Alabama Power

Dustin G. Brooks
Environmental Affairs Supervisor
Environmental Compliance

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Received: 4/30/20

April 30, 2020

Mr. S. Scott Story, Chief
Solid Waste Branch
Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2400

Re: Revised Closure Permit Application for the Plant Gorgas Bottom Ash Landfill

Dear Mr. Story:

Alabama Power Company is the owner and operator of the Plant Gorgas Bottom Ash Landfill, located at Parrish, Alabama. Pursuant to rules 335-13-15-.09 and 335-13-5-.02 of the regulations of the Alabama Department of Environmental Management (ADEM), and in response to your letter dated April 10, 2020, please find enclosed a revised closure permit application for the Plant Gorgas Bottom Ash Landfill. This revised closure permit application has been prepared to update the permit application package previously submitted to ADEM in December 2018. Specifically, the Amended Closure Plan submitted to the Department on July 15, 2019 and a revised groundwater monitoring plan submitted on April 15, 2020 have been incorporated into the Plant Gorgas Bottom Ash Landfill closure permit application package.

Alabama Power initiated closure of the Plant Gorgas Bottom Ash Landfill on April 15, 2019. Since closure activities began on April 15, 2019, material has been moved from the southern end of the existing landfill footprint to the northern end of the existing landfill footprint. Grading of the final footprint proceeded concurrently with the removal and consolidation of the material. Currently, cover soil is being placed over the consolidated material and several acres of the final cover system has been constructed. As stated in our October 7, 2019 letter requesting an extension of the closure timeframe for the Plant Gorgas Bottom Ash Landfill, Alabama Power anticipates closure activities to be complete by October 15, 2020. We will be pleased to discuss with the Department any further revisions to the plan that may be appropriate in light of the closure timeline.

Finally, per your request and in accordance with rule 335-13-15-.08(3)(i)4., we have uploaded the Amended Closure Plan submitted on July 15, 2019 to Plant Gorgas's CCR website.

Thank you for your consideration. Please feel free to contact me if Alabama Power can provide additional information or answer any questions.

Sincerely,

Dustin Brooks

Dustin Brooks

Enclosures

PERMIT APPLICATION FOR CCR LANDFILL
PLANT GORGAS BOTTOM ASH LANDFILL
PARRISH, ALABAMA
ALABAMA POWER COMPANY

PERMIT APPLICATION FOR CCR LANDFILL
PLANT GORGAS BOTTOM ASH LANDFILL
ADEM Admin. Code r. 335-13-15-.09
ADEM Admin Code r. 335-13-5-.02

1. ADEM Application form [r. 335-13-5-.02(1)(a)]

The completed application form can be found in Appendix 1.

2. Documentation of host government approval [r. 335-13-5-.02(1)(b)]

The Plant Gorgas Bottom Ash Landfill is an industrial facility receiving waste generated by the permittee only and on site for purposes of §§ 22-27-48(h) and 22-27-48.1(m). Accordingly, by the operation of those provisions, §§ 22-27-48 and 22-27-48.1 do not apply.

3. Facility Design Plans and Operational Procedures [r. 335-13-5-02(1)(c)]

Facility design plans and operational related procedures and documents are addressed in Parts 5 and Parts 11 through 15 of this application.

4. Technical data and reports to comply with r. 335-13-4-.01 [r. 335-13-5-.02(1)(d)]

(i) Floodplain [335-13-4-.01(1)(a)].

Based on the Flood Insurance Rate Maps (FIRM) of Walker County, Alabama, Panel Nos. 490 and 495, Map No. 01127C0490D, no portion of the Plant Gorgas Bottom Ash Landfill is located in the 100-yr floodplain. Portions of the applicable maps are shown on ES2418 Figure 3_3 found in Appendix 2.

(ii) Threatened and Endangered Species [335-13-4-.01(1)(b)].

Alabama Power Company Field Biologists conducted a site assessment of the adjoining lined CCR landfill sites in 2012 to identify any possible inhabitation of Federally protected species. No Federally protected species were observed within the site boundaries, and there are no critical habitat units on the site and the facility will not result in destruction or adverse modification of critical habitat. The full report can be found in Appendix 2.

(iii) Airport vicinity [335-13-4-.01(1)(c)].

The two nearest airport runways are located at Walker County Bevill Field near Jasper, Alabama at a distance of about 16 miles, and the Birmingham-Shuttlesworth International Airport at a distance of about 24 miles. The Plant Gorgas Bottom Ash

Landfill is not located within 10,000 feet of any airport runway end, nor within 5 miles of any airport.

(iv) Fault areas [335-13-4-.01(1)(d)3.].

A review was conducted of various publications, including geologic maps available from the Geological Survey of Alabama, USGS databases and Open-File reports, historic mining maps from Russel Coal Company (1977) and site specific boring logs. The results of the review process indicate there are no faults within 200 feet of the landfill and therefore no faults that have had displacement since Holocene within 200 feet of the landfill.

(v) Seismic impact zones [335-13-4-.01(1)(d)4.].

The Peak Ground Acceleration for the facility location, as determined using the online USGS Unified Hazard Tool, Conterminous U.S. 2014 (v4.0.x) was determined to be 0.18. Therefore, the horizontal component of the site is assumed to exceed 0.10g, indicating the facility is located within a Seismic Impact Zone. As the facility is unlined and does not contain a leachate collection system or other control structures, there are no structural components that would be damaged in the event of a seismic event.

(vi) Unstable area [335-13-4-.01(1)(d)5.].

The Bottom Ash Landfill is formed by excavations in previously placed mine spoil material and natural hillsides, as well as low earthen embankments. The foundation materials beneath the CCR unit generally consist of previously placed mine spoils. There has been no visible evidence of instability in the landfill, and there are no structural components associated with the landfill that would be adversely impacted by settlements that may have occurred over the years of operation. Furthermore, the CCR unit is not located within karst terrain, and the site and its surrounding areas are not subject to mass movements (e.g. landslides). Also, there are no local man-made features or events that would affect stability of the site.

(vii) Archaeological or Historical sensitivity [335-13-4-.01(1)(e)].

The University of Alabama’s Office of Archaeological Research performed a cultural resources assessment of the adjoining landfill areas in November 2012, prior to construction of the lined CCR units located to either side of the Bottom Ash Landfill. The assessment was submitted to the State of Alabama Historical Commission for review. The Commission determined that the planned adjoining landfill construction would have no adverse effect on cultural resources eligible for or listed on the National Register of Historic Places and issued a letter concurring with the project activities proposed at the time, and thus as constructed. It is our opinion this conclusion applies to the Bottom Ash Landfill, as it was in operation prior to the assessment. The project was assigned AHC Tracking Number 13-0201. A copy of the letter from the AHC can be found in Appendix 2.

(viii) NPDES Permit [335-13-4-.01(2)(a)].

Plant Gorgas currently maintains NPDES Permit No. AL002909 for discharges associated with plant operations. The ADEM Water Division approved changes to the permit to include the leachate piping system from the outlet of the landfill leachate ponds to the water treatment facility. The facility is regulated under the existing permit and has been designed so as to not cause a discharge of pollutants into the waters of the State in violation of this permit.

(ix) Wetlands [335-13-4-.01(2)(b)].

The Plant Gorgas Bottom Ash Landfill does not cause non-point source pollution of waters of the State, including wetlands, that violates any requirements of an area wide and statewide water quality management plan that has been approved under the Alabama Water Pollution Control Act. Furthermore, the facility will not cause non-point source pollution of waters of the State, including wetlands, that violates any requirements of an area wide and statewide water quality management plan that has been prepared under the Alabama Water Pollution Control Act.

Alabama Power Company Field Biologists conducted a site assessment in 2012 prior to the design and construction of the adjoining CCR landfill cells to identify, delineate, assess and document possible U.S. Army Corps of Engineers' (Corps) "waters of the United States" which may be present on the site. No streams, open waters or wetlands were found on the landfill site. The landfill, including buffers, is not located in wetlands, beaches or dunes, and is not located in an area that would cause degradation of the same. The landfill is not located in the boundaries of the coastal area of Alabama. The full report can be found in Appendix 2.

5. Hydrogeology [335-13-4-.11(2) (per r. 335-13-5-.02(1)(d))]

A discussion of the geological and hydrogeological characteristics of the site can be found in the Groundwater Monitoring plan located in Appendix 4.

6. Plans and Operational Reports [335-13-4-.12 (per r. 335-13-5-.02(1)(d))]

The Bottom Ash Landfill at Plant Gorgas has been in operation for many years, and there are not formal design plans available. There are design plans being finalized for closure of the facility, as well as a formal boundary survey. Operational reports for normal operation, maintenance, closure and post-closure care have been prepared and are maintained on site at Plant Gorgas.

Copies of the Boundary Survey and Closure Design and Construction drawings can be found in Appendix 3.

7. **Site Geology and Hydrogeology [335-13-4-.13 (per r. 335-13-5-.02(1)(d))]**

A discussion of the geological and hydrogeological characteristics of the site can be found in the Groundwater Monitoring plan located in Appendix 4.

8. **Groundwater Resources [335-13-4-.14 (per 335-13-5-.02(1)(d))].**

A discussion of groundwater resources and a groundwater monitoring plan can be found in Appendix 4.

9. **Cover [335-13-4-.15 (per r. 335-13-5-.02(1)(d))]**

Intermediate cover will not be routinely utilized on the active face of the CCR disposal areas. Any exposed area of the CCR disposal area materials that will not receive CCR for three months will be covered with temporary soil cover, as previously approved by the Department. *See* ADEM Solid Waste Permit No. 64-10, dated June 24, 2016. Furthermore, there is an active Fugitive Dust Control Plan that has been prepared for Plant Gorgas and is included in the Operations Plan found in Appendix 6.

Stacking plan drawings for the CCR cells show a 6-in intermediate cover to be placed on all exterior slopes of stacked CCR waste during filling operations which will be vegetated and maintained until final stabilization and closure. These stacking plans, included as a part of the Design and Construction Drawings, can be found in Appendix 4.

10. **Explosive Gases [335-13-4-.16 (per r. 335-13-5-.02(1)(d))]**

The Plant Gorgas Bottom Ash Landfill accepts only coal combustion residuals. Organic wastes having a potential to generate methane or other explosive gases are not accepted. Therefore, explosive gas control and monitoring is not required. A prior variance to this requirement has been provided by the Department. *See* ADEM Solid Waste Permit No. 64-10, dated June 24, 2016.

11. **Drainage [335-13-4-.17 (per r. 335-13-5-.02(1)(d))]**

The Plant Gorgas Bottom Ash Landfill is operated to prevent flow onto the landfill from the 25-year storm. Furthermore, a runoff control system has been constructed to collect and control at least the water volume resulting from the 24-hour, 25-year storm. Incident precipitation from the disposal site is controlled by drainage features that minimize erosion and sedimentation and directs the runoff to a sedimentation pond. Incident precipitation from the disposal site is controlled by drainage structures that minimize the generation of leachate, erosion and sedimentation and directs the runoff to a sedimentation pond. The Run-on and Run-off Control Plans along with the original Design calculations can be found in Appendix 5. The Run-on and Run-off Control Plans were initially prepared to satisfy federal standards, but also satisfy r. 335-13-15-.05(2)(c). Drawings showing the drainage structures and sedimentation basin can be found in Appendix 4.

12. Liners and Leachate Collection [335-13-4-.18 (per r. 335-13-5-.02(1)(d))]

The Plant Gorgas Bottom Ash Landfill is not constructed with a liner nor a leachate collection system. Prior to ADEM's promulgation of its CCR rule, the Bottom Ash Landfill was not subject to solid waste regulation under state or federal law. Thus, the Bottom Ash Landfill was not required to operate with the design features described in 335-13-4-.18. Since that time, the federal CCR rule was enacted without requiring an existing CCR landfill to have a liner. *See* 40 C.F.R. § 275.70 (imposing design criteria for new CCR landfills and expansions of existing landfills, but not for existing landfills). This was not an oversight on EPA's part, but rather a recognition that "the potential for disruption in CCR disposal capacity . . . would be significant" if such facilities were required to retrofit, and such disruptions "are associated with significant risks to public health and the environment in their own right." 80 Fed. Reg. 21,301, 21,370 (Apr. 17, 2015). EPA also noted that existing landfills like the Bottom Ash Landfill at Gorgas would be subject to other protective measures of the CCR rule, including groundwater monitoring and corrective action. *Id.* The text of the comparable design criteria in ADEM's regulations is the same in substance as § 275.70 of the federal regulations. *See* ADEM Admin. Code r. 335-13-15-.04(1). Therefore, it is our understanding that ADEM's CCR regulations do not require installation of additional design features at the Bottom Ash Landfill. If ADEM takes a different view of the requirements of its regulations, we request a variance pursuant to 335-13-15-.15 on the grounds that such a determination is not any less stringent than the federal CCR rule and is protective of public health and the environment, which is supported by EPA's determination as expressed in the 2015 federal rule and preamble.

13. Access [335-13-4-.19. (per r. 335-13-5-.02(1)(d))]

The facility is located on Plant Gorgas property, and access to the Plant, and thereby the facility, is restricted with security gates manned 24 hours a day. Public access is not allowed unless escorted by authorized personnel. No dumping of waste material by the public is allowed.

14. Closure and Post-closure [335-13-4-.20. (per r. 335-13-5-.02(1)(d))]

As currently planned, the final cover system for the Bottom Ash Landfill will consist of a composite cover system incorporating a 60-mil geomembrane overlain with a geocomposite, both covered with 18 inches of protective soil having a permeability of 1×10^{-5} cm/sec or less and 6 inches of topsoil.

Post-closure care will be conducted for a minimum of 30 years. Post-closure maintenance will include quarterly inspections and any problems identified will be corrected in a timely manner. All eroded areas or areas having extensive surface cracks will be filled with suitable soil cover and appropriate cover established. Areas where ponding of water occurs will be maintained and regraded to reduce the potential for future ponding. Signs will be posted stating the facility is closed. Any required monitoring devices and pollution control equipment will be maintained.

Written closure and post-closure care plans containing additional details that address the requirements of r. 335-13-4-.20 can be found in Appendix 5.

15. Operation Plan [335-13-4-.21. (per r. 335-13-5-.02(1)(d))]

An Operation Plan for the Plant Gorgas Bottom Ash Landfill can be found in Appendix 6. Operation and use of the landfill will be as stipulated in the Permit. Waste accepted at the facility will be Coal Combustion Residuals generated by Alabama Power, primarily limited to bottom ash. The facility will not accept nor receive for disposal free liquids, regulated hazardous wastes, regulated medical wastes nor regulated PCB wastes.

Open burning is not allowed at the facility.

16. ADEM Admin. Code r. 335-13-4-.22 through r. 335-13-4-.24

The specific requirements for Municipal Solid Waste Landfills, Inert Construction/Demolition Landfills and Septic Tank Pumpings and Sewage Sludge, as outlined in ADEM Admin. Code sections r. 335-13-4-.22 through r. 335-13-4-.24, do not apply to CCR Landfills and are not included.

17. Groundwater Monitoring [335-13-5-.02(1)(h)3.]

A groundwater monitoring plan can be found in Appendix 4.

18. Recordkeeping [335-13-5-.02(1)(h)4.].

Records pertaining to the Plant Gorgas Bottom Ash Landfill will be maintained at Plant Gorgas, including, but not limited to, the Operating Record, the Solid Waste Disposal Permit issued by the Department, and the permit application, including the operational narrative and the engineering drawings.

All information in the Operating Record will be furnished upon request to the Department and will be made available at reasonable times for inspection by the Department.

In accordance with the requirements of 335-13-15 [per 335-13-5-.02(1)(h)5.], all required plans and assessments periodically required for CCR landfills will be updated when conditions change that modify such updates. Amended plans and assessments will be placed in the Plant Gorgas Operating Record, posted to the public internet website and notifications will be made to the Director of the Department.

19. Additional Permit Application Requirements [r. 335-13-5-.02(1)]

Plans, specifications, operational procedures and letters of final construction certification for construction of the operation of the facility have been previously submitted to the Department under signature and seal of a Professional Engineer licensed in the State of Alabama in support of ADEM Solid Waste Permit No. 64-10 dated June 24, 2016. Plans and operational procedures are again submitted with this application in Appendix 4 and Appendix 6, respectively. [r. 335-13-5-.02(1)(e)1.]

Reports, letters of certification and other documents concerning the siting standards of 335-13-

4-.01, prepared by a person with technical expertise in the field of concern, have been previously submitted to the Department in support of ADEM Solid Waste Permit 64-10 dated June 24, 2016, and are again submitted with this application in Appendix 2, Appendix 3 and Appendix 4. [r. 335-13-5-.02(1)(e)2.]

A listing of adjacent property owners can be found in Appendix 7. [r. 335-13-5-.02(1)(f)]

Technical data and reports documenting compliance with the unstable area requirements of 335-13-15-.03(5) have been provided in Part 4.(vi) of this application. The Unstable Area demonstration originally submitted to satisfy federal standards also satisfies r. 335-13-15-.03(5) and is included in Appendix 8. [r. 335-13-15-.02(1)(h)1.]

A run-on and run-off control system plan developed in accordance with 335-13-15-.05(2)(1)(c) has been addressed in Part 11 of this application and is included in Appendix 9. [r. 335-13-15-.02(1)(h)1.]

As required by r. 335-13-15-.04, Alabama Power will conduct and update assessments required by r. 335-13-15-.04(4)(a)2., (d) and (e) every 5 years. [335-13-5-.02(1)(h)5.]

Location restriction documentation showing compliance with the requirements of r. 335-13-5-.02(1)(i) have been addressed in Part 4 of this application.

A groundwater monitoring and analysis program developed in accordance with r. 335-13-15-.06 has been addressed in Part 17 of this application and is included in Appendix 4 [r. 335-13-15-.02(1)(h)3.]

Procedures for complying with recordkeeping and notification as required under r. 335-13-15-.08 has been addressed in Part 18 of this application.

By signature below, I hereby certify that the information contained within this permit application is accurate and correct based on the available information.

ALABAMA
LICENSED
12/4/18
16516
PROFESSIONAL
ENGINEER
JAMES C. PEGUES, JR.

James C. Pegues, P.E., D.GE
Alabama Licensed Professional Engineer No. 16516

Mike Godfrey

Mike Godfrey
Alabama Power Company

APPENDIX 1
ADEM PERMIT APPLICATION FORM

SOLID WASTE APPLICATION

PERMIT APPLICATION
SOLID WASTE DISPOSAL FACILITY
ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
(Submit in Triplicate)

1. **Facility type:**
   _____ Municipal Solid Waste Landfill (MSWLF)
   _____ Industrial Landfill (ILF)
   __X__ CCR Landfill (CCRLF)
   _____ CCR Surface Impoundment (CCRSI)
   _____ Other (explain)_______________

2. **Facility Name** Plant Gorgas Bottom Ash Landfill

3. **Applicant:**

   Name: Mr Mike Godfrey (Physical Address)

   Address: Alabama Power Company — Plant Gorgas

   Post Office Box 2641 — 460 Gorgas Road

   Birmingham, Alabama 35291 — Parrish, AL 35580-5715

   Telephone: (205) 257-6131

4. **Location: (include county highway map or USGSmap)**

   Township 16-South **Range** 06-West
   Section 17 **County** Walker

5. **Land Owner:**

   Name: Alabama Power Company

   Address: Post Office Box 2641

   Birmingham, AL 35291-0830

   Telephone: (205) 257-4194

   (Attach copy of agreement from landowner if applicable.)

6. **Contact Person:**

Name James Douglas | Che George

Position or Affiliation Environmental Affairs Specialist | Senior Compliance Specialist

Address: Post Office Box 2641 | 460 Gorgas Road

Birmingham, AL 35291-0831 | Parrish, AL 35580-5716

Telephone: (205) 257-6782 | (205) 686-2324

7. **Size of Facility:** 287.06 **Acres**

Size of Disposal Area(s): 44.92 **Acres**

8. **Identify proposed service area or specific industry that waste will be received from:**

The CCRLF service area was limited to waste generated only from Alabama Power Company.

9. **Proposed maximum average daily volume to be received at landfill (choose one):**

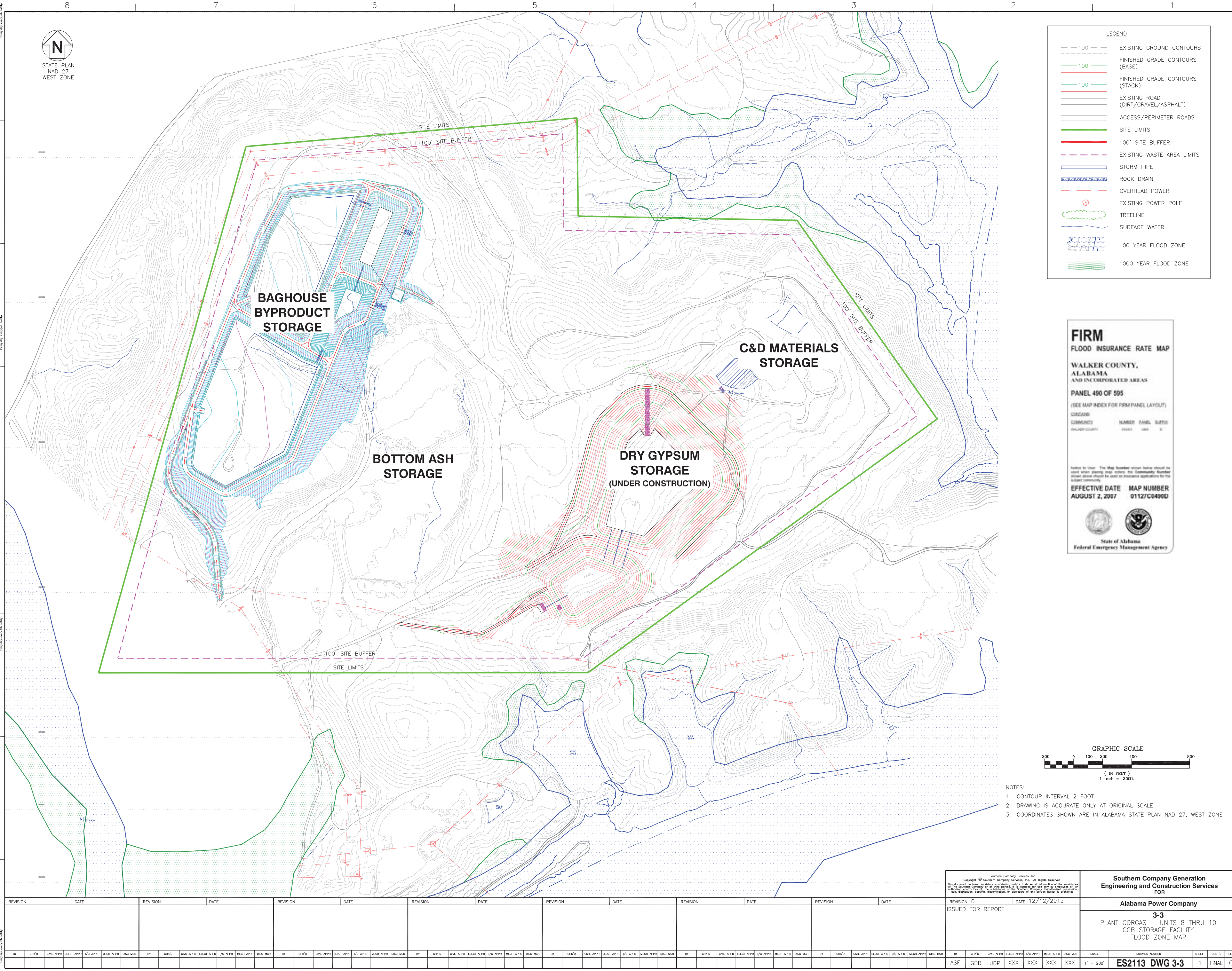
N/A **Tons/Day** N/A **Cubic Yards/Day**

10. **List all waste streams to be accepted at the facility (i.e., household solid waste, wood boiler ash, tires, trees, limbs, stumps, etc.):**

The CCRLF will undergo closure and it contains CCR waste.

[signature] 11/20/18
SIGNATURE **DATE**

APPENDIX 2
FLOOD PLAIN, THREATENED & ENDANGERED SPECIES, CULTURAL RESOURCES AND WETLANDS DOCUMENTATION


BAGHOUSE BYPRODUCT STORAGE
BOTTOM ASH STORAGE
DRY GYPSUM STORAGE (UNDER CONSTRUCTION)
C&D MATERIALS STORAGE
SITE LIMITS
100' SITE BUFFER
STATE PLAN NAD 27 WEST ZONE
LEGEND
EXISTING GROUND CONTOURS
FINISHED GRADE CONTOURS (BASE)
FINISHED GRADE CONTOURS (STACK)
EXISTING ROAD (DIRT/GRAVEL/ASPHALT)
ACCESS/PERIMETER ROADS
SITE LIMITS
100' SITE BUFFER
EXISTING WASTE AREA LIMITS
STORM PIPE
ROCK DRAIN
OVERHEAD POWER
EXISTING POWER POLE
TREELINE
SURFACE WATER
100 YEAR FLOOD ZONE
1000 YEAR FLOOD ZONE
FIRM
FLOOD INSURANCE RATE MAP
WALKER COUNTY, ALABAMA AND INCORPORATED AREAS
PANEL 490 OF 595
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
EFFECTIVE DATE AUGUST 2, 2007
MAP NUMBER 01127C0490D
State of Alabama
Federal Emergency Management Agency
GRAPHIC SCALE
(IN FEET)
1 inch = 200ft.
NOTES:
1. CONTOUR INTERVAL 2 FOOT
2. DRAWING IS ACCURATE ONLY AT ORIGINAL SCALE
3. COORDINATES SHOWN ARE IN ALABAMA STATE PLAN NAD 27, WEST ZONE
Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company
3-3
PLANT GORGAS – UNITS 8 THRU 10
CCB STORAGE FACILITY
FLOOD ZONE MAP
REVISION 0
DATE 12/12/2012
ISSUED FOR REPORT
ASF GBD JDP XXX XXX XXX XXX
1" = 200'
ES2113 DWG 3-3
1 FINAL 0
Drawing name: T:\ESEE MAJOR PROJECTS\PROJECTS\Gorgas\GORGAS 2012\ES2113_Gorgas SAR Data\dwg\Final Drawing files\ES2113FIG3_3 FLOOD MAP.dwg Dec 13, 2012 – 11:04am
ANSI E: 44x34

STATE OF ALABAMA
ALABAMA HISTORICAL COMMISSION
468 SOUTH PERRY STREET
MONTGOMERY, ALABAMA 36130-0900

FRANK W. WHITE
EXECUTIVE DIRECTOR

TEL: 334-242-3184
FAX: 334-240-3477

November 20, 2012

William S. Gardner
Alabama Power Company
600 North 18th Street
Birmingham, Alabama 35291

Re: AHC 13-0201
Cultural Resource Assessment
Gorgas Steam Plant Industrial Landfill
Walker County, Alabama

Dear Mr. Gardner:

Upon review of the cultural resource assessment conducted by the University of Alabama's Office of Archaeological Research, we have determined that project activities will have no adverse effect on cultural resources eligible for or listed on the National Register of Historic Places. Therefore, we concur with the proposed project activities. However, should artifacts or archaeological features be encountered during project activities, work shall cease and our office shall be consulted immediately.

We appreciate your efforts on this project. Should you have any questions, please contact Greg Rhinehart at (334) 230-2662. Please have the AHC tracking number referenced above available and include it with any correspondence.

Truly yours,

Elizabeth Ann Brown

Elizabeth Ann Brown
Deputy State Historic Preservation Officer

EAB/RJG/GCR/gcr

THREATENED AND ENDANGERED SPECIES REPORT & WETLANDS DELINEATION AND STREAM ASSESSMENT REPORT

ALABAMA POWER COMPANY

PLANT GORGAS
LANDFILL PERMIT #64-10 MODIFICATION

PARRISH, WALKER COUNTY, ALABAMA

ALABAMA POWER
A SOUTHERN COMPANY

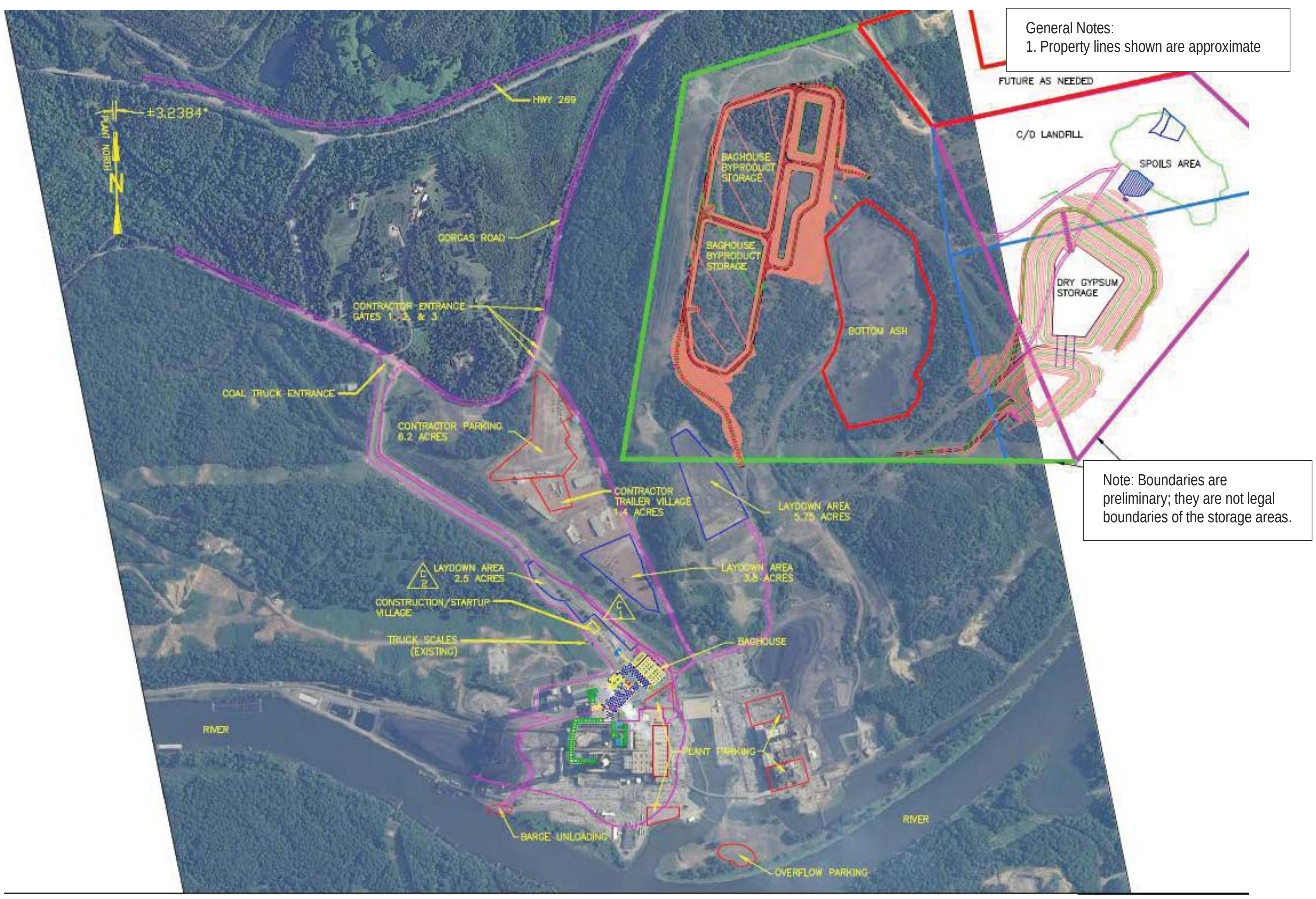
Prepared By:
Alabama Power Company
Birmingham, Alabama

December 2012

EXECUTIVE SUMMARY

In the winter of 2011, Alabama Power Company performed a site assessment to identify any possible inhabitation of Federally protected species in the proposed sites located on a landfill site as well as to identify, delineate, assess and document possible U.S. Army Corps of Engineers' (Corps) "waters of the United States" which may have occurred on the site.

The subject study area consisted of an approximate 352-acre study area and is located within Alabama Power's plant property, south of Alabama Highway 269, near Goodsprings, Alabama. Specifically, the property is located in portions of Sections 17 & 8, Township 16 north and Range 6 west. Center coordinates of the project are as follows: 33.6513 Latitude and -87.1872 Longitude.



Study Area – Gorgas Steam Plant Landfill

For the field studies, Alabama Power personnel identified the location of two areas of proposed work. Area 1 consists of a proposed Dry Gypsum Storage and existing C&D Materials Storage Site that is located on approximately 100 acres on the eastern side of the landfill. Area 2 consists of a site for Baghouse Byproduct Storage located on approximately 65 acres on the western side of the landfill.

SITE CONDITIONS

According to the Alabama Geological Survey, Geologic Map of Alabama dated 1988; the project lies in the Cumberland Plateau Physiographic Province and is underlain by the Pottsville Formation. The Pottsville Formation is Pennsylvanian in age and is primarily composed of sandstone, siltstone, shale and coal. The primary drainages in the area are Baker Creek and its tributaries, which drain to the Mulberry Fork with the primary drainage being the Mulberry Fork of the Black Warrior River. There are varying degrees of impacts to the streams and wetlands due to past land use practices in and adjacent the proposed project boundaries. The project is located in HUC 03160109 – Mulberry Watershed.

According to the Walker Soil Survey most of the acreage within the subject area consists of previous mineral extraction (coal mining), which has been reclaimed. The topography is moderate to steep with few drainage courses. The elevation ranges from about 600 feet to approximately 240 feet above sea level in the project area. Specifically, the study area consisted primarily of Brilliant channery loam. These soils are formed in recent areas of excavated surface, typical of surface mining in the area. See attached Soil Report (Walker County).

Federally Protected Species

Field surveys were conducted for protected species known to occur within Walker County. Table 1 represents a list of state and federally protected species in Walker County. No federally protected species were observed with the site boundaries.

Table 1. List of state and federally protected species in Walker County.

Scientific Name	Common Name	Federal Status	State Status
Aneides aeneus	Green Salamander		SP
Necturus alabamensis	Black Warrior Waterdog	C	SP
Corvus corax	Common Raven		SP
Dendroica petechia	Yellow Warbler		SP
Falco sparverius	American Kestrel		SP
Thryomanes bewickii	Bewick's Wren		SP
Mustela frenata	Long-tailed Weasel		SP
Ursus americanus	Black Bear		GANOS
Macrochelys temminckii	Alligator Snapping Turtle		SP
Masticophis flagellum	Coachwhip		SP
Sternotherus depressus	Flattened Musk Turtle	T	SP
Marshallia mohrii	Mohr's Barbara's Buttons	T	
Platanthera integrilabia	White Fringeless Orchid	C	

C = Candidate Species, T = Federally Threatened, SP = State Protected, GANOS = Game Animal with No Open Season.

Waters of the United States (Wetlands and Streams and Open Waters)

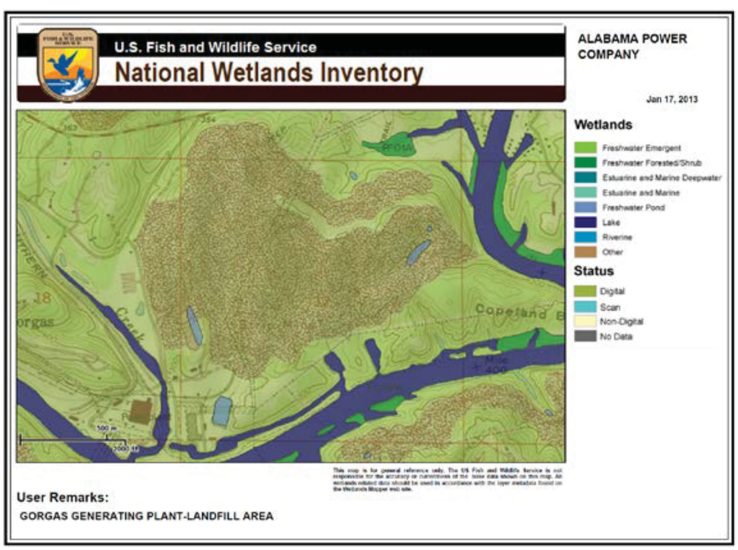
For the purpose of the current Corps guidance and subsequent jurisdiction over waters of the U.S., the following applies:

The agencies will assert jurisdiction over the following waters:

- Traditional navigable waters
- Wetlands adjacent to traditional navigable waters
- Non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g., typically three months)
- Wetlands that directly abut such tributaries

Three features characterize wetlands by definition: hydrology (hydroperiod, mean depth, etc.), the presence of hydric soils and the resulting biotic communities, particularly the presence of hydrophytic vegetation. Hydrology is considered the primary variable of wetland ecosystems, driving the development of wetland soils and leading to the development of the biotic communities (Mitsch and Gosselink 2000). First-order streams, usually designated by solid blue lines on U.S. Geological Survey (USGS) 7.5-min topographic maps (scale 1:24,000), are normally associated with riverine wetlands. They may also continue farther upstream where broken blue lines on topographic maps indicate the presence of channels. Perennial flow is not a requirement for a wetland to be classified as riverine.

A field plan was prepared to assist in the identification and location of wetlands within the subject property. Utilizing existing topographic maps, aerial photography, National Wetlands Inventory Maps (NWI), and field reconnaissance identified wetlands. The wetland survey was conducted in accordance with the USACE *Piedmont and Eastern Mountains Regional Supplement (April 2012).*



NWI –USFWS Wetland Map

The NWI maps show no wetlands within the project boundary, but show two open water ponds located on the subject property, but do not currently exist. These NWI Maps are used as indicators that wetlands could exist and further investigation was performed to confirm the presence of jurisdictional wetlands.

DELINEATION RESULTS

The objective of the work was to perform a site study to determine possible Corps "waters of the United States". The results of that delineation work are as follows:

Assessment and Findings

Waters of the U.S.

- **Area 1** - Area 1 consisted of approximately 100 acres on the eastern side of the landfill that contain a C&D Materials Storage Site and a proposed site for Dry Gypsum Storage. On Tuesday November 29, 2011, Jack Fuqua and Carl Hubbert surveyed the proposed site and surrounding areas included in Area 1. No streams, open waters or wetlands were found.
- **Area 2** - Area 2 consisted of approximately 65 acres on the western side of the landfill and will contain the proposed Baghouse Storage Site. On Thursday, September 20, 2012, Steve Krotzer and Chad Fitch surveyed the Gorgas Baghouse Project Site. No Streams, open waters or wetlands were observed.

QUALIFICATIONS

Steve Krotzer – Alabama Power Environmental Affairs

- Masters Degree in Biology
- 25 Years experience delineating wetlands submitted to the Corps for numerous APC Projects
- Has attended many workshops pertaining to wetland delineation, vegetation and hydric soils

Chad Fitch - Alabama Power Environmental Affairs

- Masters Degree in Biology
- 8 years experience delineating wetlands submitted to the Corps for numerous APC projects
- Has attended many workshops pertaining to wetland delineation, vegetation and hydric soils

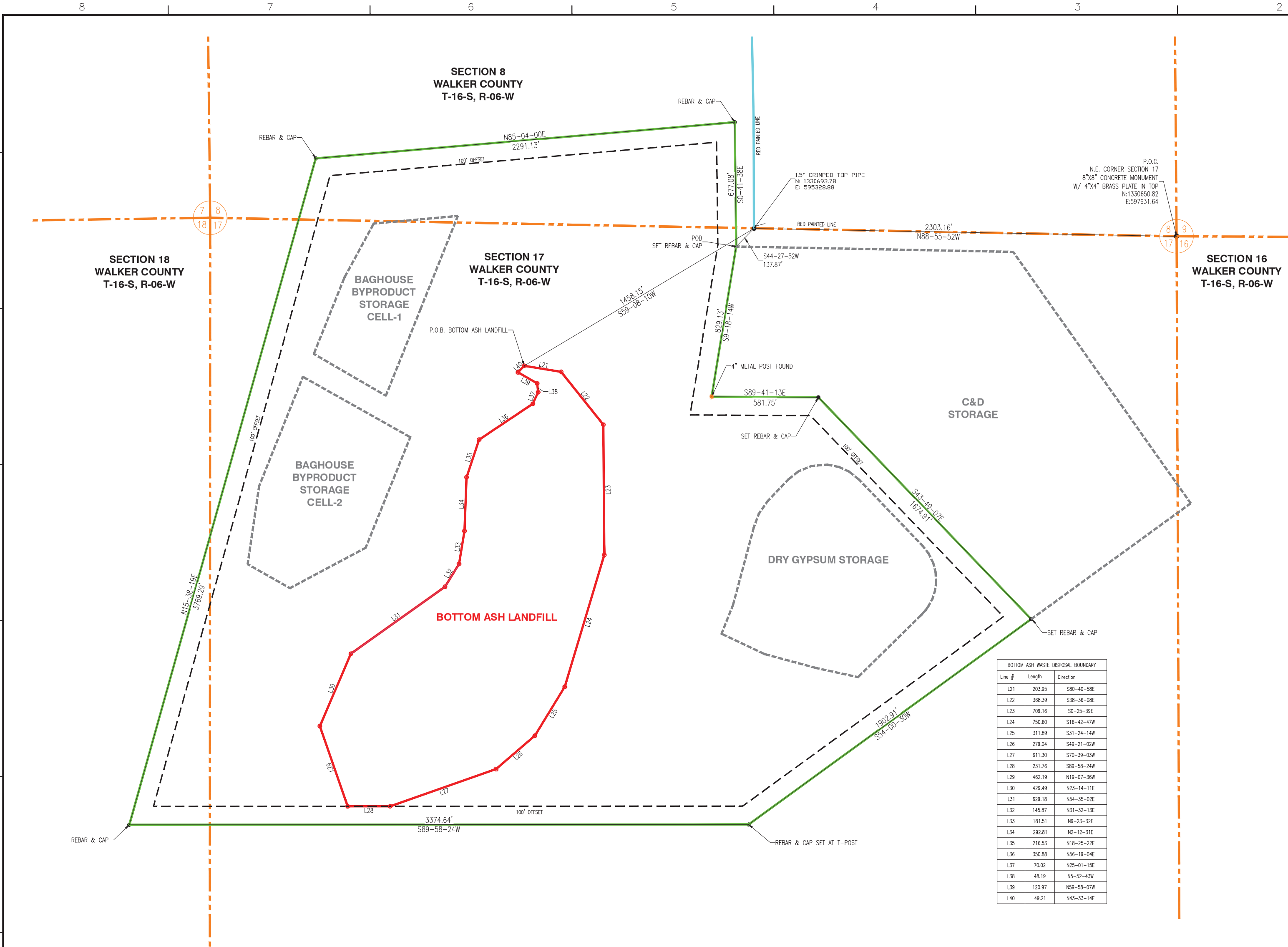
Jack Fuqua - Alabama Power Environmental Affairs

- Successfully completed U.S Army Corps of Engineers 40-Hour Wetland Delineation Course and continuing education as recommended by the Corps related to wetland/upland plants, hydric soils, site hydrology, wetland mitigation, stream creation and classification and stream restoration.
- Mr. Fuqua has performed well over 300 wetland delineations over a 20-year period.
- His wetland forms and field experience have been verified by the Corps on dozens of instances for power line projects, substations, generating plant projects, and lakeshore projects.

Carl Hubbert - Alabama Power Environmental Affairs (Contractor)

- Bachelors Degree in Political Science with emphasis in U.S. Government Regulation and Policy
- Registered Environmental Manager #11752-National Registry of Environmental Professionals (NREP)
- Successfully completed U.S Army Corps of Engineers 40-Hour Wetland Delineation Course and continuing education
- Over 30 years of environmental experience specializing in permitting and compliance, 13 years experience in wetlands delineations and 404(b) Clean Water Act (33 U.S.C. 1344) and state (ADEM) permitting, water quality and prevention of sediment and erosion control

APPENDIX 3
BOUNDARY SURVEY
&
DESIGN AND CONSTRUCTION DRAWINGS



BOTTOM ASH WASTE DISPOSAL BOUNDARY		
Line #	Length	Direction
L21	203.95	S80-40-58E
L22	368.39	S38-36-08E
L23	709.16	S0-25-39E
L24	750.60	S16-42-47W
L25	311.89	S31-24-14W
L26	279.04	S49-21-02W
L27	611.30	S70-39-03W
L28	231.76	S89-58-24W
L29	462.19	N19-07-36W
L30	429.49	N23-14-11E
L31	629.18	N54-35-02E
L32	145.87	N31-32-13E
L33	181.51	N9-23-32E
L34	292.81	N2-12-31E
L35	216.53	N18-25-22E
L36	350.88	N56-19-04E
L37	70.02	N25-01-15E
L38	48.19	N5-52-43W
L39	120.97	N59-58-07W
L40	49.21	N43-33-14E

N

0 200' 400'

GRID COORDINATES
ALABAMA STATE PLANE
NAD 27 WEST ZONE

Boundary Description
Gorgas Steam Plant
Bottom Ash Landfill Facility Boundary

This proposed Facility Boundary is that certain plot of land situated in Sections 8,17,18 T-16-S, R-6-W Walker County, Alabama containing 287.06 acres more or less and more particularly described as follows ; Commence at the NE corner of Section 17, T-16-S, R-6-W, which is identified by an 8"x8" concrete monument with a 4"x4" embedded brass plate, and having West Zone State Plane Coordinates of N:1330650.82 and E:597631.64;
thence N 88-55-52 W a distance of 2303.16 feet to a 1.5" Crimped Top Pipe;
having coordinates of N:1330693.78 and E:595328.88;
thence S 44-27-52 W a distance of 137.87 feet to a set rebar & cap;
this point will be known as the Point of Beginning;
thence bearing S 9-18-14 W a distance of 829.13 feet to a 4" metal post;
thence bearing S 89-41-13 E a distance of 581.75 feet to a set rebar & cap;
thence bearing S 43-49-07 E a distance of 1674.91 feet to a set rebar & cap;
thence bearing S 54-00-30 W a distance of 1902.91 feet to a rebar & cap set at T-post;
thence bearing S 89-58-24 W a distance of 3374.64 feet to a rebar & cap;
thence bearing N 15-38-19 E a distance of 3769.29 feet to a rebar & cap;
thence bearing N 85-04-00 E a distance of 2291.13 feet to a rebar & cap;
thence bearing S 0-41-38 E a distance of 677.08 feet to the point of beginning.

Boundary Description
Gorgas Steam Plant
Bottom Ash Landfill Waste Disposal Boundary

An area of land situated in Section 17, T-16-S, R-6-W Walker County, Alabama containing 44.92 acres more or less and more particularly described as follows ; Commence at the NE corner of Section 17, T-16-S, R-6-W, which is identified by an 8"x8" concrete monument with a 4"x4" embedded brass plate, and having West Zone State Plane Coordinates of N:1330650.82 and E:597631.64;
thence N 88-55-52 W a distance of 2303.16 feet to a 1.5" Crimped Top Pipe
having coordinates of N:1330693.78 and E:595328.88;
thence S 59-08-10 W a distance of 1458.15 feet to a point;
this point will be known as the Point of Beginning;
thence bearing S 80-40-58 E a distance of 203.95 feet to a point;
thence bearing S 38-36-08 E a distance of 368.39 feet to a point;
thence bearing S 0-25-39 E a distance of 709.16 feet to a point ;
thence bearing S 16-42-47 W a distance of 750.60 feet to a point ;
thence bearing S 31-24-14 W a distance of 311.89 feet to a point ;
thence bearing S 49-21-02 W a distance of 279.04 feet to a point ;
thence bearing S 70-39-03 W a distance of 611.30 feet to a point ;
thence bearing S 89-58-24 W a distance of 231.76 feet to a point ;
thence bearing N 19-07-36 W a distance of 462.19 feet to a point ;
thence bearing N 23-14-11 E a distance of 429.49 feet to a point ;
thence bearing N 54-35-02 E a distance of 629.18 feet to a point ;
thence bearing N 31-32-13 E a distance of 145.87 feet to a point ;
thence bearing N 9-23-32 E a distance of 181.51 feet to a point ;
thence bearing N 2-12-31 E a distance of 292.81 feet to a point ;
thence bearing N 18-25-22 E a distance of 216.53 feet to a point ;
thence bearing N 56-19-04 E a distance of 350.88 feet to a point ;
thence bearing N 25-01-15 E a distance of 70.02 feet to a point ;
thence bearing N 5-52-43 W a distance of 48.19 feet to a point ;
thence bearing N 59-58-07 W a distance of 120.97 feet to a point ;
thence bearing N 43-33-14 E a distance of 49.21 to the point of beginning.

LEGEND
POC = POINT OF COMMENCEMENT
POB = POINT OF BEGINNING
BOUNDARY CORNER MONUMENT SET (T-POST)
4 " METAL POST FOUND
SET REBAR & CAP
CALCULATED POINT
PIPE
FACILITY BOUNDARY
100' OFFSET
WASTE DISPOSAL BOUNDARY

State of Alabama

I, the undersigned, Michael T. Hammett, for Alabama Power Company as a Registered Professional Land Surveyor, hereby certify that this map was based upon a survey performed by employees of Southern Company Services, Inc., and is a true and accurate depiction of the lands described hereon, and was produced, to the best of my knowledge, in compliance with the Standards of Practice for Land Surveying in the State of Alabama.

Alabama Power Company
by
Michael T. Hammett
Alabama Register No. 14161

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

Plant Gorgas
BOTTOM ASH LANDFILL
FACILITY & WASTE DISPOSAL BOUNDARY
PERMIT DRAWING

REVISION	DATE
	09/27/2018

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
ENP			XXX	XXX	XXX		As Noted	434OGOR	1	FINAL	0

ANSI E: 44x34

PLANT GORGAS BOTTOM ASH STORAGE AREA CLOSURE

SITEWORK CONSTRUCTION DRAWINGS

WALKER COUNTY, ALABAMA

SECTIONS 17 AND 20, TOWNSHIP 16 SOUTH, RANGE 6 WEST

DRAWING INDEX

PROJECT STREET/LOCATION

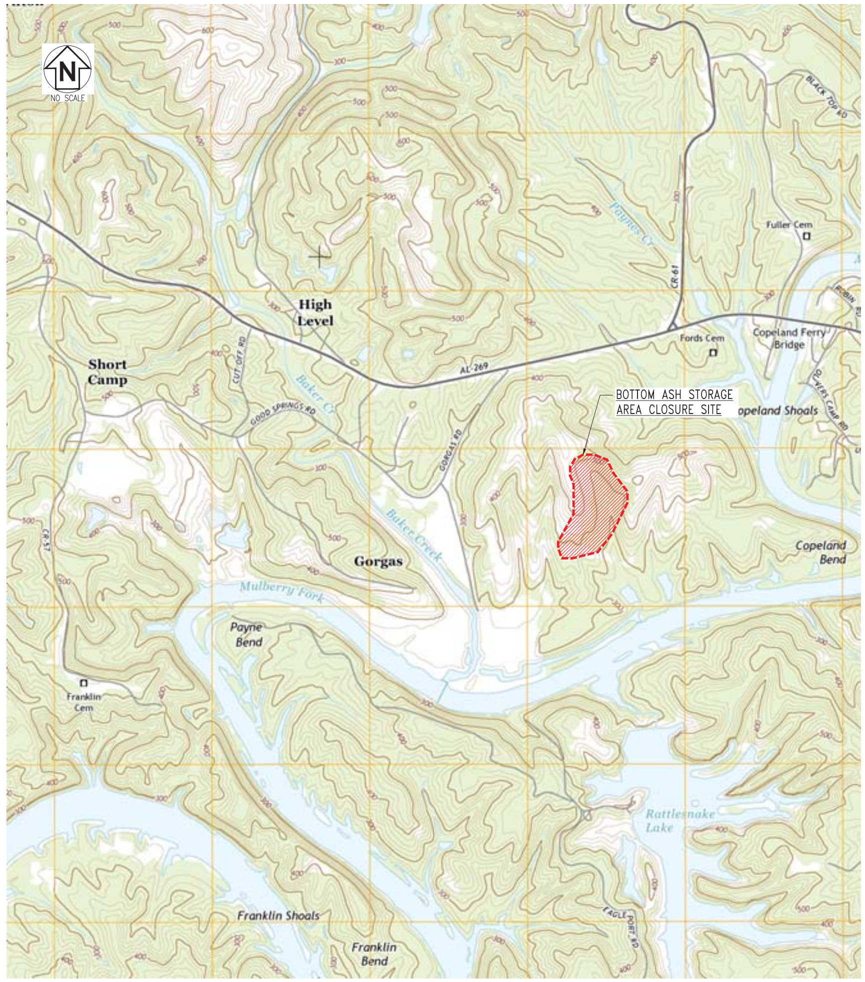
PLANT GORGAS
460 GORGAS ROAD
PARRISH, ALABAMA 35580

PERMITTEE:

ALABAMA POWER COMPANY
600 18TH STREET NORTH
BIRMINGHAM, ALABAMA 35203

PROJECT MANAGER:

SOUTHERN COMPANY SERVICES, INC.
DAVID B. PRATER
460 GORGAS ROAD
PARRISH, ALABAMA 35580-5715
TEL: (205) 992-7266
EMAIL: DBPRATER@SOUTHERNCO.COM



GOODSPRINGS, AL QUADRANGLE
2014

VICINITY MAP
NO SCALE

LOCATION MAP
NOT TO SCALE

LEGEND:
PROJECT AREA

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
TITLE SHEET AND DRAWING INDEX

REVISION 0 DATE 11/21/18
ISSUED FOR CONSTRUCTION
PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
WFW	CRU	JKB	XXX	XXX	MPB	JCP	NONE	E720258	1	FINAL	0

ANSI E: 44x34

TECHNICAL SPECIFICATION REFERENCE

1. REFER TO THE PROJECT TECHNICAL SPECIFICATIONS TITLED "TECHNICAL SPECIFICATIONS SECTION 31 23 00 FOR EXCAVATION AND BACKFILL" (LATEST REVISION).

SURVEY AND TOPOGRAPHY NOTES:

1. CONTOURS ARE A COMPOSITE OF AERIAL LIDAR AND GROUND SURVEY BY SOUTHERN COMPANY CIVIL – FIELD SERVICES AND SOUNDING DATA COLLECTED JULY 2015 – MAY 2018.
2. AERIAL LIDAR PROVIDED BY HALIS, LLC.
3. CONTOUR INTERVAL 1 FOOT @ 30 SCALE, 2 FOOT @ 100 SCALE.
4. CONTOURS WERE PRODUCED BY DIGITAL TERRAIN MODEL.

DEMOLITION NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGES TO EXISTING IMPROVEMENTS ON– OR OFF–SITE DUE TO THE CONSTRUCTION OF THIS PROJECT. ANY DAMAGE WILL BE REPAIRED AT THE CONTRACTOR'S EXPENSE AND TO THE PURCHASER'S SATISFACTION.
2. CONTRACTOR SHALL COORDINATE WITH PURCHASER PRIOR TO BEGINNING ANY AND ALL DEMOLITION OPERATIONS. CONTRACTOR SHALL COORDINATE DEMOLITION OPERATION PHASING WITH PURCHASER PRIOR TO AND THROUGHOUT THE PROJECT LIFE.
3. SOME EXISTING UTILITIES SCHEDULED TO REMAIN ARE LOCATED WITHIN PROPOSED DEMOLITION AREAS. CONTRACTOR SHALL USE EXTREME CAUTION WHILE WORKING IN THESE AREAS TO ASSURE NO UTILITY SERVICE INTERRUPTIONS. CONTRACTOR SHALL HAVE ANY AND ALL EXISTING UTILITIES LOCATED BY UTILITY LINE LOCATER SERVICE PRIOR TO ANY DEMOLITION AND/OR CONSTRUCTION OPERATIONS.
4. CONTRACTOR SHALL COORDINATE WITH PURCHASER PRIOR TO DISRUPTION OF ANY UTILITY SERVICE.
5. ALL UTILITY LOCATIONS, DIMENSIONS AND ELEVATIONS SHOWN ARE APPROXIMATE AND OTHER UTILITIES MAY EXIST.
6. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL/RELOCATION OF ALL ABOVE AND BELOW GROUND EXISTING IMPROVEMENTS THAT ARE IN CONFLICT WITH THE PROPOSED IMPROVEMENTS.
7. REMOVAL AND DISPOSAL OF ANY AND ALL MATERIALS FROM DEMOLITION ACTIVITIES WILL BE DONE IN ACCORDANCE WITH APPLICABLE ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT REGULATIONS AND REQUIREMENTS.
8. ALL EXISTING IMPROVEMENTS SHALL REMAIN UNLESS SPECIFICALLY NOTED, "TO BE REMOVED".

GENERAL CONSTRUCTION NOTES

1. GRID COORDINATE SYSTEM IS ALABAMA WEST STATE PLANE NAD 27.
2. SEE SURVEY AND TOPOGRAPHY NOTES, THIS DRAWING, FOR SURVEY INFORMATION.
3. CONTRACTOR TO USE CAUTION WHEN WORKING UNDER OR NEAR TRANSMISSION LINES. REQUIRED CLEARANCES FROM EQUIPMENT AND PERSONNEL PERFORMING WORK NEAR HIGH VOLTAGE POWER LINES ARE SPECIFIED IN OSHA 1910.333.
4. EXISTING ACCESS AND ROADS SHALL BE MAINTAINED AND REPAIRED AS NECESSARY DURING CONSTRUCTION BY THE CONTRACTOR TO THE SATISFACTION OF THE PURCHASER'S PROJECT CONSTRUCTION MANAGER, PCM.
5. THE CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING HIS OWN STANDARD QUALITY CONTROL AND QUALITY ASSURANCE PROGRAM OR PRACTICES AND SHALL INSTITUTE ANY ADDITIONAL CONTROLS OR PROCEDURES IN ACCORDANCE WITH PROVEN INDUSTRY PRACTICE TO ASSUME COMPLIANCE WITH THESE DRAWINGS AND TECHNICAL SPECIFICATIONS.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PLANNING AND OPERATING ANY DEWATERING, SURFACE WATER RUNOFF CONTROL, AND PROVISIONS FOR DRAINAGE OF EXCAVATIONS, AND FOR THE PLACEMENT OF MATERIALS. SUCH WORK SHALL BE AT NO ADDITIONAL EXPENSE TO THE PURCHASER.
7. ALL WORK SHALL BE IN STRICT COMPLIANCE WITH CURRENT OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS. CONTRACTOR IS RESPONSIBLE FOR ALL SHORING/CRIBBING REQUIRED FOR INSTALLATION OF PIPES AND APPURTENANCES INCLUDING ANY DEEP EXCAVATIONS REQUIRING AN ENGINEER'S DESIGN.
8. CONSTRUCTION ACTIVITIES INCLUDING MATERIAL STOCKPILING ARE NOT PERMITTED IN AREAS OUTSIDE OF THE DESIGNATED LIMITS OF DISTURBANCE UNLESS OTHERWISE SHOWN ON THE DRAWINGS OR AS APPROVED BY THE PCM.
9. CONSTRUCTION DEBRIS, FLOWABLE FILL, OLD SUPPORT MATERIALS OR OTHER REFUSE SHALL BE DISPOSED IN APPROVED LANDFILLS OFFSITE.
10. DRAINAGE FROM THE DISTURBED AREA WITHIN THE PROJECT LIMITS WILL DRAIN TO THE EXISTING WASTE WATER POND OR WILL BE CONTAINED AND REUSED ON–SITE. THE EXISTING WASTE WATER POND HAS A PERMITTED AND MONITORED DISCHARGE, THEREFORE IT DOES NOT REQUIRE A NOTICE OF INTENT (N.O.I.) OR A SET OF PERMITTED EROSION, SEDIMENT, AND POLLUTION CONTROL PLANS (ES&PCP). BEST MANAGEMENT PRACTICES (BMP'S) ARE TO BE INSTALLED AND MAINTAINED, AS SHOWN IN THE PLANS AND ASSOCIATED DETAILS, IN CONFORMANCE WITH THE "ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL, AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS" (LATEST EDITION).
11. SIX INCHES OF UNSETTLED TOPSOIL SHALL BE PLACED ON ALL AREAS THAT REQUIRE PERMANENT GRASSING PRIOR TO APPLICATION OF SEEDING. THE CONTRACTOR SHALL ADHERE TO PROPER SEEDING PROCEDURES AND SPECIFICATIONS, SPECIFICALLY, PAGE 119 THROUGH 127 OF THE "ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME I" LATEST EDITION. THE CONTRACTOR SHALL PERFORM SOIL TESTS TO IDENTIFY AND IMPLEMENT SITE–SPECIFIC FERTILIZER NEEDS OR OTHER SOIL AMENDMENTS FOR ALL AREAS THAT REQUIRE PERMANENT SEEDING.
12. SEVERAL APPLICATIONS OF TEMPORARY OR PERMANENT VEGETATION MAY BE REQUIRED DURING CONSTRUCTION IN ORDER TO ESTABLISH AN ACCEPTABLE FINAL VEGETATIVE COVER. THE CONTRACTOR SHALL ADJUST HIS/HER BID ACCORDINGLY TO ACCOUNT FOR THIS DURING CONSTRUCTION.
13. THE PROJECT LIMITS SHOWN ON THE CONSTRUCTION DRAWINGS FOR THIS PROJECT WILL ALSO ACT AS THE LIMITS OF DISTURBANCE.

EARTHWORK AND CONSTRUCTED FILL

1. FILL AREAS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS TITLED "TECHNICAL SPECIFICATIONS SECTION 31 23 00 FOR EXCAVATION AND BACKFILL" (LATEST REVISION).
2. EARTH FILL MATERIAL SHALL BE OBTAINED FROM APPROVED BORROW AREAS AS DESIGNATED OR APPROVED BY THE PURCHASER. MATERIAL SHALL BE CLEAN/UNCONTAMINATED AND FREE OF CULTURAL RESOURCES AND APPROVED PRIOR TO USE.
3. PROPOSED GRADES INDICATED ON THIS PLAN ARE TO FINISH GRADE. CONTRACTOR SHALL MAKE SUBGRADE ADJUSTMENTS FOR TOPSOIL, PAVING, BUILDING PAD, ETC. FOR DELINEATION OF FINISHED GRADE ELEVATIONS, SEE DRAWINGS E720263–E720265 AND E720275–E720287.
4. ALL EARTHWORK CONSTRUCTION SHALL BE DONE TO THE LINES, GRADES, AND CROSS SECTIONS SHOWN ON THE DRAWINGS. THE CONTRACTOR WILL ESTABLISH ALL NECESSARY BENCHMARKS AND BASE LINES REQUIRED FOR THE WORK.
5. BORROW SITE OR SITES FOR STOCKPILING FILL DIRT SHALL BE PROHIBITED WITHIN 50 FEET OF STREAM BANKS AND WETLANDS. NORMAL GRADING ACTIVITIES SUCH AS CUT/FILL OPERATIONS WITHIN THIS 50 FEET SHALL BE PERMITTED IF DELINEATED AS SUCH BY THE DISTURBANCE LIMITS SHOWN ON THE DRAWINGS.
6. MAXIMUM SLOPES SHALL BE 4–FEET HORIZONTAL TO 1–FOOT VERTICAL UNLESS SHOWN OTHERWISE.

CONCRETE

1. DESIGN, MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE FOLLOWING LATEST STANDARDS AND SPECIFICATIONS UNLESS OTHERWISE MODIFIED ON THE DESIGN DRAWINGS.
   –ACI–318 BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE.
   –ACI–315 MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES.
   –ACI–347R RECOMMENDED PRACTICE FOR CONCRETE FORMWORK.
   –CRSI RECOMMENDED PRACTICE FOR PLACING REINFORCING STEEL.
2. ALL CAST–IN–PLACE CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI IN 28 DAYS, UNLESS OTHERWISE NOTED.
3. USE A TYPE I/II PORTLAND CEMENT AND A W/C RATIO OF 0.45.
4. CONCRETE MIX USING FLY ASH SHALL HAVE A FLY ASH CONTENT EQUAL TO 15–30% OF THE TOTAL CEMENTITIOUS MATERIAL, UNLESS OTHERWISE APPROVED BY THE ENGINEER. FLY ASH SHALL CONFORM TO REQUIREMENTS OF ASTM C618, CLASS F.
5. IF READY–MIX CONCRETE IS USED FROM AN APPROVED SUPPLIER, ALL CONCRETE SHALL BE PLACED WITHIN 1½ HOURS AFTER MIXING.
6. CONCRETE SLABS SHALL HAVE A LIGHT BROOM FINISH.
7. REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO ASTM A615, GRADE 60. WELDED STEEL WIRE FABRIC SHALL BE ASTM A185 PLAIN TYPE.
8. CHAMFER ALL EXPOSED EXTERNAL CORNERS OF CONCRETE WITH A 45 DEGREE CHAMFER, UNLESS OTHERWISE NOTED.
9. PROVIDE A MINIMUM COVER OF 3" FOR ALL REINFORCING STEEL.
10. EMBEDMENT AND SPLICE LENGTHS FOR REINFORCING STEEL SHALL CONFORM TO ACI–318, UNLESS OTHERWISE NOTED.
11. ALL REINFORCING BAR HOOKS SHOWN ON DRAWINGS SHALL BE ACI STANDARD 90 DEGREE HOOKS, UNLESS OTHERWISE NOTED.
12. REBAR FABRICATOR SHALL OBTAIN APPROVAL OF HIS DETAIL DRAWINGS BEFORE BEGINNING FABRICATION, UNLESS OTHERWISE NOTED IN PURCHASE ORDER.

