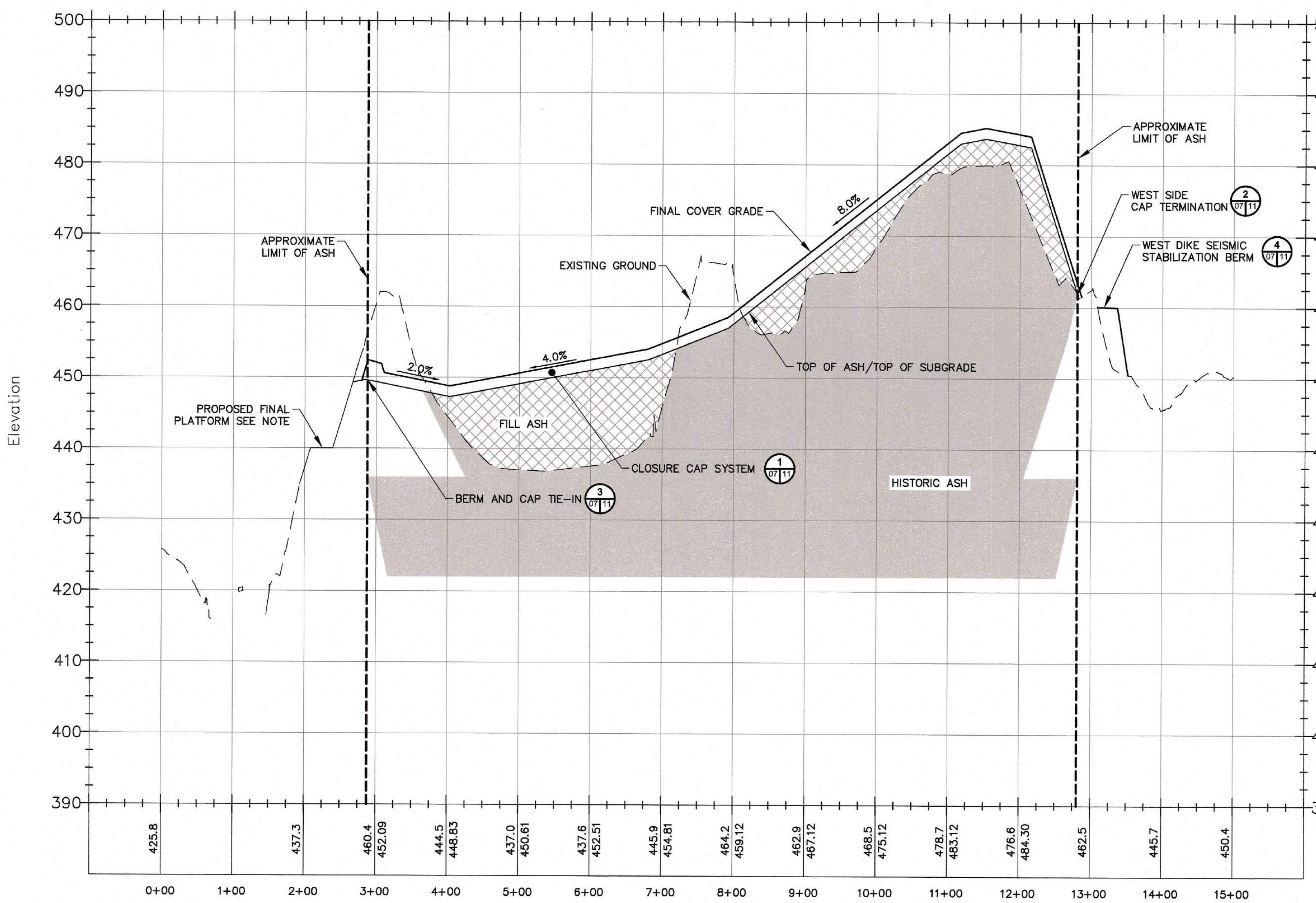
COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | 09/02/16 | 47 | C | 10WXXX-06 | R 0

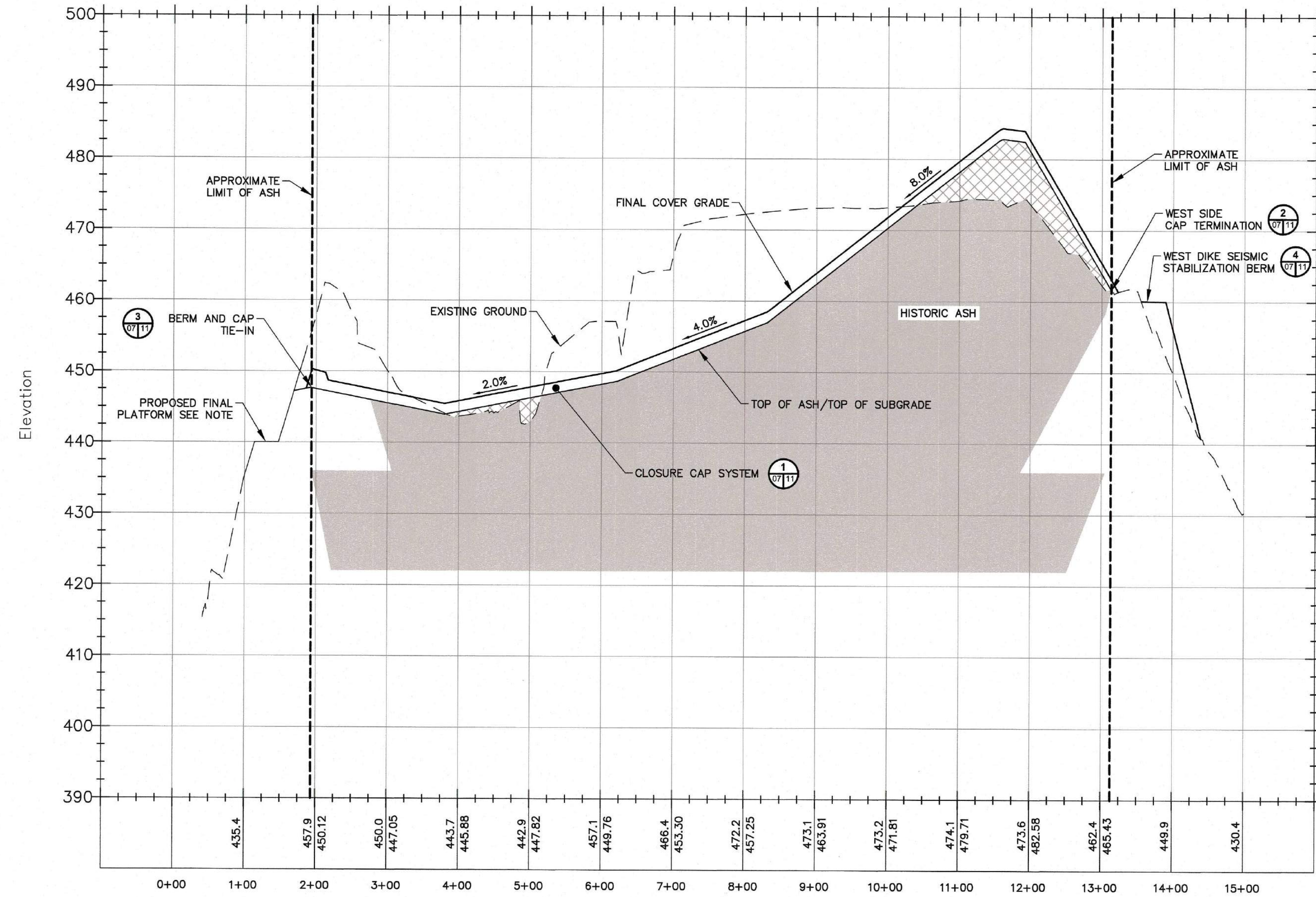
AECOM | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY



SECTION C - C
HORIZONTAL SCALE: 1"=100'
VERTICAL SCALE: 1"=10'



SECTION D - D
HORIZONTAL SCALE: 1"=100'
VERTICAL SCALE: 1"=10'

LEGEND

- HISTORIC ASH
- ASH CLOSURE FILL

NOTES:
1. LIMIT OF ASH IS BASED ON AVAILABLE HISTORIC INFORMATION.
2. PROPOSED FINAL PLATFORM CONSTRUCTION IN PROGRESS AS PART OF SEISMIC REMEDIATION PROJECT.

ISSUED FOR ADEM

DRAFT

ISSUED FOR APPROVAL NOT FOR CONSTRUCTION

AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	09/02/2016	SEB	CMA	MJS	MJS	RSH	MST	JCK	204316	

SCALE: AS SHOWN EXCEPT AS NOTED

SECTIONS C-C & D-D

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	CMA	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | 09/02/16 | 47 | C | 10WXXX-07 | R 0

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

AECOM | 0
TASK COMPLETED BY: | REV NO

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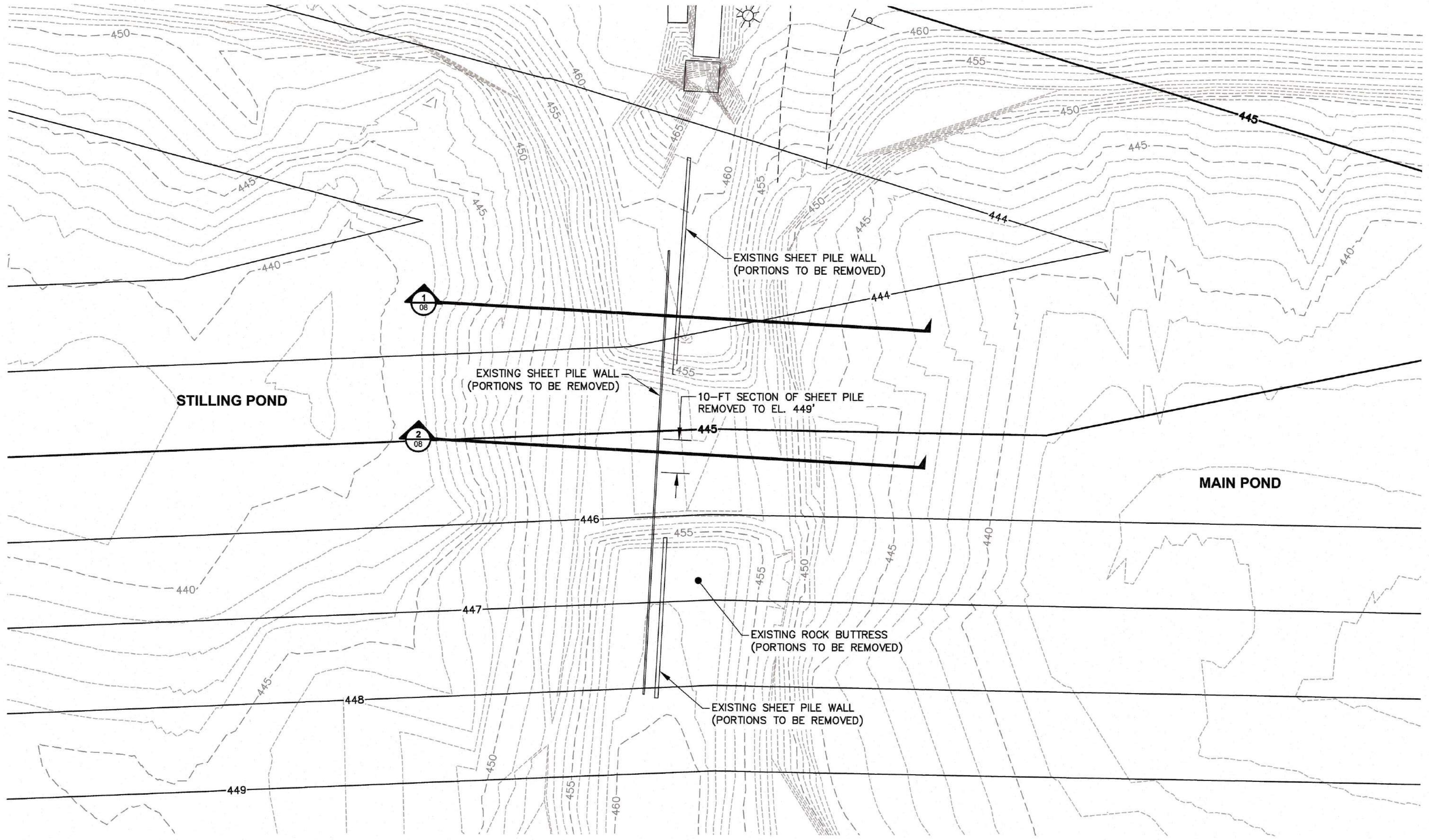


PLAN - SHEET PILE CUTOFF WALL (1, 02 08)
SCALE: 1"=20'

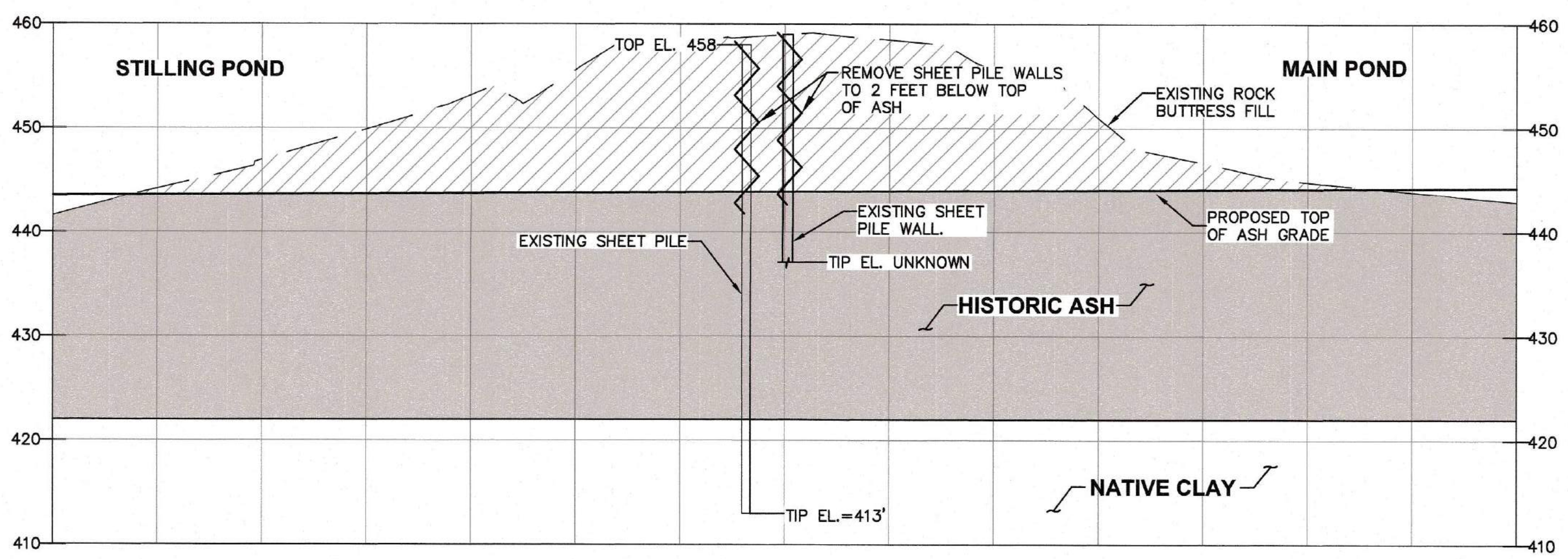
SCALE IN FEET: 0 20 40
SCALE IN FEET: 0 10 20

LEGEND

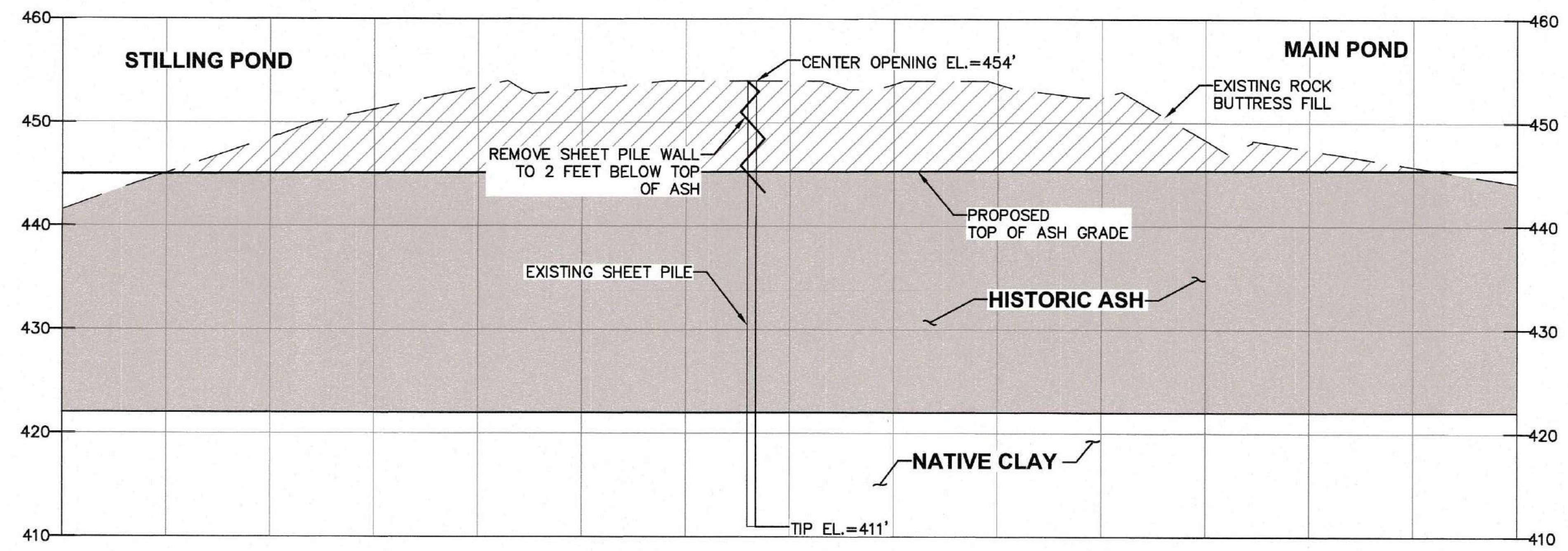
- 450 — EXISTING MAJOR CONTOUR
- 463 — EXISTING MINOR CONTOUR
- 630 — TOP OF ASH MAJOR CONTOUR
- 629 — TOP OF ASH MINOR CONTOUR
- AREA TO BE REMOVED
- HISTORIC ASH

NOTES

1. DECANTING TO BE COMPLETED PRIOR TO SHEET PILE WALL DEMOLITION.
2. CONTRACTOR SHALL NOT MAKE CUTS AT THE TOE OF THE ROCK BUTTRESS UNTIL THE BUTTRESS AND SHEET PILE WALLS HAVE BEEN REMOVED TO FINAL GRADES.
3. EXPOSE EXISTING SHEET PILE WALLS BY REMOVING DIKE TO PROPOSED GRADES.
4. CUT EXISTING SHEET PILES TO 2 FEET BELOW PROPOSED TOP OF ASH.
5. ROCK OBTAINED FROM THE EXISTING BUTTRESS MAY BE USED ON SITE WITH APPROVAL FROM THE ENGINEER.



SECTION 1-1'
HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"=10'



SECTION 2-2'
HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"=10'

ISSUED FOR ADEM

DRAFT

ISSUED FOR APPROVAL NOT FOR CONSTRUCTION

AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	09/02/2016	SEB	APM	MJS	MJS	RSH	MST	JCK	204316	D

SCALE: AS SHOWN EXCEPT AS NOTED

SHEET PILE CUTOFF WALL DEMOLITION PLAN

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	APM	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | 09/02/16 | 47 | C | 10WXXX-08 | R 0

AECOM | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

ALABAMA LICENSED No. 30576 PROFESSIONAL ENGINEER

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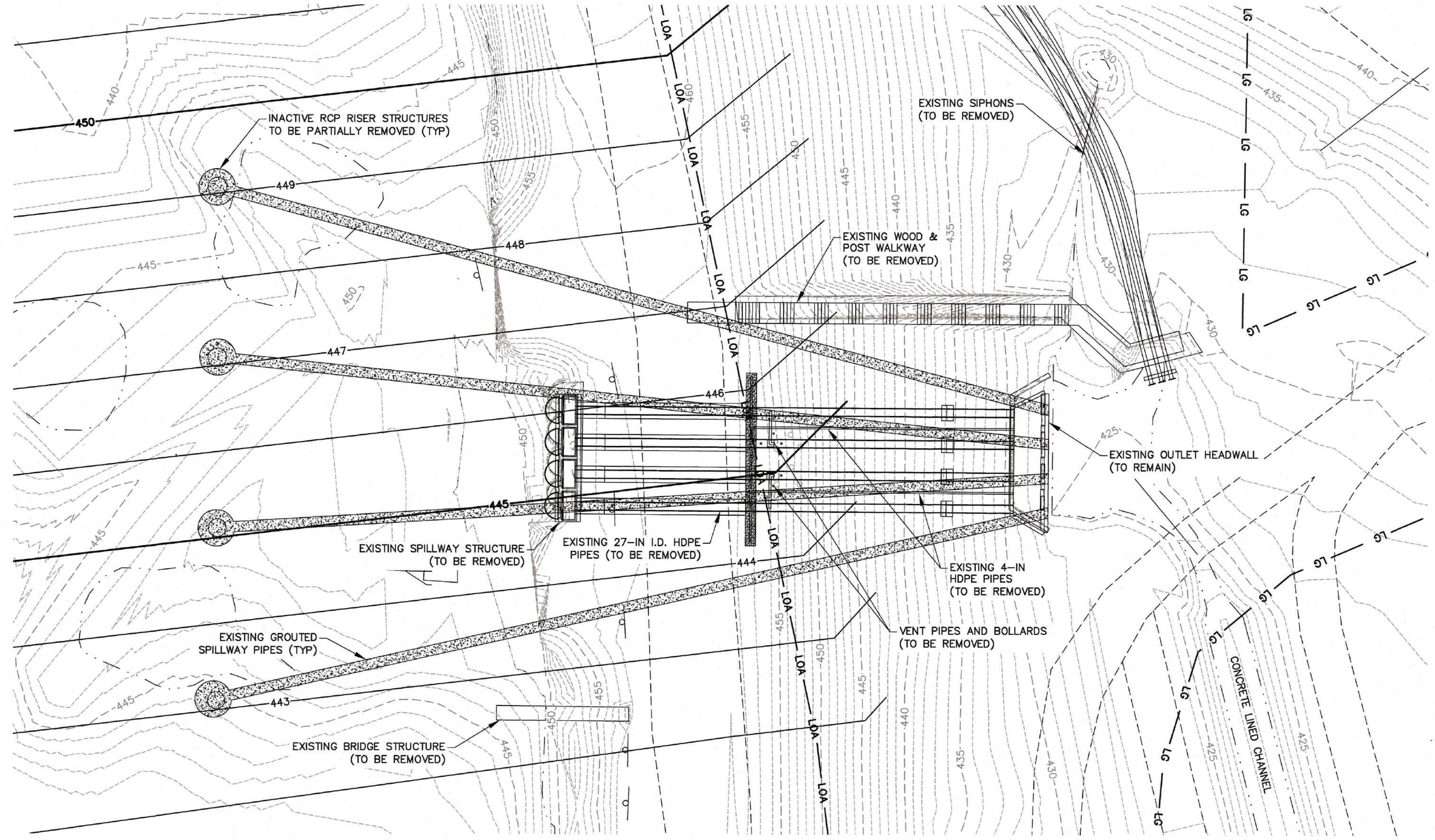
47 | C | 10WXXX-08

47 | C | 10WXXX-09



PLAN - SPILLWAY DEMOLITION
SCALE: 1"=20'

0 20 40
SCALE IN FEET

LEGEND

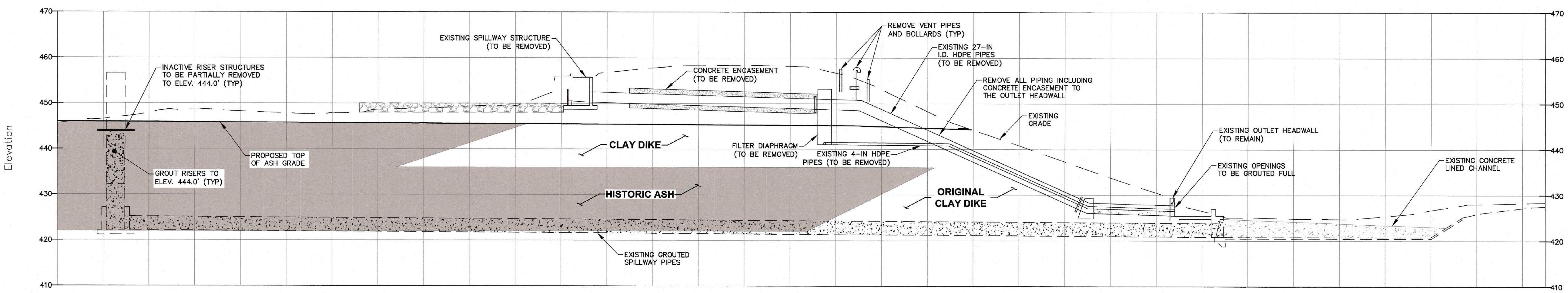
Symbol	Description
450 (dashed)	EXISTING MAJOR CONTOUR
463 (dotted)	EXISTING MINOR CONTOUR
430 (bold)	PROPOSED TOP OF ASH MAJOR CONTOUR
429	PROPOSED TOP OF ASH MINOR CONTOUR
LOA	LIMIT OF ASH
LG	LIMIT OF GRADING
(shaded)	HISTORIC ASH

NOTES

1. THE PORTION OF PIPING BETWEEN THE THRUST BLOCKS AND OUTLET HEADWALL IS ENCASED IN FLOWABLE FILL.

SUGGESTED SEQUENCE

1. DECANTING TO BE COMPLETED PRIOR TO SPILLWAY DEMOLITION.
2. INSTALL BERM (SANDBAGS) OR APPROVED EQUIVALENT FOR SEDIMENT CONTROL WITHIN DOWNSTREAM CONCRETE LINED CHANNEL.
3. REMOVE EXISTING SIPHONS.
4. REMOVE EXISTING RISERS TO 2 FT BELOW PROPOSED TOP OF ASH.
5. REMOVE SPILLWAY AND INLET STRUCTURES, AS SHOWN.
6. REMOVE ALL PIPING TO THE OUTLET HEADWALL. CUT AT THE HEADWALL AND GROUT THE OPENING IN THE HEADWALL.
7. REMOVE EXISTING SPILLWAY APPURTENANCES.
8. ITEMS SALVAGED FROM SPILLWAY DEMOLITION SHALL BE RELOCATED TO POINT DESIGNATED BY TVA.



PROFILE - SPILLWAY DEMOLITION
HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"=10'

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NOT FOR CONSTRUCTION

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REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	09/02/2016	SEB	APM	MJS	MJS	RSH	MST	JCK	204316	D

SCALE: AS SHOWN — EXCEPT AS NOTED

SPILLWAY DEMOLITION PLAN

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	APM	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX-09 | R 0

AECOM | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

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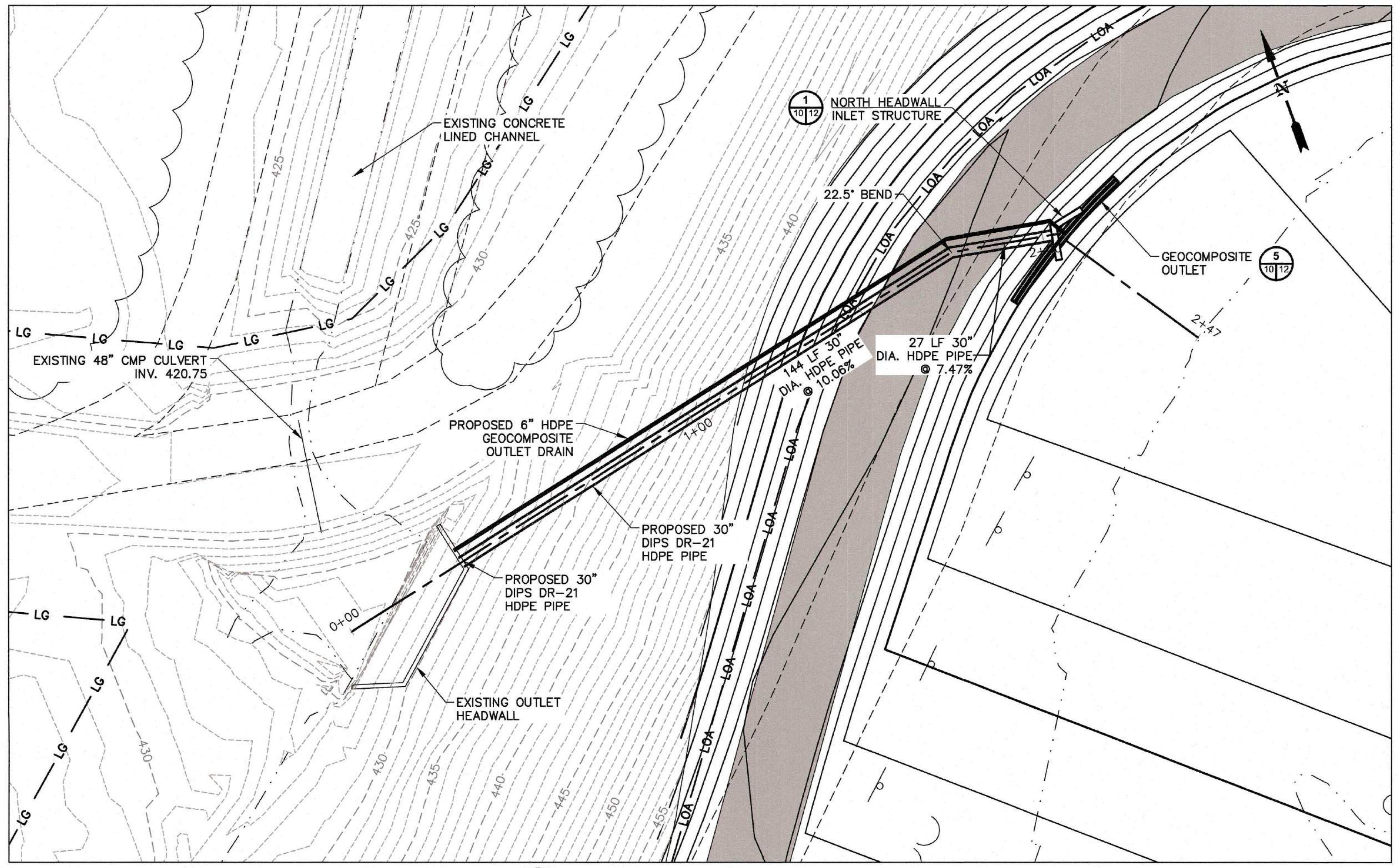
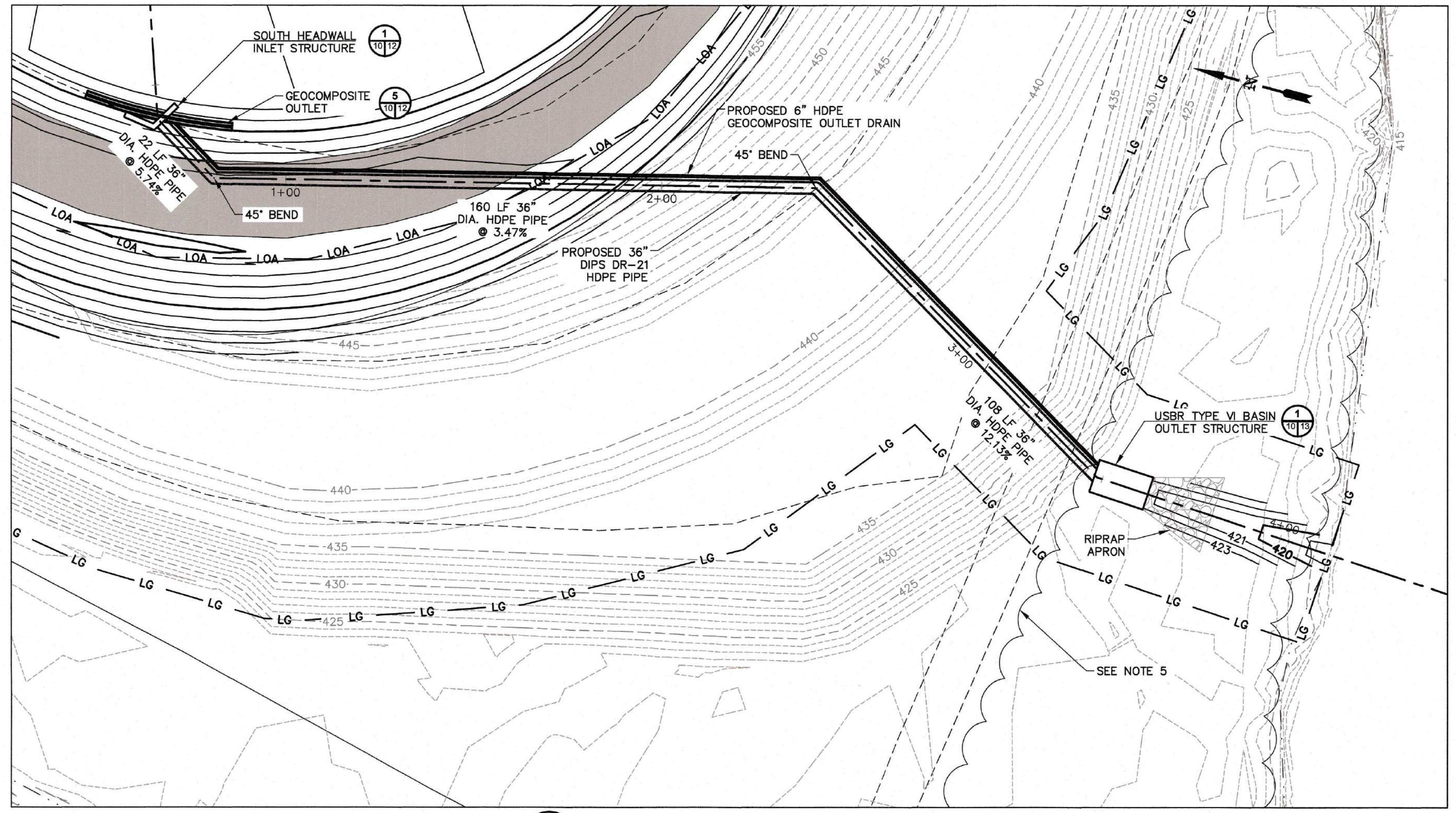


1 PLAN - NORTH OUTLET
SCALE: 1"=20'



2 PLAN - SOUTH OUTLET
SCALE: 1"=20'

0 20 40
SCALE IN FEET

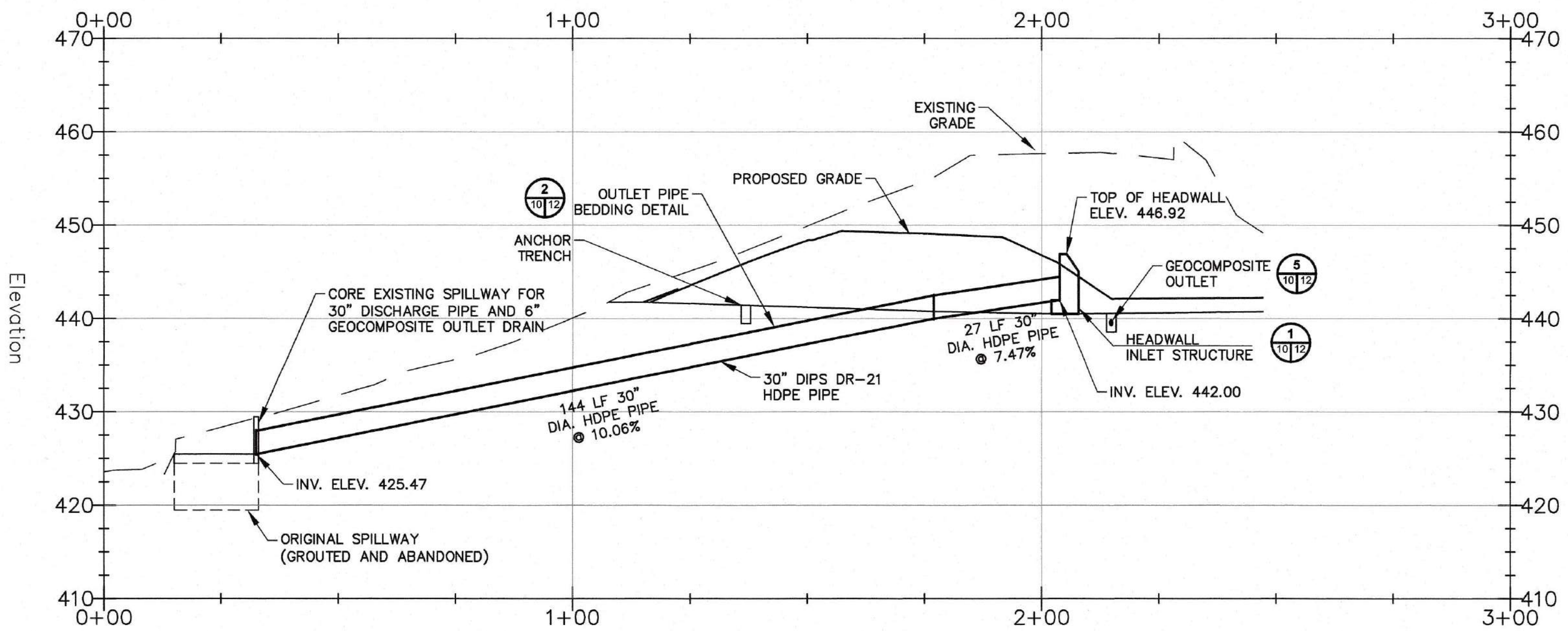
0 10 20
SCALE IN FEET

LEGEND

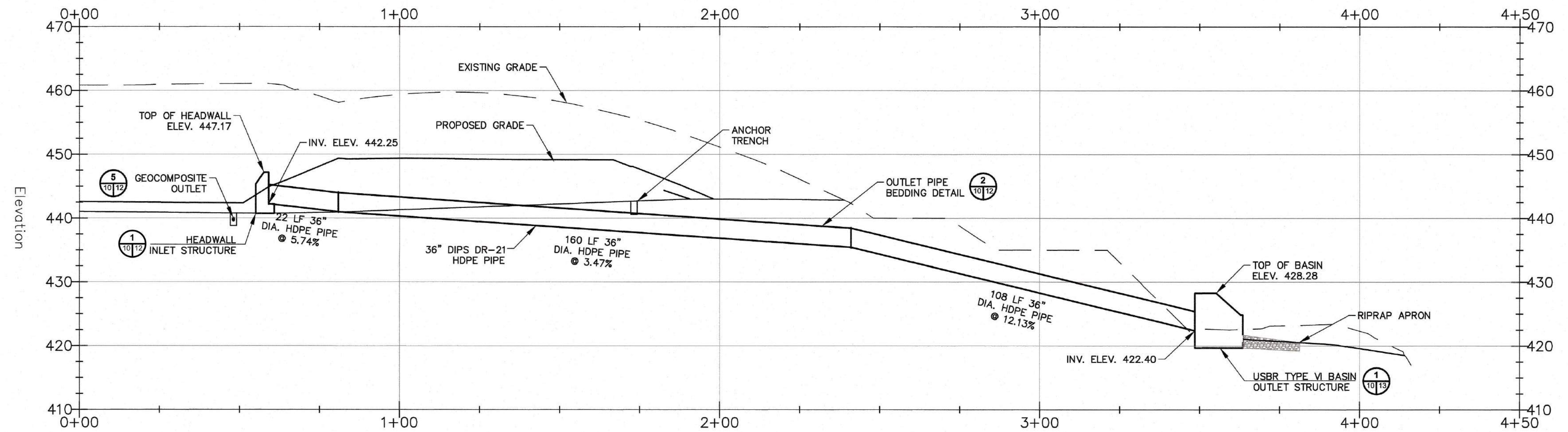
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING VEGETATION
- EXISTING HAUL ROAD
- EXISTING CREEK
- EXISTING LIGHT POLE
- PROPOSED STORM WATER LINE
- LOA — LIMIT OF ASH
- LG — LIMIT OF GRADING

NOTES

1. EXACT LOCATION OF EXISTING UTILITIES TO BE VERIFIED.
2. ALL HORIZONTAL COORDINATES GIVEN ON THESE DRAWINGS ARE IN COLBERT PLANT COORDINATES. ELEVATION DATA ARE IN NGVD 29. EXISTING GRADES ARE BASED ON SURVEY PROVIDED BY TVA FROM TUCK MAPPING SOLUTIONS, INC. DATED AUGUST 12, 2014.
3. BATHYMETRIC CONTOURS ARE FROM "POND 4 HYDROGRAPHIC SURVEY" BY THE R.L.S. GROUP DATED JUNE 2, 2015.
5. ADDITIONAL SURVEY IN THE BOTTOM ASH AND SLUICING AREA ARE FROM "ASH AREA #4 DREDGE CELL" BY THE R.L.S GROUP DATED JUNE 01, 2016.
6. BENCHMARK COORDINATES TO BE PROVIDED BY TVA.
7. CONTRACTOR TO COORDINATE PROTECTION AND/OR REMOVAL OF ANY BAT HABITAT TREES WITH TVA ENVIRONMENTAL.



PROFILE - NORTH OUTLET
HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=10'



PROFILE - SOUTH OUTLET
HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=10'

NOTES

1. GEOCOMPOSITE OUTLET DRAIN NOT SHOWN ON PROFILE FOR CLARITY.
2. ALL PIPE PENETRATIONS OF THE GEOCOMPOSITE LINER SHALL BE SEALED WITH A PIPE BOOT.

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NOT FOR CONSTRUCTION

AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	09/02/2016	SEB	APM	MJS	MJS	RSH	MST	JCK	204316	0

SCALE: AS SHOWN EXCEPT AS NOTED

DISCHARGE PIPES PLAN & PROFILE

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	APM	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX-10 | R 0

AECOM | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
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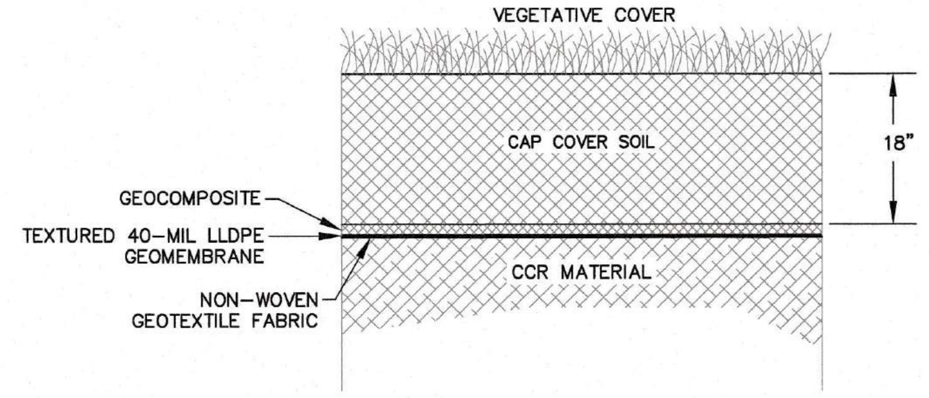
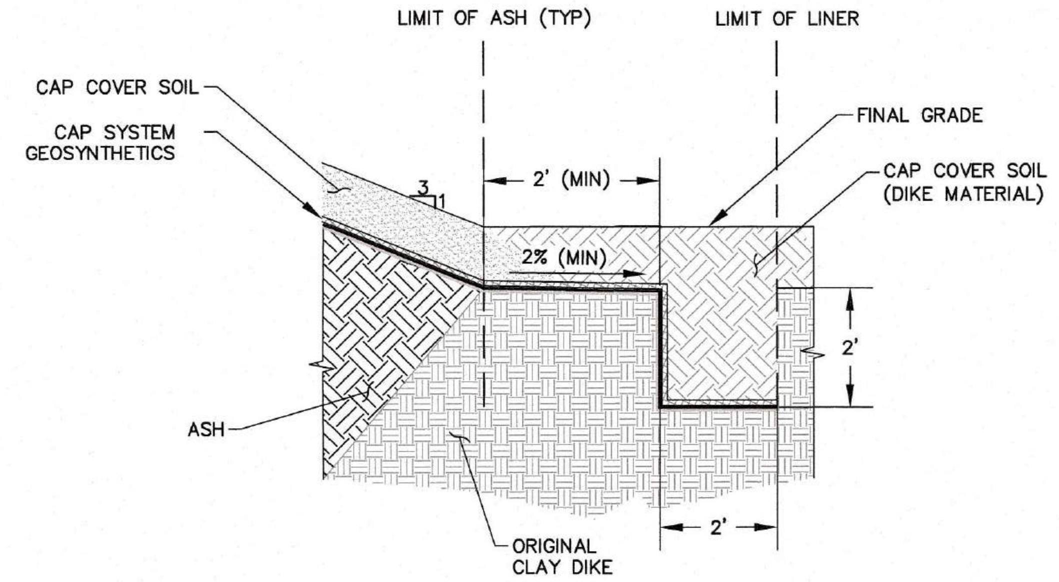


1 CLOSURE CAP SYSTEM 06 11 07 N.T.S.



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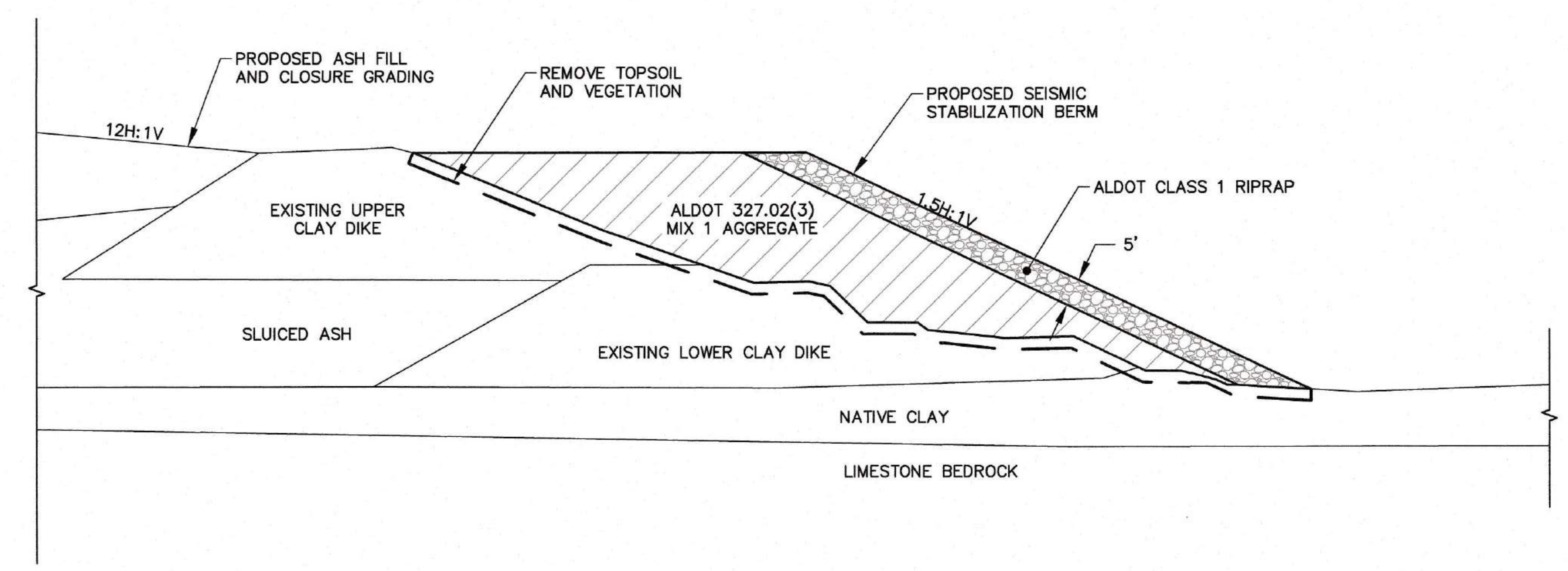
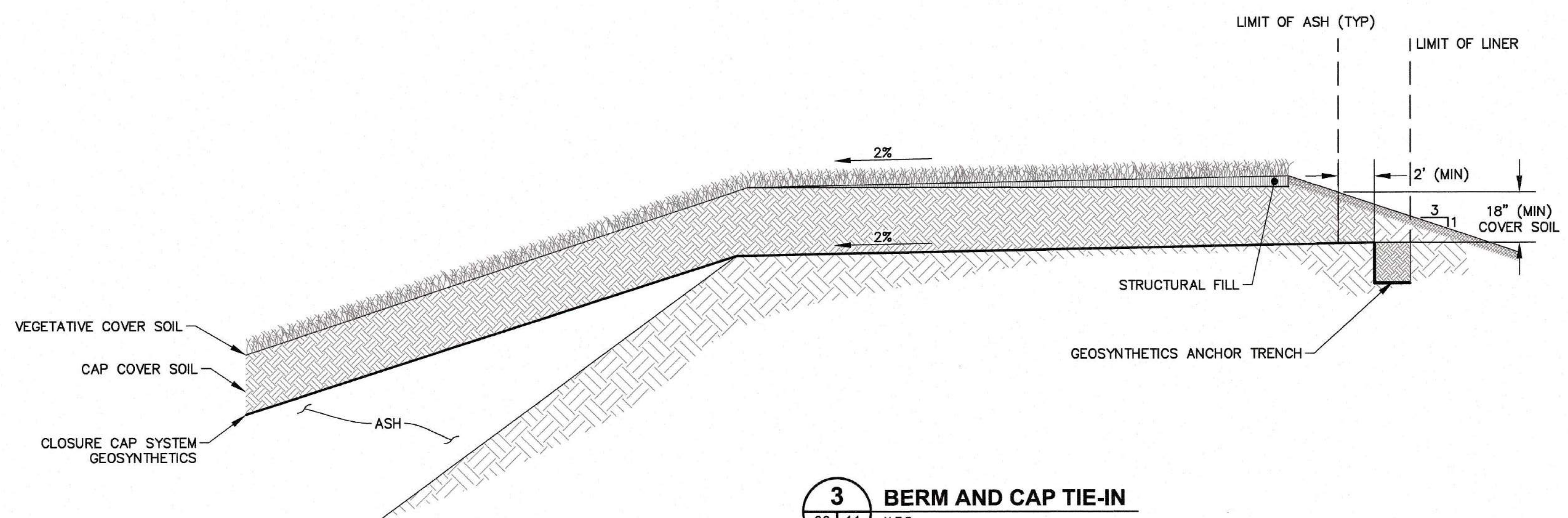


4 SEISMIC STABILIZATION BERM 07 11 N.T.S.



3 BERM AND CAP TIE-IN 03 11 04 06 07 N.T.S.

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REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 0	09/02/2016	SEB	APM	MJS	MJS	RSH	MST	JCK	204316		D

SCALE: AS SHOWN — EXCEPT AS NOTED

MISCELLANEOUS DETAILS

ASH POND 4 CLOSURE
COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	APM	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX-11 | R 0

PLOT FACTOR:XX W_TVA — C.A.D. DRAWING DO NOT ALTER MANUALLY

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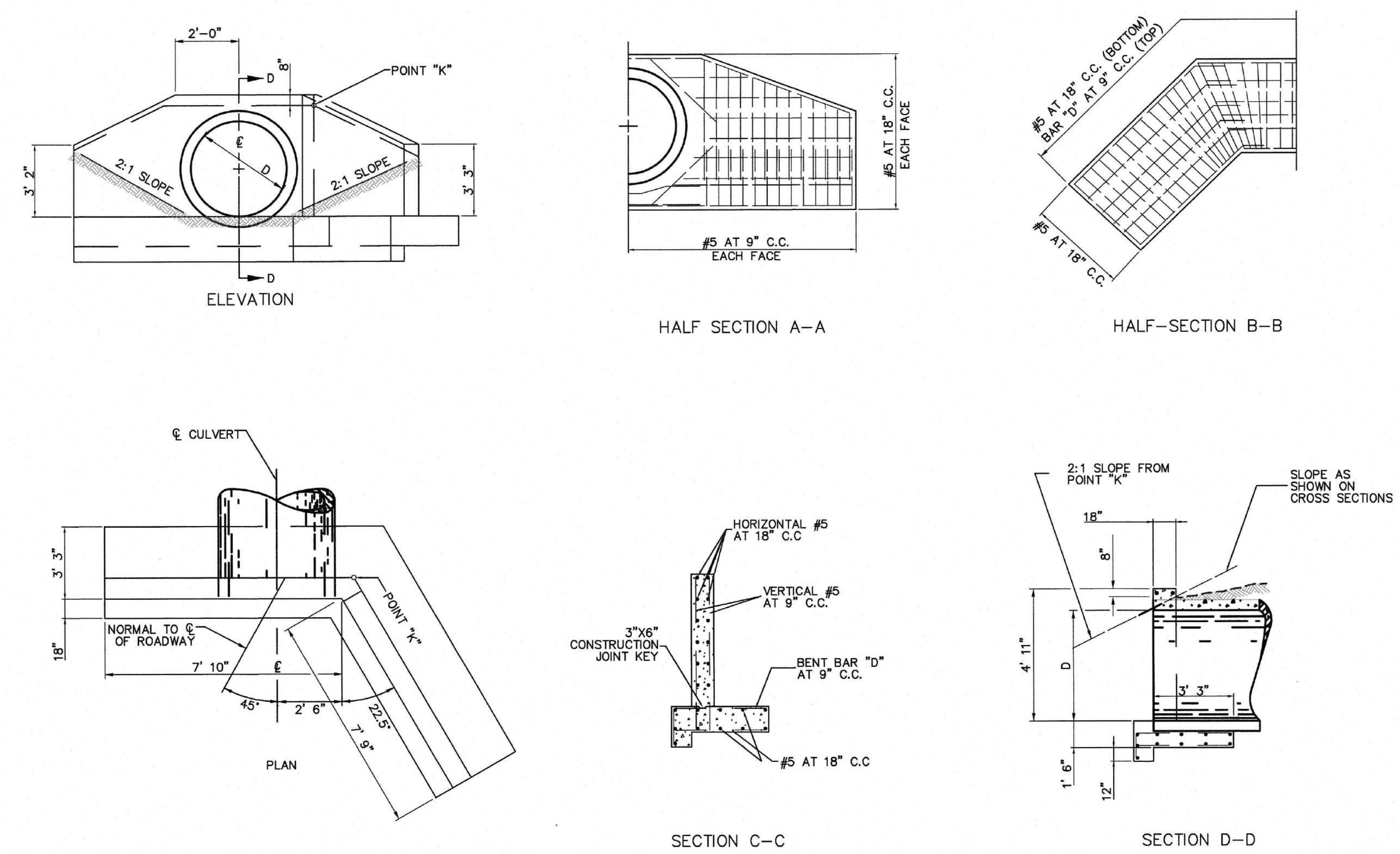
47 | C | 10WXXX-12



1 HEADWALL STRUCTURE (03 | 12; 04; 10)
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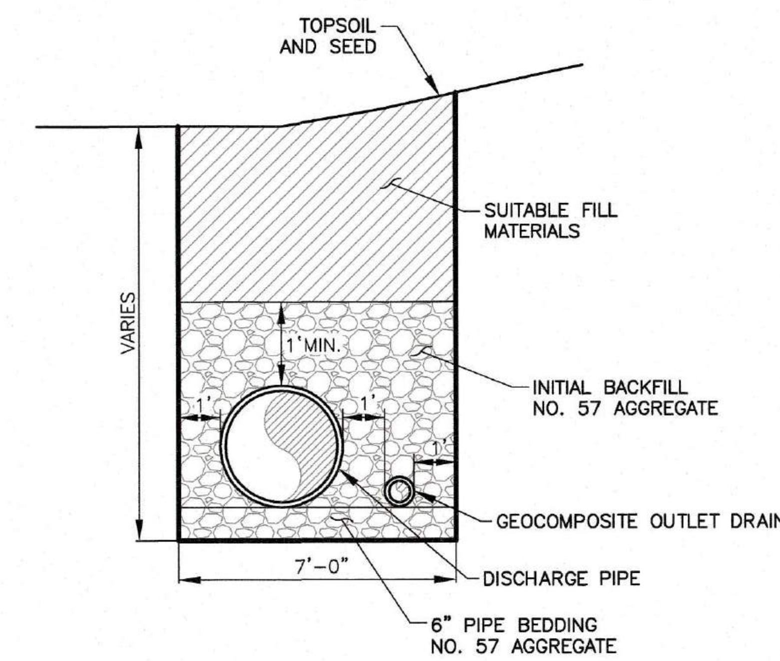
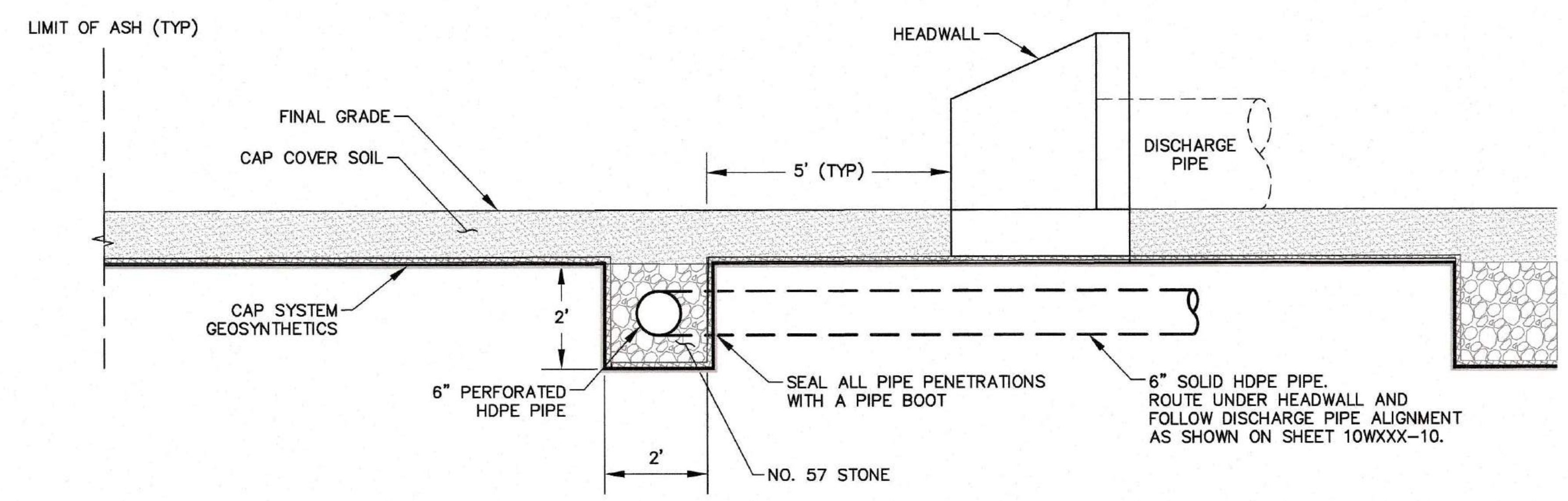


2 OUTLET PIPE BEDDING DETAIL (10 | 12)
N.T.S



5 GEOCOMPOSITE OUTLET DRAIN (10 | 12)
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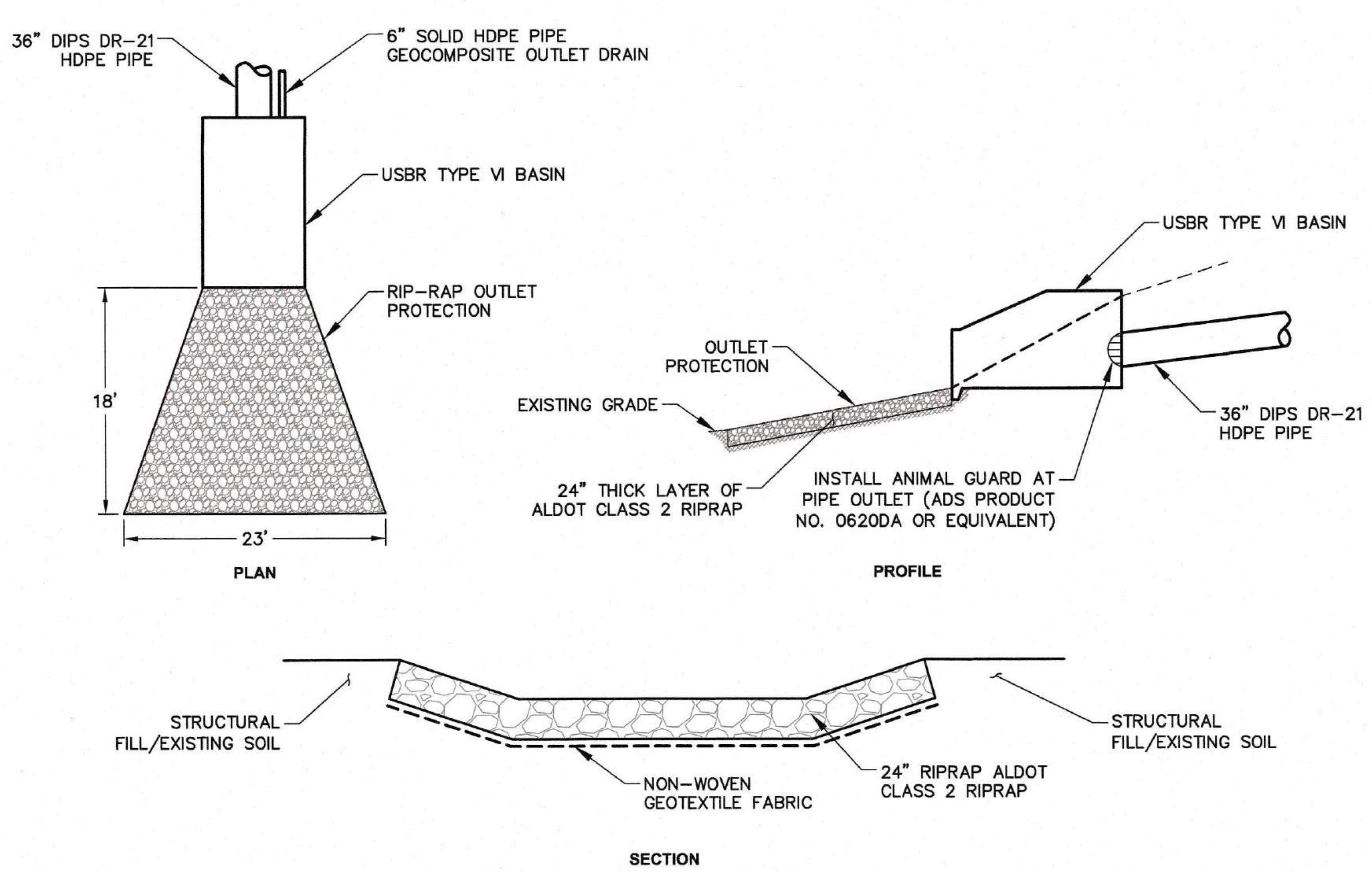
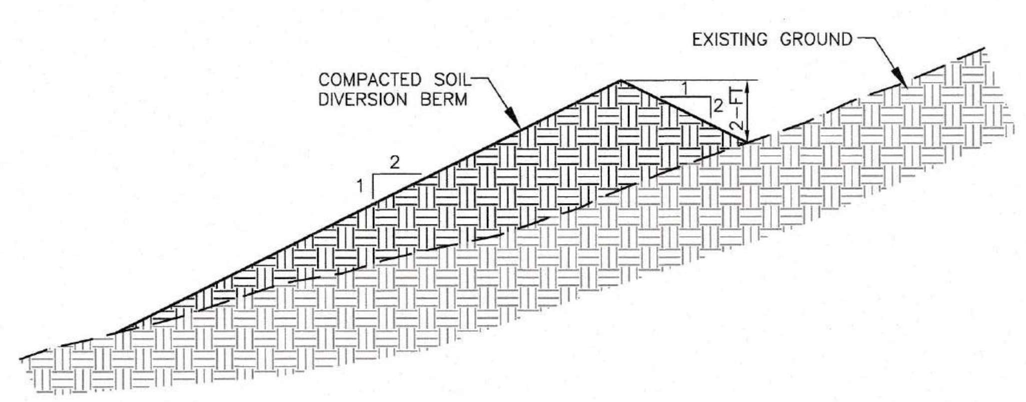


3 SOUTH OUTLET PROTECTION (04 | 12)
N.T.S



4 DRAINAGE SWALE (04 | 12)
N.T.S.

ALABAMA LICENSED No. 30591 PROFESSIONAL ENGINEER

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REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV
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SCALE: AS SHOWN — EXCEPT AS NOTED

STORM WATER DETAILS I

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	APM	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX-12 | R 0

AECOM	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

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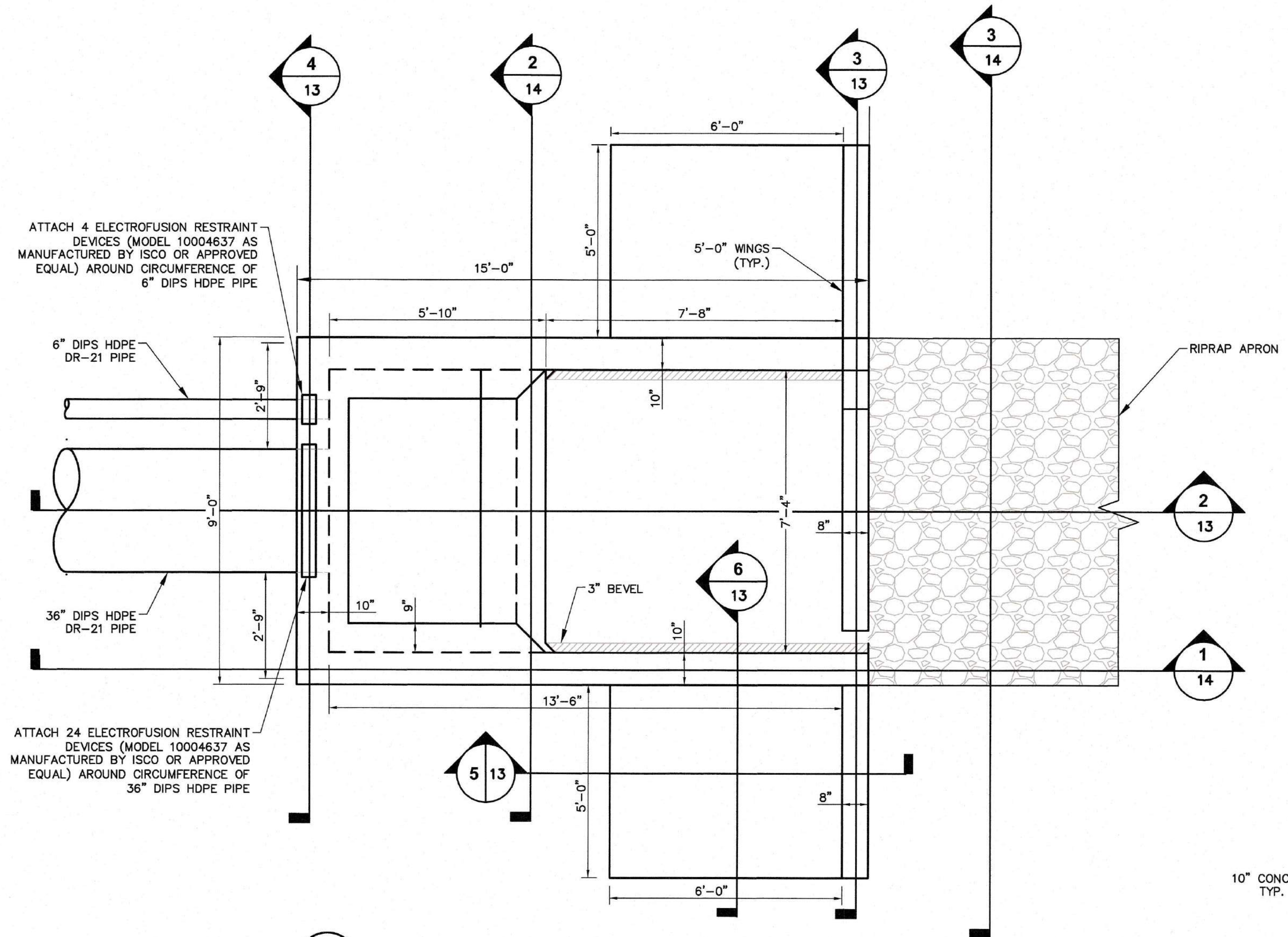
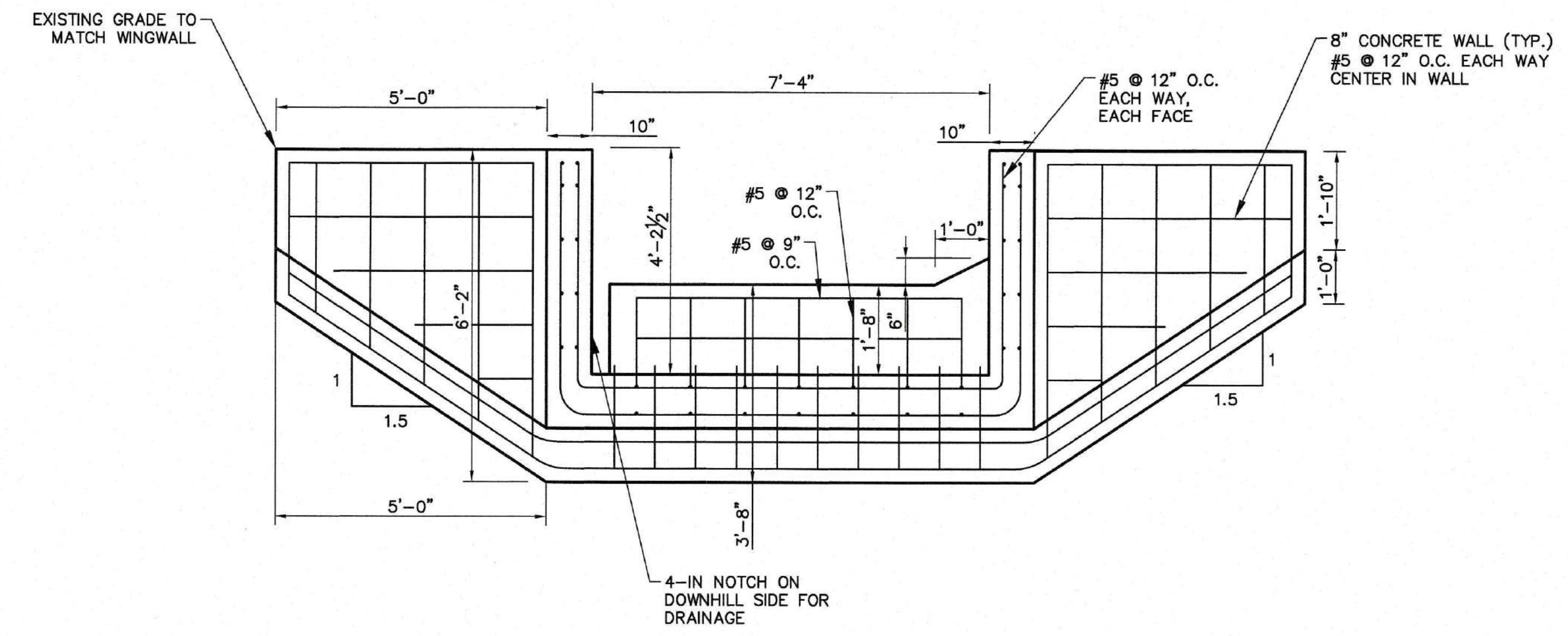


1 USBR TYPE VI BASIN - PLAN
N.T.S.



3 USBR TYPE VI BASIN - SECTION
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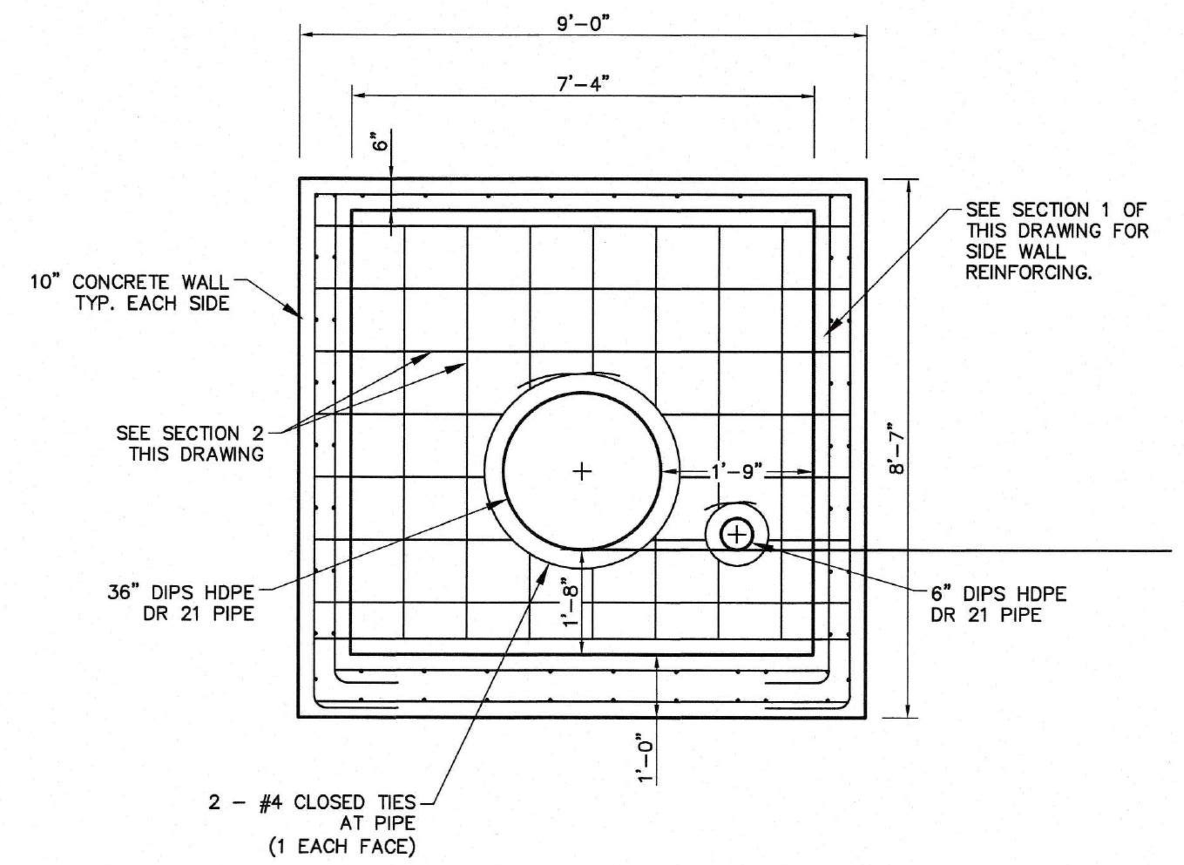

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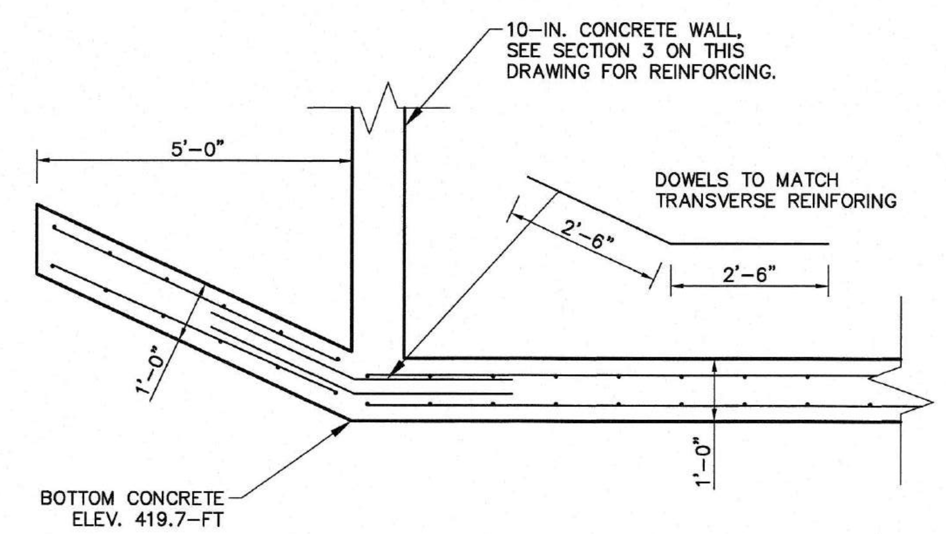
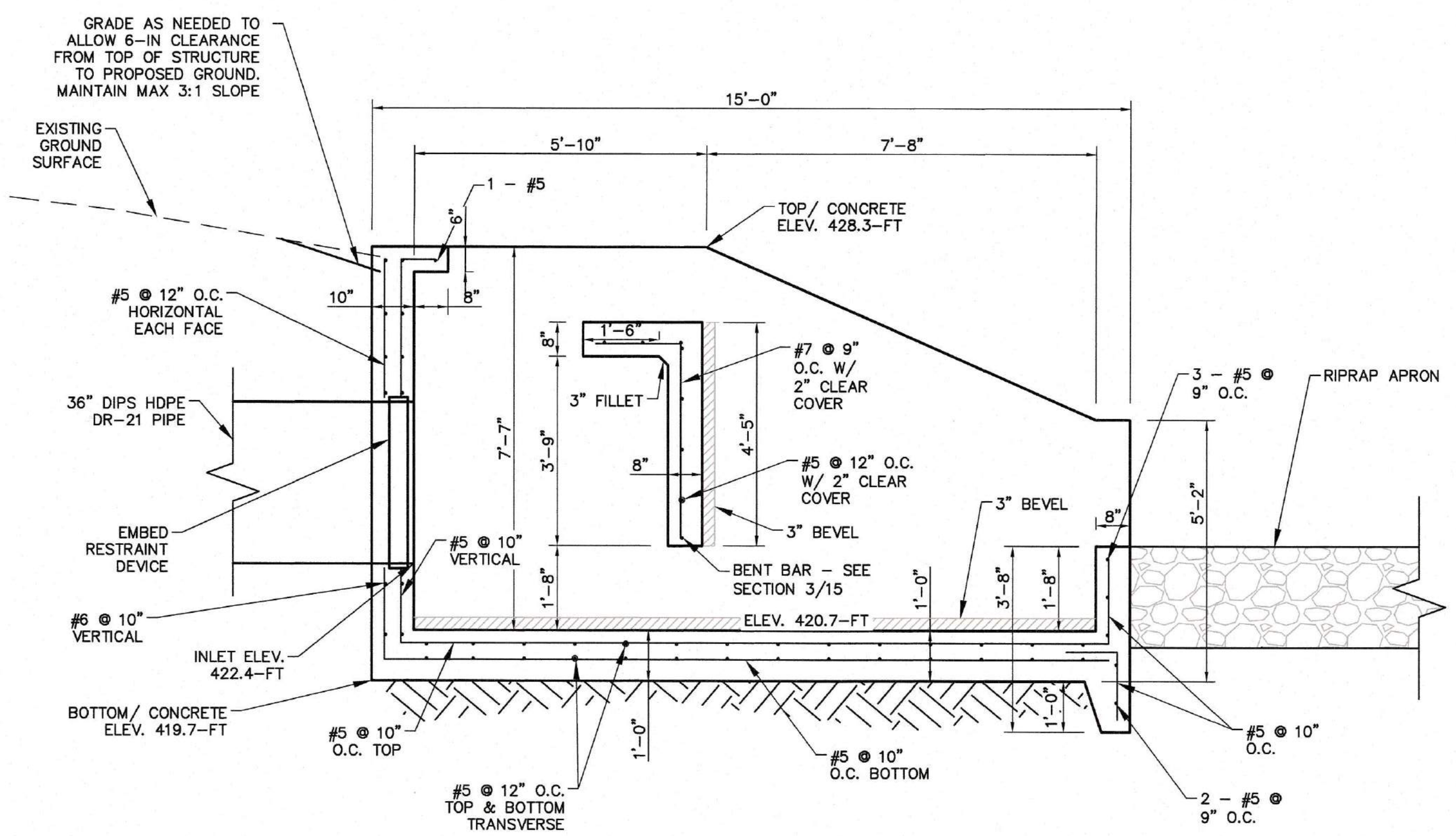
N.T.S.