FLOWABLE FILL

1. A FLY ASH/CEMENT FLOWABLE FILL MIX SHALL CONSIST OF THE FOLLOWING:
   2000 LBS OF CLASS "F" FLY ASH
   150 LBS OF CEMENT
   200 LBS OF CONCRETE SAND(OPTIONAL)
   87 GALLONS OF WATER(POTABLE)
2. ALL FLOWABLE FILL TO SET 72 HOURS PRIOR TO PLACING COMPACTED SOIL BACKFILL ON FLOWABLE FILL.
3. TO PREVENT FLOTATION, HOLD DOWN STRAPS SHALL BE USED ON HDPE PIPES PRIOR TO PLACING FLOWABLE FILL.
4. PIPE SUPPORT MATERIAL FOR FLOWABLE FILL CONSTRUCTION SHALL BE CONCRETE BLOCKS OR BRICKS. WOODEN SUPPORTS ARE NOT ALLOWED.
5. COMPRESSION TESTING OF FLOWABLE FILL INCLUDING MAKING OF TEST CYLINDERS IS NOT REQUIRED FOR THIS PROJECT.

STORM DRAINAGE PIPES/APPURTENANCES GENERAL INFORMATION & NOTES

1. PIPE LENGTHS AND SLOPES ARE CALCULATED FROM THE WORK POINTS OF THE PIPES/STRUCTURES.
   WORK POINTS FOR PIPES/STRUCTURES:
   MANHOLES – CENTER OF MANHOLE
   PIPES WITH SLOPE PAVED HEADWALL – END OF PIPE/FACE OF CONCRETE.
2. ALL MANHOLES SHALL CONTAIN STEPS INSTALLED IN ACCORDANCE WITH OSHA REGULATIONS AND SHALL BE SEALED AT JOINTS AND PIPE ENTRY/EXIT POINTS TO PROVIDE A WATERTIGHT STRUCTURE.
3. THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS ON ALL STORM PIPE MATERIALS AND STRUCTURES TO THE PROJECT CONSTRUCTION MANAGER PRIOR TO INSTALLATION AND/OR FABRICATION.
4. STORM DRAINAGE SYSTEMS SHALL BE CONSTRUCTED FROM DOWNSTREAM TO UPSTREAM.
5. THE CONTRACTOR SHALL VERIFY ALL EXISTING AND NEW STORM PIPE GRADES AND CONNECTION POINTS PRIOR TO INSTALLATION. THE PURCHASER SHALL BE NOTIFIED OF ANY DEVIATIONS PRIOR TO CONSTRUCTION.
6. ALL STORM PIPES SHALL BE BEDDED IN A MINIMUM OF 6" OF CRUSHED AGGREGATE (ALDOT #57 STONE OR APPROVED EQUAL).
7. STORM PIPES SHALL BE HANCOR BLUE SEAL OR ADS DUAL WALL, N–12 WTIB HDPE PIPE OR AN EQUAL APPROVED BY ENGINEERING. THE PIPES SHALL HAVE A SMOOTH INTERIOR AND ANGULAR EXTERIOR CORRUGATIONS. PIPE JOINTS SHALL BE GASKETED WATER TIGHT.

ABBREVIATIONS:

ACI — AMERICAN CONCRETE INSTITUTE
A.S.T.M. — AMERICAN SOCIETY OF TESTING MATERIALS
BP — BEGIN POINT
DWG. — DRAWING
EL. — ELEVATION
EP — END POINT
EX. — EXISTING
F.B. — FLAT BOTTOM
G.A.B. — GRADED AGGREGATE BASE
HDPE — HIGH DENSITY POLYETHYLENE
HP — HIGH POINT
IE. — INVERT ELEVATION
LF — LINEAR FEET
LP — LOW POINT
MAX. — MAXIMUM
MIN. — MINIMUM
N.T.S. — NOT TO SCALE
PI — POINT OF INTERSECTION
PC — POINT OF CURVE
PCC — POINT OF COMPOUND CURVE
PT — POINT OF TANGENT
PVI — POINT OF VERTICAL INTERSECTION
R — RADIUS
TYP — TYPICAL

LEGEND

300	FINISH GRADE CONTOURS (MAJOR)
301	FINISH GRADE CONTOURS (MINOR)
x 715.50	EXISTING SPOT ELEVATION
x 715.50	FINISH GRADE SPOT ELEVATION
300	℄ NEW DITCHES
	EXISTING ROADS
x	EXISTING FENCE
x	FENCE
	AGGREGATE ROADS
	RIPRAP
GP	GUARDPOST
	PROJECT LIMITS
	CLOSURE CAP LIMITS
	EXISTING STORM DRAINAGE PIPE
	STORM DRAINAGE PIPE
	STORM PIPE WITH CONCRETE HEADWALL
	STORM PIPE WITH RISER SECTION
715	EXISTING CONTOURS (MAJOR)
715	EXISTING CONTOURS (MINOR)
	EXISTING WATER
OHE	OVERHEAD ELECTRICAL

EROSION CONTROL LEGEND

DC	DUST CONTROL
ECB	EROSION CONTROL BLANKET
LG	LAND GRADING
OP	OUTLET PROTECTION
PS	PERMANENT SEEDING
TS	TEMPORARY SEEDING
TSG	TOPSOILING

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

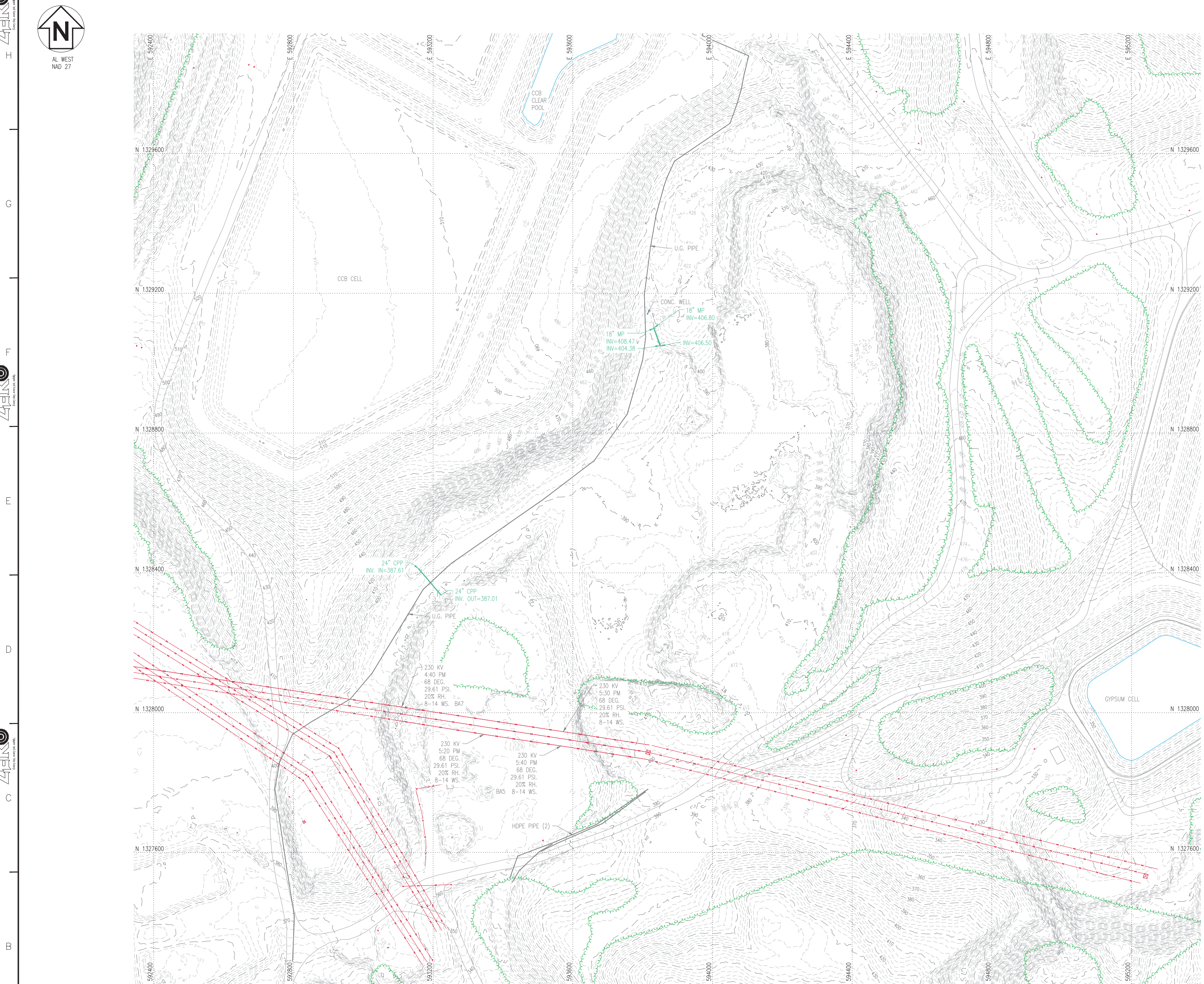
PLANT GORGAS
SITEWORK
GENERAL NOTES, ABBREVIATIONS AND LEGEND

REVISION 0 DATE 11/21/18
ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
WFW	CRU	JKB	XXX	XXX	MPB	JCP	NONE	E720259	1	FINAL	0

ANSI E: 44x34



GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation
Engineering and Construction Services
FOR

Alabama Power Company

PLANT GORGAS
SITEWORK
EXISTING TOPOGRAPHIC MAP

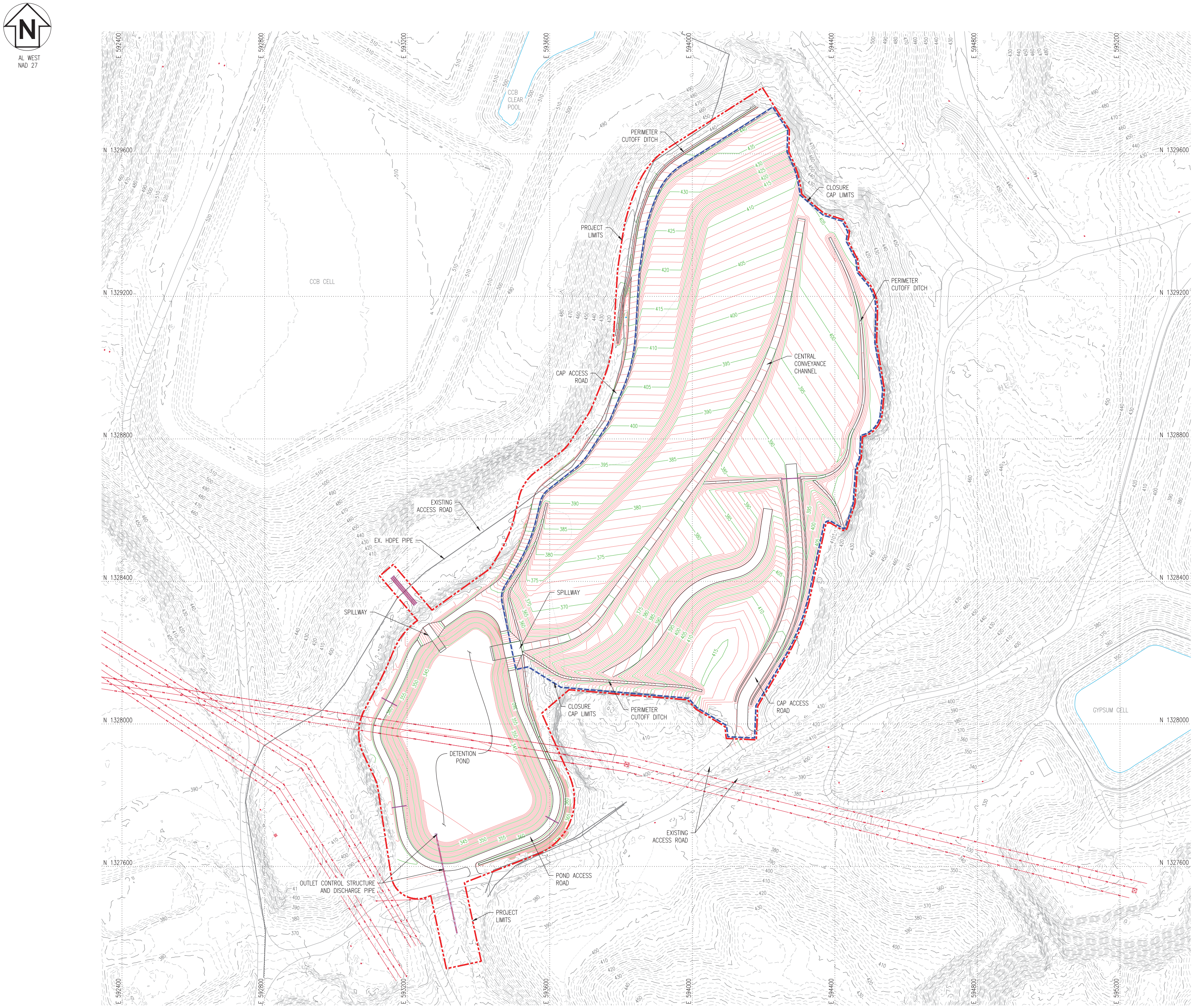
REVISION 0 | DATE 11/21/18

ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
WFW	CRU	JKB	XXX	XXX	MPB	JCP	1" = 100'	E720260	1	FINAL	0

ANSI E: 44x34



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

Southern Company Generation Engineering and Construction Services
FOR
Alamba Power Company

PLANT GORGAS
SITEWORK
GENERAL ARRANGEMENT
AND PROJECT LIMITS

REVISION	DATE
0	11/21/18
ISSUED FOR CONSTRUCTION	

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
WFW	CRU	JKB	XXX	XXX	MPB	JCP

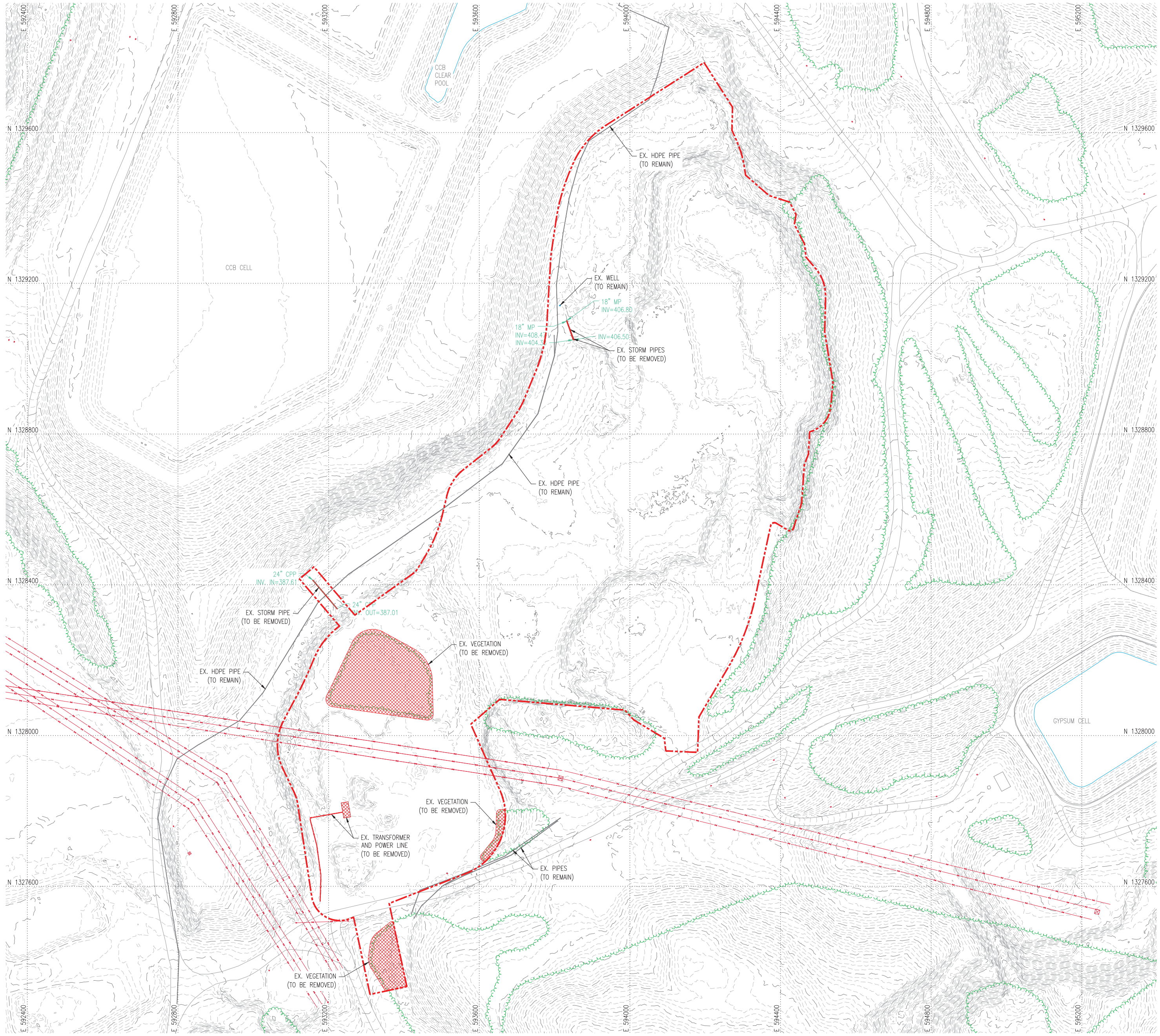
SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 100'	E720261	1	FINAL	0

ANSI E: 44x34

AL WEST
NAD 27

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.



GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
DEMOLITION PLAN

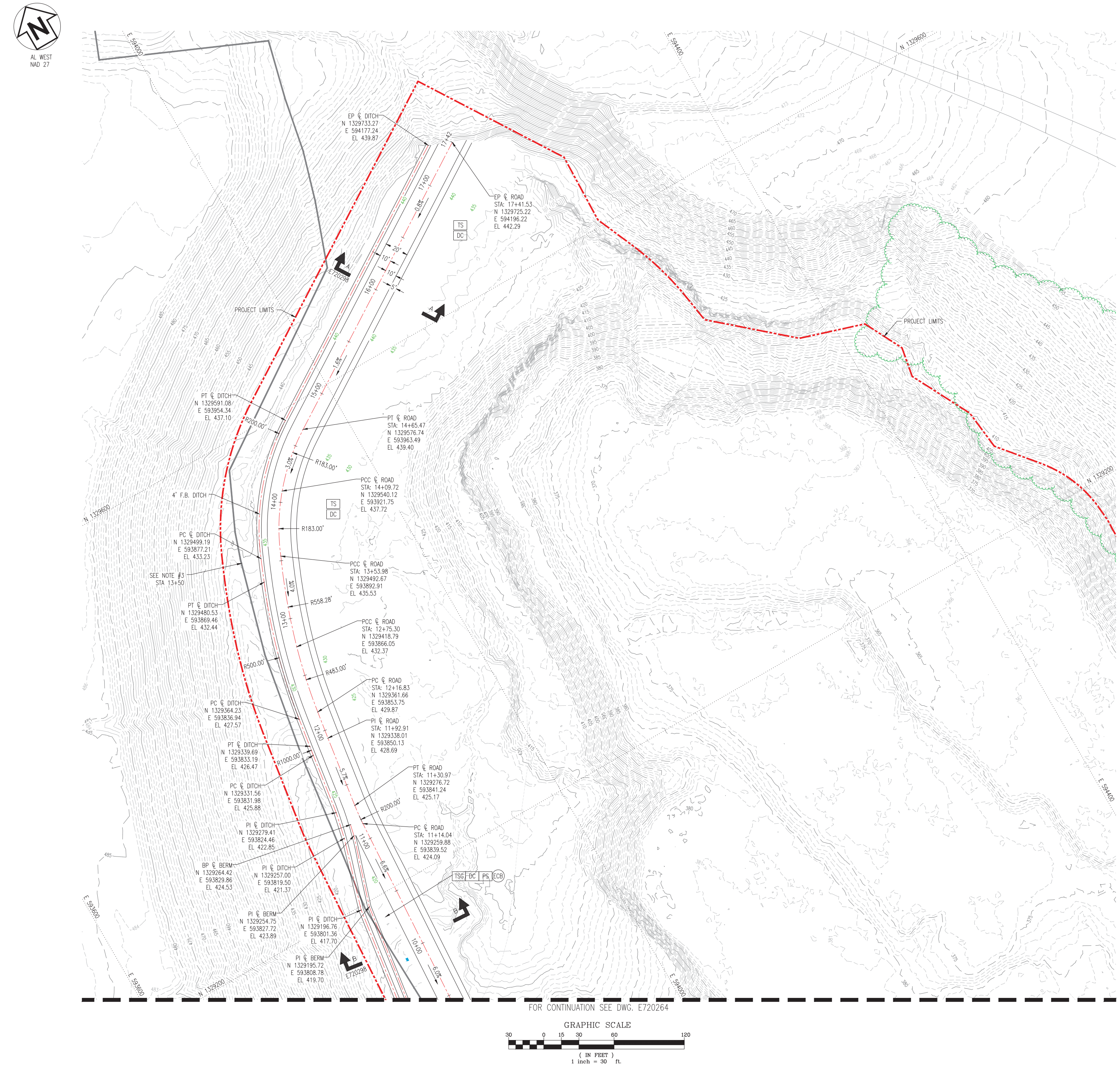
REVISION	DATE
0	11/21/18
ISSUED FOR CONSTRUCTION	

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
WFW	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 100'	E720262	1	FINAL	0

ANSI E: 44x34



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.
3. BETWEEN STATIONS 8+00 AND 13+50, CONTRACTOR SHALL REMOVE ALL ASH ABOVE EXISTING HDPE PIPE AND BACKFILL WITH STRUCTURAL FILL.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH INITIAL LAYOUT & GRADING PLAN
SHEET 1

REVISION	DATE	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
					XXX	XXX		

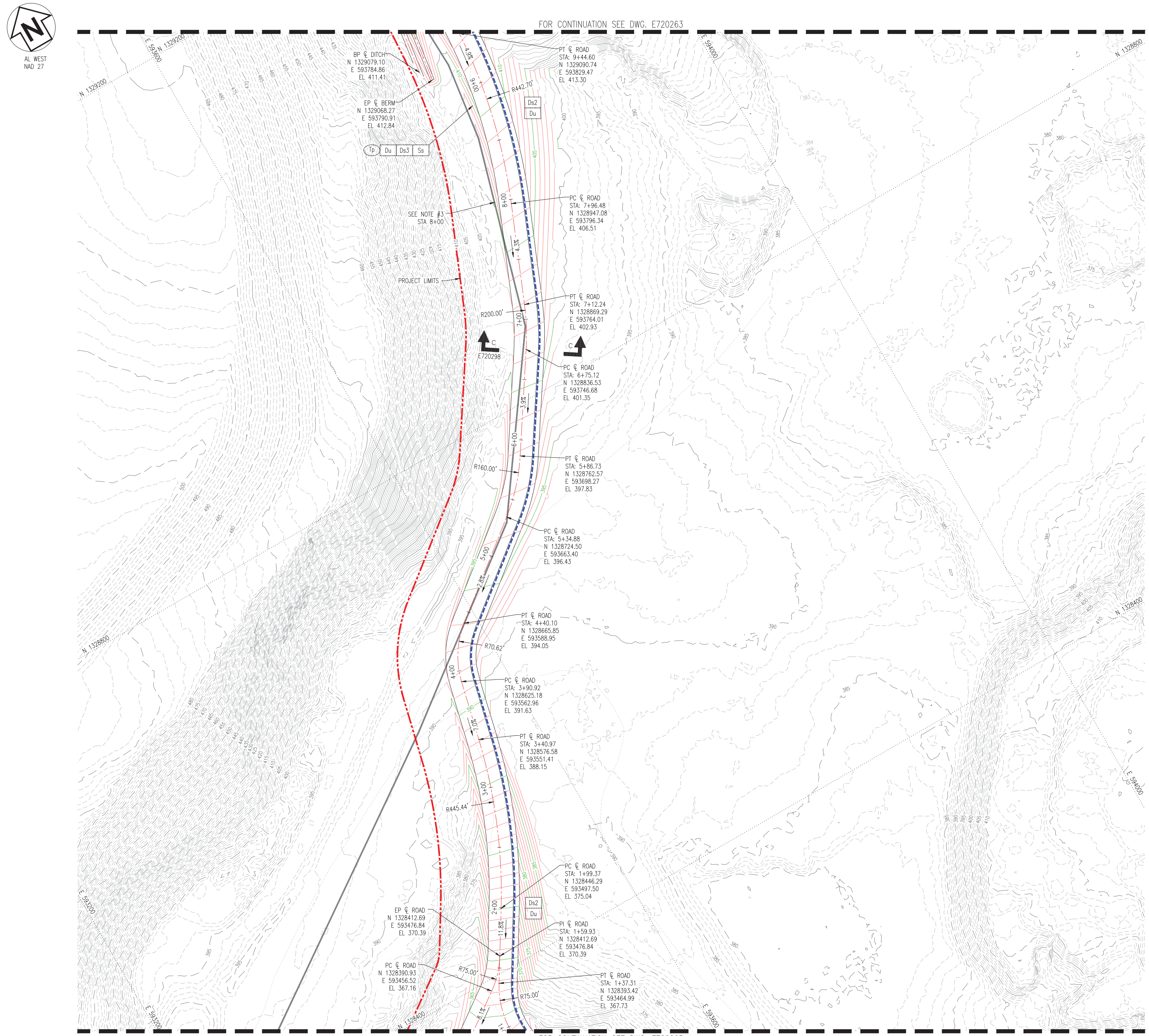
SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 30'	E720263	1	FINAL	0

ANSI E: 44x34

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.
3. BETWEEN STATIONS 8+00 AND 13+50, CONTRACTOR SHALL REMOVE ALL ASH ABOVE EXISTING HDPE PIPE AND BACKFILL WITH STRUCTURAL FILL.

FOR CONTINUATION SEE DWG. E720263



FOR CONTINUATION SEE DWG. E720265

GRAPHIC SCALE
30 0 15 30 60 120
(IN FEET)
1 inch = 30 ft.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH INITIAL LAYOUT & GRADING PLAN
SHEET 2

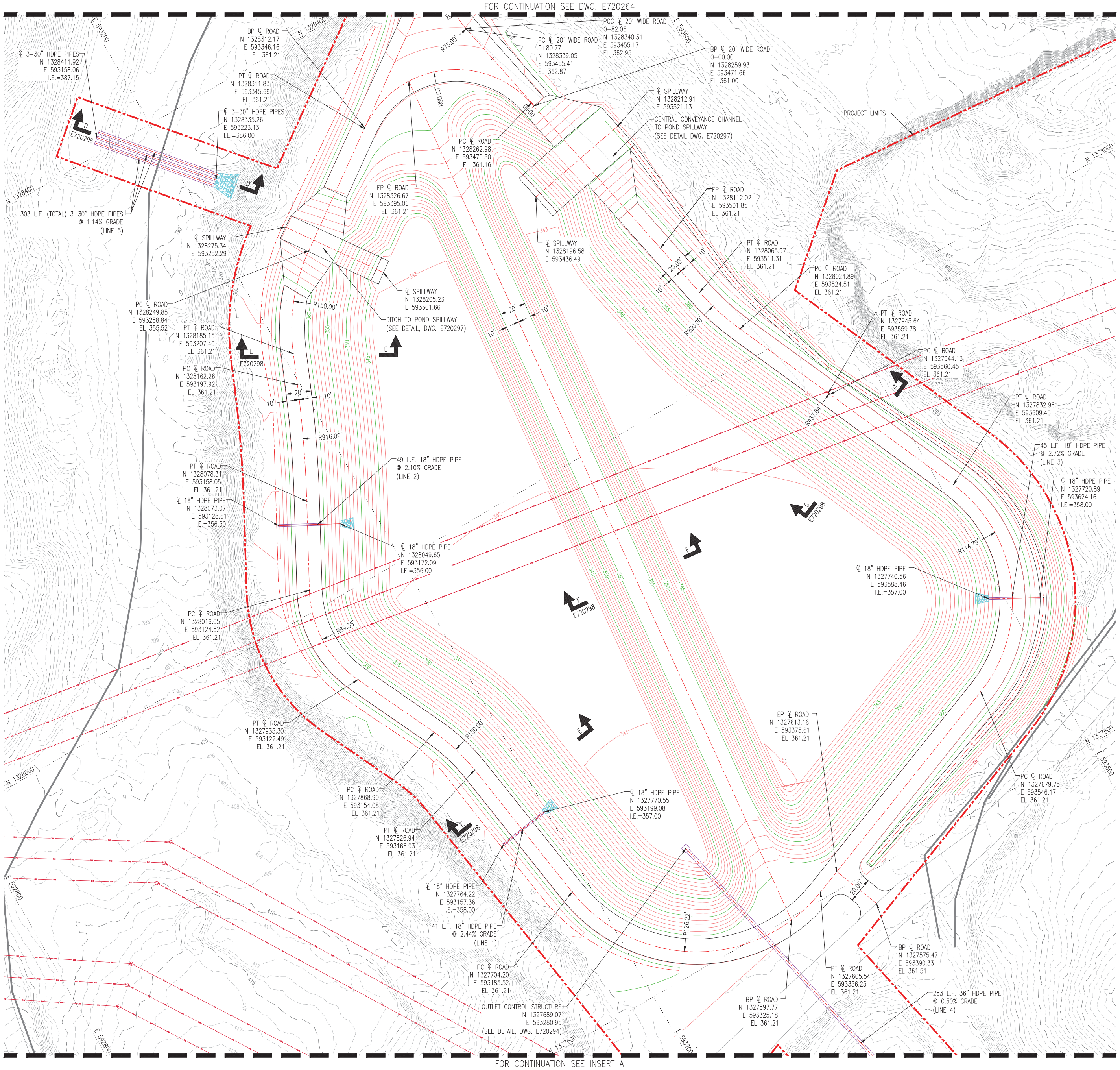
REVISION 0 DATE 11/21/18
ISSUED FOR CONSTRUCTION
PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

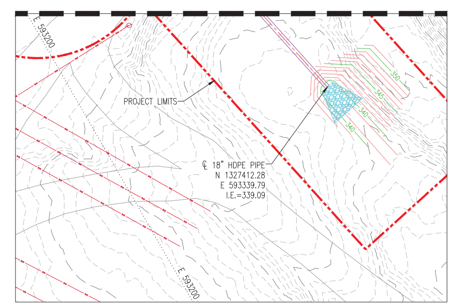
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
JAA	CRU	JKB	XXX	XXX	MPB	JCP	1" 30'	E720264	1	FINAL	0

ANSI E: 44x34

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.





INSERT A

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

REVISION	DATE
0	11/21/18
ISSUED FOR CONSTRUCTION	

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JAA	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

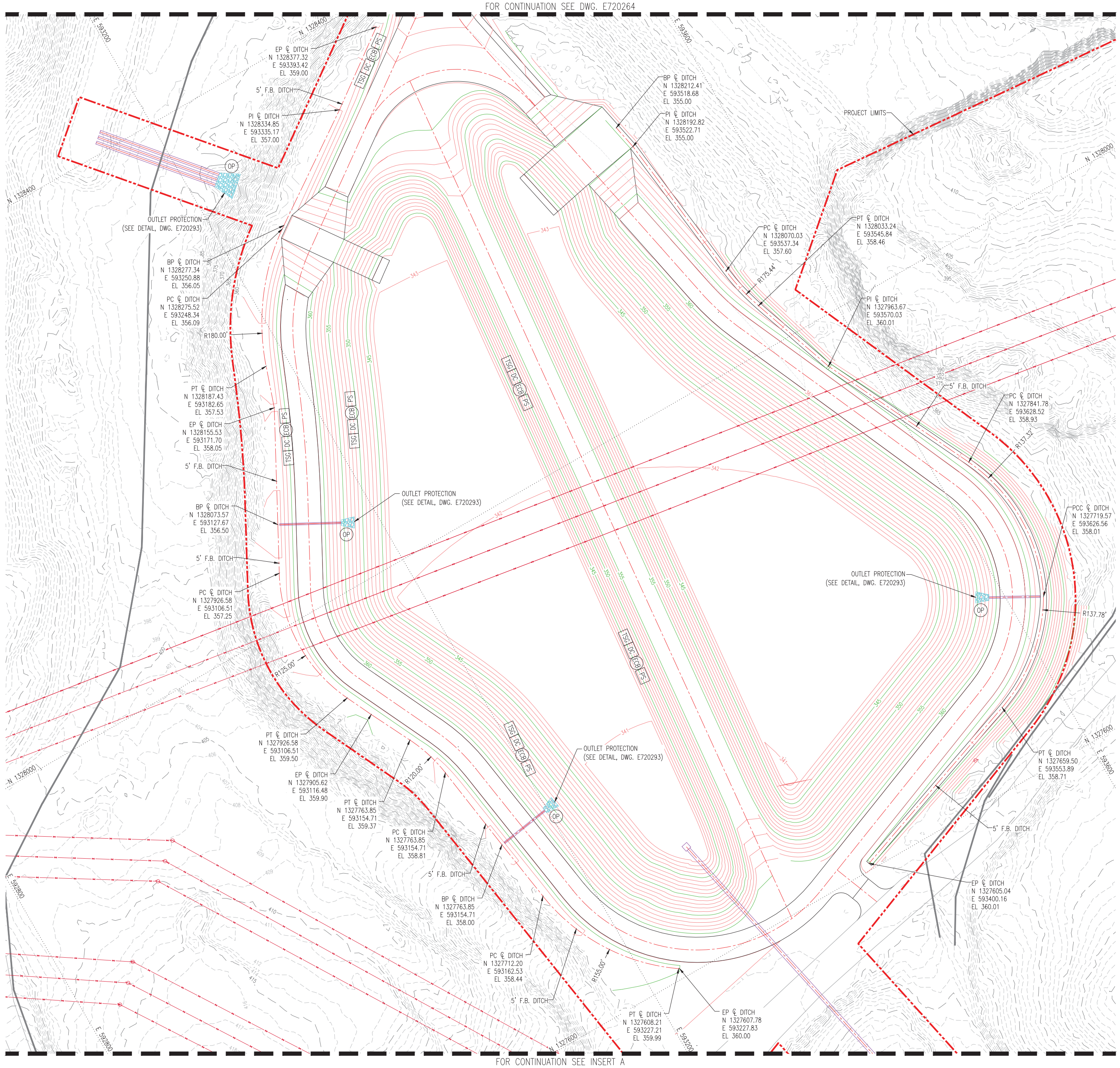
PLANT GORGAS
SITEWORK
BOTTOM ASH INITIAL LAYOUT PLAN
SHEET 3

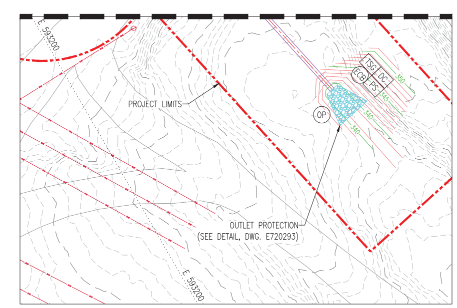
SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 30'	E720265	1	FINAL	0

ANSI E: 44x34

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.





INSERT A

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH INITIAL GRADING PLAN
SHEET 3

REVISION 0 DATE 11/21/18
ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
JAA	CRU	JKB	XXX	XXX	MPB	JCP	1" = 30'	E720266	1	FINAL	0

ANSI E: 44x34

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES, ABBREVIATIONS, AND LEGEND.

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

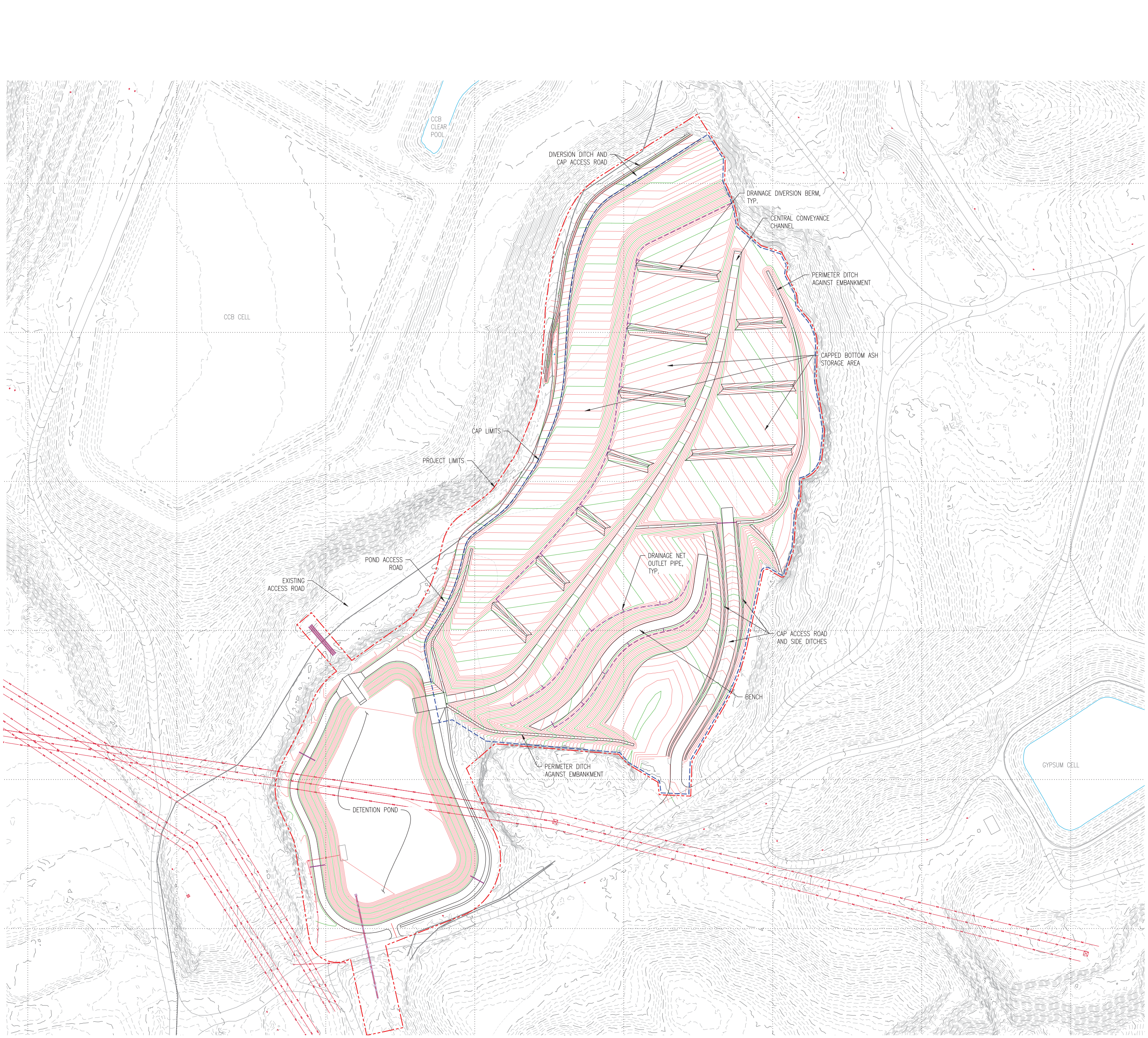
PRELIMINARY NOT FOR CONSTRUCTION

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL STACK OVERALL PLAN

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 100'	E720274	1	FINAL	B

ANSI E: 44x34



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL OVERALL PLAN

REVISION 0 DATE 11/16/18
ISSUED FOR CONSTRUCTION
PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

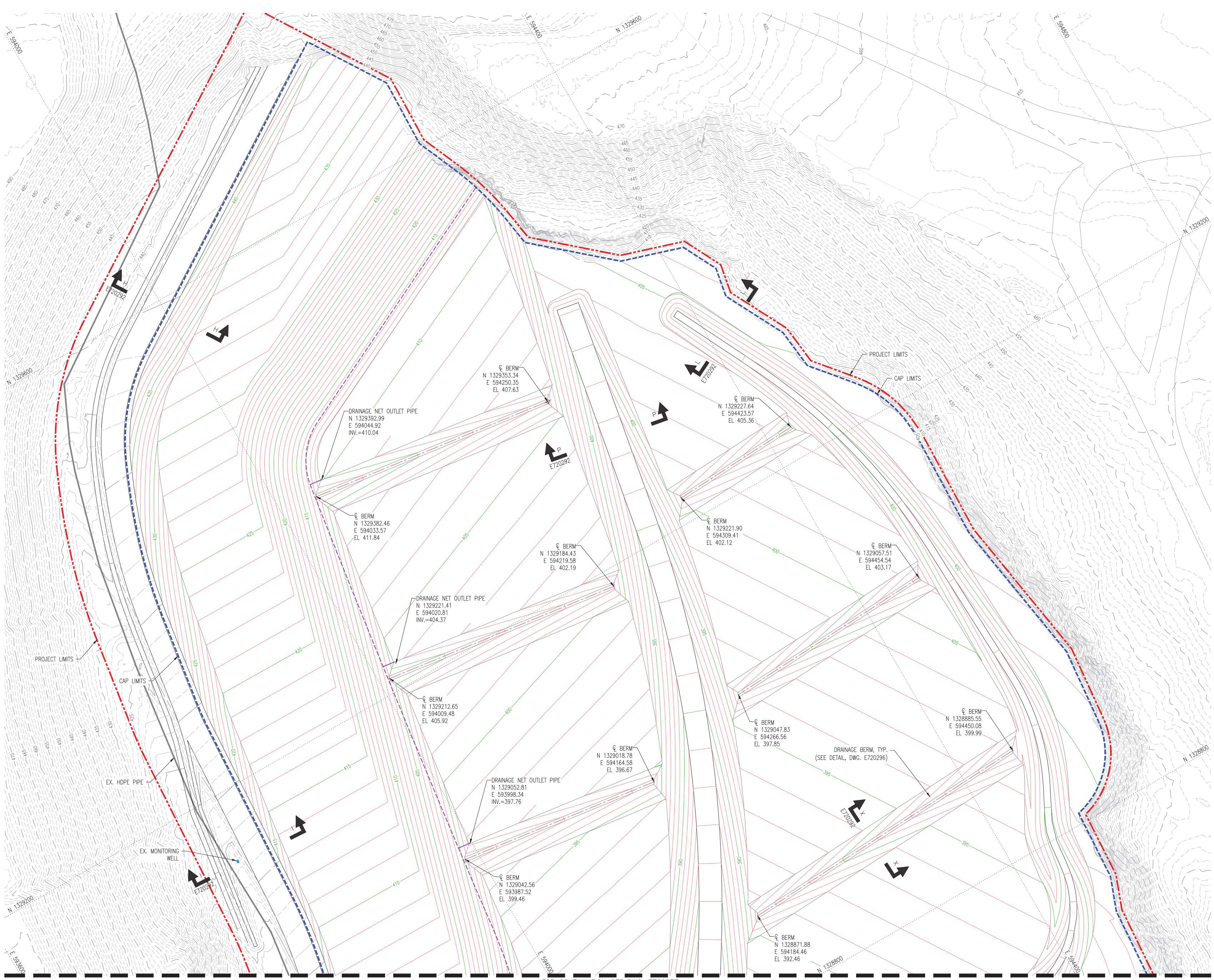
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JAA	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 100'	E720275	1	FINAL	0

ANSI E: 44x34

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.



FOR CONTINUATION SEE DWG. E720277

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

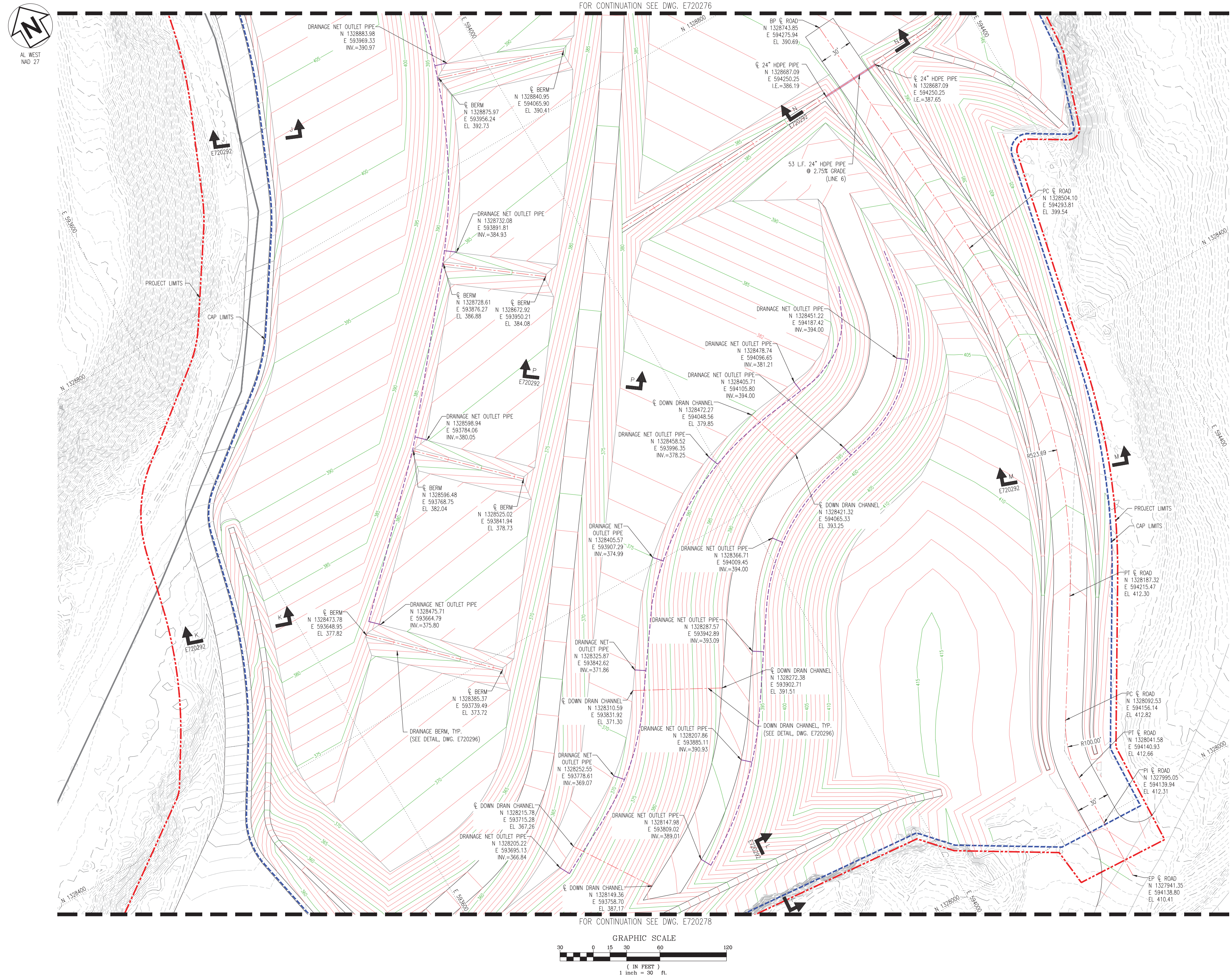
PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL LAYOUT PLAN
SHEET 1

REVISION	DATE
0	11/21/18
ISSUED FOR CONSTRUCTION	
PROJ ID: GOR18003	
BOTTOM ASH STORAGE AREA CLOSURE	

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JAA	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 30'	E720276	1	FINAL	0

ANSI E: 44x34



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL LAYOUT PLAN
SHEET 2

REVISION	DATE
0	11/21/18
ISSUED FOR CONSTRUCTION	

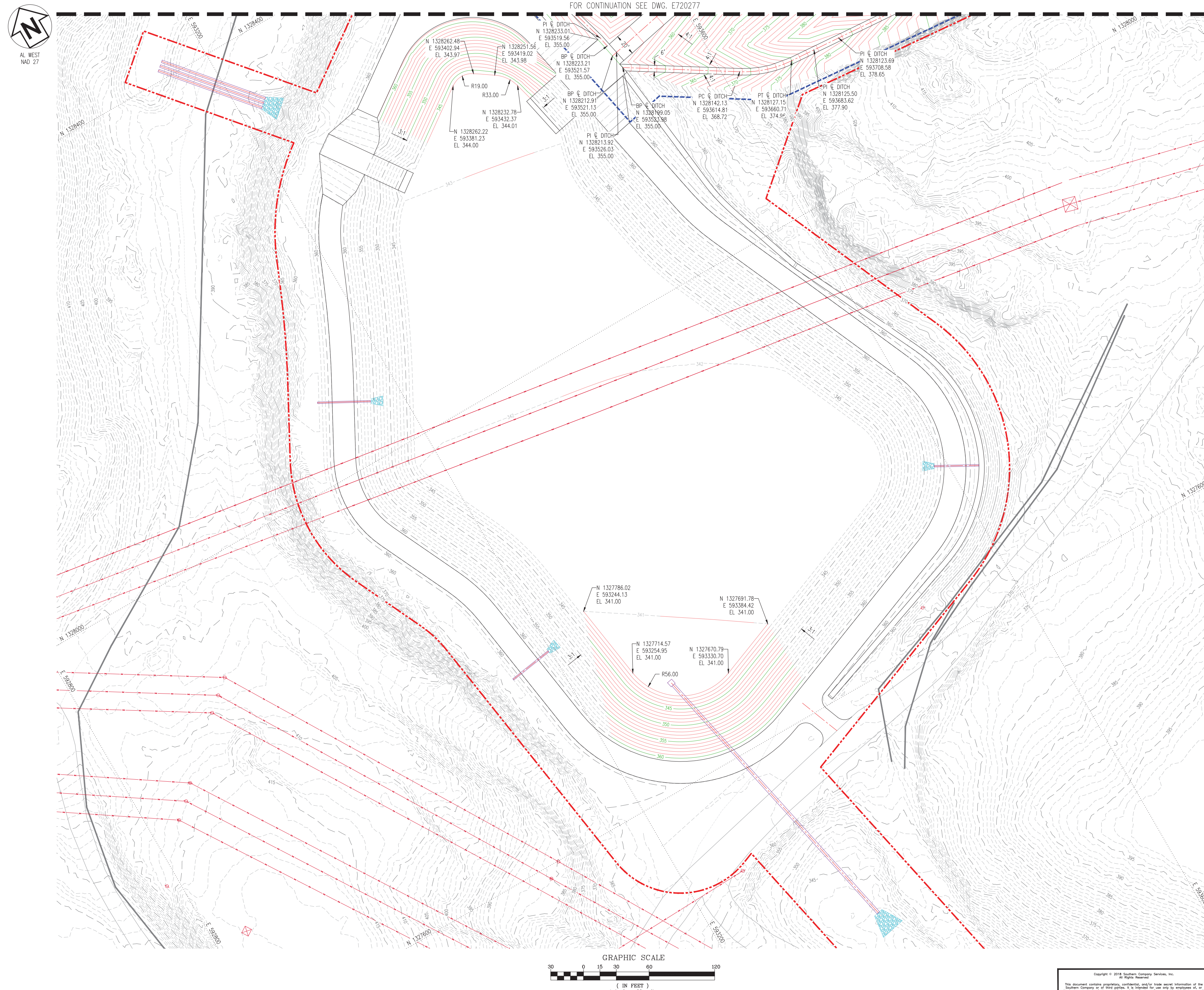
PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JAA	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 30'	E720277	1	FINAL	0

ANSI E: 44x34

FOR CONTINUATION SEE DWG. E720277



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL LAYOUT PLAN
SHEET 3

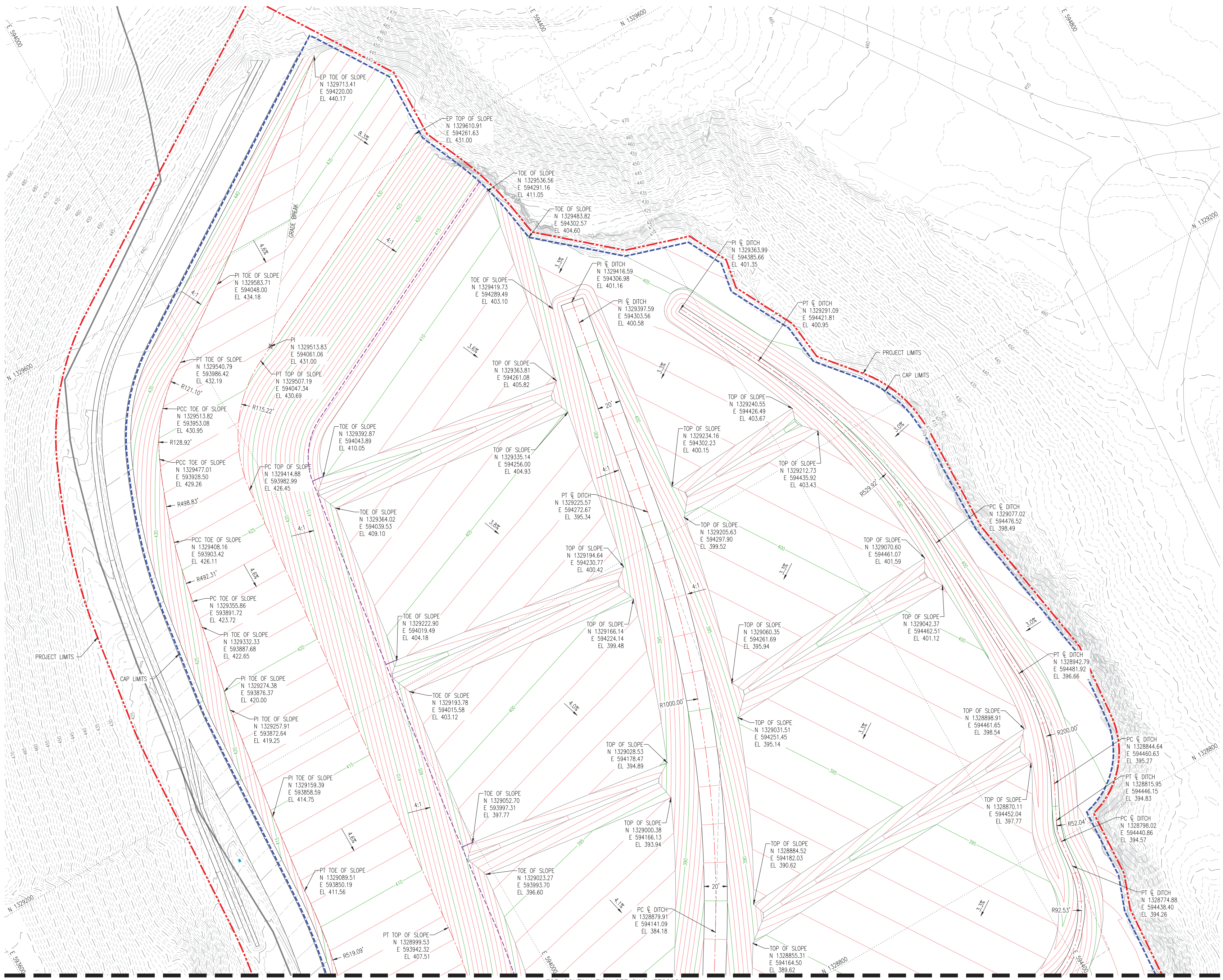
SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 30'	E720278	1	FINAL	0

ANSI E: 44x34

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

AL WEST
NAD 27



FOR CONTINUATION SEE DWG. E720280

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

Southern Company Generation
Engineering and Construction Services
FOR

Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL GRADING PLAN
SHEET 1

REVISION	DATE
0	11/21/18

ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

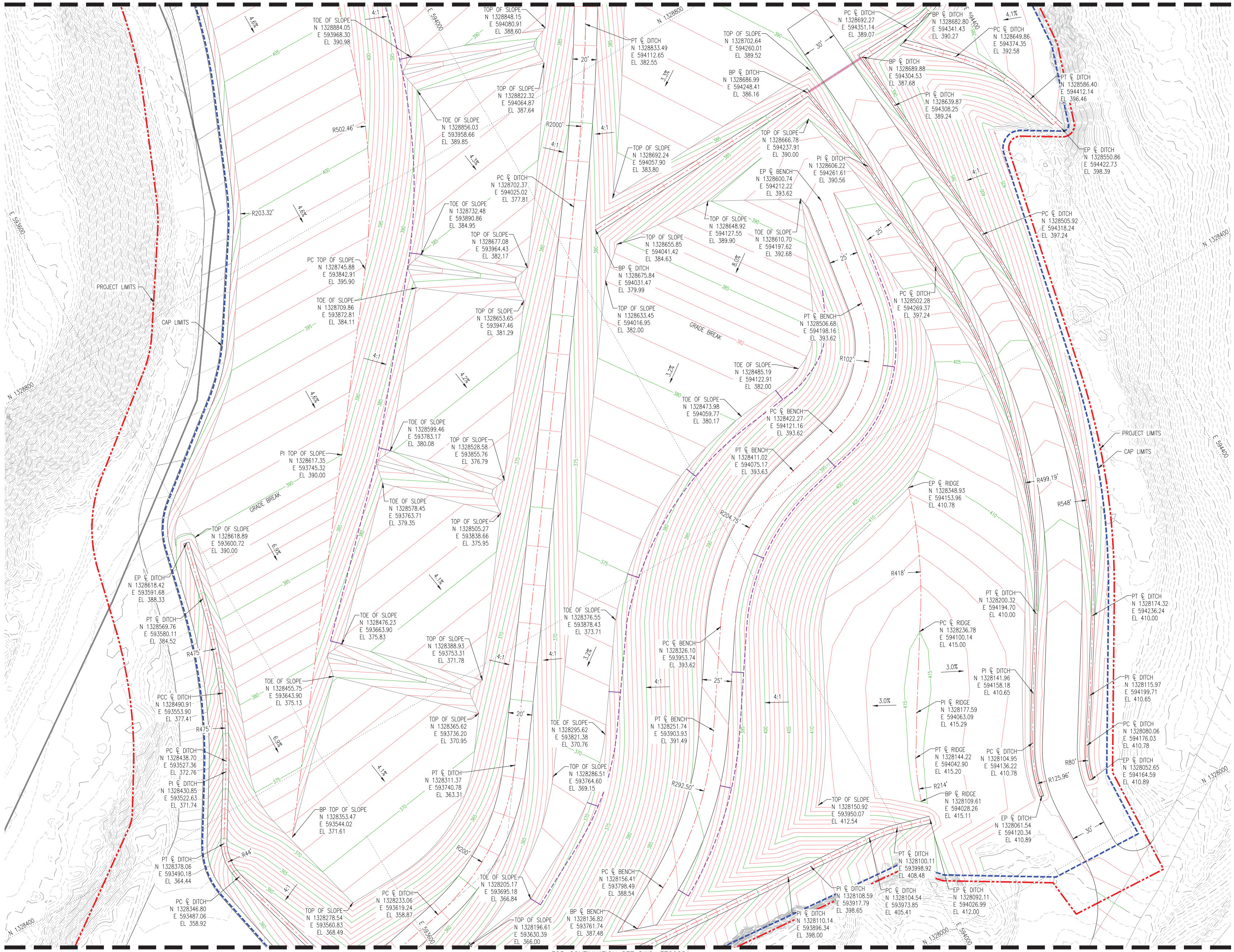
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JAA	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 30'	E720279	1	FINAL	0

ANSI E: 44x34

AL WEST
NAD 27

FOR CONTINUATION SEE DWG. E720279



FOR CONTINUATION SEE DWG. E720281

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation
Engineering and Construction Services
FOR

Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL GRADING PLAN
SHEET 2

REVISION	DATE
0	11/21/18

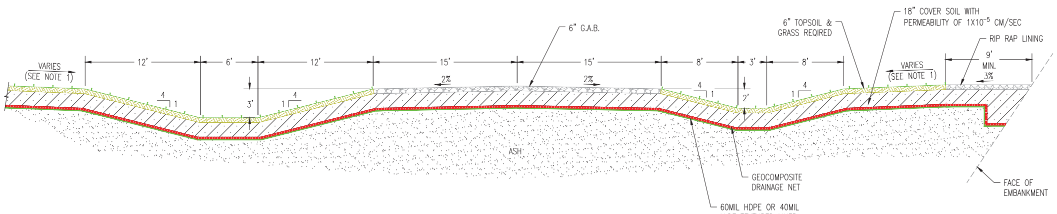
ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

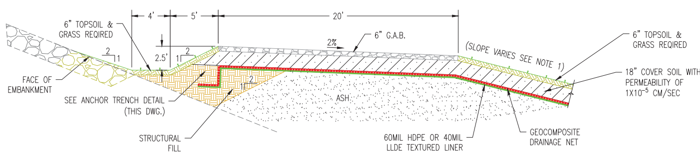
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JAA	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 30'	E720280	1	FINAL	0

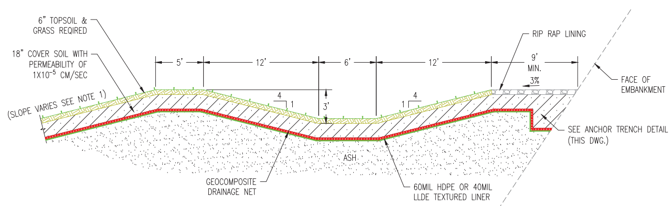
ANSI E: 44x34



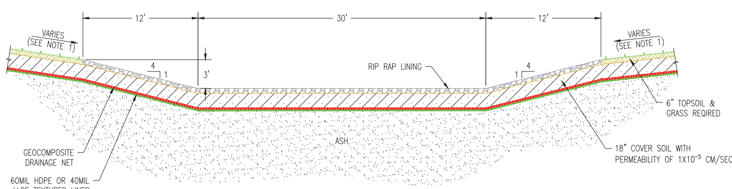
SECTION B–B
PERIMETER DITCH AND
CAP ACCESS ROAD EAST DETAIL
N.T.S.



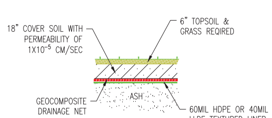
SECTION C–C
DIVERSION DITCH AND
CAP ACCESS ROAD WEST DETAIL
N.T.S.



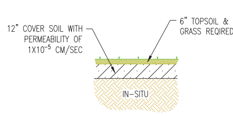
SECTION D–D
PERIMETER DITCH
AGAINST EMBANKMENT DETAIL
N.T.S.



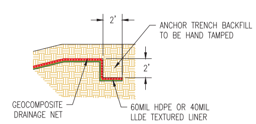
SECTION A–A
CENTRAL CONVEYANCE CHANNEL DETAIL
N.T.S.



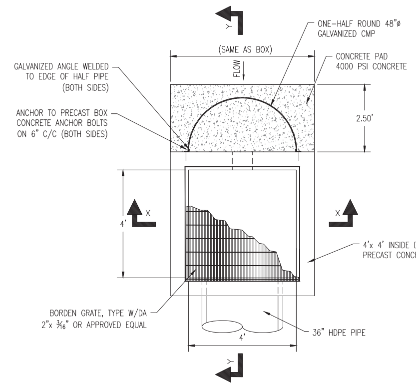
CAP COVER DETAIL
N.T.S.



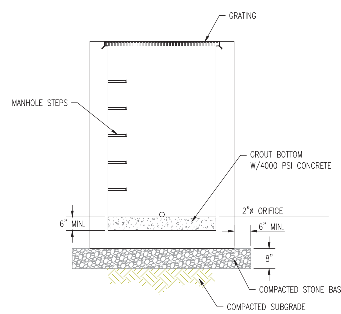
POND COVER DETAIL
N.T.S.



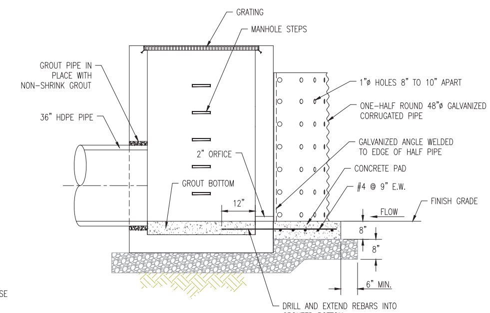
ANCHOR TRENCH DETAIL
N.T.S.



PLAN



SECTION X–X



SECTION Y–Y

OUTLET CONTROL STRUCTURE DETAIL
N.T.S.

NOTE:
PAINT ALL WELDS AND EXPOSED STEEL WITH "7007G CROWN GOLD" GALVANIZED PAINT OR APPROVED EQUAL. APPLY PER THE MANUFACTURERS REQUIREMENT.

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES, ABBREVIATIONS AND LEGEND.

GENERAL NOTES:

1. ALL FINISHED SLOPES WITHIN BOTTOM ASH AREA CAP SHALL BE A MINIMUM OF 3.0% AND MAXIMUM OF 4:1 SIDE SLOPES. SEE PLAN FOR DETAILS.

PRELIMINARY
NOT FOR
CONSTRUCTION

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 1

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
NONE	E720290	1	FINAL	B

REVISION	DATE	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
					XXX	XXX	XXX	

ANSI E: 44x34

TOPSOILING IS THE REMOVAL OF A DESIRABLE SOIL SURFACE, REFERRED TO AS TOPSOIL, AT A SITE PRIOR TO CONSTRUCTION AND USING IT ON AREAS TO BE VEGETATED. TOPSOILING A SITE USUALLY IMPROVES THE QUALITY OF THE PLANT GROWTH MEDIUM AT THE SITE AND INCREASES THE LIKELIHOOD OF SUCCESSFUL PLANT ESTABLISHMENT AND PERFORMANCE. THIS PRACTICE APPLIES TO SITES THAT ARE TO BE DISTURBED BY EXCAVATION, COMPACTION OR FILLING, AND TO OTHER AREAS WHERE THE SUBSOIL IS UNSUITABLE FOR PLANT GROWTH.

DESIGN CRITERIA
MATERIALS
FIELD EVALUATION OF THE SITE SHOULD BE MADE TO DETERMINE IF THERE IS SUFFICIENT SURFACE SOIL OF GOOD QUALITY TO JUSTIFY STRIPPING. TOPSOIL SHALL BE FRIABLE AND LOAMY (LOAM, SANDY LOAM, SILT LOAM, SANDY CLAY LOAM, AND CLAY LOAM). IT SHALL BE RELATIVELY FREE OF DEBRIS, TRASH, STUMPS, ROCKS, ROOTS AND NOXIOUS WEEDS, AND SHALL GIVE EVIDENCE OF BEING ABLE TO SUPPORT HEALTHY VEGETATION. IT SHALL CONTAIN NO SUBSTANCE THAT IS POTENTIALLY TOXIC TO PLANT GROWTH.

TOPSOIL SHOULD MEET THE FOLLOWING CRITERIA:
- PH RANGE SHOULD BE FROM 6.0–7.0. IF PH IS LESS THAN 6.0, LIME SHOULD BE ADDED IN ACCORDANCE WITH SOIL TEST RESULTS OR IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE VEGETATIVE ESTABLISHMENT PRACTICE BEING USED.
- SOLUBLE SALTS SHALL NOT EXCEED 500 PPM.
- IF ADDITIONAL OFF–SITE TOPSOIL IS NEEDED, IT SHOULD MEET THE STANDARDS STATED ABOVE.
- THE DEPTH OF MATERIAL MEETING THE ABOVE QUALIFICATIONS SHOULD BE AT LEAST 4". SOIL FACTORS SUCH AS ROCK FRAGMENTS, SLOPE, DEPTH TO WATER TABLE, AND LAYER THICKNESS AFFECT THE EASE OF EXCAVATION AND SPREADING OF TOPSOIL.

GENERALLY, THE UPPER PART OF THE SOIL, WHICH IS RICHEST IN ORGANIC MATTER, IS MOST DESIRABLE; HOWEVER, MATERIAL EXCAVATED FROM DEEPER LAYERS MAY BE WORTH STORING IF IT MEETS THE OTHER CRITERIA LISTED ABOVE.

STRIPPING
STRIP ONLY THOSE AREAS THAT WILL BE AFFECTED BY CONSTRUCTION OR DEVELOPMENT. A NORMAL STRIPPING DEPTH IS 4–6" BUT DEEPER DEPTHS MAY BE SATISFACTORY IF THE SOIL IS SUITABLE AND UNDERCUTTING IS ALLOWABLE IN LOCATIONS SUCH AS BUILDINGS, WATER IMPOUNDMENT STRUCTURES, ROADWAYS, ETC. APPROPRIATE SEDIMENT CONTROL MEASURES SUCH AS SEDIMENT BARRIERS, SEDIMENT BASINS, INLET PROTECTION, ETC., SHOULD BE IN PLACE BEFORE THE TOPSOIL IS STRIPPED. STRIPPING SHOULD NOT BE DONE ON AREAS INTENDED TO SUPPORT CONVENTIONAL ON–SITE EFFLUENT DISPOSAL LINES (FIELD LINES).

STOCKPILING
THE STOCKPILE LOCATION SHOULD BE OUT OF DRAINAGEWAYS AND TRAFFIC ROUTES. STOCKPILES SHOULD NOT BE PLACED ON STEEP SLOPES WHERE UNDUE EROSION WILL TAKE PLACE. MEASURES SHOULD BE TAKEN TO PREVENT EROSION OF THE STOCKPILES. THESE WOULD INCLUDE:
- MULCHING THE STOCKPILE WHEN IT IS LEFT INACTIVE FOR OVER 13 DAYS.
- PLANTING TEMPORARY VEGETATION WHEN THE STOCKPILE IS TO BE INACTIVE OVER 30 DAYS.
- COVERING THE STOCKPILE WITH PLASTIC WHENEVER THE PILES ARE SMALL AND ANY SOIL LOSS WOULD PROVIDE SEDIMENT TO DAMAGE EXISTING BUILDINGS OR FACILITIES OR ENTER WATERS.
- PLANTING PERMANENT VEGETATION WHEN THE STOCKPILE USE WILL BE INACTIVE OVER 12 MONTHS.
- IN CASES WHERE THE STOCKPILE IS SMALL AND WILL BE REMOVED IN LESS THAN 14 DAYS, IT MAY BE MORE PRACTICAL TO USE A SEDIMENT BARRIER THAN AN EROSION CONTROL PRACTICE.

SITE PREPARATION
AREAS TO BE COVERED WITH TOPSOIL SHALL BE EXCAVATED, GRADED, FILLED AND SHAPED TO THE PROPER LINES, GRADES AND ELEVATIONS BEFORE TOPSOIL PLACEMENT IS STARTED.
THE SUBGRADES SHOULD BE CHECKED FOR PH AND LIMED IF IT IS LESS THAN 6.0. LIMING SHALL BE DONE IN ACCORDANCE WITH SOIL TESTS AND IN RELATION TO THE SEEDING MIXTURE TO BE PLANTED. INCORPORATE LIME TO A DEPTH OF AT LEAST 2" BY DISKING.

APPLYING TOPSOIL
THE SUBSOIL SHOULD BE DISKED OR CHISELED TO A DEPTH OF 2" OR MORE TO ENHANCE BONDING OF THE SUBSOIL AND TOPSOIL, IMMEDIATELY BEFORE PLACEMENT OF TOPSOIL. TOPSOIL SHOULD BE UNIFORMLY SPREAD TO A MINIMUM COMPACTED DEPTH OF 4". REQUIRED VOLUMES OF TOPSOIL MAY BE DETERMINED USING TABLE TSG–1.

TABLE TSG–1 VOLUME OF SOIL NEEDED FOR TOPSOILING

DEPTH TO SPREAD (INCHES)	CUBIC YARDS PER 1000 SQ. FT.	CUBIC YARDS PER ACRE
1	3.1	134
2	6.2	268
3	9.3	403
4	12.4	537
5	15.5	672
6	18.6	806

WHEN APPLYING TOPSOIL, MAINTAIN NEEDED EROSION CONTROL PRACTICES SUCH AS DIVERSIONS, GRASSED SWALES, LINED SWALES, ETC. TOPSOIL SHOULD NOT BE SPREAD WHEN IT OR THE SUBGRADE IS FROZEN OR MUDDY.

PRECAUTIONS SHOULD BE TAKEN TO PREVENT LAYERING OF THE TOPSOIL OVER THE SUBSOIL.
MIXING AND BONDING OF THE TWO SOILS SHOULD BE ENHANCED.

SETTLING OF THE TOPSOIL IS NECESSARY TO BOND THE SOILS TOGETHER, BUT EXCESSIVE COMPACTION SHOULD BE PREVENTED. LIGHT COMPACTION IS NECESSARY TO INCREASE SOIL STRENGTH, REDUCE EROSION AND ENHANCE VEGETATION ESTABLISHMENT.

EXCESSIVE COMPACTION SHOULD BE PROHIBITED AS IT INCREASES RUNOFF AND INHIBITS SEED GERMINATION AND ROOT DEVELOPMENT.

SURFACE IRREGULARITIES THAT WOULD IMPEDE DRAINAGE, INCREASE EROSION OR OTHERWISE DAMAGE THE SITE SHOULD BE REMOVED IN FINAL GRADING.

MAINTENANCE
INSPECT TOPSOILED AREAS FREQUENTLY UNTIL VEGETATION IS ESTABLISHED.

REPAIR ERODED OR DAMAGED AREAS AND REVEGETATE.

REPAIR SLOUGHING ON STEEP SLOPES – REMOVE TOPSOIL, ROUGHEN SUBGRADE AND RESPREAD TOPSOIL.
CONSULT WITH QUALIFIED DESIGN PROFESSIONAL IF DRAINAGE (WETNESS CAUSED BY SEEPAGE) OR SHALLOWNESS TO BEDROCK (LESS THAN 24") IS INVOLVED.

TOPSOILING TSG

TEMPORARY SEEDING IS THE ESTABLISHMENT OF FAST–GROWING ANNUAL VEGETATION FROM SEED ON DISTURBED AREAS. TEMPORARY VEGETATION PROVIDES ECONOMICAL EROSION CONTROL FOR UP TO A YEAR AND REDUCES THE AMOUNT OF SEDIMENT MOVING OFF THE SITE. THIS PRACTICE APPLIES WHERE SHORT–LIVED VEGETATION CAN BE ESTABLISHED BEFORE FINAL GRADING OR IN A SEASON NOT SUITABLE FOR PLANTING THE DESIRED PERMANENT SPECIES. IT HELPS PREVENT COSTLY MAINTENANCE OPERATIONS ON OTHER PRACTICES SUCH AS SEDIMENT BASINS AND SEDIMENT BARRIERS. IN ADDITION, IT REDUCES PROBLEMS OF MUD AND DUST PRODUCTION FROM BARE SOIL SURFACES DURING CONSTRUCTION. TEMPORARY OR PERMANENT SEEDING IS NECESSARY TO PROTECT EARTHEN STRUCTURES SUCH AS DIKES, DIVERSIONS, GRASS–LINED CHANNELS AND THE BANKS AND DAMS OF SEDIMENT BASINS.

DESIGN CRITERIA
PLANT SELECTION
SELECT PLANTS THAT CAN BE EXPECTED TO MEET PLANTING OBJECTIVES. TO SIMPLIFY PLANT SELECTION, USE TABLE TS–1 ON THIS DRAWING AND FIGURE TS–1, GEOGRAPHICAL AREAS FOR SPECIES ADAPTATION AND SEEDING DATES, AS FOUND ON PAGE 159 IN THE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1. SEEDING MIXTURES COMMONLY SPECIFIED BY THE ALABAMA DEPARTMENT OF TRANSPORTATION ARE AN APPROPRIATE ALTERNATIVE FOR PLANTINGS ON RIGHTS–OF–WAYS. **NOTE: JEFFERSON COUNTY IS LOCATED IN THE NORTH GEOGRAPHICAL AREA FOR SPECIES ADAPTATION AND SEEDING DATES (FIGURE TS–1).**

TABLE TS–1 COMMONLY USED PLANTS FOR TEMPORARY COVER

SPECIES	SEEDING RATES/AC PLS	NORTH	CENTRAL	SOUTH
			SEEDING DATES	
MILLET, BROWNTOP, OR GERMAN	40 LBS	MAY 1–AUG 1	APR 1–AUG 15	APR 1–AUG 15
RYE	3 BU	SEP 1–NOV 15	SEP 15–NOV 15	SEP 15–NOV 15
RYEGRASS	30 LBS	AUG 1–SEP 15	SEP 1–OCT 15	SEP 1–OCT 15
SORGHUM–SUDAN HYBRIDS	40 LBS	MAY 1–AUG 1	APR 15–AUG 1	APR 1–AUG 15
SUDANGRASS	40 LBS	MAY 1–AUG 1	APR 15–AUG 1	APR 1–AUG 15
WHEAT	3 BU	SEP 1–NOV 1	SEP 15–NOV 15	SEP 15–NOV 15
COMMON BERMUDAGRASS	10 LBS	APR 1–JULY 1	MAR 15–JULY 15	MAR 1–JULY 15
CRIMSON CLOVER	10 LBS	SEP 1–NOV 1	SEP 1–NOV 1	SEP 1–NOV 1

PLS MEANS PURE LIVE SEED AND IS USED TO ADJUST SEEDING RATES. FOR EXAMPLE, TO PLANT 10 LBS PLS OF A SPECIES WITH GERMINATION OF 80% AND PURITY OF 90%, PLS=0.8X0.9=72%.
10 LBS PLS=10/0.72=13.9 LBS OF THE SPECIES TO BE PLANTED.

SITE PREPARATION AND SOIL AMENDMENTS
COMPLETE GRADING AND SHAPING BEFORE APPLYING SOIL AMENDMENTS IF NEEDED TO PROVIDE A SURFACE ON WHICH EQUIPMENT CAN SAFELY AND EFFICIENTLY BE USED TO APPLY SOIL AMENDMENTS AND ACCOMPLISH SEEDBED PREPARATION AND SEEDING.

LIME
APPLY LIME ACCORDING TO SOIL TEST RECOMMENDATIONS. IF A SOIL TEST IS NOT AVAILABLE, USE 1 TON OF AGRICULTURAL LIMESTONE OR EQUIVALENT PER ACRE ON COARSE TEXTURED SOILS AND 2 TONS PER ACRE ON FINE TEXTURED SOILS. DO NOT APPLY LIME TO ALKALINE SOILS OR TO AREAS WHICH HAVE BEEN LIMED DURING THE PRECEDING 2 YEARS. OTHER LIMING MATERIALS THAT MAY BE SELECTED SHOULD BE PROVIDED IN AMOUNTS THAT PROVIDE EQUAL VALUE TO THE CRITERIA LISTED FOR AGRICULTURAL LIME OR BE USED IN COMBINATION WITH AGRICULTURAL LIMESTONE OR SELMA CHALK TO PROVIDE EQUIVALENT VALUES TO AGRICULTURAL LIMESTONE.

FERTILIZER
APPLY FERTILIZER ACCORDING TO SOIL TEST RESULTS. IF A SOIL TEST IS NOT AVAILABLE, APPLY 8–24–24 FERTILIZER.

WHEN VEGETATION HAS EMERGED TO A STAND AND IS GROWING, 30 TO 40 LBS/ACRE (APPROXIMATELY 0.8 LBS/1000 FT^2) OF ADDITIONAL NITROGEN FERTILIZER SHOULD BE APPLIED.

NOTE: FERTILIZER CAN BE BLENDED TO MEET EXACT FERTILIZER RECOMMENDATIONS. TAKE SOIL TEST RECOMMENDATIONS TO LOCAL FERTILIZER DEALER FOR BULK FERTILIZER BLENDS. THIS MAY BE MORE ECONOMICAL THAN BAGGED FERTILIZER.

APPLICATION OF SOIL AMENDMENTS
INCORPORATE LIME AND FERTILIZER INTO THE TOP 6" OF SOIL DURING SEEDBED PREPARATION.

SEEDBED PREPARATION
GOOD SEEDBED PREPARATION IS ESSENTIAL TO SUCCESSFUL PLANT ESTABLISHMENT. A GOOD SEEDBED IS WELL PULVERIZED, LOOSE, AND SMOOTH. IF SOILS BECOME COMPACTED DURING GRADING, LOOSEN THEM TO A DEPTH OF 6" TO 8" USING A RIPPER OR CHISEL PLOW. **IF RAINFALL HAS CAUSED THE SURFACE TO BECOME SEALED OR CRUSTED, LOOSEN IT JUST PRIOR TO SEEDING BY DISKING, RAKING, HARROWING, OR OTHER SUITABLE METHODS. WHEN HYDROSEEDING METHODS ARE USED, THE SURFACE SHOULD BE LEFT WITH A MORE IRREGULAR SURFACE OF CLODS.**

PLANTING METHODS
SEEDING
EVENLY APPLY SEED USING A CYCLONE SEEDER (BROADCAST), DRILL SEEDER, CULTIPACKER SEEDER, OR HYDROSEEDER. BROADCAST SEEDING AND HYDROSEEDING ARE APPROPRIATE FOR STEEP SLOPES WHERE EQUIPMENT CANNOT OPERATE SAFELY. SMALL GRAINS SHOULD BE PLANTED NO MORE THAN 1" DEEP, AND GRASSES AND LEGUMES NO MORE THAN $\frac{1}{2}$" DEEP. SEED THAT ARE BROADCAST MUST BE COVERED BY RAKING OR CHAIN DRAGGING, AND THEN LIGHTLY FIRMED WITH A ROLLER OR CULTIPACKER.

HYDROSEEDING
SURFACE ROUGHENING IS PARTICULARLY IMPORTANT WHEN HYDROSEEDING, AS A ROUGHENED SLOPE WILL PROVIDE SOME NATURAL COVERAGE FOR LIME, FERTILIZER, AND SEED. THE SURFACE SHOULD NOT BE COMPACTED OR SMOOTH. FINE SEEDBED PREPARATION IS NOT NECESSARY FOR HYDROSEEDING OPERATIONS; LARGE CLODS, STONES, AND IRREGULARITIES PROVIDE CAVITIES IN WHICH SEEDS CAN LODGE.
MIX SEED, INOCULANT IF REQUIRED, AND A SEED CARRIER WITH WATER AND APPLY AS A SLURRY UNIFORMLY OVER THE AREA TO BE TREATED. THE SEED CARRIER SHOULD BE A CELLULOSE FIBER, NATURAL WOOD FIBER OR OTHER APPROVED FIBER MULCH MATERIAL WHICH IS DYED AN APPROPRIATE COLOR TO FACILITATE UNIFORM APPLICATION OF SEED. USE THE CORRECT LEGUME INOCULANT AT 4 TIMES THE RECOMMENDED RATE WHEN ADDING INOCULANT TO A HYDROSEEDER SLURRY. THE MIXTURE SHOULD BE APPLIED WITHIN ONE HOUR AFTER MIXING TO REDUCE DAMAGE TO SEED.
FERTILIZER SHOULD NOT BE MIXED WITH THE SEED–INOCULANT MIXTURE BECAUSE FERTILIZER SALTS MAY DAMAGE SEED AND REDUCE GERMINATION AND SEEDLING VIGOR. FERTILIZER MAY BE APPLIED WITH A HYDROSEEDER AS A SEPARATE OPERATION AFTER SEEDLINGS ARE ESTABLISHED.

MULCHING
THE USE OF APPROPRIATE MULCH PROVIDES INSTANT COVER AND HELPS ENSURE ESTABLISHMENT OF VEGETATION UNDER NORMAL CONDITIONS AND IS ESSENTIAL TO SEEDING SUCCESS UNDER HARSH SITE CONDITIONS (SEE MULCHING PRACTICE FOR GUIDANCE). HARSH SITE CONDITIONS INCLUDE THE FOLLOWING: SLOPES STEEPER THAN 3:1 AND ADVERSE SOILS (SOILS THAT ARE SHALLOW TO ROCK, ROCKY, OR HIGH IN CLAY OR SAND). AREAS WITH CONCENTRATED FLOW SHOULD BE TREATED DIFFERENTLY AND REQUIRE A HYDROMULCH FORMULATED FOR CHANNELS OR AN APPROPRIATE EROSION CONTROL BLANKET.

MAINTENANCE
RESEEDING
INSPECT SEEDINGS WEEKLY UNTIL A STAND IS ESTABLISHED AND THEREAFTER AT LEAST MONTHLY FOR STAND SURVIVAL AND VIGOR. ALSO, INSPECT THE SITE FOR EROSION.
ERODED AREAS SHOULD BE ADDRESSED APPROPRIATELY BY FILLING AND/OR SMOOTHING, AND REAPPLICATION OF LIME, FERTILIZER, SEED AND MULCH.
A STAND SHOULD BE UNIFORM AND DENSE FOR BEST RESULTS. STAND CONDITIONS, PARTICULARLY THE COVERAGE, WILL DETERMINE THE EXTENT OF REMEDIAL ACTIONS SUCH AS SEEDBED PREPARATION AND RESEEDING. A QUALIFIED DESIGN PROFESSIONAL SHOULD BE CONSULTED TO ADVISE ON REMEDIAL ACTIONS. CONSIDER DRILL SEEDING WHEN DOING A REMEDIAL PLANTING.

FERTILIZING
IF VEGETATION FAILS TO GROW, HAVE THE SOIL TESTED TO DETERMINE WHETHER pH IS IN THE CORRECT RANGE OR NUTRIENT DEFICIENCY IS A PROBLEM.
SATISFACTORY ESTABLISHMENT MAY REQUIRE REFERTILIZING THE STAND, ESPECIALLY IF THE PLANTING IS MADE EARLY IN THE PLANTING SEASON. FOLLOW SOIL TEST RECOMMENDATIONS OR THE SPECIFICATIONS PROVIDED TO ESTABLISH THE PLANTING.

MOWING
TEMPORARY PLANTINGS MAY BE MOWED AND BALED OR SIMPLY MOWED TO COMPLIMENT THE USE OF THE SITE.
MILLET, SORGHUM–SUDAN HYBRIDS, SUDANGRASS, RYE AND WHEAT MAY BE MOWED, BUT NO LOWER THAN 6" (CLOSER MOVING MAY DAMAGE THE STAND).
RYEGRASS IS TOLERANT OF MOST MOWING REGIMES AND MAY BE MOWED OFTEN AND AS CLOSE AS 4" TO 6" IF THIS REGIME IS STARTED BEFORE IT ATTAINS TALL GROWTH (OVER 8").
BERMUDAGRASS IS TOLERANT OF MOST MOWING REGIMES AND CAN BE MOWED OFTEN AND CLOSE, IF SO DESIRED, DURING ITS GROWING SEASON.

TEMPORARY SEEDING (TS) TS

PERMANENT SEEDING IS THE ESTABLISHMENT OF PERENNIAL VEGETATION ON DISTURBED AREAS FROM SEED. PERMANENT VEGETATION PROVIDES ECONOMICAL LONG–TERM EROSION CONTROL AND HELPS PREVENT SEDIMENT FROM LEAVING THE SITE. THIS PRACTICE IS USED WHEN VEGETATION IS DESIRED AND APPROPRIATE TO PERMANENTLY STABILIZE THE SOIL.

DESIGN CRITERIA
PLANT SELECTION
SELECT PLANTS THAT CAN BE EXPECTED TO MEET PLANTING OBJECTIVES. TO SIMPLIFY PLANT SELECTION, USE FIGURE PS–1 GEOGRAPHICAL AREAS FOR SPECIES ADAPTATION AND SEEDING DATES FOUND ON PAGE 121 OF THE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1, AND TABLE PS–1 ON THIS DRAWING, COMMONLY USED PLANTS FOR PERMANENT COVER. MIXTURES COMMONLY SPECIFIED BY THE ALABAMA DEPARTMENT OF TRANSPORTATION ARE AN APPROPRIATE ALTERNATIVE FOR PLANTINGS ON RIGHTS–OF–WAYS.

THE PLANTS USED FOR TEMPORARY VEGETATION MAY BE USED FOR COMPANION PLANTS PROVIDED THE SEEDING RATE IS REDUCED BY ONE HALF. SEE THE TEMPORARY SEEDING PRACTICE FOR ADDITIONAL INFORMATION ON ESTABLISHING TEMPORARY VEGETATION. RYEGRASS OR OTHER HIGHLY COMPETITIVE PLANTS SHOULD NOT BE USED AS A COMPANION PLANT.

TABLE PS–1 COMMONLY USED PLANTS FOR PERMANENT COVER WITH SEEDING RATES AND DATES

SPECIES	SEEDING RATES/AC PLS	NORTH	CENTRAL	SOUTH
			SEEDING DATES	
BAHIAGRASS, PENSACOLA	40 LBS	--	MAR 1–JULY 1	FEB 1–NOV 1
BERMUDAGRASS, COMMON	10 LBS	APR 1–JULY 1	MAR 15–JULY 15	MAR 1–JULY 15
BAHIAGRASS, PENSACOLA BERMUDAGRASS, COMMON	30 LBS 5 LBS	--	MAR 1–JULY 1	MAR 1–JULY 15
BERMUDAGRASS, HYBRID (LAWN TYPES)	SOLID SOD	ANYTIME	ANYTIME	ANYTIME
BERMUDAGRASS, HYBRID (LAWN TYPES)	SPRIGS 1/SQ FT	MAR 1–AUG 1	MAR 1–AUG 1	FEB 15–SEP 1
FESCUE, TALL	40–50 LBS	SEP 1–NOV 1	SEP 1–NOV 1	--
SERICEA	40–60 LBS	MAR 15–JULY 15	MAR 1–JULY 15	FEB 15–JULY 15
SERICEA & COMMON BERMUDAGRASS	40 LBS 10 LBS	MAR 15–JULY 15	MAR 1–JULY 15	FEB 15–JULY 15
SWITCHGRASS, ALAMO	4 LBS	APR 1–JUN 15	MAR 15–JUN 15	MAR 15–JUN 15

PLS MEANS PURE LIVE SEED AND IS USED TO ADJUST SEEDING RATES. FOR EXAMPLE, TO PLANT 10 LBS PLS OF A SPECIES WITH GERMINATION OF 80% AND PURITY OF 90%, PLS = 0.8 X 0.9 = 72%. 10 LBS PLS = 10/0.70 = 13.9 LBS. OF THE SPECIES TO BE PLANTED.

SEEDBED REQUIREMENTS
ESTABLISHMENT OF VEGETATION SHOULD NOT BE ATTEMPTED ON SITES THAT ARE UNSUITABLE DUE TO COMPACTION OR INAPPROPRIATE SOIL TEXTURE, POOR DRAINAGE, CONCENTRATED OVERLAND FLOW, OR STEEPNESS OF SLOPE UNTIL MEASURES HAVE BEEN COMPLETED TO CORRECT THESE PROBLEMS. TO MAINTAIN A GOOD STAND OF VEGETATION, THE SOIL MUST MEET CERTAIN MINIMUM REQUIREMENTS AS A GROWTH MEDIUM. A GOOD GROWTH MEDIUM SHOULD HAVE THESE ATTRIBUTES:
- SUFFICIENT PORE SPACE TO PERMIT ROOT PENETRATION.
- ENOUGH FINE–GRAINED SOIL MATERIAL (SILT AND CLAY) TO MAINTAIN ADEQUATE MOISTURE AND NUTRIENT SUPPLY.
- SUFFICIENT DEPTH OF SOIL TO PROVIDE AN ADEQUATE ROOT ZONE. THE DEPTH TO ROCK OR IMPERMEABLE LAYERS SUCH AS HARDPANS SHOULD BE 12" FOR MORE, EXCEPT ON SLOPES STEEPER THAN 2:1 WHERE TOPSOILING IS NOT FEASIBLE.
- A FAVORABLE pH RANGE FOR PLANT GROWTH, USUALLY 6.0–6.5.
- SUFFICIENT NUTRIENTS (NITROGEN, PHOSPHORUS AND POTASSIUM) FOR INITIAL PLANT ESTABLISHMENT.
- FREEDOM FROM LARGE ROOTS, BRANCHES, STONES, OR LARGE CLODS. CLODS AND STONES MAY BE LEFT ON SLOPES STEEPER THAN 3:1 IF THEY ARE TO BE HYDROSEEDED.

IF ANY OF THE ABOVE ATTRIBUTES ARE NOT MET: I.E., IF THE EXISTING SOIL IS TOO DENSE, COARSE, SHALLOW OR ACIDIC TO FOSTER VEGETATION – CHISELING, TOPSOIL, OR SPECIAL AMENDMENTS SHOULD BE USED TO IMPROVE SOIL CONDITIONS. THE SOIL CONDITIONERS DESCRIBED BELOW MAY BE BENEFICIAL OR TOPSOIL MAY BE APPLIED (FOR GUIDANCE ON TOPSOILING SEE TOPSOILING PRACTICE). THESE AMENDMENTS SHOULD ONLY BE NECESSARY WHERE SOILS HAVE LIMITATIONS THAT MAKE THEM POOR FOR PLANT GROWTH OR FOR ESTABLISHMENT.
- PEAT – APPROPRIATE TYPES ARE SPHAGNUM MOSS PEAT, REED–SEDGE PEAT, OR PEAT HUMUS, ALL FROM FRESH–WATER SOURCES. PEAT SHOULD BE SHREDDED AND CONDITIONED IN STORAGE PILES FOR AT LEAST 6 MONTHS AFTER EXCAVATION.
- SAND – SHOULD BE CLEAN AND FREE OF TOXIC MATERIALS.
- VERMICULITE – USE HORTICULTURAL GRADE.
- ROTTED MANURE – USE STABLE OR CATTLE MANURE NOT CONTAINING UNDUE AMOUNTS OF STRAW OR OTHER BEDDING MATERIALS.
- THOROUGHLY ROTTED SAWDUST – SHOULD BE FREE OF STONES AND DEBRIS. ADD 6 LBS OF NITROGEN TO EACH CUBIC YARD.

SOIL AMENDMENTS
LIMING MATERIALS
LIME (AGRICULTURAL LIMESTONE) SHOULD HAVE A NEUTRALIZING VALUE OF NOT LESS THAN 90 PERCENT CALCIUM CARBONATE EQUIVALENT AND 90 PERCENT WILL PASS THROUGH A 10 MESH SIEVE AND 50 PERCENT WILL PASS THROUGH A 60 MESH SIEVE.

SELMA CHALK SHOULD HAVE A NEUTRALIZING VALUE OF NOT LESS THAN 80 PERCENT CALCIUM CARBONATE EQUIVALENT AND 90 PERCENT WILL PASS THROUGH A 10 MESH SIEVE.

OTHER LIMING MATERIALS THAT MAY BE SELECTED SHOULD BE PROVIDED IN AMOUNTS THAT PROVIDE EQUAL VALUE TO THE CRITERIA LISTED FOR AGRICULTURAL LIME OR BE USED IN COMBINATION WITH AGRICULTURAL LIMESTONE OR SELMA CHALK TO PROVIDE EQUIVALENT VALUES TO AGRICULTURAL LIMESTONE.

PLANT NUTRIENTS
COMMERCIAL GRADE FERTILIZERS THAT COMPLY WITH CURRENT ALABAMA FERTILIZER LAWS SHOULD BE USED TO SUPPLY NUTRIENTS REQUIRED TO ESTABLISH VEGETATION.

LIME AND FERTILIZER NEEDS SHOULD BE DETERMINED BY SOIL TESTS. SOIL TESTING IS PERFORMED BY THE AUBURN UNIVERSITY SOIL TESTING LABORATORY AND PROVIDES RECOMMENDATIONS BASED ON FIELD TESTS ON ALABAMA SOILS. THE LOCAL COUNTY COOPERATIVE EXTENSION SERVICE CAN PROVIDE INFORMATION ON OBTAINING SOIL TESTS. COMMERCIAL LABORATORIES THAT MAKE RECOMMENDATIONS BASED ON SOIL ANALYSIS MAY BE USED.

WHEN SOIL TESTS ARE NOT AVAILABLE, USE THE FOLLOWING RATES FOR APPLICATION OF SOIL AMENDMENTS.

SANDY SOILS: USE 1 TON/ACRE (EXCEPTION ON SANDY SOILS – IF THE COVER WILL BE TALL FESCUE AND CLOVER USE 2 TONS/ACRE).
CLAYEY SOILS: 2 TONS/ACRE
(DO NOT APPLY LIME TO ALKALINE SOILS).

GRASSES ALONE: USE 400 LBS/ACRE OF 8–24–24 OR THE EQUIVALENT. APPLY 30 LBS OF ADDITIONAL NITROGEN WHEN GRASS HAS EMERGED AND BEGUN GROWTH (APPROXIMATELY 0.8 LBS/1000 FT^2).
GRASS–LEGUME MIXTURES: USE 800 TO 1200 LBS/ACRE OF 5–10–10 OR THE EQUIVALENT.
LEGUMES ALONE: USE 400 TO 600 LBS/ACRE OF 0–20–20 OR THE EQUIVALENT.

NOTE: FERTILIZER CAN BE BLENDED TO MEET EXACT FERTILIZER RECOMMENDATIONS. TAKE SOIL TEST RECOMMENDATIONS TO LOCAL FERTILIZER DEALER FOR BULK FERTILIZER BLENDS. THIS MAY BE MORE ECONOMICAL THAN BAGGED FERTILIZER.

APPLICATION OF SOIL AMENDMENTS
APPLY LIME AND FERTILIZER EVENLY AND INCORPORATE INTO THE TOP 6" OF SOIL BY DISKING, CHISELING OR OTHER SUITABLE MEANS DURING SEEDBED PREPARATION. OPERATE MACHINERY ON THE CONTOUR. ON SITES TOO STEEP FOR SEEDBED PREPARATION, FERTILIZER AND LIME CAN BE APPLIED WITH A HYDROSEEDER.

SEEDBED PREPARATION
IF NEEDED, GRADE AND SHAPE TO PROVIDE A SURFACE ON WHICH EQUIPMENT CAN SAFELY AND EFFICIENTLY BE USED FOR SEEDBED PREPARATION AND SEEDING.

INSTALL NECESSARY SEDIMENT CONTROL PRACTICES BEFORE SEEDBED PREPARATION AND COMPLETE GRADING ACCORDING TO THE APPROVED PLAN.

PREPARE A FRIABLE SEEDBED WITH TILLAGE TO A DEPTH OF AT LEAST 6". BREAK UP LARGE CLODS, ALLEVIATE COMPACTION, AND SMOOTH AND FIRM THE SOIL INTO A UNIFORM SURFACE. FILL IN OR LEVEL DEPRESSIONS THAT CAN COLLECT WATER.

PLANTING METHODS
SEEDING
USE CERTIFIED SEED FOR PERMANENT SEEDING WHENEVER POSSIBLE. CERTIFIED SEED IS INSPECTED BY THE ALABAMA CROP IMPROVEMENT ASSOCIATION TO MEET HIGH QUALITY STANDARDS AND WILL BE TAGGED WITH A "CERTIFIED SEED" TAG. (NOTE: ALL SEED SOLD IN ALABAMA IS REQUIRED BY LAW TO BE TAGGED TO IDENTIFY SEED PURITY, GERMINATION, AND PRESENCE OF WEED SEEDS. SEED MUST MEET STATE STANDARDS FOR CONTENT OF NOXIOUS WEEDS).

SEEDING DATES ARE DETERMINED USING TABLE PS–1 FOUND ON THIS DRAWING AND FIGURE PS–1 GEOGRAPHICAL AREAS FOR SPECIES ADAPTATION AND SEEDING DATES FOUND ON PAGE 121 OF THE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1. **NOTE: JEFFERSON COUNTY IS LOCATED IN THE NORTH GEOGRAPHICAL AREA FOR ADAPTATION AND SEEDING.**

INOCULATE LEGUME SEED WITH THE RHIZOBIUM BACTERIA APPROPRIATE TO THE SPECIES OF LEGUME. DETAILS OF LEGUME INOCULATION ARE LOCATED IN CHAPTER 2 IN THE PART ON VEGETATION FOR EROSION AND SEDIMENT CONTROL UNDER INOCULATION OF LEGUMES.

PLANT SEED UNIFORMLY WITH A CYCLONE SEEDER, A DRILL SEEDER, A CULTIPACKER SEEDER, OR BY HAND ON A FRESH, FIRM, FRIABLE SEEDBED. IF THE SEEDBED HAS BEEN SEALED BY RAINFALL, IT SHOULD BE DISKED SO THE SEED WILL BE SOWN INTO A FRESHLY PREPARED SEEDBED.

WHEN USING BROADCAST–SEEEDING METHODS, SUBDIVIDE THE AREA INTO WORKABLE SECTIONS AND DETERMINE THE AMOUNT OF SEED NEEDED FOR EACH SECTION. APPLY ONE–HALF THE SEED WHILE MOVING BACK AND FORTH ACROSS THE AREA, MAKING A UNIFORM PATTERN; THEN APPLY THE SECOND HALF IN THE SAME WAY, BUT MOVING AT RIGHT ANGLES TO THE FIRST PASS.

COVER BROADCAST SEED BY RAKING OR CHAIN DRAGGING; THEN FIRM THE SURFACE WITH A ROLLER OR CULTIPACKER TO PROVIDE GOOD SEED CONTACT. SMALL GRAINS SHOULD BE PLANTED NO MORE THAN 1" DEEP AND GRASSES AND LEGUME SEED NO MORE THAN $\frac{1}{2}$" DEEP.

HYDROSEEDING
SURFACE ROUGHENING IS PARTICULARLY IMPORTANT WHEN HYDROSEEDING, AS A ROUGHENED SLOPE WILL PROVIDE SOME NATURAL COVERAGE FOR LIME, FERTILIZER, AND SEED. THE SURFACE SHOULD NOT BE COMPACTED OR SMOOTH. FINE SEEDBED PREPARATION IS NOT NECESSARY FOR HYDROSEEDING OPERATIONS; LARGE CLODS, STONES, AND IRREGULARITIES PROVIDE CAVITIES IN WHICH SEEDS CAN LODGE.

MIX SEED, INOCULANT IF REQUIRED, AND A SEED CARRIER WITH WATER AND APPLY AS A SLURRY UNIFORMLY OVER THE AREA TO BE TREATED. THE SEED CARRIER SHOULD BE A CELLULOSE FIBER, NATURAL WOOD FIBER OR OTHER APPROVED FIBER MULCH MATERIAL WHICH IS DYED AN APPROPRIATE COLOR TO FACILITATE UNIFORM APPLICATION OF SEED. USE THE CORRECT LEGUME INOCULANT AT 4 TIMES THE RECOMMENDED RATE WHEN ADDING INOCULANT TO A HYDROSEEDER SLURRY. THE MIXTURE SHOULD BE APPLIED WITHIN ONE HOUR AFTER MIXING TO REDUCE DAMAGE TO SEED.

FERTILIZER SHOULD NOT BE MIXED WITH THE SEED–INOCULANT MIXTURE BECAUSE FERTILIZER SALTS MAY DAMAGE SEED AND REDUCE GERMINATION AND SEEDLING VIGOR.

FERTILIZER MAY BE APPLIED WITH A HYDROSEEDER AS A SEPARATE OPERATION AFTER SEEDLINGS ARE ESTABLISHED.

LIME IS NOT NORMALLY APPLIED WITH A HYDRAULIC SEEDER BECAUSE IT IS ABRASIVE BUT IF NECESSARY IT CAN BE ADDED TO THE SEED SLURRY AND APPLIED AT SEEDING OR IT MAY BE APPLIED WITH THE FERTILIZER MIXTURE. ALSO LIME CAN BE BLOWN ONTO STEEPER SLOPES IN DRY FORM.

SPRIGGING
HYBRID BERMUDAGRASS CANNOT BE GROWN FROM SEED AND MUST BE PLANTED VEGETATIVELY. VEGETATIVE METHODS OF ESTABLISHING COMMON AND HYBRID BERMUDAGRASS, CENTIPEDEGRASS AND ZOYSIA INCLUDE SODDING, PLUGGING AND SPRIGGING (SEE SODDING PRACTICE).

WHEN SPRIGS ARE PLANTED WITH A SPRIGGING MACHINE, FURROWS SHOULD BE 4–6" DEEP AND 2 FEET APART. PLACE SPRIGS NO FARTHER THAN 2 FEET APART IN THE ROW AND SO THAT AT LEAST ONE ROOTING NODE IS IN THE FURROW.

WHEN BROADCASTING IS USED FOR SPRIG PLANTING, BROADCAST SPRIGS AT THE SPECIFIED RATE (TABLE PS–1). PRESS INTO THE TOP $\frac{1}{2}$" TO 2" OF SOIL WITH A CULTIPACKER OR WITH A DISK SET NEARLY STRAIGHT SO THAT THE SPRIGS ARE NOT BROUGHT BACK TO THE SURFACE. A MULCH TACKING MACHINE MAY BE USED TO PRESS SPRIGS INTO THE SOIL.

MULCHING
THE USE OF MULCH PROVIDES INSTANT COVER AND HELPS ENSURE ESTABLISHMENT OF VEGETATION UNDER NORMAL CONDITIONS AND IS ESSENTIAL TO SEEDING SUCCESS UNDER HARSH SITE CONDITIONS (SEE MULCHING PRACTICE). HARSH SITE CONDITIONS INCLUDE: SLOPES STEEPER THAN 3:1 AND ADVERSE SOILS (SHALLOW, ROCKY, OR HIGH IN CLAY OR SAND). AREAS WITH CONCENTRATED FLOW SHOULD BE TREATED DIFFERENTLY AND REQUIRE SOD, A HYDROMULCH FORMULATED FOR CHANNELS OR AN APPROPRIATE EROSION CONTROL BLANKET.

IRRIGATION
MOISTURE IS ESSENTIAL FOR SEED GERMINATION AND VEGETATION ESTABLISHMENT. SUPPLEMENTAL IRRIGATION CAN BE VERY HELPFUL IN ASSURING ADEQUATE STANDS IN DRY SEASONS OR TO SPEED DEVELOPMENT OF FULL COVER. IT IS A REQUIREMENT FOR ESTABLISHMENT OF VEGETATION FROM SOD AND SPRIGS AND SHOULD BE USED ELSEWHERE WHEN FEASIBLE. HOWEVER, IRRIGATION IS RARELY CRITICAL FOR LOW–MAINTENANCE VEGETATION PLANTED AT THE APPROPRIATE TIME OF THE YEAR.

WATER APPLICATION RATES MUST BE CAREFULLY CONTROLLED TO PREVENT RUNOFF. INADEQUATE OR EXCESSIVE AMOUNTS OF WATER CAN BE MORE HARMFUL THAN NO SUPPLEMENTAL WATER.

MAINTENANCE
GENERALLY, A STAND OF VEGETATION CANNOT BE DETERMINED TO BE FULLY ESTABLISHED UNTIL SOIL COVER HAS BEEN MAINTAINED FOR 1 FULL YEAR FROM PLANTING. INSPECT VEGETATED AREAS FOR FAILURE AND MAKE NECESSARY REPAIRS AND VEGETATE AS SOON AS POSSIBLE.

RESEEDING
INSPECT SEEDINGS MONTHLY FOR STAND SURVIVAL AND VIGOR. ALSO, INSPECT THE SITE FOR EROSION.
IF A STAND IS INADEQUATE, IDENTIFY THE CAUSE OF FAILURE (CHOICE OF PLANT MATERIALS, LIME AND FERTILIZER QUANTITIES, POOR SEEDBED PREPARATION OR WEATHER) AND TAKE CORRECTIVE ACTION. IF VEGETATION FAILS TO GROW, HAVE THE SOIL TESTED TO DETERMINE WHETHER Ph IS IN THE CORRECT RANGE OR NUTRIENT DEFICIENCY IS A PROBLEM.

STAND CONDITIONS, PARTICULARLY THE COVERAGE, WILL DETERMINE THE EXTENT OF REMEDIAL ACTIONS SUCH AS SEEDBED PREPARATION AND RESEEDING. A QUALIFIED DESIGN PROFESSIONAL SHOULD BE CONSULTED TO ADVISE ON REMEDIAL ACTIONS. CONSIDER DRILL SEEDING WHERE POSSIBLE.

ERODED AREAS SHOULD BE ADDRESSED APPROPRIATELY BY FILLING AND/OR SMOOTHING, AND REAPPLICATION OF LIME, FERTILIZER, SEED AND MULCH.

FERTILIZING
SATISFACTORY ESTABLISHMENT MAY REQUIRE FERTILIZING THE STAND IN THE SECOND GROWING SEASON. FOLLOW SOIL TEST RECOMMENDATIONS OR THE SPECIFICATIONS PROVIDED TO ESTABLISH AND MAINTAIN THE PLANTING. AFTER THE SECOND YEAR, FERTILIZING IS OFTEN NEEDED ANNUALLY OR PERIODICALLY TO MAINTAIN A HEALTH STAND AND COVER SUFFICIENT FOR EROSION CONTROL.

MOWING
MOW VEGETATION ON STRUCTURAL PRACTICES SUCH AS EMBANKMENTS AND GRASS–LINED CHANNELS TO PREVENT WOODY PLANTS FROM INVADING.

OTHER AREAS SHOULD BE MOWED TO COMPLIMENT THE USE OF THE SITE.

CERTAIN SPECIES CAN BE WEAKENED BY MOWING REGIMES THAT SIGNIFICANTLY REDUCE THEIR FOOD RESERVES STORED FOR THE NEXT GROWING SEASON: FESCUE SHOULD NOT BE MOWED CLOSE DURING THE SUMMER; SERICEA SHOULD NOT BE MOWED CLOSE IN LATE SUMMER.

BERMUDAGRASS AND BAHIAGRASS ARE TOLERANT OF MOST MOWING REGIMES AND CAN BE MOWED OFTEN AND CLOSE, IF SO DESIRED, DURING THEIR GROWING SEASON.

PERMANENT SEEDING PS

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation Engineering and Construction Services FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 1

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
			XXX	XXX			NONE	E720292	1	FINAL	0

ANSI E: 44x34

EROSION CONTROL BLANKETS ARE USED TO AID IN CONTROLLING EROSION ON CRITICAL AREAS BY PROVIDING A PROTECTIVE COVER MADE OF STRAW, JUTE, WOOD OR OTHER PLANT FIBERS; PLASTIC NYLON, PAPER OR COTTON. THIS PRACTICE IS BEST UTILIZED ON SLOPES AND CHANNELS WHERE THE EROSION HAZARD IS HIGH, AND PLANT GROWTH IS LIKELY TO BE SLOW TO PROVIDE ADEQUATE PROTECTIVE COVER. EROSION CONTROL BLANKETS ARE TYPICALLY USED AS AN ALTERNATIVE TO MULCHING BUT CAN ALSO BE USED TO PROVIDE STRUCTURAL EROSION PROTECTION. SOME IMPORTANT FACTORS IN THE CHOICE OF A BLANKET ARE: SOIL CONDITIONS, STEEPNESS OF SLOPE, LENGTH OF SLOPE, TYPE AND DURATION OF PROTECTION REQUIRED TO ESTABLISH DESIRED VEGETATION, AND PROBABLE SHEER STRESS.

DESIGN CRITERIA
GENERAL
ALL BLANKETS SHALL BE NONTOXIC TO VEGETATION AND TO THE GERMINATION OF SEED AND SHALL NOT BE INJURIOUS TO THE UNPROTECTED SKIN OF HUMANS. EROSION CONTROL PRODUCTS SHALL BE OF SUFFICIENT STRENGTH TO HOLD THE PREPARED GROUND AND, IF APPLICABLE, COVER MATERIAL (MULCH, SOD, ETC.) IN PLACE UNTIL AN ACCEPTABLE GROWTH OF NATURAL OR PLANTED MATERIAL IS ESTABLISHED.

EROSION CONTROL PRODUCTS SHALL BE IDENTIFIED BY A CLASSIFICATION DESIGNATION (CLASS 1.A, 1.B, 1.C, ETC.) WHERE THE CLASSIFICATION IS BASED ON THE PHYSICAL PROPERTIES OF THE PRODUCT.

TABLE ECB-1 TEMPORARY EROSION CONTROL BLANKET CLASSES AND APPLICATIONS

CLASS	APPLICATION
1.C	DESIGNED FOR USE ON GEOTECHNICALLY STABLE SLOPES WITH GRADIENTS UP TO 3:1 AND CHANNELS WITH SHEAR STRESSES UP TO 1.5 POUNDS PER SQUARE FOOT.

CLASS DESIGNATIONS AND DURABILITY
EROSION CONTROL PRODUCTS SHALL HAVE THE CONFIGURATIONS AND DURABILITY AS SHOWN IN TABLES ECB-3 AND ECB-4.

TABLE ECB-3 TYPICAL CONFIGURATION AND DURABILITY OF TEMPORARY EROSION CONTROL BLANKETS

CLASS DESIGNATION	USUAL CONFIGURATION	TYPICAL DURABILITY
1.C ULTRA-SHORT TERM SINGLE NET EROSION CONTROL BLANKET OR OPEN WEAVE TEXTILE	AN EROSION CONTROL BLANKET COMPOSED OF PROCESSED DEGRADABLE NATURAL AND/OR POLYMER FIBERS MECHANICALLY BOUND TOGETHER BY A SINGLE RAPIDLY DEGRADING, SYNTHETIC OR NATURAL FIBER NETTING TO FORM A CONTINUOUS MATRIX. OR AN OPEN WEAVE TEXTILE COMPOSED OF PROCESSED RAPIDLY DEGRADING NATURAL OR POLYMER YARNS OR TWINES WOVEN INTO A CONTINUOUS MATRIX.	3 MONTHS

PRODUCT PLACEMENT
THE EROSION CONTROL PRODUCT SHOULD BE PLACED IMMEDIATELY AFTER COMPLETION OF THE PREPARATION OF THE AREA WHERE THE PRODUCT WILL BE PLACED.
FOLLOW THE MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION OR USE THE FOLLOWING INSTRUCTIONS. IF THERE IS A CONFLICT, FOLLOW THE MANUFACTURER'S RECOMMENDATIONS. STRIPS SHALL BE ROLLED OUT PARALLEL TO THE DIRECTION OF FLOW, IN FLUMES AND DITCHES. ON STEEP SLOPES, STRIPS SHALL BE ROLLED OUT IN THE DIRECTION OF FLOW TO REDUCE RILL EROSION. WHEN 2 OR MORE STRIPS ARE REQUIRED TO COVER AN AREA, THEY SHALL OVERLAP AT LEAST 3" (75 MM); HOWEVER, SOME TYPE BLANKETS WILL NOT REQUIRE LAPPING BUT ARE TO BE BUTTED TOGETHER AND STAPLED WITH HALF OF EACH STAPLE LOCATED IN EACH OF THE ADJOINING BLANKETS. ENDS OF STRIPS SHALL OVERLAP AT LEAST 6" (150 MM) WITH THE UPGRADE SECTION ON TOP. THE UPSLOPE END (ANCHOR SLOT) OF EACH STRIP SHALL BE BURIED IN 6" (150 MM) VERTICAL SLOTS, AND SOIL TAMPED FIRMLY AGAINST IT. WHEN, IN THE OPINION OF THE QUALIFIED DESIGN PROFESSIONAL, THAT CONDITIONS WARRANT, ANY OTHER EDGE EXPOSED TO EXCESSIVE FLOW SHALL BE BURIED AS NOTED ABOVE. THE EROSION CONTROL PRODUCT SHALL BE SPREAD EVENLY AND SMOOTHLY, AND MOST IMPORTANTLY, SHALL BE IN CONTACT WITH THE SOIL AT ALL POINTS. THE PRODUCT SHOULD NOT BE STRETCHED TIGHT IN SUCH A MANNER THAT THE MATERIAL "TENTS" OVER THE SOIL SURFACE. IF THE MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION OF THE EROSION CONTROL PRODUCT ARE DIFFERENT THAT THOSE GIVEN HERE, THE CONTRACTOR WILL BE REQUIRED TO FOLLOW THE MORE STRINGENT OF THE TWO.

TABLE ECB-5 MINIMUM PHYSICAL REQUIREMENTS FOR EROSION CONTROL BLANKETS

CLASS	MINIMUM TENSILE STRENGTH (POUNDS/FT.) (ASTM D4594) [1]	MINIMUM PERMISSIBLE SHEAR STRESS (POUNDS/SQ. FT.) (ASTM D 6460) [2], [5]	MAXIMUM "C" FACTOR FOR TEMPORARY PRODUCTS (ASTM D 6459) [3], [5]	UV STABILITY (MINIMUM % TENSILE RETENTION) FOR PERMANENT PRODUCTS (ASTM D 4355) (500 HOUR EXP.)	MINIMUM THICKNESS (INCHES) FOR PERMANENT PRODUCTS (ASTM D 6525) [4]
1.C	50	1.50	0.15 @ 3:1	N/A	N/A

1. **MINIMUM AVERAGE ROLL VALUES, MACHINE DIRECTION. FOR TURF REINFORCEMENT MATS USED IN FIELD CONDITIONS WITH HIGH LOADING AND/OR HIGH SURVIVABILITY REQUIREMENTS TENSILE STRENGTHS OF 3000 POUNDS/FT OR GREATER.**
2. **MINIMUM SHEAR STRESS THE ROLLED EROSION CONTROL PRODUCTS OR TURF REINFORCEMENT MATS CAN SUSTAIN WITHOUT PHYSICAL DAMAGE OR EXCESS EROSION** (>.5" OF SOIL LOSS) DURING A 30 MINUTE FLOW EVENT IN LARGE SCALE TESTING. THESE PERFORMANCE TEST VALUES SHOULD BE SUPPORTED BY PERIODIC BENCH SCALE TESTING UNDER SIMILAR TEST CONDITIONS AND FAILURE CRITERIA USING EROSION CONTROL TECHNOLOGY COUNCIL TEST METHOD NO. 3. FOR TEMPORARY PRODUCTS THE PERMISSIBLE SHEAR STRESS LEVELS WERE ESTABLISHED FOR EACH CLASS BASED ON HISTORICAL EXPERIENCE WITH PRODUCTS CHARACTERIZED BY MANNING'S ROUGHNESS COEFFICIENTS IN THE RANGE OF 0.03 TO 0.05.
3. "C" FACTOR CALCULATED AS RATIO OF SOIL LOSS FROM ROLLED EROSION CONTROL PRODUCT PROTECTED SLOPE (TESTED AT THE SPECIFIED GRADIENT) TO SOIL LOSS FROM UNPROTECTED (CONTROL) PLOT IN LARGE SCALE TESTING. THESE PERFORMANCE TEST VALUES SHOULD BE SUPPORTED BY PERIODIC BENCH SCALE TESTING UNDER SIMILAR TEST CONDITIONS AND FAILURE CRITERIA USING EROSION CONTROL TECHNOLOGY COUNCIL TEST METHOD NO.2.
4. MINIMUM AVERAGE ROLL VALUES.
5. OTHER LARGE SCALE TEST METHODS MAY BE DETERMINED ACCEPTABLE.

CHECK SLOTS SHALL BE PLACED SO THAT ONE CHECK SLOT, JUNCTION SLOT, OR ANCHOR SLOT OF THE EROSION CONTROL PRODUCT OCCURS EVERY 50 FEET (15 M) OF SLOPE. CHECK SLOTS SHALL BE MADE BY BURYING A TIGHT FOLD OF THE PRODUCT VERTICALLY IN THE SOIL A MINIMUM OF 6" (150 MM) DEEP, AND TAMPING AND STAPLING THE FOLD IN PLACE. IF THE MANUFACTURER'S RECOMMENDATIONS FOR THE INSTALLATION OF CHECK SLOTS ARE DIFFERENT THAN THOSE GIVEN HERE, THE CONTRACTOR WILL BE REQUIRED TO FOLLOW THE MORE STRINGENT OF THE TWO.

EACH STRIP SHALL BE STAPLED IN 3 ROWS, AT EACH EDGE AND THE CENTER, WITH STAPLES SPACED NOT MORE THAN 3 FEET (900 MM) LONGITUDINALLY. CHECK SLOTS AND ENDS OF STRIPS SHALL BE STAPLED AT 9" (225 MM) INTERVALS ACROSS THEIR WIDTH.

FOR TEMPORARY BLANKETS, STAPLES SHOULD BE U-SHAPED WIRE WITH AN 11 GAUGE THICKNESS OR GREATER. STAPLES SHOULD BE OF SUFFICIENT THICKNESS FOR SOIL PENETRATION WITHOUT UNDUE DISTORTION. THE LEGS OF THE STAPLES SHALL BE AT LEAST 6" LONG WITH A CROWN OF 1". APPROPRIATE BIODEGRADABLE STAPLES CAN BE USED IN LIEU OF WIRE STAPLES.

MAINTENANCE
INSPECT AFTER STORM EVENTS UNTIL VEGETATION IS ESTABLISHED FOR EROSION OR UNDERMINING BENEATH THE BLANKETS. IF ANY AREA SHOWS EROSION, PULL BACK THAT PORTION OF THE BLANKET, ADD TAMPED SOIL AND RESEED; THEN RESECURE THE BLANKETS.

IF BLANKETS SHOULD BECOME DISLOCATED OR DAMAGED, REPAIR OR REPLACE AND RESECURE IMMEDIATELY.

EROSION CONTROL BLANKET (ECB)

THIS PRACTICE IS DESIGNED TO PREVENT EROSION AT THE OUTLET OF A CHANNEL OR CONDUIT BY REDUCING THE VELOCITY OF FLOW AND DISSIPATING THE ENERGY. OUTLET PROTECTION MEASURES USUALLY CONSIST OF A RIPRAP-LINED APRON, A REINFORCED CONCRETE FLUME WITH CONCRETE BAFFLES, A REINFORCED CONCRETE BOX WITH CHAMBERS OR BAFFLES AND POSSIBLY PRE-MANUFACTURED PRODUCTS. THIS PRACTICE APPLIES WHEREVER HIGH VELOCITY DISCHARGE MUST BE RELEASED ON ERODIBLE MATERIAL.

DESIGN CRITERIA
STRUCTURALLY LINED APRONS AT THE OUTLETS OF PIPES AND PAVED CHANNEL SECTIONS SHALL BE DESIGNED ACCORDING TO THE FOLLOWING CRITERIA:

CAPACITY
THE STRUCTURALLY LINED APRON SHOULD HAVE THE CAPACITY TO CARRY THE PEAK STORMFLOW FROM THE 25-YEAR 24-HOUR FREQUENCY STORM OR THE STORM SPECIFIED IN STATE LAWS OR LOCAL ORDINANCES OR THE DESIGN DISCHARGE OF THE WATER CONVEYANCE STRUCTURE, WHICHEVER IS GREATEST.

TAILWATER DEPTH
THE DEPTH OF THE TAILWATER IMMEDIATELY BELOW THE PIPE OUTLET MUST BE DETERMINED FOR THE DESIGN CAPACITY OF THE PIPE. MANNING'S EQUATION MAY BE USED TO DETERMINE TAILWATER DEPTH. MANNING'S EQUATION MAY BE FOUND IN THE PRACTICE GRASS SWALES. IF THE TAILWATER DEPTH IS LESS THAN HALF THE DIAMETER OF THE OUTLET PIPE, IT SHALL BE CLASSIFIED AS A MINIMUM TAILWATER CONDITION. IF THE TAILWATER DEPTH IS GREATER THAN HALF THE PIPE DIAMETER, IT SHALL BE CLASSIFIED AS A MAXIMUM TAILWATER CONDITION. PIPES WHICH OUTLET ONTO FLAT AREAS, WITH NO DEFINED CHANNEL, MAY BE ASSUMED TO HAVE A MINIMUM TAILWATER CONDITION.

APRON LENGTH
THE APRON LENGTH SHOULD BE DETERMINED FROM FIGURE OP-2 OR OP-3 FOUND IN THE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1, PAGES 232 AND 233, ACCORDING TO THE TAILWATER CONDITION.

APRON THICKNESS
THE APRON THICKNESS SHOULD BE DETERMINED BY THE MAXIMUM STONE SIZE (DMAX), WHEN THE APRON IS LINED WITH RIPRAP. THE MAXIMUM STONE SIZE SHALL BE 1.5 X d_{50} (MEDIAN STONE SIZE), AS DETERMINED FROM FIGURE OP-2 OR OP-3 FOUND IN THE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1, PAGES 232 AND 233. THE APRON THICKNESS SHALL BE 1.5 X DMAX.

WHEN THE APRON IS LINED WITH CONCRETE, THE MINIMUM THICKNESS OF THE CONCRETE SHALL BE 4".

APRON WIDTH
IF THE PIPE DISCHARGES DIRECTLY INTO A WELL-DEFINED CHANNEL, THE APRON SHOULD EXTEND ACROSS THE CHANNEL BOTTOM AND UP THE CHANNEL BANKS TO AN ELEVATION ONE FOOT ABOVE THE MAXIMUM TAILWATER DEPTH OR TO THE TOP OF THE BANK, WHICHEVER IS THE LEAST.

IF THE PIPE DISCHARGES ONTO A FLAT AREA WITH NO DEFINED CHANNEL, THE WIDTH OF THE APRON SHALL BE DETERMINED AS FOLLOWS:

- THE UPSTREAM END OF THE APRON, ADJACENT TO THE PIPE, SHOULD HAVE A WIDTH 3 TIMES THE DIAMETER OF THE OUTLET PIPE.
- FOR A MINIMUM TAILWATER CONDITION, THE DOWNSTREAM END OF THE APRON SHOULD HAVE A WIDTH EQUAL TO THE PIPE DIAMETER PLUS THE LENGTH OF THE APRON OBTAINED FROM THE FIGURES.
- FOR A MAXIMUM TAILWATER CONDITION, THE DOWNSTREAM END SHALL HAVE A WIDTH EQUAL TO THE PIPE DIAMETER PLUS 0.4 TIMES THE LENGTH OF THE APRON FROM FIGURES OP-2 OR OP-3. (SEE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1, PAGES 232 AND 233)

BOTTOM GRADE
THE APRON SHALL BE CONSTRUCTED WITH NO SLOPE ALONG ITS LENGTH (0.0% GRADE). THE INVERT ELEVATION OF THE DOWNSTREAM END OF THE APRON SHALL BE EQUAL TO THE ELEVATION OF THE INVERT OF THE RECEIVING CHANNEL. THERE SHALL BE NO OVERFALL AT THE END OF THE APRON.

SIDE SLOPE
IF THE PIPE DISCHARGES INTO A WELL-DEFINED CHANNEL, THE SIDE SLOPES OF THE CHANNEL SHALL NOT BE STEEPER THAN 2:1 (HORIZONTAL:VERTICAL).

ALIGNMENT
THE APRON SHALL BE LOCATED SO THAT THERE ARE NO BENDS IN THE HORIZONTAL ALIGNMENT.

GEOTEXTILE
WHEN RIPRAP IS USED TO LINE THE APRON, GEOTEXTILE SHOULD BE USED AS A SEPARATOR BETWEEN THE GRADED STONE, THE SOIL SUBGRADE, AND THE ABUTMENTS. GEOTEXTILE SHOULD BE PLACED IMMEDIATELY ADJACENT TO THE SUBGRADE WITHOUT ANY VOIDS BETWEEN THE FABRIC AND THE SUBGRADE. THE GEOTEXTILE WILL PREVENT THE MIGRATION OF SOIL PARTICLES FROM THE SUBGRADE INTO THE GRADED STONE. THE GEOTEXTILE SHALL BE OF THE STRENGTH AND DURABILITY REQUIRED FOR THE PROJECT TO ENSURE THE AGGREGATE AND SOIL BASE ARE STABLE. GENERALLY, THE NON-WOVEN GEOTEXTILE SHOULD MEET THE REQUIREMENTS FOUND IN ASSHTO M288.

MATERIALS
THE APRON MAY BE LINED WITH LOOSE ROCK RIPRAP, GROUTED RIPRAP, OR CONCRETE. THE MEDIAN SIZED STONE FOR RIPRAP SHOULD BE DETERMINED FROM THE CURVES ON FIGURE OP-2 AND OP-3 ACCORDING TO THE TAILWATER CONDITION. (SEE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1, PAGES 232 AND 233)

AFTER THE MEDIAN STONE SIZE IS DETERMINED, THE GRADATION OF ROCK TO BE USED SHOULD BE SPECIFIED USING TABLES OP-2 AND OP-3. TABLE OP-2 IS USED TO DETERMINE THE WEIGHT OF THE MEDIAN STONE SIZE (d_{50}). USING THIS MEDIAN WEIGHT, A GRADATION CAN BE SELECTED FROM TABLE OP-3, WHICH SHOWS THE COMMERCIALLY AVAILABLE RIPRAP GRADATIONS AS CLASSIFIED BY THE ALABAMA DEPARTMENT OF TRANSPORTATION.

STONE FOR RIPRAP SHOULD CONSIST OF FIELD STONE OR ROUGH UNHEWN QUARRY STONE OF APPROXIMATELY RECTANGULAR SHAPE. THE STONE SHOULD BE HARD AND ANGULAR AND OF SUCH QUALITY THAT IT WILL NOT DISINTEGRATE ON EXPOSURE TO WATER OR WEATHERING AND IT SHALL BE SUITABLE IN ALL OTHER RESPECTS FOR THE PURPOSE INTENDED. THE SPECIFIC GRAVITY OF THE INDIVIDUAL STONES SHOULD BE AT LEAST 2.5.

WHEN THE APRON IS LINED WITH CONCRETE, THE CONCRETE SHOULD HAVE A MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS OF 3000 POUNDS PER SQUARE INCH. AMERICAN CONCRETE INSTITUTE GUIDELINES SHOULD BE USED TO DESIGN CONCRETE STRUCTURES AND REINFORCEMENT. AS A MINIMUM, THE CONCRETE SHOULD BE REINFORCED WITH STEEL WELDED WIRE FABRIC.

MAINTENANCE
INSPECT RIPRAP OUTLET STRUCTURES AFTER HEAVY RAINS TO SEE IF ANY EROSION AROUND OR BELOW THE RIPRAP HAS TAKEN PLACE OR IF STONES HAVE BEEN DISLODGED. CHECK CONCRETE STRUCTURES FOR CRACKS AND MOVEMENT. IMMEDIATELY MAKE ALL NEEDED REPAIRS TO PREVENT FURTHER DAMAGE.