6 SECTION AT BASE
N.T.S.



2 USBR TYPE VI BASIN - SECTION
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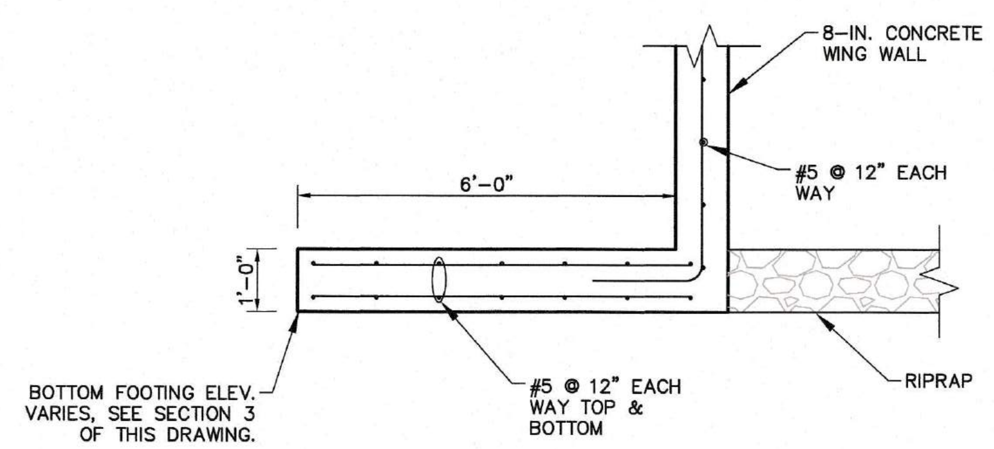

5 WING WALL FOUNDATION - SECTION
N.T.S.

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AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	09/02/2016	SEB	APM	MJS	MJS	RSH	MST	JCK	204316	

SCALE: AS SHOWN EXCEPT AS NOTED

STORM WATER DETAILS II

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	APM	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX-13 | R 0

AECOM | 0
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PLOT FACTOR:XX
W_TVA

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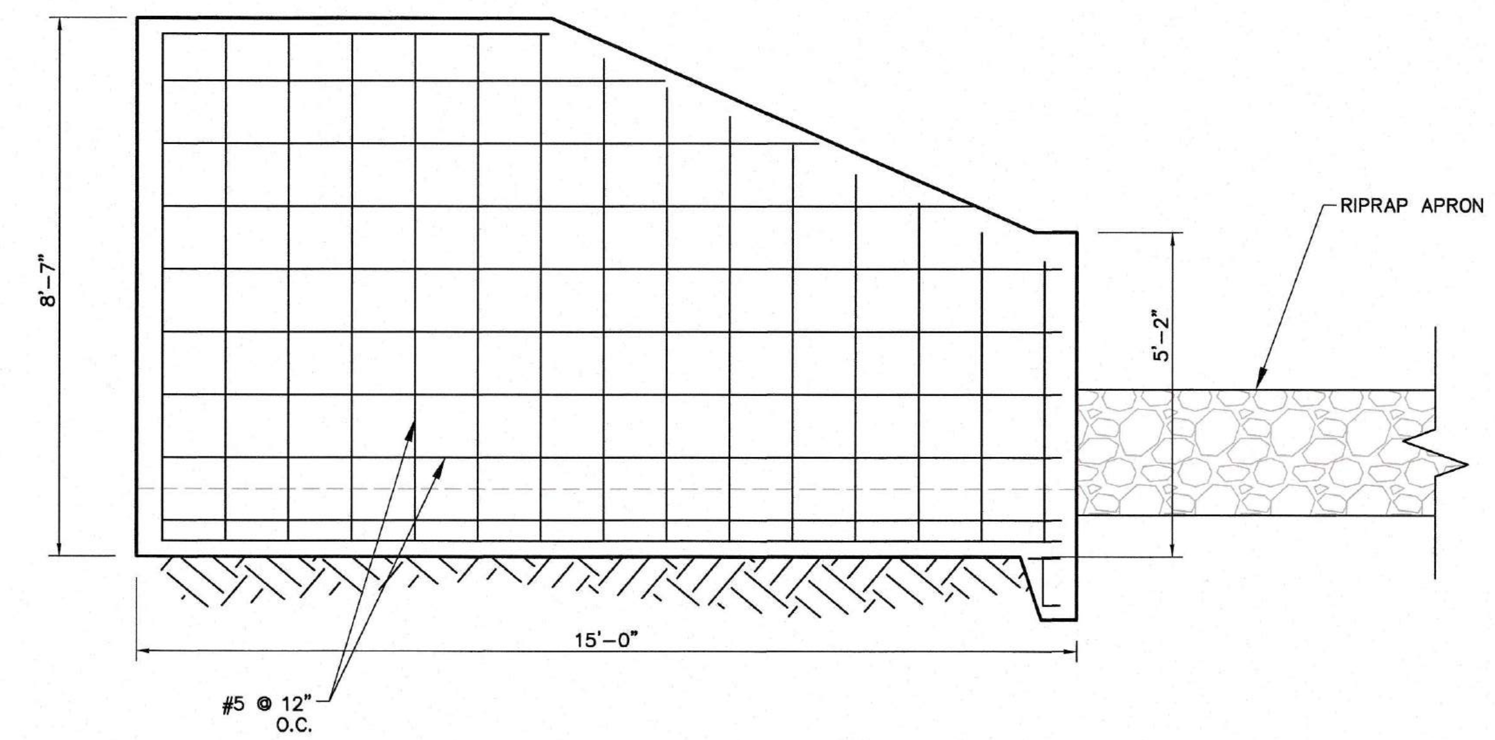

USBR TYPE VI BASIN - SECTION (1, 13 | 14)
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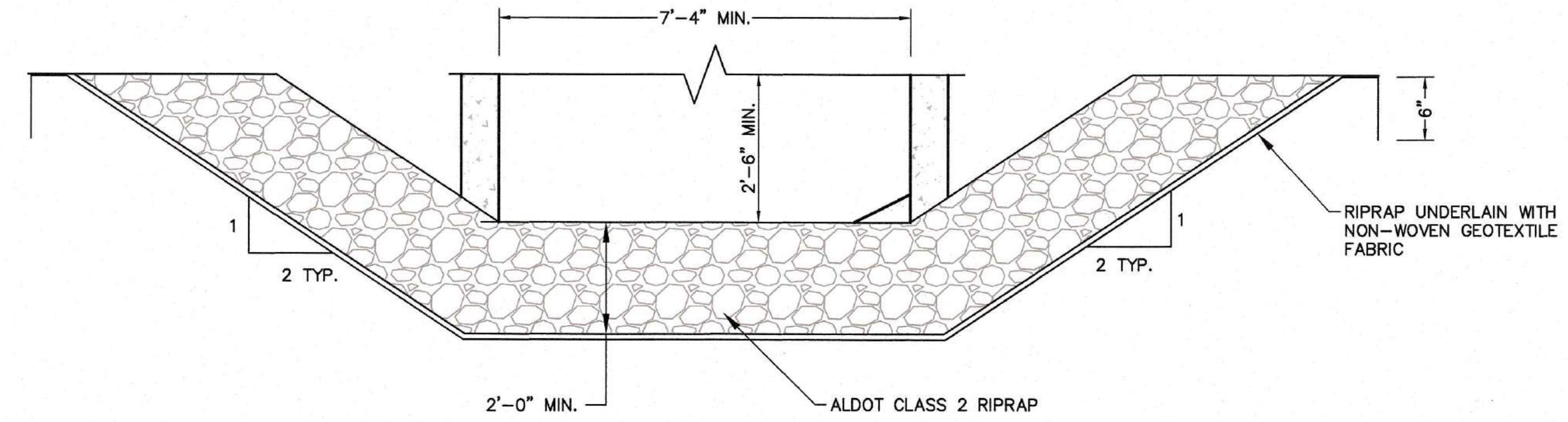

RIPRAP APRON - SECTION (3, 13 | 14)
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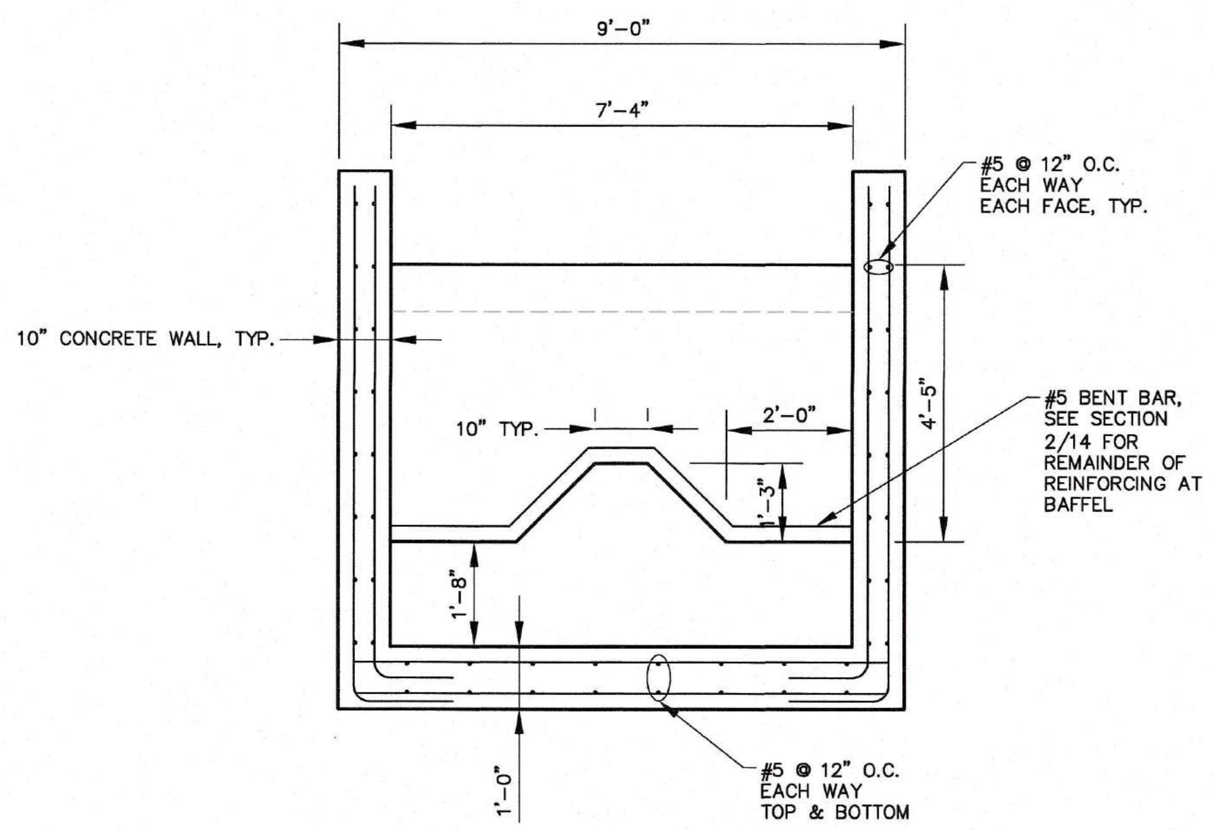

USBR TYPE VI BASIN - SECTION (2, 13 | 14)
N.T.S.

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AECOM

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 0	09/02/2016	SEB	APM	MJS	MJS	RSH	MST	JCK	204316		D

SCALE: AS SHOWN EXCEPT AS NOTED

STORM WATER DETAILS III

ASH POND 4 CLOSURE

COLBERT FOSSIL PLANT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
SEB	APM	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 09/02/16 | 47 | C | 10WXXX-14 | R 0

PLOT FACTOR:XX W_TVA

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Appendix B

The Groundwater Monitoring Plan for Ash Pond 4 has been removed from this document. The updated Groundwater Monitoring Plan is provided in Attachment G - Operations Plan

APPENDIX C

The Ash Pond 4 Final Closure QA/QC Plan is included in Attachment F - QA/QC Plan

APPENDIX D

Memo

To: Mr. Shane Harris, P.E. - TVA

From: Jim Nickerson and Bill Walton, P.E., GEI

Date: May 10, 2016

Re: Slope Stability of Seismic Improvements
Seismic Improvement Project, East Dike, Ash Pond 4
Colbert Fossil Plant, Tuscumbia, Alabama

The purpose of this memorandum is to present our slope stability analyses for the proposed regrading of the Colbert Fossil Plant Ash Pond 4.

Background

In 2015 GEI submitted a seismic improvement design for the east dike of Ash Pond 4. The project involves the construction of deep mix method (DMM) soil-cement walls at the downstream toe of the east dike. The DMM walls are designed to bear on the limestone bedrock. The improvement was designed for the final closure grading of Ash Pond 4.

GEI worked with AECOM to develop a proposed final grading and closure plan for Ash Pond 4. In general the final grading and closure consists of lowering the perimeter north, east, and south dikes to El. 443 to El. 452, with perimeter drainage swale on the upstream side of the dike crest. The west dike will be raised up to El. 487.

Final Closure Slope Stability Analyses

As part of our design we performed global stability analyses on seven cross-sections (B through F2) on the east dike, and five cross-sections on the west dike (H through L) for the post-closure conditions with the final closure grading and with seismic stability improvements. We performed analyses using static loading with both static and post-earthquake shear strengths. Unit weights and shear strengths for materials used in the stability analyses are summarized in Table 1 and discussed in Appendix A. Strengths for three different loading conditions were used in the analyses:

- Drained strength, for long-term loading of both saturated and unsaturated soils.
- Undrained strength for end of construction loading.
- Post-earthquake strength, for the native sand, saturated clay, and saturated ash for post-earthquake loading.

The properties used in each stability analysis are shown in table format on the plot of the results of each analysis in Appendix B.

The stability analyses were performed with the computer program SLOPE/W using the Spencer method. We used the SLOPE/W optimization routine to check whether a non-circular surface would have a lower factor of safety. The resulting optimized failure surfaces had lower factors of safety and more closely followed the weaker layers.

Slope Stability Analysis of East Dike

We performed post-closure slope stability analyses for design sections along the east dike where seismic stabilization improvement was needed. The location of the DMM walls for each of the design cross sections requiring stability improvement is shown in the stability results in Appendix B, Figures 1 through 28.

We varied the strength of the DMM-treated zone to determine the strength necessary to obtain a post-earthquake factor of safety of at least 1.1 in the SLOPE/W runs. The critical failure surfaces for each design section passes through the walls, indicating that the location and geometry of the walls are suitable to intercept and stabilize the critical surface. These analyses also indicate that failure surfaces that pass above the walls are not the critical surfaces, and have higher factors of safety than the critical surfaces that pass deeper through the body of the walls or along the DMM/bedrock interface.

After we selected the minimum composite strength of the DMM walls, we performed stability analyses for the end-of-construction and long-term loading conditions. The factors of safety for these two conditions were above 1.9. Table 2 presents a summary of the slope stability analysis results for each load case.

Slope Stability Analysis of West Dike

We performed stability analyses for the long-term and post-earthquake loading conditions on five cross-sections of the west dike. We used the proposed post-closure geometry for the analyses.

The improvements consist of constructing a compacted stone fill berm at the downstream toe of the central and south portion of the west dike and at the west portion of the south dike. The berm will be installed as part of the final closure of the ash pond after the Colbert plant is shut down. The berm will be constructed prior to raising the ash fill level on the west side of the pond.

With the berm, the factors of safety for the post-earthquake loading condition were above 1.2, as shown in Table 2. After we selected the dimensions of the berm for the post-earthquake loading conditions we performed stability analyses for the long-term loading condition. The factors of safety for this loading condition were above 2.4 as shown in Table 2. SLOPE/W outputs are presented in Appendix B, Figures 28 through 38.

Attachments:

- Table 1 – Material Properties Summary
- Table 2 – Slope Stability Result Summary
- Figure 1 – East Dike Analysis Cross-Sections
- Figure 2 – West Dike Analysis Cross-Sections
- Appendix A – Soil Strength Parameters for Analyses
- Appendix B – Slope Stability Analyses

MPC/JFN:mrb

CERTIFICATION

TVA Colbert Fossil Plant, Ash Pond 4 Closure/Post-Closure Plan

Static Slope Stability of Seismic Improvements

May 10, 2016

I hereby certify that this report was prepared either by me or under my supervision. The report was prepared in accordance with sound geoltechnical principles and practices. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

ALABAMA
LICENSED
NO. 34318-E
PROFESSIONAL
ENGINEER
WILLIAM HERBERT WALTON

Name
Alabama PE License #34318-E

Tables

Table 1. Material Properties Summary
Seismic Improvement Project, East Dike, Ash Pond 4
Colbert Fossil Plant,Tuscumbia, Alabama
Tennessee Valley Authority

Material Properties							
Material Name	Unit Weight	Drained Strengths		Undrained Strengths		Post-EQ Strengths[1]	
		c'	φ'	c	φ	c	φ
	(pcf)	(psf)	(deg)	(psf)	(deg)	(psf)	(deg)
Upper Clay Dike (Unsaturated)	127	200	28	1500	0	1500	0
Upper Clay Dike (Saturated)	127	200	28	1500	0	1200	0
Stacked Ash (Unsaturated)	107	0	30	0	30	0	30
Sluiced Ash (Saturated)	107	0	26	400	10	$c/\sigma'_v = .06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	200	29	1500	0	1500	0
Lower Clay Dike (Saturated)	127	200	29	1500	0	1200	0
Native Clay (Unsaturated)	129	200	28	1250	0	1250	0
Native Clay (Saturated)	129	200	28	750	0	600	0
Native Clay Under Dike (Saturated)	129	200	28	1250	0	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	0	30	0	30	235	0
Rip Rap	120	0	38	0	38	0	38
West Dike Stability Berm Fill	140	0	45	0	45	0	45
Granular Fill	125	0	35	0	35	0	35
Limestone Bedrock	135	20000	45	20000	45	20000	45

Notes:
1. EQ = Earthquake

Table 2. Slope Stability Summary
Seismic Improvement Project, East Dike, Ash Pond 4
Colbert Fossil Plant,Tuscumbia, Alabama
Tennessee Valley Authority

Analysis Section	Post-Closure Conditions			
	End-of-Construction (Undrained)	Long-Term (Drained)	Post-EQ [1] (Undrained)	Post-EQ Failure in Ash Stack [1] (Undrained)
	FS	FS	FS	FS
B	2.4	2.3	1.1	1.1
C	2.5	2.6	1.1	1.1
D1	2.2	1.9	1.1	1.1
D2	2.1	2.0	1.1	1.1
E	2.2	2.0	1.1	1.1
F1	2.2	1.9	1.1	3.0
F2	2.4	2.1	1.1	3.0
H	2.7	--	1.2	--
I	2.4	--	1.3	--
J	2.5	--	1.2	--
K	2.5	--	1.2	--
L	2.4	--	1.4	--

Notes:
1. EQ = Earthquake

Figures

CONCEPTUAL STABILITY BERM FOR WEST DIKE
GEOMETRY AND LIMITS TO BE DETERMINED

East Dike Seismic Improvement Project
Colbert Fossil Plant Ash Pond No. 4
Tuscumbia, Alabama

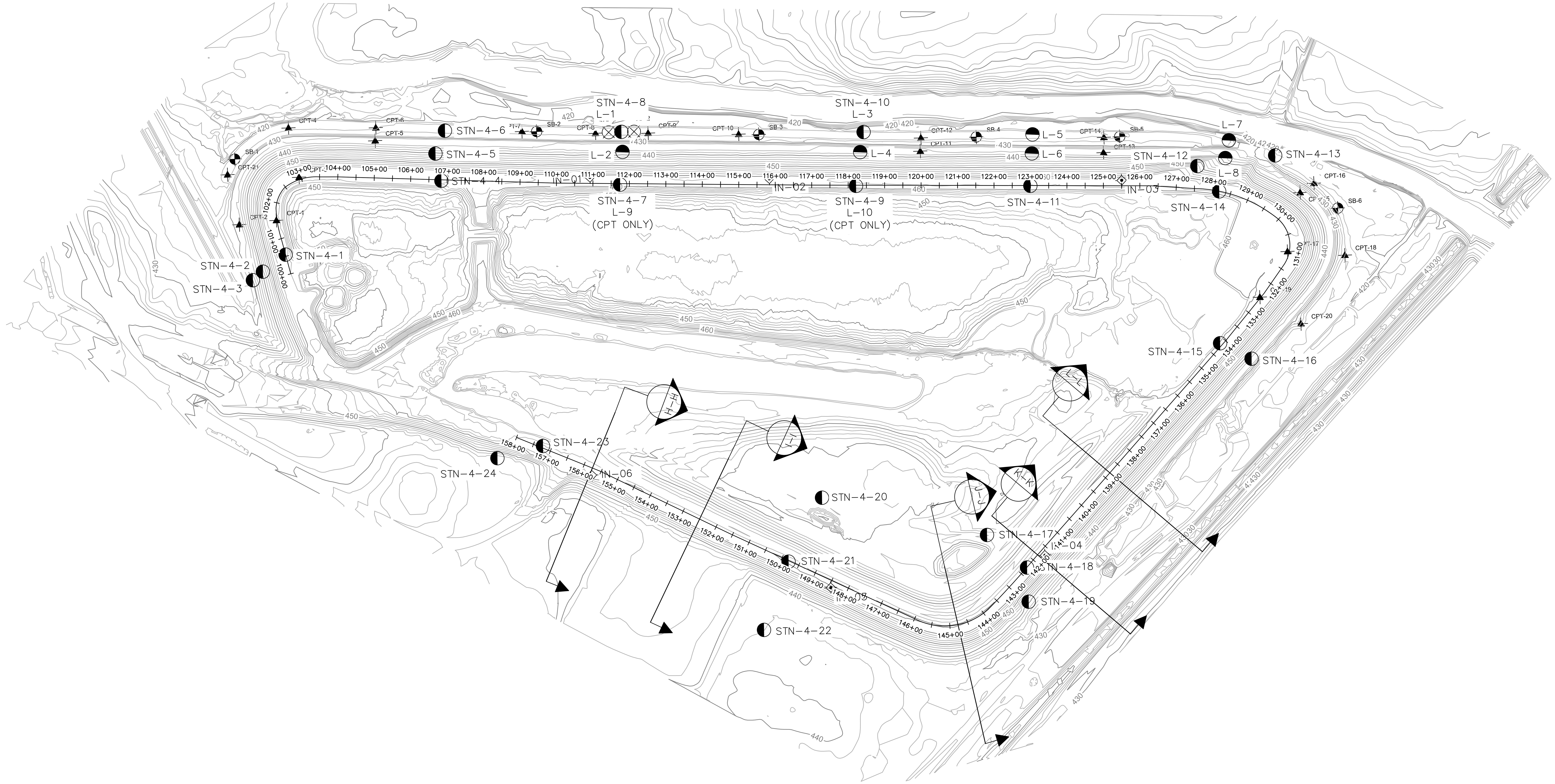
Tennessee Valley Authority
Chattanooga, Tennessee

GEI Consultants

East Dike Analysis Cross-Sections

May 2016

Fig. 1



LEGEND:

CPT - □□1□CO□E PE□E□RA□IO□ □ES□□□

SB - □□1□SOIL □OR□□ W□□ S□A□DARD PE□E□RA□IO□ □ES□□□ A□D PIE□OME□ERS

AP - □□1□AU□ER PRO□E

L - □IS□ORIC SOIL □OR□□ W□□ S□A□DARD PE□E□RA□IO□ □ES□S□U□E SAMPL□□□ A□D/OR CO□E PE□E□RA□IO□ □ES□□□ □□14 EXPLORA□IO□□

STN - □IS□ORIC SOIL □OR□□ W□□ CO□□□UOUS S□A□DARD PE□E□RA□IO□ □ES□S A□D/OR S□EL□□ □U□E SAMPL□□ □□1□EXPLORA□IO□□□ O□□ERS□

STN - □IS□ORIC SOIL □OR□□ W□□ CO□□□UOUS S□A□DARD PE□E□RA□IO□ □ES□S A□D/OR S□EL□□ □U□E PIS□O□ SAMPL□□□A□D PIE□OME□ER □□S□ALLA□IO□ □□1□ EXPLORA□IO□□□ O□□ERS□

STN - □IS□ORIC SOIL □OR□□ W□□ CO□□□UOUS S□A□DARD PE□E□RA□IO□ □ES□S A□D/OR S□EL□□ □U□E SAMPL□□□ROC□ CORE□A□D PIE□OME□ER □□S□ALLA□IO□ □□1□EXPLORA□IO□□□ O□□ERS□

NOTES□

1. S□□- A□D L- SERIES EXPLORA□IO□ LOCA□IO□S PRO□IDED □□ S□A□□EC.

□. CP□- A□D S□- SERIES EXPLORA□IO□ LOCA□IO□S PRO□IDED □□ □□A.

□. □OPO□RAP□IC SUR□E□ □□□ORMA□IO□ □AS □EE□ PRO□IDED □□ □□E □□A A□D S□OULD □E USED □OR □□□ORMA□IO□ O□L□.

CO□□OUR □□□ER□AL □ □□

Wes□D□e Se□s□c □□ □ro□e□e□□Proec□ Col□er□□oss□l Pla□□As□Po□d □o. 4 □uscu□ □a□Ala□a□a	GEI Consultants	West Dike Analysis Cross-Sections
□e□□essee □alle□Au□□or□□ C□a□a□oo□a□□e□□essee		May 2016 □□. 2

Appendix A

Soil Strength Parameters for Analyses

Soil Strength Parameters for Analysis

Purpose:

Select representative shear strength parameters for typical soil types at the site, using the available sources below. Selected values will be applied in our stability analyses.

References:

AECOM (2009) Kingston Fossil Plant, Root Cause Failure Analysis, Dredge Cell 2 Failure of December 22, 2008, June 25, 2009.

Federal Highway Administration (FHWA) (2002), NHI Course No. 132031, Subsurface Explorations-Geotechnical Site Characterization.

GEI Consultants, Inc. (2015), Geotechnical Data Report, Phase 2 Subsurface Explorations COF Ash Pond No. 4 East Dike Seismic Remediation, Colbert Fossil Plant, Tuscumbia, Alabama.

GEI Consultants, Inc. (2015), Lab and Field Data, and Triggering Analysis for Seismic Stability Evaluations Colbert Fossil Plant Ash Pond 4, Tuscumbia, Alabama.

Hatanaka, M. and Uchida, A. (1996), Empirical correlation between penetration resistance and effective friction of sandy soil. Soils & Foundations, Vol. 36, No. 4, Japanese Geotechnical Society.

Leps, T.M. (1970), Review of Shearing Strength of Rockfill, Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 96, No. SM4, July, pp. 1159-1170.

Makdisi, F. I., Seed, H. B. (1978), Simplified Procedure for Estimating Dam and Embankment Earthquake-Induced Deformations, Journal of the Geotechnical Engineering Division, GT7, July 1978, pp 849-867

Stantec (2010), Report of Geotechnical Exploration and Slope Stability Evaluation, Ash Pond 4 Colbert Fossil Plant, Tuscumbia, Alabama.

Stantec (2010), Report of Geotechnical Explorations and Slope Stability Evaluation, Disposal Area 5 Dry Stack and Drainage Basin, Colbert Fossil Plant, Tuscumbia, Alabama.

Appendix A: Soil Strength Parameters for Analysis

Summary:

Our selected shear strength parameters are summarized in the following table:

Material Properties							
Material Name	Unit Weight (pcf)	Drained Strengths		Undrained Strengths		Post-EQ Strengths	
		c' (psf)	φ' (deg)	c (psf)	φ (deg)	c (psf)	φ (deg)
Upper Clay Dike (Unsaturated)	127	200	28	1500	0	1500	0
Upper Clay Dike (Saturated)	127	200	28	1500	0	1200	0
Stacked Ash (Unsaturated)	107	0	30	0	30	0	30
Sluiced Ash (Saturated)	107	0	26	400	10	c/σ'_v= .06 c_{min}= 100	0
Lower Clay Dike (Unsaturated)	127	200	29	1500	0	1500	0
Lower Clay Dike (Saturated)	127	200	29	1500	0	1200	0
Native Clay (Unsaturated)	129	200	28	1250	0	1250	0
Native Clay (Saturated)	129	200	28	750	0	600	0
Native Clay Under Dike (Saturated)	129	200	28	1250	0	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	0	30	0	30	235	0
Rip Rap	120	0	38	0	38	0	38
West Dike Stability Berm Fill	140	0	45	0	45	0	45
Granular Fill	125	0	35	0	35	0	35
Limestone Bedrock	135	20000	45	20000	45	20000	45

Approach:

We selected soil strength parameters based on our subsurface explorations and subsurface explorations performed by Stantec in 2010 and 2014.

The parameters were used to evaluate slope stability for four failure modes: static drained, static undrained, post-earthquake static stability and pseudostatic stability.

We developed three sets of shear strength parameters for each layer, depending on loading conditions: (1) drained effective strengths, using effective stress c' and ϕ' parameters, (2) undrained total strengths, using total stress c and ϕ parameters, and (3) undrained post-earthquake strengths, using post liquefaction s_{us} and $\phi = 0°$ parameters for soils susceptible to liquefaction (sluiced ash and native sand) and reduced shear strength for the saturated fine-grained soils (compacted clay dikes and native clay).

Static Drained Case

The static drained strengths are used in our analyses for the current conditions and the post-closure conditions and assume that steady-state seepage conditions are achieved in the embankment. Drained strengths were assigned to all materials.

Static Undrained Case

The static undrained case assumes that proposed construction is performed rapidly enough to induce undrained loading of the soil. Therefore, shear strengths fine grained materials and sluiced ash are defined using undrained shear strengths.

The coarse grained materials and stacked ash are relatively freely draining soils. Therefore, we assigned drained strengths to the freely draining layers in static undrained case.

Post-Earthquake Static Case

For the post-earthquake static case we assigned post-liquefaction shears strengths to the materials that were identified as being potentially liquefiable. Non-liquefiable coarse grained soils were assigned drained strengths. Saturated undrained soils were assigned 80% of the peak undrained strength to limit the available strength from these layers (Makdisi and Seed, 1978).

Pseudostatic Case

For the pseudostatic case a horizontal seismic coefficient (see Design Report) was applied. We assigned post-liquefaction shears strengths to the materials that were identified as being potentially liquefiable. Non liquefiable material strengths were increased 33% to account for the short term duration of the dynamic loading.

Unit Weights:

We based the selection of unit weights for the embankment, fill, and foundation soils based on:

- The measured unit weights from the 2010 and 2014 laboratory testing.
- Values reported in previous evaluations.
- Typical values from the literature and experience.

Drained (Effective Stress) Strength Parameter Selection:

We selected drained effective stress strength parameters based on laboratory data from Stantec (2010). The following paragraphs discuss how we selected these parameters for each layer.

Fine Grained Soils and Sluiced Ash

Drained strength parameters for fine grained soils and the sluiced ash were selected from the Stantec (2010) report. Stantec used data from isotropically consolidated undrained triaxial compression tests. The values of ϕ' and c' were selected by fitting a K_f line to the p'-q failure points such that approximately two thirds of the data points were above the failure envelope. This K_f line has a slope of tan α' and a y-intercept a'. The drained strength parameters were then calculated using the following equations.

$$\sin \phi' = \tan \alpha$$
$$c' = a'/\cos\phi'$$

1. **Upper Clay Dike**

Drained strength parameters for the upper clay dike were selected from the Stantec (2010) report. The resulting failure envelope from Stantec for the upper clay dike is shown in Figure I-1. The drained friction angle was rounded to the nearest degree and the cohesion intercept was limited to a maximum of 200 pcf. The selected parameters were ϕ′=28° and c'=200 psf.

2. **Lower Clay Dike**

Drained strength parameters for the lower clay dike were selected from the Stantec (2010) report. The resulting failure envelope from Stantec for the lower clay dike is shown in Figure I-2. The drained friction angle was rounded to the nearest degree and the cohesion intercept was limited to a maximum of 200 pcf. The selected parameters were ϕ′=29° and c'=200 psf.

3. **Native Clay**

Drained strength parameters for the native clay were selected from the Stantec (2010) report. The resulting failure envelope from Stantec for the native clay is shown in Figure I-3. The drained friction angle was rounded to the nearest degree and the cohesion intercept was limited to a maximum of 200 pcf. The selected parameters were ϕ′=28° and c'=200 psf.

4. **Sluiced Ash**

Drained strength parameters for the sluiced ash were selected from the Stantec (2010) report. The y-intercept was set to zero for the sluiced ash. The resulting failure envelope from Stantec is shown in Figure I-4. The drained friction angle was rounded to the nearest degree. The selected parameters were ϕ′=26° and c'=0 psf.

Coarse Grained Soils and Stacked Ash

Drained strength parameters for in situ coarse grained soils and stacked ash were based on empirical correlations to SPT N-values. Drained strength parameters for proposed fill materials were based on available literature.

1. Stacked Ash

Drained strength parameters for the stacked ash were estimated using empirical correlations to SPT N-values. We used the correlation from FHWA (2002), adapted from Hatanaka and Uchida (1996). This correlation uses SPT $N_{1(60)}$ (SPT-N field values with energy correction and overburden correction) to estimate drained friction angle for coarse grained soils. The correlation is presented in Figure I-5. The $N_{1(60)}$ values in the stacked ash ranged from 0 blows per foot (bpf) to 51 bpf. The median $N_{1(60)}$ was 18 bpf. The drained friction angle estimated from the correlation is 37°. We conservatively used drained strength parameters of <u>ϕ′=30° and c’=0 psf</u>.

2. Native Sand and Low Plasticity Silts

Drained strength parameters for the native sand and low plasticity silt layers were estimated using empirical correlations to SPT N-values. We used the correlation from FHWA (2002), adapted from Hatanaka and Uchida (1996). This correlation uses SPT $N_{1(60)}$ (SPT-N field values with energy correction and overburden correction) to estimate drained friction angle for coarse grained soils. The correlation is presented in Figure I-5. The $N_{1(60)}$ values in the native sand and low plasticity silts ranged from 0 blows per foot (bpf) to 51 bpf. The median $N_{1(60)}$ was 8 bpf. The drained friction angle estimated from the correlation is 31°. We selected a slightly lower drained friction angle because some borings had consistently lower SPT-N values. We used drained strength parameters of <u>ϕ′=30° and c’=0 psf</u>.

3. Rip Rap

We selected drained strength parameters for the rip rap based on data for rock fills from Leps (1970) presented here in Figure I-6. We used conservative drained strength parameters of <u>ϕ′=38° and c’=0 psf</u>.

4. West Dike Stability Berm Fill

We selected drained strength parameters for the proposed west dike stability berm fill based on data for rock fills from Leps (1970) presented here in Figure I-6. We used drained strength parameters of <u>ϕ′=45° and c’=0 psf</u>.

5. Granular Fill

The proposed granular fill will be a dense graded aggregate. We selected drained strength parameters based on common values for that type of fill. We used drained strength parameters of <u>ϕ′=35° and c’=0 psf</u>.

Limestone Bedrock

Strength parameters for the limestone bedrock were estimated based on laboratory tests on rock core samples collected by GEI. The Rock Quality Designation (RQD) of the rock cores ranged from 46% to 100% with a median of 100% indicating excellent rock quality. Uniaxial compressive strength tests were performed on intact rock samples by Stantec. The results are presented in our 2015 Geotechnical Data Report. The unconfined compressive strength of the rock ranged from 116 ksi to 186 ksi. We used drained strength parameters of <u>ϕ′=45° and c’=20,000 psf</u>.

Undrained (Total Stress) Strength Parameter Selection:

Fine grained Soils

Undrained total stress shear strengths for the clay soils (upper dike, lower dike and native clay) were selected based on the results of laboratory triaxial tests reported in Stantec (2010) and recent tests performed in 2014 by GEI. The triaxial tests are mostly isotropically consolidated undrained triaxial compression tests with pore pressure measurement (CIU' tests) and a few unconsolidated undrained triaxial compression tests (UU tests). The following table provides a summary of the type and number of tests performed on each soil.

Soil	CIU' Tests (2010)	CIU' Tests (2014)	UU Tests (2014)
Upper Dike	14	--	--
Lower Dike	11	2	2
Native Clay	10	15	5

We used the test data to develop a plot of undrained shear strength (s_u) versus currently consolidated vertical effective stress (σ_{vc}') for each soil. For the CIU' tests we used an equivalent value of field σ_{vc}' computed from the isotropic consolidation stress applied in the test (σ_c') by assuming:

$$\sigma_{vc}' (1 + 2 K_o)/3 = \sigma_c' \quad \text{with an at-rest pressure coefficient } K_o = 0.5$$

Most of the CIU' tests were consolidated to an equivalent field σ_{vc}' that is equal to or greater than the estimated field σ_{vc}' of the sample. For the UU triaxial tests we used the estimated field σ_{vc}'. The s_u versus σ_v' plots are presented in Figures I-7 through I-9. Tabular summary of the data used to generate the plots is provided in our GEI (2015) Draft Triggering Report. As shown in these plots, the measured values of s_u increase with increasing σ_v', although there is considerable scatter.

For each soil we estimated an approximate range of field σ_{vc}' in the general zone where the expected critical failure surfaces pass through that soil. The estimated σ_{vc}' ranges are shown on the s_u versus σ_v' plots (Figures I-7 through I-9). As shown in the plots, a significant portion of the available test data corresponds to values of σ_v' that are greater than the field σ_{vc}' values. For each soil we selected a value of s_u that corresponds to the range of σ_{vc}' in the field.

1. **Upper Clay Dike**

We selected undrained strengths for the upper clay dike based on available CIU tests. The s_u versus σ_v' plot is presented in Figure I-7. We used undrained strength parameters of ϕ=0° and c=1,500 psf.

2. **Lower Clay Dike**

We selected undrained strengths for the lower clay dike based on available CIU and UU tests. The s_u versus σ_v' plot is presented in Figure I-8. We used undrained strength parameters of ϕ=0° and c=1,500 psf.

3. **Native Clay**

We selected undrained strengths for the lower clay dike based on available CIU and UU tests. We divided the native clay layer in two sections to benefit from the higher strength of the clay that has been consolidated beneath the upper and lower clay dikes. One material was called Native Clay and the other Native Clay Under Dike. The s_u versus σ_v' plot is presented in Figure I-9.

We used undrained strength parameters for the Native Clay of ϕ=0° and c=750 psf.
We used undrained strength parameters for the Native Clay Under Dike of ϕ=0° and c=1,250 psf.

Sluiced Ash

Undrained strength parameters for the sluiced ash were selected from the Stantec (2010) report. Stantec used data from isotropically consolidated undrained triaxial compression tests. The values of ϕ and c were selected by fitting a K_f line to the p-q failure points such that approximately two thirds of the data points were above the failure envelope. This K_f line has a slope of tan α and a y-intercept a. The drained strength parameters were then calculated using the following equations.

$$\sin \phi = \tan \alpha$$
$$c' = a' / \cos\phi$$

The resulting failure envelope from Stantec is shown in Figure I-10. The undrained friction angle and cohesion intercept were rounded to the nearest degree and psf. The selected parameters were ϕ′=10° and c'=400 psf.

Coarse Grained Soils and Stacked Ash

Coarse grained soils and the stacked ash are considered freely draining materials. Therefore drained strengths were used for the static undrained analyses.

Undrained Post-Earthquake Strength Parameter Selection:

Fine Grained Soils

For post-earthquake stability analyses, the fine grained soils were divided into saturated and unsaturated materials. For unsaturated material strengths we used the undrained total strengths. For saturated material strengths we used 80% of the undrained total strengths. This strength reduction is suggested by Makdisi and Seed (1978) and is widely used in post-earthquake analyses to account for potential softening during the earthquake loading.

1. **Upper Clay Dike**

We used post-earthquake strength parameters for the Upper Clay Dike (Unsaturated) of ϕ=0° and c=1500 psf.
We used post-earthquake strength parameters for the Upper Clay Dike (Saturated) of ϕ=0° and c=1,200 psf.

2. **Lower Clay Dike**

We used post-earthquake strength parameters for the Lower Clay Dike (Unsaturated) of ϕ=0° and c=1500 psf.
We used post-earthquake strength parameters for the Lower Clay Dike (Saturated) of ϕ=0° and c=1,200 psf.

3. Native Clay

We used post-earthquake strength parameters for the Native Clay (Unsaturated) of $\phi=0°$ and c=750 psf.
We used post-earthquake strength parameters for the Native Clay (Saturated) of $\phi=0°$ and c=600 psf.
We used post-earthquake strength parameters for the Native Clay Under Dike (Unsaturated) of $\phi=0°$ and c=1,250 psf.
We used post-earthquake strength parameters for the Native Clay Under Dike (Saturated) of $\phi=0°$ and c=1,000 psf.

Liquefiable Soils

The triggering analyses indicate that strength loss could be triggered in the native sand and the sluiced ash during the design earthquake. Therefore, values of undrained steady state (residual) shear strength s_{us} are used for the post-earthquake stability analyses. The selection of s_{us} for each fill and soil type is described below.

1. Native Sand and Low Plasticity Silts

For the native sand we used correlations from Idriss & Boulanger (2008) and Castro (1995) to estimate s_{us} based on the values of corrected SPT resistance $N_{1,60}$ measured in the sand. Figure I-11 shows a histogram of $N_{1,60}$ values measured in the sand. We selected a representative value of $N_{1,60} = 7$ for the sand. Based on the sample descriptions and available grain size test data we selected representative fines content (i.e., material passing the #200 sieve by weight) of 30% for the sand. Using these values in the Idriss and Boulanger (2008) correlation we obtained a value of s_{us} = 235 psf. We obtained a value of s_{us} = 380 psf using the GEI lower bound curve in the Castro (1995) correlation.

The selected value of s_{us} for the native sand is input in the stability analyses as a value of cohesion with a friction angle of zero. We used post-earthquake strength parameters for the native sand and low plasticity silts of $\phi=0°$ and c=235 psf.

2. Sluiced Ash

For the sluiced ash we used a residual strength ratio of s_{us}/σ_{vc}' = 0.06 which is the design value that was used for a similar sluiced ash material in the remedial design for the Kingston Fossil Plant (Stantec 2012). This ratio gives s_{us} as a function of the current consolidated geometry effective vertical overburden stress σ_{vc}'. The Kingston design value was derived from an extensive post-failure investigation using correlations with SPT and piezocone CPT testing and laboratory testing by AECOM to determine post failure steady state shear strengths. The Kingston results are considered applicable to the Colbert sluiced ash because the materials are similar and have similar values of $N_{1,60}$. Based on the histogram of $N_{1,60}$ values in Figure I-12, an $N_{1,60}$ of 3 to 4 is considered representative of the Colbert sluiced fly ash. This is similar to the Kingston sluiced fly ash, which had a reported average of $N_{1,60}$ = 3.1 for the values equal to 10 or less.

For situations where the existing σ_v' is reduced by removal of material as part of the remedial design, we used a s_{us} based on the higher value σ_{vc}' to compute s_{us} existing prior to the fill soil removal. This is consistent with the concept underlying the use of a strength ratio, i.e., increasing σ_v' reduces the void ratio by compressing the soil and the lower void ratio results in higher s_{us} (Olson and Stark, 2002). Assuming that subsequent unloading does not result in a significant change in void ratio, it is appropriate to use the value of original σ_{vc}' that existed prior to the unloading as the material has been subject to pre-consolidation prior to upcoming removal.

In zones of sluiced ash not affected by fill soil removal, the selected value of s_{us}/σ_{vc}' = 0.06, with a minimum value of 100 psf, is input directly into a SLOPEW soil strength model for undrained steady state shear strength versus vertical effective stress. We used the figures in Idriss and Boulanger (2008) to compute the minimum s_{us}, as case history data shows there is residual shear strength even with SPT blowcounts are less than unity. In zones affected by soil removal, values of s_{us} versus depth are calculated based on the original σ_{vc}' prior to soil removal. These values are input in the stability analysis as a value of cohesion varying with depth and a friction angle of zero.

Non-liquefiable Coarse Grained Soils

For very coarse materials excess pore pressures will not accumulate, and the drained strength was used.

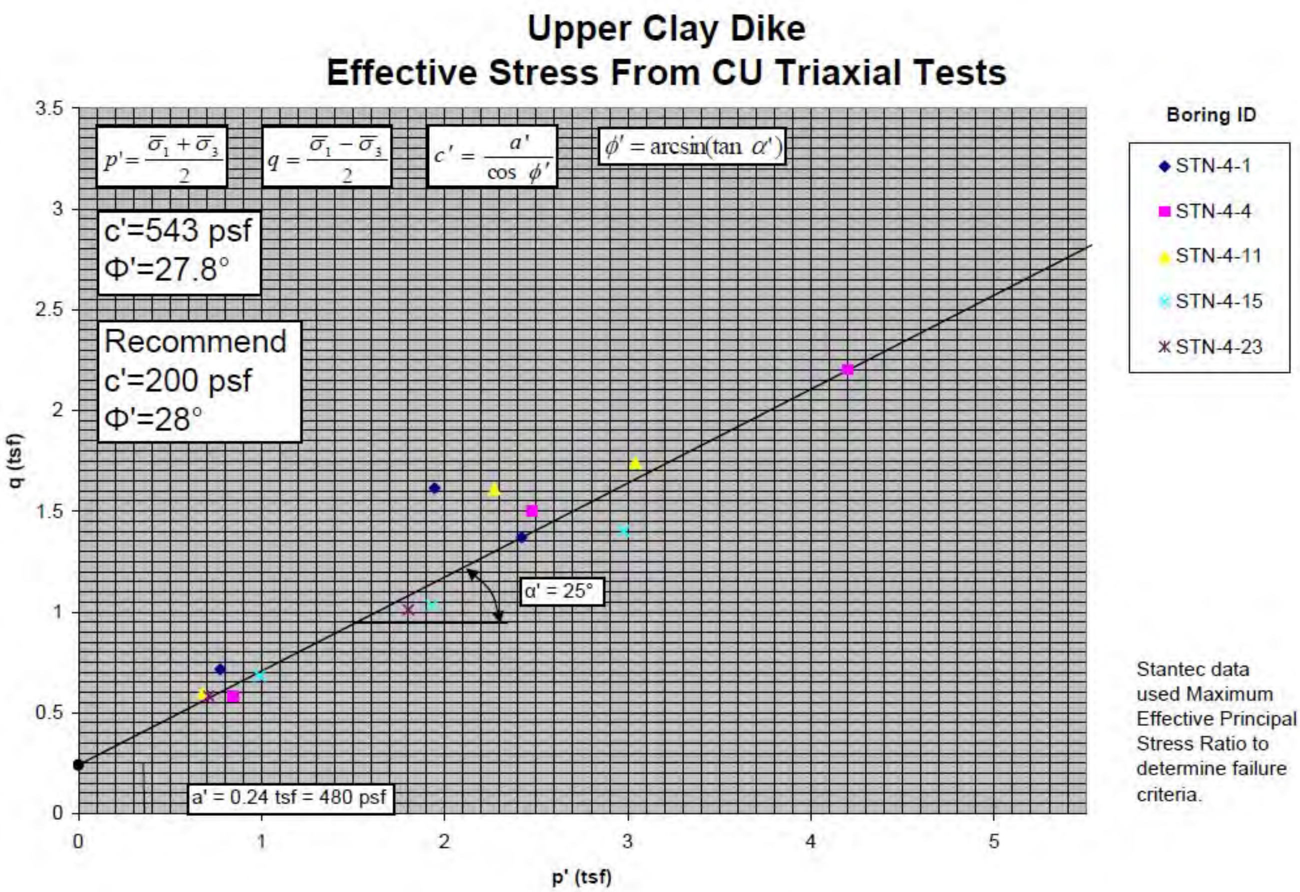


Figure I-1. Drained Failure Envelope for Upper Clay Dike (Stantec, 2010).

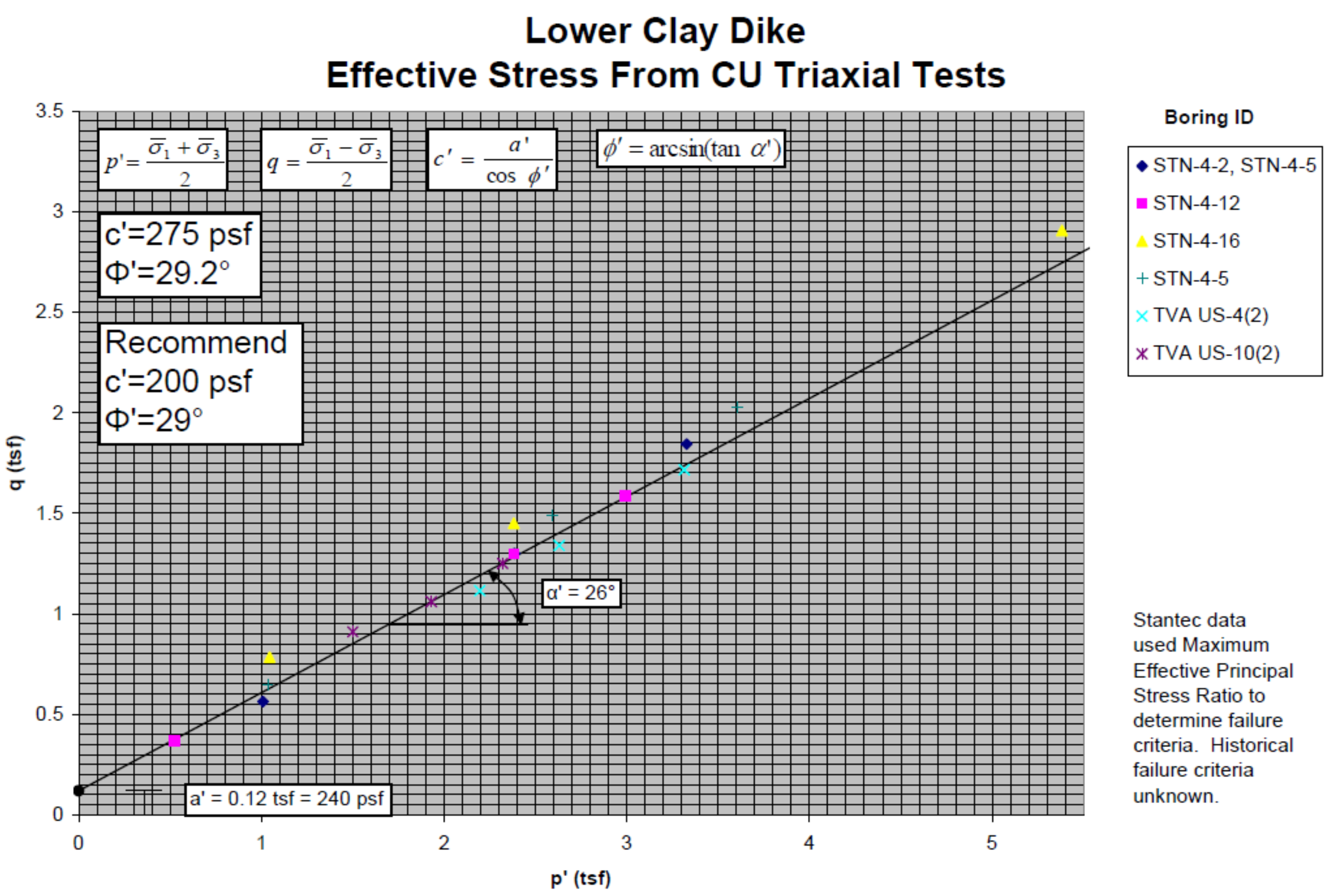


Figure I-2. Drained Failure Envelope for Lower Clay Dike (Stantec, 2010).

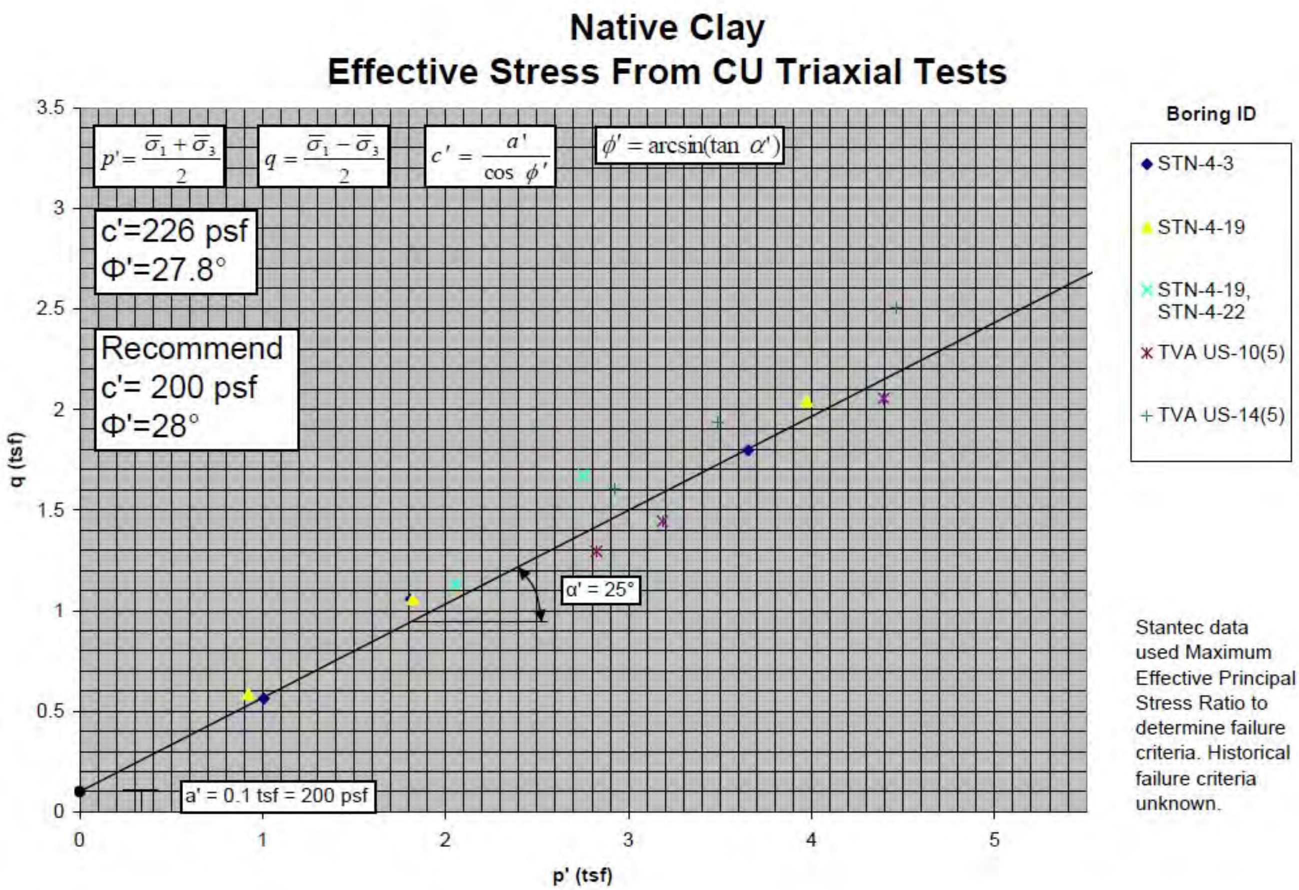


Figure I-3. Drained Failure Envelope for Native Clay (Stantec, 2010).

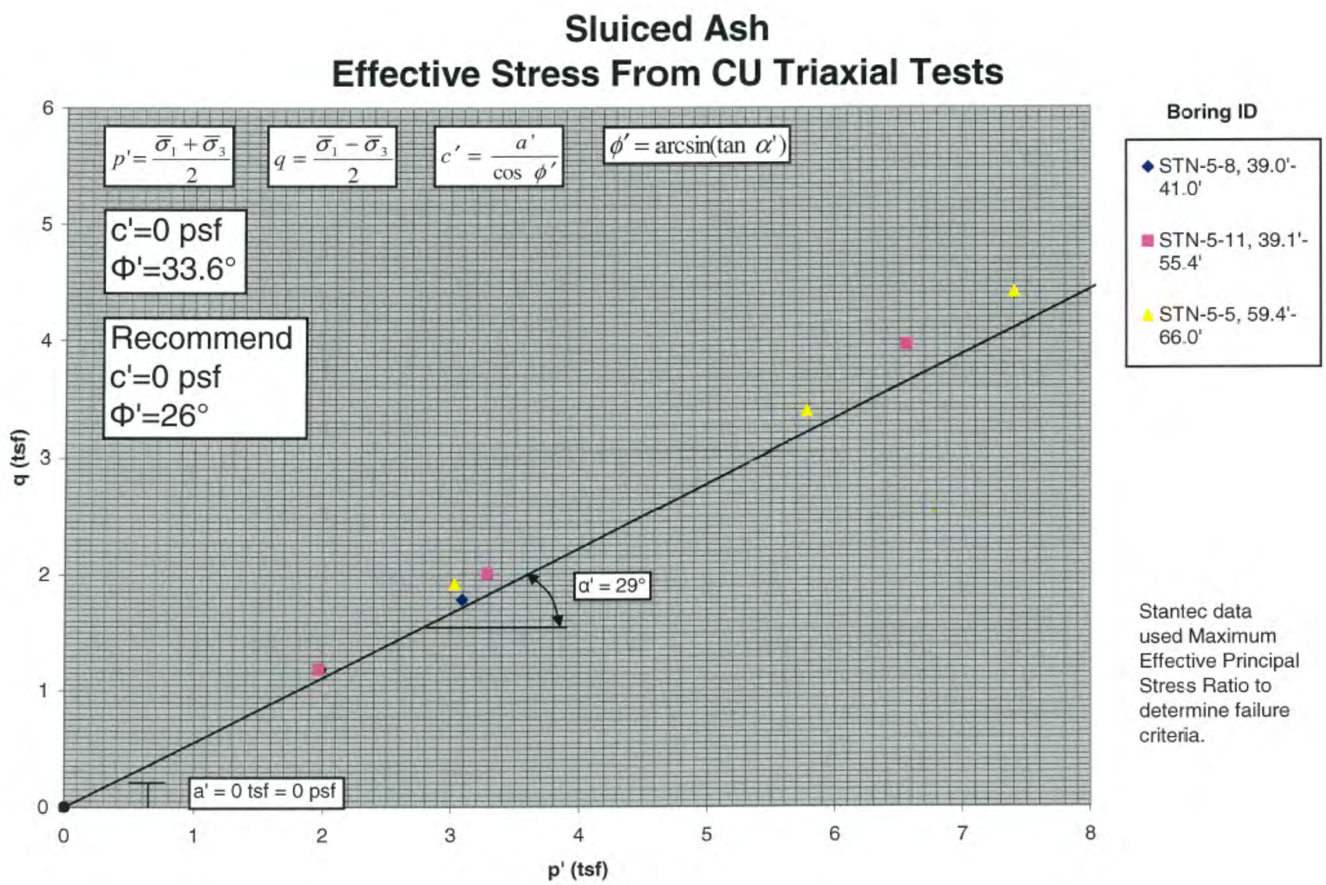


Figure I-4. Drained Failure Envelope for Sluiced Ash (Stantec, 2010).

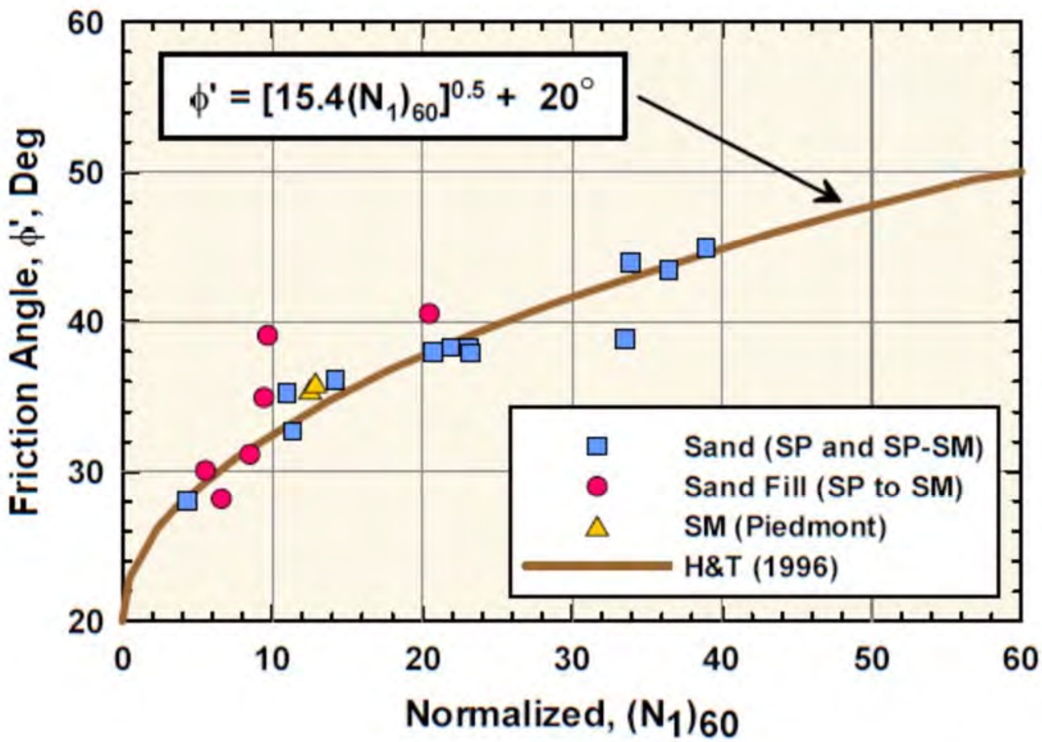


Figure I-5. Peak Friction Angle of Sands from SPT Resistance (Adapted from Hatanaka & Uchida, 1996; Figure from FHWA NHI, 2002).

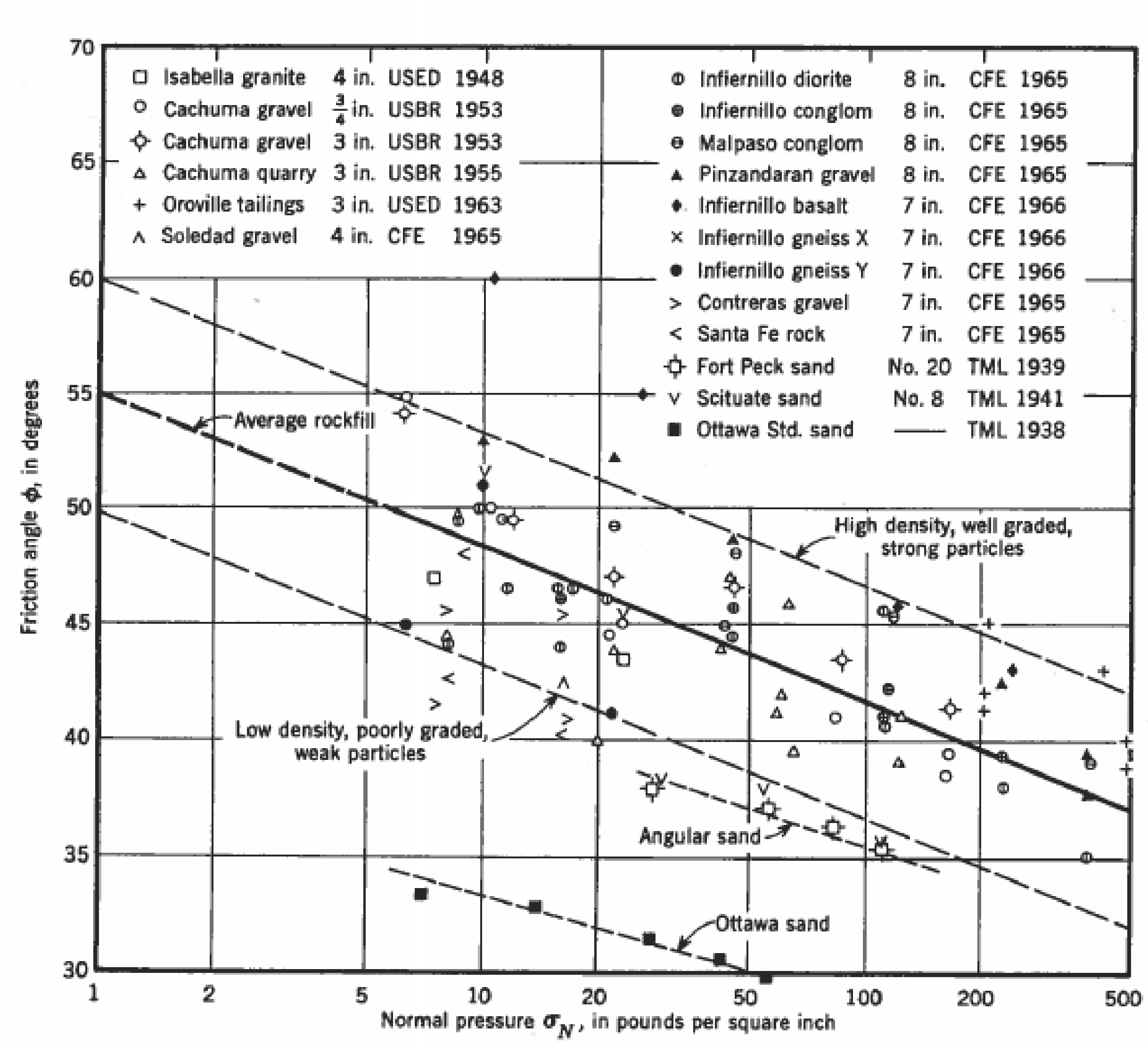


Figure I-6. Shearing Strengths of Rockfill from Large Triaxial Tests (Leps, 1970).

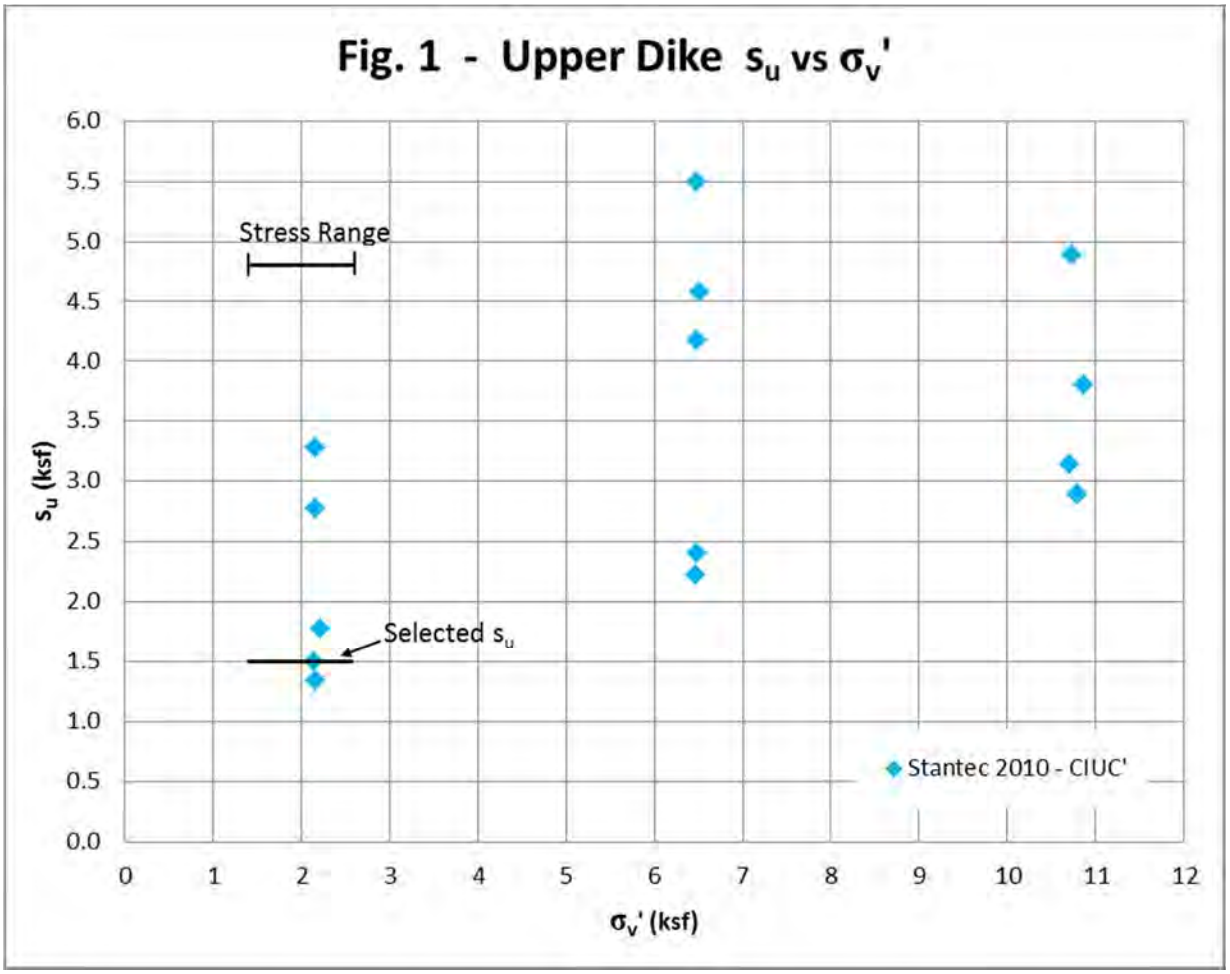


Figure I-7. s_u Versus σ_v' Plots for Upper Clay Dike.

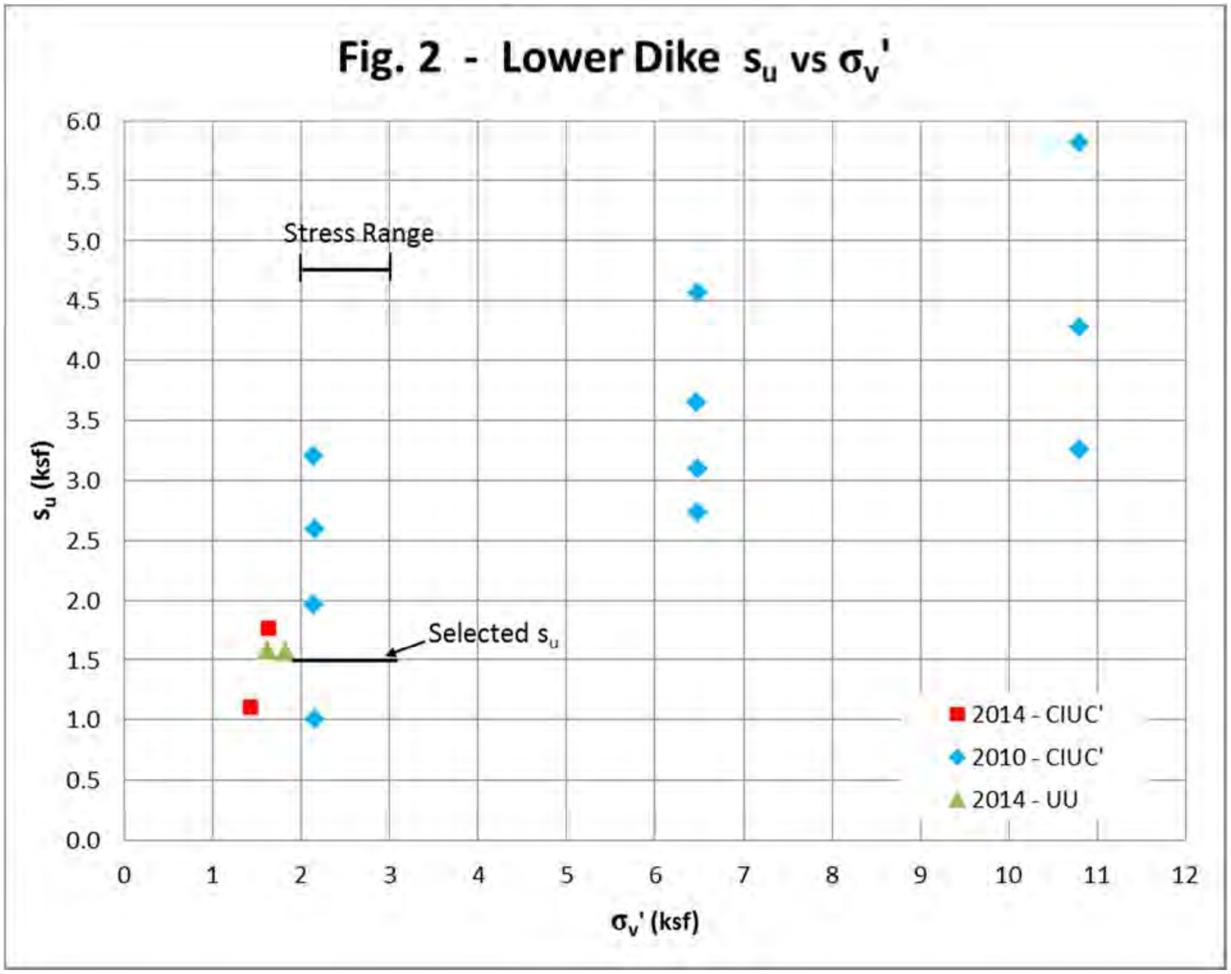


Figure I-8. s_u Versus σ_v' Plots for Lower Clay Dike.