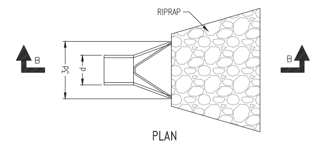
TABLE OP-2 SIZE OF RIPRAP STONES

WEIGHT	MEAN SPHERICAL DIAMETER (FEET)	RECTANGULAR SHAPE LENGTH	RECTANGULAR SHAPE WIDTH, HEIGHT (FEET)
50	0.8	1.4	0.5
100	1.1	1.75	0.6
150	1.3	2.0	0.67
300	1.6	2.6	0.9
500	1.9	3.0	1.0
1000	2.2	3.7	1.25
1500	2.6	4.7	1.5
2000	2.75	5.4	1.8
4000	3.6	6.0	2.0
6000	4.0	6.9	2.3
8000	4.5	7.6	2.5
20000	6.1	10.0	3.3

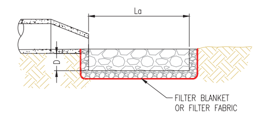
TABLE OP-3 GRADED RIPRAP

CLASS	WEIGHT (LBS.) d_{10}	d_{15}	d_{25}	d_{50}	d_{75}	d_{90}
1	10	–	–	50	–	100
2	10	–	–	80	–	200
3	–	25	–	200	–	500
4	–	–	50	500	1000	–
5	–	–	200	1000	–	2000

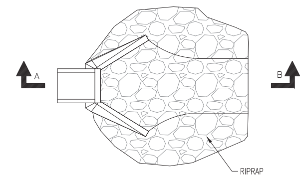
NOTES:
1. La IS THE LENGTH OF THE RIPRAP APRON.
2. D = 1.5 TIMES THE MAXIMUM STONE DIAMETER, BUT NOT LESS THAN 6".
3. IN A WELL-DEFINED CHANNEL, EXTEND THE APRON UP THE CHANNEL BANKS TO AN ELEVATION OF 6" ABOVE THE MAXIMUM TAILWATER DEPTH OR TO THE TOP OF THE BANK, WHICHEVER IS LESS.
4. A FILTER BLANKET OR FILTER FABRIC SHOULD BE INSTALLED BETWEEN THE RIPRAP AND SOIL FOUNDATION.



PLAN



SECTION B-B
PIPE OUTLET TO FLAT AREA – NO WELL-DEFINED CHANNEL



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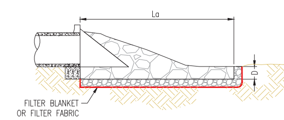


SECTION A-A
PIPE OUTLET TO WELL-DEFINED CHANNEL

OUTLET PROTECTION (OP)
N.T.S.

DUST CONTROL INCLUDES A WIDE RANGE OF TECHNIQUES THAT PREVENT OR REDUCE MOVEMENT OF WIND-BORNE SOIL PARTICLES (DUST) DURING LAND DISTURBING ACTIVITIES. THIS PRACTICE APPLIES TO CONSTRUCTION ROUTES AND OTHER DISTURBED AREAS WHERE ON-SITE AND OFF-SITE DAMAGE OR HAZARDS MAY OCCUR IF DUST IS NOT CONTROLLED.

DESIGN CRITERIA
PERMANENT METHODS:

VEGETATIVE COVER: FOR DISTURBED AREAS NOT SUBJECT TO TRAFFIC, VEGETATION PROVIDES THE MOST PRACTICAL METHOD OF DUST CONTROL. ESTABLISH VEGETATIVE COVER ACCORDING TO THE PERMANENT SEEDING OR TEMPORARY SEEDING PRACTICE

TOP SOILING: THIS ENTAILS COVERING THE SURFACE WITH LESS EROSIVE SOIL MATERIAL. SEE TOPSOILING PRACTICE FOR GUIDANCE.

STONE: STONE USED TO STABILIZE CONSTRUCTION ROADS CAN ALSO BE EFFECTIVE FOR DUST CONTROL. STONE SHOULD BE SPREAD A MINIMUM OF 6" THICK OVER CONSTRUCTION ROADS IN THE DISTURBED AREA. FOR HEAVILY TRAVELED ROADS OR ROADS SUBJECTED TO HEAVY LOADS THE STONE THICKNESS SHOULD BE 8" TO 10". A NON-WOVEN GEOTEXTILE MEETING THE REQUIREMENTS of ASSHTO M288 SHOULD BE USED UNDER THE STONE.

TEMPORARY METHODS:

MULCHES: MULCH OFFERS A FAST, EFFECTIVE MEANS OF CONTROLLING DUST WHEN PROPERLY APPLIED. SEE MULCHING PRACTICE FOR GUIDELINES FOR PLANNING AND INSTALLING THE PRACTICE.

TEMPORARY VEGETATIVE COVER: FOR DISTURBED AREAS WHERE NO ACTIVITY IS ANTICIPATED FOR 14 DAYS OR LONGER, TEMPORARY SEEDING CAN EFFECTIVELY CONTROL DUST. ESTABLISH VEGETATIVE COVER ACCORDING TO TEMPORARY SEEDING PRACTICE GUIDELINES.

CALCIUM CHLORIDE: CALCIUM CHLORIDE MAY BE APPLIED BY MECHANICAL SPREADER AS LOOSE, DRY GRANULES OR FLAKES AT A RATE THAT KEEPS THE SURFACE MOIST BUT NOT SO HIGH AS TO CAUSE WATER POLLUTION OR PLANT DAMAGE. SITES MAY NEED TO BE RETREATED BECAUSE THE PRODUCT DEGRADES OVER TIME.

SPRAY-ON ADHESIVES: SPRAY-ON ADHESIVES MAY BE USED ON MINERAL SOILS FOR DUST CONTROL. TRAFFIC MUST BE KEPT OFF TREATED AREAS TO PREVENT THE PRODUCT FROM BECOMING INEFFECTIVE. EXAMPLES OF SPRAY-ON ADHESIVES FOR USE IN DUST CONTROL ARE LISTED IN TABLE DC-1.

TABLE DC-1 SPRAY-ON ADHESIVES FOR DUST CONTROL ON MINERAL SOIL

MATERIAL	WATER DILUTION	TYPE OF NOZZLE	APPLY GAL/AC
ANIONIC ASPHALT EMULSION	7:1	COARSE SPRAY	1,200
LATEX EMULSION	12.5:1	FINE SPRAY	235
RESIN IN WATER	4:1	FINE SPRAY	300

CHEMICAL STABILIZATION (CHS): CHEMICAL PRODUCTS MAY BE USED ON MINERAL SOILS FOR DUST CONTROL. TRAFFIC MUST BE KEPT OFF TREATED AREAS TO PREVENT THE PRODUCT FROM BECOMING INEFFECTIVE. THE MANUFACTURER OF SUPPLIER SHALL PROVIDE WRITTEN APPLICATION METHODS. THE APPLICATION METHOD SHALL ENSURE UNIFORM COVERAGE TO THE TARGET AND AVOID DRIFT TO NON-TARGET AREAS INCLUDING WATERS OF THE STATE. THE MANUFACTURER OR SUPPLIER SHALL ALSO PROVIDE WRITTEN INSTRUCTIONS TO ENSURE PROPER SAFETY, STORAGE, AND MIXING OF THE PRODUCT. REFER TO THE PLANNING CONSIDERATIONS FOR CHEMICAL STABILIZATION PRACTICE FOR PLANNING CONSIDERATION BEFORE DECIDING TO USE THIS PRODUCT.

SPRINKLING OR IRRIGATION: SPRINKLING IS ESPECIALLY EFFECTIVE FOR DUST CONTROL ON HAUL ROADS AND OTHER TRAFFIC ROUTES. SPRINKLE THE SITE UNTIL THE SURFACE IS WET. REPEAT AS NEEDED. ALSO BARE AREAS MAY BE KEPT WET WITH IRRIGATION TO CONTROL DUST AS AN EMERGENCY TREATMENT.

TILLAGE: TILLAGE IS USED TO ROUGHEN THE SITE AND BRING CLODS AND MOIST SOIL TO THE SURFACE. THIS IS A TEMPORARY EMERGENCY MEASURE THAT CAN BE USED ON LARGE OPEN DISTURBED AREAS AS SOON AS SOIL BLOWING STARTS. BEGIN TILLING ON THE WINDWARD EDGE OF THE SITE. THE DEPTH OF TILLAGE IS DETERMINED BY THE DEPTH TO MOIST SOIL AND THE AMOUNT OF MOIST SOIL DESIRED AT THE SURFACE. IN SANDY SOILS, THE DEPTH TO MOIST SOIL MAY MAKE TILLAGE IMPRACTICAL.

BARRIERS: A BOARD FENCE, WIND FENCE, SEDIMENT FENCE, HAY BALES, OR SIMILAR BARRIERS CAN CONTROL AIR CURRENTS AND BLOWING SOIL. PLACE BARRIERS PERPENDICULAR TO PREVAILING AIR CURRENTS AT INTERVALS ABOUT 15 TIMES THE BARRIER HEIGHT.

MAINTENANCE: CHECK CONSTRUCTION SITE DURING VEHICULAR TRAFFIC OR WINDY CONDITIONS TO SEE IF MEASURES ARE WORKING ADEQUATELY. MAINTAIN DUST CONTROL MEASURES CONTINUOUSLY THROUGHOUT DRY WEATHER PERIODS, UNTIL ALL DISTURBED AREAS HAVE BEEN STABILIZED.

DUST CONTROL (DC)

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 2

REVISION	DATE	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
0 ISSUED FOR CONSTRUCTION	11/21/18	JMH	CRU	JKB	XXX	XXX	MPB	JCP

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
NONE	E720293	1	FINAL	0

ANSI E: 44x34

LAND GRADING IS RESHAPING OF THE GROUND SURFACE TO PROVIDE SUITABLE TOPOGRAPHY FOR BUILDINGS, FACILITIES AND OTHER LAND USES, TO CONTROL SURFACE RUNOFF, AND TO MINIMIZE SOIL EROSION AND SEDIMENTATION BOTH DURING AND AFTER CONSTRUCTION. THIS PRACTICE APPLIES TO SITES WHERE THE EXISTING TOPOGRAPHY MUST BE MODIFIED TO PREPARE FOR ANOTHER LAND USE, OR WHERE ADAPTING PROPOSED DEVELOPMENT TO THE EXISTING LANDSCAPE CAN REDUCE THE EROSION POTENTIAL OF THE SITE AND THE COST OF INSTALLING EROSION AND SEDIMENT CONTROL MEASURES. IN SOME INSTANCES OTHER PRACTICES SUCH AS DIVERSIONS OR BENCHES CAN BE USED TO REDUCE THE LENGTH OF CONTINUOUS SLOPES AND REDUCE EROSION POTENTIAL.

DESIGN CRITERIA
SITE PREPARATION
A DETAILED SURVEY OF THE CONSTRUCTION SITE SHOULD BE PERFORMED BY A QUALIFIED SURVEYOR PRIOR TO GRADING PLAN DEVELOPMENT. THIS SURVEY SHOULD INCLUDE EXISTING TOPOGRAPHIC INFORMATION A THE SITE INCLUDING EXISTING ELEVATIONS, EXISTING DRAINAGE PATTERNS, LOCATIONS OF EXISTING OVERHEAD AND UNDERGROUND UTILITIES, AND CONSTRUCTION LIMIT BOUNDARIES.

THE GRADING PLAN SHOULD REQUIRE THAT THE EXISTING TOPSOIL AT SITES TO BE GRADED BY REMOVED AS THE FIRST STEP IN THE GRADING PROCESS. THE PLAN SHOULD INCLUDE A LOCATION ON THE CONSTRUCTION SITE WHERE TOPSOIL WILL BE STOCKPILED. STOCKPILED TOPSOIL SHOULD BE PROTECTED BY TEMPORARY VEGETATION (SEE TEMPORARY VEGETATION PRACTICE) FOR OTHER APPROPRIATE TEMPORARY COVER, SUCH AS PLASTIC, UNTIL IT IS USED TO COVER DISTURBED AREAS IN ADVANCE OF PERMANENT VEGETATION OF THE SITE.

THE GRADING PLAN SHOULD INCLUDE A SCHEDULE OF DISTURBANCE ACTIVITIES THAT MINIMIZES THE AREA DISTURBED AT ANY POINT IN TIME USING SEQUENCING AND STAGING CONCEPTS. IN AREAS WHERE CLEARING OF EXISTING VEGETATION IS PLANNED, THE AREA SHOULD BE CLEARED AND GRUBBED BY REMOVING REES, VEGETATION, ROOTS AND OTHER DEBRIS SUCH AS TRASH. IN AREAS TO BE FILLED ALL LOOSE OR WEAK SOIL AND OVERSIZED ROCKS SHOULD BE REMOVED FROM THE AREA. THE FOUNDATION OF THE AREA TO BE FILLED SHOULD CONSIST OF SOIL OR ROCK MATERIAL OF ADEQUATE STRENGTH TO SUPPORT THE PROPOSED FILL MATERIAL AND THE STRUCTURES TO BE BUILT AT THE SITE. THE EXACT DEPTH OF MATERIAL TO BE REMOVED SHOULD BE DETERMINED BY A QUALIFIED GEOTECHNICAL PROFESSIONAL ACCORDING TO ACCEPTED ENGINEERING STANDARDS.

GRADING
A PLAN FOR PLACEMENT OF FILL SHOULD BE DEVELOPED BY A QUALIFIED GEOTECHNICAL PROFESSIONAL. THE PLAN SHOULD SPECIFY THE SOURCE OF FILL MATERIALS, WHICH SHOULD BE OBTAINED ON SITE IF POSSIBLE. MATERIALS USED FOR FILL, WHEN PLACED ACCORDING TO THE PLANS AND SPECIFICATIONS, SHOULD PROVIDE SUFFICIENT STRENGTH TO SUPPORT STRUCTURES PLANNED FOR CONSTRUCTION AT THE LOCATION.

LOOSE FILL MATERIAL SHOULD BE PLACED IN LAYERS NOT EXCEEDING 9" IN THICKNESS. THE MATERIALS SHOULD BE COMPACTED TO A MOISTURE CONTENT AND TO A DR4Y DENSITY THAT WILL PRODUCE THE DESIGN BEARING STRENGTH REQUIRED FOR STRUCTURES PLANNED AT THE SITE. A QUALIFIED GEOTECHNICAL ENGINEER SHOULD PROVIDE FILL PLACEMENT SPECIFICATIONS USING STANDARD ACCEPTED ENGINEERING PRACTICES.
LONG AND/OR STEEP SLOPE LENGTHS CAN RESULT IN RILL AND GULLY EROSION ON SLOPES. EROSION ON THESE TYPE SLOPES CAN BE MINIMIZED BY BREAKING THE SLOPE WITH DIVERSIONS OR BENCHES (SEE DIVERSION PRACTICE). DIVERSION WIDTHS SHOULD BE COMPATIBLE WITH THE EXPECTED MAINTENANCE EQUIPMENT. CARE IS NEEDED IN LOCATING OUTLETS THAT WILL BE STABLE AND NOT CAUSE GULLY EROSION. THE FOLLOWING TABLE GIVES GENERAL GUIDANCE ON THE HORIZONTAL SPACING OF SLOPE BREAKS:

TABLE LG-1 GUIDELINES FOR SPACING SLOPE BREAKS[1]

SLOPE (H:V)	HORIZONTAL SPACING (FT)
1:1	20
2:1	40
3:1	60
4:1 AND 5:1	80
6:1 TO 9:1	120
10:1 OR FLATTER	200

IN AREAS WHERE SEEPAGE AND GROUND WATER ARE PRESENT, SUBSURFACE DRAINS SHOULD BE INSTALLED TO IMPROVE SLOPE STABILITY OF SOIL BEARING CAPACITY (SEE SUBSURFACE DRAIN PRACTICE).

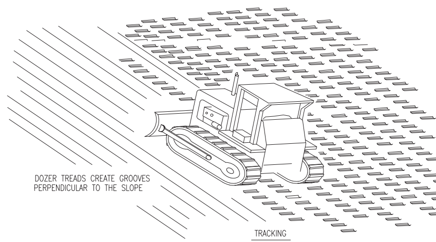
STEEP SLOPES SHOULD BE AVOIDED IF POSSIBLE. SLOPES THAT ARE TO BE VEGETATED SHOULD BE 2 HORIZONTAL TO 1 VERTICAL OR FLATTER. IF THE SLOPE IF TO BE MAINTAINED BY TRACTOR OR OTHER EQUIPMENT THE SLOPE SHOULD BE 3 HORIZONTAL TO 1 VERTICAL OR FLATTER. SLOPES SHOULD BE DESIGNED TO BLEND WITH SURROUNDING TOPOGRAPHY AS MUCH AS POSSIBLE.

EROSION CONTROL
THE GRADING PLAN SHOULD INCLUDE PROVISIONS FOR STABILIZATION OF GRADED AREAS IMMEDIATELY AFTER FINAL GRADING IS COMPLETED. ON AREAS THAT WILL HAVE NO ADDITIONAL DISTURBANCE, PERMANENT VEGETATION SHOULD BE APPLIED IMMEDIATELY TO THE SITE (SEE PERMANENT SEEDING PRACTICE) IF GRADING IS FINISHED DURING THE PLANTING SEASON. IF GRADING IS FINISHED OUTSIDE OF THE RECOMMENDED PLANTING DATES A TEMPORARY COVER SHOULD BE INSTALLED USING A TEMPORARY SEEDING OR OTHER APPROPRIATE COVER AND THE PERMANENT SEEDING PLANNED FOR THE NEXT PLANTING PERIOD. ON AREAS WHERE WORK IS TO BE INTERRUPTED OR DELAYED FOR 14 CALENDAR DAYS OR LONGER, SUCH AS TOPSOIL STOCKPILES, THE AREA SHOULD BE STABILIZED USING MULCH OR TEMPORARY SEEDING (SEE MULCHING OR TEMPORARY SEEDING PRACTICE). OTHER STABILIZATION MEASURES SUCH A HYDRAULIC MULCH OR EROSION CONTROL BLANKETS SHOULD BE USED IN EXTREME CONDITIONS, SUCH AS STEEP SLOPES AND CHANNELS.

WHERE PRACTICAL, RUNOFF FROM UNDISTURBED OFF-SITE AREAS SHOULD BE DIVERTED AROUND THE CONSTRUCTION SITE TO PREVENT EROSION ON THE DISTURBED AREAS (SEE DIVERSION PRACTICE).

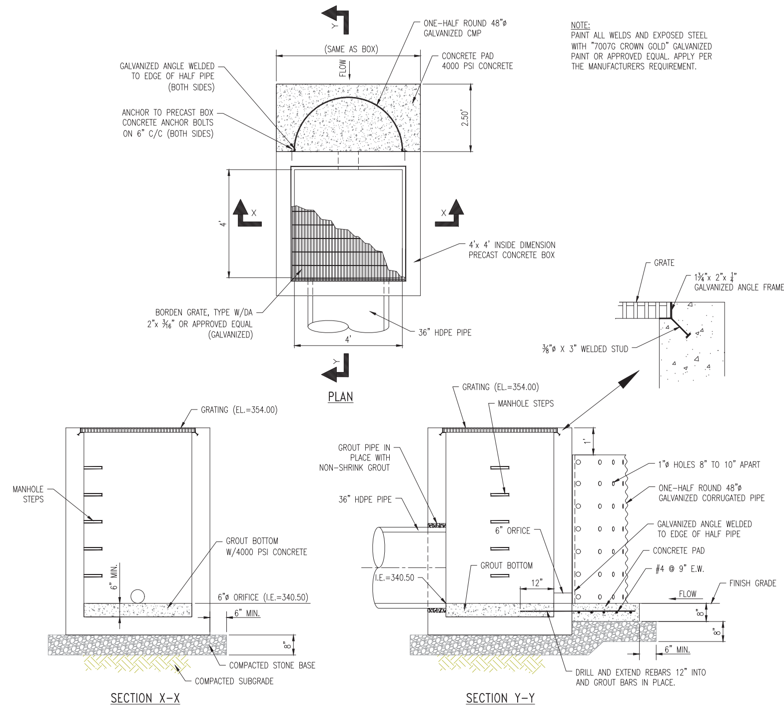
SEDIMENT CONTROL
REQUIRED SEDIMENT CONTROL PRACTICES SHOULD BE INSTALLED BEFORE LAND DISTURBANCE ACTIVITIES IN THE DRAINAGE AREA OF THE SEDIMENT CONTROL PRACTICES. UNTIL DISTURBED AREAS CAN BE STABILIZED, APPROPRIATE SEDIMENT CONTROL MEASURES WILL BE MAINTAINED TO MINIMIZE SEDIMENT DELIVERY OFF-SITE. MEASURES SHOULD INCLUDE AS A MINIMUM:

- SEDIMENT BARRIERS – PLACED ALONG TOES OF SLOPES (SEE SEDIMENT BARRIER PRACTICE)
- SEDIMENT BASINS – DIVERT SEDIMENT LADEN RUNOFF TO BASINS AS NEEDED TO MINIMIZE OFF-SITE SEDIMENTATION (SEE SEDIMENT BASIN PRACTICE).
- INLET PROTECTION – WHERE SEDIMENT-LADEN RUNOFF IS DIVERTED TO ON-SITE STORMWATER DRAIN INLETS, THE INLETS SHOULD BE PROTECTED WITH AN APPROPRIATE SEDIMENT CONTROL PRACTICE.
- STABILIZED OUTLETS – ALL RUNOFF FROM THE SITE SHOULD BE CONVEYED IN STABILIZED CHANNELS (SEE GRASSED SWALE, LINED SWALE, RIP-RAP LINED SWALE, OR OTHER APPROPRIATE CHANNEL STABILIZATION).

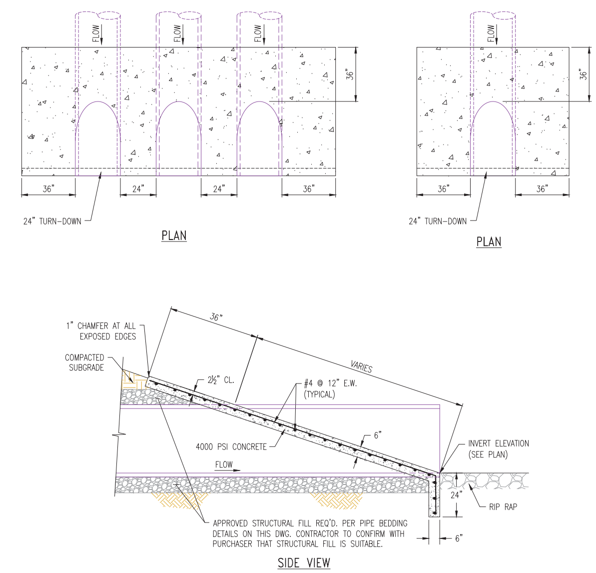


MAINTENANCE
PERIODICALLY CHECK ALL GRADED AREAS AND THE RELATED EROSION AND SEDIMENT CONTROL PRACTICES FOR DAMAGE BY EQUIPMENT AND ESPECIALLY AFTER HEAVY RAINFALLS FOR DAMAGE BY RUNOFF. REPAIR SILT FENCES AND OTHER TEMPORARY SEDIMENT CONTROL MEASURES. CLEAN SEDIMENT OUT OF ADJACENT DIVERSIONS AND OTHER STRUCTURES AS NEEDED. REPAIR ANY FAILURES THAT OCCUR IN SURFACE MEASURES SUCH AS PLANTINGS.

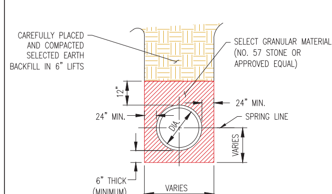
LAND GRADING (LG)



OUTLET CONTROL STRUCTURE DETAIL
N.T.S.

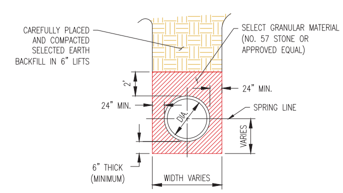


SLOPED CONCRETE HEADWALL
N.T.S.



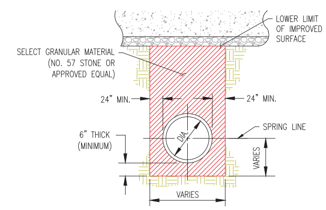
NOTE:
1. BACKFILL DETAILS SHALL BE USED FOR REINFORCED CONCRETE AND HIGH DENSITY POLYETHYLENE STORM DRAINAGE PIPE.
2. CONTRACTOR SHALL COMPACT MATERIAL IN DEEPER FILL AREAS TO A MINIMUM OF 1 FT ABOVE TOP OF PIPE PRIOR TO EXCAVATING PIPE INSTALLATION TRENCH.

TYPICAL PIPE BEDDING AND INITIAL BACKFILL DETAIL (0-8 FT COVER)
N.T.S.



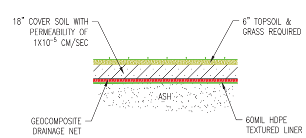
NOTE:
1. BACKFILL DETAILS SHALL BE USED FOR REINFORCED CONCRETE AND HIGH DENSITY POLYETHYLENE STORM DRAINAGE PIPE.
2. CONTRACTOR SHALL COMPACT MATERIAL IN DEEPER FILL AREAS TO A MINIMUM OF 1 FT ABOVE TOP OF PIPE PRIOR TO EXCAVATING PIPE INSTALLATION TRENCH.

TYPICAL PIPE BEDDING AND INITIAL BACKFILL DETAIL (8 FT+ COVER)

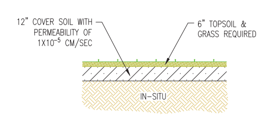


NOTE:
1. BACKFILL DETAILS SHALL BE USED FOR REINFORCED CONCRETE AND HIGH DENSITY POLYETHYLENE STORM DRAINAGE PIPE.
2. CONTRACTOR SHALL COMPACT MATERIAL IN DEEPER FILL AREAS TO A MINIMUM OF 1 FT ABOVE TOP OF PIPE PRIOR TO EXCAVATING PIPE INSTALLATION TRENCH.

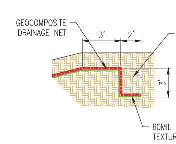
TYPICAL PIPE BEDDING AND BACKFILL UNDER IMPROVED SURFACES
N.T.S.



CAP COVER DETAIL
N.T.S.



POND COVER DETAIL
N.T.S.



ANCHOR TRENCH DETAIL
N.T.S.

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 3

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
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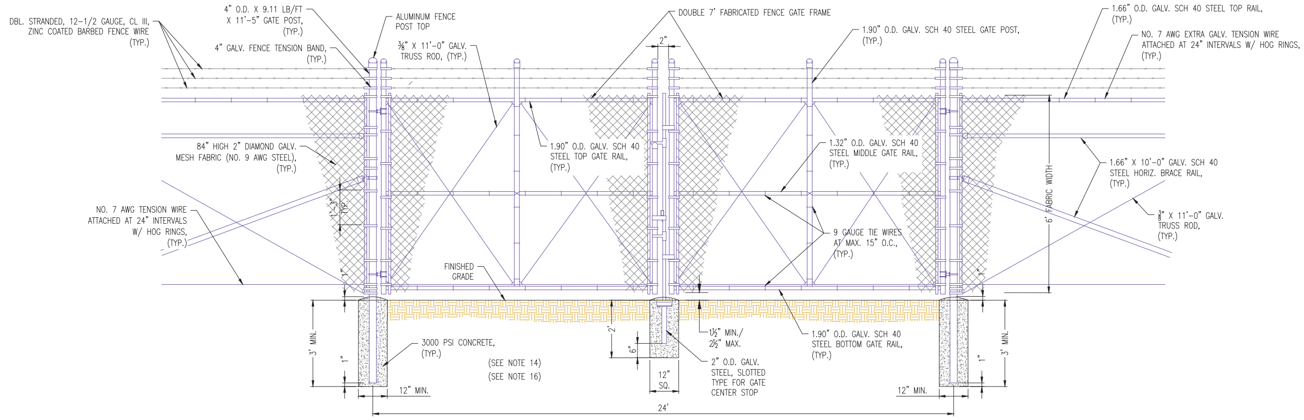
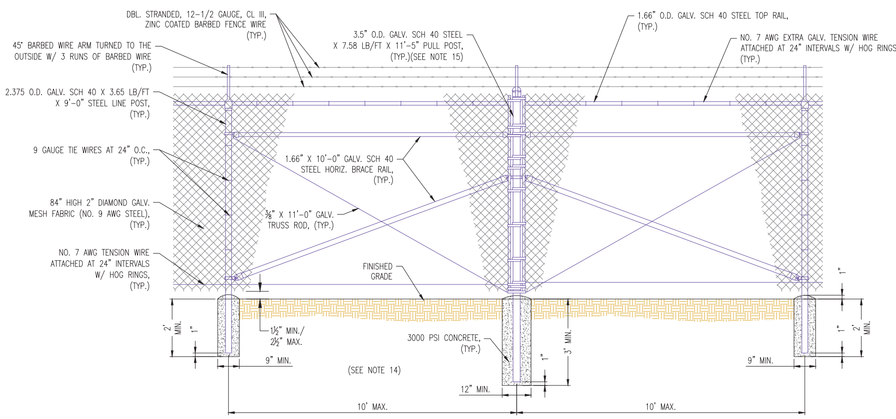
ANSI E: 44x34



24' WIDE CHAINLINK DOUBLE SWING SECURITY GATE
N.T.S.



PULL POST
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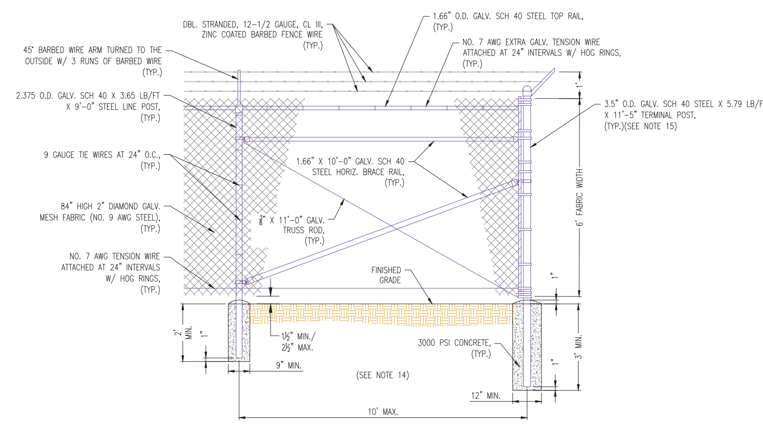
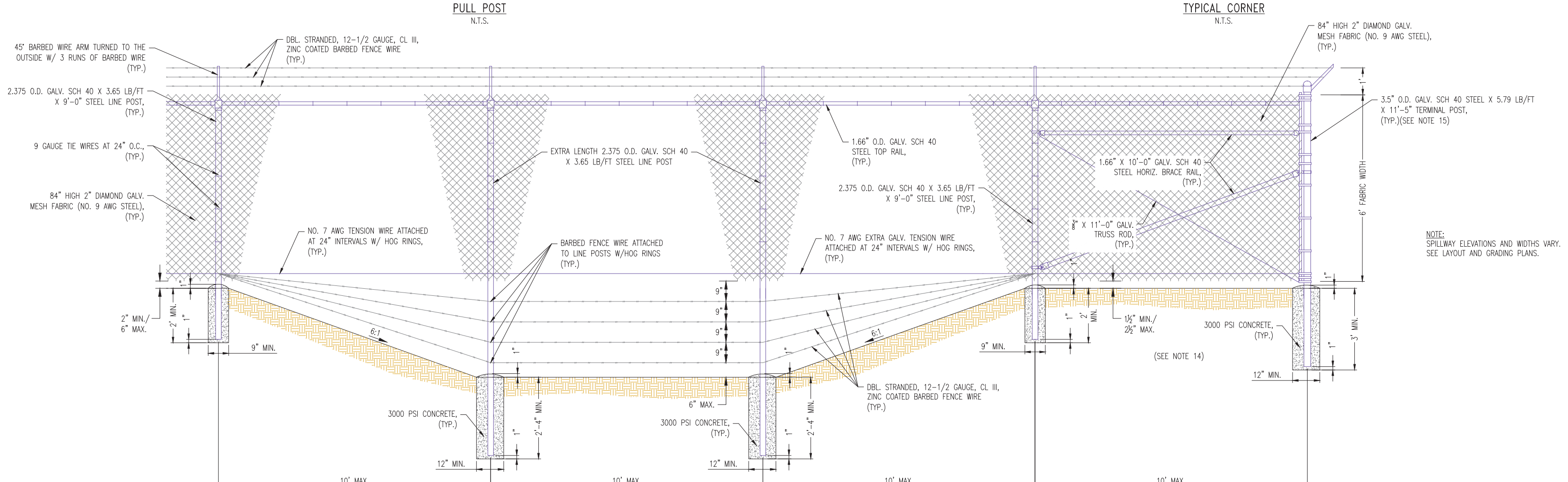


TYPICAL CORNER
N.T.S.



FENCE SPILLWAY CROSSING
N.T.S.

NOTES:
1. FENCE MATERIALS AND ERECTION SHALL BE IN ACCORDANCE WITH THE SOUTHERN COMPANY GENERAL PROVISIONS FOR CHAIN LINK FENCE SPECIFICATION 32 31 13.
2. TIE FENCE FABRIC TO SPIRALED TENSION WIRE BETWEEN POSTS WITH GALVANIZED STEEL HOG RINGS TOP AND BOTTOM AT INTERVALS OF TWO FEET.
3. LIMIT TENSION IN FABRIC AND WIRE TO PREVENT BENDING OF GATE POSTS AND CORNER POSTS.
4. WHEN GATE PANEL IS INSTALLED ON A CORNER POST, THE LATCH SHOULD BE INSTALLED ON THE OPPOSITE PANEL.
5. PULL POSTS WILL BE INSTALLED AT APPROXIMATELY MID-SPAN WHERE SPACING BETWEEN CORNER POSTS OR TERMINAL POSTS EXCEEDS 100 FEET TO PROVIDE FENCE GROUNDING POINT PER NESC, OR WHERE IT IS NECESSARY TO TERMINATE THE FENCE DUE TO A CHANGE IN GRADE. MATERIAL FOR PULL POSTS TO BE SAME AS CORNER POSTS.
6. HINGE TO BE INSTALLED WITH GALVANIZED STEEL BOLT WITH TWO NUTS OR A PREFERRED SELF-LOCKING TYPE NUT TO LOCK BOLT IN PLACE.
7. CHAIN FOR GATE TO BE ONE PIECE; 1/4" GALVANIZED STEEL, WELDED, SIZE 5/0, INSERTED BETWEEN GATE FRAME AND TENSION BAR, SUCH THAT A TIGHT FIT IS OBTAINED WITH LOCK INSTALLED FROM OUTSIDE GATE. EXCESS LINKS SHOULD BE REMOVED.
8. FENCE FABRIC TO BE INSTALLED WITH TWIST SELVAGES AT BOTTOM.
9. GATE HINGE TO BE INSTALLED FOR 1/4" OR LESS GAP BETWEEN GATE POST AND FRAME TO PREVENT ACCESS WHEN CLOSED AND TO ALLOW APPROX. 180-DEGREES INWARD OPENING.
10. GATE KEEPER TO BE INSTALLED FOR EACH PANEL OF DOUBLE GATES AT MAXIMUM OPEN POSITION.
11. TRUSS RODS ARE NOT REQUIRED WHEN ONLY ONE LINE POST IS IN A CONTINUOUS SPAN OF FABRIC.
12. BOTTOM OF CHAIN LINK FABRIC TO BE INSTALLED A MINIMUM OF 2" TO A MAXIMUM OF 6" ABOVE FINISHED GRADE.
13. USE 3½" O.D. X 11'-5" POST FOR CORNER AND PULL POSTS REQUIRING BARBED WIRE TO BE HELD BY 45-DEGREE ARMS, CUT 12" OFF POST FOR A HEIGHT OF 10'-5".
14. DOUBLE DRIVE GATES TO BE INSTALLED TO MINIMIZE OPENING TO 2" MAXIMUM. (CHAIN SHOULD NOT BE SLACK.)
15. CONCRETE TO BE POURED WITH A 1" DOME TO PREVENT PUDDLING NEAR POST.

NOTE:
SPILLWAY ELEVATIONS AND WIDTHS VARY. SEE LAYOUT AND GRADING PLANS.

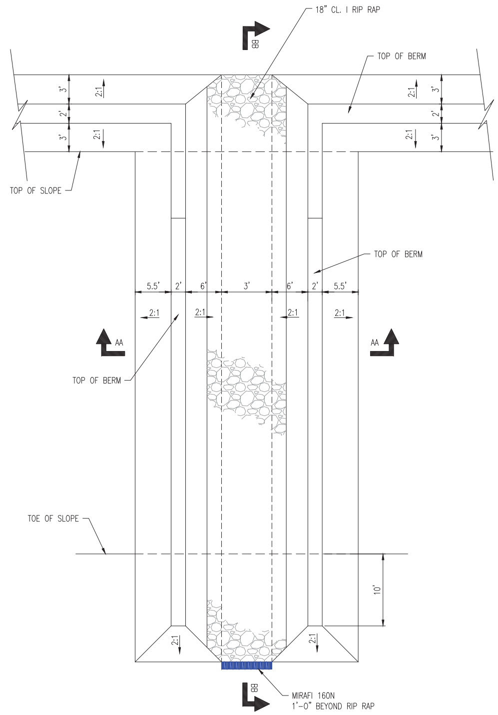
NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 4

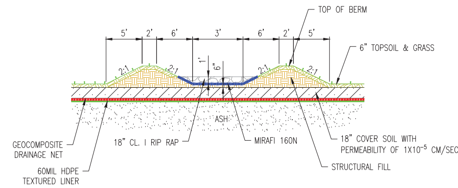
SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
NONE	E720295	1	FINAL	0

ANSI E: 44x34



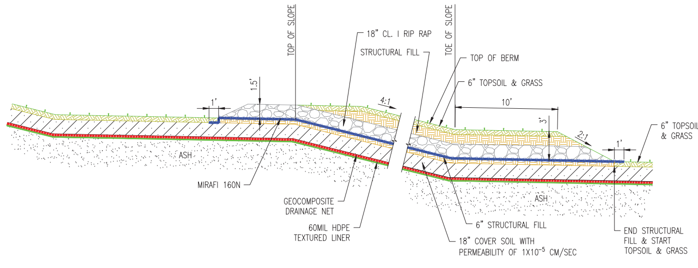
DOWN DRAIN CHANNEL DETAIL

N.T.S.



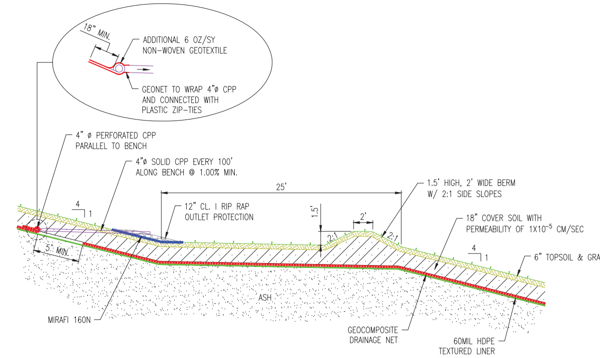
SECTION AA-AA

N.T.S.



SECTION BB-BB

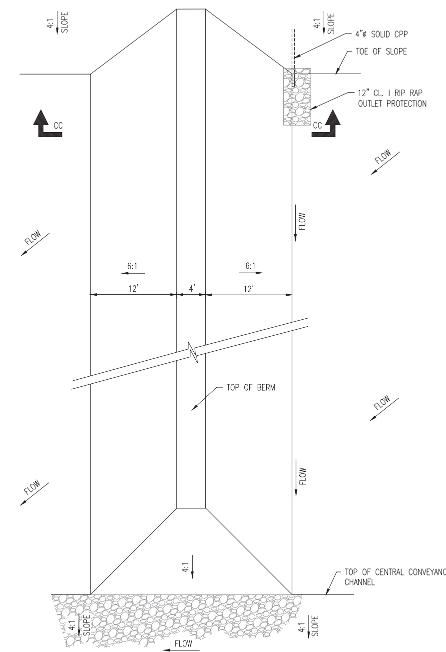
N.T.S.



DRAINAGE NET COLLECTION ON BENCH DETAIL

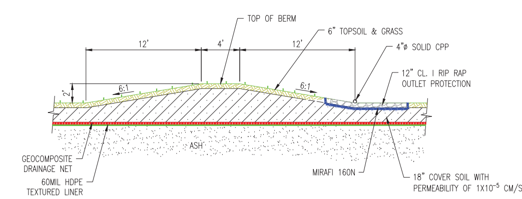
N.T.S.

NOTES:
1. CPP PIPE NOT AT ALL DRAINAGE BERM LOCATIONS. SEE PLAN.
2. IN LOCATION WITH CPP PIPE, PIPE TO BE ON UP HILL SIDE OF DRAINAGE BERM.



PLAN

N.T.S.



SECTION CC-CC

N.T.S.

DRAINAGE BERM DETAIL

N.T.S.

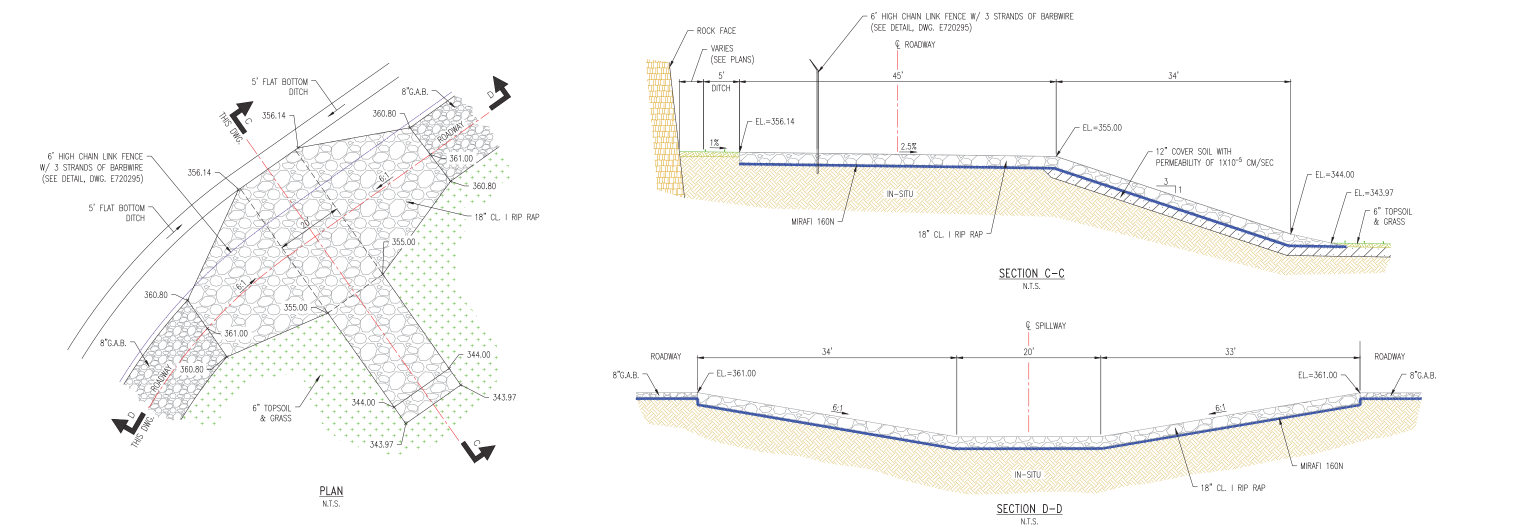
NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

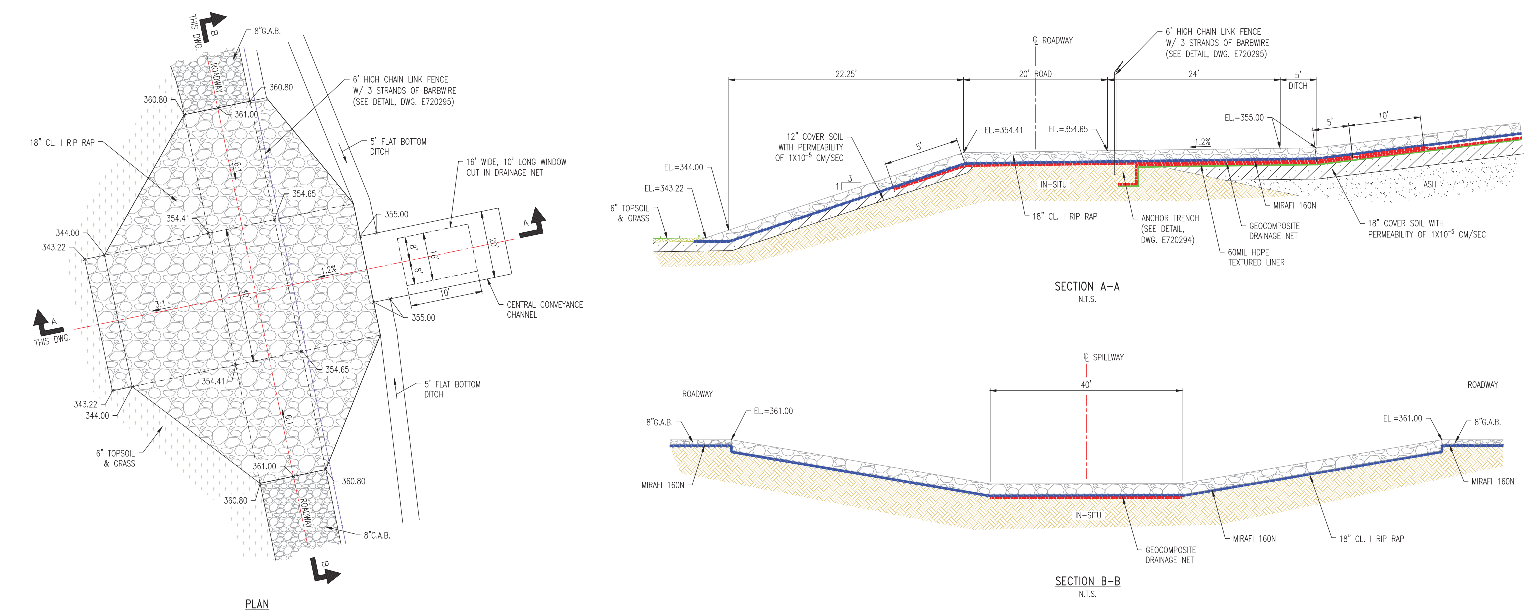
PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 5

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
NONE	E720296	1	FINAL	0

ANSI E: 44x34



DITCH TO POND SPILLWAY DETAIL
N.T.S.



CENTRAL CONVEYANCE CHANNEL TO POND SPILLWAY DETAIL
N.T.S.

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

REVISION	0	DATE	11/21/18
ISSUED FOR CONSTRUCTION			

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JMH	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation Engineering and Construction Services FOR

Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 6

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
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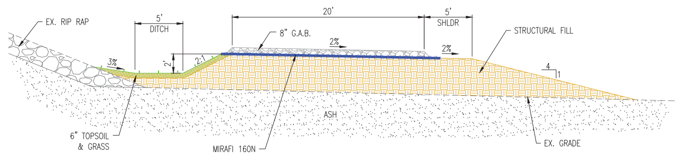
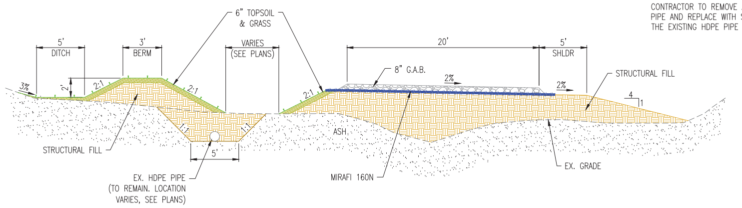


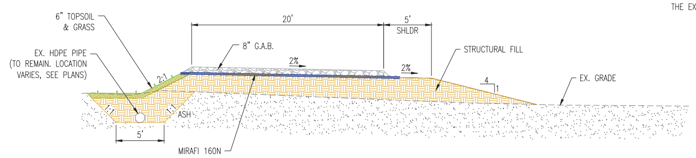
SECTION A–A
N.T.S.

NOTE:
CONTRACTOR TO REMOVE ASH ABOVE EXISTING HDPE PIPE AND REPLACE WITH STRUCTURAL FILL. ASH UNDER THE EXISTING HDPE PIPE MAY REMAIN IN PLACE.



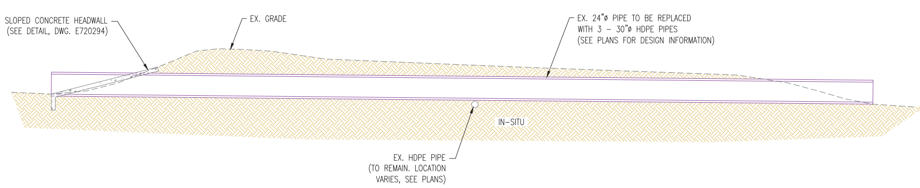
SECTION B–B
N.T.S.

NOTE:
CONTRACTOR TO REMOVE ASH ABOVE EXISTING HDPE PIPE AND REPLACE WITH STRUCTURAL FILL. ASH UNDER THE EXISTING HDPE PIPE MAY REMAIN IN PLACE.



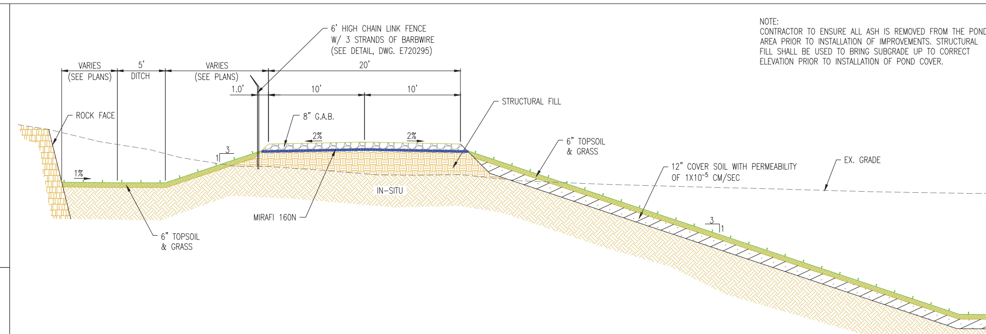
SECTION C–C
N.T.S.

NOTE:
CONTRACTOR SHALL VERIFY LOCATION OF EXISTING HDPE PIPE PRIOR TO REPLACEMENT OF EXISTING 24"φ STORM DRAINAGE PIPE WITH THREE (3) 30"φ STORM DRAINAGE PIPES. CONTRACTOR TO USE EXTREME CAUTION TO NOT DAMAGE EXISTING HDPE PIPE.



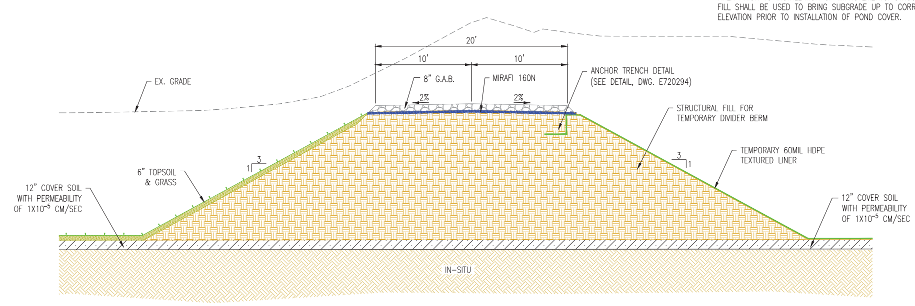
SECTION D–D
N.T.S.

NOTE:
CONTRACTOR TO ENSURE ALL ASH IS REMOVED FROM THE POND AREA PRIOR TO INSTALLATION OF IMPROVEMENTS. STRUCTURAL FILL SHALL BE USED TO BRING SUBGRADE UP TO CORRECT ELEVATION PRIOR TO INSTALLATION OF POND COVER.



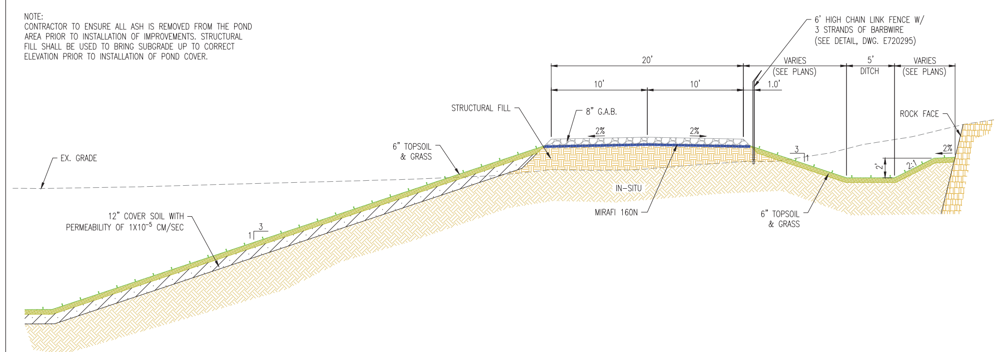
SECTION E–E
N.T.S.

NOTE:
CONTRACTOR TO ENSURE ALL ASH IS REMOVED FROM THE POND AREA PRIOR TO INSTALLATION OF IMPROVEMENTS. STRUCTURAL FILL SHALL BE USED TO BRING SUBGRADE UP TO CORRECT ELEVATION PRIOR TO INSTALLATION OF POND COVER.



SECTION F–F
N.T.S.

NOTE:
CONTRACTOR TO ENSURE ALL ASH IS REMOVED FROM THE POND AREA PRIOR TO INSTALLATION OF IMPROVEMENTS. STRUCTURAL FILL SHALL BE USED TO BRING SUBGRADE UP TO CORRECT ELEVATION PRIOR TO INSTALLATION OF POND COVER.



SECTION G–G
N.T.S.

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 7

REVISION	DATE
0	11/21/18

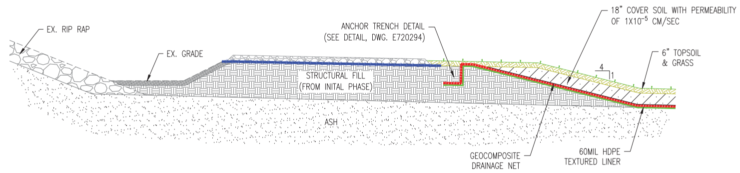
ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

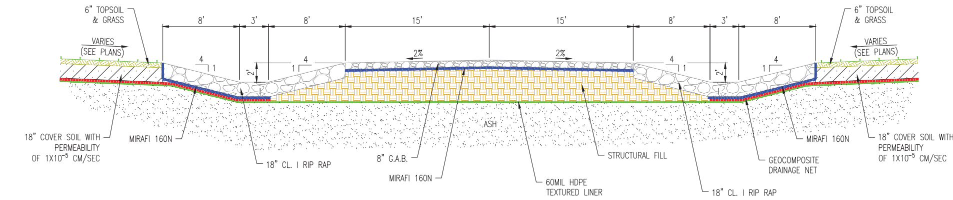
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JMH	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
NONE	E720298	1	FINAL	0

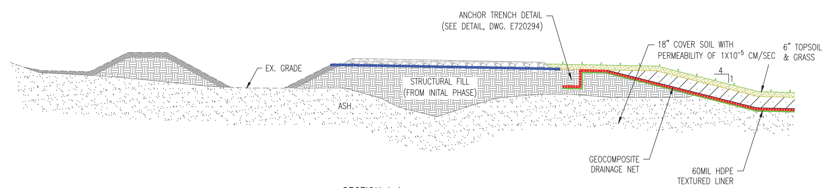
ANSI E: 44x34



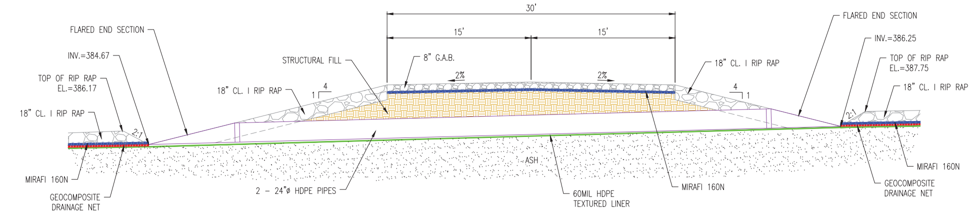
SECTION H-H
N.T.S.



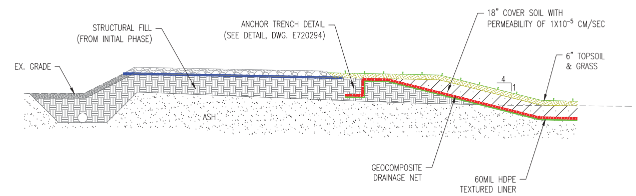
SECTION M-M
N.T.S.



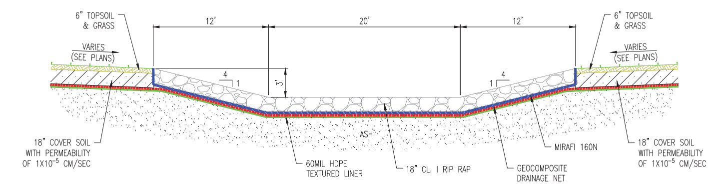
SECTION I-I
N.T.S.



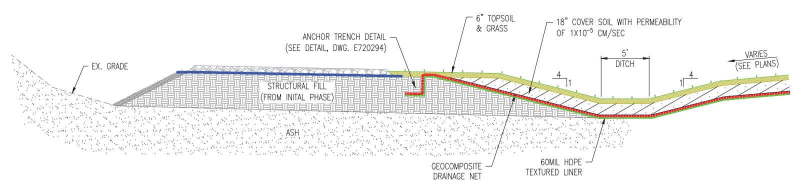
SECTION N-N
N.T.S.



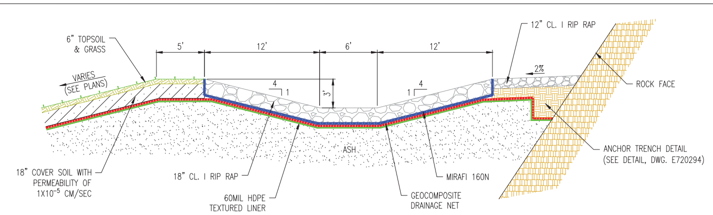
SECTION J-J
N.T.S.



SECTION P-P
N.T.S.



SECTION K-K
N.T.S.



SECTION L-L
N.T.S.

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation Engineering and Construction Services FOR

Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 8

REVISION	DATE	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
0 – ISSUED FOR CONSTRUCTION	11/21/18	JMH	CRU	JKB	XXX	XXX	MPB	JCP

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
NONE	E720299	1	FINAL	0

ANSI E: 44x34

APPENDIX 4
GROUNDWATER MONITORING PLAN

Alabama Power

Dustin G. Brooks
Environmental Affairs Supervisor
Environmental Compliance

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March 8, 2021

Received: 3/8/21

Via email to SSS@adem.alabama.gov

Mr. S. Scott Story, Chief
Solid Waste Branch
Land Division
Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2400

Re: ADEM Letter of January 20, 2021
Response to Groundwater Monitoring Plans Submitted to the Department
William C. Gorgas Electric Generating Plant

Dear Mr. Story:

The following provides responses to comments received in a letter from the Alabama Department of Environmental Management (ADEM) Land Division dated January 20, 2021. The letter pertains to the revised groundwater monitoring plans (GWMPs) submitted to the Department on August 24, 2020, for the (1) Ash Pond, (2) Bottom Ash Landfill, (3) CCR and Gypsum Landfill, and (4) Gypsum Pond at the Alabama Power Company (APC) William C. Gorgas Electric Generating Plant. The following presents the full text of the comments provided by ADEM in italics followed by our response indented in plain text.

As discussed in telephone call with ADEM on February 22, 2021, in lieu of providing responses in a revised GWMP as requested in the Department's letter, many of the responses are provided as a *Supplemental Site Hydrogeologic Characterization Report*, attached to this letter. A revised GWMP will be submitted to the Department under separate cover no later than March 15, 2021.

General Comments:

A table of all historical ground water, pore water, and surface water data is needed to aid in the review of statistical background. In addition to the GWMP a historical groundwater data table should be included in all groundwater monitoring reports.

> The GWMP will be amended to identify this information as an item that will be included in semi-annual Groundwater Monitoring Reports (GWMR). Currently, historical

groundwater quality data is tabulated and included in routine GWMRs and the requested historical data table will be included in all subsequent groundwater monitoring reports.

Plant Gorgas Ash Pond:

1. *The GWMP describes a process for using intrawell analysis. Because no compliance monitoring wells were installed prior to the placement of waste at the facility, it does not appear that intrawell analysis will accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit required by ADEM Admin. Code r. 335-13-15-.06 (2)(a)1. It is recommended that intrawell analysis procedures be removed from the GWMP and SAP.*

   Section 8 of the GWMP and Section 5 of the site-specific statistical analysis plan (SAP) provide details regarding statistical methods used during detection and assessment monitoring. These sections explicitly describe the interwell approach used at the site and the rationale for the approach. Intrawell methods are not mentioned in the GWMP and are only mentioned in the SAP for 2 reasons: (1) to describe the other statistical approach provided for in the CCR rules and USEPA guidance as a means of supporting the interwell statistical method selected for use at the site, and (2) to outline when it may be appropriate to propose for the use of intrawell methods at the site due to a change in site conditions. Both the GWMP and the SAP note that any change to the statistical method requires Department approval.

2. *Figure 7 indicates that monitoring wells GS-AP-MW-5, GS-AP-MW-9, GS-AP-MW-10, GS-AP- MW-11, GS-AP-MW-13, and GS-AP-MW-14 have been abandoned. Section 4.3 of the GWMP indicates that a plan for replacing downgradient monitoring wells GS-AP-MW-9, GS-AP-MW-11, and GS-AP-MW-14 will be submitted to the department in the future. Section 4.3 lists GS-AP-MW-13 as a downgradient location. Please clarify the designation of monitoring well GS-AP-MW-13. The replacement of monitoring wells GS-AP-MW-5 and GS-AP-MW-10, and GS-AP-MW-13 should be addressed. The GWMP should specify that an adequate set of replacement wells will be installed to monitor the site.*

   GS-AP-MW-13 was abandoned in July 2019 as shown on Figure 7. It was erroneously listed in Section 4.3 as a downgradient location when in fact it is an upgradient background well as identified on Table 2 of the GWMP and in the SAP. Although the well was abandoned, the data from the well remains in the database for statistical analysis.

As requested by the Department, the figures and tables of the GWMP will identify current and planned wells so the monitoring network is sufficiently described for permitting purposes. The figures and tables in the GWMP will be updated to clearly identify (1) existing upgradient and downgradient locations, (2) anticipated additional or replacement wells, (3) current and anticipated well abandonments, and (4) a general description of the timing of future proposed well installation and removal sequencing.

3. *It appears that monitoring wells should be installed to monitor the (deep) Pratt Aquifer downgradient of the waste management unit between GS-AP-MW-15 and GS-AP-MW-25H in topographic low areas of the drainage feature depicted west of the site on Figure 6A.*

As requested by the Department, the figures and tables of the GWMP will be updated to identify current and planned wells so the monitoring network is sufficiently described for permitting purposes. Since submission of the GWMP to the Department, additional wells have been installed within the (deep) Pratt Aquifer. As presented on Figure 5 in the *2020 Annual Groundwater Monitoring and Corrective Action Report*, dated January 31, 2021, wells GS-AP-MW-37H and GS-AP-MW-39H were installed as part of delineation efforts at the site. However, as often occurs in the Pratt Aquifer, significant groundwater-bearing zones were not encountered, and the wells yielded insufficient groundwater for sampling. Also shown on Figure 5 are the locations of 4 wells that were abandoned pursuant to Department approval to facilitate pond closure work. These 4 wells are to be reinstalled when construction permits. A workplan and proposed replacement locations will be submitted to the Department by March 31, 2021. Well GS-AP-MW-12 remains in that area and is sampled semi-annually. Arsenic concentrations have steadily decreased in well GS-AP-MW-12 from 0.11 milligram per liter in August 2016 (mg/L) to 0.00616 mg/L during the most recent sampling event in September 2020. Concentrations have been below the GWPS during the last two sampling events. This steady decrease from the initial sampling event fits the description of chemical equilibrium restoring after the initial disturbance generated from the boring and well installation process.

4. *The screened interval for proposed background monitoring well GS-AP-MW-8 is located from 370.02 to 390.02 feet MSL. The screened interval for proposed background well GS-AP-MW-13 is located from 350.63 to 370.63 feet MSL. The elevation of the ash pond appears to be approximately 380 feet MSL. It appears that there may be potential for impacts to proposed background monitoring wells GS-AP-MW-8 and GS-AP-MW-13 from the waste management unit because a portion of the screened interval/the screened interval of these wells were installed*

below the elevation of the ash pond unit. It is recommended that the GWMP justify that these wells will produce background that meets the requirement s of ADEM Admin Code R. 335-13-15-.06(2)(a)1.

Section 4.2.1 of the GWMP describes the rationale for including wells GS-AP-MW-8 and GS-AP-MW-13 as upgradient wells. Although the well screens for these wells are lower than the ash pond, groundwater elevations within these wells are typically at least 7 feet greater than the pond elevation, resulting in a hydraulic gradient toward the ash pond. The geology and hydrogeology at the site are complex; however, the hydraulic pressure within different stratigraphic zones and surface water will govern water flow potential. Despite stratigraphic complexity, groundwater will migrate from zones of higher pressure (higher elevation) to those of lower pressure (elevation). Therefore, we are confident that that wells GS-AP-MW-8 and GS-AP-MW-13 represent background water quality that is present at a greater pressure and migrates toward the former ash pond, which occurs at a lower pressure potential. We note that well GS-AP-MW-13 has been abandoned and will be reinstalled when feasible in the near future. This replacement will be addressed in the forthcoming revised GWMP.