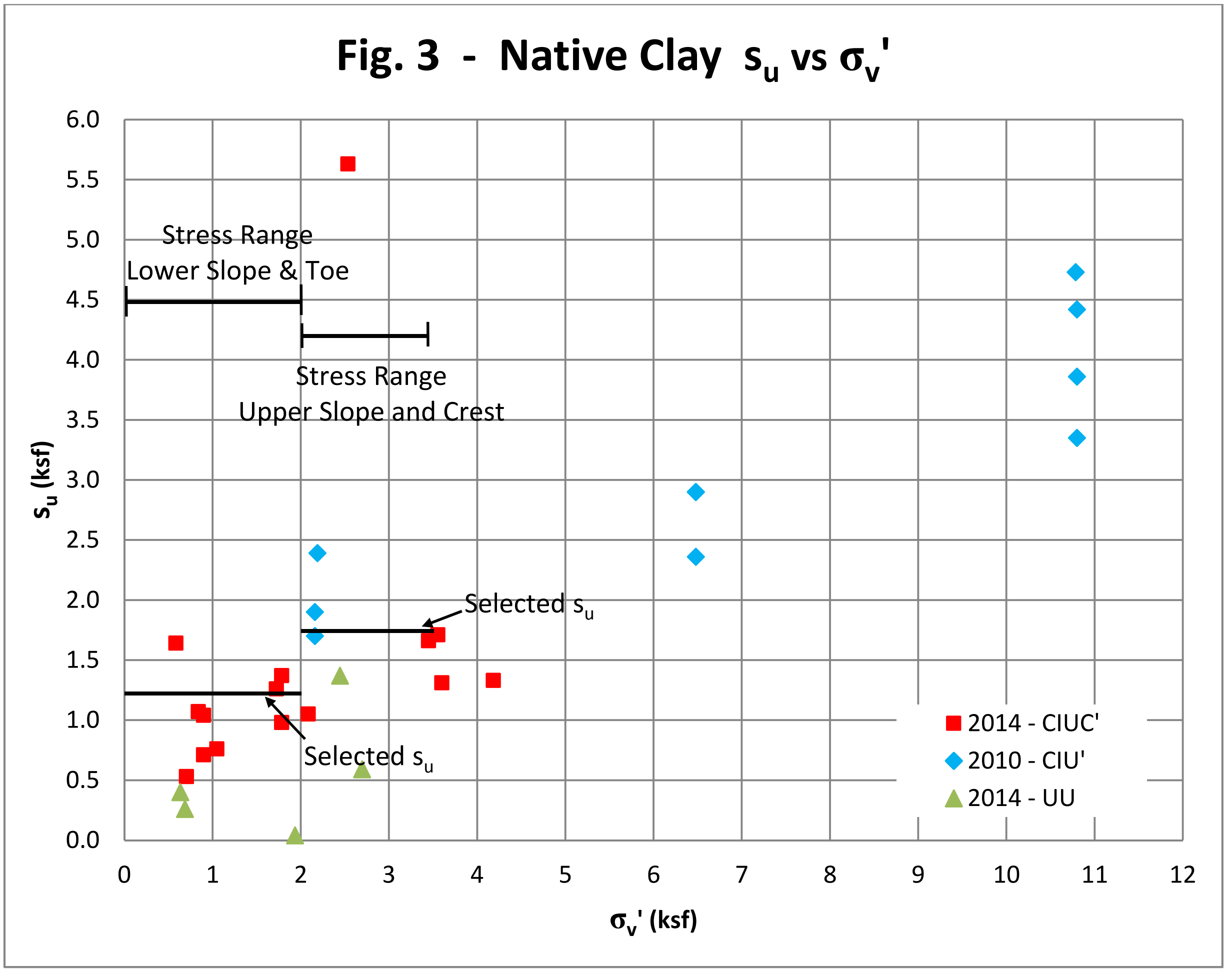


Figure I-9. s_u Versus σ_v' Plots for Native Clay.

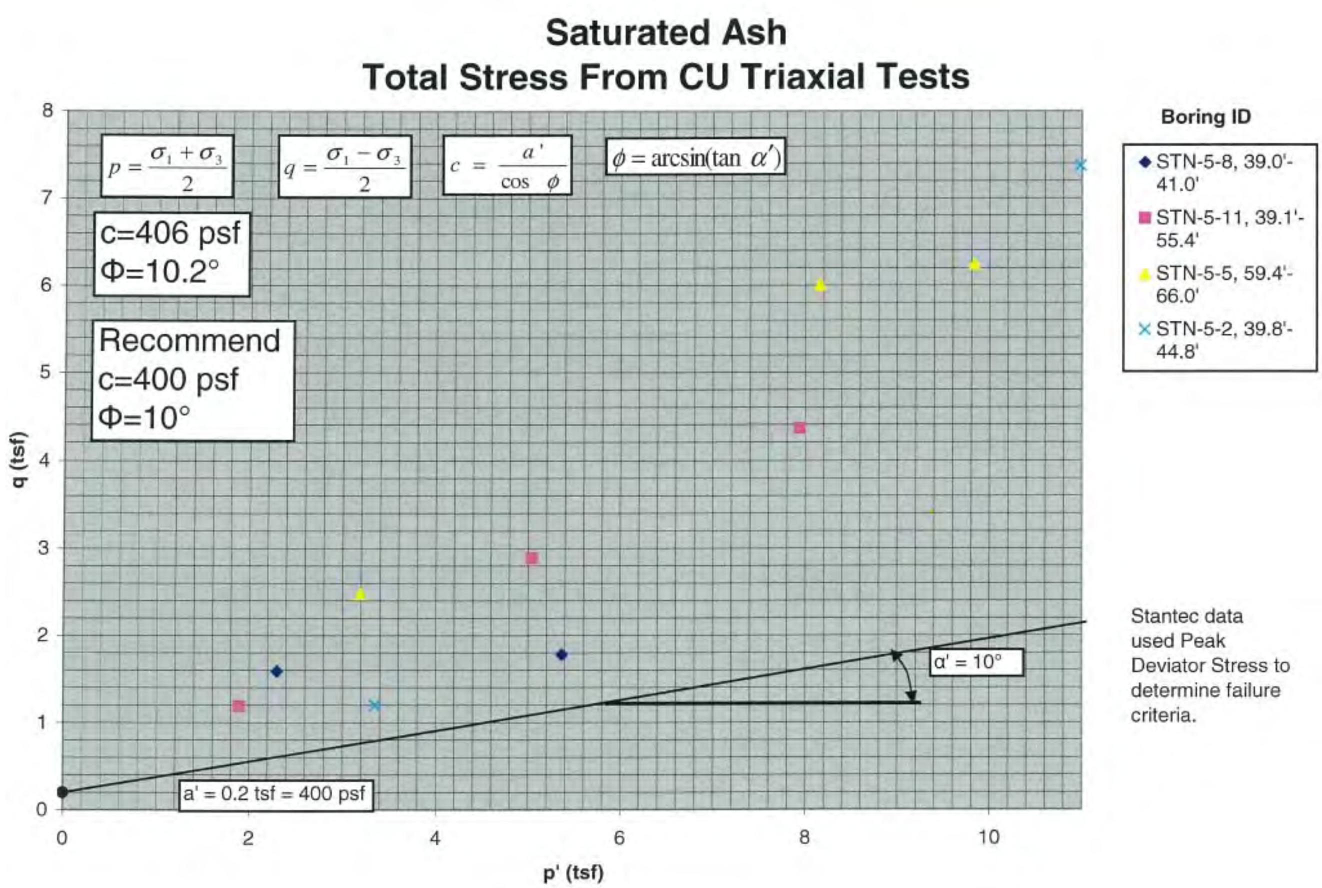


Figure I-10. Undrained Failure Envelope for Sluiced Ash (Stantec, 2010).

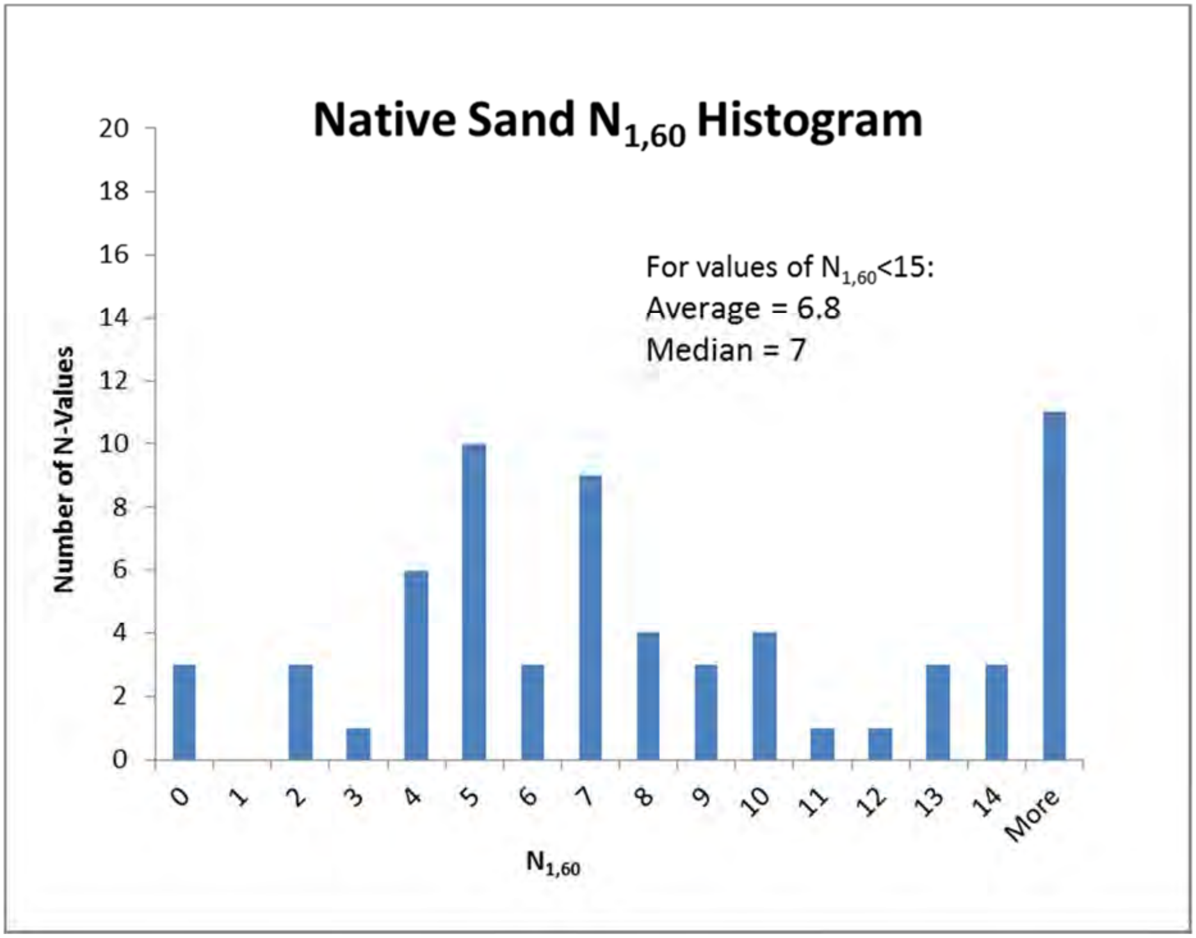


Figure I-11. Histogram of $N_{1,60}$ Values Measured in the Native Sand and Low Plasticity Silt.

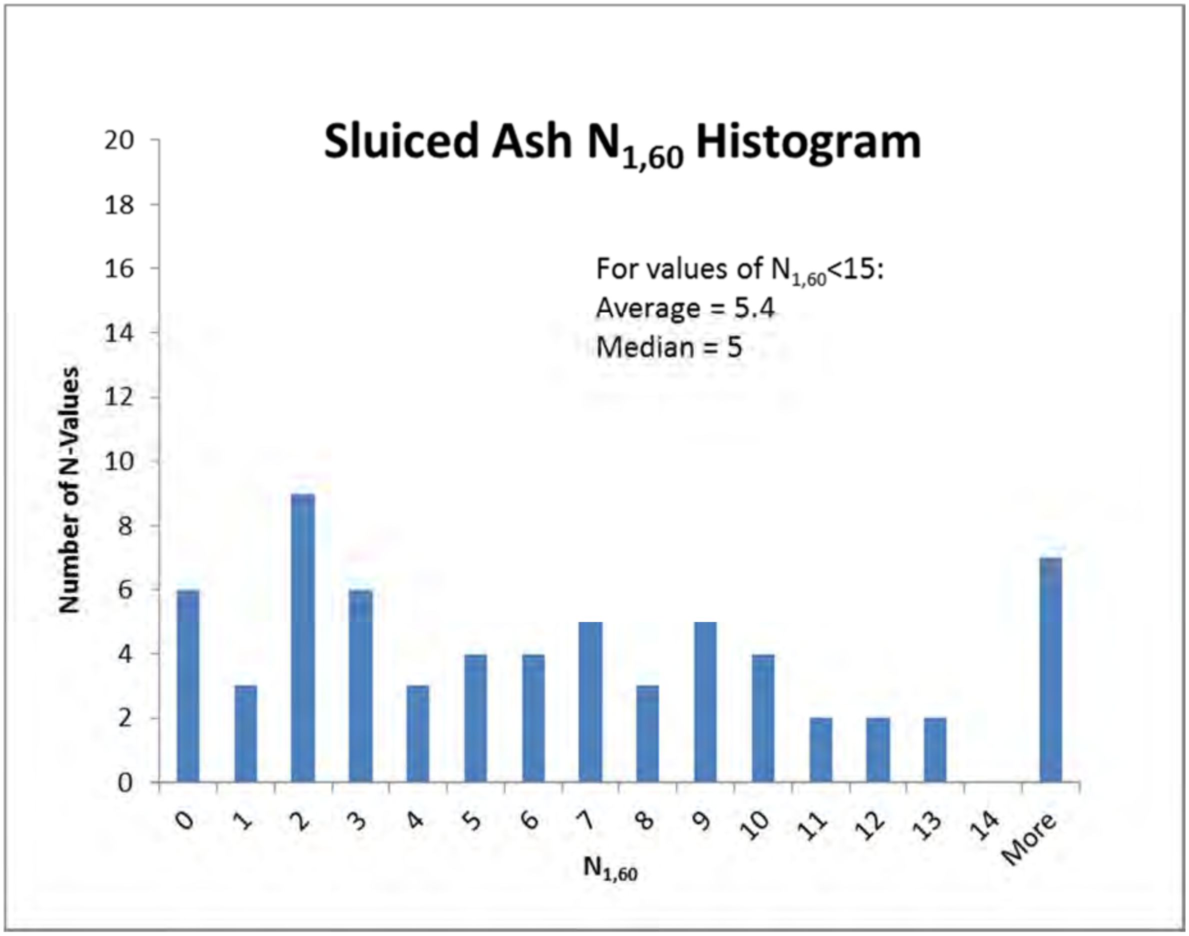
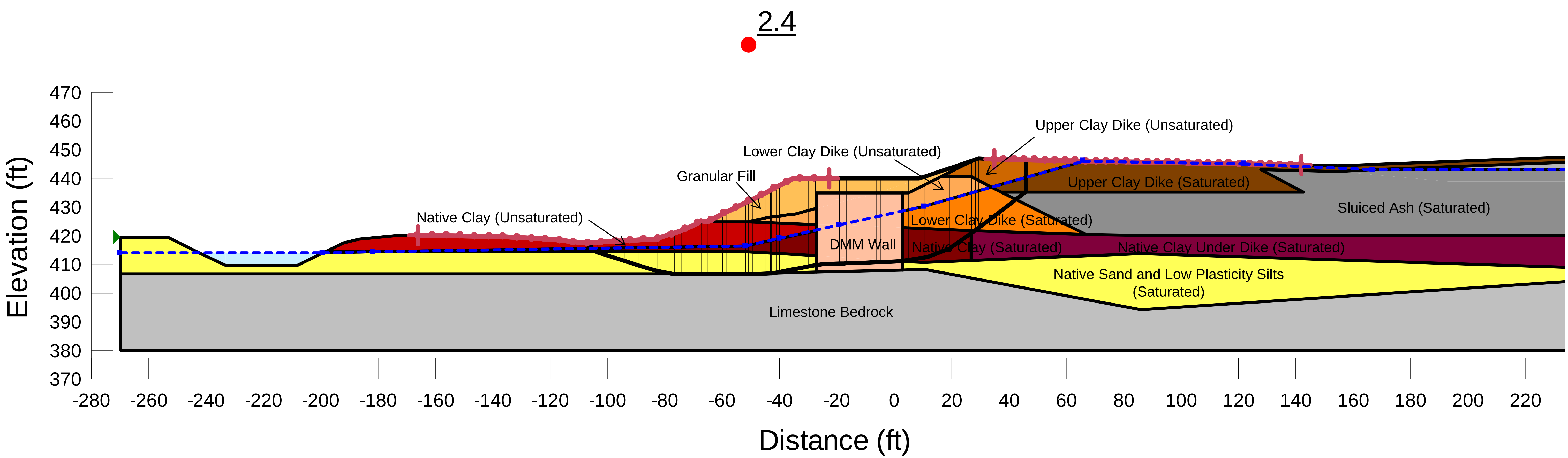


Figure I-12. Histogram of $N_{1,60}$ Values Measured in the Sluiced Ash.

Appendix B

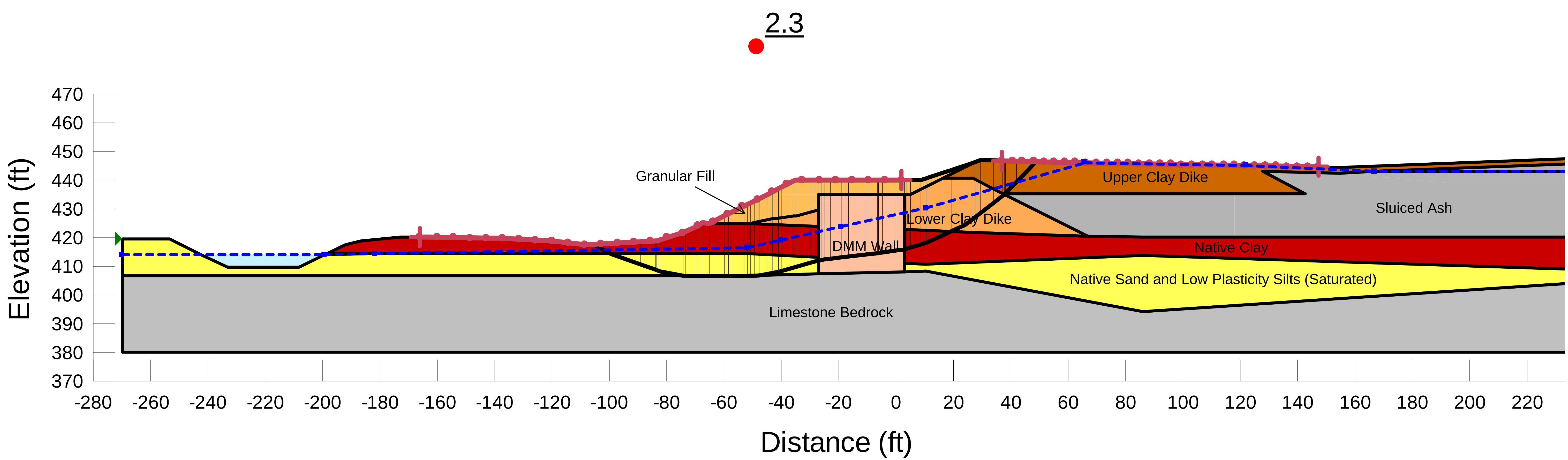
Slope Stability Analyses

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1500	0
Sluiced Ash (Saturated)	107	400	10
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1500	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	750	0
Native Clay Under Dike (Saturated)	129	1250	0
Native Sand and Low Plasticity Silts (Saturated)	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Design Section B Proposed Regrading With DMM Walls End of Construction (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 1

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Lower Clay Dike	127	200	29
Native Clay	129	200	28
Native Sand and Low Plasticity Silts	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

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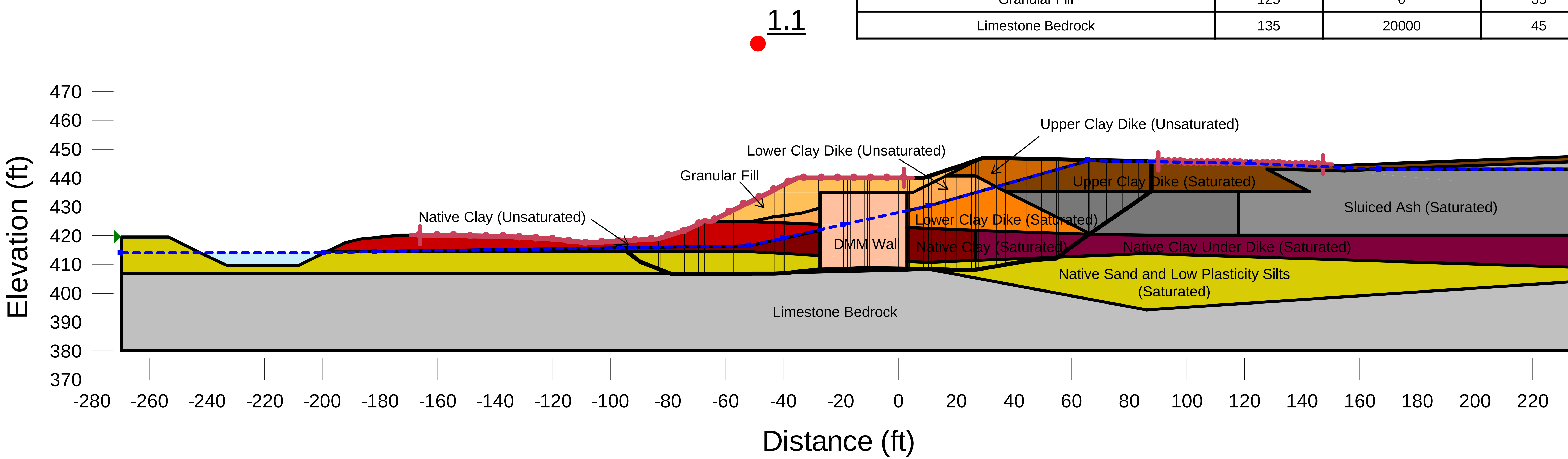
Design Section B
Proposed Regrading With DMM Walls
Long Term (Drained)

May 2016

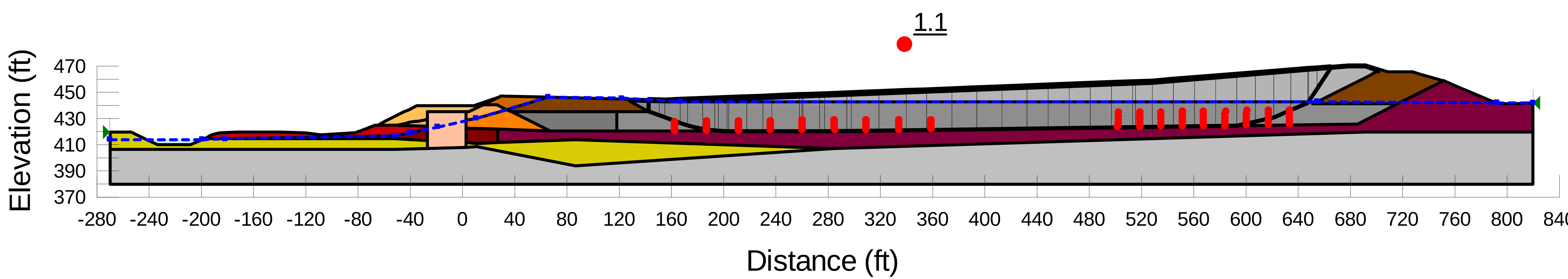
FIG. 2

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	800	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



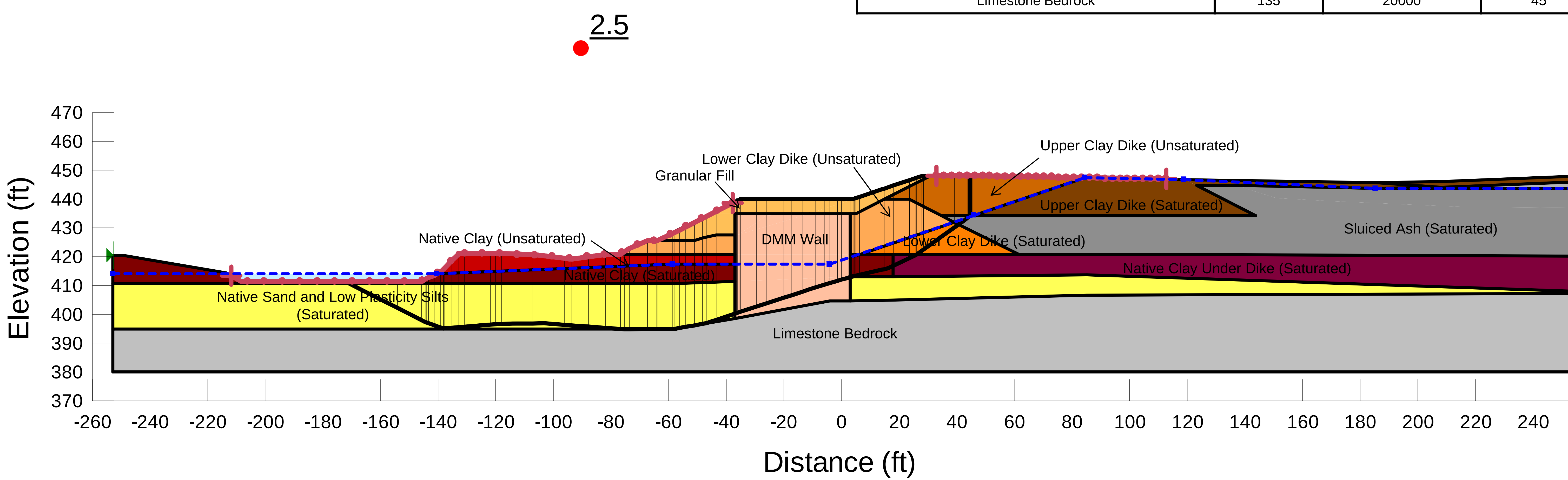
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Design Section B Proposed Regrading With DMM Walls Post-Earthquake (Undrained)	
Tennessee Valley Authority Chattanooga, Tennessee		May 2016	FIG. 3

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	c/σ'_v= 0.06 c_{min}= 100	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	800	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



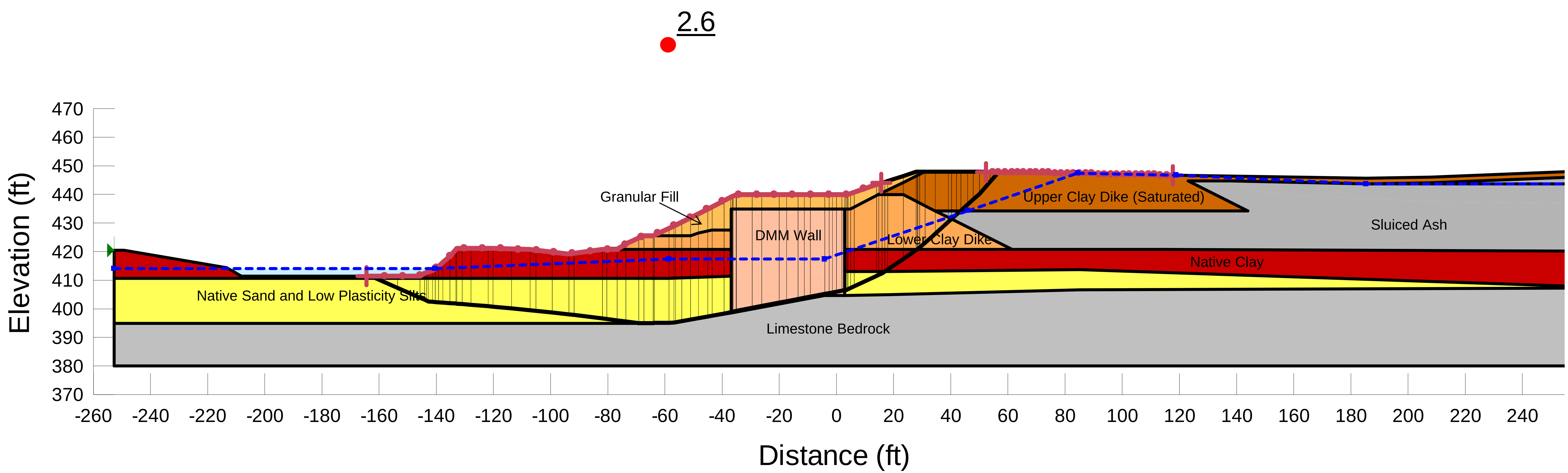
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Design Section B Failure in Ash Stack Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 4

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1500	0
Sluiced Ash (Saturated)	107	400	10
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1500	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	750	0
Native Clay Under Dike (Saturated)	129	1250	0
Native Sand and Low Plasticity Silts (Saturated)	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



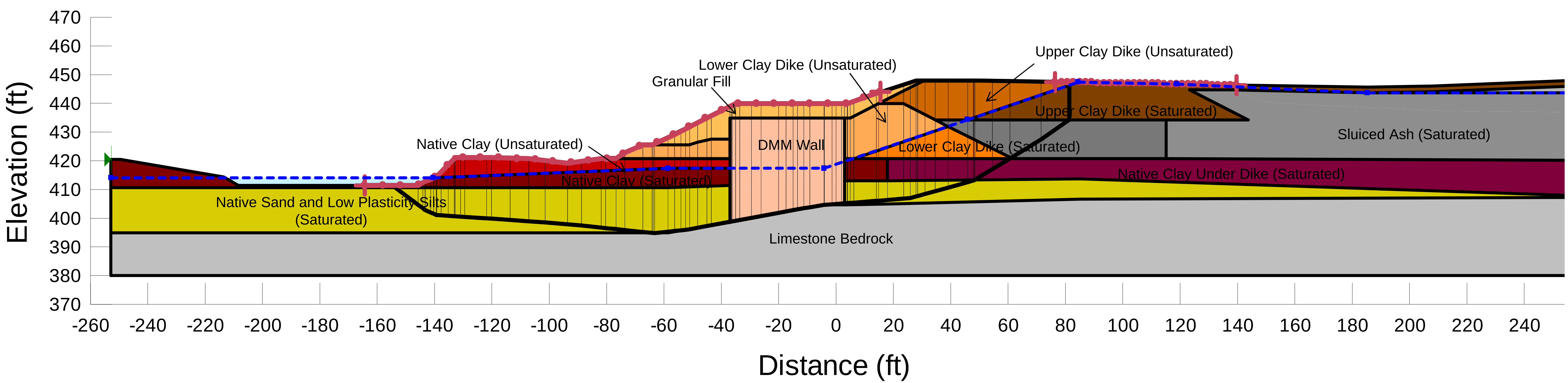
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Design Section C Proposed Regrading With DMM Walls End of Construction (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 5

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Lower Clay Dike	127	200	29
Native Clay	129	200	28
Native Sand and Low Plasticity Silts	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



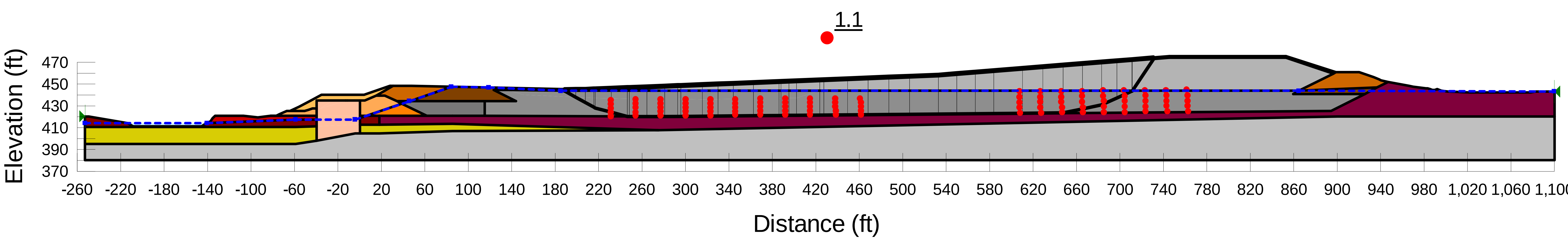
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section C Proposed Regrading With DMM Walls Long Term (Drained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 6

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1650	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section C Proposed Regrading With DMM Walls Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 7

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1650	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

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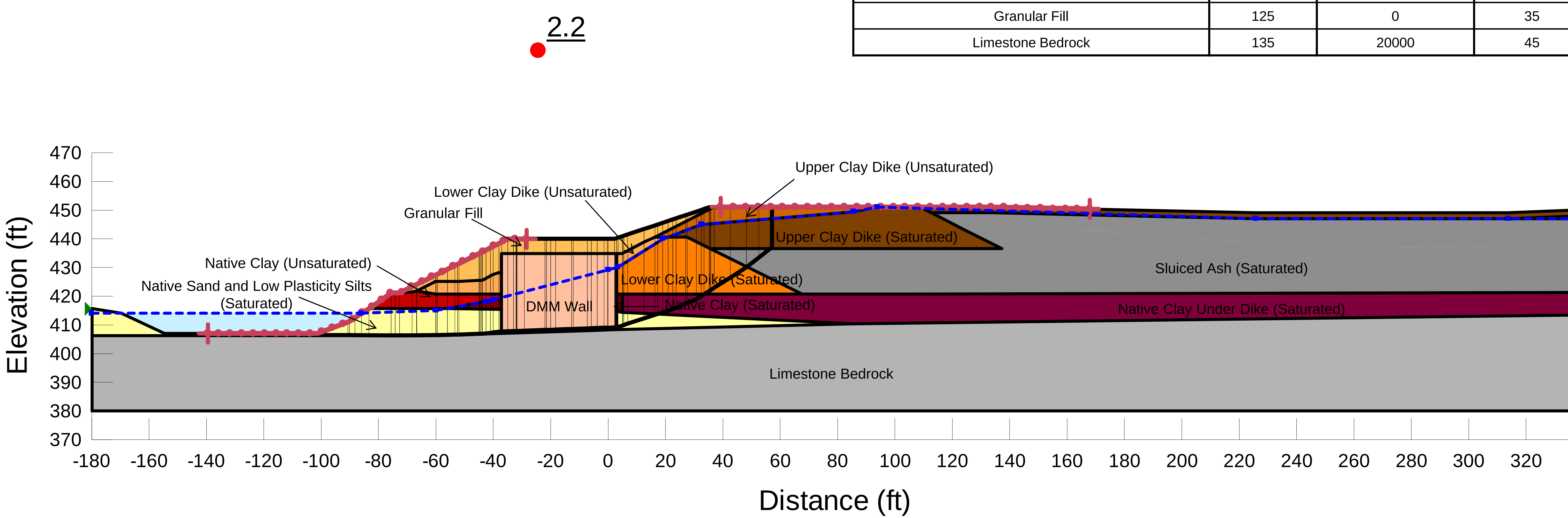
Section C
Failure in Ash Stack
Post-Earthquake (Undrained)

May 2016

FIG. 8

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1500	0
Sluiced Ash (Saturated)	107	400	10
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1500	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	750	0
Native Clay Under Dike (Saturated)	129	1250	0
Native Sand and Low Plasticity Silts (Saturated)	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

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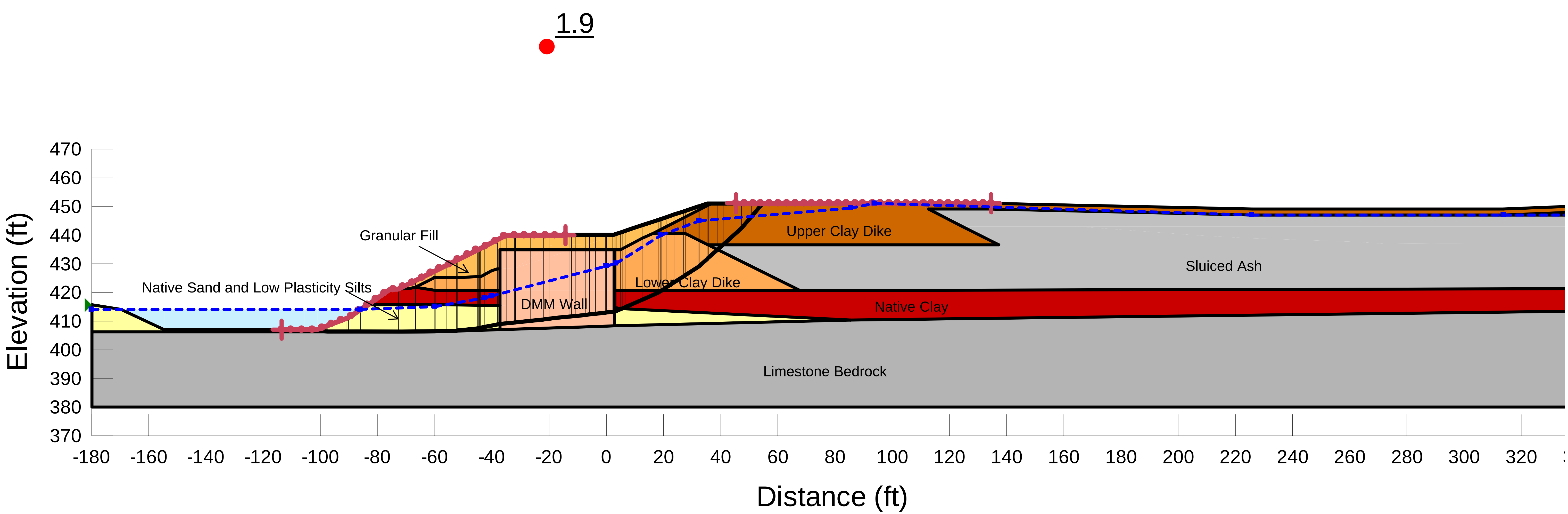
Section D1
Proposed Regrading With DMM Walls
End of Construction (Undrained)

May 2016

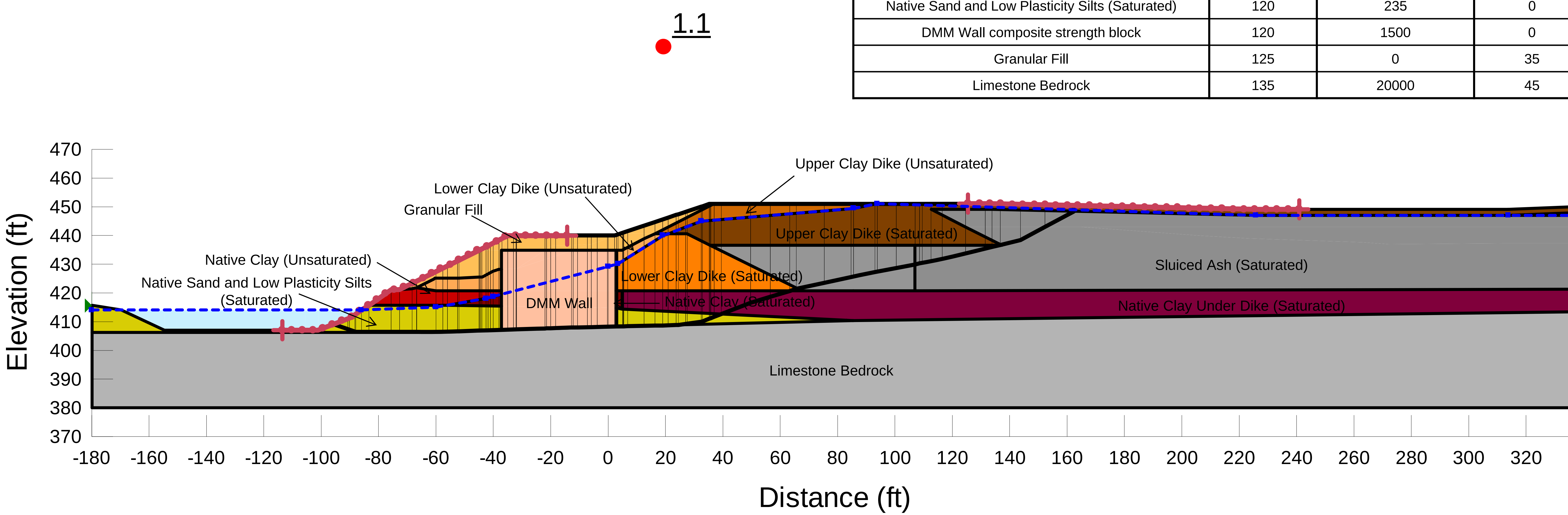
FIG. 9

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Lower Clay Dike	127	200	29
Native Clay	129	200	28
Native Sand and Low Plasticity Silts	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



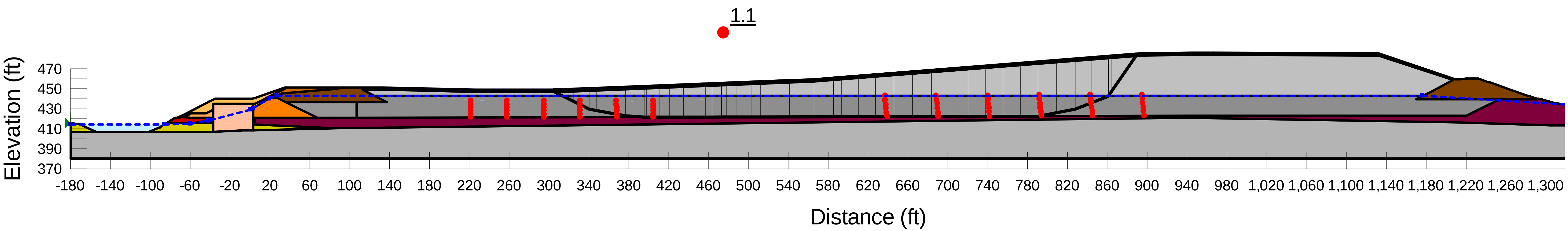
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section D1 Proposed Regrading With DMM Walls Long Term (Drained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 10

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1500	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



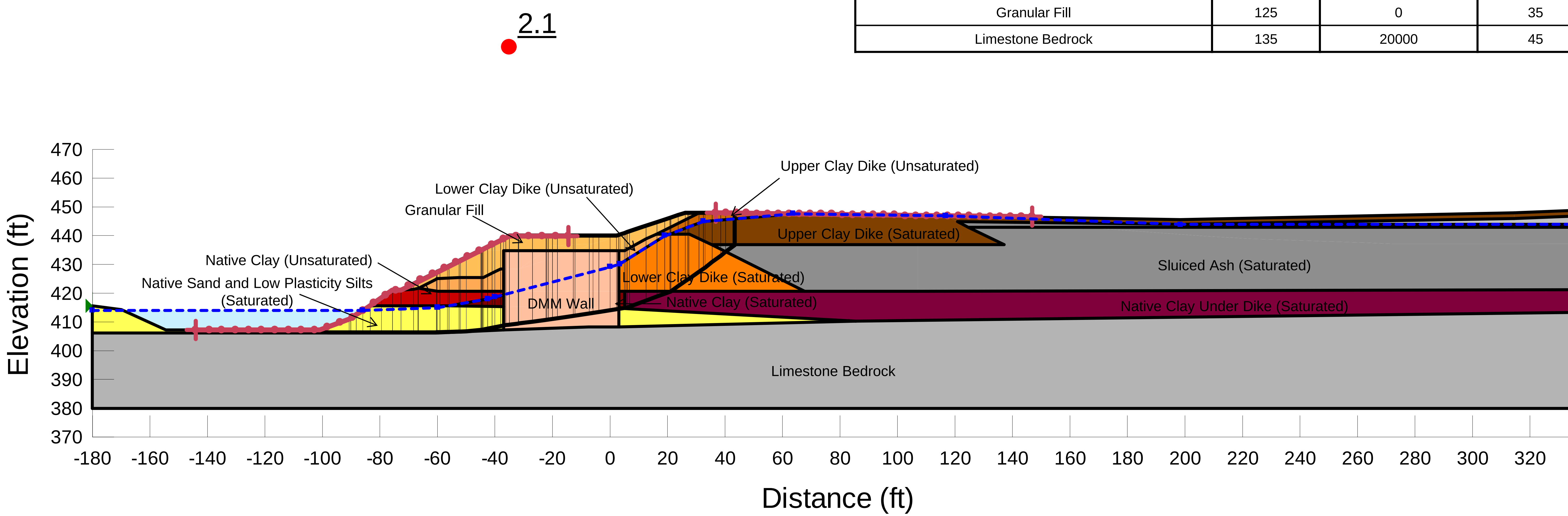
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section D1 Proposed Regrading With DMM Walls Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 11

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	c/σ'_v= 0.06 c_{min}= 100	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1500	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



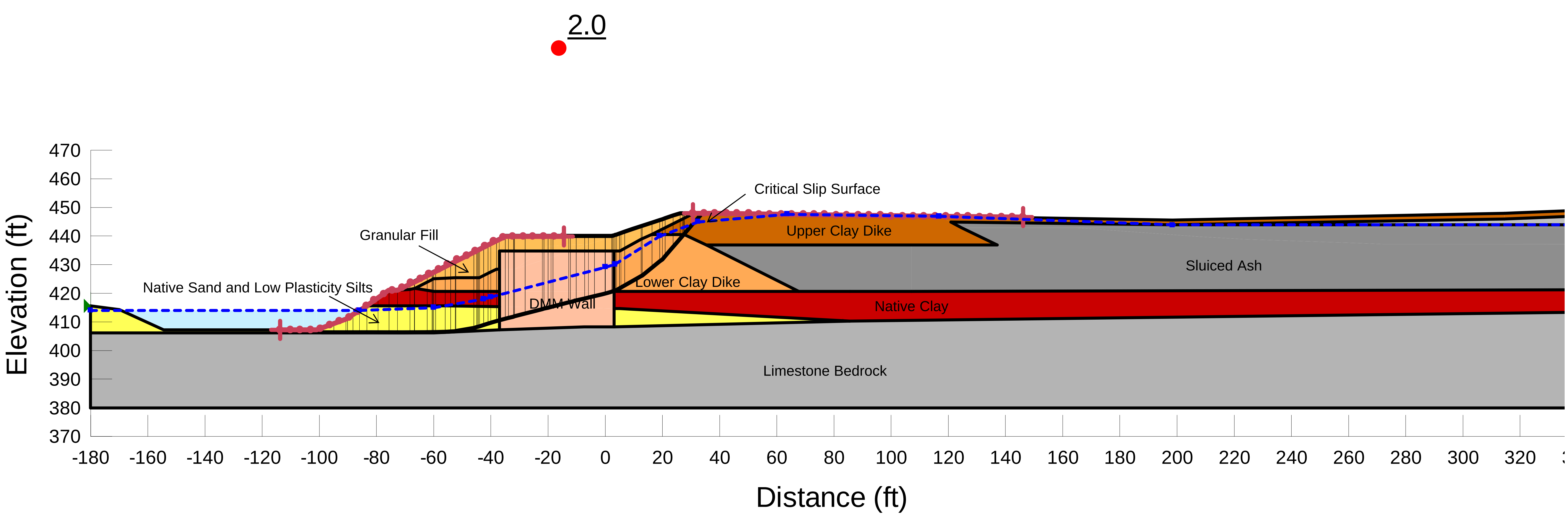
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section D1 Failure in Ash Stack Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 12

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1500	0
Sluiced Ash (Saturated)	107	400	10
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1500	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	750	0
Native Clay Under Dike (Saturated)	129	1250	0
Native Sand and Low Plasticity Silts (Saturated)	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



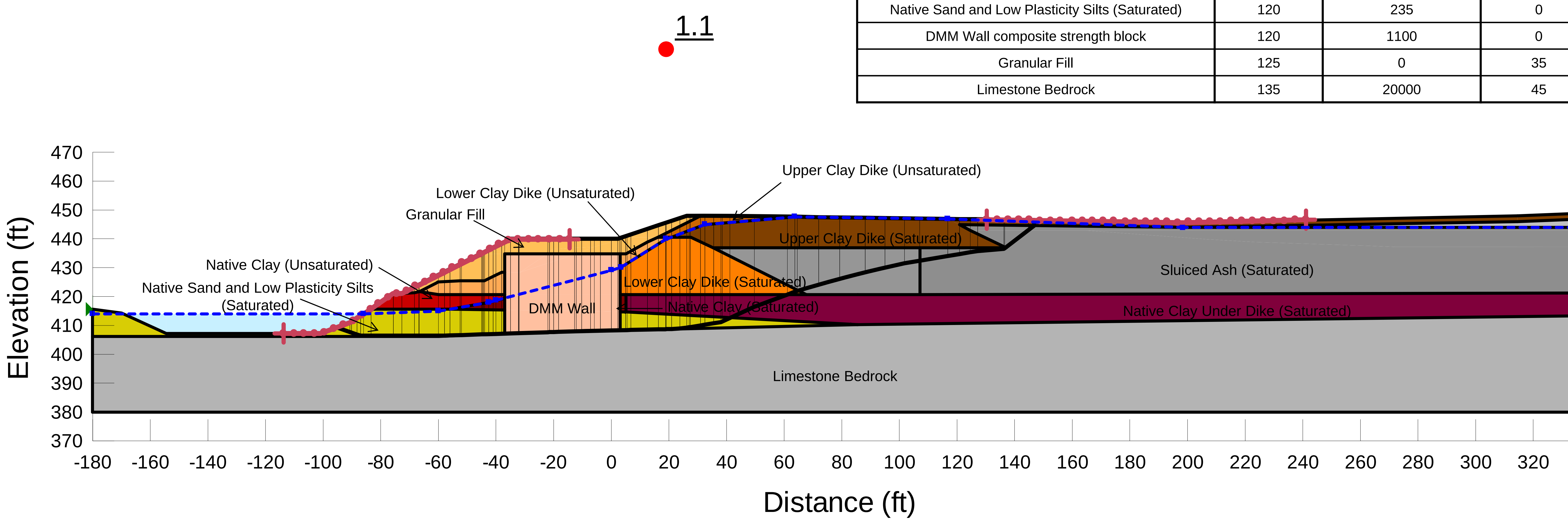
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section D2 Proposed Regrading With DMM Walls End of Construction (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 13

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Lower Clay Dike	127	200	29
Native Clay	129	200	28
Native Sand and Low Plasticity Silts	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



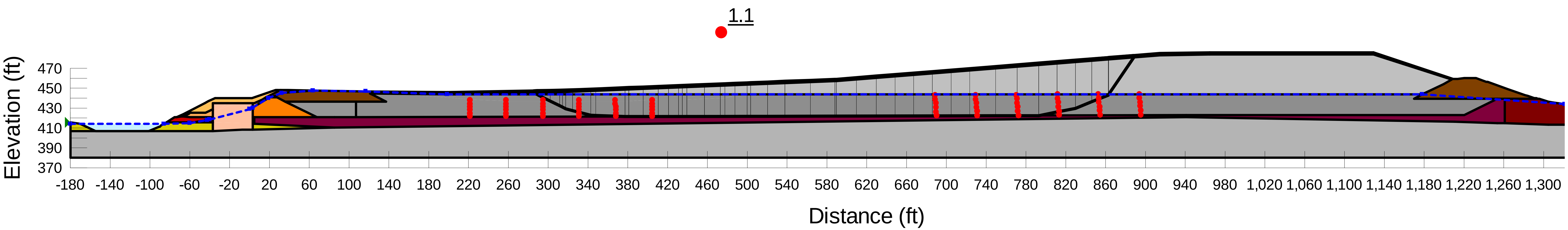
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section D2 Proposed Regrading With DMM Walls Long Term (Drained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 14

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1100	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



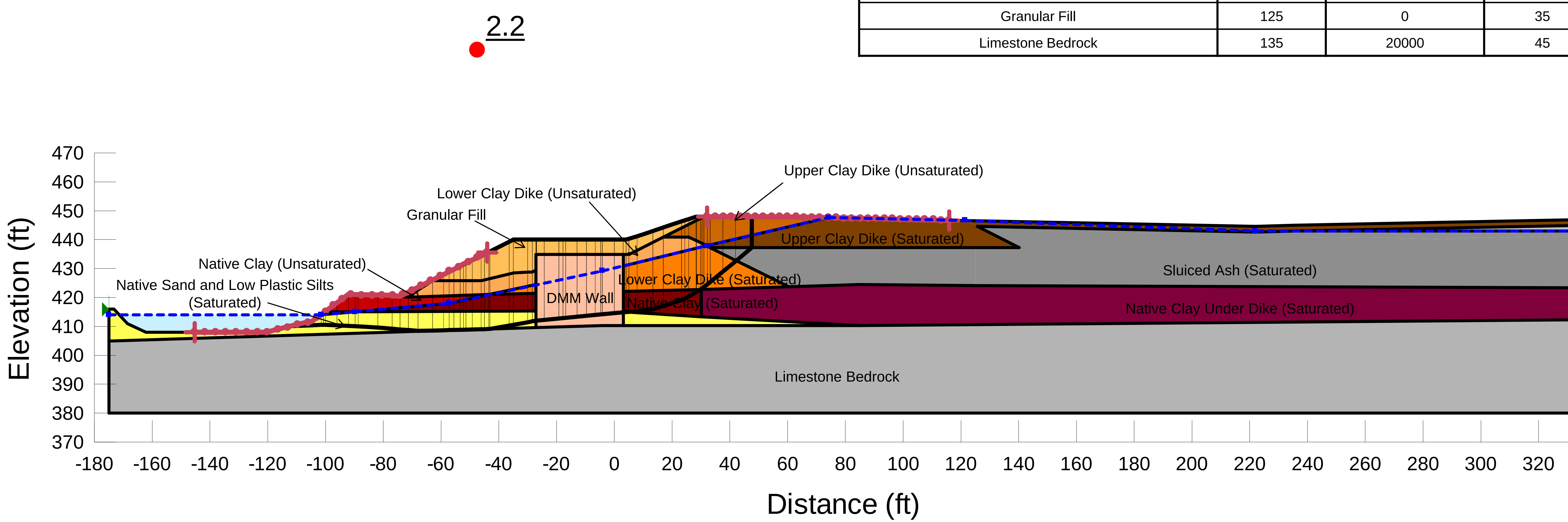
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section D2 Proposed Regrading With DMM Walls Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 15

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1150	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



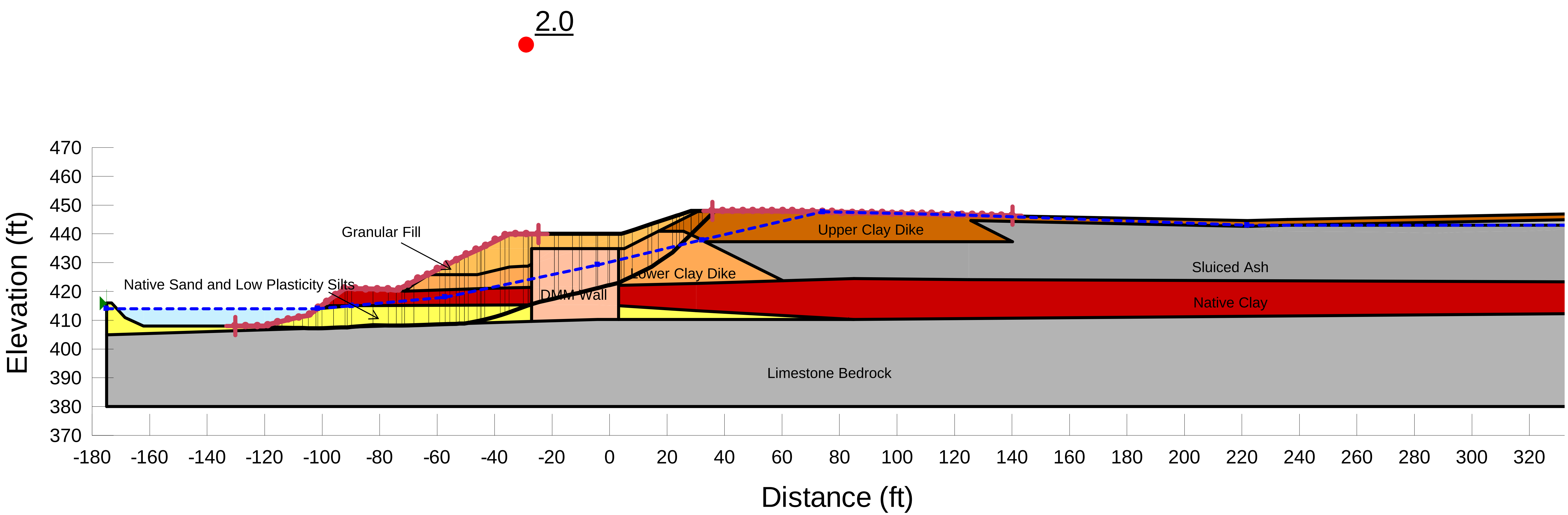
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section D2 Failure in Ash Stack Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 16

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1500	0
Sluiced Ash (Saturated)	107	400	10
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1500	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	750	0
Native Clay Under Dike (Saturated)	129	1250	0
Native Sand and Low Plasticity Silts (Saturated)	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section E Proposed Regrading With DMM Walls End of Construction (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 17

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Lower Clay Dike	127	200	29
Native Clay	129	200	28
Native Sand and Low Plasticity Silts	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

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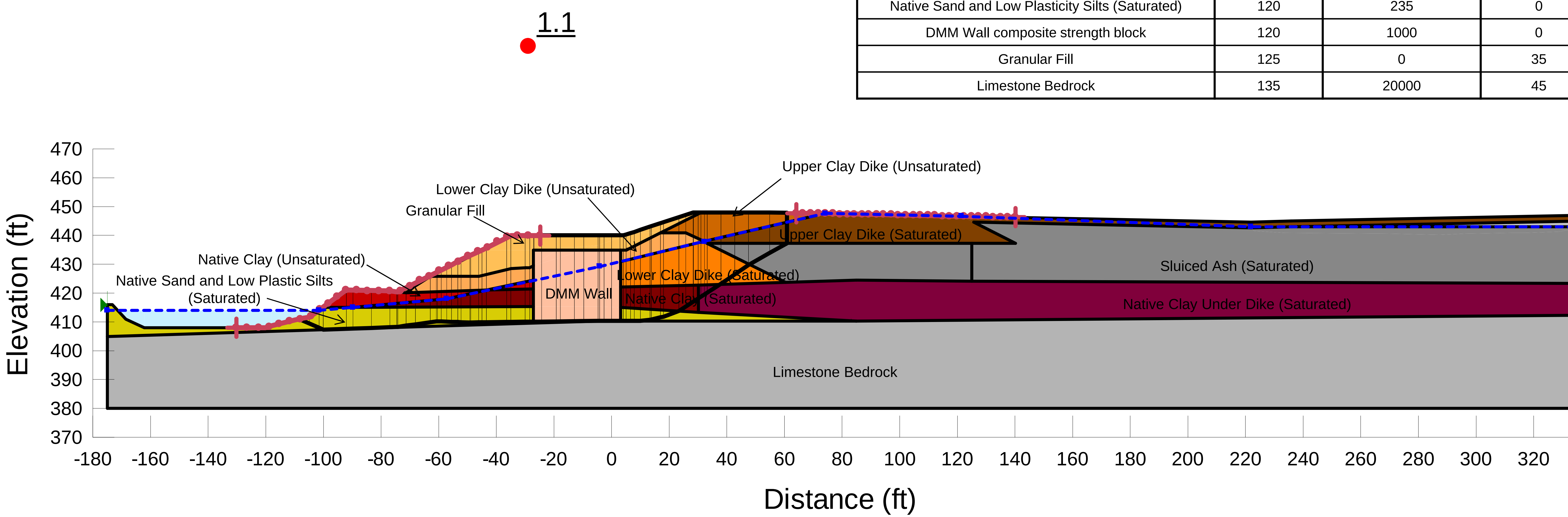
Section E
Proposed Regrading With DMM Walls
Long Term (Drained)

May 2016

FIG. 18

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1000	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

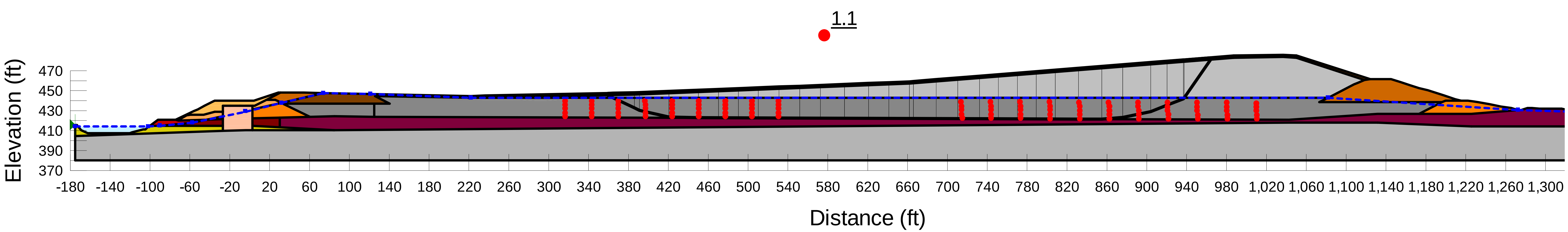
GEI Consultants

Section E
Proposed Regrading With DMM Walls
Post-Earthquake (Undrained)

May 2016

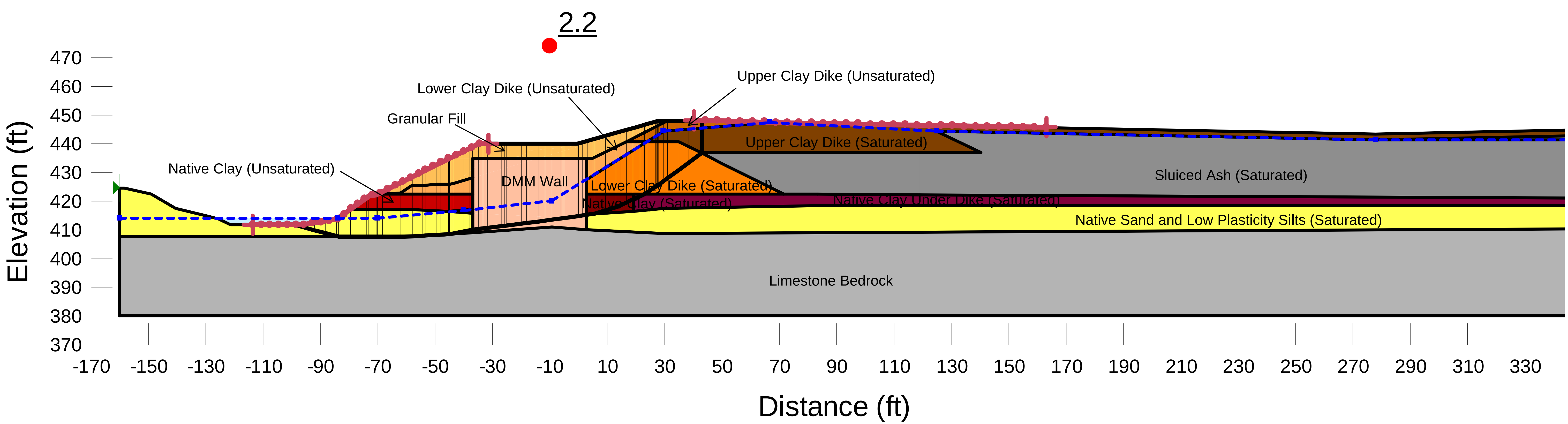
FIG. 19

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1150	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



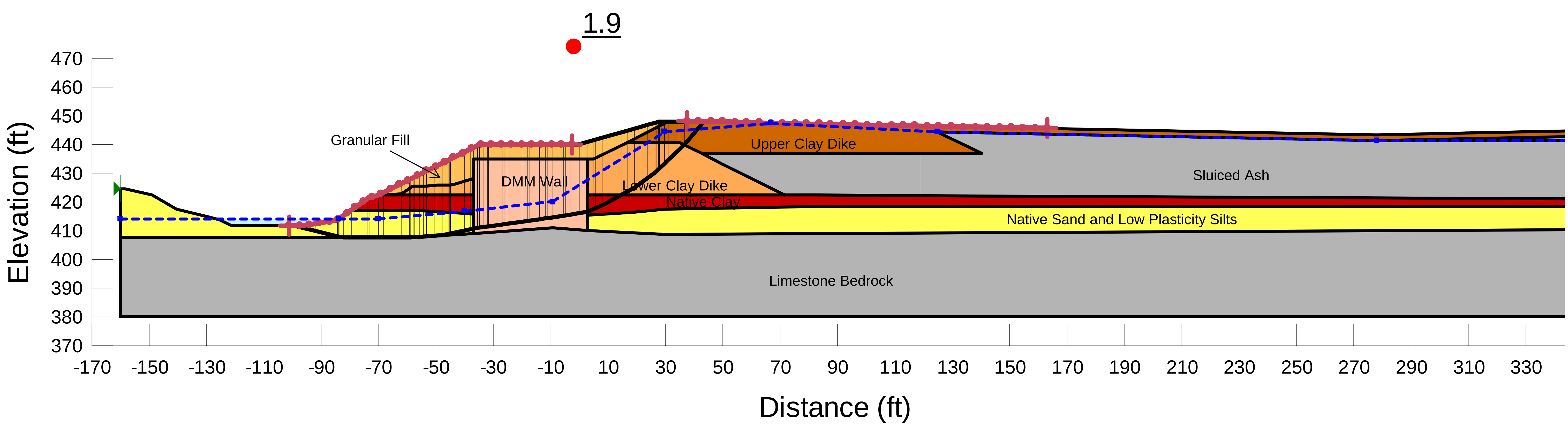
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section E Failure in Ash Stack Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 20

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1500	0
Sluiced Ash (Saturated)	107	400	10
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1500	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	750	0
Native Clay Under Dike (Saturated)	129	1250	0
Native Sand and Low Plasticity Silts (Saturated)	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section F1 Proposed Regrading With DMM Walls End of Construction (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 21

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Lower Clay Dike	127	200	29
Native Clay	129	200	28
Native Sand and Low Plasticity Silts	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

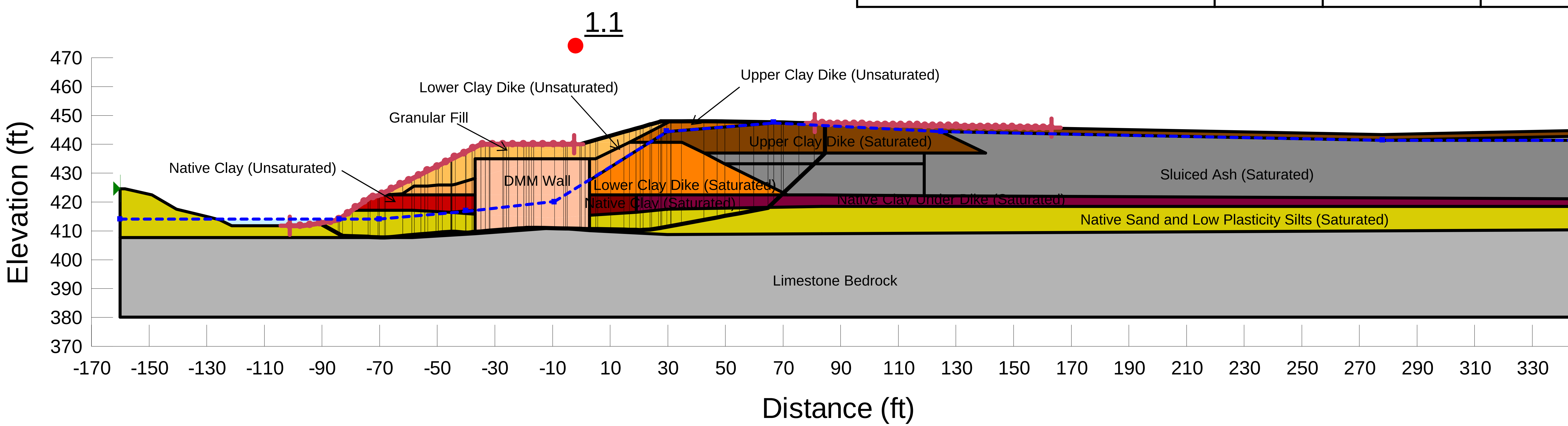
GEI Consultants

Section F1
Proposed Regrading With DMM Walls
Long Term (Drained)

May 2016

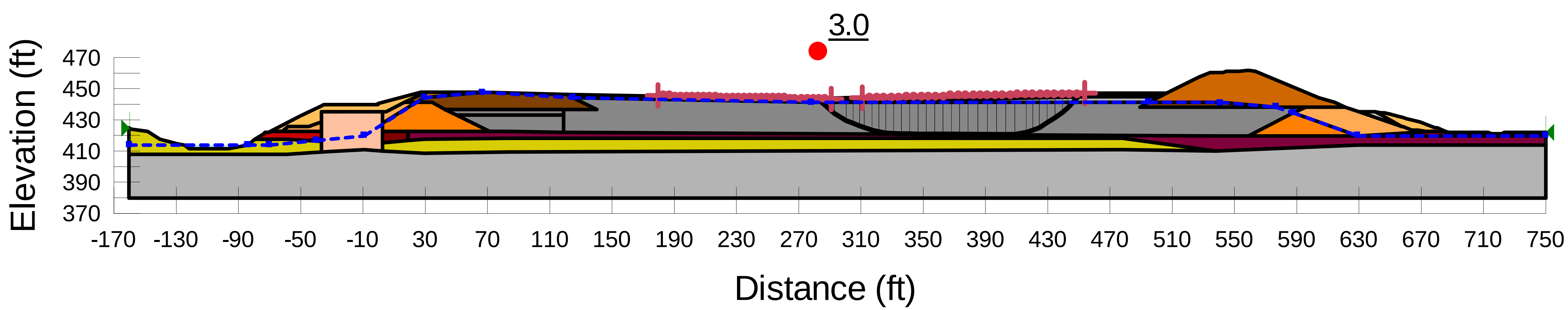
FIG. 22

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	c/σ'_v= 0.06 c_{min}= 100	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1150	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section F1 Proposed Regrading With DMM Walls Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 23

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1150	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

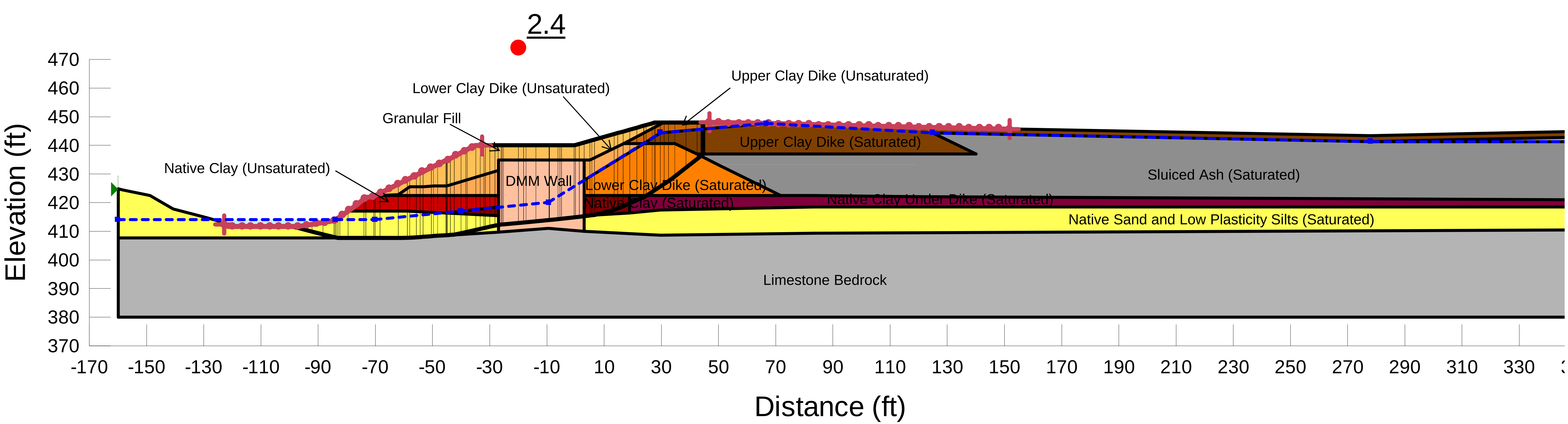
GEI Consultants

Section F1
Failure in Ash Stack
Post-Earthquake (Undrained)

May 2016

FIG. 24

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1500	0
Sluiced Ash (Saturated)	107	400	10
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1500	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	750	0
Native Clay Under Dike (Saturated)	129	1250	0
Native Sand and Low Plasticity Silts (Saturated)	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

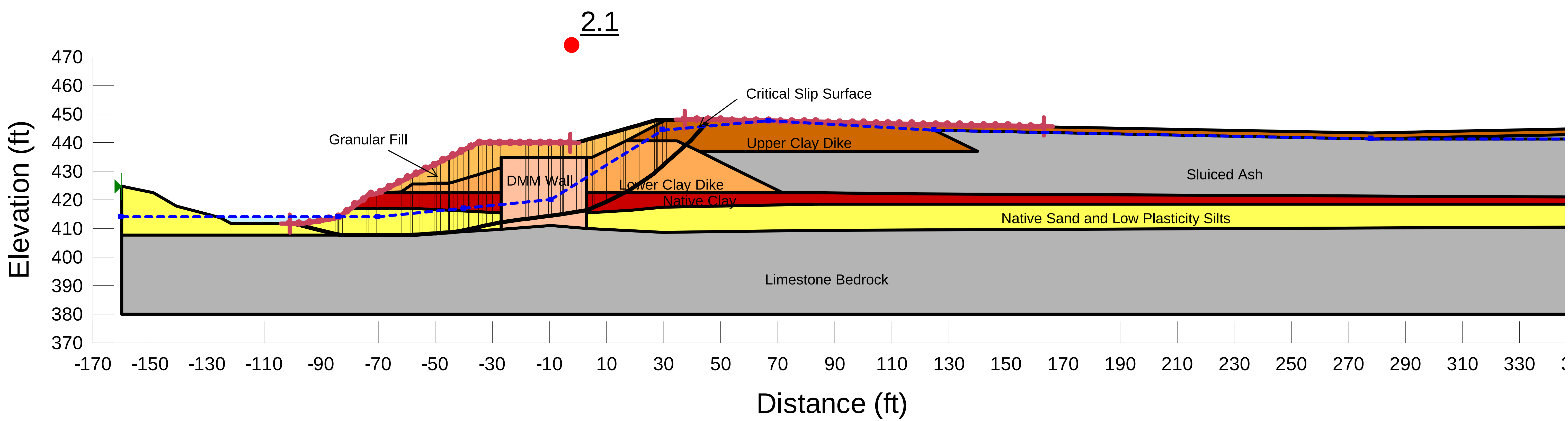
GEI Consultants

Section F2
Proposed Regrading With DMM Walls
End of Construction (Undrained)