5. *Two cross sections are included as Figures 5A and 5B to characterize the site. Additional detailed geologic cross sections across the Northern and Eastern portions of the site are requested to be included as part of the pending assessment of corrective measures plan to thoroughly characterize site conditions.*

The requested cross sections are included in the attached *Supplemental Site Hydrogeologic Characterization Report*. In addition, these cross sections presenting site stratigraphy and groundwater quality data were provided in the report titled *Semi-Annual Progress and Groundwater Delineation Report*, dated September 30, 2020. Figure 4D in the report presents a cross section along the eastern portion of the site. Figures 4F and 4H provide additional geologic interpretations along the northern and north-central parts of the site, respectively. Slight variability in groundwater quality is expected between monitoring events. These cross sections depicting groundwater quality data will be updated in subsequent semi-annual reports if groundwater quality changes and substantively alters interpretations of delineation.

6. *The faults depicted on figures 5A and 5b should be indicated on Figure 4.*

A revised figure including the faults is included in the attached *Supplemental Site Hydrogeologic Characterization Report*. Fault locations are included on Figures 3a and 3b of this report.

7. *It is recommended that Table 1 in the GWMP, Groundwater Monitoring Well Network Details and Table 1 in the SAP, Groundwater Monitoring Well Network Details identify the same monitoring well network. It is recommended that the GWMP clearly note the designation of monitoring well GS-AP-MW-l7V.*

   The figures and tables of the GWMP will be updated to identify current and planned wells so the monitoring network is sufficiently described for permitting purposes. Well GS-AP-MW- l7V was originally installed as a vertical delineation well, but groundwater elevations at GS-AP-MW-17V indicate that this location is upgradient of the ash pond. Data from the well is being evaluated for a period to support a recommendation regarding inclusion of the well in the compliance monitoring network. The GWMP and SAP will be updated to assure that tables identifying the groundwater monitoring network details are consistent and the designation of well GS-AP-MW- l7V clearly identified.

<u>Plant Gorgas Bottom Ash Landfill:</u>

1. *The GWMP describes a process for using intrawell analysis. Because no compliance monitoring wells were installed prior to the placement of waste at the facility, it does not appear that intrawell analysis will accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit required by ADEM Admin. Code r. 335-13-15-.06 (2)(a)1. It is recommended that intrawell analysis procedures be removed from the GWMP and SAP.*

   Section 8 of the GWMP and Section 5 of the SAP provide details regarding statistical methods used during detection and assessment monitoring. These sections explicitly describe the interwell approach used at the site and the rationale for the approach. Intrawell methods are not mentioned in the GWMP and are only mentioned in the SAP for 2 reasons: (1) to describe the other statistical approach provided for in the CCR rules and USEPA guidance as a means of supporting the interwell statistical method selected for use at the site, and (2) to outline when it may be appropriate to propose for the use of intrawell methods at the site due to a change in site conditions. Both the GWMP and SAP note that any change to the statistical method requires Department approval.

2. *Monitoring wells MW-10, MW-11, and MW-12 appear to be located approximately 400 feet downgradient of the waste unit boundary. ADEM Admin. Code r. 335-13-15-(2)(a)2 requires that the downgradient monitoring system be installed at the waste boundary that ensures detection of groundwater contamination in the*

uppermost aquifer. It is recommended that justification for the locations of these site wells be included in the GWMP.

These wells were installed downgradient of the Bottom Ash Landfill in 2012 and 2014 prior to publication of the CCR rule and in accordance with ADEM Admin. Code r. 335-13-4-.27(2)(a)3 identifying the compliance boundary as no more than 150 meters (492 feet) of the waste boundary. The hydrogeology at the site is complex and groundwater producing zones are often unable to be located: several wells have been installed at the site that cannot be used for groundwater monitoring because of insufficient yield and recharge. These wells have been installed at locations that yield sufficient water for sampling and have a substantial background data set for statistical analysis. Attempts to install additional wells may not be successful and will forfeit the use of data trends established in the current monitoring wells. In addition, these wells are located at least 1,500 feet from the downgradient property boundary, providing sufficient room for future delineation if necessary. Therefore, these wells were installed in accordance with Department regulations at the time, are representative of groundwater migrating from the Bottom Ash Landfill area that will detect impacts, and have substantial buffer from the downgradient property line should exceedances require further investigation.

<u>Plant Gorgas CCR and Gypsum Landfill:</u>

1. *Monitoring wells MW-6, MW-7, and MW- 17R appear to be located approximately 400 feet downgradient of respective waste unit boundaries. ADEM Admin. Code r. 335-13-15-(2)(a)2 requires that the downgradient monitoring system be installed at the waste boundary that ensures detection of groundwater contamination in the uppermost aquifer. It is recommended that justification for the locations of these site wells be included in the GWMP.*

   Due to the steep downward slopes at the site and construction activities, wells MW-6 and MW-7 were installed as close as practical to the CCR Landfill. In addition, they were installed in 2014 prior to publication of the CCR rule and at Department-approved locations. Since construction has been completed, it may be feasible to install a replacement well closer to the unit between wells MW-5 and MW-7. The GWMP will be updated to reflect the proposed addition but will account for the possibility that a replacement location may provide insufficient water for monitoring.

   Well MW-17 was originally located near the Gypsum Landfill waste boundary; however, the well yielded insufficient water for monitoring. Replacement well MW-17R was installed at the present location and it yields sufficient water for sampling.

Plant Gorgas Gypsum Pond:

1. *The background monitoring wells proposed for the Gorgas Gypsum pond are the same background monitoring wells proposed for the CCR landfill. Tables 1 and 2 in the GWMP and Table 1 in the SAP should note that proposed background monitoring wells MW-1 through MW-4 are located at the CCR landfill site because wells with the same names were installed at the Plant Gorgas Gypsum Pond.*

   The background monitoring wells proposed for the Gorgas Gypsum Pond are the same background monitoring wells that are proposed for the CCR Landfill. The report titled *Semi-Annual Progress and Groundwater Delineation Report*, dated September 30, 2020, includes all current well designations for the Gorgas Gypsum Pond. Tables 1 and 2 in the revised GWMP and Table 1 in the revised SAP will include a note clarifying that the background wells for the Gypsum Pond are the same as those for the CCR Landfill.

2. *One cross section is included as Figure 5 to characterize the site. Additional detailed geologic cross sections across the Southern and Eastern portions of the site are requested to be included to thoroughly characterize site conditions.*

   Additional cross sections are included in the attached *Supplemental Site Hydrogeologic Characterization Report*. In addition, these 5 cross sections presenting site stratigraphy and groundwater quality data were provided in the report titled *Semi-Annual Progress and Groundwater Delineation Report*, dated September 30, 2020. Reliable geologic data is not available on the east side of the site because boreholes conducted in that area for wells were dry and thus, not surveyed. Therefore, a geologic profile was not produced for that area.

We appreciate the opportunity to provide these clarifications. I will be pleased to discuss these items if that is helpful to you. If you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,

Dustin Brooks

Dustin G. Brooks
Environmental Affairs Supervisor

Cc: Eric Wallis – Southern Company Services

Attachment

Alabama Power

Dustin G. Brooks
Environmental Affairs Supervisor
Environmental Compliance

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August 24, 2020

Received: 8/24/20

Via email to sss@adem.alabama.gov

Mr. S. Scott Story, Chief
Solid Waste Branch
Land Division
Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2400

Re: Response to ADEM Letter of August 14, 2020 -- Groundwater Monitoring Plan Comments

Dear Mr. Story:

The following provides responses to comments received in a letter received from the Alabama Department of Environmental Management (ADEM or Department) Land Division dated August 14, 2020. The following presents the full text of the letter provided by ADEM followed by our response in italics.

General Comments

1) Additional information is requested to be included as part of the pending Assessment of Corrective Measures Plan to thoroughly characterize site conditions. The information should include the following:
   a) Additional historical potentiometric figures. This is requested to aid in the assessment of the groundwater flow at the site.
   b) Additional detailed geologic cross sections. Cross sections aid the hydrogeologic interpretation of groundwater flow direction and are crucial for assessing the monitoring well network.
   c) A table of all historical groundwater, pore water, and surface water data is needed to aid in the review of statistical background. In addition to the GWMP, a historical groundwater data table should be included in all groundwater monitoring repo1ts.
   d) Please provide the data associated with the advanced geophysical methods that were used for the Plant Gaston Ash Pond Monitoring Wells.

This information will be provided for each plant in the subsequent Delineation Reports to be submitted to the Department on or before September 30, 2020.

2) Section 4.5 of the Groundwater Monitoring Plan (GWMP) states "If an upgradient well is abandoned due to pond closure activities or by an unforeseen circumstance, the historical data from that well will remain in the upgradient data pool and, therefore, the well remains part of the upgradient network by legacy." Data from a background well that is abandoned may remain relevant for use as statistical background. However, it is recommended that background data for each background well proposed for abandonment be evaluated and included in statistical background upon Department approval prior to submiss ion of the monitoring well abandonment plan.

This has been addressed by modifications to Section 2.2.2 of the SAP and Section 4.5 of the monitoring plans consistent with this request. Background data for each upgradient well proposed for abandonment (or otherwise removed from the background network) will be statistically evaluated with respect to the background data pool. Based on the evaluation, a proposal will be submitted to the Department for approval detailing the evaluation of the data and proposing the continued use (or disuse) of the data in the background data set. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

3) Section 2.2.2 of the Statistical Analysis Plan (SAP) should clearly specify how background will be evaluated, and eliminated or included. lt is recommended that Section 2.2.2 of the SAP indicate that modifications to background will occur with Department approval.

This has been addressed by modifications to Section 2.2.2 of the SAP. Language has been added to Sections 1.0, 2.0, and 2.2 that clearly state that any changes to the statistical analysis plan (including background wells and the background data set) require Department approval. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

4) Section 6.3 of the GWMP states that the analytical "method used will be able to reach a suitable practical quantification limit to detect natural background conditions at the facility." It is recommended that the GWMP be revised to reflect the requirements of ADEM Admin. Code r. 335-13-15-.06(4)(g)5.

Section 6.3 of the GWMPs have been modified consistent with this request using language consistent with ADEM Admin. Code r. 335-13-15-.06(4)(g)5. The plans clearly state "that any practical quantitation limit that is used will be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility." See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

5) The GWMPs for Plant Barry, Plant Gadsden, Plant Greene, and Plant Miller describe a process for using intrawell analysis. Because no compliance monitoring wells were installed prior to the placement of waste at the facility, it does not appear that intrawell analysis will accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit as require d by ADEM Admin. code r. 335-13-15-.06(2)(a)1. Intrawell analysis procedures should be removed from all Ash Pond GWMPs and SAPs. Intrawell analysis may be justifiable for the lined Barry Gypsum and Gaston Gypsum ponds.

Intrawell analysis has been used on a very limited basis for select few parameters during detection monitoring. Each of these sites is in assessment monitoring and proceeding with groundwater remedy selection. Nonetheless, intrawell statistical analysis of Appendix III detection constituents will be discontinued. Section 8.1 of the GWMPs for Plant Barry, Plant Gadsden, Plant Greene, and Plant Miller have been amended to remove the option of intrawell statistical analysis for Appendix III detection monitoring constituents. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

6) The proposed use of tolerance intervals to set Groundwater Protection Standard s (GWPSs) using pooled data from multiple wells screened in different hydrostratigraphic positions, without explicit checks for spatial variation, does not comply with requirements listed in Section 17.2 .1 of the March 2009 Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance (Unified Guidance) to set adequate tolerance limits. It is recommended that the GWMP comply with recommendations stated in the Unified Guidance.

Section 5.2 of the SAP has been modified to address this request. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

7) Sections 7.5 and 21.0 of the Unified Guidance present GWPS testing as an either/or decision using either a multi-sample approach (using detection monitoring tests listed in Part III of the Unified Guidance), or a single-sample approach (using assessment and corrective action tests listed in Part IV of the Unified Guidance). The GWMP includes a combined approach using both tolerance limits to set an elevated GWPS and confidence intervals that require the entire interval to exceed the GWPS before corrective action is indicated. Section 7.5 and Example 7-1 of the Unified Guidance couch multi-sample tests to provide a reasonable GWPS for concentrations of constituents that "are occasionally found at uncontaminated background well concentrations exceeding the irrespective MCLs. The regulations then provide that a GWPS based on background levels is appropriate. "It appears that the multi- sample approach should only be applied to constituents with observed concentrations that

occasionally exceed relative MCLs and health-based standards in uncontaminated background rather than applied universally to all Appendix IV constituents.

Section 5.2 of the SAP has been modified to address this request. Additional documentation provided by Dr. Kirk Cameron, primary author of the Unified Guidance, explains the intended use of interwell tolerance limits (a detection monitoring test) when applied to Assessment Monitoring programs to establish an alternate GWPS when concentrations upgradient naturally exceed MCLs. The documentation supports the use of parametric and nonparametric tolerance limits (depending on the distribution of a given constituent) using pooled upgradient well data regardless of the presence of spatial variation. The resulting statistical limit establishes the threshold of all anticipated unimpacted average concentrations at downgradient wells when compared to a GWPS through the use of confidence intervals. Parametric tolerance limits will be used with Department approval when data sets follow a normal distribution. In the event that a data transformation or high degree of variability establishes a background limit that is less than conservative from a regulatory perspective, a nonparametric tolerance limit will be constructed. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

8) Section 4.1 of the SAP indicates that parametric confidence intervals will be constructed at the 99% confidence level, which is the highest confidence level in the guidance. Because statistical confidence is not the same as power, Section 7.4.1 of " the Unified Guidance recommends reversing the usual sequence: first select the desired level of power for the test, (I-B), and then compute the associated (maximum) false positive rate (a). In this way a pre-specified power can be maintained even if the sample size is too low to simultaneously minimize the risks of both Type I and Type II errors (i.e., false positives and false negatives)." Section 7.4.1 of the Unified Guidance indicates "statistical confidence is not the same as power. The confidence level merely indicates how often - in repeated applications - the population will contain the true population parameter (0); not how often the test will indicate an exceedance of a fixed standard. "It appears that parametric confidence intervals should be constructed at a confidence level based on power to minimize the risk of missing contamination above the GWPS. Justification for the use of confidence intervals set at the 99% confidence level should include calculations demonstrating that the true population coefficient of variation is no greater than 0.5.

Section 4.1 of the SAP has been modified to address this request. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

9) Section 4.2 of the SAP states that "In Corrective Action, a well/parameter pair is declared to no longer be an SSI over the GWPS when the entire interval falls below a specified limit (i.e., the Upper Confidence Limit [UCL] falls below the limit), or when the LCL of the Append ix IV parameters does not exceed the GWPS for a period of three consecutive years." Section 7.5 of the Unified Guidance indicates that the proposed combined single-sample and multi-sample approach "based on both background sample size and sample variability is recommended for identifying the background GWPS at a suitably high enough level above current background to allow for reversal of the test hypotheses. ... a GWPS based on this method allows for a variety of confidence interval tests (e.g., a one-way normal mean confidence interval identified in [7.3] and [7.4])." The statistical methods referenced in ADEM Adm in. code r. 335-13- l 5-.06(9)(d)2 are applicable to detection monitoring tests referenced in ADEM Adm in. code r. 335-13- 15-.06(4)(f) and (g). Confidence intervals require justification for use under ADEM Admin. code r. 335- 13-15-.06(4)(f)5. Hypothesis test structures using confidence intervals should be consistent with equations [7.1] and [7.2] of the Unified Guidance when us in g the proposed method. It is recommended that the portion of the GWMP stating "or when the LCL of the Appendix IV parameters does not exceed the GWPS for a period of three consecutive years." be removed.

Section 4.2 of the SAP has been modified to address this request by striking the phrase "or when the LCL of the Appendix IV parameters does not exceed the GWPS for a period of three consecutive years." The removed language does not appear in the GWMPs. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

10) The term "statistical limit " appears to be used twice in Section 5.2 of the SAP to describe the GWPS in assessment monitoring comparisons described in ADEM Admin. Code r. 335-13-15-.06(e), (f), and (g). It is recommended that the terminology used in the SAP be consistent with terminology used in Solid Waste regulations.

We presume that the intended reference in this comment was to ADEM Admin. Code r. 335-13-15-.06<u>(6)</u>(e), (f), and (g). *Section 5.2 of the SAP has been modified to address this request by using terminology consistent with Solid Waste regulations (i.e. groundwater protection standard or GWPS). See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.*

Individual CCR Unit Comments

Plant Barry Ash Pond

1) Table 2 provides a comparison of constituents between background and downgradient wells to demonstrate that proposed background wells are not impacted. Boron is listed as ND, however time series graphs included in the background update indicate that there are detections (not J values for boron) in proposed background monitoring wells at the Plant Barry Ash Pond. The footnote indicates that the detection was below the MDL, and thus considered ND. However, Table 3 shows the RL for boron as 0.05 mg/L, the detections are at minimum greater than 0.1 mg/L. Time series graphs are not included for other key indicator parameters (time series graphs were not constructed for this purpose, but they provide the only reference to historical data in the GWMP). It is recommended that the GWMP be revise d to accurately represent monitoring data.

Table 2 has been updated to use average boron concentrations, using ½ the reporting limit where not detected. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

Plant Barry Gypsum Pond

1) Table 2 provides a comparison of constituents between background and downgradient wells to demonstrate that proposed background wells are not impacted. Boron is listed as ND, however time series graphs included in the background update indicate that there are detections (not J values for boron) in proposed background monitoring wells at the Plant Barry Gypsum Pond. The footnote indicates that the detection was below the MDL, and thus considered ND. However, Table 3 shows the RL for boron as 0.05 mg/L, the detections are at minimum greater than 0.1 mg/L. Time series graphs are not included for other key indicator parameters (time series graphs were not constructed for this purpose, but they provide the only reference to historical data in the GWMP). It is recommended that the GWMP be revise d to accurately represent monitoring data.

Table 2 has been updated to use average boron concentrations, using ½ the reporting limit where not detected. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

Plant Gadsden Ash Pond

1) The Table of contents in the SAP indicates that Appendix A is "Background Screening and Compliance Evaluation" however no such document is attached, as was provided for the other CCR units. Please provide this in formation.

Appendix A was inadvertently omitted from the SAP and is now included. See the Revised Statistical Analysis Plans and the updated Groundwater Monitoring Plans submitted to the Department on August 24, 2020.

Plant Miller Ash Pond

1) Section 5 .2 of the GWMP states that " Screen length will not exceed 10 feet without justification as to why a longer screen is necessary (e.g. significant variation in groundwater level)." Table 1 indicates that monitoring wells GS-AP-MW-8, GS-AP-MW-13, GS-AP-MW- 17V, MR-AP-MW- 19 HA, MR-AP-M W-28H, MR-AP-MW-30H, MR-AP-MW-31H, MR-AP-MW-33H, MR-AP- MW -36 H, and MR-AP-MW-2V were installed with 20 feet of well screen. It is recommended that the GWMP include information to explain the reason these wells were installed with longer screens.

Section 5.2 of the GWMPs for Plants Miller and Gorgas have been modified to explain the reasoning for installing certain wells with screen lengths greater than 10 feet. As previously discussed with the Department, because of the nature of the geology at Plants Miller and Gorgas locating water-bearing fractures and zones is difficult, as evidenced by numerous dry holes drilled at the site. Additional well screen length is often necessary at fractured rock sites such as Plant Miller and Gorgas: groundwater yield is so low that wells are not able to be developed or sampled using conventional methods. The additional footage of well screen assists well development and sampling by providing a greater volume of groundwater and can provide more fracture and groundwater flow zone intersection. See the updated Groundwater Monitoring Plan submitted to the Department on August 24, 2020.

2) Monitoring wells MR-AP-MW-21 and MR-AP-MW-23 are screened 95 feet in elevation apart. Groundwater elevations appear to indicate that these wells are screened in an unconfined aquifer. Additional information should be provided to identify the geology at MR-AP-MW-23 and provide rationale for installing the well screens such a distance apart. Figure 6C should identify the aquifer in which these wells are screened.

A revised Figure 6C including the requested information has been included in the updated Groundwater Monitoring Plan submitted to the Department on August 21, 2020. Additional geologic information will be submitted in the upcoming Plant Miller groundwater delineation report due on or before September 30th, 2020.

At Plant Miller compliance wells vary in depth from approximately 40 feet below ground surface (ft BGS) to 291 ft BGS and are screened across multiple discrete flow zones. This variability in well screen depth and flow zone(s) can lead to natural variability in groundwater quality. These proposed upgradient locations were chosen based upon similar position on the Sequatchie Anticline and APC land ownership. These locations sit on the opposite limb of the Sequatchie Anticline, but at similar elevation, structural, and stratigraphic setting. Staggered depth *intervals are an attempt to capture depth dependent variation in groundwater quality which can differ based upon age of groundwater and groundwater-rock interactions along heterogenous Pottsville Strata.*

3) The boring log for monitoring well MR-AP-MW-21 indicates that at 175 feet BGS the "Driller lost all water circulation at the beginning of Run 19 and never got it back. Mud tub drained out." It appears that the drilling fluid may have been los t down the borehole. Please clarify what occurred during the installation of proposed background monitoring well MR-AP-MW-21.

As evidenced by the caliper log provided in the GWMP, the bore intersected a fracture between 174.5 ft BGS and 175.3 ft BGS. The loss of water circulation occurred across this interval indicating relatively high permeability and ability for the fracture to take drilling water. The use of the description "Mud tub" was not meant to imply that drilling mud was utilized in the boring advancement process. Sonic drilling relies on water as drilling lubricant and only water was utilized at this location. Groundwater quality samples collected from this location do not exhibit unusual physical appearance or a geochemical signature indicating drilling-induced bias.

4) The monitoring well installation process described in Section 5.2 of the GWMP does not adequately describe the process indicated on provided boring logs. In many cases monitoring wells constructed at the site were installed after boring hundreds of feet to bedrock, conducting geophysical methods on the borehole, and abandoning the boring below the interval selected for monitoring with bentonite chips. The process of inserting bentonite chips into the borehole requires a specific process to ensure that bridging does not occur, resulting in an inadequate seal. It is recommended that the process used to install monitoring wells above abandoned bore holes be thoroughly described in the GWMP.

Section 5.2 of the revised GWMP has been updated to include the requested information, including the use of bentonite and the process used to install monitoring wells over abandoned boreholes. See the updated Groundwater Monitoring Plan submitted to the Department on August 24, 2020.

5) The elevation of the screened interval for monito ring well MR-AP-PZ-5 is incorrectly listed in Table 1. It is recommended that the table be corrected.

Table 1 has been corrected and included in the updated Groundwater Monitoring Plan submitted to the Department on August 24, 2020.

We appreciate the opportunity to provide these clarifications. I will be pleased to discuss these items if that is helpful to you. If you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,

Dustin Brooks

Dustin G. Brooks
Environmental Affairs Supervisor

cc: Eric Wallis – Southern Company Services

PLANT GORGAS BOTTOM ASH LANDFILL GROUNDWATER MONITORING PLAN

Revised August 21, 2020

PREPARED FOR:

Southern Company Services
Earth Sciences and Environmental Engineering

REVISED GROUNDWATER MONITORING PLAN

ALABAMA POWER COMPANY - PLANT GORGAS

This *Revised Groundwater Monitoring Plan, Alabama Power Company - Plant Gorgas Bottom Ash Landfill*, has been prepared to document that the Site groundwater monitoring network and monitoring plan meets the requirements described by ADEM Admin Code r. 335-13-15-.06(2). It has been completed under the supervision of a licensed Professional Geologist with Southern Company Services.

Report Prepared by:

Greg Budd
Gregory F. Budd, P.G.
Alabama Professional Geologist No. 1455

8/21/2020
Date

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1. INTRODUCTION

The Gorgas Bottom Ash Landfill Groundwater Monitoring Plan (GMP or plan) has been updated to include additional information regarding the hydrogeological evaluation for the site, the background groundwater monitoring network, procedures for updating the background data set, and statistical methods used to evaluate groundwater quality data.

Groundwater monitoring at the Plant Gorgas Bottom Ash Landfill 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. This GMP meets the requirements set forth for groundwater monitoring networks as described by ADEM Admin. Code r. 335-13-15-.06(2). The plan describes the groundwater monitoring program for the site, including the following key components: description of subsurface hydrogeology and uppermost aquifer, monitoring well network design, sampling and analyses program, and statistical analyses program.

Groundwater monitoring has occurred since 2016 in accordance with the United States Environmental Protection Agency (EPA) coal combustion residual (CCR) rule (40 CFR Part 257, Subpart D) and the State of Alabama's CCR Regulations (ADEM Admin. Code Ch. 335-13-15) and results reported to ADEM. Upon initiating detection groundwater monitoring at the site in 2017 statistically significant increases (SSIs) of Appendix III monitoring parameters were detected above background levels. Pursuant to State and Federal regulations assessment monitoring was implemented. During assessment monitoring, one or more Appendix IV monitoring parameter was detected at statistically significant levels (SSLs) above groundwater protection standards (GWPS). Consequently, Assessment of Corrective Measures (ACM) was prepared and submitted to ADEM in February 2020.

The purpose of this plan is to present the groundwater monitoring network, field and lab procedures, and site-specific statistical analysis plan for Departmental review and approval. This plan also provides procedures for managing changes to the monitoring network, background, and statistical analyses.

2. SITE LOCATION AND DESCRIPTION

Alabama Power Company's Plant Gorgas is located in southeastern Walker County, Alabama, approximately fifteen miles south of Jasper, at 460 Gorgas Road, Parrish, Alabama 35580. Plant Gorgas lies in portions of Sections 7, 8, 9, 16, 17, 18, 19, 20, 21, 28, and 29, Township 16 South, Range 6 West and Section 12, 13, and 24, Township 16 South, Range 7 West. Section/Township/Range data are based on visual inspection of USGS topographic quadrangle maps and GIS maps (USGS, 1975; USGS, 1983).

The Plant Gorgas Bottom Ash Landfill is located east and northeast of the main power generation facility and is bordered to the north by Highway 269 and to the south by the Mulberry Fork of the Black Warrior River. **Figure 1, Site Location Map**, depicts the location of the site referenced to roadways and geographic features. **Figure 2, Site Plan Map**, depicts the general configuration of the CCR unit and the site monitoring well network referenced to local topography. **Figure 3, Site Topographic Map**, depicts the topography of the site.

3. GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Plant Gorgas lies in the Warrior Basin physiographic region (Sapp and Emplaincourt, 1975), a late Paleozoic basin formed as a result of flexure and sediment loading associated with Appalachian and Ouachita orogenies. The bedrock geology is dominated by clastic sedimentary rocks of the Lower Pottsville Formation (GSA, 2010b). Deeper stratigraphy is marked by carbonates, shales, chert, and sandstones of Mississippian to Cambrian in age (Raymond et al., 1988). Plant Gorgas is directly underlain by rocks belonging to the Pratt Coal Group (Ward II et al., 1989). In general, the Pratt Group consists of mudstone, shale, fine-grained sandstone, and interbedded coal. **Figure 4, Site Geologic Map**, illustrates the surface geology at the site and neighboring areas.

Strip mining was conducted over a large portion of the area down to the American Seam. As a result, the overburden beneath the CCR units is dominated by backfilled mine overburden and is characterized by weathered shale and sandstone boulders with lenses of fine sediments and small amounts of coal fragments and coarse sediments. Geologic logs generated during various on-site investigations indicate that the depth to rock varies significantly, ranging from as little as five feet (un-mined areas) to as much as 155 feet below ground surface (BGS). **Figure 5a & 5b, Geologic Cross-Sections A-A' and B-B'** illustrate the geologic layering beneath the site. These figures essentially show two major layers – (1) mine spoil backfill material and (2) the Pottsville Formation (Pratt Group). Borehole geophysical logs, boring logs, and well construction data is presented in **Appendix A, Boring and Well Construction Logs.**

Two water-bearing zones are present beneath the site: (1) the mine overburden/top-of-rock interface, and (2) the underlying Pottsville Aquifer. The first saturated zone beneath the site generally corresponds to the mine overburden/top of rock interface zone at which the mine-spoil overburden transitions to bedrock (Pottsville Formation). The average depth of the first saturated zone beneath the site is approximately 107 feet (BGS). The depth of the first saturated zone is generally between 105 and 115 feet (BGS) near the Bottom Ash landfill with an average piezometric surface rising to 18 feet above the base of the screen.

The saturated thickness of the first saturated zone ranges between 3 and 8 feet. Hydraulic conductivity (K) in this zone varies widely, but is generally between 10^{-1} to 10^{-4} cm/sec. Well developments generally indicate low groundwater yields (quantity) between 0.05 and 1.0 gallons per minute (gpm).

The principal aquifer system from a local and regional perspective is the Pottsville Formation. The Pottsville Formation is also the uppermost aquifer beneath the site. In the Pottsville, two types of secondary porosity were observed to yield groundwater: (1) fractured intervals and (2) bedding plane weaknesses associated with fissile, siderite-banded, iron-claystone sequences. Fractured intervals are sporadic across the site and tend to occur with greater density in the upper 100 feet of rock. The upper portions of the Pottsville Aquifer beneath the proposed disposal facilities indicate unconfined to semi-confined, fractured, and extremely anisotropic conditions. The Pottsville Aquifer functions as a series of confined to semi-confined water producing zones (aquifers) since large permeability contrasts exist within the strata (Stricklin, 1989). Depth to groundwater varies significantly across the site and is wholly dependent upon encountering a fractured interval or zone of fissile, iron-claystone. Based on published data, groundwater quality produced from the Pottsville Formation can be characterized by high concentrations of sulfate, iron, and other trace metals (Jennings and Cook, 2010). Trace metals in Pottsville Formation groundwater are associated with sulfide minerals contained in organic-rich strata (e.g., Mudstones and Coal Seams) and siliceous/carbonate healed fractures and joints. Trace element enrichment is likely the result of migrating hydrothermal fluids generated during the late Paleozoic Allegheny orogeny (Diehl et al., 2005). Arsenic, antimony, molybdenum, selenium, copper, thallium, and mercury are elevated in Warrior Basin coal strata (Goldhaber et al., 2002).

The topography of the site creates a localized flow system where groundwater flow direction is south and south-southeast across the site, paralleling trends in topography, structural dip, and historic strip pit floors. Groundwater discharge in this local flow system is to the Mulberry Fork of the Warrior River. Mine spoil layering and complex Pottsville Formation lithofacies contribute to the vertical and horizontal heterogeneity present within the aquifer system and overlying saturated mine spoils. The potentiometric surface presented in **Figure 6, Potentiometric Surface Contour Map (October 7, 2019)**, indicate that groundwater flow direction is consistent despite seasonal fluctuations. This heterogeneity focuses groundwater flow along more permeable pathways, such as parallel to coal seams and bedding plains, or along vertical or sub-vertical discontinuities in the rock fabric. Thus, groundwater flow paths across the site may be tortuous.

4. SELECTION OF WELL LOCATIONS

According to ADEM Admin Code r. 335-13-15-.06(2)(a), the groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

1. Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit; and
2. Accurately represent the quality of groundwater passing the waste boundary of the CCR unit.

ADEM Admin Code r. 335-13-15-.06(2)(b) states that the number, spacing, and depths of groundwater monitoring system wells must be determined based upon site-specific technical information that must include a characterization of:

1. Aquifer thickness, groundwater flow rate, groundwater flow direction, including seasonal and temporal fluctuations in groundwater flow; and
2. Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

ADEM Admin Code r. 335-13-15-.06(2)(c) requires the groundwater monitoring system to include the number of monitoring wells necessary to meet the performance standard set forth in the rules. The monitoring system must contain a minimum of one upgradient and three downgradient monitoring wells but consist of additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

4.1 COMPLIANCE MONITORING NETWORK

Groundwater monitoring wells are installed to monitor the uppermost occurrence of groundwater beneath the site which accurately represent the quality of groundwater passing the waste boundary of the CCR unit. Locations are selected based on facility layout and site geologic and hydrogeologic considerations. The proposed groundwater monitoring network at the Plant Gorgas Bottom Ash Landfill is subdivided into background and compliance locations as based upon potentiometric contours and interpretations by a qualified groundwater scientist. Background wells represent the quality of background water that has not been or would not be affected by the CCR unit. Compliance wells are screened within the uppermost aquifer and are used to assess potential impacts to the first “aquifer” in the event of a release. Groundwater monitoring wells are designed and constructed using “Design and Installation of Groundwater Monitoring Wells in Aquifers”, ASTM Subcommittee D18.21 on Groundwater

Monitoring, as a guide. **Table 1, Groundwater Monitoring Well Network Details,** and **Figure 7, Monitoring Well Location Map**, present the designed purpose and locations of monitoring wells with respect to the facility. Groundwater monitoring wells are generally screened across the mine spoil overburden – top of rock interface as this corresponds to the first zone of saturation beneath the site. If groundwater saturation is not present, deeper Pottsville intervals will be targeted for well screens (e.g., MW-10).

4.2 BACKGROUND MONITORING WELLS

Background groundwater is the baseline quality of groundwater that is representative of the aquifer being monitored, and that has not been affected by CCR material. A background groundwater monitoring network has been identified at the Site 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). The following describes the selected background network based on these criteria.

To evaluate upgradient well locations at the Site, groundwater elevations and CCR indicator parameters were reviewed. As presented on **Table 1** and **Figure 7**, 4 monitoring wells (MW-1, MW-2, MW-3, and MW-4) located upgradient of the Bottom Ash Landfill serve as background monitoring wells.

The following subsections describe in detail the results of this upgradient well evaluation process.

4.2.1 Groundwater Elevations and Flow

Groundwater elevations and potentiometric surfaces constructed for the Site since 2012 as documented in groundwater monitoring reports demonstrate a consistent groundwater flow direction and establish areas hydraulically upgradient of the Bottom Ash Landfill. As shown on **Figure 6**, groundwater flow at the Site is towards the south with only a slight 3 to 5-degree bend towards the east. Groundwater flow direction is driven by gravity and closely mimics site topography which has a north to south slope toward the Mulberry Fork of the Black Warrior River. Potentiometric surface contours and groundwater flow direction demonstrate that wells located to the north of the Bottom Ash Landfill are hydraulically upgradient. Therefore, monitoring well locations MW-1, MW-2, MW-3, and MW-4 located approximately 1500 feet to the north of the Bottom Ash Landfill, are hydraulically upgradient of the Bottom Ash Landfill and would not be impacted by the Bottom Ash Landfill.

4.2.2 Groundwater Geochemistry

A comparison of the concentrations of key EPA Appendix III and Appendix IV indicator parameters can be particularly useful in determining if a well is impacted by the CCR unit. Pore-water concentrations, coal source data, and leachate data, when available, can identify these key indicator parameters and these themselves can be a useful point of comparison. For this discussion, average concentrations of key indicator parameters from upgradient well locations where compared to: (1) pore-water chemistry data and (2) downgradient wells. The results are presented in **Table 2, Upgradient Comparisons – Key Indicator Parameters**.

To summarize findings on Table 2, boron is a strong indicator of a CCR impact to groundwater. Concentrations in upgradient wells were significantly lower than pore water concentrations and lower than downgradient wells. Boron concentrations reviewed in upgradient wells are typically low-level trace detections or non-detects and therefore, not indicative of being impacted by the CCR unit. Downgradient wells detected boron at slightly higher concentrations. This supports the conclusion that the upgradient wells fairly represent background and have not been affected by CCR material.

Similarly, chloride is very low (<4 mg/L) in upgradient locations. These very low concentrations in-and-of-themselves indicate that groundwater has not likely been impacted by an outside source. Although still low, slightly higher concentrations are observed in downgradient wells. This further supports the conclusion that the upgradient wells fairly represent background and have not been affected by CCR material.

Finally, these comparisons also revealed comparable concentrations of sulfate and calcium in upgradient and downgradient wells. This is expected given the geology of the area and confirms that calcium and sulfate are naturally occurring and support the conclusion that the upgradient wells represent background.

<u>Comparison of Field Data</u>

Comparing field parameters can often be useful for evaluating potential upgradient locations. In upgradient locations, it is more likely to find higher dissolved oxygen (DO), positive oxidation-reduction potential (ORP), lower conductivity, and lower pH. This because upgradient locations are more likely to be screened across younger, recharging groundwater. Recharging water generally carries higher DO (closer connection/more recent interaction with atmosphere) and have lower pH values more like meteoric water which is slightly acidic due to interactions with carbon dioxide in the atmosphere. Lower conductivity is expected due to a shorter residence time and consequently, less time for groundwater-rock interaction which naturally contributes to higher total dissolved solids. Conversely, downgradient and impacted wells are more likely to show reducing conditions (low DO, more strongly negative ORP), higher pH values, and higher conductivity (indicates higher total dissolved solids). The Bottom Ash Landfill is underlain by mine spoils as described in **Section 3** and the high degree of heterogeneity may not fit this classic model as well as some Sites or to the degree, but as presented in **Table 2,** a comparison between upgradient wells and the average of downgradient wells generally do show these patterns.

As presented in **Table 2,** well locations MW-1, MW-2, MW-3, and MW-4 generally do show lower pH and positive ORP values when compared to downgradient wells.

The most notable difference is the comparison of ORP data in which 3 of the 4 upgradient locations (MW-1, MW-3, and MW-4) average greater than 150 millivolts and indicate strongly oxidizing conditions. Conversely, the average from downgradient wells was 20.3 millivolts and indicates largely neutral or more neutral ORP. DO and pH generally fit the model as well where upgradient locations have pH values closer to 5.5 SU and downgradient wells average around 6.5 SU and the DO in upgradient locations averages slightly higher than downgradient wells (0.75 mg/L vs 0.48 mg/L). These comparisons show that upgradient wells have not been impacted by a CCR source.

Upgradient well, MW-3, represents the potential variability that can be observed in mine spoil and Pottsville rocks as pH values can range from 3.77 to 5.69 SU, ORP from 66.4 to 353.4 millivolts, and DO from 0.52 to 1.07 mg/L. These variations are reflective of wetter than normal rainy seasons over the past couple of seasons combined with a recovery from the summer drought of 2016. The infiltration of weakly acidic rainwater and interactions with pyritic intervals (oxidization) decreases pH and can lead to the release of naturally occurring trace elements within pyritic and iron hydroxide/oxyhydroxide rich zones.

Based on review of data presented in Section 4.2.1 and 4.2.2, the wells identified for use as background groundwater monitoring points satisfy the requisite criteria: the wells are located hydraulically upgradient of the Bottom Ash Landfill and do not show evidence of having been impacted by a release from the Bottom Ash Landfill or CCR source. The wells are screened in the same groundwater flow system as the downgradient compliance wells and thus represent background groundwater quality migrating toward the Bottom Ash Landfill

4.2.3 Statistical Screening

Details regarding screening of the background is presented in **Appendix B, Statistical Analysis Plan**. Groundwater quality was determined to be representative of a statistical background following screening in accordance with the Unified Guidance (*Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance*, March 2009, USEPA 530/R-09-007).

4.3 DOWNGRADIENT COMPLIANCE WELLS

Adequately locating and screening downgradient monitoring wells are essential to being able to detect potential impacts to groundwater from the Bottom Ash Landfill. Well locations, MW-7, MW-8, MW-10, MW-11, and MW-12, as shown on **Table 1** and **Figure 7** are designated as downgradient compliance monitoring wells. These wells are screened at or near the mine spoil – top of rock interface which represents the first saturated zone and water-table flow system beneath the Site and are installed in the downgradient direction of flow away from the Bottom Ash Landfill as shown on the potentiometric surface contour map (**Figure 6**). Downgradient compliance wells installed across the mine spoil-top of rock interface are at the same stratigraphic interval or slightly lower than the base of the Bottom Ash Landfill in the down dip directions and therefore, monitor groundwater that preferentially flows horizontally along the top of rock interface due to the large permeability contrast. Water levels in these wells are generally equal to or within a few feet of the screen length indicating water table conditions.

Based upon a review of the data discussed above, downgradient compliance wells are adequately installed to detect downgradient and vertical migration to deeper Pottsville flow systems from the facility. Additionally, although not part of the immediate downgradient network for the Bottom Ash Landfill, other wells downgradient and cross gradient of the Bottom Ash Landfill surrounding the Gypsum Landfill could be utilized for detection or delineation if necessary.

4.4 DELINEATION WELLS

Pursuant to ADEM Admin. Code r. 335-13-15-.06(6)(g)2., if assessment monitoring is implemented and exceedances of GWPS are observed, wells may be required to delineate the nature and extent of exceedances. A site-specific well delineation plan will be submitted to the Department for approval. Any newly-installed delineation well(s) will be sampled for Appendix III and IV constituents as part of the Assessment groundwater monitoring program until the Department approves a change to the monitoring program.

Delineation wells, when installed, will be sampled along with the compliance groundwater monitoring events during semi-annual compliance sampling events. Occasionally, due to the remote nature or location along surface water bodies, delineation wells may not be accessible due to unavoidable circumstances (flooding, impassable access, etc). In this event, delineation wells will be sampled at a later date or during the next scheduled semi-annual sampling event. Existing delineation well locations and details are presented on **Table 1** and **Figure 7**. **Table 1** will be updated if additional delineation wells are required.

4.5 UPDATING THE BACKGROUND WELL NETWORK

The intention of this groundwater monitoring plan is to present the final groundwater monitoring network and designation of monitoring wells for permitting. However, in the future and over time the upgradient or background well network may be updated by adding or removing wells, updating background periods, re-designating existing wells, or modifying the background data set.

Changes to the background well network and data set will be made after receipt of Departmental approval.

If an update or modification to the permitted background network is recommended in the future, APC will complete the following:

- A notice will be submitted to the Department describing the proposed change(s) and the rationale for the change. The notice will contain statistical screening of the background data set and include sufficient information to evaluate and approve the request.
- Upon approval by the Department, the background network and data set will be adjusted pursuant to the proposal and used for future analyses.
- A revised groundwater monitoring plan and minor modification will be submitted to the Department.

The Statistical Analysis Plan in Appendix B provides details regarding requesting Department approval for updates and changes to the background well network and data set.

When well re-designations are approved by the Department, new statistical limits will be calculated based upon the resulting monitoring well network. When background data is updated, historical reports and exceedance lists will not be updated unless approved by the Department. Changes will apply to future analysis unless an immediate change is warranted. If delineation or groundwater corrective action is underway, the new background may be applied to those actions as appropriate with Department approval.

When background data is updated changes will apply to future analysis unless an immediate change is warranted. If delineation or groundwater corrective action is underway, the new background will be applied to those actions as appropriate with Department approval.

5. MONITORING WELL DRILLING, CONSTRUCTION, ABANDONMENT & REPORTING

The following describes monitoring system performance standards that have been applied to monitoring well activities subsequent to this monitoring plan and that will be applicable to all work performed in the future.

5.1 DRILLING

Drilling methodology may include, but not be limited to: hollow stem augers, direct push, air rotary, mud rotary, or rotosonic techniques. The drilling method will minimize the disturbance of subsurface materials and will not cause impact to the groundwater. Borings will be advanced using an appropriate drilling technology capable of drilling and installing a well in site-specific geology. Drilling equipment will be decontaminated before use and between borehole locations using the procedures described in the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Field Equipment Cleaning and Decontamination as a guide.

Sampling or coring may be used to help determine the stratigraphy and geology. Samples will be logged by a qualified groundwater scientist. Screen depths will be chosen based on the depth of the uppermost aquifer. Logging will be performed by a geologist or geotechnical engineer registered in the State of Alabama or working under the direction of a geologist or engineer registered in Alabama.

5.2 DESIGN AND CONSTRUCTION

Well construction materials will be sufficiently durable to resist chemical and physical degradation and will not interfere with the quality of groundwater samples. Groundwater monitoring wells are designed and constructed in accordance with ADEM Admin Code r. 335-13-15-.06(2)(e) using “Design and Installation of Groundwater Monitoring Wells in Aquifers”, ASTM Subcommittee D18.21 on Groundwater Monitoring as a guide. Well installations will generally follow the procedures outlined below.

The minimum boring diameter will be four inches larger than the outside diameter of the well casing, and a minimum well casing diameter of two inches will be used. Up to ten feet of ASTM NSF-rated Schedule 40 PVC with 0.010- in. slots will be set at an approximate depth of 10-20 ft below the typical water table depth. ASTM NSF-rated Schedule 40 PVC flush-threaded riser casing with will be used to finish the well approximately 3 feet of above-ground surface. A filter pack consisting of well-rounded and chemically inert materials (e.g., clean quartz) will be packed around the screen from the bottom of the borehole to a minimum 2 feet above the top of the screen. Sodium bentonite pellets will be placed to create a seal above the screen in the annulus for a minimum of 2-ft above the filter pack by dropping or washing down with potable water, or by tremie method. The annular space above the seal will be filled via tremie injection with a high-solids bentonite slurry, neat cement, or cement-bentonite grout mixture to the ground surface.

The design and construction of the intake of the groundwater wells will: (1) allow sufficient groundwater flow to the well for sampling; (2) minimize the passage of formation materials (turbidity) into the well; and (3) ensure sufficient structural integrity to prevent the collapse of the intake structure.

Each groundwater monitoring well will include a well screen designed to limit the amount of formation material passing into the well when it is purged and sampled. Screens with 0.010-inch slots have proven effective for the earth materials at the site and will be used unless geologic conditions discovered at the time of installation dictate a different size. Screen lengths are site and conditions dependent but are typically 10 feet. In some cases, screen lengths of 20 feet are utilized if the water table may undergo large fluctuations in elevation, particularly seasonally, or to capture a sufficient volume of water to adequately sample the groundwater well.

Additional well screen length is a tool utilized at fractured rock sites such as Plant Miller and Gorgas where groundwater yield is low and often is below the threshold for development and subsequent low-flow sampling. The additional footage of well screen assists well development and sampling by providing a greater volume of groundwater and can offer a technical advantage by providing more fracture/discrete flow zone intersection with the screened interval. Successful wells, that do not intersect groundwater yielding coal seams or well-connected fracture zones, are often predicated on encountering numerous, discrete low-yield fractures or bedding planes (where individual contributions may be sub 25 mL/min). In these instances, additional screen length can be a deciding factor in the success of a monitoring well installation.

If the above prove ineffective for developing a well with sufficient yield or acceptable turbidity, further steps will be taken to assure that the well screen is appropriately sized for the formation material. This may include performing sieve analysis of the formation material and determining well screen slot size based on the grain size distribution.

The placement of well screens at fractured rock sites such as Plant Miller and Gorgas is dependent upon sound borehole characterization to identify fracture networks and water bearing units. Groundwater is found chiefly in fractures and coal seams and is commonly confined by sharp permeability contrasts within the aquifer. Previously conducted conceptual site models are utilized to select target depths of well screen intervals during installation of monitor wells. In some instances, rising head tests are conducted at field dependent intervals while the borehole is being advanced to provide a preliminary characterization of borehole yield across intervals. Borehole geophysics and hydrophysical logging suites are utilized upon completion of the borehole. These logs will be utilized to determine borehole lithology and potential groundwater yielding zones. A combination of gamma, 3-arm, caliper, acoustic/optical televiewer combined with fluid resistivity/temperature logging will provide the principal points of comparison. Upon completion of the borehole geophysics, it may be necessary to backfill the boring to the well design depth. Boring are backfilled with bentonite chips to the design depth by slowly pouring the chips down the drill casing at a target pour rate of 3 minutes per 50-pound bag to prevent bridging. Additionally, periodically a weighted tape is used to check for bridging and the depth of the backfill. A target thickness of 5-ft of filter pack sand will separate the base of sand from bentonite chip backfill and to complete the backfill process.

Pre-packed dual-wall well screens may be used for well construction. Pre-packed well screens combine a centralized inner well screen, a developed filter sand pack, and an outer conductor screen in one integrated unit composed of inert materials. Pre-packed well screens will be installed following general industry standards and using the latest version of the Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Operating Procedure for Design and Installation of Monitoring Wells as a general guide. If the dual-wall pre-packed-screened wells do not yield sufficient water or are excessively turbid after development, further steps will be taken to assure that the well screen is appropriately sized for the formation material. This may include performing sieve analysis of the formation material and determining well screen slot size based on the grain size distribution.

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

5.3 WELLS WITH INCONSISTENT WATER LEVELS

The following procedures should be followed when field observations suggest that saturated conditions may exist at the target borehole depth at temporary and permanent well locations, but only minor amounts of free water (i.e., water capable of being sampled from a well casing) are observed in the well boreholes during drilling. These procedures should not be followed when “dry” (i.e., no free water) conditions are observed in the well boreholes at the target borehole depth. The field geologist will communicate with the project manager to determine if the boring should then be properly abandoned.
The decision to install a permanent well will be based on measurement of a target water column length. The target water column length for permanent wells is five (5) feet based on placement of the pump intake at least one (1) foot above the base of the screen and the well yielding sufficient sample volume to collect a complete sample set with quality assurance/quality control samples within one (1) day.
The following summarizes the procedure that will be followed:

- Prepare a workplan describing, at a minimum, well location(s), purpose, drilling method, target depth, and water level performance standards outlined below and submit to the Department per ADEM Admin Code r. 35-13-15-.06(2)(e).
- Drill the monitoring well borehole to the target depth.
- If sonic or core drilling, and a significant volume of drilling lubricant (drilling water) is used in tight formations (low permeability), the purging of 1 borehole volume and subsequent monitoring of water level recovery may be utilized to evaluate recharge rate.
- If the target water column length is not observed in the borehole after drilling, allow the water level in the borehole to equilibrate for 24 hours. The area around the borehole will be prepared to prevent surface water infiltration into the borehole.
- If a minimum of 5 feet of water is present in the borehole (or 4 feet of water will be present above the planned pump intake depth) after 24 hours, install the monitoring well at the target depth.
- If the above water column criteria are not present in the borehole after 24 hours, then terminate drilling at the location and grout the borehole following the appropriate Department standards.
- If a well is not installed, the Department will be notified, and an alternative well installation plan developed if necessary, to meet Department requirements.

5.4 WELL DEVELOPMENT

Upon completion of well construction, the monitoring wells will be developed using a combination of surging and purging to remove excess fines and sediments and to promote good hydraulic communication with the aquifer. Development will continue until the purged water is free of visible fines, and water quality field parameters (turbidity, pH, temperature, and conductivity) have stabilized. In cases of slow recharge and slow turbidity reduction, potable water may be injected and purged as needed to remove fines. If this approach is used, a minimum of three times the volume of water introduced must be purged from the well.

5.5 ABANDONMENT

If a permitted monitoring well should be abandoned, procedures will be followed in accordance with ADEM Admin Code r. 335-13-15-.06(2)(g). If practical, the entire well casing and screen will be removed. Removal can be accomplished by over-drilling the well with hollow stem augers and removing the grout and filter pack material from the well, followed by removal of the casing and the well screen. The clean borehole will then be backfilled with neat Portland cement from bottom to top by pressure grouting using the positive displacement (tremie) method. If the casing cannot be removed the well will be tremie grouted from the bottom of the well upwards with a neat cement. Additionally, a concrete seal will be placed at the ground surface. In either case, 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 depth of emplacement and volume of all abandonment materials, methods of casing removal, and depth to water and well bottom prior to abandonment. A copy of these records will be provided to ADEM and a copy placed in the operating record.

If a replacement well is required, a plan and justification will be submitted to support replacement location(s) and screened intervals along with the proposal to abandon wells.

5.6 DOCUMENTATION

Pursuant to ADEM Admin. Code r. 335-13-15-.06(2)(e)4., APC will document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. Name of drilling contractor and type of drill rig.

6. GROUNDWATER SAMPLING AND ANALYSIS PLAN

Pursuant to ADEM Admin. Code r. 335-13-15-.06(4), the following section describes groundwater sampling requirements with respect to parameters for analysis, sampling frequency, sample preservation and shipment, analytical methods, chain of custody control, and quality assurance and quality control. Groundwater samples used to provide compliance monitoring data will not be filtered prior to collection.

6.1 SAMPLE COLLECTION

Groundwater samples will be collected from the monitoring well network as part of the Detection Monitoring Program, and potentially as part of the Assessment Monitoring Program, in accordance with the APC Low-Flow Groundwater Sampling Technical Standard Operating Procedures (TSOP) included as **Appendix C**. Samples will be collected using low-volume purge, or "low-flow" sampling methods with peristaltic or bladder pumps. Depth to water readings at each well location will be taken prior to sampling. Water quality parameters (pH, redox potential, conductivity, etc.) will be measured during purging and recorded on a field sampling form. Samples will be collected after field parameter stabilization criteria are met.

Low-flow (minimal drawdown) groundwater sampling procedures will be used for purging and sampling monitoring wells that will sustain a pumping rate of at least 100 milliliters per minute (mL/min) without significant water-level drawdown. Flow rates should not exceed 500 mL/min. Field water quality parameters recorded during purging will be used as criteria to determine when purging has been completed.

Where non-dedicated pumps are used, the sampling equipment must be slowly lowered into the well so as to avoid agitation of the water column. Sampling equipment and pump intakes must not extend below the midpoint of any well screen unless the well is known to drawdown and is a threat to go dry even with low flow rates or the water level in the well does not extend above the screened interval.

Most wells are screened with the top-of-screen below the static water level in the well. In these wells (1) the water level in the well must not be drawn down below the top of screen, and (2) stabilization of the water column will be considered achieved when three consecutive water level measurements vary by 0.33 feet or less at a pumping rate of no less than 100 mL/min.

If the static (pre-pumping) water level is below the top-of-screen, the water level must not be drawn down below the top of pump where it can be accurately measured.

Field water quality parameters (temperature, pH, turbidity, conductivity, dissolved oxygen and oxidation-reduction potential) will be measured but not all will be used for determining stabilization. Stabilization will be considered achieved and purging will be considered complete when three consecutive measurements of each field parameter vary within the following limits:

- 0.2 standard units for pH,
- 5% for specific conductance,
- 0.2 mg/L or 10% for DO > 0.5 mg/L (whichever is greater),
- IF DO < 0.5 mg/L there is no stabilization criteria for DO,
- Turbidity (see the following section for more detail), and
- Temperature and ORP – record only, no stabilization criteria.

The goal when sampling is to attain a turbidity of less than 5 nephelometric turbidity units (NTU); however, samples may be collected where turbidity is less than 10 NTU and the stabilization criteria described above are met. If sample turbidity is greater than 10 NTU and all other stabilization criteria have been met, samplers must take reasonable steps (i.e., Additional purging) to reduce the turbidity to 10 NTU or less.

- If turbidity is less than 10 NTU, and all other parameters are stabilized, the well should be sampled.
- Where turbidity remains above 10 NTU and turbidity has stabilized within 10% for 3 consecutive readings, the well has been pumped for at least 2 hours and the water quality indicator parameters have stabilized, a complete sample set using the appropriate, pre-preserved containers will be collected followed by an additional sample set using unpreserved containers to be lab filtered and analyzed for the dissolved portion of target constituents.

If necessary, and pursuant to industry-accepted guidance, stabilization criteria may be adjusted to accommodate site-specific or well-specific conditions (USEPA, 1996).

6.2 SAMPLE PRESERVATION AND SHIPMENT

Groundwater samples will be collected in the designated size and type of containers required for specific parameters and laboratory methods. Sample bottles will be pre-preserved and do not require field preservation. Where temperature control is required, field personnel will place samples in a cooler with ice immediately after sample collection. Dry ice, blue ice, and other cooling packs may not be used. Samples will be cooled to less than 6°C and maintained until receipt by the analytical laboratory.

Samples will be delivered to the APC General Testing Laboratory within 48 hours of collection following appropriate temperature control and chain-of-custody procedures. At no time will samples be analyzed after the method-prescribed hold time has expired. If using commercial shipping methods and relinquishing control of the samples to a third-party courier, the shipping cooler will be sealed using a custody seal to identify samples which may have been tampered with during transport to the laboratory. The seal must be labeled with instructions for the laboratory to notify the shipper if the seal is broken when the samples arrive at the laboratory.

6.3 ANALYTICAL METHODS

As shown on **Table 3, Monitoring Parameters and Reporting Limits**, the groundwater samples will be analyzed using methods specified in USEPA Manual SW-846, EPA 600/4-79-020, Standard Methods for the Examination of Water and Wastewater (SM18-20), USEPA Methods for the Chemical Analysis of Water and Wastes (MCAWW), American Society for Testing and Materials (ASTM), or other suitable analytical methods approved by ADEM. Any practical quantitation limit (reporting limit) that is used will be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility. Field instruments used to measure pH must be accurate and reproducible to within 0.2 Standard Units (S.U.).

6.4 CHAIN OF CUSTODY CONTROL

The COC record is required for tracing sample possession from time of collection to time of receipt at the laboratory. The National Enforcement Investigations Center (NEIC) of USEPA considers a sample to be in custody under any of the following conditions:

- It is in the individual’s possession
- It is in the individual’s view after being in his/her possession
- It was in the individual’s possession and (s)he locked it up (e.g. locked in a vehicle)
- It is in a designated secure area

All samples will be handled under strict COC procedures beginning in the field. The field team leader will be the field sample custodian and will be responsible for ensuring that COC procedures are followed. The use of electronic COCs are encouraged and utilized by APC Water Field Services. The record will contain the following information:

- Sample destination and transporter
- Sample identification numbers
- Signature of collector
- Date and time of collection
- Sample type
- Identification of monitoring well
- Number of sample containers
- Parameters requested for analysis
- Signature of person(s) involved in the chain of possession
- Inclusive dates of possession

The samples must be in the custody of assigned personnel, an assigned agent, or the laboratory. If the samples are transferred to other employees for delivery or transport, the sampler or possessor must relinquish possession and the samples must be received by the new owner.

If the samples are being shipped, a hard copy COC must be signed and enclosed within the shipping container in a watertight bag. Shipping agents such as Federal Express do not sign the chain-of-custody form. The shipping receipt must be retained by the samplers as part of the record documenting sample transfer.

6.5 SAMPLING PARAMETERS AND FREQUENCY

Table 4, Groundwater Monitoring Parameters and Frequency, presents the groundwater monitoring parameters and sampling frequency. A minimum of eight independent samples from each groundwater well will be collected and analyzed for 40 CFR 257, Subpart D, Appendix III and Appendix IV test parameters to establish a background statistical dataset.

<u>DETECTION MONITORING</u>
After background has been established, detection monitoring will be performed in accordance with ADEM Admin. Code r. 335-13-15-.06(5)(b). The detection monitoring frequency for the Appendix III parameters will be at least semi-annual during the active life of the facility and the post-closure care period.

<u>ASSESSMENT MONITORING</u>
If required, assessment monitoring will be performed per ADEM Admin. Code r. 335-13-15-.06(6). Assessment monitoring is required whenever a SSI over background levels has been detected for one or more of the constituents listed in 40 CFR 257, Subpart D, Appendix III test parameters.

For assessment sampling at the Site, two semi-annual sampling events will be performed. As shown on **Table 4**, the full suite of Appendix III and IV constituents will be sampled and statistically analyzed semiannually. During these events all compliance monitoring wells and any newly-installed delineation well(s) will be sampled for Appendix III and IV constituents.

A proposal may be made to the Department to modify the subset of delineation wells sampled during assessment monitoring, or the sampling frequency. Proposed changes will be implemented following Department approval.

6.6 QUALITY ASSURANCE AND QUALITY CONTROL

All field quality control samples will be prepared the same as compliance samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected during each sampling event.

<u>FIELD EQUIPMENT RINSATE BLANKS</u>
In cases where sampling equipment is not new or dedicated, an equipment rinsate blank will be collected at a rate of one blank per 10 samples. The equipment rinsate blanks are prepared in the field using the

same distilled or deionized water used for decontamination. The water is poured over and through each type of sampling equipment and submitted to the laboratory for analysis of target constituents. If the equipment is dedicated or new for each monitoring well, equipment rinsate blanks will be collected at a rate of 1 blank per CCR unit. If a plant has multiple CCR storage units, an equipment rinsate blank should be collected at each unit (e.g. ash pond, gypsum storage, etc.)

FIELD DUPLICATES

Field duplicates are collected by filling additional containers at the same location, and the field duplicate is assigned a unique sample identification number. One field duplicate will be collected for every group of 10 samples.

FIELD BLANKS

Field blanks are collected in the field using the same distilled or deionized water source that is used for decontamination. The water is poured directly into the supplied sample containers in the field and submitted to the laboratory for analysis of target constituents. One field blank will be collected for every group of 10 samples.

The groundwater samples will be analyzed by licensed and accredited laboratories through the National Environmental Laboratory Accreditation Program (NELAP). Lab data reports will include the records of standard laboratory QA/QC reports.

7. REPORTING RESULTS

The following subsections outline reportable results and delivery.

7.1 14-DAY NOTIFICATION

Pursuant to ADEM Admin. Code r. 335-13-15-.06(4)(h)3., the Department will be notified of any new statistical exceedances identified during detection or assessment monitoring within 14 days. Since the exceedance will also be described in subsequent monitoring reports and addressed pursuant to the rules, the initial notification will not be repeated for the same exceedance in subsequent monitoring events.

7.2 SEMI-ANNUAL GROUNDWATER MONITORING REPORTS

Pursuant to ADEM Admin. Code R. 335-13-15-.06(1)(f), an annual groundwater monitoring and corrective action report documenting the results of sampling and analysis will be submitted to ADEM by January 31st of each year. Pursuant to ADEM Admin. Code r. 335-13-15-.06(5)(g), a semi-annual report to coincide with the semi-annual groundwater sampling will also be submitted. The semi-annual report will be submitted to ADEM by July 31st of each year. At a minimum, semi-annual and annual reports will include:

1. A narrative describing sampling activities and findings including a summary of the number of samples collected, the dates the samples were collected and whether the samples were required by the detection or assessment monitoring programs.
2. A brief overview of purging/sampling methodologies.
3. If applicable, analytical results for samples collected from each delineation well during the semi-annual period.
4. Discussion of results.
5. Recommendations for future monitoring consistent with ADEM's CCR rules.
6. Potentiometric surface contour map for the aquifer(s) being monitored, signed and sealed by an Alabama-registered P.G. or P.E.
7. Table of as-built information for groundwater monitoring wells including top of casing elevations, ground elevations, screened elevations, current groundwater elevations and depth to water measurements.
8. Groundwater flow rate and direction calculations.
9. Identification of any groundwater wells that were installed or decommissioned during the preceding year, along with a narrative description of why these actions were taken.

10. A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels.

11. If applicable, assessment monitoring results.

12. Any alternate source demonstration completed during the previous monitoring period, if applicable.

13. Laboratory Reports and COC documentation.

14. Field sampling logs including field instrument calibration, indicator parameters and parameter stabilization data.

15. Documentation of non-functioning wells, dry surface water and underdrain sampling locations.

16. Table of current analytical results for each well, highlighting statistically significant increases and concentrations above maximum contaminant level (MCL).

17. Statistical analyses.

18. Certification by a qualified groundwater scientist.

8. STATISTICAL ANALYSIS

Groundwater quality data from each sampling event will be statistically evaluated to determine if there has been a statistically significant change in groundwater chemistry. Historical background data will be used to determine statistical limits.

According to ADEM Admin Code r. 335-13-15-.06(4)(f), which incorporates the statistical analysis requirements of 40 CFR 257.93, the site must specify in the operating record the statistical methods to be used in evaluating groundwater monitoring data for each hazardous constituent.

A site-specific statistical analysis plan that provides details regarding the statistical methods to be used will be placed in the site's operating record pursuant to ADEM Admin. Code r. 335-13-15-.06(4)(f). **Appendix B, Statistical Analysis Plan**, provides the site-specific plan.

The Sanitas Groundwater statistical software is used to perform the statistical analyses. Sanitas is a decision support software package that incorporates the statistical tests required of RCRA Subtitle C and D facilities by EPA regulations. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities as well as with the USEPA Unified Guidance (2009).

The following subsections provide a high-level summary of the statistical analyses plan as broken down by monitoring program status.

8.1 DETECTION MONITORING

As discussed in **Appendix B**, Intrawell prediction limits, combined with a 1-of-2 verification resample plan, are used to evaluate calcium, fluoride, sulfate, and total dissolved solids (TDS). Interwell prediction limits, combined with a 1-of-2 verification resample plan, are used for boron, chloride and pH to determine whether there has been a SSI) over background groundwater quality. Intrawell prediction limits use screened historical data within a given well to establish limits for parameters at that well. The most recent sample from the same well is compared to its respective background to identify SSIs over background. Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent. The most recent sample from each downgradient well is compared to the background limit to identify SSIs.

Groundwater Stats Consulting demonstrated that these test methods were appropriate in the October 2017 Statistical Analysis Plan, which was updated in the September 2019 data screening evaluation. Time series plots were used to screen proposed background data for suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective. Suspected outliers at all wells for Appendix III parameters are formally tested using Tukey's box plot method and, when identified, flagged in the computer database.

The following adjustments are also applicable to the statistical analysis per the Unified Guidance:

- No statistical analyses are required on wells and analytes containing 100% non-detects (EPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in the background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for non-detects is the practical quantitation limit (PQL) as reported by the laboratory.
- When data contain between 15-50% non-detects the Kaplan-Meier non-detect adjustment is applied to the background data.
- Non-parametric prediction limits are used on data containing greater than 50% non-detects.

8.2 ASSESSMENT MONITORING

When in assessment monitoring, Appendix IV constituent concentrations are compared to a GWPS. Appendix IV analysis uses the pooled results from the individual downgradient well to develop a well-specific Confidence Interval that is compared to the statistical limit (GWPS). The statistical limit is either the Inter-well Tolerance Limit (i.e. background) calculated using the pool of all available upgradient well data (see Chapter 7 of the Unified Guidance), or an applicable GWPS published in the regulations such as the Maximum Contaminant Level (MCL). As discussed in the Statistical Analysis Plan, Appendix IV background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Interwell Tolerance Limits (background) were calculated using pooled upgradient well data for Appendix IV parameters with a target of 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. The Upper Tolerance Limits (UTLs) were then used as the GWPS.

As described in 40 CFR § 257.95(h)(1)-(3) and specified by ADEM Variance dated April 15, 2019, the GWPS is:

(1) The maximum contaminant level (MCL) established under 40 CFR §141.62 and 141.66.
(2) Where an MCL has not been established:
   - (i) Cobalt 0.006 mg/L;
   - (ii) Lead 0.015 mg/L;
   - (iii) Lithium 0.040 mg/L; and
   - (iv) Molybdenum 0.100 mg/L.
(3) Background levels for constituents where the background level is higher than the MCL or rule-specified GWPS.

In assessment monitoring, when the Lower Confidence Limit (LCL), or the entire interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSL. Appendix IV constituents will be updated every two years beginning with the most recent event (Fall 2019).

8.2.1 Delineation Wells

During assessment monitoring, any newly-installed delineation well will be sampled for Appendix III and IV constituents on the same schedule as the compliance monitoring well network. A proposal may be made to the Department to modify the subset of delineation wells sampled during assessment monitoring, or the sampling frequency. Data obtained from delineation wells will be compared to the GWPS numerically until sufficient data is obtained to prepare well-specific Confidence Intervals.

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Tables

Table 1.
Groundwater Monitoring Well Network Details

Well Name	Purpose	Northing [1]	Easting [1]	Ground Elevation [2]	Top of Casing Elevation [2]	Well Depth (ft.) Below Top of Casing	Top of Screen Elevation [2,3]	Bottom of Screen Elevation [2,3]	Screen Length (ft.)
MW-1	Upgradient	1330794.064	594082.361	499.19	502.25	107.56	405.09	395.09	10
MW-2	Upgradient	1331053.309	593548.802	498.54	502.12	94.58	417.94	407.94	10
MW-3	Upgradient	1330842.402	593025.397	522.23	525.9	119.07	417.23	407.23	10
MW-4	Upgradient	1330289.727	592896.414	516.67	518.63	128.66	400.37	390.37	10
MW-7	Downgradient	1328515.235	593408.341	391.59	394.59	74.00	330.99	320.99	10
MW-8	Downgradient	1329140.729	593813.964	413.15	416.10	72.25	354.25	344.25	10
MW-10	Downgradient	1327686.069	593704.952	391.66	395.10	108.64	306.86	286.86	20
MW-11	Downgradient	1328083.497	594546.311	403.69	406.96	135.00	282.36	272.36	10
MW-12	Downgradient	1328578.93	594708.212	470.70	474.24	169.04	315.60	305.60	10
MW-12V	Vertical Delineation	1328481.68	2063196.25	478.64	481.32	206.08	285.64	275.64	10

1. Northing and easting are in feet relative to the State Plane Alabama West North America Datum of 1983.
2. Elevations are in feet relative to the North American Vertical Datum of 1988.
3. Top of screen and bottom of screen depths are calculated relative Top of Casing elevation and less the well sump length of 0.4’.

Table 2. Plant Gorgas Bottom Ash Landfill Upgradient Comparisons – Key Indicator Parameters

Well Designation	**Well ID**	**DO** (mg/L)	**pH** (SU)	**ORP** (mV)	**Conductivity** (uS/cm)	**Boron** (mg/L)	**Calcium** (mg/L)	**Sulfate** (mg/L)	**Chloride** (mg/L)
Pore Water	PW-1	0.19	6.03	15.3	1557.6	2.01	322	896	1.27
Upgradient	MW-1	0.50	5.17	197.3	2326.3	0.022	149.23	1500.00	2.31
Upgradient	MW-2	0.20	5.93	59.4	1957.8	0.028	171.85	1039.00	3.39
Upgradient	MW-3	0.68	5.08	159.5	3600.5	0.040	301.38	2490.77	1.61
Upgradient	MW-4	1.62	6.15	151.8	3791.5	0.043	301.38	2597.69	1.95
Downgradient Compliance [1]	Average Concentrations	0.48	6.49	20.3	2653.6	0.197	304.42	2471.85	29.16
Delineation Well	MW-12V	0.59	6.74	-53.53	2670.7	0.149	337	1430	82.05

Notes:

1. Downgradient compliance wells included MW-7, MW-8, MW-10, MW-11, and MW-12

Table 3.
Monitoring Parameters and Reporting Limits

Appendix III Parameters		
Parameter	**Analytical Method**	**Reporting Limit (mg/L) [1]**
Boron	EPA 200.7/200.8	0.05
Calcium	EPA 200.7/200.8	0.25
Chloride	EPA 300.0	2
Fluoride	EPA 300.0	0.1
pH	None	None
Sulfate	EPA 300.0	5
Total Dissolved Solids (TDS)	SM 2540C	5
Appendix IV Parameters		
Parameter	**Analytical Method**	**Reporting Limit (mg/L)**
Antimony	EPA 200.7/200.8	0.0025
Arsenic	EPA 200.7/200.8	0.00125
Barium	EPA 200.7/200.8	0.0025
Beryllium	EPA 200.7/200.8	0.0025
Cadmium	EPA 200.7/200.8	0.0025
Chromium	EPA 200.7/200.8	0.0025
Cobalt	EPA 200.7/200.8	0.0025
Fluoride	EPA 300.0	0.1
Lead	EPA 200.7/200.8	0.00125
Lithium	EPA 200.7/200.8	0.0025
Mercury	EPA 7470A	0.0002
Molybdenum	EPA 200.7/200.8	0.015
Selenium	EPA 200.7/200.8	0.00125
Thallium	EPA 200.7/200.8	0.0005
Radium 226 & 228 combined [2]	EPA 9315/9320	1 pCi/L

Notes:

1. mg/L - Milligrams per liter

2. Combined Radium 226 + 228 reported in pCi/L - Picocuries per liter

Table 4. Groundwater Monitoring Parameters and Frequency

Monitoring Parameters		Groundwater Sampling Schedule	
		Semi-Annual Event 1 (Jan-June)	Semi-Annual Event 2 (July-Dec)
Field Parameters	Temperature	X	X
	pH	X	X
	Specific Conductance	X	X
	Dissolved Oxygen	X	X
Appendix III (Detection)	Boron	X	X
	Calcium	X	X
	Chloride	X	X
	Fluoride	X	X
	pH	X	X
	Sulfate	X	X
	Total Dissolved Solids	X	X
Appendix IV (Assessment)	Antimony	X	X
	Arsenic	X	X
	Barium	X	X
	Beryllium	X	X
	Cadmium	X	X
	Chromium	X	X
	Cobalt	X	X
	Fluoride	X	X
	Lead	X	X
	Lithium	X	X
	Mercury	X	X
	Molybdenum	X	X
	Selenium	X	X
	Thallium	X	X
	Radium 226 & 228	X	X

Figures

Legend

Property Boundary (Approximate)

Bottom Ash Landfill Boundary (Approximate)

N

0 500 1,000 2,000 3,000 Feet

SCALE 1:9000	DRAWING TITLE SITE LOCATION MAP PLANT GORGAS BOTTOM ASH LANDFILL
DATE 3/23/2020	
DRAWN BY KAR	FIGURE NO **FIGURE 1**
CHECKED BY GBD	Southern Company

Legend

- Gorgas BALF Boundary
- Property Boundary (Approximate)
- 20-Foot Topographic Contour
- Downgradient Monitoring Well
- Upgradient Monitoring Well
- Vertical Delineation Monitoring Well

N

0 500 1,000 2,000 Feet

SCALE	1:8,400
DATE	4/14/2020
DRAWN BY	KAR
CHECKED BY	GBD

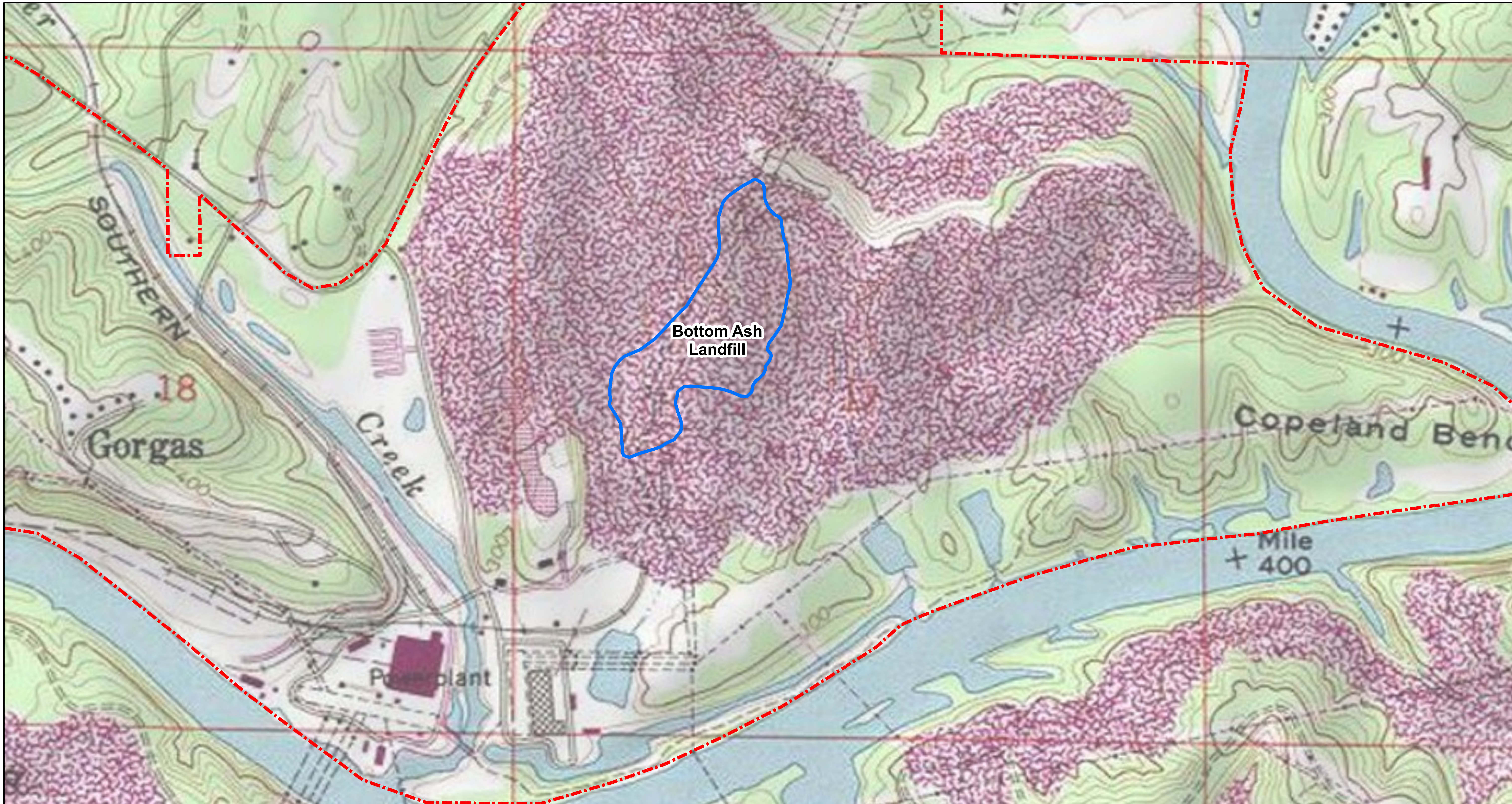
DRAWING TITLE

SITE PLAN MAP
PLANT GORGAS BOTTOM ASH LANDFILL

FIGURE NO

FIGURE 2

Southern Company



Legend

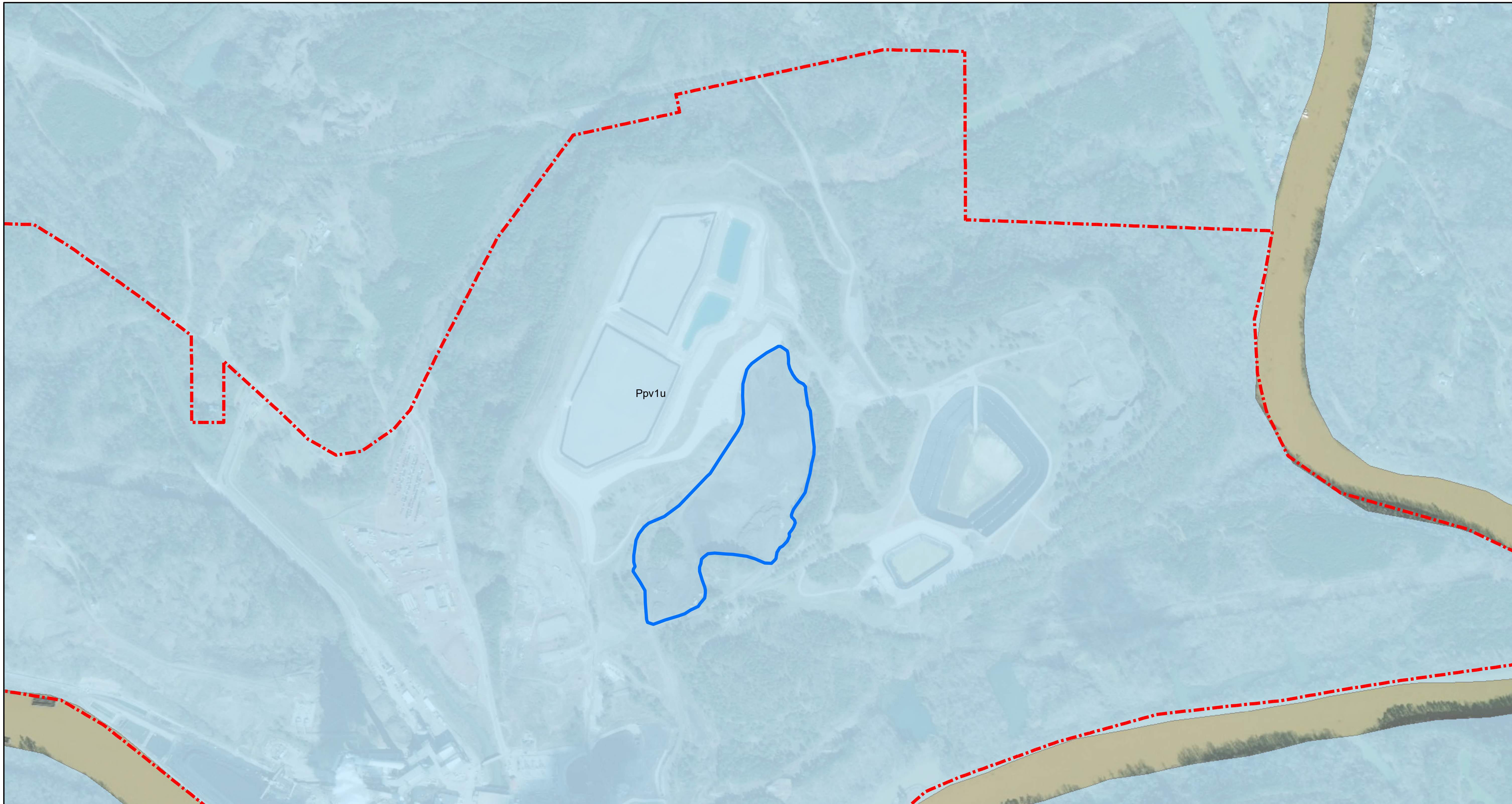
Property Boundary (Approximate)

Bottom Ash Landfill Boundary (Approximate)

N

0 500 1,000 2,000 3,000 Feet

SCALE 1:9000	DRAWING TITLE SITE TOPOGRAPHIC MAP PLANT GORGAS BOTTOM ASH LANDFILL
DATE 3/23/2020	
DRAWN BY KAR	FIGURE NO **FIGURE 3**
CHECKED BY GBD	Southern Company



Legend

Property Boundary (Approximate)

Bottom Ash Landfill Boundary (Approximate)

Geologic Units

Pottsville Formation (upper part), Appalachian Plateaus (Ppv1u)

N

0 500 1,000 2,000 3,000 Feet

SCALE	1:9000
DATE	3/23/2020
DRAWN BY	KAR
CHECKED BY	GBD

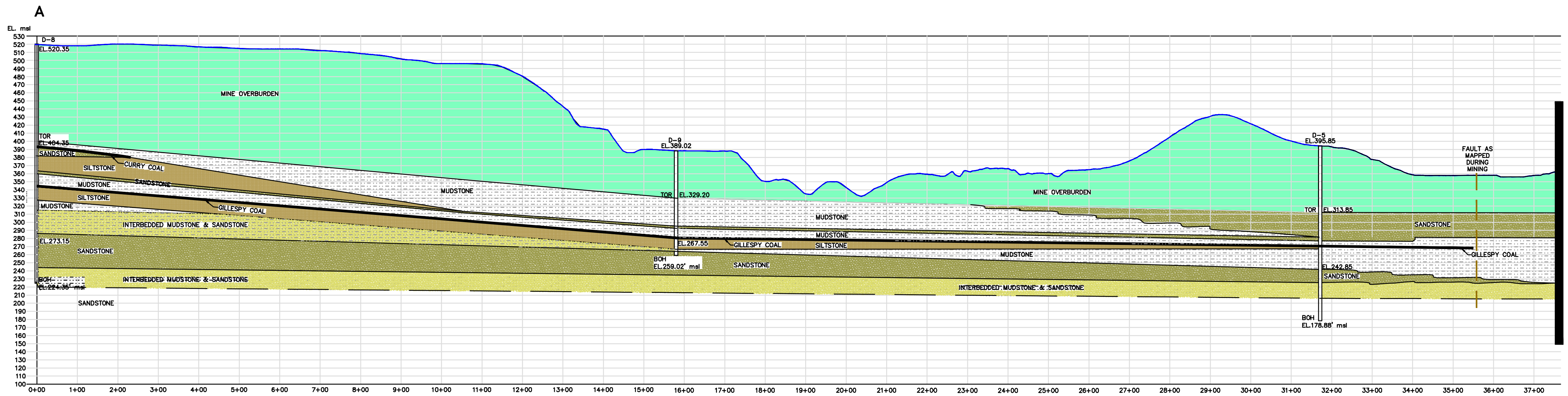
DRAWING TITLE

SITE GEOLOGIC MAP
PLANT GORGAS BOTTOM ASH LANDFILL

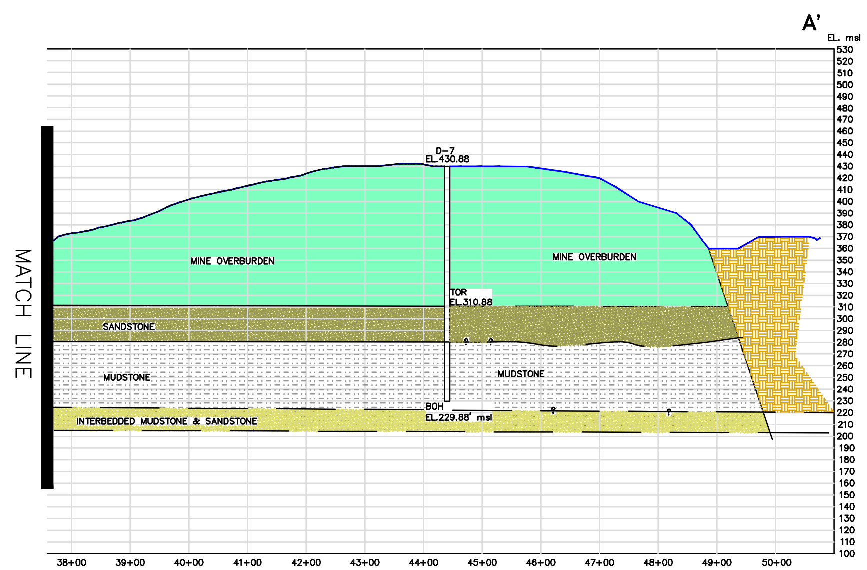
FIGURE NO

FIGURE 4

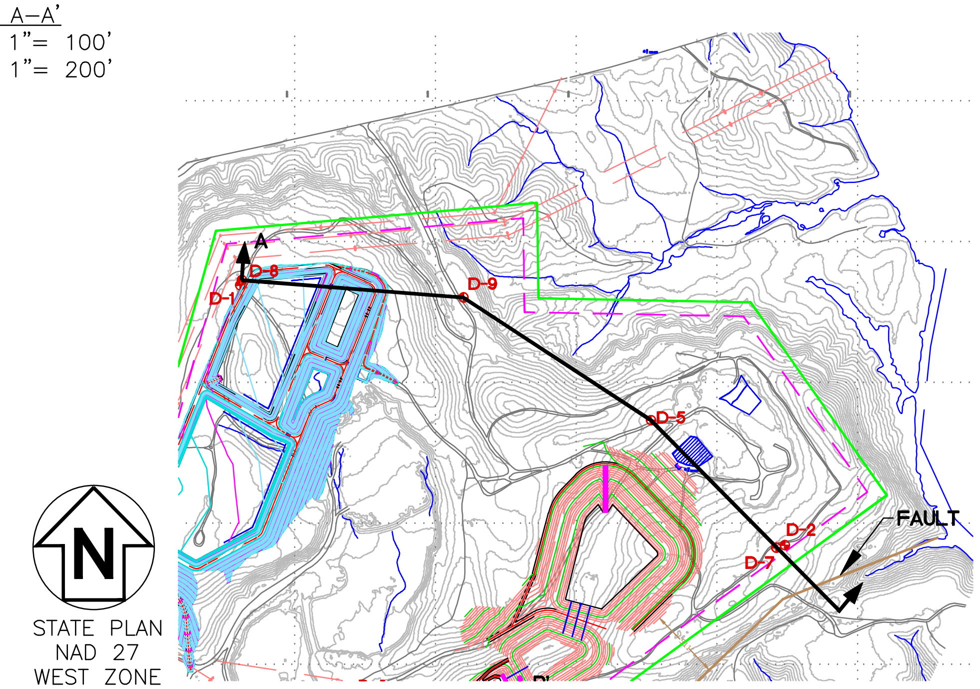
Southern Company



SECTION A–A'
SCALE: VERT: 1"= 100'
HORIZ: 1"= 200'



SECTION A–A'
SCALE: VERT: 1"= 100'
HORIZ: 1"= 200'



STATE PLAN
NAD 27
WEST ZONE

GRAPHIC SCALE

800 0 400 800 1600 3200

(IN FEET)
1 inch = 800ft.

Southern Company Services
Engineering and Construction Services
FOR
Alabama Power Company

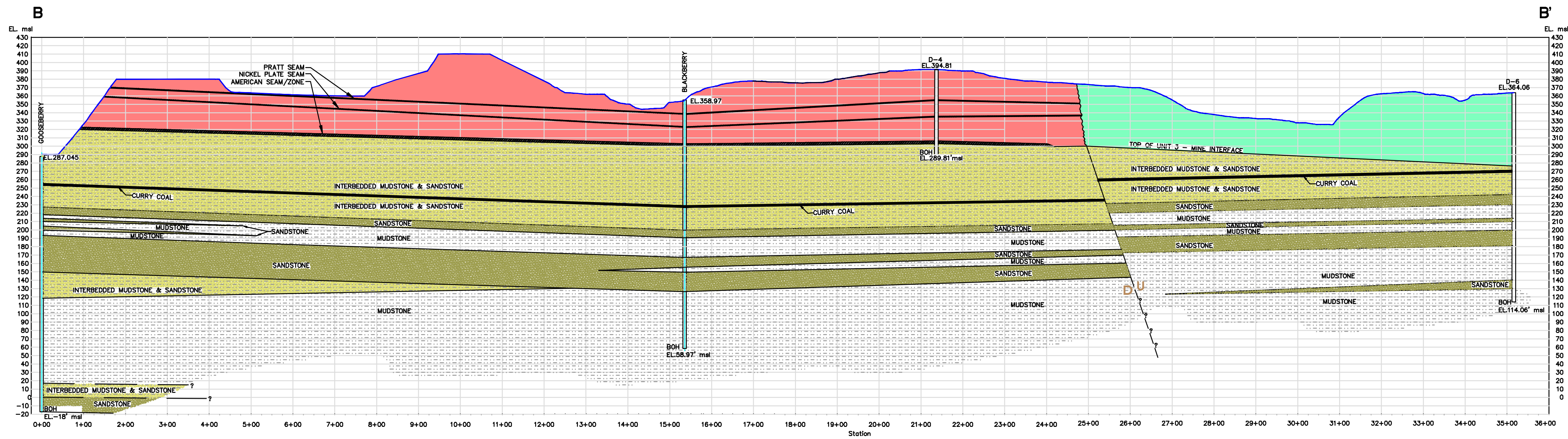
PLANT GORGAS
UNIT 8, UNIT 9 AND UNIT 10
CCB STORAGE FACILITY
GEOLOGIC CROSS
SECTION A–A'

REVISION	DATE	REVISION	DATE	REVISION	DATE
				0 ISSUED FOR REPORT	07/07/2017

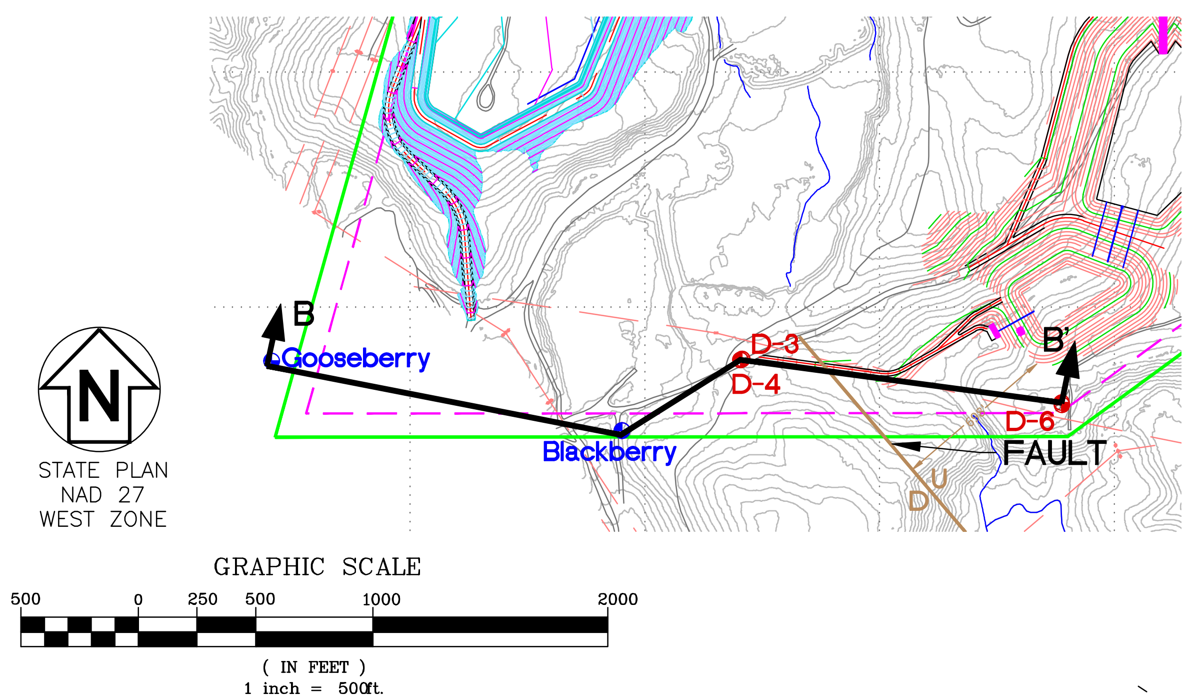
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
GBD	GBD	SCB	XXX	XXX	XXX	XXX

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
AS SHOWN	FIGURE 5A	1	FINAL	0

ANSI C: 22x17 Acad2013



SECTION B–B'
SCALE: VERT: 1"= 100'
HORIZ: 1"= 200'



Southern Company Services
Engineering and Construction Services
FOR
Alabama Power Company

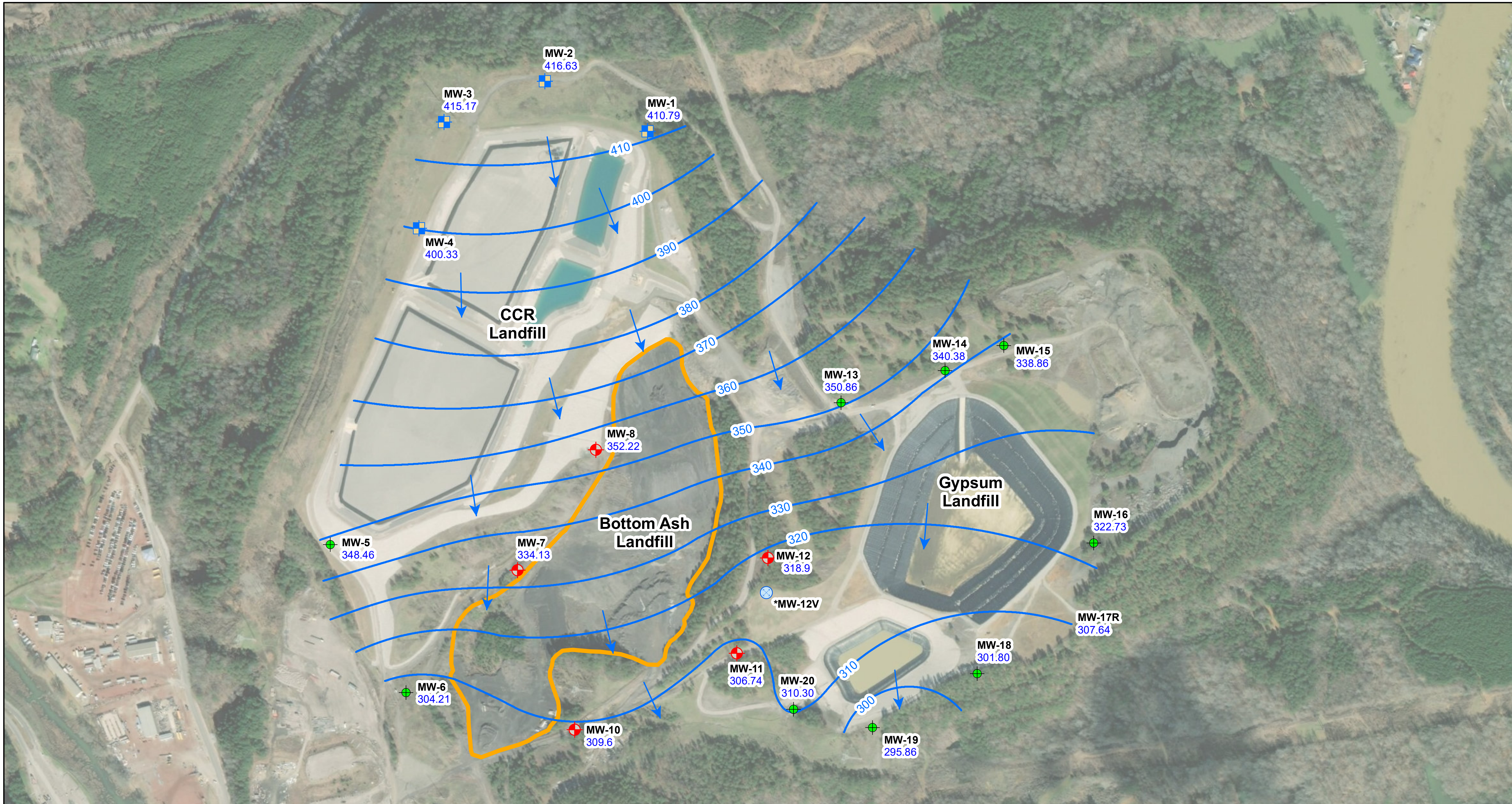
PLANT GORGAS
UNIT 8, UNIT 9 AND UNIT 10
CCB STORAGE FACILITY
GEOLOGIC CROSS
SECTION B–B'

REVISION	DATE	REVISION	DATE	REVISION 0	DATE 07/07/2017
				ISSUED FOR REPORT	

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
GBD	GBD	SCB	XXX	XXX	XXX	XXX

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
AS SHOWN	FIGURE 5b	1	FINAL	0

ANSI C: 22x17 Acad2013



Legend

- Downgradient Monitoring Well
- Upgradient Monitoring Well
- Vertical Delineation Monitoring Well
- Monitoring Well
- MW-1 Well ID
- 410.79 Groundwater Elevation
- Approximate Groundwater Flow Direction
- Potentiometric Surface Contour (ft NAVD88)
- Bottom Ash Landfill Boundary (Approximate)

N

0 250 500 1,000 1,500 2,000 Feet

NOTES: 1. NAVD88 indicates North American Vertical Datum of 1988.
2. *MW-12V was screened at a different depth and was not factored into potentiometric contours.

SCALE	1:6000	DRAWING TITLE	POTENTIOMETRIC SURFACE CONTOUR MAP OCTOBER 7, 2019 PLANT GORGAS BOTTOM ASH LANDFILL
DATE	4/14/2020		
DRAWN BY	KAR	FIGURE NO	FIGURE 6
CHECKED BY	GBD		Southern Company

Legend

- Downgradient Monitoring Well
- Upgradient Monitoring Well
- Vertical Delineation Monitoring Well
- Bottom Ash Landfill Boundary (Approximate)

N

0 250 500 1,000 1,500 2,000 Feet

SCALE 1:6000	DRAWING TITLE MONITORING WELL LOCATION MAP PLANT GORGAS BOTTOM ASH LANDFILL		
DATE 4/2/2020			
DRAWN BY KAR	FIGURE NO **FIGURE 7**	Southern Company	
CHECKED BY GBD			

Appendix A

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 1/13/2014 **COMPLETED** 1/15/2014 **SURF. ELEV.** 499.2 **COORDINATES:** N:1,330,794.06 E:594,082.36
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 104.7 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 88.92 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 502.25)
		Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments	499.2		**Surface Seal**
5					
10					
15					
20					**Annular Fill**
25					
30					
35					
40					

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 502.25)
		Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments*(Con't)*	499.2		(CONTINUED)
45					
50					
55					
60					
65					**Annular Fill**
70					
75					
80					
85					**Annular Seal**

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA Top of casing Elev. = 502.25 (CONTINUED)
90		**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments *(Con't)*	499.2		Annular Seal
95		**Shale (mudstone)** Pottsville formation	404.0		Filter Pack
100			394.5		Screen Tip Elevation

Bottom of borehole at 104.7 feet.

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 498.5 **COORDINATES:** N:1,331,053.31 E:593,548.80
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 91 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 81.7 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 501.54)
			498.5		
		Fill (FILL) dark gray to medium gray mudstone/siltstone with trace sandstone, coarse sand to coarse gravel sized angular rock fragments within a dark gray to brownish gray to orangish brown sandy silt			Surface Seal
5					
		trace cobble sized rock fragments			
10					Annular Fill
15					
		trace reddish brown staining on some rock fragments			
20					
25					
		upper coarse sand to bolder sized (limited core recovered) dark gray to medium gray rock fragments within a dark gray silty matrix with trace layers of orangish brown clay/silt			
30					
35					Annular Seal
		trace weathered sandstone fragments with orangish brown staining			
40					
45					
50					

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 501.54) (CONTINUED)
		Fill (FILL) dark gray to medium gray mudstone/siltstone with trace sandstone, coarse sand to coarse gravel sized angular rock fragments within a dark gray to brownish gray to orangish brown sandy silt *(Con't)*	498.5		
55					
60					
65					Annular Seal
70		trace zones of orangish brown silt with rusty red to light brown stained sandstone fragments, within a dark gray to medium gray silty matrix with upper coarse sand to coarse gravel sized angular to subangular dark gray to medium gray mudstone/siltstone/sa			
75					
80					
		Mudstone (MUDSTONE) mostly mechanical fracture due to sonic, brittle/friable rock	415.0		
85					Filter Pack
		core breaks easily along apparent bedding planes, trace plant fossils visible in some zones, trace interbedded siltstone			
90			407.5		Screen Tip Elevation

Bottom of borehole at 91.0 feet.

BORING LOG

BORING MW-3

SOUTHERN COMPANY

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 522.2 **COORDINATES:** N:1,330,842.40 E:593,025.40
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 115.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 106.91 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 525.23)
0		**Fill (FILL)** dark gray to medium gray mudstone/siltstone fragments within dark gray silty soil matrix.	522.2		Surface Seal
		trace rock fragments with orangish brown to rusty red staining			
10					Annular Fill
20					
		zone of subangular rock fragments within a dark gray to orangish brown silty to clayey sand, trace light brown to reddish brown siltstone/sandstone fragments			
30					
40					Annular Seal
		fine gravel to cobble sized angular to subangular mudstone/siltstone fragments			
50					

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75 / 150 / 225)	WELL DATA (Top of casing Elev. = 525.23) (CONTINUED)
		Fill (FILL) dark gray to medium gray mudstone/siltstone fragments within dark gray silty soil matrix.*(Con't)*	522.2		
60		increasing dark brown to orangish brown sandy silt to sandy clay matrix with dark gray to medium gray upper coarse sand to cobble sized mudstone/siltstone fragments with trace sandstone fragments			
		decrease in clayey matrix, dark gray to medium gray rock fragments/matrix			
70					
80					Annular Seal
		@ approx. 90' change from dark gray to light brown (overburden) siltstone/sandstone angular fine gravel to coarse gravel sized rock fragments			
90					
		increasing dark gray brittle/friable rock fragments			
100					
			414.2		
110		**Sandstone (SANDSTONE)** trace dark gray nodular inclusions			Filter Pack
			406.7		Screen Tip Elevation

Bottom of borehole at 115.5 feet.

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 2/12/2014 COMPLETED 2/19/2012 SURF. ELEV. 516.7 COORDINATES: N:1,330,289.73 E:592,896.41
CONTRACTOR CFS EQUIPMENT METHOD CME
DRILLED BY S. Milam LOGGED BY G. Dyer CHECKED BY
BORING DEPTH 129.5 ft. GROUND WATER DEPTH: DURING COMP. DELAYED 116.59 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 518.63)
0		**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments	516.7		Surface Seal
5					
10					
15					
20					Annular Fill
25					
30					
35					
40					

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA Top of casing Elev. = 518.63 (CONTINUED)
		Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments *(Con't)*	516.7		
45					
50					
55					
60					
65					**Annular Fill**
70					
75					
80					
85					

(Continued Next Page)

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/13/17 15:23 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION	WELL DATA
	Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments *(Con't)*	516.7	(CONTINUED)
90			
95			
100			Annular Fill
105			
110			Annular Seal
115			
120			Filter Pack
	Shale (SHALE) Pottsville formation, lenticular bedding	395.9	
125			Screen Tip Elevation
		387.2	

Natural Gamma: 75, 150, 225

Top of casing Elev. = 518.63

Bottom of borehole at 129.5 feet.

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/29/2014 **COMPLETED** **SURF. ELEV.** 391.6 **COORDINATES:** N:1,328,515.24 E:593,408.34
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 71 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 58 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 394.59)
0		**Fill (FILL)** dark gray to medium gray fine gravel to coarse gravel sized angular to subangular mudstone/siltstone within a medium gray silty matrix	391.6		Surface Seal
5					
		trace cobble sized fragments			
10					Annular Fill
15					
		trace sandstone fragments			
20					
25					
		trace reddish brown to rusty red staining on trace rock fragments			
30					Annular Seal
35					
40					

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB

LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 394.59) (CONTINUED)
		Fill (FILL) dark gray to medium gray fine gravel to coarse gravel sized angular to subangular mudstone/siltstone within a medium gray silty matrix *(Con't)*	391.6		
45					
		@ approx. 52.0' dark gray to medium gray mudstone/siltstone to light brown sandstone fragments within a brownish gray to medium brown to orangish brown with reddish brown mottling silty to clayey matrix			**Annular Seal**
50					
55					
60					
			327.6		**Filter Pack**
65		**Mudstone (MUDSTONE)** no recovered core only fine gravel to coarse gravel sized angular fragments, @ approx. 66' trace coal fragments carbonaceous mudstone, interbedded/interlayered coal and rock core breaks along horizontal planes when struck with hammer			
70			320.6		**Screen Tip Elevation**

Bottom of borehole at 71.0 feet.

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/13/17 15:23 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 1/15/2014 COMPLETED 1/16/2014 SURF. ELEV. 413.2 COORDINATES: N:1,329,140.73 E:593,813.96
CONTRACTOR CFS EQUIPMENT METHOD CME
DRILLED BY S. Milam LOGGED BY G. Dyer CHECKED BY
BORING DEPTH 69.5 ft. GROUND WATER DEPTH: DURING COMP. DELAYED 61.02 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 415.68)
0		**Fill (FILL)** Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments	413.2		Surface Seal
5					
10					
15					
20					Annular Fill
25					
30					
35					
40					

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas
LOCATION

DATE STARTED 12/2/2015 **COMPLETED** **SURF. ELEV.** Not Surveyed **COORDINATES:**
CONTRACTOR Cascade Drilling **EQUIPMENT** Prosonic **METHOD** Sonic
DRILLED BY L. Yancey **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
BORING DEPTH 107 ft. **GROUND WATER DEPTH: DURING** **COMP.** 20.4 ft. **DELAYED**
NOTES Left open with casing in ground to 107 ft per G. Dyer.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	Natural Gamma (75, 150, 225)	WELL DATA Top of casing Elev. = Not Surveyed
0–8		**Partially Weathered Rock (GM)** black (10YR 2/1) fill moist, silty, well graded, clayey, possible coal seam		
8–17		**Well-graded Gravel with Silt (GM)** dusky red / dark reddish brown (10R 3/4) saprolite dry, well graded, angular		
10				
17–30		**MUDSTONE** medium dark gray (N4) medium hard to hard, slightly to moderately weathered, completely fractured, interbedded sandstone, oxidized		
20	▼			
30		**SANDSTONE** medium dark gray (N4) fine grain, hard, not weathered, horizontal, moderate to not fractured, moderate to massively shaly bedding, poorly graded		
40		medium dark gray (N4) fine grain, hard, slightly to moderately weathered, horizontal, shaly zone		
		medium dark gray (N4) fine grain, hard, not to slightly weathered, horizontal, shaly, interbedded mudstone		
50		moderately fractured		
60				

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. =) (CONTINUED)
		SANDSTONE medium dark gray (N4) fine grain, hard, not weathered, horizontal, moderate to not fractured, moderate to massively shaly bedding, poorly graded *(Con't)*	Not Surveyed	
70		small coal seam		
		more massive		
80		with thin shaly bedding		
90		medium dark gray (N4) fine grain, hard, slightly to moderately weathered, horizontal, shaly zone		
		medium dark gray (N4) fine grain, medium hard to hard, slightly to moderately weathered, horizontal, intensly to moderately fractured, shaly, interbedded sandstone/mudstone		
100				

Bottom of borehole at 107.0 feet.

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA Top of casing Elev. = 415.68 (CONTINUED)
		Fill (FILL) Backfilled Spoil consisting of rock fragments, silty clay, clayey silt, and lesser amounts of sand and coal fragments *(Con't)*	413.2		
45					**Annular Fill**
50					
55					**Annular Seal**
60					**Filter Pack**
65		**Shale (SHALE)** pottsville formation, lenticular bedding	348.7		
			343.7		**Screen Tip Elevation**

Bottom of borehole at 69.5 feet.

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas
LOCATION

DATE STARTED 12/2/2015 **COMPLETED** **SURF. ELEV.** Not Surveyed **COORDINATES:**
CONTRACTOR Cascade Drilling **EQUIPMENT** Prosonic **METHOD** Sonic
DRILLED BY L. Yancey **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
BORING DEPTH 107 ft. **GROUND WATER DEPTH: DURING** **COMP.** 20.4 ft. **DELAYED**
NOTES Left open with casing in ground to 107 ft per G. Dyer.

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	Natural Gamma (75 / 150 / 225)	WELL DATA (Top of casing Elev. = Not Surveyed)
		Partially Weathered Rock (GM) black (10YR 2/1) fill moist, silty, well graded, clayey, possible coal seam		
10		**Well-graded Gravel with Silt (GM)** dusky red / dark reddish brown (10R 3/4) saprolite dry, well graded, angular		
20		**MUDSTONE** medium dark gray (N4) medium hard to hard, slightly to moderately weathered, completely fractured, interbedded sandstone, oxidized		
30		**SANDSTONE** medium dark gray (N4) fine grain, hard, not weathered, horizontal, moderate to not fractured, moderate to massively shaly bedding, poorly graded		
40		medium dark gray (N4) fine grain, hard, slightly to moderately weathered, horizontal, shaly zone		
		medium dark gray (N4) fine grain, hard, not to slightly weathered, horizontal, shaly, interbedded mudstone		
50		moderately fractured		
60				

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	Natural Gamma (75, 150, 225)	WELL DATA Top of casing Elev. = (CONTINUED)
		SANDSTONE medium dark gray (N4) fine grain, hard, not weathered, horizontal, moderate to not fractured, moderate to massively shaly bedding, poorly graded *(Con't)*	Not Surveyed	
70		small coal seam		
		more massive		
80		with thin shaly bedding		
90		medium dark gray (N4) fine grain, hard, slightly to moderately weathered, horizontal, shaly zone		
		medium dark gray (N4) fine grain, medium hard to hard, slightly to moderately weathered, horizontal, intensly to moderately fractured, shaly, interbedded sandstone/mudstone		
100				

Bottom of borehole at 107.0 feet.

BORING MW-11

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/30/2014 **COMPLETED** **SURF. ELEV.** 403.7 **COORDINATES:** N:1,328,108.24 E:594,813.97
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 136 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 104.09 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 406.69)
			403.7		
0		**Fill (FILL)** dark gray to medium gray upper coarse sand to coarse gravel sized angular to subangular mudstone/siltstone with trace sandstone fragments within a dark gray to medium gray silty matrix			**Surface Seal**
		trace bolder sized rock fragments due to pulverized rock powder and trace core pieces recovered			
10					**Annular Fill**
20		trace zones of interlayered reddish brown to orangish brown gravelly silt and gravelly clay with dark gray the medium gray subangular to subrounded rock fragments			
30					
40					**Annular Seal**
50		trace reddish brown to rusty red staining on some rock fragments			
60		trace orangish brown to reddish brown clayey zones			

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 406.69) (CONTINUED)
		Fill (FILL) dark gray to medium gray upper coarse sand to coarse gravel sized angular to subangular mudstone/siltstone with trace sandstone fragments within a dark gray to medium gray silty matrix *(Con't)*	403.7		
70					
80		dark gray to medium gray silty matrix grading to light brown to orangish brown gravelly silt matrix (overburden layer) with subangular to subrounded dark gray to medium gray to reddish brown coarse sand to fine gravel sized mudstone/siltstone and trace sa			
90		trace coal fragments included in a light brown to orangish brown to grayish brown silty to clayey matrix			Annular Seal
100		dark gray to medium gray to light brown upper coarse sand to coarse gravel with trace cobble sized angular to subangular rock fragments within an orangish brown to brownish gray sandy silt matrix			
110		trace coal fragments and coal dust increasing with depth			
120		dark gray to medium gray rock fragments within a dark gray to medium gray silty matrix, @ approx. 124' - 125' light brown to orangish brown silt with fine gravel sized angular rock fragments (overburden layer)	278.7		Filter Pack
130		**Mudstone (Mudstone)** @ approx. 125' - 126' light gray pulverized rock powder with coarse sand to fine gravel sized brittle/friable mudstone fragments, @ 127' tagged up competent rock - dark gray to medium gray mudstone that breaks along horizontal planes when struck with a ha	267.7		Screen Tip Elevation

Bottom of borehole at 136.0 feet.

SIMPLE GEOLOGY WITH WELL - ESEE DATABASE.GDT - 10/13/17 15:23 - T:\ESEE MAJOR PROJECTS\PROJECTS\GORGAS\GORGAS 2015\ES2418_HYDROGEO CHARACTER REPORT_CCB\DATA\BORING LOGS\PLANT GORGAS CCB.GPJ

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/3/2014 **COMPLETED** **SURF. ELEV.** 470.7 **COORDINATES:** N:1,328,563.73 E:594,741.23
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 166 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 152.33 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75, 150, 225)	WELL DATA (Top of casing Elev. = 473.74)
0		**Fill (FILL)** dark gray to medium gray upper coarse sand to coarse gravel with trace cobble sized angular to subangular mudstone/siltstone fragments within a dark gray to medium gray silty matrix	470.7		**Surface Seal**
10					**Annular Fill**
20		trace reddish brown to rusty red staining on some rock fragments			
30					
40		trace zones of orangish brown silt and clay matrix with upper coarse sand to fine gravel sized rock fragments, trace orangish brown sandstone fragments			
50		dark gray to medium gray upper coarse sand to coarse gravel with trace cobble sized angular to subangular mudstone/siltstone fragments within a dark gray to medium gray silty matrix			**Annular Seal**
60		trace zones of orangish brown silt and clay matrix with upper coarse sand to fine gravel sized rock fragments, trace orangish brown sandstone fragments			
70					
80		dark gray to medium gray upper coarse sand to coarse gravel with trace cobble sized angular to subangular mudstone/siltstone fragments within a dark gray to			

(Continued Next Page)

SOUTHERN COMPANY

BORING LOG

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION	Natural Gamma (75 / 150 / 225)	WELL DATA (Top of casing Elev. = 473.74)
		medium gray silty matrix **Fill (FILL)** dark gray to medium gray upper coarse sand to coarse gravel with trace cobble sized angular to subangular mudstone/siltstone fragments within a dark gray to medium gray silty matrix*(Con't)*	470.7		(CONTINUED)
90		zone of lower coarse to fine gravel sized rock fragments within a dark gray silty matrix, poorly graded zone			
100		trace cobble to bolder sized rock fragments within a dark gray to medium gray matrix			
110		increase in bolder sized fragments due to increased core pieces recovered			
120					Annular Seal
130					
140		dark gray to medium gray fine gravel to cobble sized mudstone/siltstone fragments within a dark gray to brownish gray silty matrix, trace rusty red to reddish brown staining, zones of light gray pulverized rock powder			
150					
160		increase in bolder sized rock fragments	311.7		Filter Pack
		Mudstone (MUDSTONE) carbonaceous mudstone with trace coal spars, graphite like luster, brittle/friable with firm zones, core breaks easily along horizontal planes when struck with hammer, very dark gray to black, very fine to upper fine, soft limited intact core recovered, dark gray to medium gray	304.7		Screen Tip Elevation

Bottom of borehole at 166.0 feet.

RECORD OF BOREHOLE GS-LF-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 230.00 ft
LOCATION: Gorgas Landfill

DRILL RIG: TSI 150CC
DATE STARTED: 2/27/19
DATE COMPLETED: 3/1/19

NORTHING: 1,328,481.68
EASTING: 2,063,196.25
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
0		0.00 - 0.10 Note: Retrieved silt/clay-sized material throughout is considered to be mostly rock flour induced by the drilling process.			0.10				
		0.10 - 20.00 (GP), GRAVEL, some silt, trace sand, gravels of highly weathered shale, fine to coarse; light gray to brown; non-cohesive, dry. [FILL]	GP						Grout (Aquaguard)
	475								
5						1		4.50 / 10.00	
	470								
10									
	465								
15						2		6.50 / 10.00	
	460								
20		20.00 - 90.00 (GM), silty GRAVEL, fine to coarse, trace COAL, trace sand, some cobbles of highly weathered shale; gray to brown with some orange mottling; non-cohesive, moist to dry; possible ash. [FILL]	GM		458.64 20.00				
	455								
25						3		6.00 / 10.00	
	450								
30									
	445								
35						4		7.00 / 10.00	
	440								
40									

Log continued on next page

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 193'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 193' - 203'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 191' - 204.5'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 187' - 191'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 187'
Type: Grout (Aquaguard)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

DRAFT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-LF-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 230.00 ft
LOCATION: Gorgas Landfill

DRILL RIG: TSI 150CC
DATE STARTED: 2/27/19
DATE COMPLETED: 3/1/19

NORTHING: 1,328,481.68
EASTING: 2,063,196.25
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
40		20.00 - 90.00 (GM), silty GRAVEL, fine to coarse, trace COAL, trace sand, some cobbles of highly weathered shale; gray to brown with some orange mottling; non-cohesive, moist to dry; possible ash. [FILL] *(Continued)*							
	435								
45						5		8.50 / 10.00	
	430								
50									
	425								
55						6		8.50 / 10.00	
	420								
60			GM						
	415								
65						7		4.50 / 10.00	
	410								
70									
	405								
75						8		6.50 / 10.00	
	400								
80									

Log continued on next page

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 193'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 193' - 203'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 191' - 204.5'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 187' - 191'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 187'
Type: Grout (Aquaguard)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-LF-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 230.00 ft
LOCATION: Gorgas Landfill

DRILL RIG: TSI 150CC
DATE STARTED: 2/27/19
DATE COMPLETED: 3/1/19

NORTHING: 1,328,481.68
EASTING: 2,063,196.25
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
80		20.00 - 90.00 (GM), silty GRAVEL, fine to coarse, trace COAL, trace sand, some cobbles of highly weathered shale; gray to brown with some orange mottling; non-cohesive, moist to dry; possible ash. [FILL] *(Continued)*							
	395								
85			GM			9		7.50 / 10.00	
	390				388.64				
90		90.00 - 100.00 (GC), silty clayey GRAVEL, some sand, fine to coarse; brown-gray with orange; cohesive, w < PL, soft to firm; possible ash/coal. [FILL]			90.00				
	385								
95			GC			10		4.50 / 10.00	
	380				378.64				
100		100.00 - 110.00 (GM), clayey silty GRAVEL, some sand, fine to coarse; brown-gray to gray; non-cohesive, moist to dry; possible ash/coal. [FILL]			100.00				
	375								
105			GM			11		6.50 / 10.00	
	370				368.64				
110		110.00 - 116.00 (CL), gravelly sandy CLAY, some silt, fine to coarse sand, fine to coarse gravel; orange-brown; cohesive, w ~ PL, soft to firm. [FILL]			110.00				
	365		CL						
115						12		6.00 / 10.00	
		116.00 - 160.00 (GM), silty GRAVEL, fine to coarse; gray to gray-brown, some orange mottling; non-cohesive, dry to wet; possible ash/coal. [FILL]			362.64 / 116.00				
	360		GM						
120									

Log continued on next page

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 193'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 193' - 203'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 191' - 204.5'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 187' - 191'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 187'
Type: Grout (Aquaguard)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-LF-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 230.00 ft
LOCATION: Gorgas Landfill

DRILL RIG: TSI 150CC
DATE STARTED: 2/27/19
DATE COMPLETED: 3/1/19

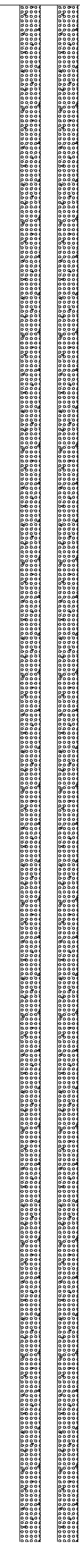
NORTHING: 1,328,481.68
EASTING: 2,063,196.25
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: SAMPLE NO.	TYPE	REC
120		116.00 - 160.00 (GM), silty GRAVEL, fine to coarse; gray to gray-brown, some orange mottling; non-cohesive, dry to wet; possible ash/coal. [FILL] *(Continued)*						
	355							
125						13		7.00 / 10.00
	350							
130		130.00 - 140.00 Some clay, some sand.						
	345							
135						14		7.00 / 10.00
	340							
140		140.00 - 160.00 Some cobbles of weathered shale/siltstone.	GM		338.64 / 140.00			
	335							
145						15		7.50 / 10.00
	330							
150								
	325							
155						16		7.00 / 10.00
	320							
160					318.64			

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 193'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 193' - 203'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 191' - 204.5'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 187' - 191'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 187'
Type: Grout (Aquaguard)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-LF-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 230.00 ft
LOCATION: Gorgas Landfill

DRILL RIG: TSI 150CC
DATE STARTED: 2/27/19
DATE COMPLETED: 3/1/19

NORTHING: 1,328,481.68
EASTING: 2,063,196.25
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
160		160.00 - 170.00 (GP), GRAVEL, some sand, trace silt, gravels and cobbles of moderately weathered shale/siltstone; gray to gray-brown with some orange mottling; non-cohesive, moist to wet. [FILL]	GP	160.00 308.64	17		8.50 / 10.00	
170		170.00 - 174.20 (GC), clayey GRAVEL, some silt, some sand; dark gray; cohesive, w ~ PL, soft to firm; possible coal/ash. [FILL]	GC	170.00 304.44				
174.2		174.20 - 180.00 (GM), silty GRAVEL, fine to coarse, some COAL fragments; light gray; non-cohesive, moist to dry; possible ash. [FILL]	GM	174.20 298.64	18		7.50 / 10.00	
180		180.00 - 204.00 Fresh; medium strong; gray to light gray; interbedded SANDSTONE and SILTSTONE. 181.00 - 190.00 Burrow structures.		180.00 288.64	19		10.00 / 10.00	Bentonite Pel-Plug Time Release Pellets
190					20		8.50 / 10.00	Filter Media #10 Sand 2" PVC Sch 40 0.010 Slot U-Pack
200								

Depth scale: 160, 165, 170, 175, 180, 185, 190, 195, 200. Elevation scale: 315, 310, 305, 300, 295, 290, 285, 280.

Log continued on next page

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 193'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 193' - 203'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 191' - 204.5'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 187' - 191'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 187'
Type: Grout (Aquaguard)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

RECORD OF BOREHOLE GS-LF-MW-12V

PROJECT: Gorgas Ash Pond
PROJECT NUMBER: 18114896
DRILLED DEPTH: 230.00 ft
LOCATION: Gorgas Landfill

DRILL RIG: TSI 150CC
DATE STARTED: 2/27/19
DATE COMPLETED: 3/1/19

NORTHING: 1,328,481.68
EASTING: 2,063,196.25
GS ELEVATION: 478.64
TOC ELEVATION: 481.32 ft

DEPTH W.L.:
DATE W.L.:
TIME W.L.:
GW ELEVATION:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLE NO.	TYPE	REC
200		180.00 - 204.00 Fresh; medium strong; gray to light gray; interbedded SANDSTONE and SILTSTONE. *(Continued)* 200.00 - 204.00 Possible iron staining; fossiliferous, burrows.			274.64 204.00			
205	275	204.00 - 230.00 Fresh to slightly weathered; weak to medium strong; gray to dark gray; some burrow structures; SILTSTONE and SHALE interbeds. 205.00 - 210.00 Some SANDSTONE partings.			268.64 210.00	21		8.50 / 10.00
210	270	210.00 - 212.00 Crushed/Fractured zone, fractures at all angles.			266.64			
		212.10: Possible 2" vertical fracture.						
215	265	215.00 - 216.00 Crushed/Fractured zone, fractures at all angles.			262.64	22		8.50 / 10.00
	260	219.00 - 220.00 Crushed/Fractured zone, fractures at all angles.			258.64			
225	255					23		6.50 / 10.00
230	250	Boring completed at 230.00 ft			248.64			
235	245							
240	240							

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

Sand Filter Pack

3/8" Hole-Plug Bentonite Chips

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0' - 193'
Material: Schedule 40 PVC
Diameter: 2"
Joint Type: Flush

WELL SCREEN
Interval: 193' - 203'
Material: Schedule 40 PVC U-Pack
Diameter: 2"
Slot Size: 0.010"
End Cap: 6", 2"-diameter, Sump

FILTER PACK
Interval: 191' - 204.5'
Type: Filter Media #10 Sand

FILTER PACK SEAL
Interval: 187' - 191'
Type: Bentonite Pellets

ANNULUS SEAL
Interval: 0' - 187'
Type: Grout (Aquaguard)

WELL COMPLETION
Pad: 4'x4' Concrete Pad
Protective Casing: 3' Stick-Ups

DRILLING METHODS
Soil Drill: Sonic
Rock Drill: Sonic

DRAFT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: J. Asua

GA INSPECTOR: Chris Tidwell
CHECKED BY: David Hannam
DATE: 4/5/19

Golder Associates

BOREHOLE RECORD 18114896 _ GORGAS WELLS (1).GPJ PIEDMONT.GDT 4/5/19

GEOPHYSICAL RECORD OF BOREHOLE: GS-LF-MW-12V

PLANT GORGAS LANDFILL DELINEATION WELLS

GOLDER

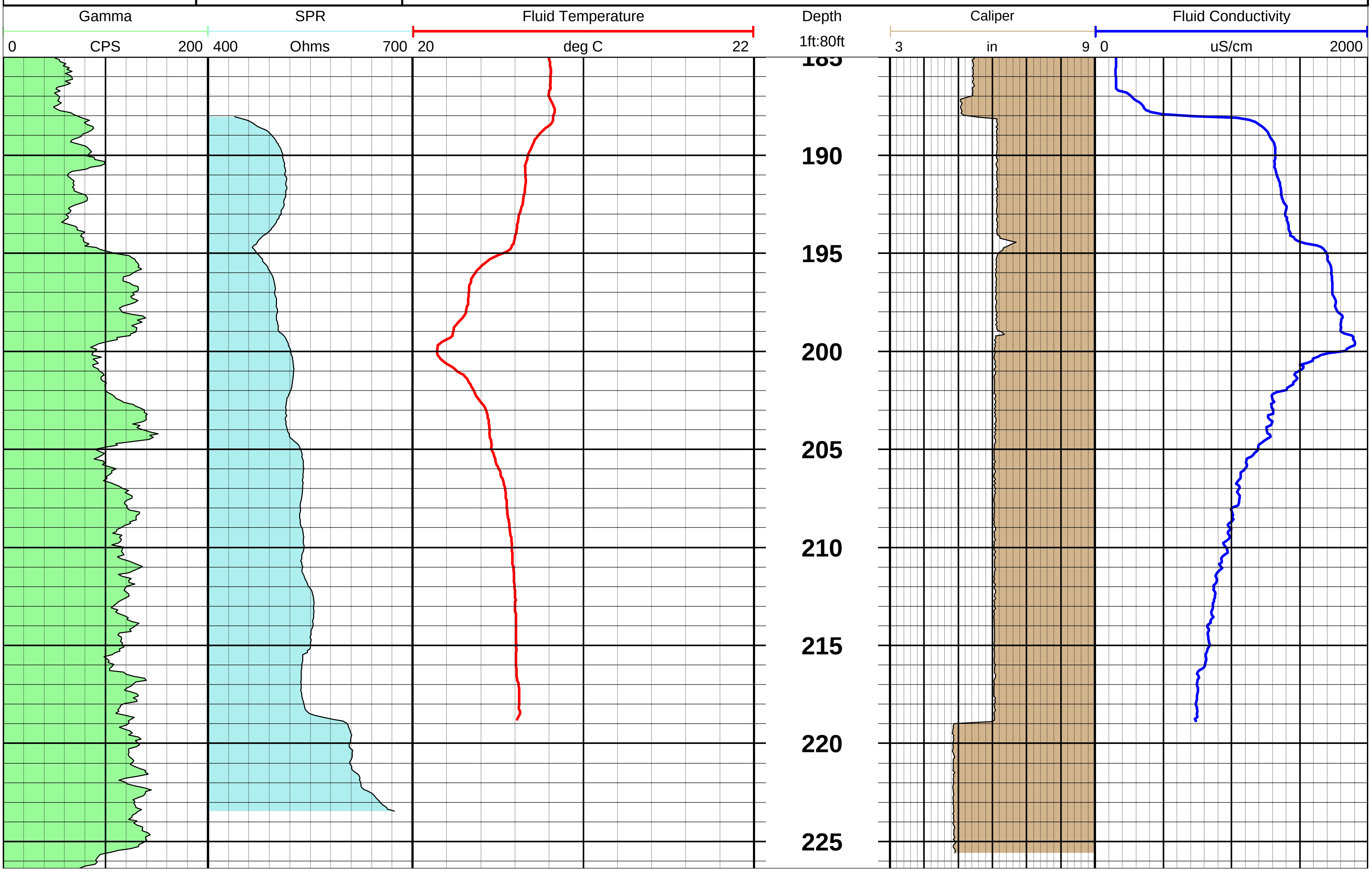
Project Number: 18114896

Client: Southern Company Services

Southern Company

Date: 3-1-2019

Location: Parrish, Al	TOC Elev msl: na	Notes: WL = 116.90-15:00/115.35 -16:00
Easting: na	Casing Stick-up: 1.9 ft ags	Deviation data recorded with MSI rental QL40-DEV sn182909.
Northing: na	Casing Diameter: 5.4 in ID	Tilt at BOH = 0.8 deg
Ground Elev msl: na	Casing Material: Steel	Tools used were:
Borehole Dip: vertical	Water Level: 156.4 ft bgs	QL40 FTC sn5518
Borehole Az: na	Logged By: CM	QL40 Caliper sn5521
Borehole Size: 6" Sonic	Log Depth Ref: Ground	Gamma + SPR 40-LGR sn5809
Drilled Depth: 230 ft	Log Date: 3-1-2019	
Drill Comp Date: 3-1-2019	Image Plot(s) Ref: MN	
Casing Depth: 188 ft bgs	Dip Referenced to Horizontal	



SOUTHERN COMPANY

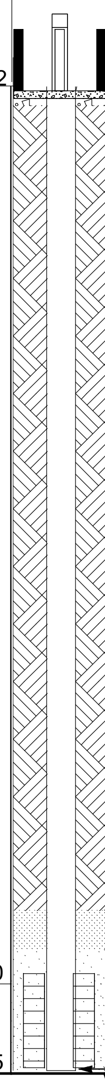
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 1/13/2014 **COMPLETED** 1/15/2014 **SURF. ELEV.** 499.2 **COORDINATES:** N:1,330,794.06 E:594,082.36
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 104.7 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 88.92 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION	WELL DATA	NOTES:
0 – 95		Fill (FILL)	499.2		
95 – 104.7		Shale (mudstone)	404.0		
		Bottom of borehole at 104.7 feet.	394.5		



Top of casing Elev. = 502.25

DEPTH

Surface Seal: concrete — 2.0

Annular Fill: 80/20 Portland Cement/Bentonite Powder — 87.4

Annular Seal: bentonite chips — 91.6

Filter Pack: 30/40 Silica Sand — 104.1

Screen Tip Elevation: 0.30 ft.