May 2016

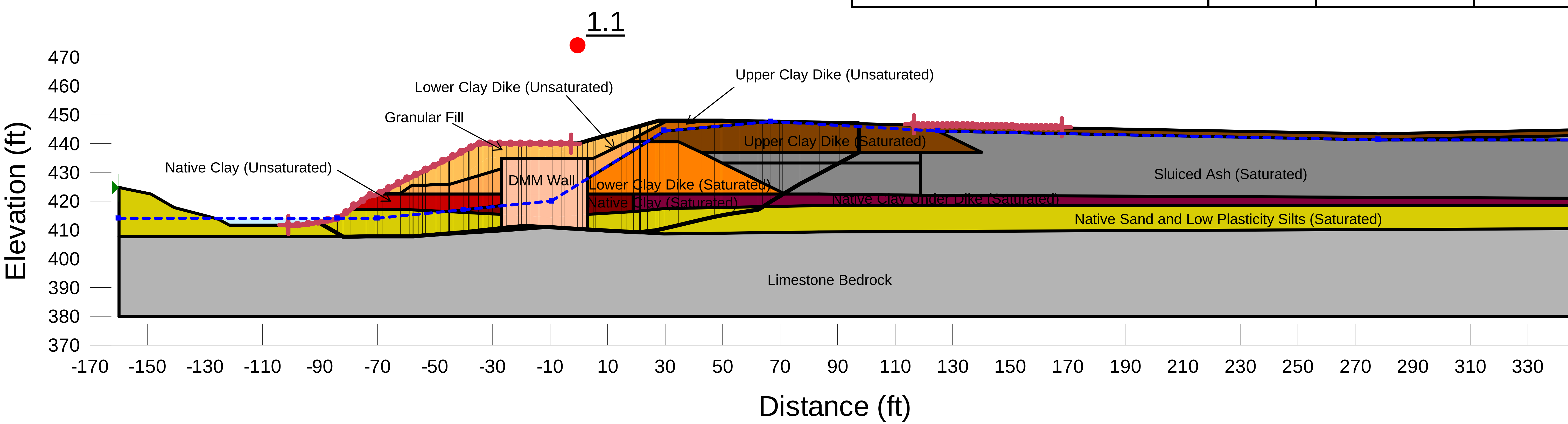
FIG. 25

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Lower Clay Dike	127	200	29
Native Clay	129	200	28
Native Sand and Low Plasticity Silts	120	0	30
Rip Rap	120	0	38
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



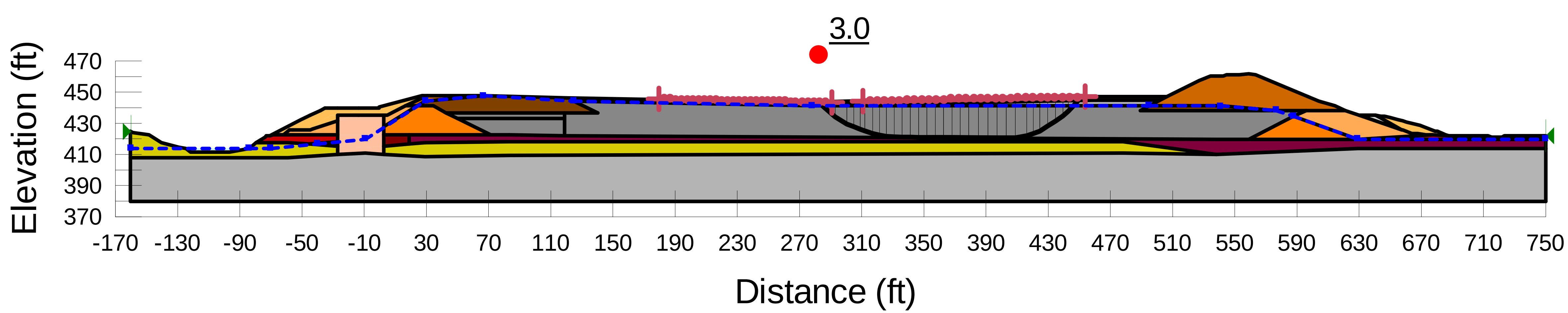
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section F2 Proposed Regrading With DMM Walls Long Term (Drained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 26

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1500	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



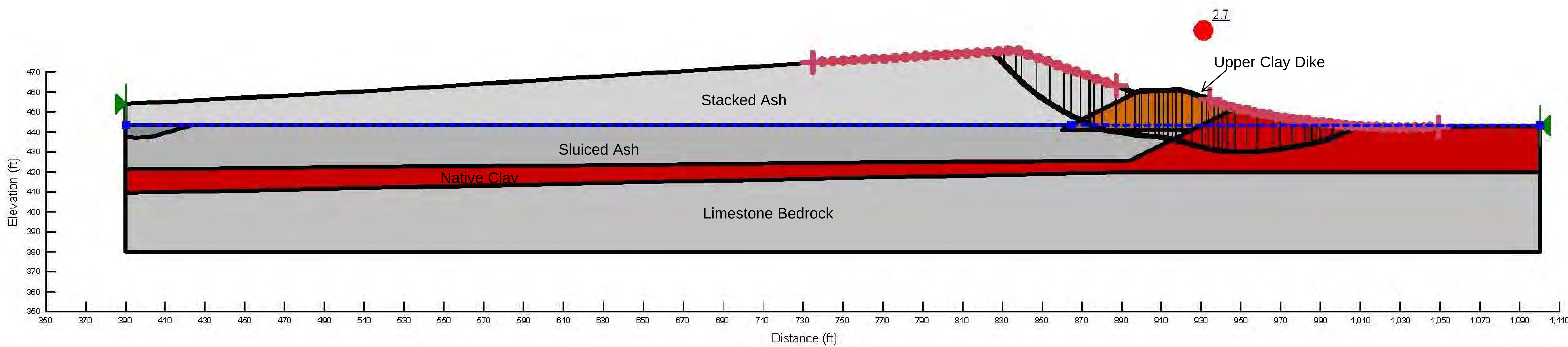
East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section F2 Proposed Regrading With DMM Walls Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 27

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash (Unsaturated)	107	0	30
Sluiced Ash (Saturated)	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Native Clay (Unsaturated)	129	1250	0
Native Clay (Saturated)	129	600	0
Native Clay Under Dike (Saturated)	129	1000	0
Native Sand and Low Plasticity Silts (Saturated)	120	235	0
DMM Wall composite strength block	120	1150	0
Granular Fill	125	0	35
Limestone Bedrock	135	20000	45



East Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section F2 Failure in Ash Stack Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 28

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Native Clay	129	200	28
Limestone Bedrock	135	20000	45



West Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

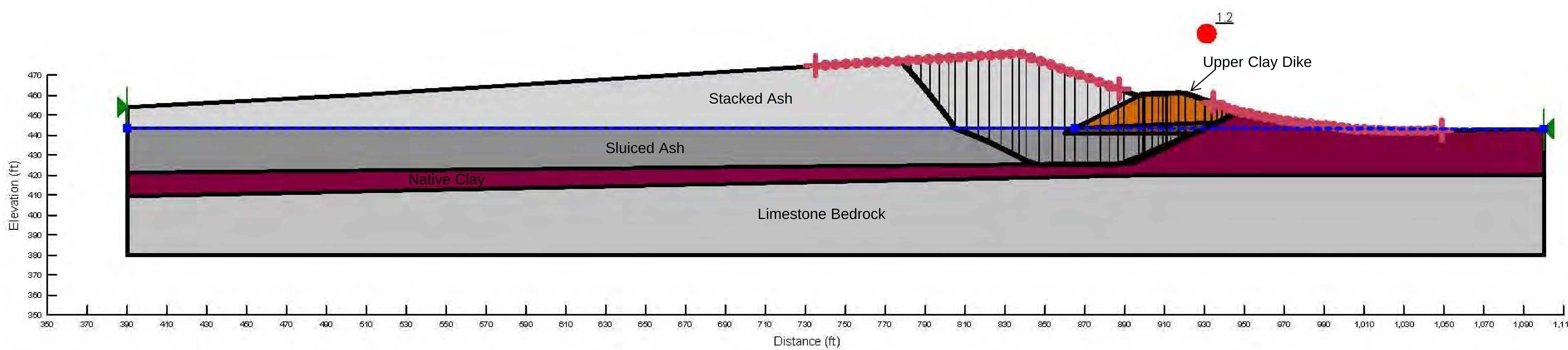
GEI Consultants

Section H
Proposed Regrading
Long Term (Drained)

May 2016

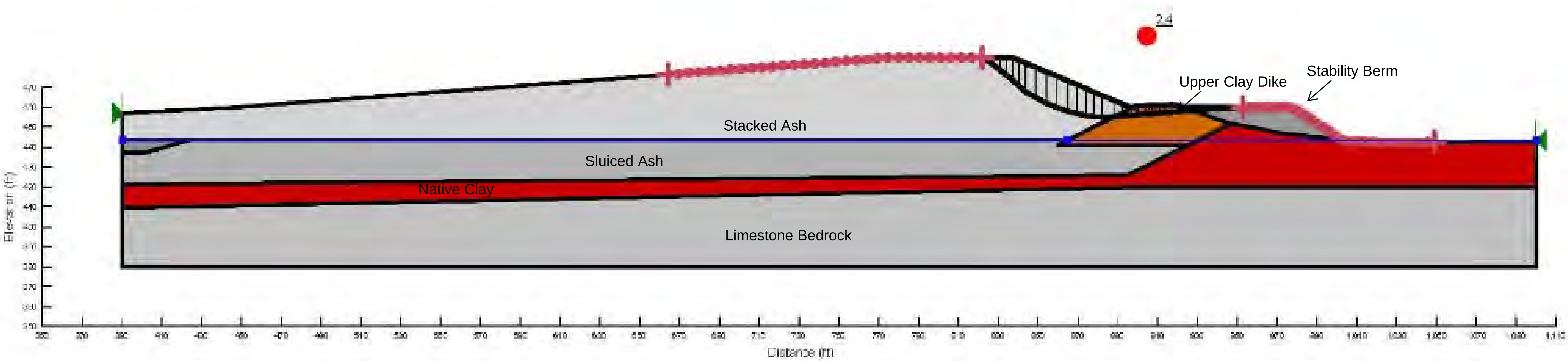
FIG. 29

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash	107	0	30
Sluiced Ash	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Native Clay	129	1000	0
Limestone Bedrock	135	20000	45



West Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section H Proposed Regrading Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 30

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Native Clay	129	200	28
Limestone Bedrock	135	20000	45



West Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

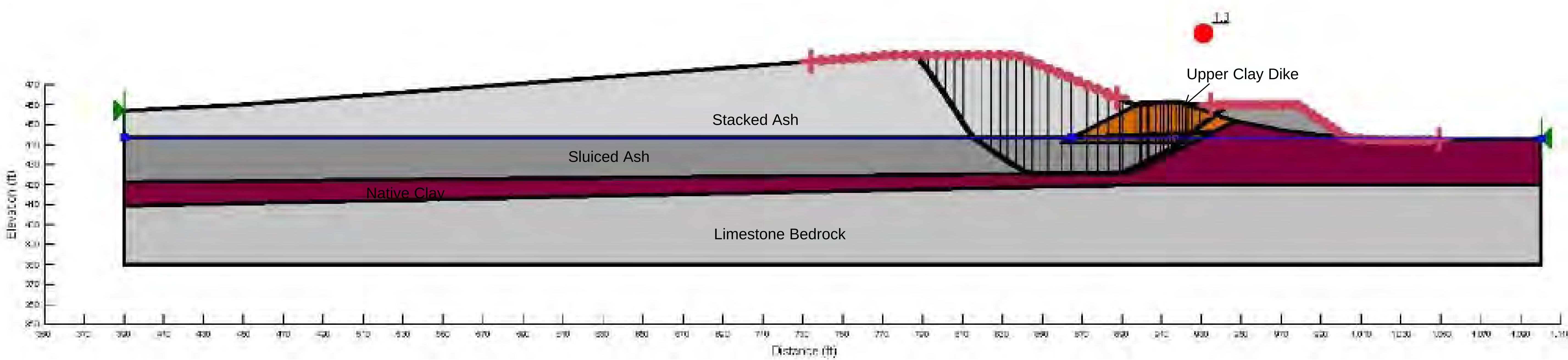
GEI Consultants

Section I
Proposed Regrading With Berm
Long Term (Drained)

May 2016

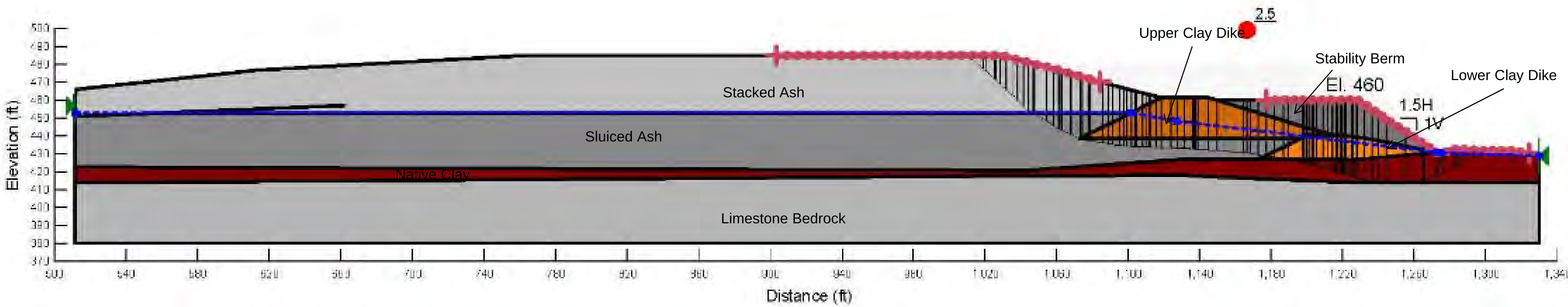
FIG. 31

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Stacked Ash	107	0	30
Sluiced Ash	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Native Clay	129	1000	0
Limestone Bedrock	135	20000	45



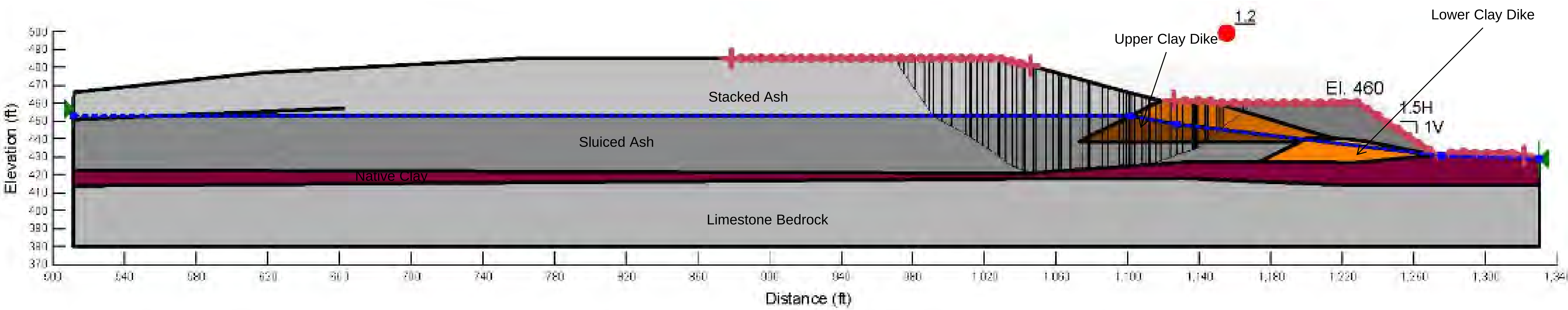
West Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section I Proposed Regrading With Berm Post-Earthquake (Undrained)	
Tennessee Valley Authority Chattanooga, Tennessee		May 2016	FIG. 32

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Lower Clay Dike	127	200	29
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Native Clay	129	200	28
Limestone Bedrock	135	20000	45



West Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section J Proposed Regrading With Berm Long Term (Drained)	
Tennessee Valley Authority Chattanooga, Tennessee		May 2016	FIG. 33

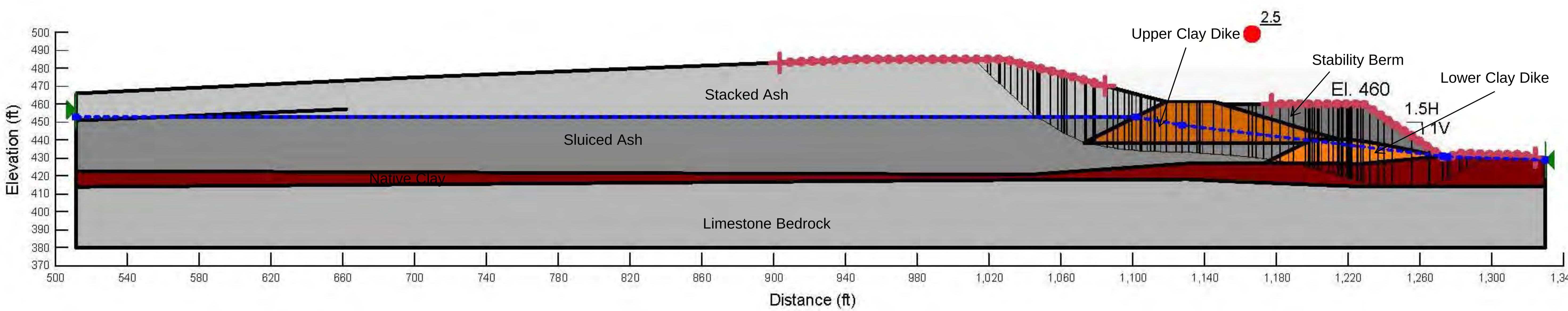
Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Stacked Ash	107	0	30
Sluiced Ash	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Native Clay	129	1000	0
Limestone Bedrock	135	20000	45



West Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	Section J Proposed Regrading With Berm Post-Earthquake (Undrained)
Tennessee Valley Authority Chattanooga, Tennessee	May 2016 FIG. 34

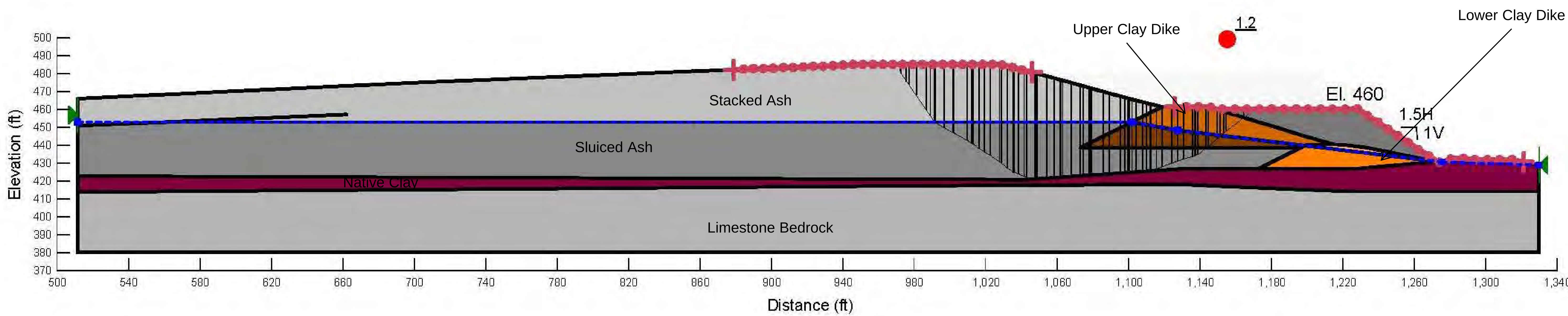
GEI Consultants

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Lower Clay Dike	127	200	29
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Native Clay	129	200	28
Limestone Bedrock	135	20000	45



West Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section K Proposed Regrading With Berm Long Term (Drained)
Tennessee Valley Authority Chattanooga, Tennessee		May 2016 FIG. 35

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Stacked Ash	107	0	30
Sluiced Ash	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Native Clay	129	1000	0
Limestone Bedrock	135	20000	45



West Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

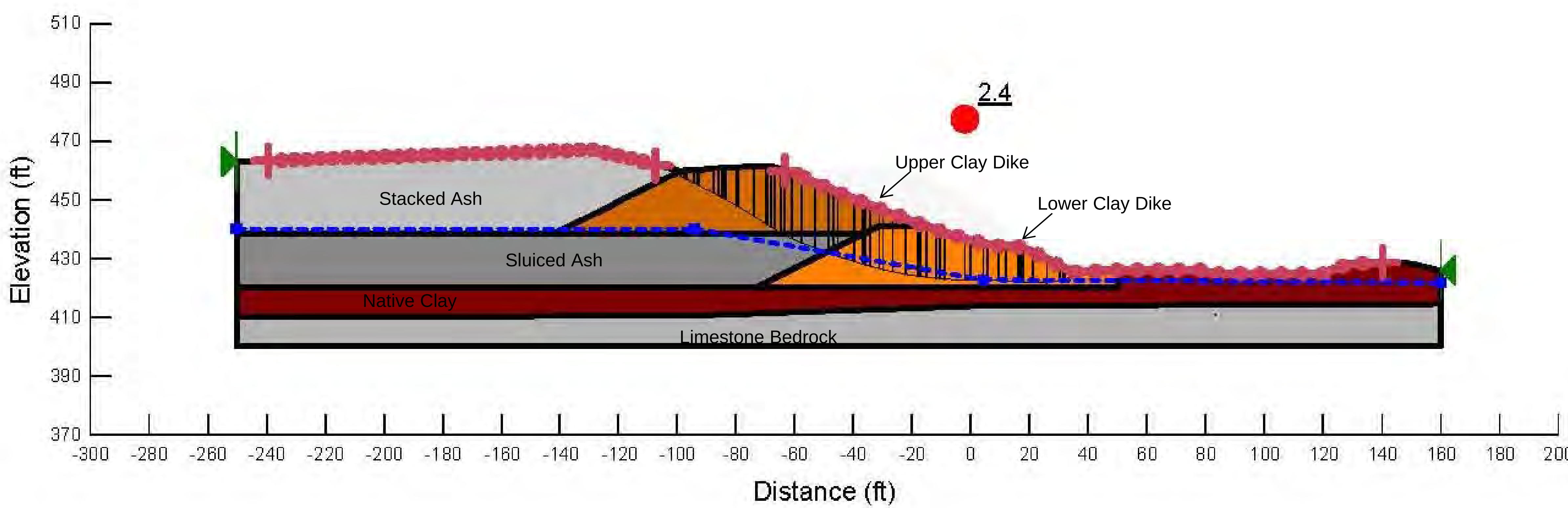
GEI Consultants

Section K
Proposed Regrading With Berm
Post-Earthquake (Undrained)

May 2016

FIG. 36

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike	127	200	28
Lower Clay Dike	127	200	29
Stacked Ash	107	0	30
Sluiced Ash	107	0	26
Native Clay	129	200	28
Limestone Bedrock	135	20000	45



West Dike Seismic Improvements
Colbert Fossil Plant - Ash Pond 4
Tuscumbia, Alabama

Tennessee Valley Authority
Chattanooga, Tennessee

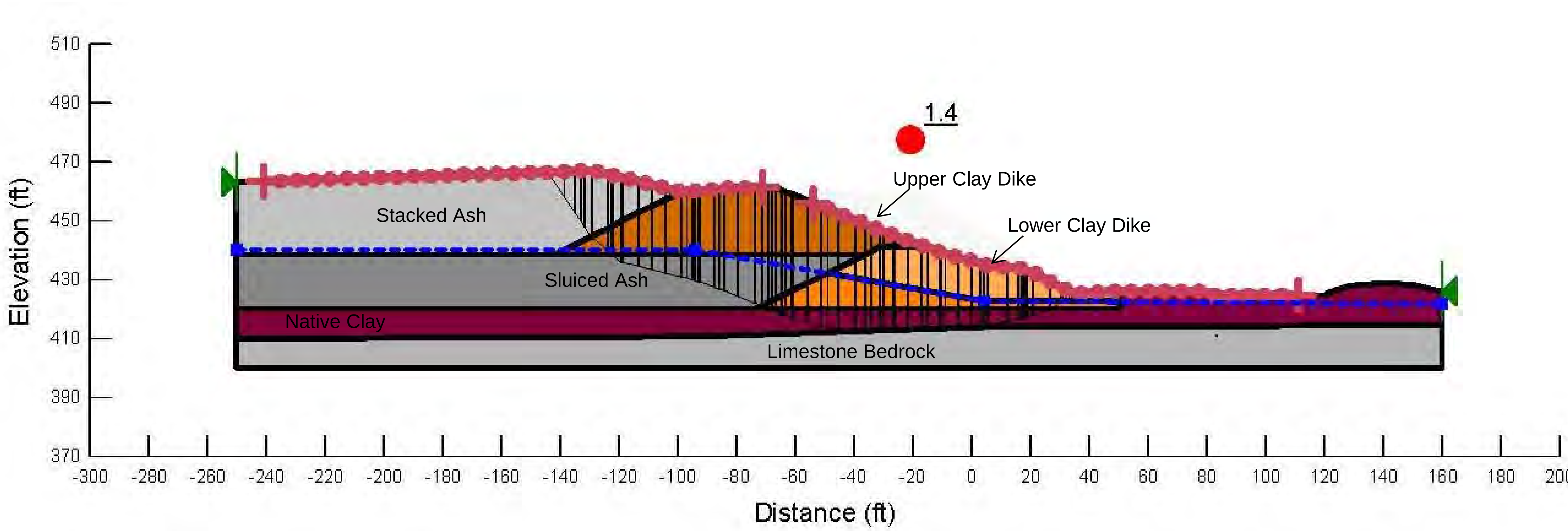
GEI Consultants

Section L
Proposed Regrading With Berm
Long Term (Drained)

May 2016

FIG. 37

Material Properties			
Material Name	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
Upper Clay Dike (Unsaturated)	127	1500	0
Upper Clay Dike (Saturated)	127	1200	0
Lower Clay Dike (Unsaturated)	127	1500	0
Lower Clay Dike (Saturated)	127	1200	0
Stacked Ash	107	0	30
Sluiced Ash	107	$c/\sigma'_v = 0.06$ $c_{min} = 100$	0
Native Clay	129	1000	0
Limestone Bedrock	135	20000	45



West Dike Seismic Improvements Colbert Fossil Plant - Ash Pond 4 Tuscumbia, Alabama	GEI Consultants	Section L Proposed Regrading With Berm Post-Earthquake (Undrained)	
Tennessee Valley Authority Chattanooga, Tennessee		May 2016	FIG. 38

Appendix E

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

September 6, 2016

Mr. Brian Marshall
Alabama Department of Environmental
Management (ADEM)
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2059

TENNESSEE VALLEY AUTHORITY (TVA) – COLBERT FOSSIL PLANT (COF) – CONSENT DECREE NO. 20-CV-2013-900123.00 – NPDES PERMIT NO. AL0003867 – ASH POND NUMBER 4 MANAGEMENT PLAN TO FACILITATE CLOSURE

TVA is herein providing an update to ADEM on activity related to paragraph 18 of the above referenced Consent Decree. In October 2016, TVA will begin activities to cap and close Ash Pond Number 4 (AP4) in Colbert County, Alabama. Closure of AP4 will be in accordance with the engineered drawings and construction plans submitted to ADEM.

The AP4 complex is regulated under NPDES permit AL0003867 as a wastewater treatment facility. Flows have continued to be reduced as a result of the site's retirement, and additional flows will continue to be eliminated as the overall process to deconstruct the site is completed in the coming years. At this time, the primary sources of inflow to the AP4 are stormwater runoff and plant sumps.

To facilitate the approved closure plan, TVA will need to begin lowering the AP4 pool elevation in October 2016. As shown in Figure 1, drawdown flows from the AP4 will continue to be discharged along with stormwater and other flows permitted for discharge through Outfall 001. TVA is in the process of converting the former coal yard runoff pond into a new stilling pond that will receive stormwater flows, plant and legacy flows, as well as drawdown flows when AP4 reaches lower pool elevations. The new outfall structure for the repurposed pond will be within 15 seconds of the current Outfall 001 latitude and longitude that discharges to Cane Creek; therefore, no NPDES permit modification is necessary prior to discharging from the new outfall structure. Enclosed is a copy of the Corps of Engineers authorization (LRN-2015-01304) to construct the new outfall structure under Nationwide Permit 18.

An operational pool lowering plan will be implemented during AP4 drawdown period to ensure wastewater discharges from Outfall 001 continue to maintain compliance with the NPDES permit and remain protective of the receiving stream water quality. As required by Part I.A of the NPDES permit, COF will continue discharge from Outfall 002 at a minimum rate of approximately 105 million gallons per day (MGD) whenever there are discharges from Outfall 001. The operational pool lowering plan will continue to be implemented until contact water within the AP4 has been eliminated.

TVA collected water quality samples from within the AP4 at the median depth in the deepest areas of the ash pond complex. As a conservative approach, TVA used the constituent concentrations detected from sampling and the maximum discharge flows from Outfall 001 along with minimum flows from Outfall 002 to calculate the expected in-stream concentration during zero flow conditions in Cane Creek. See Enclosure 1, which TVA believes demonstrates *de minimis* impacts to in-stream water quality during the drawdown period.

Throughout the AP4 closure process, discharges from Outfall 001 will continue to be via either the existing stilling pond weir structure or the new outfall structure. However, managing the flows under the operational pool lowering plan may necessitate discharging from Outfall 001 manually via pumping. As necessary, TVA will maintain pumping records on site and report the associated flows with discharge monitoring reports. Wastewaters discharged during drawdown activities will be limited to 8.45 MGD to stay consistent with previous discharges at Outfall 001. This maximum flow value was used to calculate the expected downstream concentration in Cane Creek during zero flow conditions found in Enclosure 1 and as a conservative measure to demonstrate protection of the receiving stream.

As part of the operational pool lowering plan, TVA will increase monitoring for parameters in the Outfall 001 NPDES permit limits table and report the results in the monthly discharge monitoring reports to demonstrate compliance with the permit. Additional sampling for parameters of concern will be performed to demonstrate compliance with applicable in-stream water quality standards. Monthly progress reports with monitoring results will be provided to ADEM. Water quality instrumentation will also be installed to provide continuous monitoring for turbidity and Total Dissolved Solids (TDS) at Outfall 001 and downstream in Cane Creek. The operational pool lowering plan will include action values based on data collected from the continuous water quality instrumentation. See Enclosure 2 for the constituent list and monitoring frequencies.

COF will continue to maintain compliance with the freeboard requirement in accordance with Part IV.F of the NPDES permit. TVA will manage the reduction of free water within the ash pond to meet NPDES permit limits at Outfall 001. For contingency planning, TVA may utilize approved coagulants to promote settling of solids prior to discharge.

In summary, drawdown discharges from the AP4 as described herein are comparable to and would have no greater impacts than normal operations under the COF NPDES permit. Pollutants of concern are limited and will be monitored at an increased frequency during discharges to the receiving stream through Outfall 001. TVA believes there will be *de minimis* impacts to the receiving stream during the drawdown period and that in-stream water quality standards will be protected.

If you have any comments or questions, please contact Travis Markum by email at trmarkum@tva.gov, or by phone at (423) 751-2795 in Chattanooga.

Sincerely,

Terry E. Cheek

Terry E. Cheek, Senior Manager
Water Permits, Compliance, Monitoring

Enclosures

Enclosure 1
TVA Colbert Fossil Plant
Calculated In-stream Constituent Concentrations

Parameter	Upstream Concentration in Cane Creek (mg/L)	Constituent Concentration at Outfall 001 (mg/L)	Constituent Concentration at Outfall 002 (mg/L)	Calculated Downstream Concentration (mg/L)	In-stream Water Quality Criteria (mg/L)
Mercury	0.00000183	0.00000276	0.00000497	0.00000481	0.0024[4]
Aluminum	0.342	0.370	0.130	0.145	0.750[5]
Copper	0.00239	0.003	0.002	0.002	0.009[7]
Lead	<0.002	<0.002	<0.001	<0.0005	0.0025[7]
Selenium	<0.002	<0.002	<0.001	<0.0005	0.020[4]
Arsenic	<0.002	0.005	<0.001	0.0013	0.34[4]
Cadmium	<0.001	<0.001	<0.001	<0.0005	0.0025[7]
Chromium	<0.002	<0.003	<0.001	<0.0006	0.0741[7]
Iron	0.287	0.229	0.15	0.156	1.000[8]
Manganese	0.0464	0.023	0.036	0.035	0.050[6]
Silver	<0.002	<0.002	<0.0005	<0.0003	0.0032[7]
Antimony	<0.002	<0.002	<0.001	<0.0005	0.023[4]
Barium	0.0222	0.047	0.023	0.025	-
Beryllium	0.0022	<0.002	<0.001	<0.0005	-
Nickel	<0.002	<0.002	0.0026	0.0025	0.052[7]
Thallium	<0.002	<0.002	<0.001	<0.0005	0.00017[4]
Zinc	<0.025	<0.025	<0.01	<0.0056	0.118[7]
Cyanide	<0.01	<0.011	<0.005	<0.0027	0.022[4]

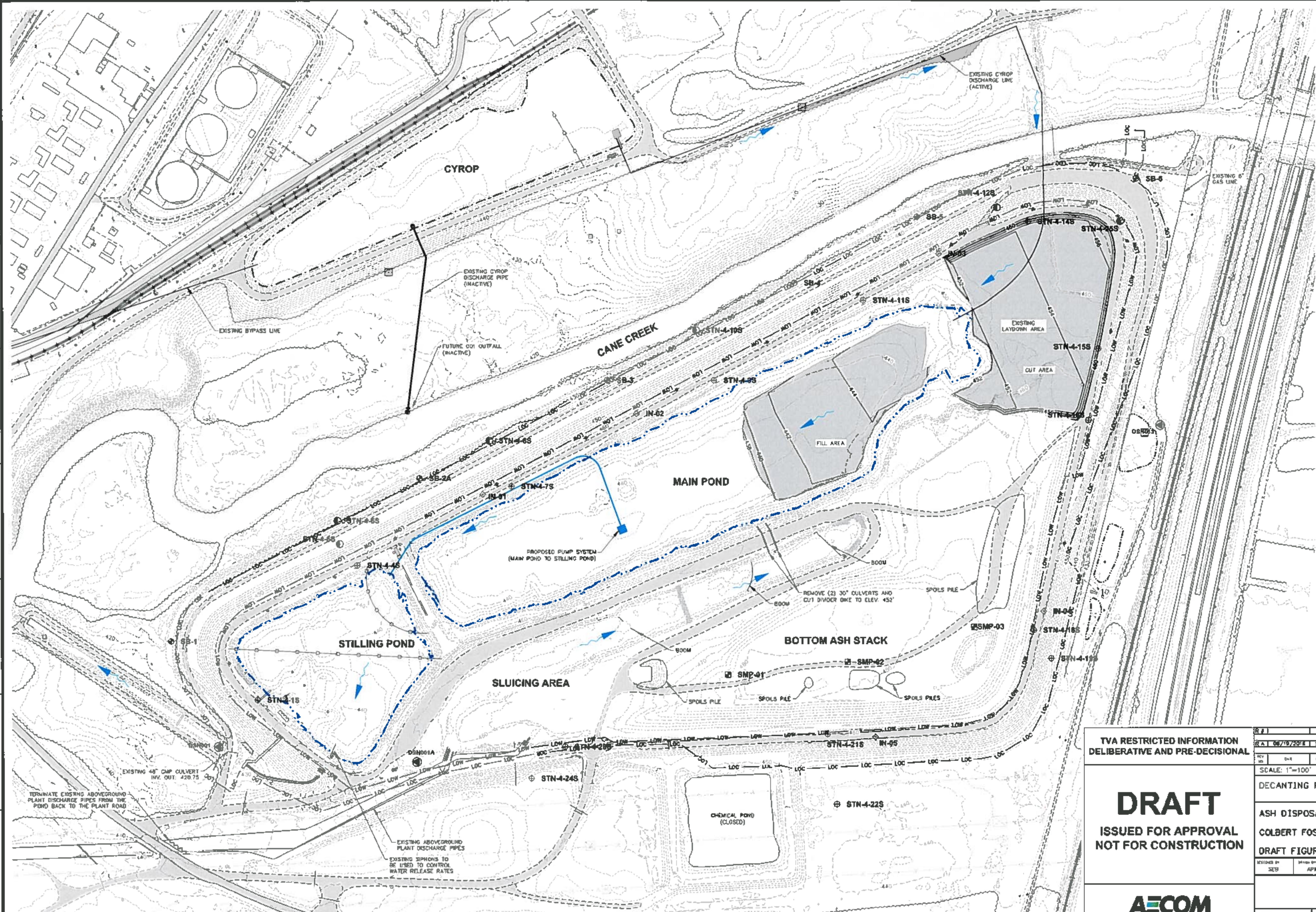
1. Calculations are based on a maximum drawdown flow rate of 8.45 MGD at Outfall 001 and a minimum discharge flow of 105 MGD at Outfall 002.
2. Assumed low flow stream condition (1Q10) in Cane Creek is 0 MGD.
3. For parameters which were not detected during the sampling period, half of the reporting level was used for calculating in-stream concentration.
4. Alabama In-stream Water Quality Criteria (acute).
5. EPA National Recommended Freshwater Criterion Maximum Concentration (acute).
6. EPA Human Health Criteria for Water plus Organism.
7. Assumed average hardness of 100 mg/L to calculate Alabama Criterion Maximum Concentration (acute).
8. EPA National Recommended Freshwater Chronic Continuous Concentration criterion.

Enclosure 2
TVA Colbert Fossil Plant
Ash Pond 4 Drawdown Monitoring Plan

Effluent monitoring of drawdown wastewater will be conducted in accordance with the following:

Parameter	Sample Location	Measurement Frequency	Sample Type
Flow[1]	Outfall 001	Daily	Calculated/Measured
pH	Outfall 001	1/Week	Grab
Oil and Grease	Outfall 001	1/Week	Grab
Total Suspended Solids	Outfall 001	1/Week	Grab
Hardness	Outfall 001	1/Week	Grab
Metals[2,3]	Outfall 001	1/Week	Grab
Cyanide	Outfall 001	1/Week	Grab
Total Dissolved Solids[4]	Outfall 001	Continuous	Measured
Turbidity[4]	Outfall 001	Continuous	Measured
Total Dissolved Solids[4]	Cane Creek (downstream)	Continuous	Measured

1. Flow will be reported in Million Gallons per Day (MGD). Flow will be calculated daily during drawdown activities based on pump run time and flow rate or measured with a flow meter or staff gauge.
2. Metals monitoring will include, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Chromium-III, Chromium-VI, Copper, Iron, Lead, Manganese, Mercury, Methyl Mercury, Nickel, Selenium, Silver, Thallium, and Zinc.
3. Mercury monitoring will be performed in accordance with 40 CFR Part 136, using method 1631E.
4. Water quality instrumentation to provide continuous monitoring for operational pool lowering plan. Data will be available to ADEM upon request.



N

0 100 200
SCALE IN FEET

LEGEND

450	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR
	EXISTING VEGETATION
F	EXISTING FENCE
	EXISTING OVERHEAD ELECTRIC LINE
	EXISTING HAUL ROAD
	EXISTING CREEK
	EXISTING WETLANDS
	EXISTING TURBIDITY CURTAIN
LOW	LIMIT OF WASTE
	PROPOSED WELL
	EXISTING DISCHARGE POINT
	EXISTING POWER POLE (TO BE REMOVED)
	EXISTING WATER LINE – EL. 449'
LOC	LIMIT OF CONSTRUCTION AND GRADING
	FLOW DIRECTION
	INTERIM GRADING
	EXISTING INCLINOMETER WITH VIBRATING WIRE PIEZOMETER
	EXISTING SETTLEMENT MONITORING POINT
	EXISTING VIBRATING WIRE PIEZOMETER
	EXISTING OPEN STANDPIPE
	EXISTING OPEN STANDPIPE

NOTES

1. ANY EXISTING PIEZOMETERS, INCLINOMETERS, OR MONITORING WELLS IN THE LIMITS OF WORK SHALL BE PROTECTED. INSTRUMENTATION MODIFICATION OR REMOVAL SHALL BE COORDINATED WITH TVA INSTRUMENTATION.
2. THE LOCATION OF THE EXISTING CYROP DISCHARGE PIPE AND FUTURE 001 OUTFALL REFLECT COMPLETION OF THE CYROP RE-PURPOSING PROJECT. THE PROJECT IS IN THE DESIGN PHASE AT THE TIME OF THESE DRAWINGS.
3. CONTRACTOR TO MONITOR PH AND WATER QUALITY AT DISCHARGE DSN001 DAILY THROUGHOUT CONSTRUCTION. CONTRACTOR MAY NEED TO ADJUST CONSTRUCTION PRACTICES IF WATER QUALITY ISSUES ARISE. CONTRACTOR TO COORDINATE WITH TVA AND ENGINEER.

SUGGESTED STAGE 1 DECANTING / PHASING SEQUENCE

1. COAL YARD RUNOFF POND TO BE DRAWN DOWN TO APPROXIMATE ELEVATION 434.0' PRIOR TO ASH DISPOSAL AREA 4 DECANTING. DRAW DOWN TO BE COORDINATED WITH TVA.
2. TERMINATE EXISTING ABOVEGROUND PLANT DISCHARGE PIPES FROM THE POND BACK TO THE PLANT ROAD.
3. BEGIN DECANTING OF THE SLUICING AREA BY LOWERING PORTIONS OF THE DIVIDER DIKE TO ELEVATION 449' AND REMOVING THE TWO EXISTING CULVERTS TO THE MAIN POND.
4. INSTALL PUMP IN MAIN POND SOUTH OF ROCK BUTTRESS. PUMP FREE WATER OVER EXISTING SHEET PILE WALL / BUTTRESS TO THE STILLING POND. LIMIT DRAWDOWN RATE IN MAIN POND TO NO MORE THAN 1-FOOT PER DAY, TO BE MONITORED WITH STAFF GAUGE.
5. DISCHARGE WATER FROM THE STILLING POND AT A SIMILAR RATE TO THE WATER PUMPED FROM THE MAIN POND TO MAINTAIN THE STILLING POND'S APPROXIMATE CURRENT LEVEL. WATER WILL GENERALLY BE REMOVED FROM THE STILLING POND BY UTILIZING THE EXISTING SPILLWAY, STOP LOGS, SIPHONS AND PUMPS.
6. COMPLETE INTERIM GRADING AS SHOWN AT THE SOUTHERN END OF DISPOSAL AREA 4.
7. DISCHARGED WATER WILL BE MONITORED AT DSN001 THROUGHOUT DECANTING TO MAINTAIN COMPLIANCE WITH NPDES PERMITTED LIMITS.

**TVA RESTRICTED INFORMATION
DELIBERATIVE AND PRE-DECISIONAL**

DRAFT

**ISSUED FOR APPROVAL
NOT FOR CONSTRUCTION**

AECOM

R A	08/19/2016	SEB	APM	MJS	MJS	RSH	MST	JCK	384316

SCALE: 1"=100' EXCEPT AS NOTED

DECANTING PLAN

ASH DISPOSAL AREA 4 CLOSURE
COLBERT FOSSIL PLANT
DRAFT FIGURE

SEB	APM	MJS	MJS	RSH	MST	JCK

COLBERT FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | 08/19/16 | 47 | C | FIGURE 1 | R A

AECOM	A
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUAL

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
Regulatory Branch
3701 Bell Road
NASHVILLE, TENNESSEE 37214

May 20, 2016

SUBJECT: File No. LRN-2015-01304; Colbert County Fossil Plant, New Outfall Structure Project, Cane Creek Mile 3.1 (TRM 244.0L), Colbert County, AL (Lat: 34.7459; Lon: -87.8595)

Mr. Terry E. Cheek
Tennessee Valley Authority
1101 Market Street, BR4A
Chattanooga, TN 37402

Dear Mr. Cheek:

This correspondence is in regard to your recent notification of construction of a new outfall structure at the subject location. Please refer to the file number LRN-2015-01304 in reference to this letter.

The proposed work consists of repurposing the coal yard runoff pond to discharge to Cane Creek by installing a new cast-in-place spillway structure and discharge pipe. The discharge line consist of 24-inch pipe HDPE pipe. The pipe will discharge into Cane Creek through a headwall structure with a riprap apron. Riprap will be installed along existing contours to armor the creek bank from the headwall at elevation 420 down to Elevation 407 (one foot below winter pool elevation). The total quantity of riprap below the ordinary high water mark at Elevation 416 will be less than 25 cubic yards. TVA owns all adjacent lands.

Based on the information submitted, it has been determined your work meets the criteria of Department of the Army Nationwide Permit (NWP) 18 for "Minor Discharges," which became effective March 19, 2012, in 77 FR 10184. The work must be performed in accordance with the enclosed plans (Attachment 1) and NWP general conditions (Attachment 2).

This verification is valid until March 18, 2017, unless the NWP authorization is modified, suspended, or revoked. If the work has not been completed by that time, you should contact this office to obtain another permit determination in accordance with the rules and regulations in effect at that time.

In addition, you are also responsible for obtaining any other federal, state, and/or local permits, approvals, or authorizations. In this respect, the Alabama Department of Environmental Management (ADEM) issued a conditional 401 certification for the NWP (Attachment 3). You must comply with the conditions specified in the certification.

If changes in the location or approved plans are necessary, revised plans shall be submitted promptly to this office for review and approval. NWP General Condition 30 requires that you submit a signed certification. Please sign and return the enclosed Compliance Certification form upon completion of the proposed activity (Attachment 5). If you have any questions, please contact me at the above address or telephone (615) 369-7504.

Sincerely,

Lisa R. Morris

Lisa R. Morris
Project Manager
Regulatory Branch

Enclosures

1. Plans
2. Nationwide Permit 18 Conditions
3. Nationwide Permit General Conditions
4. ADEM Certification
5. Compliance Certification

Copy Furnished:

Alabama Department of Environmental Management
PO Box 301463
Montgomery, AL 36130

Attachment 1
LRN-2015-01304

U.S. ARMY CORPS OF ENGINEERS **APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT** 33 CFR 325. The proponent agency is CECW-CO-R.	***Form Approved - OMB No. 0710-0003 Expires: 30-SEPTEMBER-2015***

Public reporting for this collection of information is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of the collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters, Executive Services and Communications Directorate, Information Management Division and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required)
First - JOHN Middle - C Last - KAMMEYER	First - Middle - Last -
Company - TENNESSEE VALLEY AUTHORITY	Company -
E-mail Address - JCKAMMEY@TVA.GOV	E-mail Address -
6. APPLICANT'S ADDRESS:	9. AGENT'S ADDRESS:
Address- 1101 MARKET STREET, LP 5D	Address-
City - Chattanooga State - TN Zip - 37402 Country - USA	City - State - Zip - Country -
7. APPLICANT'S PHONE NOs. w/AREA CODE	10. AGENTS PHONE NOs. w/AREA CODE
a. Residence b. Business (423) 751-8246 c. Fax	a. Residence b. Business c. Fax

STATEMENT OF AUTHORIZATION

11. I hereby authorize, N/A to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

SIGNATURE OF APPLICANT DATE

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)
Colbert Fossil Plant -

13. NAME OF WATERBODY, IF KNOWN (if applicable) Cane Creek	14. PROJECT STREET ADDRESS (if applicable) Address 900 COLBERT STEAM PLANT RD
15. LOCATION OF PROJECT Latitude: •N 34.~~7362~~ 7959 Longitude: •W -87.~~8489~~ 8595	City - TUSCUMBIA State- AL Zip- 35674

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID Municipality

Section - Township - Range -

17. DIRECTIONS TO THE SITE

From Huntsville, Alabama take AL-20 E/US-72 E west for approximately 66 miles. Turn right onto Colbert Steam Plant Road and follow along until the road ends.

18. Nature of Activity (Description of project, include all features)

The proposed work consists of repurposing the coal yard runoff pond (CYROP) to discharge to Cane Creek by installing a new cast-in-place spillway structure and discharge pipe. The discharge line consists of 24-inch HDPE pipe. The pipe will discharge into Cane Creek through a headwall structure with a riprap apron. Riprap will be installed along existing contours to armor the creek bank from the headwall at elevation 420 down to elevation 407 (one foot below the winter pool elevation). The total quantity of riprap below the Ordinary High Water mark, elevation 416, is estimated to be 20 cubic yards. Construction of the new spillway and discharge pipe is set to begin in June 2016 and completed in December 2016. TVA owns all adjacent lands.

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

COF will be retired in April 2016. At that time, TVA will begin implementing projects to deconstruct the plant and complete closure of onsite CCR units The CYROP will be repurposed into a process pond to receive plant sump waters and other wastewater flows to facilitate closure of Ash Pond 4. As part of the pond repurposing project, a new outfall structure will be constructed for discharges to Cane Creek. This new outfall structure will replace permitted Outfall 001 (NPDES permit AL0003867).

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

Riprap will be installed to armor the creek bank and prevent erosion during discharges from the new outfall structure. Riprap will be placed down to elevation 407 (one foot below the normal winter pool elevation).

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type Amount in Cubic Yards	Type Amount in Cubic Yards	Type Amount in Cubic Yards
Riprap stone - 20 CY (max)		

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres 0.42 acres (between EL 420 and EL 407)

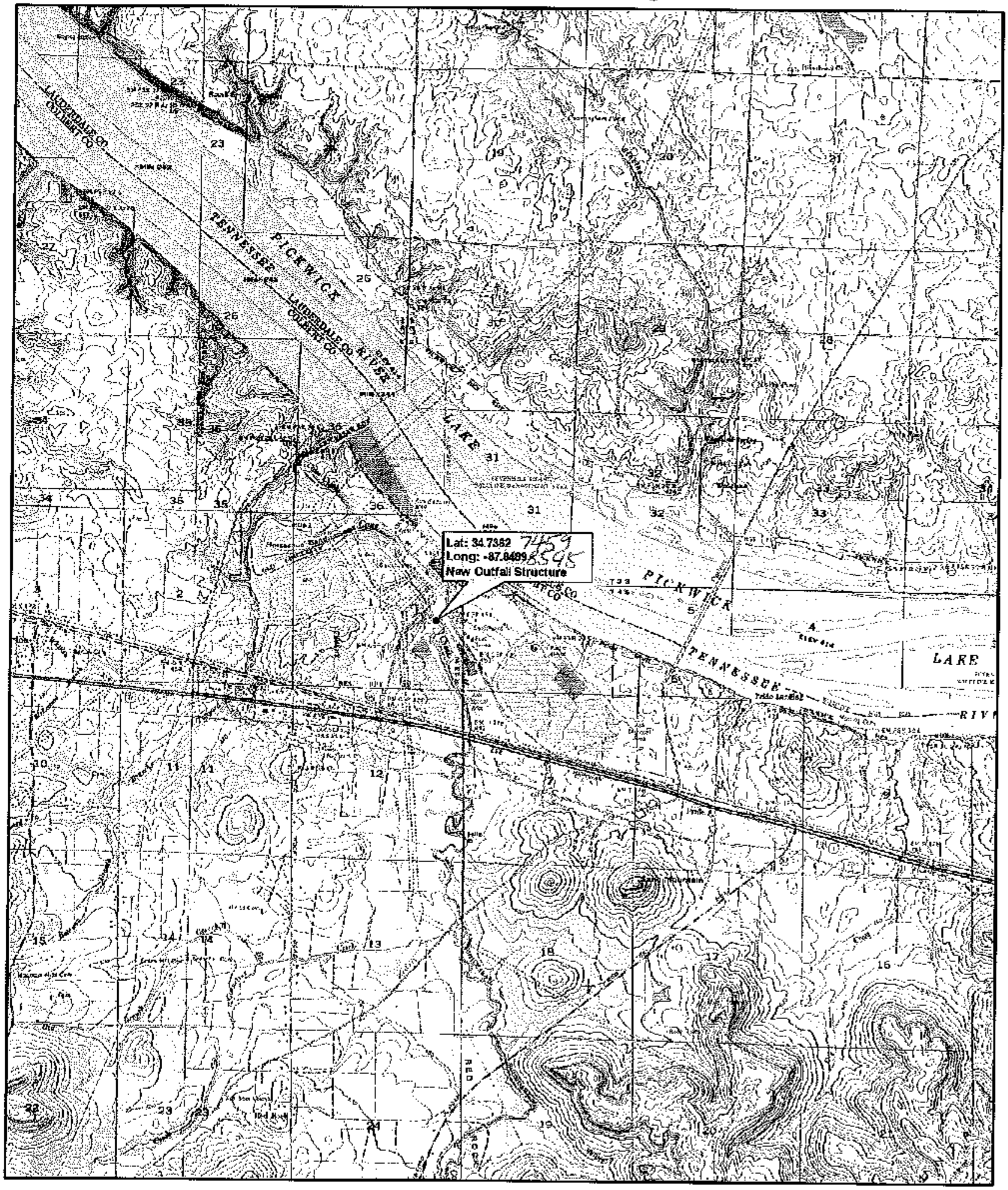
or

Linear Feet

23. Description of Avoidance, Minimization, and Compensation (see instructions)

- Disturbed areas will be stabilized or revegetated
- Fill materials will be clean and free of contaminants
- Appropriate BMPs for erosion control and stabilization of disturbed areas will be used.

LRN-2015-01304
Attachment 1a (Map)



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TVA Colbert Fossil Plant
New Outfall Structure
Preconstruction Notification

Bone Creek Mile 3.1

Colbert Co., Alabama
Barton & Pride, Alabama 7.5-minute Quadrangles
February 2016

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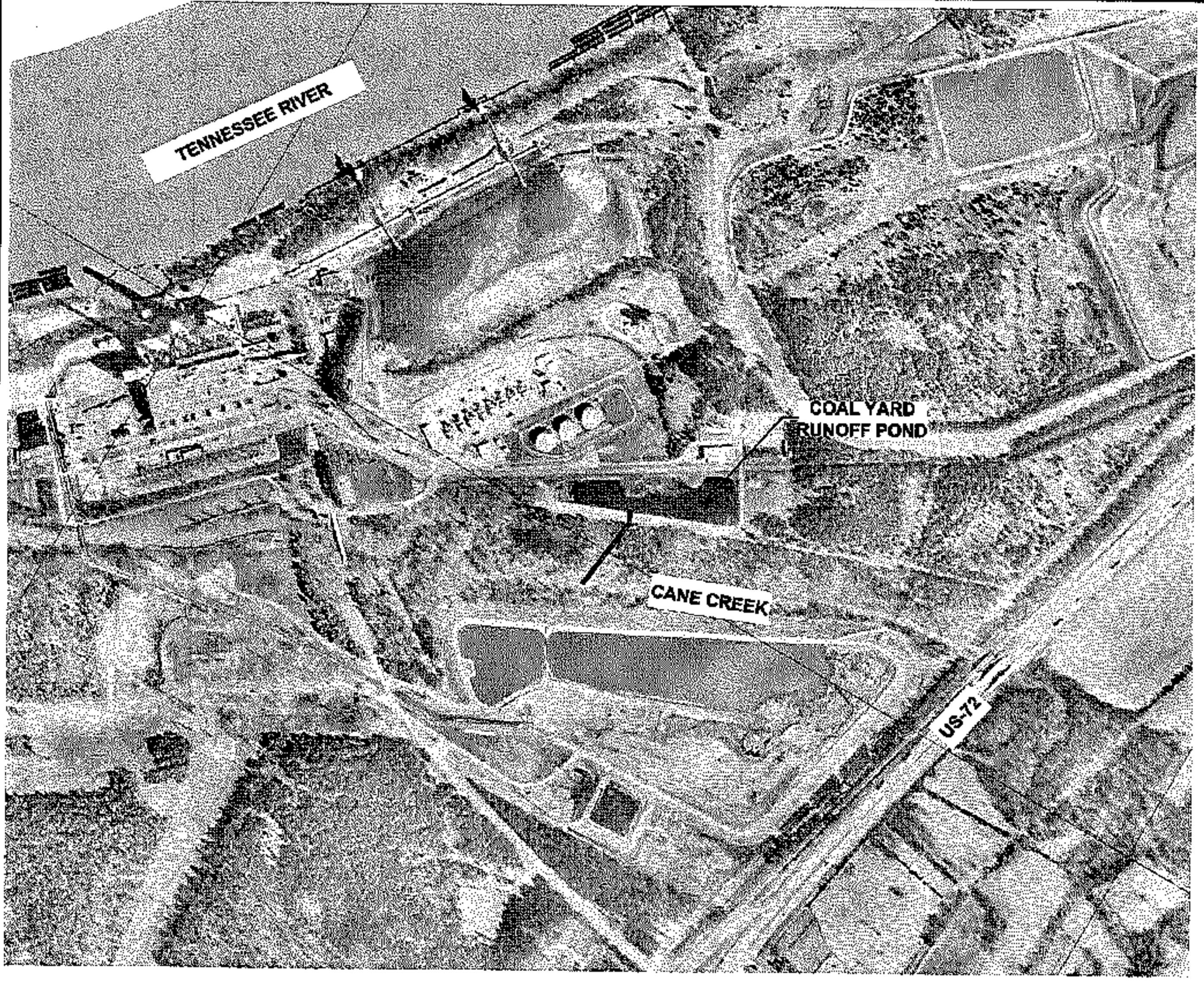


0 500 1000
SCALE IN FEET

PROPOSED DISCHARGE PIPE

LRN-2015-01304
Attachment 1b

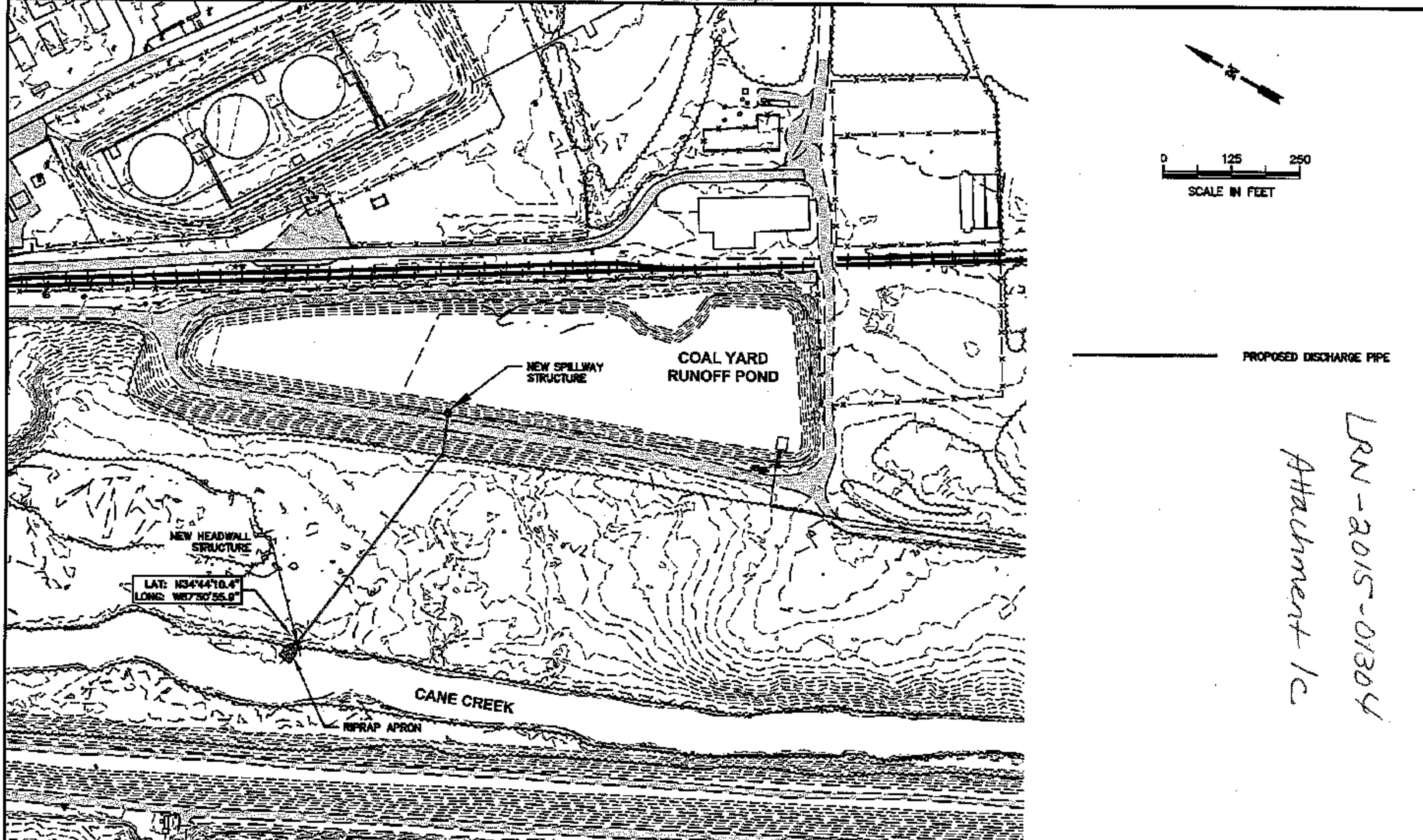
AECOM

COAL YARD RUNOFF POND SPILLWAY
COLBERT FOSSIL PLANT, TUSCUMBIA, AL

CONCEPTUAL PLAN
SPILLWAY

DRAWN BY	CHK BY	PROJECT NO.	DATE	FIGURE
MJT	SEB	60441280	02/02/2016	NO. 1

I:\Projects\TVA-COF\60441280_CYROP Ph2\DWGs\Figures\Figure-3.dwg User: mcavinewa Feb 02, 2016 - 2:18pm



LRN-2015-01304
Attachment 1C

AECOM

COAL YARD RUNOFF POND SPILLWAY COLBERT FOSSIL PLANT, TUSCUMBIA, AL.				
CONCEPTUAL PLAN SPILLWAY				
DRAWN BY MJT	CHK BY SEB	PROJECT NO. 60441280	DATE 02/02/2016	FIGURE NO. 3

LRN-2015-01304
Attachment 2

US Army Corps
of Engineers ®
Nashville District

Nationwide Permit

No. 18, Minor Discharges

Minor discharges of dredged or fill material into all waters of the United States, provided the activity meets all of the following criteria:

(a) The quantity of discharged material and the volume of area excavated do not exceed 25 cubic yards below the plane of the ordinary high water mark or the high tide line;

(b) The discharge will not cause the loss of more than $^{1}/_{10}$-acre of waters of the United States; and

(c) The discharge is not placed for the purpose of a stream diversion.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity if: (1) The discharge or the volume of area excavated exceeds 10 cubic yards below the plane of the ordinary high water mark or the high tide line, or (2) the discharge is in a special aquatic site, including wetlands. (See general condition 31.)

(Sections 10 and 404)

LRN-2015-01304
Attachment 3

US Army Corps of Engineers®
Nashville District

Nationwide Permit General Conditions

The following General Conditions must be followed in order for any authorization by NWP to be valid:

1. __Navigation.__ (a) No activity may cause more than a minimal adverse effect on navigation. (b) Any safety lights and signals prescribed by the US Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the US. (c) The permittee understands and agrees that, if future operations by the US require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the US. No claim shall be made against the US on account of any such removal or alteration.

2. __Aquatic Life Movements.__ No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

3. __Spawning Areas.__ Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. __Migratory Bird Breeding Areas.__ Activities in waters of the US that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. __Shellfish Beds.__ No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. __Suitable Material.__ No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. __Water Supply Intakes.__ No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. __Adverse Effects From Impoundments.__ If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. __Management of Water Flows.__ To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. __Fills Within 100-Year Floodplains.__ The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. __Equipment.__ Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. __Soil Erosion and Sediment Controls.__ Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the US during periods of low-flow or no-flow.

13. __Removal of Temporary Fills.__ Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. __Proper Maintenance.__ Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. __Single and Complete Project.__ The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. __Wild and Scenic Rivers.__ No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, US Forest Service, US Fish and Wildlife Service).

17. __Tribal Rights.__ No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. __Endangered Species.__ (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed. (b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary. (c) Non-federal permittees must submit a pre-construction notification (PCN) to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the

district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the PCN must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete PCN. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from Corps. (d) As a result of formal or informal consultation with the USFWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs. (e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the USFWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the US to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering. (f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the USFWS and NMFS at http://www.fws.gov/ or http://www.fws.gov/ipac and http://www.noaa.gov/fisheries.html respectively.

19. **Migratory Birds and Bald and Golden Eagles.** The permittee is responsible for obtaining any "take" permits required under the USFWS's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the USFWS to determine if such "take" permits are required for a particular activity.

20. **Historic Properties.** (a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied. (b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary. (c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the activity may have the potential to cause effects and notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA is complete. (d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps. (e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the activity on historic properties.

21. **Discovery of Previously Unknown Remains and Artifacts.** If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. **Designated Critical Resource Waters.** Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment. (a) Discharges of dredged or fill material into waters of the US are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters. (b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

23. **Mitigation.** The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal: (a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the US to the maximum extent practicable at the project site (i.e., on site). (b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal. (c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this

requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332. (1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment. (2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered. (3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the US, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)). (4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided. (5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan. (d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment. **(e)** Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the US, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs. (f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses. (g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management. (h) Where certain functions and services of waters of the US are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

24. Safety of Impoundment Structures. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. Water Quality. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. Coastal Zone Management. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. Regional and Case-By-Case Conditions. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or USEPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. Use of Multiple Nationwide Permits. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the US authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the US for the total project cannot exceed 1/3-acre.

29. Transfer of Nationwide Permit Verifications. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature: "When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

_______________________ _______________________

Transferee Date

30. Compliance Certification. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include: (a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions; (b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and (c) The signature of the permittee certifying the completion of the work and mitigation.

31. **Pre-Construction Notification (PCN).** (a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a PCN as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either: (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or (2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2). (b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information: (1) Name, address and telephone numbers of the prospective permittee; (2) Location of the proposed project; (3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the US expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans); (4) The PCN must include a delineation of wetlands, other special aquatic sites, and waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the US. The 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate; (5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan. (6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and (7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act. (c) Form of PCN Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used. (d) Agency Coordination: (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level. (2) For all NWP activities that require PCN notification and result in the loss of greater than 1/2-acre of waters of the US, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require PCN notification and will result in the loss of greater than 300 linear feet of intermittent and ephemeral stream bed, and for all NWP 48 activities that require PCN notification, the district engineer will immediately provide (e.g., via e-mail, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (USFWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the PCN notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each PCN notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5. (3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act. (4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of PCN notifications to expedite agency coordination.

Further Information

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.
3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project.

LRN-2015-01304
Attachment 4

LANCE R. LEFLEUR
DIRECTOR

ADEM

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ROBERT J. BENTLEY
GOVERNOR

March 12, 2012

Colonel Steven J. Roemhildt, P.E.
Commander, Mobile District
U.S. Army Corps of Engineers
P.O. Box 2288
Mobile, AL 36628-0001

RE: Clean Water Act (CWA) Section 401 Water Quality Certification (WQC), U.S. Army Corps of Engineers (COE) Proposed Reissuance of Alabama Nationwide Permits (NWPs) Activities Within the State of Alabama With Minimal Individual And Cumulative Adverse Impacts On The Aquatic Environment, SAM 2011-00006-JMT

Dear Colonel Roemhildt:

This office has completed a review of the below-referenced joint public notices and all associated materials submitted related to the proposed NWPs. Any comments made during the public notice period have also been forwarded to us for review.

1. Aids to Navigation
2. Structures in Artificial Canals
3. Maintenance
4. Fish and Wildlife Harvesting, Enhancement, and Attraction Devices and Activities
5. Scientific Measurement Devices
6. Survey Activities
7. Outfall Structures and Associated Intake Structures
8. Oil and Gas Structures on the Outer Continental Shelf
9. Structures in Fleeting and Anchorage Areas
10. Mooring Buoys
11. Temporary Recreational Structures
12. Utility Line Activities
13. Bank Stabilization
14. Linear Transportation Projects
15. U.S. Coast Guard Approved Bridges
16. Return Water From Upland Contained Disposal Areas
17. Hydropower Projects
18. Minor Discharges
19. Minor Dredging
20. Response Operations for Oil and Hazardous Substances
21. Surface Coal Mining Activities
22. Removal of Vessels

23. Approved Categorical Exclusions
24. Indian Tribe or State Administered Section 404 Programs
25. Structural Discharges
26. [Reserved]
27. Aquatic Habitat Restoration, Establishment, and Enhancement Activities
28. Modifications of Existing Marinas
29. Residential Developments
30. Moist Soil Management for Wildlife
31. Maintenance of Existing Flood Control Facilities
32. Completed Enforcement Actions
33. Temporary Construction, Access, and Dewatering
34. Cranberry Production Activities
35. Maintenance Dredging of Existing Basins
36. Boat Ramps
37. Emergency Watershed Protection and Rehabilitation
38. Cleanup of Hazardous and Toxic Waste
39. Commercial and Institutional Developments
40. Agricultural Activities
41. Reshaping Existing Drainage Ditches
42. Recreational Facilities
43. Stormwater Management Facilities
44. Mining Activities
45. Repair of Uplands Damaged by Discrete Events
46. Discharges in Ditches
47. [Reserved]
48. Existing Commercial Shellfish Aquaculture Activities
49. Coal Remining Activities
50. Underground Coal Mining Activities
51. Land-Based Renewable Energy Generation Facilities
52. Water-Based Renewable Energy Generation Pilot Projects

Because action pertinent to water quality certification (WQC) is required by Section 401(a)(1) of the Clean Water Act (CWA), 33 U.S.C. Section 1251, et seq., we hereby issue certification until **March 18, 2017**, that there is reasonable assurance that the discharge resulting from the proposed activities as submitted will not violate applicable water quality standards established under Section 303 of the CWA and Title 22, Section 22-22-9(g), Code of Alabama, 1975, provided the applicant acts in accordance with the following conditions as specified. We further certify that there are no applicable effluent limitations under Section 301 and 302 nor applicable standards under Section 306 and 307 of the CWA in regard to the activities specified.

To minimize adverse impacts to State waters by copy of this letter we are requesting the Mobile District Corps of Engineers to incorporate the following as special conditions appropriate to each activity in Alabama authorized by the COE NWPs:

1. During project implementation, the applicant shall ensure compliance with applicable requirements of ADEM. Admin. Code Chapter 335-6-6 [National Pollutant Discharge Elimination System (NPDES)], Chapter 335-6-10 (Water Quality Criteria), and Chapter 335-6-11 (Water Use Classifications for Interstate and Intrastate Waters).

2. ADEM permit coverage may be required prior to commencing and/or continuing certain activities/operations relating to or resulting from the project. If an applicant has any questions regarding ADEM regulated activity or the need for NPDES permit coverage, the applicant can contact ADEM's Water Division at (334) 271-7823. If an applicant has any questions regarding ADEM regulated activity or the need for air permit coverage, the applicant can contact ADEM's Air Division at (334) 271-7869. If the applicant has any questions regarding ADEM regulated activity or the need for hazardous, toxic, and/or solid waste permit coverage, the applicant can contact ADEM's Land Division at (334) 271-7730.

3. Upon the loss or failure of any treatment facility, Best Management Practice (BMP), or other control, the applicant shall, where necessary to maintain compliance with this certification, suspend, cease, reduce or otherwise control work/activity and all discharges until effective treatment is restored. It shall not be a defense for the applicant in a compliance action that it would have been necessary to halt or reduce work or other activities in order to maintain compliance with the conditions of this certification.

4. The applicant shall retain records adequate to document activities authorized by this certification for a period of at least three years after completion of work/activity authorized by the certification. Upon written request, the applicant shall provide ADEM with a copy of any record/information required to be retained by this paragraph.

5. The applicant shall conduct or have conducted, at a minimum, weekly comprehensive site inspections until completion of the proposed activity to ensure that effective BMPs are properly designed, implemented, and regularly maintained (i.e. repair, replace, add to, improve, implement more effective practice, etc.) to prevent/minimize to the maximum extent practicable discharges of pollutants in order to provide for the protection of water quality.

6. The applicant shall prepare a detailed general or project-specific BMP Plan commensurate with activities of the type proposed. Effective BMPs shall be implemented and continually maintained for the prevention and control of sediment and other sources of pollutants, including measures to ensure permanent revegetation or cover of all disturbed areas, during and after project implementation.

7. The applicant shall implement a Spill Prevention Control and Countermeasures (SPCC) Plan for all temporary and permanent onsite fuel or chemical storage tanks or facilities consistent with the requirements of ADEM Admin. Code R. 335-6-6-.12(r), Section 311 of the Federal Water Pollution Control Act, and 40 CFR Part 112. The applicant shall maintain onsite or have readily available sufficient oil & grease absorbing material and flotation booms to contain and clean-up fuel or chemical spills and leaks. The applicant shall immediately notify ADEM after becoming aware of a significant visible oil sheen in the vicinity of the proposed activity. In the event of a spill with the potential to impact groundwater or other waters of the State, the applicant should immediately call the National Response Center at 1-800-424-8802 and the Alabama Emergency Management Agency at 1-800-843-0699. The caller should be prepared to report the name, address and telephone number of person reporting spill, the exact location of the spill, the company name and location, the material spilled, the estimated quantity, the source of spill, the cause of the spill, the nearest downstream water with the potential to receive the spill, and the actions taken for containment and cleanup.

8. Additional, effective BMPs shall be fully implemented and maintained on a daily basis as needed to prevent to the maximum extent possible potential discharges of pollutants from activities authorized by this certification, directly to or to a tributary or other stream segment, that have the potential to impact a State water currently considered impaired [waterbody is identified on the Alabama 303(d) list, a total maximum daily load (TMDL) has been finalized for the waterbody, and/or the waterbody is otherwise considered a Tier 1 water pursuant to ADEM Admin. Code Ch. 335-6-10]. The applicant shall inspect all BMPs as often as is necessary (daily if needed) for effectiveness, need for maintenance, and the need to implement additional, effective BMPs. Additional effective BMPs shall immediately be implemented as needed to ensure full compliance with ADEM requirements and the protection of water quality in the impaired waterbody.

9. All construction and worker debris (e.g. trash, garbage, etc.) must be immediately removed and disposed in an approved manner. If acceptable offsite options are unavailable, effective onsite provisions for collection and control of onsite worker toilet wastes or gray waste waters (i.e. port-o-let, shower washdown, etc.) must be implemented and maintained. Soil contaminated by paint or chemical spills, oil spills, etc. must be immediately cleaned up or be removed and disposed in an approved manner. Also, the applicant shall manage and dispose of any trash, debris, and solid waste according to applicable state and federal requirements.

10. The applicant shall implement appropriate measures to minimize the potential for a decrease of instream dissolved oxygen concentrations as a result of project implementation. In addition, the applicant shall ensure that the activities authorized by this certification do not significantly contribute to or cause a violation of applicable water quality standards for instream dissolved oxygen. The applicant shall implement appropriate, effective BMPs, including installation of floating turbidity screens as necessary, to minimize downstream turbidity to the maximum extent practicable. The applicant shall visually monitor or measure background turbidity. The applicant must suspend operations should turbidity resulting from project implementation exceed background turbidity by more than 50 NTUs. Operations may resume when the turbidity decreases to within acceptable levels.

11. NWP21 (Surface Coal Mining Activities) Special Condition: The applicant shall obtain and maintain valid NPDES permit coverage prior to commencing and/or continuing activities authorized under NWP21. The applicant can contact ADEM's Water Division at (334) 271-7823 or H2o_mail@adem.state.al.us with any questions regarding ADEM NPDES permitting/regulatory requirements for surface and/or underground mining activity.

In recognition that projects are site specific in nature and conditions can change during project implementation, ADEM reserves the right to require the submission of additional information or require additional management measures to be implemented, as necessary on a case by case basis, in order to ensure the protection of water quality. Liability and responsibility for compliance with this certification are not delegable by contract or otherwise. The applicant shall ensure that any agent, contractor, subcontractor, or other person employed by, under contract, or paid a salary by the applicant complies with this certification. Any violations resulting from the actions of such person shall be considered violations of this certification.

Issuance of a certification by ADEM neither precludes nor negates an operator/owner's responsibility or liability to apply for, obtain, or comply with other ADEM, federal, state, or local government permits, certifications, licenses, or other approvals. This certification does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to persons or property or invasion of other private rights, trespass, or any infringement of Federal, State, or local laws or regulations, and in no way purports to vest in the applicant title to lands now owned by the State of Alabama nor shall it be construed as acquiescence by the State of Alabama of lands owned by the State of Alabama that may be in the applicant's possession.

Should you have any questions on this or related matters, please do not hesitate to contact Richard Hulcher, Office of Field Services, by email at rfh@adem.state.al.us or by phone at 334-394-4311.

Sincerely,

Steven O. Jenkins, Chief
Field Operations Division

File: WQ401/12545
c: Water Division, ADEM
Nashville District COE
EPA Region IV

LRN-2015-01304
Attachment 5

COMPLIANCE CERTIFICATION

YOU ARE REQUIRED TO SUBMIT THIS SIGNED CERTIFICATION REGARDING THE COMPLETED ACTIVITY AND ANY REQUIRED MITIGATION

I hereby certify that the work authorized by **Permit No.** LRN-2015-01304, and any required mitigation was done in accordance with the Corps authorization, including any general or special conditions.

____
Permittee Signature

____
Date

Please note that your permitted activity is subject to a compliance inspection by an U.S. Army Corps of Engineers representative.

Submit this signed certification to the address checked below:

☒ U.S. Army Corps of Engineers
Regulatory Branch
3701 Bell Road
Nashville, TN 37214

☐ Eastern Regulatory Field Office
501 Adesa Blvd
Suite 250
Lenoir City, Tennessee 37771

☐ Western Regulatory Field Office
2042 Beltline Road, Southwest
Building C, Suite 415
Decatur, AL 35601

Lisa R. Morris
Project Manager