WELL SPECIFICATIONS

Casing Diameter: 2 inches **Screen Diameter:** 2 inches
Casing Material: Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
Casing Length: feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

SOUTHERN COMPANY

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

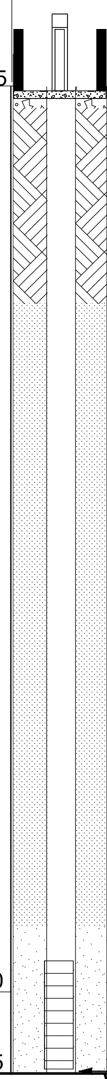
DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 498.5 **COORDINATES:** N:1,331,053.31 E:593,548.80
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 91 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 81.7 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION
0			498.5
0–84		**Fill (FILL)**	
84			415.0
84–91		**Mudstone (MUDSTONE)**	
91			407.5

Bottom of borehole at 91.0 feet.

WELL DATA

Top of casing Elev. = 501.54



Component	Material	Depth
Surface Seal:	concrete	2.0
Annular Fill:	80/20 Portland Cement/Bentonite Powder	20.0
Annular Seal:	bentonite chips	77.5
Filter Pack:	30/40 Silica Sand	90.6

Screen Tip Elevation: 0.40 ft.

NOTES:

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

SOUTHERN COMPANY

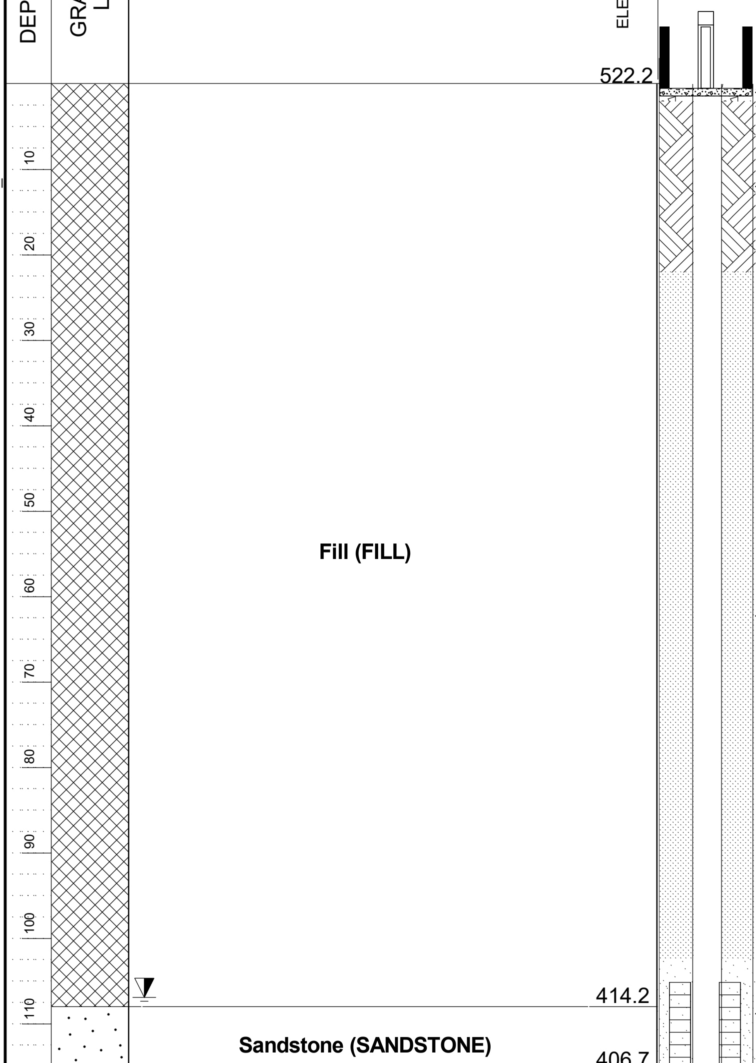
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/23/2014 **COMPLETED** **SURF. ELEV.** 522.2 **COORDINATES:** N:1,330,842.40 E:593,025.40
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 115.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 106.91 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION	WELL DATA	DEPTH	NOTES:
				Top of casing Elev. = 525.23		
0			522.2	Surface Seal: concrete	2.0	
				Annular Fill: 80/20 Portland Cement/Bentonite Powder	22.0	
		Fill (FILL)		Annular Seal: bentonite chips	102.5	
			414.2	Filter Pack: 30/40 Silica Sand	115.1	
		Sandstone (SANDSTONE)	406.7	Screen Tip Elevation: 0.40 ft.		



Bottom of borehole at 115.5 feet.

WELL SPECIFICATIONS

Casing Diameter: 2 inches **Screen Diameter:** 2 inches
Casing Material: Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
Casing Length: feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

SOUTHERN COMPANY

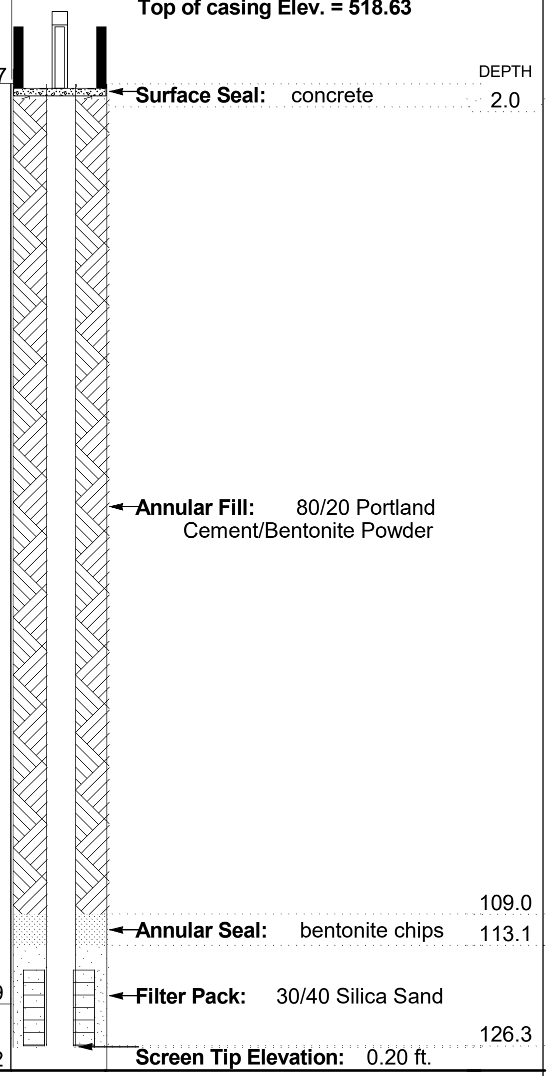
LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 2/12/2014 **COMPLETED** 2/19/2012 **SURF. ELEV.** 516.7 **COORDINATES:** N:1,330,289.73 E:592,896.41
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 129.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 116.59 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION	WELL DATA	NOTES:
0–121.0		**Fill (FILL)**	516.7	Top of casing Elev. = 518.63	
121.0–129.5		**Shale (SHALE)**	395.9		
			387.2		



Bottom of borehole at 129.5 feet.

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

SOUTHERN COMPANY

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

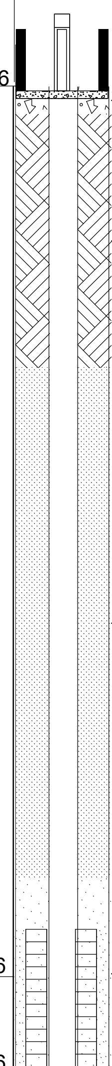
PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 10/29/2014 **COMPLETED** **SURF. ELEV.** 391.6 **COORDINATES:** N:1,328,515.24 E:593,408.34
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 71 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 58 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION
0–65		Fill (FILL)	391.6
65–71		Mudstone (MUDSTONE)	327.6
71		Bottom of borehole at 71.0 feet.	320.6

WELL DATA

Top of casing Elev. = 394.59



Well component	Material	DEPTH
Surface Seal:	concrete	2.0
Annular Fill:	80/20 Portland Cement/Bentonite Powder	20.2
Annular Seal:	bentonite chips	57.0
Filter Pack:	30/40 Silica Sand	70.6

Screen Tip Elevation: 0.40 ft.

NOTES:

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

SOUTHERN COMPANY

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

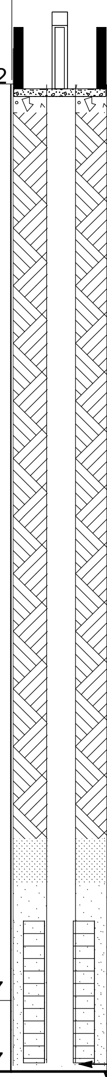
DATE STARTED 1/15/2014 **COMPLETED** 1/16/2014 **SURF. ELEV.** 413.2 **COORDINATES:** N:1,329,140.73 E:593,813.96
CONTRACTOR CFS **EQUIPMENT** **METHOD** CME
DRILLED BY S. Milam **LOGGED BY** G. Dyer **CHECKED BY**
BORING DEPTH 69.5 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 61.02 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION
0 – 65.5		Fill (FILL)	413.2
65.5 – 69.5		Shale (SHALE)	348.7
			343.7

Bottom of borehole at 69.5 feet.

WELL DATA

Top of casing Elev. = 415.68



Well component	Material	DEPTH
Surface Seal:	concrete	2.0
Annular Fill:	80/20 Portland Cement/Bentonite Powder	53.1
Annular Seal:	bentonite chips	56.3
Filter Pack:	30/40 Silica Sand	68.9
Screen Tip Elevation:	0.20 ft.	

NOTES:

WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

LOG OF WELL INSTALLATION

SOUTHERN COMPANY

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas
LOCATION

DATE STARTED 12/2/2015 **COMPLETED** **SURF. ELEV.** Not Surveyed **COORDINATES:**
CONTRACTOR Cascade Drilling **EQUIPMENT** Prosonic **METHOD** Sonic
DRILLED BY L. Yancey **LOGGED BY** S. Baxter **CHECKED BY** B. Coates
BORING DEPTH 107 ft. **GROUND WATER DEPTH: DURING** **COMP.** 20.4 ft. **DELAYED**
NOTES Left open with casing in ground to 107 ft per G. Dyer.

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	WELL DATA	NOTES:
			Top of casing Elev. = Not Surveyed	
		Partially Weathered Rock (GM)		
10		Well-graded Gravel with Silt (GM)		
20	▼	MUDSTONE		
30–100		SANDSTONE		

Bottom of borehole at 107.0 feet.

WELL SPECIFICATIONS

Casing Diameter: inches **Screen Diameter:** inches
Casing Material: **Screen Length:** feet **Screen Material:**
Casing Length: feet **Screen Mesh:** **PrePack Screen:**

SOUTHERN COMPANY

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

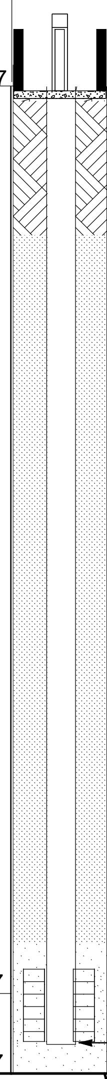
DATE STARTED 10/30/2014 **COMPLETED** **SURF. ELEV.** 403.7 **COORDINATES:** N:1,328,108.24 E:594,813.97
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 136 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 104.09 ft.
NOTES

DEPTH (ft)	GRAPHIC LOG	GENERAL STRATA DESCRIPTION	ELEVATION
0–127		Fill (FILL)	403.7
127–136		Mudstone (Mudstone)	278.7
136		Bottom of borehole at 136.0 feet.	267.7

Depth scale: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130

WELL DATA

Top of casing Elev. = 406.69



Component	Material	DEPTH
Surface Seal:	concrete	2.0
Annular Fill:	80/20 Portland Cement/Bentonite Powder	20.5
Annular Seal:	bentonite chips	118.0
Filter Pack:	30/40 Silica Sand	131.6
Screen Tip Elevation:	0.40 ft.	132.0
Backfill:	30/40 silica sand (sand up to 132.0')	

NOTES:

WELL SPECIFICATIONS

Casing Diameter: 2 inches **Screen Diameter:** 2 inches
Casing Material: Schedule 40 PVC **Screen Length:** 10 feet **Screen Material:** PVC
Casing Length: feet **Screen Mesh:** 0.010 **PrePack Screen:** Yes

BORING MW-12
PAGE 1 OF 1

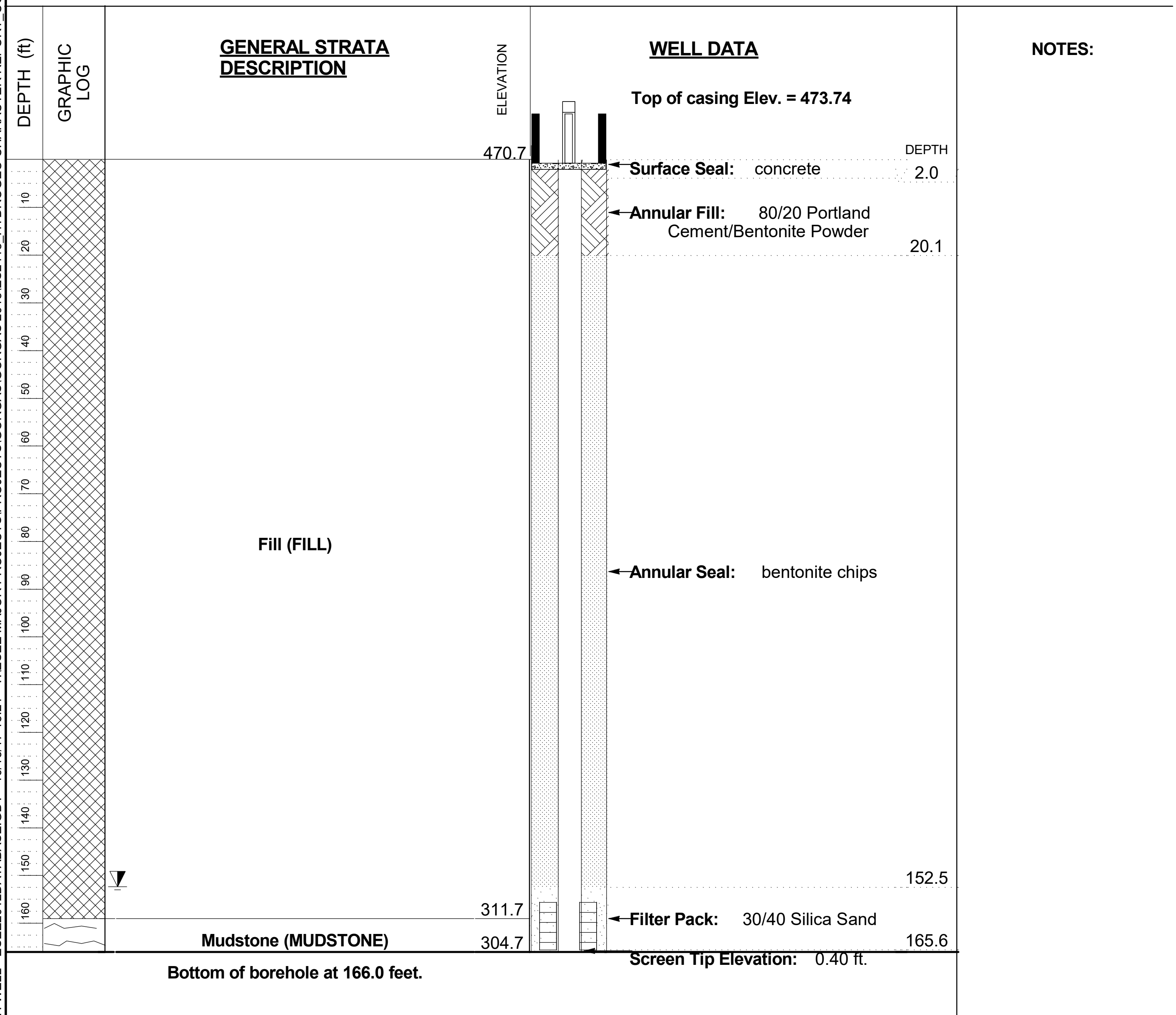
SOUTHERN COMPANY

LOG OF WELL INSTALLATION

SOUTHERN COMPANY SERVICES, INC.
EARTH SCIENCE AND ENVIRONMENTAL ENGINEERING

PROJECT Plant Gorgas CCB
LOCATION

DATE STARTED 11/3/2014 **COMPLETED** **SURF. ELEV.** 470.7 **COORDINATES:** N:1,328,563.73 E:594,741.23
CONTRACTOR Cascade Drilling **EQUIPMENT** J-1866 **METHOD** Rotosonic
DRILLED BY M. Coleman **LOGGED BY** B. Smelser **CHECKED BY**
BORING DEPTH 166 ft. **GROUND WATER DEPTH: DURING** **COMP.** **DELAYED** 152.33 ft.
NOTES



WELL SPECIFICATIONS

Casing Diameter: 2 inches
Casing Material: Schedule 40 PVC
Casing Length: feet
Screen Diameter: 2 inches
Screen Length: 10 feet
Screen Mesh: 0.010
Screen Material: PVC
PrePack Screen: Yes

Appendix B

ALABAMA POWER COMPANY
PLANT GORGAS
BOTTOM ASH LANDFILL
STATISTICAL ANALYSIS PLAN

Prepared for

Alabama Power Company
Birmingham, Alabama

Prepared by

Groundwater Stats Consulting
Mobile, Alabama

Revised August 2020

ALABAMA POWER COMPANY
PLANT GORGAS
BOTTOM ASH LANDFILL
STATISTICAL ANALYSIS PLAN

Kristina L. Rayner
Groundwater Stats Consulting, LLC
Originator

Gregory T. Whetstone, P.E.
Southern Company Services, Inc.
Reviewer

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

This updated Statistical Analysis Plan (SAP) describes the site-specific statistical analysis approach that will be used to evaluate groundwater at Alabama Power Company's Plant Gorgas Bottom Ash Landfill pursuant to ADEM Admin. Code r. 335-13-15-.06 and 40 CFR Part 257. 90 through 95 under detection and assessment monitoring programs.

A compliance groundwater monitoring well system was installed pursuant to requirements of 40 CFR 257.91(e)(1). A background well network is installed upgradient of the CCR unit. Downgradient monitoring wells were installed along the downgradient waste boundary pursuant to 40 CFR 257.91(a)(2). The compliance monitoring well network is described in the site-specific groundwater monitoring plan and summarized in the attached Table 1.

Alabama Power Company conducted 8 background monitoring sample events beginning in 2016. Samples were collected from the compliance monitoring wells and analyzed for CCR Appendix III and IV parameters pursuant to 40 CFR 257.91 Appendix III and IV parameters are as follows:

1) Appendix III (Detection Monitoring) - boron, calcium, chloride, fluoride, pH, sulfate, and TDS
2) Appendix IV (Assessment Monitoring) – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

This updated SAP has been developed based upon the characteristics of the groundwater quality data collected since groundwater monitoring was implemented in 2016 following the requirements in 40 CFR 257.91[1], and the United States Environmental Protection Agency (USEPA) Unified Guidance (March 2009)[2]. The plan describes:

[1] Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities, 2015.
[2] U.S. EPA, March 2009. *Unified Guidance*, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

1) Background data collection, management, and updates;
2) Statistical concepts applicable to detection and assessment monitoring programs;
3) Site-specific statistical analysis methods for Detection Monitoring; and
4) Statistical approach for Assessment Monitoring and Corrective Action.

As part of ongoing site activities, installation of additional wells may be necessary to characterize site conditions or supplement the assessment monitoring well network. The disposition of these additional wells will be described in the site groundwater monitoring plan. Procedures for statistically evaluating additional wells are described in this SAP.

Any change to the statistical analysis plan (e.g. statistical analysis method, background period, background data set, well network, screening method, etc.) will only be implemented upon receipt of approval from the Alabama Department of Environmental Management (Department).

2.0 BACKGROUND

This section describes the establishment, screening, update, and management of the background data sets used for detection, assessment and corrective action phases of groundwater monitoring. Included are descriptions of the tests that are used to determine whether the potential background data represent site-specific conditions and the procedures used to update (expand or truncate) the background data set. Also described are procedures that will be used to update the data set with more current monitoring data or as new background monitoring wells are installed.

Changes or updates to background updates will only be made after Department approval.

2.1 Background Screening

Background is determined based on site-specific conditions such upgradient wells, wells not in the groundwater flow path of the unit, or wells determined to not be affected by the disposal unit. Once background wells are selected based on site-specific conditions, the data are screened as follows:

2.1.1 Outlier Testing

An outlier is defined as an observation that is unlikely to have come from the same distribution as the rest of the data. A statistical outlier test, such as the 1989 EPA Outlier Test [3]or Tukey's Outlier Test as discussed in the USEPA Guidance, will be performed on the monitoring well data when time series plots or box and whiskers plots indicate the presence of extreme observations relative to other observations. The outlier test will serve as a data quality check to help identify errors from data entry and other sources.

Statistical outliers in the background data will be deselected unless it can be proven that the data point is not an anomalous value and does represent naturally occurring variation. This is conservative from a regulatory perspective in that it ensures that the background limits are not artificially elevated. When outliers are identified, they are flagged in the data set and the values excluded from background limit calculations. Re-testing for outliers will be performed when background updates are proposed.

2.1.2 Testing and Adjusting for Seasonal Effects

Testing and adjusting data for seasonal factors ensures that seasonal effects will not affect the test results. When seasonal effects are suspected, the Kruskal-Wallis seasonality test will be used to determine whether the seasonal effects are statistically significant when there are sufficient data to test for seasonality. When seasonal effects are confirmed, the data will be de-seasonalized prior to calculating a statistical limit. Data are de-seasonalized by subtracting the seasonal mean and adding back the grand mean to each observation. Background data will be re-tested when there are at least four new values available and a background update is proposed.

2.1.3 Temporal Trend Testing

The Sen's Slope/Mann-Kendall statistical analysis will be performed on all well/constituent pairs to evaluate concentrations over time. The Sen's Slope Estimator will be used to estimate the rate of change (increasing, no change, or decreasing) for each constituent at each well. The Mann Kendall statistic will be used to determine whether each of those trends is statistically significant. The Sen's Slope/Mann Kendall analysis requires at least five observations.

[3] 1953, "Processing data for outliers", *Biometrics*, Vol. 9, pp.74-89.

When a significant trend is present, older historical values may be deselected from the background data prior to computing background limits in cases where groundwater is presumed not to be impacted by the unit. The resulting limits will reflect more current conditions and will not be influenced by older, historical conditions that are no longer relevant. If upgradient concentration levels are changing over time (i.e. trending upward or downward), the prospective background data set may need to be truncated, removing older data to ensure that the resulting limits continue to represent current natural conditions.

For instance, when background concentration levels are increasing over time due to upgradient water quality changes, if the background data sets are not adjusted, the established PLs could result in increased false positive or false negative risk. In some cases, including older historical data in the background data set may result in overly sensitive limits and an increased chance of false positive readings. In other cases, using all background data when there are temporal changes in background levels may artificially elevate limits. This scenario may occur even when there is a decreasing trend in background concentration levels. An elevated limit under these circumstances is a direct result of an inflated standard deviation that is used in the computation of the parametric limit, which in turn will increase the risk of false negative test outcomes.

Well/constituent pairs that have increasing or decreasing concentration levels over time will be evaluated to determine if earlier data are no longer representative of present-day groundwater quality. In those cases, earlier data may be deselected prior to construction of limits to reduce variation as well as to provide limits that are conservative from a regulatory perspective that will detect future changes in groundwater quality.

Background limits also need to allow for random variation in groundwater concentration levels that are naturally present at a site. The availability of multiple background wells can give an indication of the natural variability in groundwater constituent levels across a site.

2.1.4 Sample Size

While a parametric prediction limit may be constructed with as little as four samples per well, the CCR Rule and the EPA Unified Guidance recommend that a minimum of at least 8 independent background observations be collected for constructing statistical limits. The reliability of the statistical results is greatly enhanced by increasing the sample size to eight or more. An increased sample size tends to more accurately characterize the variation and typically reduce the probability of erroneous conclusions. Furthermore, if a nonparametric prediction limit is required, the confidence level associated with the test will be dependent on the number of background data available as well as the number of comparisons to the statistical limit.

2.1.5 Non-Detect Data

When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit (RL) utilized for nondetects is the practical quantification limit (PQL) used by the laboratory.

When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit. Trace (or estimated) values which are reported above the method detection limit (MDL) and below the PQL/RL are used in the statistical analysis as reported by the laboratory. These values are flagged with “J” to distinguish between estimated values and values reported above the PQL.

If detection limits change over a period of analysis, then a statistically significant trend could be the result of increasing or decreasing laboratory precision and not an actual change in water quality. Under those circumstances, an appropriate substitution of the detection limit will be considered, such as the median or most recent detection limit.

2.2 Updating Interwell Background

The following describes the process that will be used to update interwell background data sets. Background updates described below will only be performed after Department approval.

Interwell statistical methods are constructed by pooling upgradient well data from 2 or more upgradient wells. For the Detection Monitoring program, background-derived Prediction Limits will be updated during each semi-annual event by incorporating the most recent sampling results from the existing background well network into the background data set. New background data will be screened for any new outliers as described above.

For the Assessment and Corrective Action program, background-derived tolerance limits are used to construct background limits using pooled upgradient well data for comparison against established standards. The tolerance limits will be updated every 2 years after screening as described above.

Once background has been established, the background well network may be updated by (1) adding wells to the background well network, or (2) removing wells and data from the background well network. The following describes the additional statistical screening steps that will be taken to update the background after a site-specific determination is made that the wells meet the hydraulic and geochemical requirements of a background location.

2.2.1 Adding to the Background Well Network

The background data set may be updated or adjusted by incorporating new wells into the network or installing new background monitoring wells. When new wells are installed, the following process will be used to statistically evaluate the results and incorporate them into the background data set upon receipt of ADEM approval.

Prior to incorporating new upgradient well data for construction of statistical limits, Tukey's outlier test and visual screening are used to evaluate data. Any confirmed outliers are flagged as such in the database and deselected prior to construction of interwell prediction limits. Any flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. A summary of Tukey's test results and flagged values will be provided with the report.

Upgradient well data will be further tested for trends as described earlier. When no statistically significant trends are identified, all new well data will be incorporated into the background. Any records with trending data will be evaluated on a case by case basis, and records may require deselection if historical data are no longer representative of present-day groundwater quality conditions. Interwell prediction limits using all upgradient well data are re-calculated as a result of this screening.

2.2.2 Removing Wells and Data from Background

As additional background data are collected, or site conditions change, a recommendation may be made to remove a well from the background network for any number of reasons (e.g. removal, change in groundwater flow conditions, change in chemistry, vandalism, etc.). If an upgradient well will no longer be part of the background network, the historical data from that well will no longer be included in the construction of interwell limits (which pool upgradient well data) without Department approval.

When wells are proposed for removal from the network, a site-specific statistical and geochemical evaluation will be made to identify the population(s) of data that may not represent background conditions. A proposal will be submitted to the Department for approval identifying the recommended use or disuse of historical data from the well(s) proposed for removal. The proposal will include statistical data screening and will explain the rationale for the proposed use of the data.

In the case where an upgradient well is no longer sampled (i.e. due to well damage, etc.), but historical data are still representative of upgradient water quality, an evaluation will be conducted as described below to determine whether data are still representative of background and should continue to be included in the background data set. When demonstration shows that groundwater quality from a well is still representative of naturally occurring groundwater quality upgradient of the facility, this data will be used in construction of statistical limits with ADEM approval. In cases where data from upgradient wells removed from the network do not represent upgradient groundwater quality, a proposal will be made for ADEM approval whereby interwell prediction limits will be re-calculated using data from only those upgradient wells in the network.

When preparing a background data evaluation for Department approval, the statistical portion of the evaluation will be accomplished by:

i. Using the ANOVA to determine whether significant variation exists among upgradient wells which would prevent the well’s data from being included in construction of interwell prediction limits;
ii. Visual screening using Time Series and Box Plots to determine whether measurements are similar to neighboring upgradient wells;
iii. Screening the background data set for outliers as described above; and

iv. Performing trend tests to identify statistically significant increasing or decreasing trends which may require adjustment of the record to eliminate trending data and reduce variation.

2.3 Updating Intrawell Background

Intrawell statistical methods may be used at well locations that have not been impacted by a release from the unit being monitored. When using intrawell methods, once the background limits are established, data will not be evaluated again for updating until a minimum of 4 new samples are available, or every 2 years[4]. Data will be screened for outliers and trends as described above.

When updating an intra-well background, data are tested for suitability of updating by consolidating new sampling observations with the screened background data. Before updating the data for intrawell testing, it is necessary to verify that the most recent observations represent an unimpacted state as compared with the existing background. Data are first screened for outliers and, when confirmed, flagged as such in the database and deselected prior to constructing statistical limits. This step results in statistical limits that are conservative from a regulatory perspective.

The Mann-Whitney (Wilcoxon Rank Sum) two-sample test is then used to compare the median of the first group of background observations to the median of the more recent 4 or more observations. If the most recent data group is not found to be statistically different than the older data, the background data set may be updated and the prediction limits will be reconstructed to include the more recent background samples. When statistical differences are identified by the Mann Whitney test, statistical limits may not be eligible for updating. When more samples are available, data will be tested again for suitability of updating background data sets. In the event it is determined that the historical data are no longer representative of present-day groundwater quality in the absence of suspected impacts, only the more recent 8 or more measurements will be used to update the prediction limits.

[4] US EPA Unified Guidance, March 2009. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities – Section 5.3*. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

3.0 STATISTICAL APPROACH FOR DETECTION MONITORING

The following sections describe the concepts related to developing a site-specific SAP for detection monitoring. The statistical evaluation includes screening upgradient well data to characterize groundwater upgradient of the facility and determine whether intrawell or interwell methods are recommended as the most appropriate statistical method for each Appendix III constituent.

3.1 Statistical Method

When data from multiple upgradient wells are available, a determination will be made as to whether the upgradient well data appear to come from the same population or whether there is evidence of spatial variation upgradient of the facility. Data for each constituent are plotted using box and whisker plots to assist in making this determination, providing visual representation of concentrations within and across wells. Analysis of Variance (ANOVA) may be used initially to statistically evaluate whether significant spatial variation exists at each unit.

Interwell prediction limits (PLs) pool upgradient well data to construct statistical limits which are used to evaluate data at downgradient wells. These tests are appropriate when the ANOVA determines that no significant spatial variation exists among the background wells.

In the event the ANOVA determines:

1) evidence of significant spatial variation upgradient of the facility, or
2) that there are insufficient upgradient well data, or
3) that interwell methods will not adequately address the question of a change in groundwater quality at any of the downgradient wells,

the USEPA Unified Guidance recommends switching from interwell methods to intrawell methods when it can be reasonably demonstrated that no impact from the CCR unit is present for well/constituent pairs in detection monitoring.

Intrawell PLs, which compare the most recent sample from a given well to statistical limits constructed from historical measurements at the same well, are extremely useful for rapidly detecting changes over time at a given location. Intrawell methods remove the influence of on-site spatial variation in well-to-well concentration levels. Site monitoring data are evaluated for the appropriateness of intrawell methods, including screening of background data from within each well for trends, seasonality when sufficient data are available, and outliers.

3.2 Prediction Limits

The use of PL tests is restricted to Appendix III parameters recently sampled at groundwater monitoring wells to represent *current* conditions. Background stability will be tested using temporal and seasonal trend tests, utilizing de-seasonalizing adjustments when seasonal trends are present. Moreover, statistical conditions including background sample size requirements as specified in USEPA guidance and regulations will be verified prior to the use of each statistical approach.

3.3 Criteria for Using the Interwell Statistical Methodology

There are a number of conditions that need to be met before an interwell statistical analysis can be considered appropriate for a specific site. These conditions are described in this section.

1. Ensuring that the aquifer underlying the site is continuous and that all monitoring wells are screened in the same level;
2. Ensuring that limits will be adequately sensitive in detecting a facility release;
3. Ensuring that limits reflect current background conditions; and
4. Ensuring that confounding factors will not confuse the results.

3.3.1 Aquifer Designation and Monitoring Wells

Where the uppermost aquifer underlying a site is discontinuous, where downgradient monitoring wells are screened in differing levels, or where the upgradient monitoring well network is limited, EPA recommends performing intrawell analyses, to avoid confusing an impact caused by a release from the facility with a difference between wells caused by heterogeneous hydrogeology.

The statistical approach for constituents of concern will be based on interwell or intrawell PLs, and in some cases a combination of both methods, as a result of evaluation of spatial variation at the site. Box and whisker plots may be provided to demonstrate concentration levels within each well and across wells. When significant differences exist in concentration levels, particularly between upgradient wells, this indicates spatial variation in the groundwater quality. Spatial variation and/or limited upgradient well data would tend to create statistical limits that are:

1) not conservative from a regulatory perspective; or
2) not representative of background water quality.

3.4 Criteria for Using an Intrawell Statistical Methodology

The following is a description of the criteria that a site must meet to use an intrawell statistical methodology if it is determined that interwell methods are not appropriate.

3.4.1 Screening of Prospective Historical Background Data

Prior to using an intrawell analysis, it will be necessary to demonstrate that there have been no potential prior impacts at downgradient wells on the prospective historical background data as a result of the current practices at the Site. In addition to an independent investigation for prior impacts, prospective background data for intrawell tests will be screened for trends, seasonality and outliers as described above. If intrawell analyses are not feasible due to elevated concentrations in downgradient wells relative to concentrations upgradient of the facility, as determined during the screening process, interwell analyses will initially be utilized until further evidence supports the use of intrawell testing.

3.4.2 Stable Naturally Occurring Concentrations

The background data screening procedure described here is designed to check for stable background conditions, and account for existing groundwater quality from past or present activities in the area. While having pre-waste data is ideal for characterization of groundwater quality prior to waste placement, these facilities do not have pre-waste data.

The Sen's Slope/Mann-Kendall test for increasing or decreasing temporal trends will be used to test prospective background data when time series plots indicate the possibility of either increasing or decreasing trends over time. In the case where significant trends are found, unrepresentative values will be deselected only when it is clear that the trend is not the result of contamination. Assuming no alternative source, if similar trends and/or concentration levels are noted upgradient of the unit for the same parameters, it will be assumed that concentration levels represent natural variation in groundwater, and thus, earlier data will be removed so that compliance limits reflect current groundwater conditions upgradient of the unit.

3.5 Site-Wide False Positive Rates (SWFPR) and Statistical Power

The USEPA Unified Guidance recommends an annual site-wide false positive rate of 10%, which is distributed equally among the total number of sampling events. A site-wide false positive rate of 5% is targeted for each semi-annual sampling event. USEPA also requires demonstration that the statistical methodology selected for a facility will provide adequate statistical power, as discussed in Section 3.7 to detect a release, should one occur.

3.6 Determination of Future Compliance Observations Falling Within Background Limits

Intrawell or interwell upper PL are constructed with a test-specific alpha based on the overall site-wide false positive rate (SWFPR) of 5% for each sampling event. Any compliance observation that exceeds the background prediction limit will be followed with one or two independent resamples, depending on the resample plan, to determine whether the initial exceedance is verified.

The following pretests are used to ensure that the statistical test criteria are met:

1) *Data Distribution*. The distribution of the data will be tested using either the Shapiro-Wilk test (for background sample sizes of 50 or less) or the Shapiro-Francia test (for background sample sizes greater than 50). Non-normally distributed data will be transformed using the ladder of powers[5] to normalize the data prior to construction of background limits. When background data cannot be normalized, nonparametric PL will be calculated.

2) *Handling Non-Detects*. Simple substitution per USEPA Guidance[6] will be used when non-detects comprise less than or equal to 15% of the individual well data. Simple substitution refers to the practice of substituting one-half the reporting or

[5] 1992, *Statistical Methods In Water Resources*, Elsevier, Helsel, D. R., & Hirsch, R. M.
[6] June 1992, *Addendum to Interim Final Guidance, Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities.* Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

detection limit for non-detects. When the proportion of non-detects (NDs) in background falls between 16 and 50%, a non-detect adjustment such as the Kaplan-Meier or Regression on Order Statistics (ROS) method for adjustment of the mean and standard deviation will be used prior to constructing a parametric prediction limit. When the proportion of non-detects exceeds 50%, or when the data cannot be normalized, a nonparametric prediction limit will be used.

3.7 Statistical Power

The USEPA Unified Guidance also requires that facilities achieve adequate statistical power to detect a release, even if only at one facility well and involving a single constituent. More specifically, EPA recommends power of approximately 55% when concentration levels are 3 standard deviations above the background mean, or approximately 80% power at 4 standard deviations above the background mean.

The performance of a given testing strategy is displayed in Power Curves which are based on the particular statistical method chosen combined with the resampling plan, the false positive rate associated with the statistical test, as well as the number of background samples available and the size and configuration of the monitoring network.

Power Curves for the PLs following this report demonstrate that the specified plan has the power to detect a release in downgradient wells and meet or exceed at least one of the power recommendations. As more data are collected during routine semi-annual sampling events and the background sets are expanded, the power requirements will exceed recommended power requirements.

4.0 STATISTICAL APPROACH FOR ASSESSMENT MONITORING & CORRECTIVE ACTION

The following describes the general statistical procedures that will be used if a facility enters Assessment or Corrective Action monitoring because of SSIs in the Detection monitoring program. Site-specific and event-specific SAPs may be developed at that time according to permit or regulatory requirements.

4.1 Assessment Monitoring

Assessment Monitoring may be initiated when there is a confirmed SSI over background in one or more wells for any of the Appendix III parameters. Wells are sampled for Appendix IV parameters semiannually concurrent with Appendix III constituents.

When in assessment monitoring, Appendix IV constituent concentrations are compared to Groundwater Protection Standards (GWPS), or other applicable standards, using Confidence Intervals. Upgradient well data are screened for outliers and trends as described above and tolerance limits are used to develop background limits. GWPS may be based on background limits when background concentrations are higher than the established Maximum Contaminant Levels (MCLs) or other rule-specified GWPS.

Parametric confidence intervals around the population mean will be constructed at the 99% confidence level when data follow a normal distribution, and around the geometric mean (or population median) when data follow a transformed-normal distribution.

Non-parametric confidence intervals will be constructed when data do not pass a normality test and cannot be normalized via a transformation. The confidence level associated with the non-parametric tests is dependent on the number of values used to construct the interval. Confidence intervals require a minimum of four samples; however, a minimum of eight samples are recommended. When non-parametric confidence intervals are constructed, a maximum of eight of the most recent samples will be used in the comparison. When a well/constituent pair does not have the minimum sample requirement, the well/constituent pair will continue to be reported and tracked using time series plots and/or trend tests until such time that enough data are available.

In Assessment Monitoring, when the Lower Confidence Limit (LCL), or the entire interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSI.

4.2 Corrective Action

If groundwater corrective action is triggered, semi-annual sampling of the assessment monitoring wells will continue and Confidence Intervals will monitor the progress of remediation efforts. Confidence Intervals are compared to GWPS and the entire interval must fall below a specified limit (i.e. the Upper Confidence Limit [UCL] must be below the limit) to demonstrate compliance. A site-specific monitoring program will be developed based on the final corrective action plan and points-of-compliance.

5.0 SITE-SPECIFIC STATISTICAL ANALYSIS METHODS

A site-specific statistical analysis approach was developed after applying the screening criteria described previously. Results of the site-specific screening are presented in Appendix A, Background Screening and Compliance Evaluation. The following is a detailed description of the statistical analysis methodology that will be used for groundwater quality analysis at the site when monitored constituents are present in any of the downgradient wells.

Background sampling began in February 2016. The monitoring well network is described on Table 1.

For the statistical analysis of analytical results obtained from the existing monitoring well network, (1) the number of samples collected will be consistent with the appropriate statistical procedures as recommended by the CCR Rule and the USEPA Unified Guidance; (2) the statistical method will comply with the EPA-recommended performance standards; and (3) determination of whether or not there is a statistically significant increase (SSI) over background values in the future will be completed per the above-mentioned regulations.

5.1 Detection Monitoring Program

Based on the background screening that was conducted by Groundwater Stats Consulting in the Fall 2017 and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting, interwell methods combined with a 1-of-2 resampling strategy will be used to evaluate boron, chloride and pH. Intrawell methods combined with a 1-of-2 resampling strategy will be used for calcium, fluoride, sulfate and TDS. If a statistical exceedance is found, one independent resample will be collected to determine whether the initial exceedance is verified.

If the initial finding is not verified by resampling, the resampled value will replace the initial finding. When the resample confirms the initial finding, the exceedance will be reported. The Sen's Slope/Mann Kendall trend test will be used, in addition to PL, to statistically evaluate concentration levels over time and determine whether concentrations are increasing, decreasing, or stabilizing.

The chance of false positive results increases with increasing numbers of statistical tests. The total number of statistical tests for a facility is the number of parameters tested multiplied by the number of monitoring wells. In an effort to reduce the overall number of statistical tests performed at each semi-annual sampling event, thereby lowering the chance of a false exceedance while maintaining a high degree of statistical confidence that a release will be detected, Plant Gorgas Bottom Ash Landfill will:

1) Monitor constituents in wells with detections (i.e. excluding well/constituent pairs with 100% nondetects); and
2) Incorporate a 1-of-2 retesting strategy

The following statistical methods will be used:

5.1.1 Parametric Prediction Limits

These limits will be computed per USEPA Unified Guidance when data can be normalized, possibly via transformation. The test alpha will be calculated based on the following configuration:

Annual SWFPR = 0.10
1-of-2 resampling plan with a minimum of 8 background samples for interwell tests
1-of-2 resampling plan with a minimum of 8 background samples for intrawell tests
w= 5 (number of compliance wells)
c= 7 constituents

5.1.2 Nonparametric Prediction Limits

The highest background value will be used to set the upper nonparametric prediction limit. The associated confidence level takes into account the prospect of additional future compliance values (retests) when there is an initial exceedance. The achieved confidence level is determined based on the background sample size, the number monitoring wells in the network, and the number of proposed retests, using tables provided in the USEPA Unified Guidance[7].

5.1.3 Retesting Strategy

When the prediction limit analyses indicate initial exceedances, discrete verification resamples from the indicating well(s) will be collected within 90 days and prior to the next regularly scheduled sampling event. If the initial exceedance is verified, a confirmed SSI will be reported. For the test to be valid, the resample needs to be statistically independent which requires that sufficient time elapse between the initial sample and resample. A minimum time interval between samples will be established to ensure that separate volumes of groundwater are being sampled.

5.1.4 Background Data Set

Interwell tests, which compare downgradient well data to statistical limits constructed from all pooled upgradient well data after careful screening, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter. Because upgradient well data represent natural groundwater quality upgradient of the facility, intrawell prediction limits are also constructed on these wells. A minimum of 8 background samples are required for both interwell and intrawell tests.

The background data set will be managed, screened and updated as described previously after receipt of Department approval.

[7] USEPA Unified Guidance, March 2009. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities*. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

5.2 Assessment Monitoring Program

Assessment monitoring will be performed following the procedures described in Section 4.0. When assessment monitoring is initiated, Appendix IV constituents are sampled semi-annually, and concentrations in downgradient wells are statistically compared as described below to GWPS. Following the Unified Guidance, the Maximum Contaminant Level (MCL) is used as the GWPS. When reported concentrations in upgradient wells are higher than the established MCLs, background limits may be developed as described below from an interwell tolerance limit using the pool of all approved upgradient well data (see Chapter 7 of the Unified Guidance).

Parametric tolerance limits, which are used when pooled upgradient well data follow a normal or transformed-normal distribution, may be constructed on upgradient well or wells with the highest average concentrations with Department approval. This step serves to reduce the effect of spatial variation on the standard deviation in the parametric case when calculating a GWPS. Non-parametric tolerance limits will be constructed when data do not follow a normal or transformed-normal distribution or when a parametric tolerance limit is not approved.

For constituents without established MCLs, the CCR-rule specified limits will be used as the GWPS unless Department-approved background is higher as calculated from interwell tolerance limit as described above. Appendix IV background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits.

Confidence Intervals are then constructed using a maximum of 8 of the most recent assessment measurements from a given downgradient well for comparison to the GWPS to determine compliance.

Parametric tolerance limits (i.e. UTLs) are calculated when data follow a normal or transformed-normal distribution using pooled upgradient well data as described above for Appendix IV parameters with a target of 95% confidence and 95% coverage. When data sets contain greater than 50% nondetects or do not follow a normal or transformed-normal distribution, the confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. The UTLs are then used as background levels for establishing the GWPS under case 3 below.

As described in 40 CFR § 257.95(h)(1)-(3) the GWPS is:

1. The maximum contaminant level (MCL) established under 40 CFR § 141.62 and 141.66.
2. Where an MCL has not been established:
   (i) Cobalt 0.006 mg/L;
   (ii) Lead 0.015 mg/L;
   (iii) Lithium 0.040 mg/L; and
   (iv) Molybdenum 0.100 mg/L.
3. Background levels for constituents where the background level is higher than the MCL or rule-specified GWPS.

In assessment monitoring, when the Lower Confidence Limit (LCL), or the entire confidence interval, exceeds the GWPS as discussed in the USEPA Unified Guidance (2009), the result is recorded as an SSL.

With Department approval, the background limits will be updated and compared to the MCLs and CCR-rule specified limits for Appendix IV constituents every two years to determine whether the established limit or background will be used as the GWPS in the confidence interval comparisons, as discussed above.

5.3 Corrective Action Monitoring Program

When implemented, groundwater corrective action will include a remedy monitoring program. The remedy monitoring program will be prepared under separate cover and include details regarding statistical analysis of results.

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Figures

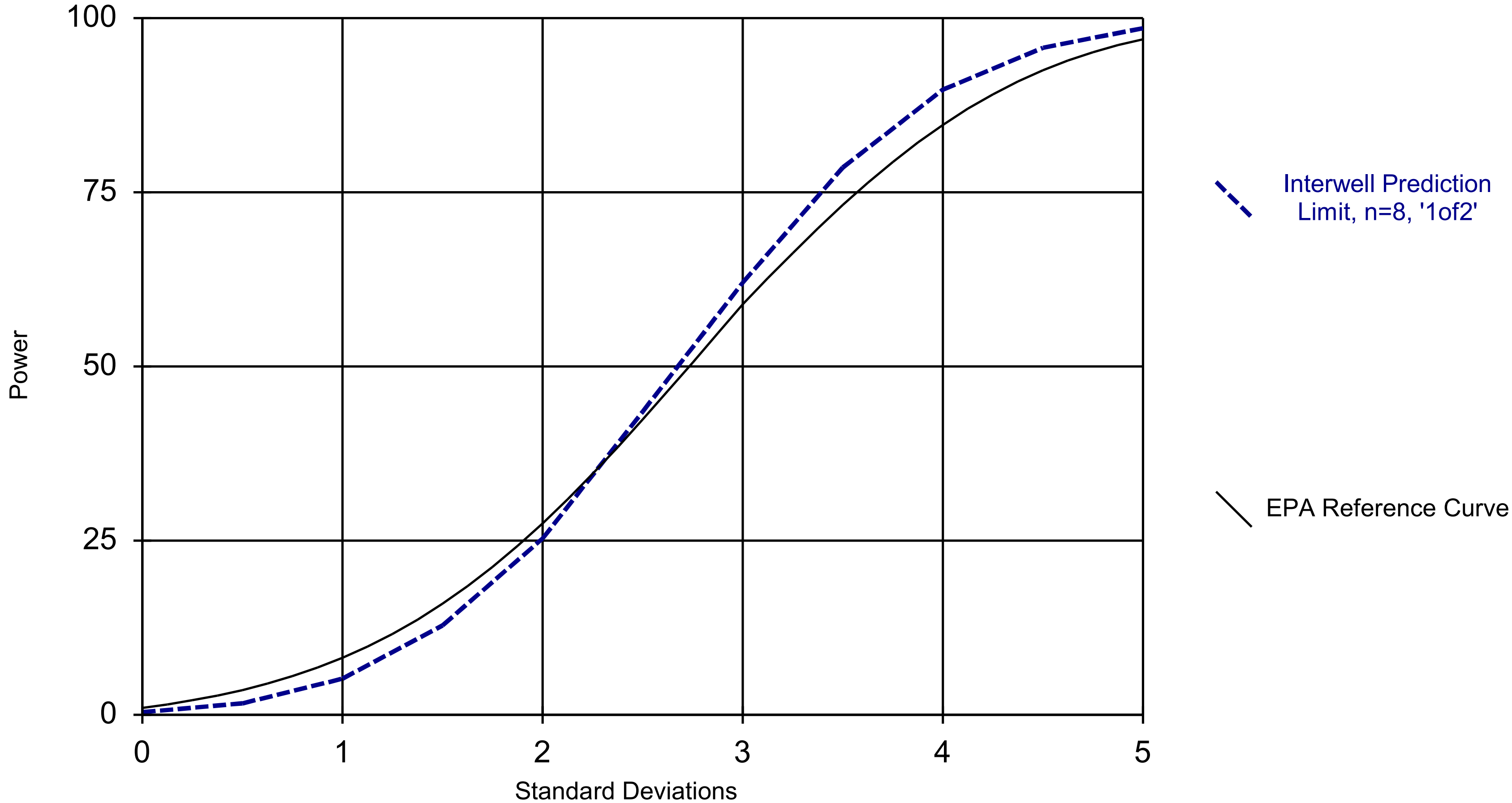
Table 1.
Groundwater Monitoring Well Network Details

Well Name	Purpose	Northing	Easting	Ground Elevation	Top of Casing Elevation	Well Depth feet Below Top of Casing	Top of Screen Elevation (Ft. MSL)	Bottom of Screen Elevation (ft. MSL)	Screen Length feet
MW-1	Upgradient	1330794.064	594082.361	499.19	502.25	107.56	405.09	395.09	10
MW-2	Upgradient	1331053.309	593548.802	498.54	502.12	94.58	417.94	407.94	10
MW-3	Upgradient	1330842.402	593025.397	522.23	525.90	119.07	417.23	407.23	10
MW-4	Upgradient	1330289.727	592896.414	516.67	518.63	128.66	400.37	390.37	10
MW-7	Downgradient	1328515.235	593408.341	391.59	394.59	74.00	330.99	320.99	10
MW-8	Downgradient	1329140.729	593813.964	413.15	416.10	72.25	354.25	344.25	10
MW-10	Downgradient	1327686.069	593704.952	391.66	395.10	108.64	306.86	286.86	20
MW-11	Downgradient	1328083.497	594546.311	403.69	406.96	135.00	282.36	272.36	10
MW-12	Downgradient	1328578.93	594708.212	470.70	474.24	169.04	315.60	305.60	10
MW-12V	Vertical Delineation	1328481.68	2063196.25	478.64	481.32	206.08	285.64	275.64	10

1. Northing and easting are in feet relative to the State Plane Alabama West North America Datum of 1983.
2. Elevations are in feet relative to the North American Vertical Datum of 1988.
3. Top of screen and bottom of screen depths are calculated relative Top of Casing elevation and less the well sump length of 0.4’.

Sanitas™ v.9.6.25f Sanitas software utilized by Groundwater Stats Consulting. UG

Power Curve

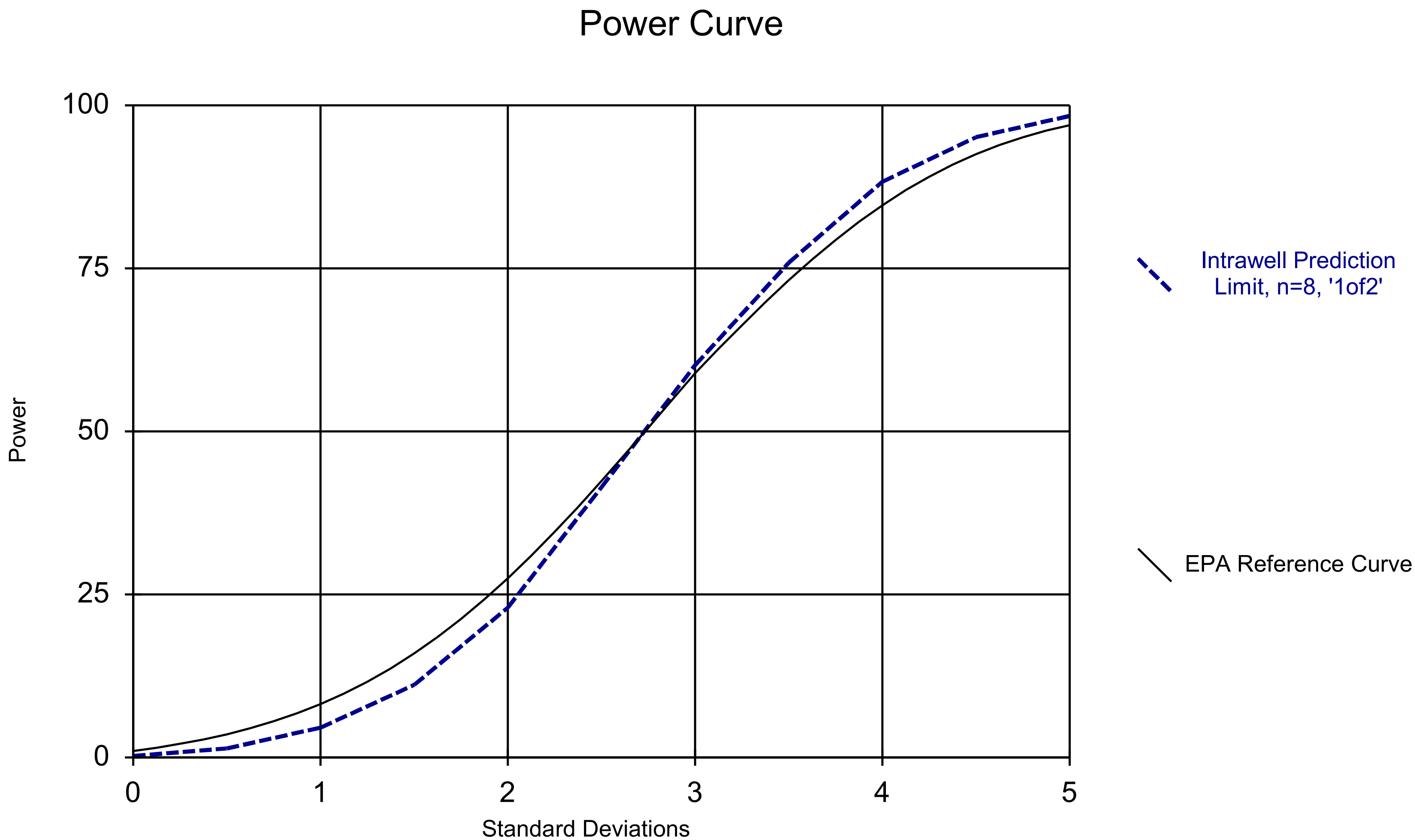


Kappa = 2.666, based on 5 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/9/2020 4:47 PM

Plant William C Gorgas Client: Southern Company Data: Gorgas BALF CCR

Sanitas™ v.9.6.25f Sanitas software utilized by Groundwater Stats Consulting. UG



Kappa = 2.74, based on 5 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/9/2020 4:47 PM

Plant William C Gorgas Client: Southern Company Data: Gorgas BALF CCR

Appendix A
Background Screening and Compliance Evaluation

GROUNDWATER STATS
CONSULTING

April 10, 2020

Southern Company Services
Attn: Mr. Greg Dyer
3535 Colonnade Parkway
Birmingham, AL 35243

Re: Plant Gorgas Bottom Ash Landfill
Background Update – 2019

Dear Mr. Dyer,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening for the proposed background update of the prediction limits with data through May 2019 for Alabama Power Company's Plant Gorgas Bottom Ash Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at site for the CCR program in 2016. The monitoring well network, as provided by Southern Company Services, consists of the following:

- **Upgradient wells:** MW-1, MW-2, MW-3, and MW-4
- **Downgradient wells:** MW-7, MW-8, MW-10, MW-11, and MW-12

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was prepared according to the Statistical Analysis Plan approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting. The analysis was reviewed by Dr. Jim Loftis, Civil & Environmental Engineering professor emeritus at Colorado State University and Senior Advisor to Groundwater Stats Consulting.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS

Time series and box plots for these parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record for the purpose of updating statistical limits (Figures A and B, respectively). Values in background which have been flagged as outliers may be seen in a lighter font and as a disconnected symbol on the graphs.

Background Update Summary

Intrawell prediction limits, which compare the most recent compliance sample from a given well to historical data from the same well, are updated by testing for the appropriateness of consolidating new sampling observations with the screened background data. This process is described below and requires a minimum of four new data points. Historical data were evaluated for updating with newer data through May 2019 through the use of time series graphs to identify potential outliers when necessary, as well as the Mann-Whitney test for equality of medians. As discussed in the Statistical Analysis Plan (October 2018), intrawell prediction limits are used to evaluate calcium, fluoride, sulfate, and TDS at all wells due to natural spatial variation for these parameters.

Interwell prediction limits, which compare the most recent sample from each downgradient well to statistical limits constructed from pooled upgradient well data, are updated during each sample event. Data from upgradient wells are periodically re-screened for newly developing trends, which may require adjustment of the background period to eliminate the trend, as well as for outliers over the entire record. Interwell prediction limits are used to evaluate boron, chloride, and pH.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. While the false positive rate associated with the parametric limits is based on an annual 10% as recommended by the EPA Unified Guidance (2009), the false positive rate associated with the nonparametric limits is dependent upon the available background sample size, number of future comparisons, and verification resample plan. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

In the case of boron, background data contained varying reporting limits consisting of <0.2 mg/L and <0.1 mg/L. Therefore, a substitution of <0.1 mg/L was used for all nondetects so that resulting statistical limits are conservative from a regulatory perspective. Note that the time series graphs for boron, chloride, and fluoride display these nondetect values with a substitution of one-half the reporting limit and the accompanying data pages provides the reporting limit data without any substitution.

Prior to performing prediction limits, proposed background data through May 2019 were reviewed to identify any newly suspected outliers at all wells for calcium, fluoride, sulfate, and TDS, and at upgradient wells for boron, chloride, and pH (Figure C). Both Tukey's Test and visual screening are used to identify potential outliers. When identified, values are flagged with "o" and excluded to reduce variation, better represent background conditions, and provide limits that are conservative from a regulatory perspective. Potential outliers that are identified by Tukey's test but are not greatly different from the rest of the data are not flagged. Also, outliers that are not identified as important by Tukey's test may be identified visually. As mentioned above, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. No data were flagged as outliers during the screening. A summary of Tukey's test results follows this letter.

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through May 2017 to compliance data through May 2019 to evaluate whether the groups are statistically similar at the 99% confidence level (Figure D).

When no statistically significant differences are found using the Mann-Whitney test, background data may be updated with newer compliance data. Statistically significant differences were found between the two groups for calcium in well MW-1; fluoride in wells MW-2 and MW-4; and TDS in well MW-1.

Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background are not updated to include the newer data but will be reconsidered in the future. Because the differences for calcium, fluoride and TDS occurred in upgradient wells, and more recent data are fairly similar to background and better represent the groundwater quality upgradient of the facility, these background data sets were updated. A summary of these results is included with the Mann-Whitney test section at the end of this report. All background data were updated to include data through May of 2019 for construction of prediction limits. While wells MW-7 and MW-8 were not included with these tests because they only had two samples collected prior to May 2017, the time series graphs demonstrate these data are stable over time and, therefore, are also eligible to use historical data through May 2019 for construction of intrawell prediction limits.

The Sen's Slope/Mann Kendall trend test was used to evaluate the entire record of data from upgradient wells for parameters utilizing interwell prediction limits (Figure E). When statistically significant increasing trends are identified in upgradient wells, the earlier portion of data is deselected prior to construction of interwell statistical limits if the trending data would result in statistical limits that are not conservative from a regulatory perspective. No statistically significant trends were noted in upgradient wells, and trend test results may be seen on the Trend Test Summary Table.

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 verification strategy were constructed for boron, chloride and pH; and intrawell prediction limits combined with a 1-of-2 verification strategy were constructed for calcium, fluoride, sulfate and TDS (Figures F and G, respectively). Future samples will be compared against these prediction limits. In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary. A summary of the updated prediction limits may be found in the Prediction Limit Summary tables following this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for Gorgas Bottom Ash Landfill. If you have any questions or comments, please feel free to contact us.

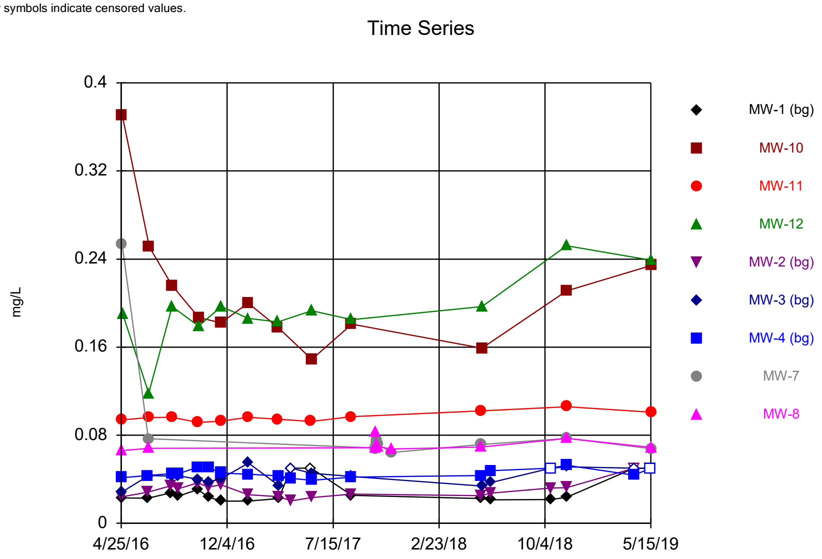
For Groundwater Stats Consulting,

Andrew T. Collins
Groundwater Analyst

Kristina L. Rayner
Groundwater Statistician

FIGURE A.

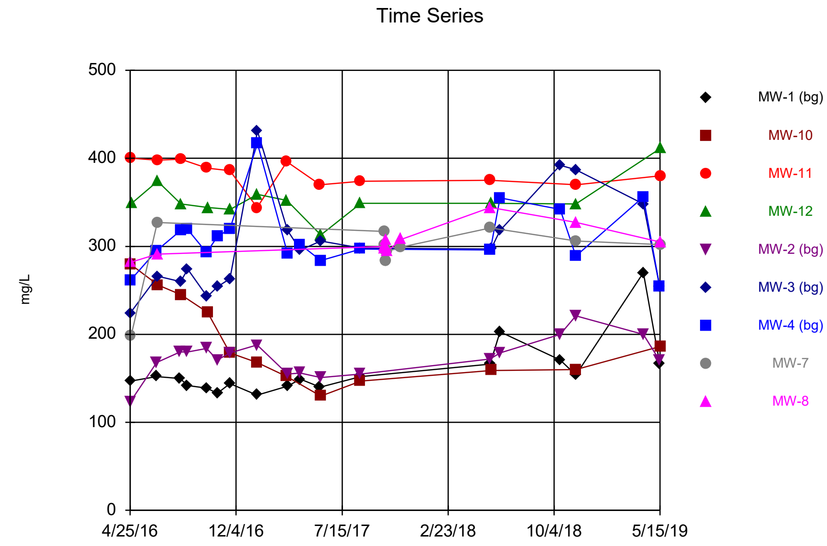
Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Boron Analysis Run 4/10/2020 10:54 AM

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

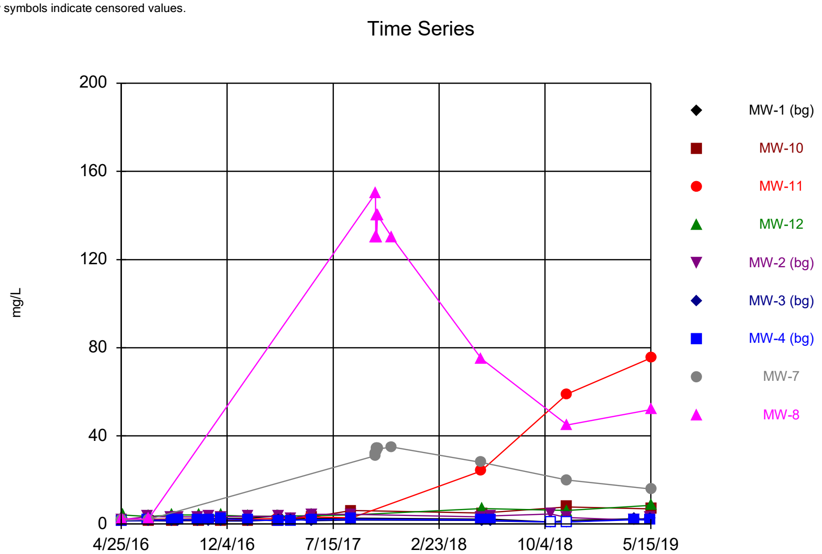
Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



Constituent: Calcium Analysis Run 4/10/2020 10:54 AM

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

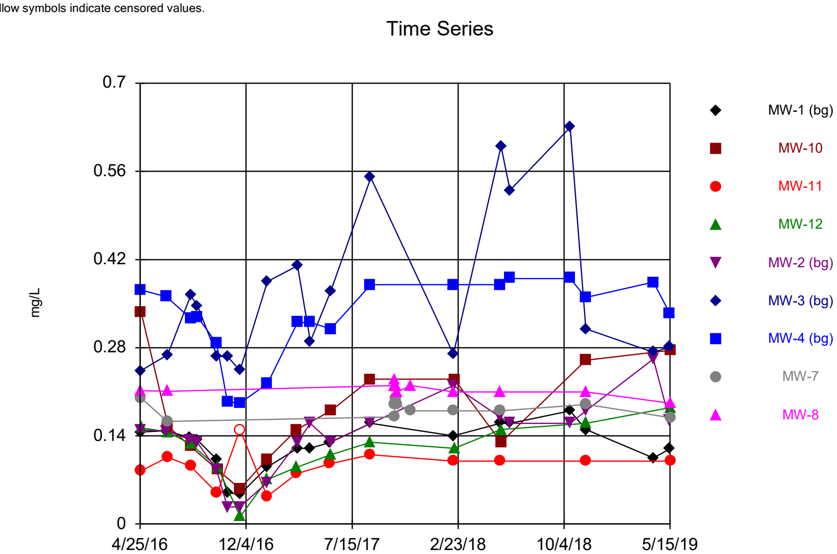
Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Chloride Analysis Run 4/10/2020 10:54 AM

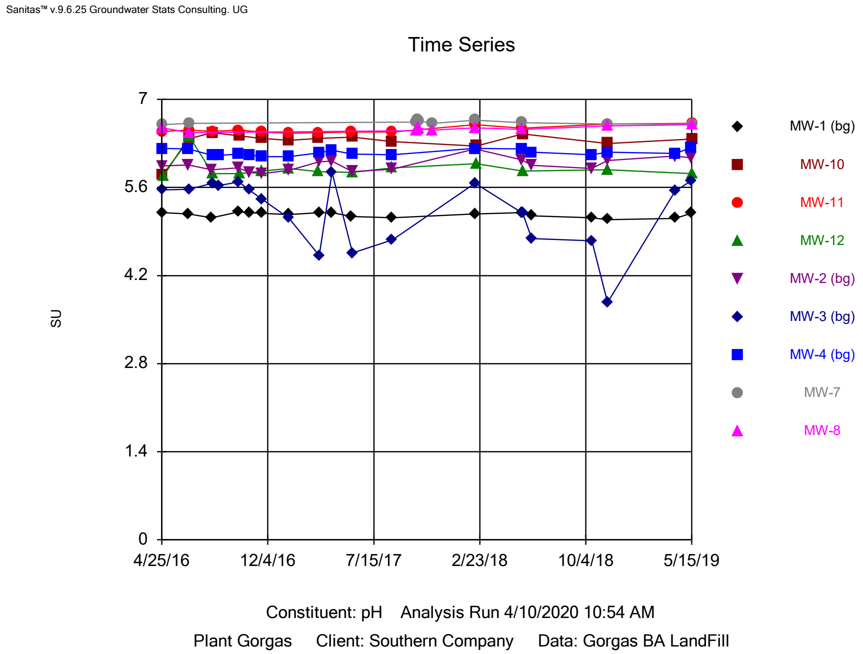
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

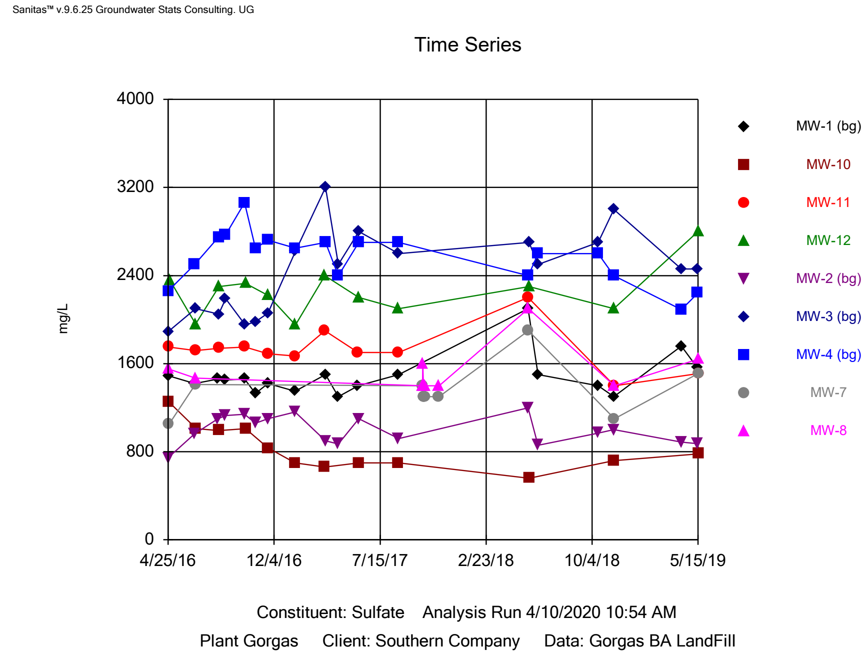
Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Fluoride Analysis Run 4/10/2020 10:54 AM

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill


Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Time Series
SU
7
5.6
4.2
2.8
1.4
0
4/25/16
12/4/16
7/15/17
2/23/18
10/4/18
5/15/19
MW-1 (bg)
MW-10
MW-11
MW-12
MW-2 (bg)
MW-3 (bg)
MW-4 (bg)
MW-7
MW-8
Constituent: pH Analysis Run 4/10/2020 10:54 AM
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill


Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Time Series
mg/L
4000
3200
2400
1600
800
0
4/25/16
12/4/16
7/15/17
2/23/18
10/4/18
5/15/19
MW-1 (bg)
MW-10
MW-11
MW-12
MW-2 (bg)
MW-3 (bg)
MW-4 (bg)
MW-7
MW-8
Constituent: Sulfate Analysis Run 4/10/2020 10:54 AM
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill


Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Time Series
mg/L
5000
4000
3000
2000
1000
0
4/25/16
12/4/16
7/15/17
2/23/18
10/4/18
5/15/19
MW-1 (bg)
MW-10
MW-11
MW-12
MW-2 (bg)
MW-3 (bg)
MW-4 (bg)
MW-7
MW-8
Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:54 AM
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Time Series

Constituent: Boron (mg/L) Analysis Run 4/10/2020 10:54 AM

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-1 (bg)	MW-10	MW-11	MW-12	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-7	MW-8
4/25/2016					0.0241 (J)	0.028 (J)	0.0414 (J)		
4/26/2016	0.0231 (J)		0.094 (J)						
4/27/2016		0.371						0.253	0.0662 (J)
4/28/2016				0.19					
6/20/2016	0.0227 (J)				0.0284 (J)		0.0434 (J)		
6/21/2016								0.0768 (J)	0.0681 (J)
6/22/2016			0.0959 (J)	0.118		0.0433 (J)			
6/23/2016		0.251							
8/8/2016	0.0278 (J)				0.034 (J)				
8/9/2016			0.0964 (J)			0.0429 (J)	0.0453 (J)		
8/10/2016		0.216		0.197					
8/24/2016	0.0247 (J)				0.0316 (J)	0.0431 (J)	0.0451 (J)		
10/3/2016	0.0307 (J)				0.0367 (J)		0.0511 (J)		
10/4/2016			0.0916 (J)			0.04 (J)			
10/5/2016		0.187		0.179					
10/26/2016	0.0241 (J)				0.0331 (J)	0.0375 (J)	0.0507 (J)		
11/21/2016	0.0202 (J)	0.182	0.0929 (J)		0.035 (J)	0.0406 (J)	0.0458 (J)		
11/22/2016				0.197					
1/17/2017	0.0201 (J)	0.2	0.0963 (J)		0.0259 (J)				
1/18/2017				0.186		0.0548 (J)	0.0445 (J)		
3/21/2017		0.178	0.0947 (J)	0.183					
3/22/2017	0.0224 (J)				0.0243 (J)	0.0344 (J)	0.0432 (J)		
4/18/2017	<0.1				0.0206 (J)	<0.1	0.0409 (J)		
5/30/2017	<0.1		0.0926 (J)						
5/31/2017		0.149		0.193	0.0234 (J)	0.0454 (J)	0.0392 (J)		
8/23/2017	0.0253 (J)	0.181	0.0968 (J)	0.185	0.0267 (J)	0.0425 (J)	0.042 (J)		
10/12/2017								0.0685 (J)	0.0687 (J)
10/13/2017								0.0674 (J)	0.0831 (J)
10/14/2017								0.0756 (J)	0.0702 (J)
10/15/2017								0.0719 (J)	0.0702 (J)
10/16/2017								0.0726 (J)	0.0707 (J)
10/17/2017								0.0716 (J)	0.0695 (J)
11/16/2017								0.0644 (J)	0.0675 (J)
5/22/2018	0.0224 (J)		0.102		0.0251 (J)				
5/23/2018							0.0433 (J)	0.0715 (J)	0.0693 (J)
5/24/2018		0.159		0.197		0.0339 (J)			
6/12/2018	0.0214 (J)				0.0275 (J)	0.0371 (J)	0.0478 (J)		
10/17/2018	0.0216 (J)				0.0321 (J)	<0.1 (J)	<0.1 (J)		
11/19/2018	0.0237 (J)	0.211		0.252	0.0324 (J)	0.0514 (J)	0.0526 (J)		
11/20/2018			0.106					0.0772 (J)	0.0771 (J)
4/10/2019	<0.1				<0.1	<0.1	0.0438 (J)		
5/14/2019	<0.1				<0.1	<0.1	<0.1		
5/15/2019		0.234	0.101 (J)	0.239				0.0678 (J)	0.0689 (J)

Time Series

Constituent: Calcium (mg/L)   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-1 (bg)	MW-10	MW-11	MW-12	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-7	MW-8
4/25/2016					123	224	261		
4/26/2016	147		400						
4/27/2016		279						198	282
4/28/2016				349					
6/20/2016	152				168		295		
6/21/2016								327	291
6/22/2016			398	374		266			
6/23/2016		256							
8/8/2016	150				180				
8/9/2016			399			260	318		
8/10/2016		245		348					
8/24/2016	142				180	274	319		
10/3/2016	139				184		293		
10/4/2016			389			243			
10/5/2016		225		344					
10/26/2016	133				171	254	311		
11/21/2016	144	179	386		179	263	320		
11/22/2016				342					
1/17/2017	131	168	344		188				
1/18/2017				359		431	417		
3/21/2017		152	396	352					
3/22/2017	141				155	318	292		
4/18/2017	149				156	296	302		
5/30/2017	140		370						
5/31/2017		130		313	151	306	284		
8/23/2017	152	147	374	349	155	298	297		
10/12/2017								317	300
10/13/2017								302	298
10/14/2017								283	299
10/15/2017								294	307
10/16/2017								284	299
10/17/2017								294	294
11/16/2017								299	308
5/22/2018	166		375		172				
5/23/2018							296	321	344
5/24/2018		159		349		297			
6/12/2018	203				179	318	355		
10/17/2018	171				200	392	342		
11/19/2018	154	160		348	221	387	289		
11/20/2018			370					306	327
4/10/2019	270				200	348	356		
5/14/2019	167				170	254	254		
5/15/2019		186	380	411				302	305

Time Series

Constituent: Chloride (mg/L)   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-1 (bg)	MW-10	MW-11	MW-12	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-7	MW-8
4/25/2016					1.9	1.32	1.53		
4/26/2016	1.94		2.16						
4/27/2016		1.46						1.71	2.34
4/28/2016				4.12					
6/20/2016	2.09				3.43		1.85		
6/21/2016								2.04	2.29
6/22/2016			2.16	3.44		1.46			
6/23/2016		1.49							
8/8/2016	2.18				3.31				
8/9/2016			2.19			1.35	1.95		
8/10/2016		1.55		4.15					
8/24/2016	2.22				3.23	1.47	2.07		
10/3/2016	2.34				3.21		2.02		
10/4/2016			2.21			1.59			
10/5/2016		1.58		4.12					
10/26/2016	2.34				3.35	1.27	2.07		
11/21/2016	2.5	1.62	2.24		3.34	1.38	2.39		
11/22/2016				3.98					
1/17/2017	2.68	1.61	2.23		3.58				
1/18/2017				3.6		1.34	1.9		
3/21/2017		1.6 (J)	2.5	3.6					
3/22/2017	3.7				3.4	2	1.5 (J)		
4/18/2017	2.4				2.6	2.2	1.6 (J)		
5/30/2017	2.6		3.2						
5/31/2017		3.2		3.9	4.4	1.5 (J)	2.1		
8/23/2017	2.7	6.1	2.8	4.2	4.4	1.8 (J)	2.3		
10/12/2017								31	150
10/13/2017								32	130
10/14/2017								33	140
10/15/2017								34	130
10/16/2017								34	140
10/17/2017								34	140
11/16/2017								35	130
5/22/2018	2.3		24		3.2				
5/23/2018							2	28	75
5/24/2018		5		7.1		1.6 (J)			
6/12/2018	2.3				3.7	1.4 (J)	1.7 (J)		
10/17/2018	<2 (J)				4.6	<2	<2 (J)		
11/19/2018	1.7 (J)	7.8		6.1	3	<2	<2		
11/20/2018			59					20	45
4/10/2019	2.35				1.76	2.25	1.88		
5/14/2019	2.28				2.87	2.28	1.82		
5/15/2019		6.93	75.4	8.51				15.9	52

Time Series

Constituent: Fluoride (mg/L)   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-1 (bg)	MW-10	MW-11	MW-12	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-7	MW-8
4/25/2016					0.149 (J)	0.243 (J)	0.372		
4/26/2016	0.146 (J)		0.084 (J)						
4/27/2016		0.337						0.2 (J)	0.212 (J)
4/28/2016				0.153 (J)					
6/20/2016	0.148 (J)				0.148 (J)		0.361		
6/21/2016								0.163 (J)	0.211 (J)
6/22/2016			0.106 (J)	0.146 (J)		0.269 (J)			
6/23/2016		0.155 (J)							
8/8/2016	0.137 (J)				0.134 (J)				
8/9/2016			0.092 (J)			0.363	0.326		
8/10/2016		0.123 (J)		0.127 (J)					
8/24/2016	0.133 (J)				0.129 (J)	0.346	0.329		
10/3/2016	0.103 (J)				0.086 (J)		0.287 (J)		
10/4/2016			0.049 (J)			0.266 (J)			
10/5/2016		0.086 (J)		0.09 (J)					
10/26/2016	0.05 (J)				0.027 (J)	0.266 (J)	0.194 (J)		
11/21/2016	0.047 (J)	0.056 (J)	<0.3		0.027 (J)	0.244 (J)	0.192 (J)		
11/22/2016				0.012 (J)					
1/17/2017	0.09 (J)	0.103 (J)	0.044 (J)		0.066 (J)				
1/18/2017				0.071 (J)		0.385	0.223 (J)		
3/21/2017		0.15	0.08 (J)	0.09 (J)					
3/22/2017	0.12				0.13	0.41	0.32		
4/18/2017	0.12				0.16	0.29	0.32		
5/30/2017	0.13		0.096 (J)						
5/31/2017		0.18		0.11	0.13	0.37	0.31		
8/23/2017	0.16	0.23	0.11	0.13	0.16	0.55	0.38		
10/12/2017								0.17	0.22
10/13/2017								0.19	0.23
10/14/2017								0.2	0.22
10/15/2017								0.2	0.22
10/16/2017								0.2	0.22
10/17/2017								0.19	0.21
11/16/2017								0.18	0.22
2/13/2018	0.14 (D)				0.22 (D)	0.27 (D)	0.38 (D)		
2/14/2018			0.1 (D)					0.18 (D)	0.21 (D)
2/15/2018		0.23 (D)		0.12 (D)					
5/22/2018	0.16		0.1		0.17				
5/23/2018							0.38	0.18	0.21
5/24/2018		0.13		0.15		0.6			
6/12/2018	0.16				0.16	0.53	0.39		
10/17/2018	0.18				0.16	0.63	0.39		
11/19/2018	0.15	0.26		0.16	0.18	0.31	0.36		
11/20/2018			0.1					0.19	0.21
4/10/2019	0.105				0.262	0.273	0.384		
5/14/2019	0.119				0.164	0.281	0.335		
5/15/2019		0.276	0.1	0.185				0.169	0.192

Time Series

Constituent: pH (SU) Analysis Run 4/10/2020 10:54 AM

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-1 (bg)	MW-10	MW-11	MW-12	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-7	MW-8
4/25/2016					5.94	5.56	6.22		
4/26/2016	5.2		6.49						
4/27/2016		5.8						6.6	6.55
4/28/2016				5.78					
6/20/2016	5.18				5.96		6.21		
6/21/2016								6.62	6.47
6/22/2016			6.51	6.41		5.57			
6/23/2016		6.38							
8/8/2016	5.12				5.88				
8/9/2016			6.49			5.67	6.11		
8/10/2016		6.47		5.82					
8/24/2016						5.63	6.11		
10/3/2016	5.21 (D)				5.91 (D)		6.13 (D)		
10/4/2016			6.51 (D)			5.69 (D)			
10/5/2016		6.42 (D)		5.82 (D)					
10/26/2016	5.2				5.84	5.56	6.12		
11/21/2016	5.19 (D)	6.38	6.48		5.82 (D)	5.42 (D)	6.09 (D)		
11/22/2016				5.86					
1/17/2017	5.17 (D)	6.35	6.46		5.87 (D)				
1/18/2017				5.9		5.11 (D)	6.09 (D)		
3/21/2017		6.38	6.47	5.85					
3/22/2017	5.2 (D)				6.01 (D)	4.52 (D)	6.15 (D)		
4/18/2017	5.2				6.02	5.84	6.19		
5/30/2017	5.14 (D)		6.48						
5/31/2017		6.4		5.84	5.85 (D)	4.56 (D)	6.13 (D)		
8/23/2017	5.12 (D)	6.33	6.48	5.91	5.89 (D)	4.77 (D)	6.12 (D)		
10/12/2017								6.64	6.5
10/13/2017								6.64	6.51
10/14/2017								6.66	6.53
10/15/2017								6.67	6.53
10/16/2017								6.67	6.54
10/17/2017								6.66	6.54
11/16/2017								6.62	6.51
2/13/2018	5.18				6.21	5.67	6.22		
2/14/2018			6.6					6.67	6.55
2/15/2018		6.26		5.98					
5/22/2018	5.2		6.54		6.04				
5/23/2018							6.21	6.63	6.52
5/24/2018		6.45		5.86		5.19			
6/12/2018	5.15				5.95	4.79	6.16		
10/17/2018	5.12				5.9	4.75	6.12		
11/19/2018	5.09 (D)	6.3		5.88	6.03 (D)	3.77 (D)	6.16 (D)		
11/20/2018			6.61					6.61	6.58
4/10/2019	5.11				6.1	5.54	6.14		
5/14/2019	5.19				6.07	5.71	6.23		
5/15/2019		6.37	6.62	5.82				6.61	6.6

Time Series

Constituent: Sulfate (mg/L)   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-1 (bg)	MW-10	MW-11	MW-12	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-7	MW-8
4/25/2016					745	1890	2260		
4/26/2016	1490		1750						
4/27/2016		1250						1050	1550
4/28/2016				2360					
6/20/2016	1420				964		2500		
6/21/2016								1410	1470
6/22/2016			1720	1960		2100			
6/23/2016		1010							
8/8/2016	1460				1100				
8/9/2016			1740			2050	2750		
8/10/2016		992		2300					
8/24/2016	1450				1130	2190	2770		
10/3/2016	1460				1140		3060		
10/4/2016			1750			1950			
10/5/2016		1010		2330					
10/26/2016	1330				1060	1980	2650		
11/21/2016	1420	834	1690		1100	2060	2720		
11/22/2016				2220					
1/17/2017	1350	700	1670		1160				
1/18/2017				1950		2620	2650		
3/21/2017		660	1900	2400					
3/22/2017	1500				900	3200	2700		
4/18/2017	1300				870	2500	2400		
5/30/2017	1400		1700						
5/31/2017		700		2200	1100	2800	2700		
8/23/2017	1500	700	1700	2100	920	2600	2700		
10/12/2017								1400	1400
10/13/2017								1400	1600
10/14/2017								1300	1400
10/15/2017								1300	1400
10/16/2017								1300	1400
10/17/2017								1300	1400
11/16/2017								1300	1400
5/22/2018	2100		2200		1200				
5/23/2018							2400	1900	2100
5/24/2018		560		2300		2700			
6/12/2018	1500				860	2500	2600		
10/17/2018	1400				970	2700	2600		
11/19/2018	1300	720		2100	1000	3000	2400		
11/20/2018			1400					1100	1400
4/10/2019	1760				889	2460	2090		
5/14/2019	1560				873	2460	2240		
5/15/2019		780	1510	2800				1510	1640

Time Series

Constituent: Total Dissolved Solids (mg/L)   Analysis Run 4/10/2020 10:54 AM

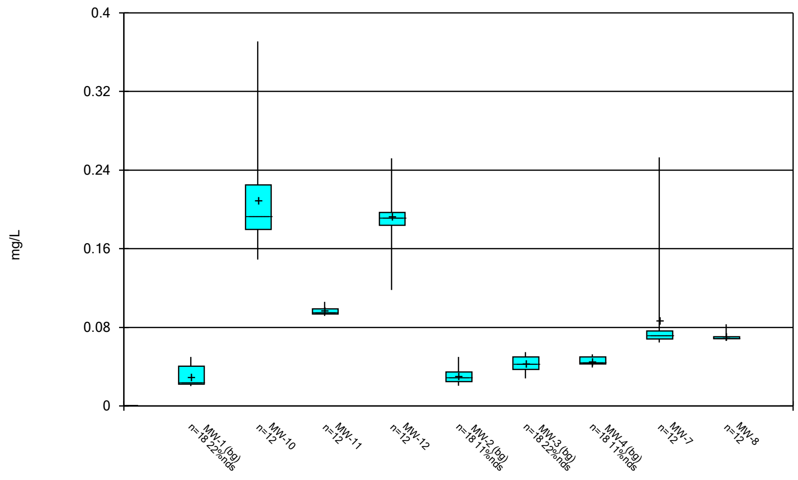
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-1 (bg)	MW-10	MW-11	MW-12	MW-2 (bg)	MW-3 (bg)	MW-4 (bg)	MW-7	MW-8
4/25/2016					1260 (D)	2720 (D)	3300 (D)		
4/26/2016	2080 (D)		2800						
4/27/2016		1940						1640	2480
4/28/2016				3730					
6/20/2016	2060 (D)				1620 (D)		3870 (D)		
6/21/2016								2460	2360
6/22/2016			2550	2760		3250 (D)			
6/23/2016		1680							
8/8/2016	2070 (D)				1740 (D)				
8/9/2016			2860			3050 (D)	4140 (D)		
8/10/2016		1660		3710					
8/24/2016	2040 (D)				1720 (D)	3080 (D)	4190 (D)		
10/3/2016	2110 (D)				1800 (D)		4190 (D)		
10/4/2016			2800			2900 (D)			
10/5/2016		1640		3580					
10/26/2016	2000 (D)				1800 (D)	2940 (D)	4400 (D)		
11/21/2016	2070 (D)	1390	2920		1740 (D)	3090 (D)	4230 (D)		
11/22/2016				3400					
1/17/2017	1930 (D)	1300	2750		1960 (D)				
1/18/2017				3360		4020 (D)	4120 (D)		
3/21/2017		1170	2750	3320					
3/22/2017	2060 (D)				1510 (D)	4180 (D)	3980 (D)		
4/18/2017	2140 (D)				1580 (D)	4440 (D)	3880 (D)		
5/30/2017	2240 (D)		2890						
5/31/2017		1210		3440	1730 (D)	3970 (D)	4210 (D)		
8/23/2017	2160 (D)	1160	2760	3250	1550 (D)	4050 (D)	3990 (D)		
10/12/2017								2460	2530
10/13/2017								2420	2740
10/14/2017								2320	2630
10/15/2017								1150	2530
10/16/2017								2320	2740
10/17/2017								2360	2650
11/16/2017								2460	2650
5/22/2018	2380 (D)		2610		1500 (D)				
5/23/2018							3740 (D)	2390	2750
5/24/2018		1100		3300		3680 (D)			
6/12/2018	2400				1550	3820	4080		
10/17/2018	2220 (D)				1740 (D)	4730	4250		
11/19/2018	2360 (D)	1220		3400	1990 (D)	4710 (D)	3920 (D)		
11/20/2018			2480					2090	2520
4/10/2019	2600 (D)				1250 (D)	3680	3280		
5/14/2019	2340 (D)				1540 (D)	3580 (D)	3130 (D)		
5/15/2019		1230	2560	3890				2310	2540

FIGURE B.

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Box & Whiskers Plot

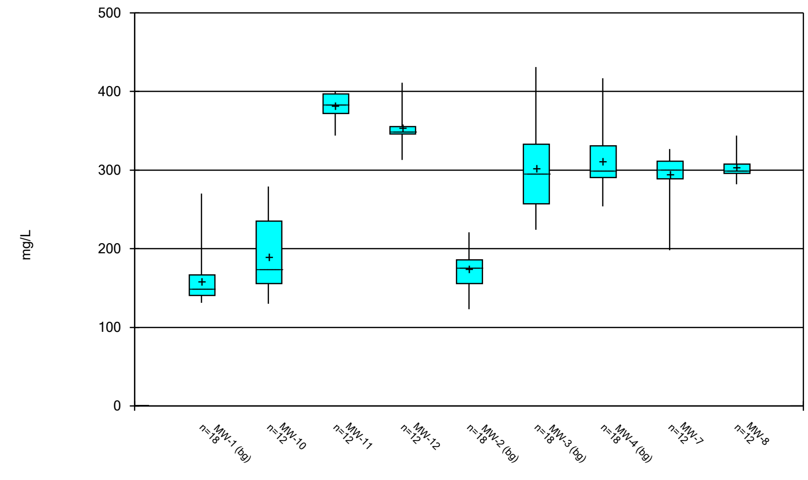


Constituent: Boron   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Box & Whiskers Plot

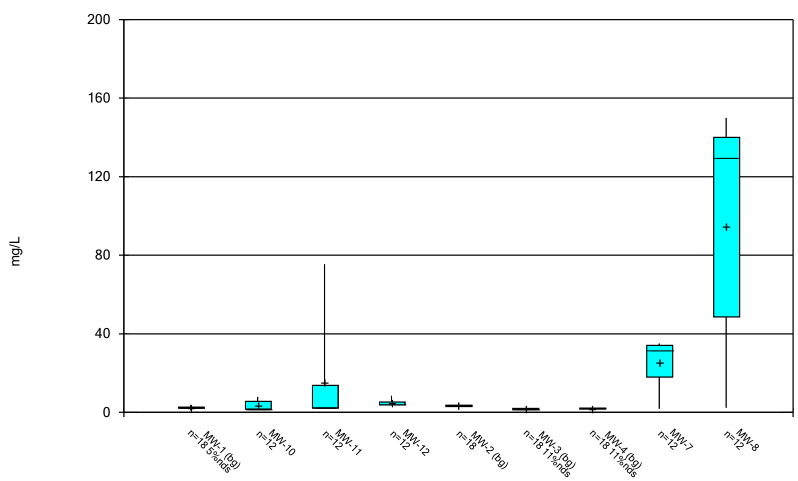


Constituent: Calcium   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Box & Whiskers Plot

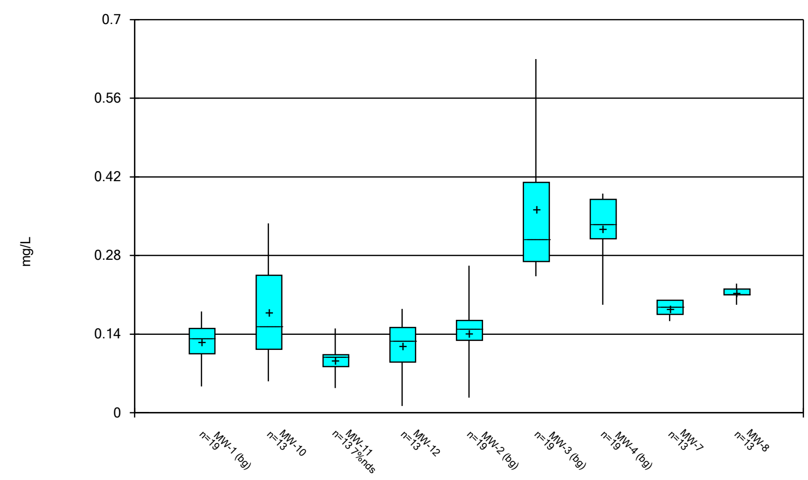


Constituent: Chloride   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Box & Whiskers Plot

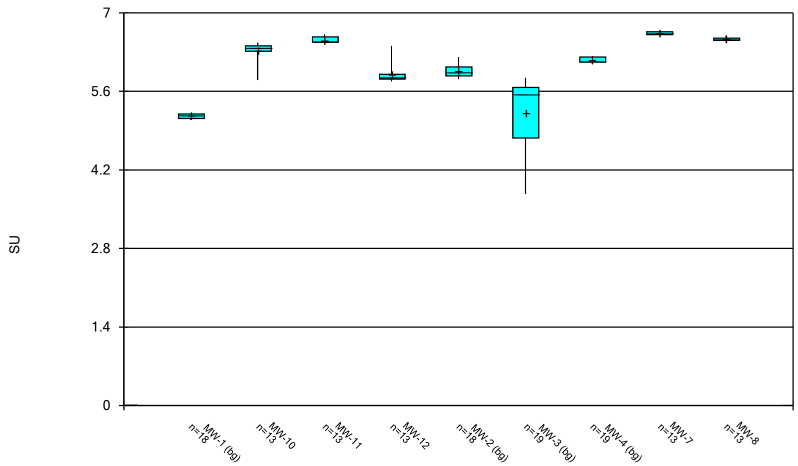


Constituent: Fluoride   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Box & Whiskers Plot

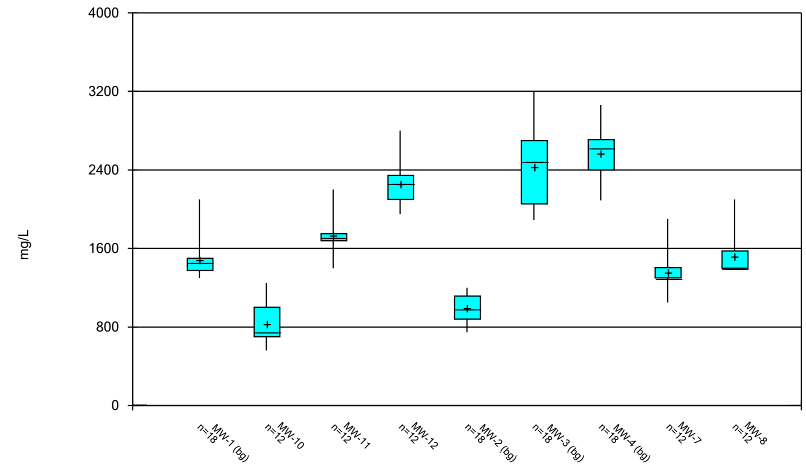


Constituent: pH   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Box & Whiskers Plot

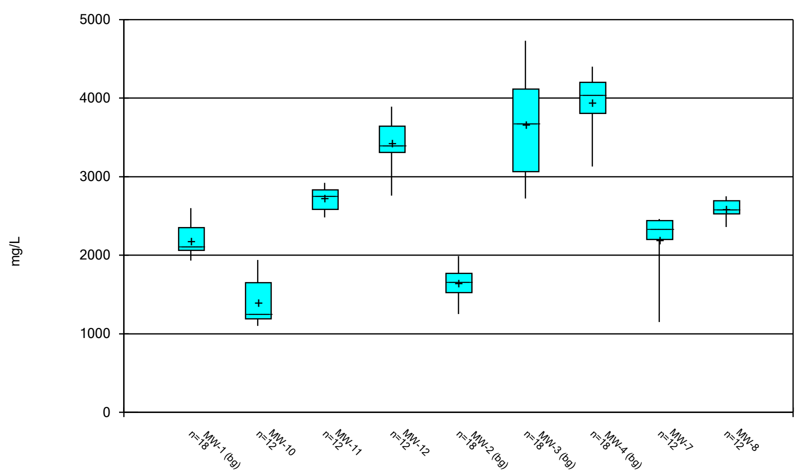


Constituent: Sulfate   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Total Dissolved Solids   Analysis Run 4/10/2020 10:54 AM

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

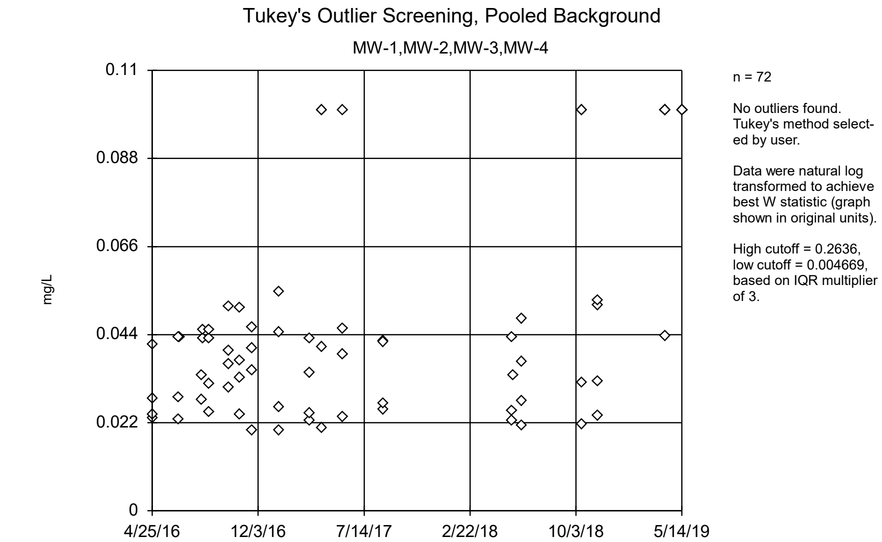
FIGURE C.

Tukey's Outlier Analysis - Interwell Parameters - All Results

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill Printed 4/10/2020, 10:49 AM

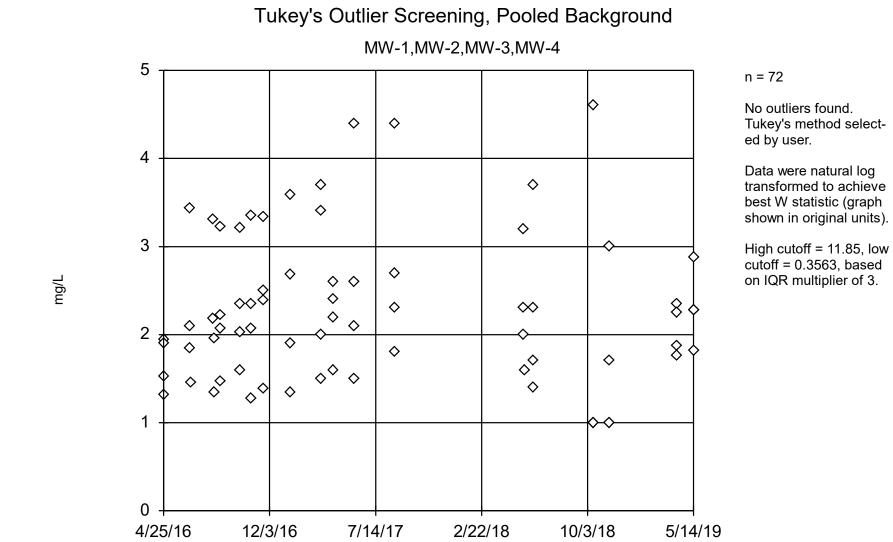
Constituent	Well	Outlier	Value(s)	Date(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	MW-1,MW-2,MW-3,MW-4	No	n/a	n/a w/combined bg	NP	72	0.04564	0.02611	ln(x)	ShapiroFrancia
Chloride (mg/L)	MW-1,MW-2,MW-3,MW-4	No	n/a	n/a w/combined bg	NP	72	2.247	0.8446	ln(x)	ShapiroFrancia
pH (SU)	MW-1,MW-2,MW-3,MW-4	No	n/a	n/a w/combined bg	NP	74	5.628	0.5228	x^6	ShapiroFrancia

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



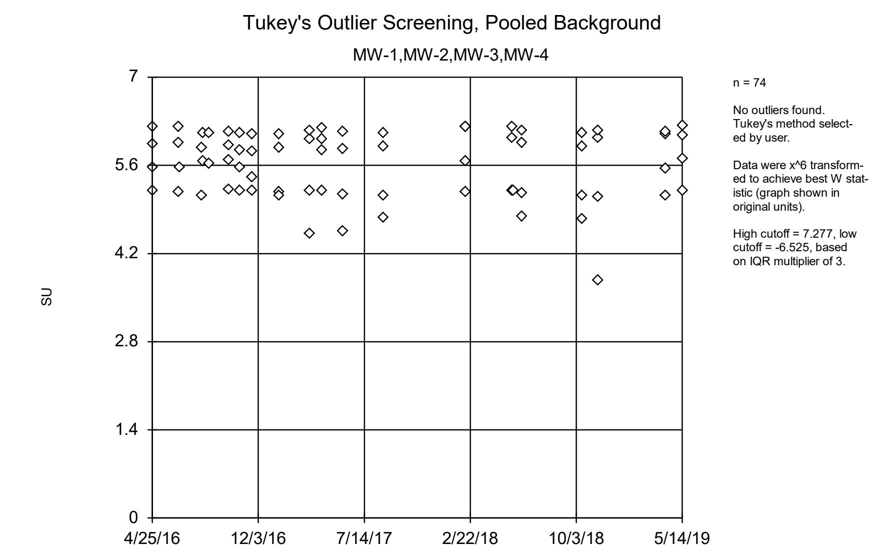
Constituent: Boron   Analysis Run 4/10/2020 10:49 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



Constituent: Chloride   Analysis Run 4/10/2020 10:49 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



Constituent: pH   Analysis Run 4/10/2020 10:49 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Tukey's Outlier Analysis - Intrawell Parameters - Significant Results

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill   Printed 4/10/2020, 10:52 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Calcium (mg/L)	**MW-12**	**Yes**	**313,411**	**5/31/2017,5/15/2019**	**NP**	**12**	**353.2**	**22.85**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	**MW-1 (bg)**	**Yes**	**2100**	**5/22/2018**	**NP**	**18**	**1483**	**187.3**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	**MW-11**	**Yes**	**2200,1400**	**5/22/2018,11/20/2018**	**NP**	**12**	**1728**	**194.2**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	**MW-7**	**Yes**	**1900**	**5/23/2018**	**NP**	**12**	**1356**	**213.5**	**ln(x)**	**ShapiroWilk**

Tukey's Outlier Analysis - Intrawell Parameters - All Results

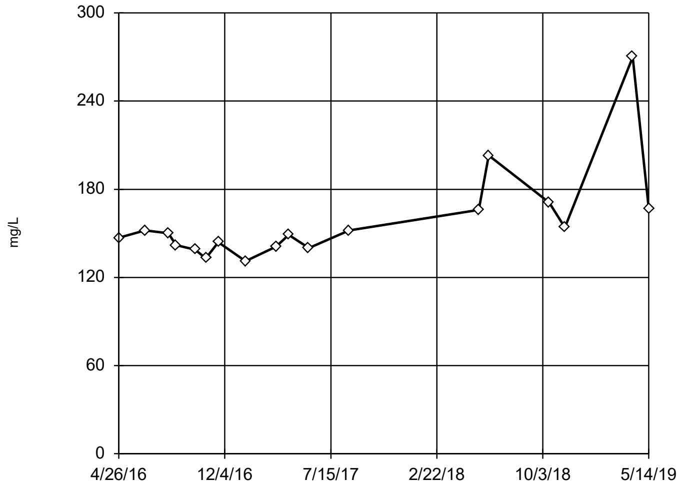
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill   Printed 4/10/2020, 10:52 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Calcium (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	18	158.4	32.55	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-10	No	n/a	n/a	NP	12	190.5	48.52	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-11	No	n/a	n/a	NP	12	381.8	16.45	x^6	ShapiroWilk
Calcium (mg/L)	**MW-12**	**Yes**	**313,411**	**5/31/2017,5/15/2019**	**NP**	**12**	**353.2**	**22.85**	**ln(x)**	**ShapiroWilk**
Calcium (mg/L)	MW-2 (bg)	No	n/a	n/a	NP	18	174	21.99	normal	ShapiroWilk
Calcium (mg/L)	MW-3 (bg)	No	n/a	n/a	NP	18	301.6	56.48	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-4 (bg)	No	n/a	n/a	NP	18	311.2	38.16	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-7	No	n/a	n/a	NP	12	293.9	33.14	x^6	ShapiroWilk
Calcium (mg/L)	MW-8	No	n/a	n/a	NP	12	304.5	16.53	ln(x)	ShapiroWilk
Fluoride (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	19	0.1262	0.03546	x^2	ShapiroWilk
Fluoride (mg/L)	MW-10	No	n/a	n/a	NP	13	0.1782	0.08298	sqrt(x)	ShapiroWilk
Fluoride (mg/L)	MW-11	No	n/a	n/a	NP	13	0.09315	0.02661	normal	ShapiroWilk
Fluoride (mg/L)	MW-12	No	n/a	n/a	NP	13	0.1188	0.04526	x^2	ShapiroWilk
Fluoride (mg/L)	MW-2 (bg)	No	n/a	n/a	NP	19	0.1401	0.05792	normal	ShapiroWilk
Fluoride (mg/L)	MW-3 (bg)	No	n/a	n/a	NP	19	0.3629	0.125	ln(x)	ShapiroWilk
Fluoride (mg/L)	MW-4 (bg)	No	n/a	n/a	NP	19	0.3281	0.06353	x^5	ShapiroWilk
Fluoride (mg/L)	MW-7	No	n/a	n/a	NP	13	0.1855	0.01295	normal	ShapiroWilk
Fluoride (mg/L)	MW-8	No	n/a	n/a	NP	13	0.2142	0.009112	x^6	ShapiroWilk
Sulfate (mg/L)	**MW-1 (bg)**	**Yes**	**2100**	**5/22/2018**	**NP**	**18**	**1483**	**187.3**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	MW-10	No	n/a	n/a	NP	12	826.3	198.7	ln(x)	ShapiroWilk
Sulfate (mg/L)	**MW-11**	**Yes**	**2200,1400**	**5/22/2018,11/20/2018**	**NP**	**12**	**1728**	**194.2**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	MW-12	No	n/a	n/a	NP	12	2252	227.8	ln(x)	ShapiroWilk
Sulfate (mg/L)	MW-2 (bg)	No	n/a	n/a	NP	18	998.9	129.3	normal	ShapiroWilk
Sulfate (mg/L)	MW-3 (bg)	No	n/a	n/a	NP	18	2431	379.6	sqrt(x)	ShapiroWilk
Sulfate (mg/L)	MW-4 (bg)	No	n/a	n/a	NP	18	2566	233.5	normal	ShapiroWilk
Sulfate (mg/L)	**MW-7**	**Yes**	**1900**	**5/23/2018**	**NP**	**12**	**1356**	**213.5**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	MW-8	No	n/a	n/a	NP	12	1513	204.7	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	18	2181	173.6	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-10	No	n/a	n/a	NP	12	1392	270.1	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-11	No	n/a	n/a	NP	12	2728	144	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-12	No	n/a	n/a	NP	12	3428	289.1	x^4	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-2 (bg)	No	n/a	n/a	NP	18	1643	200.5	x^2	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-3 (bg)	No	n/a	n/a	NP	18	3661	628.6	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-4 (bg)	No	n/a	n/a	NP	18	3939	362.7	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-7	No	n/a	n/a	NP	12	2198	402.5	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-8	No	n/a	n/a	NP	12	2593	120.2	x^2	ShapiroWilk

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-1 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

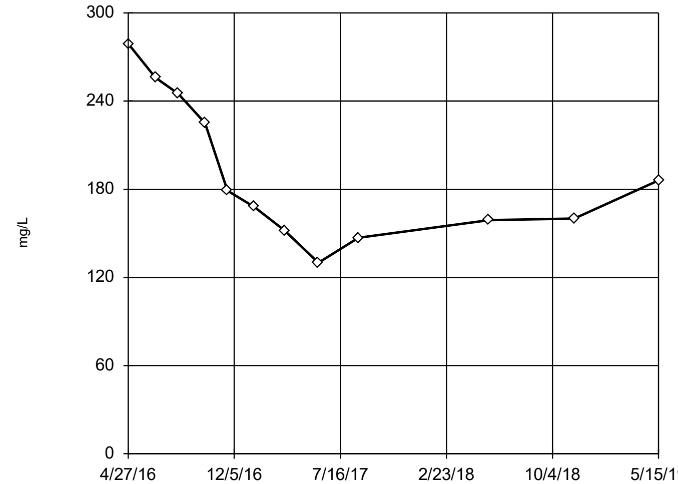
High cutoff = 277.1, low cutoff = 84.42, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-10



n = 12

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

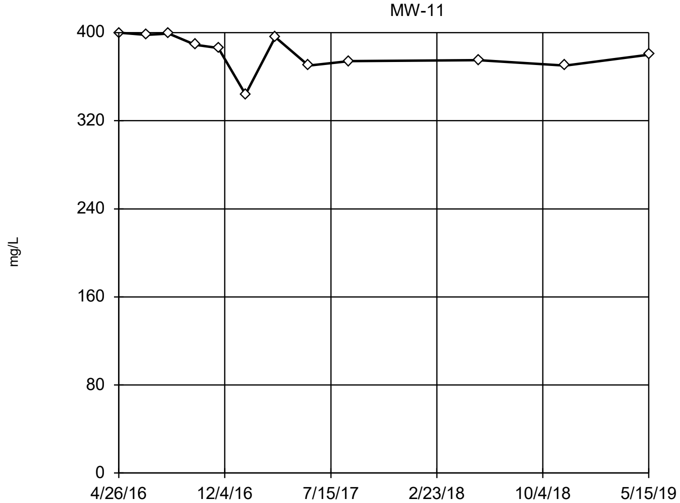
High cutoff = 808.8, low cutoff = 45.13, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-11



n = 12

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

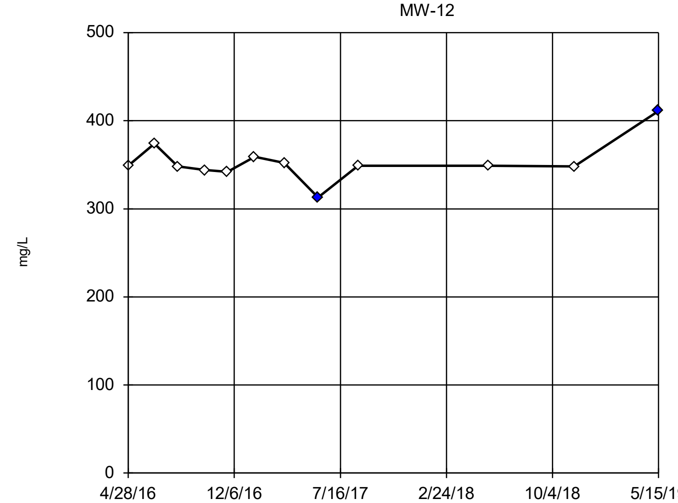
High cutoff = 444.5, low cutoff = -323.3, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-12



n = 12

Outliers are drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

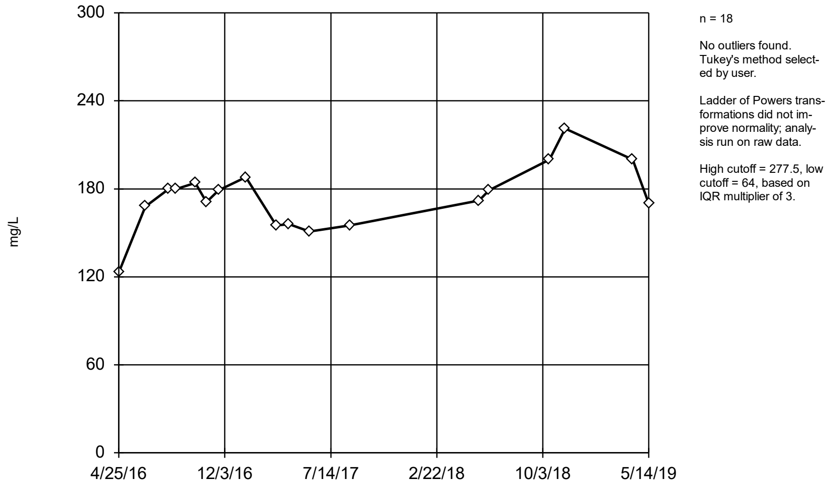
High cutoff = 385.5, low cutoff = 319, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-2 (bg)



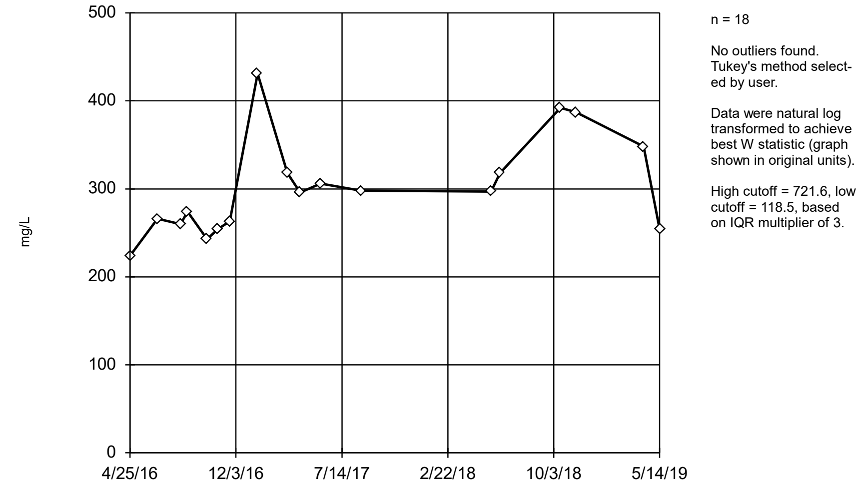
Constituent: Calcium Analysis Run 4/10/2020 10:51 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-3 (bg)



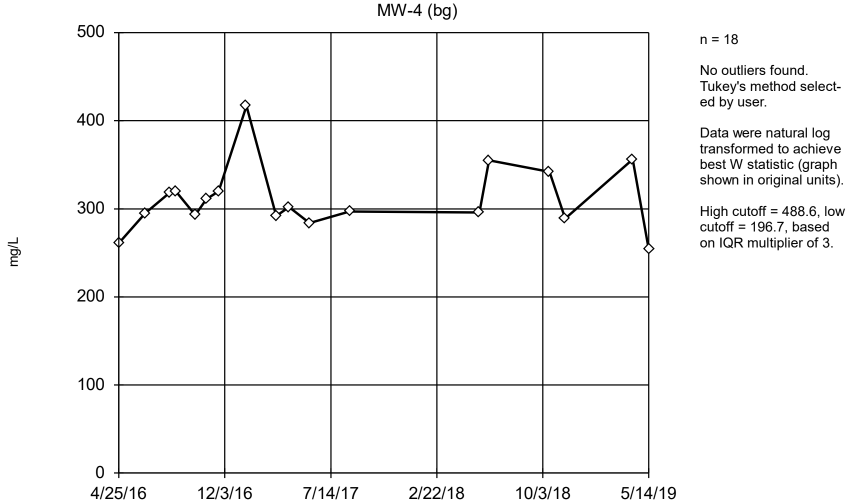
Constituent: Calcium Analysis Run 4/10/2020 10:51 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4 (bg)



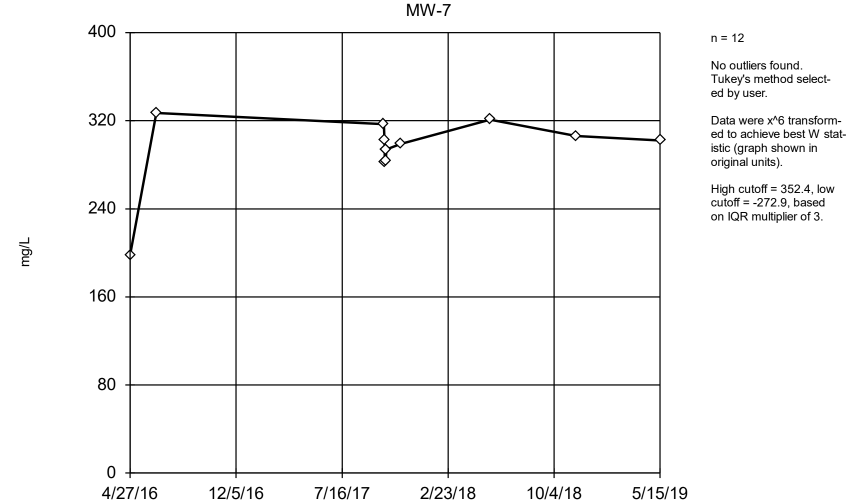
Constituent: Calcium Analysis Run 4/10/2020 10:51 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-7



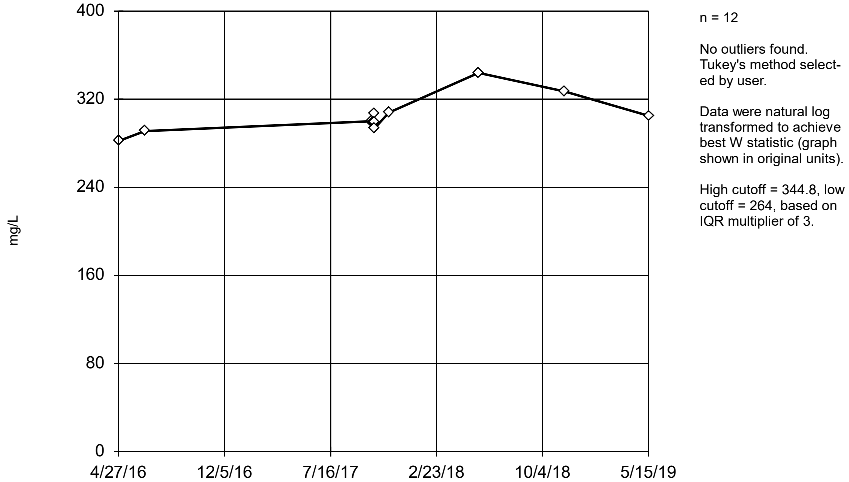
Constituent: Calcium Analysis Run 4/10/2020 10:51 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-8

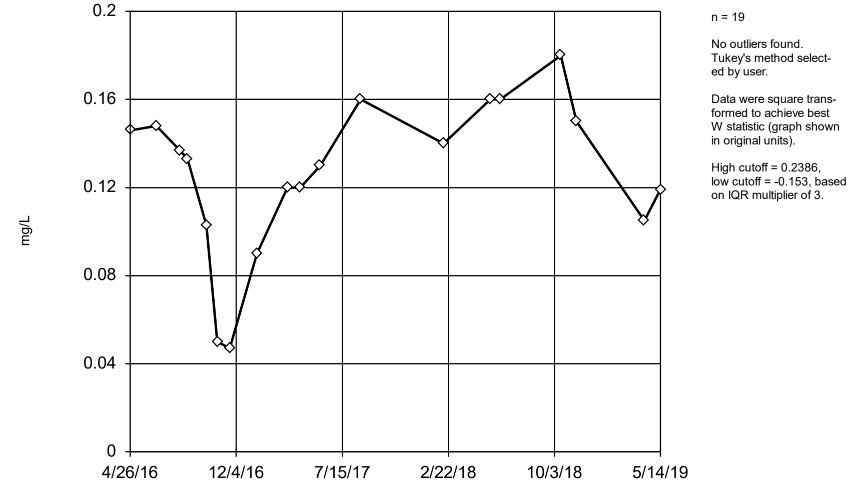


Constituent: Calcium   Analysis Run 4/10/2020 10:51 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-1 (bg)

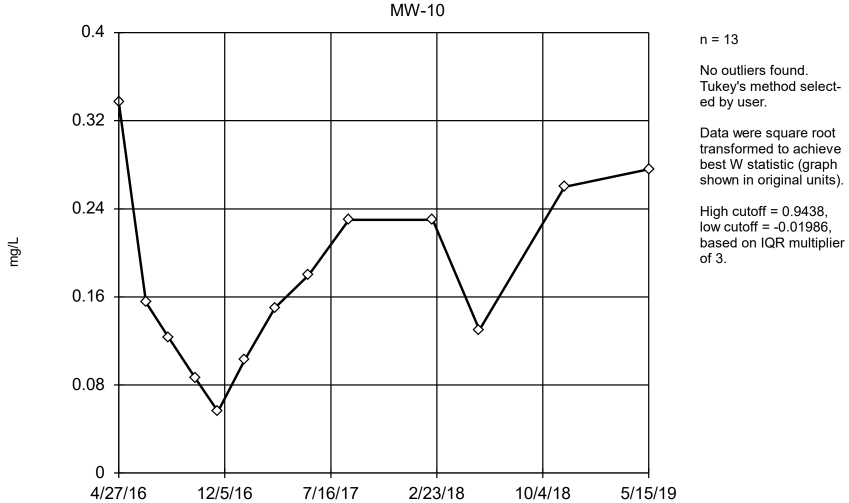


Constituent: Fluoride   Analysis Run 4/10/2020 10:51 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-10

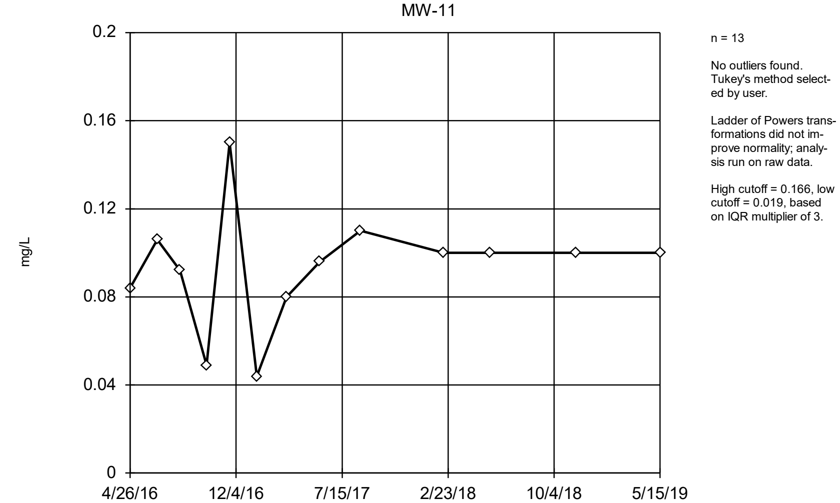


Constituent: Fluoride   Analysis Run 4/10/2020 10:51 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

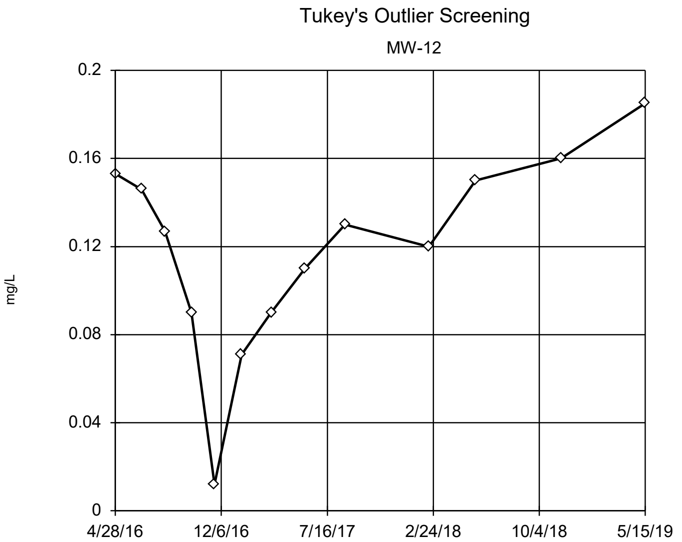
Tukey's Outlier Screening

MW-11



Constituent: Fluoride   Analysis Run 4/10/2020 10:51 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



n = 13

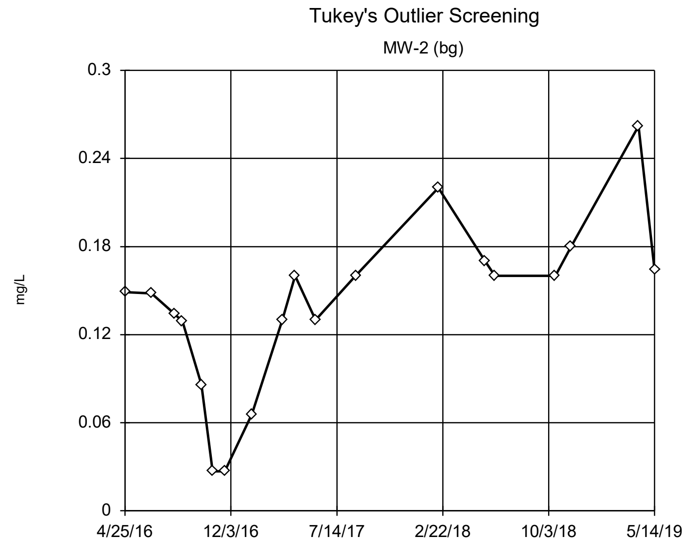
No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.2598, low cutoff = -0.191, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



n = 19

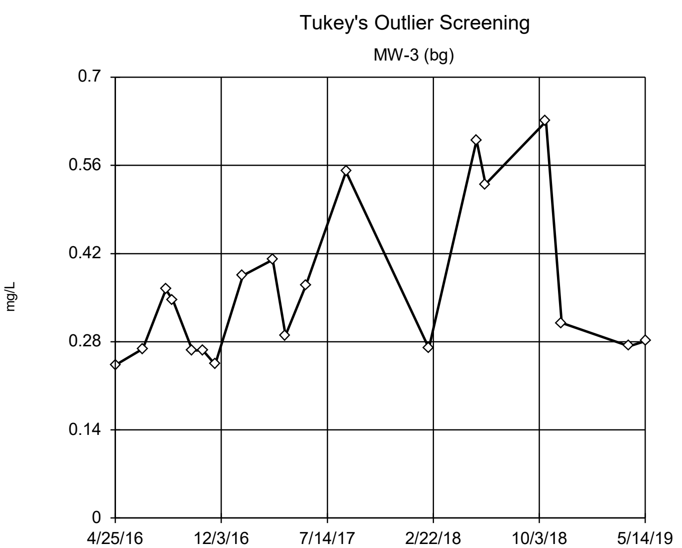
No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.269, low cutoff = 0.024, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



n = 19

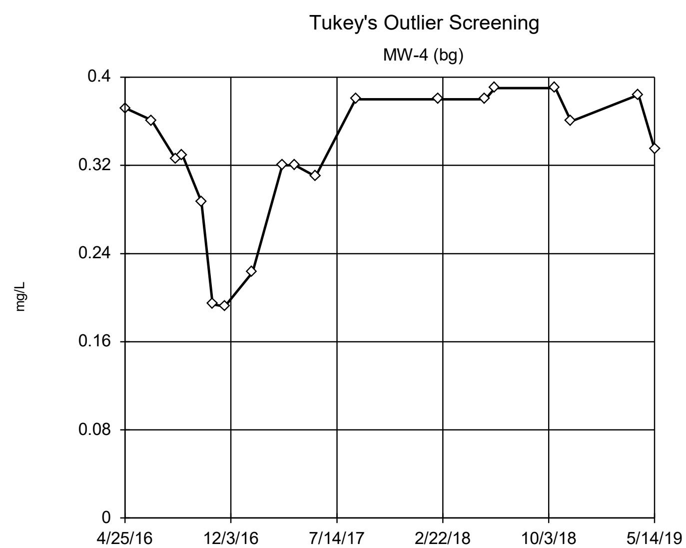
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.452, low cutoff = 0.07597, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



n = 19

No outliers found. Tukey's method selected by user.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

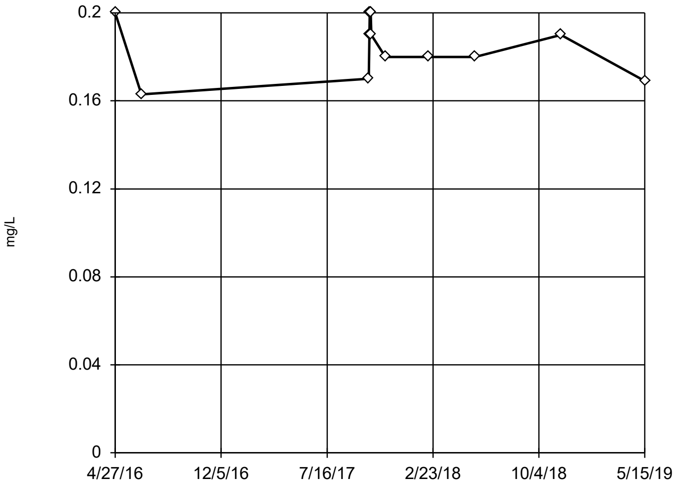
High cutoff = 0.4707, low cutoff = -0.4151, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-7



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.275, low cutoff = 0.1, based on IQR multiplier of 3.

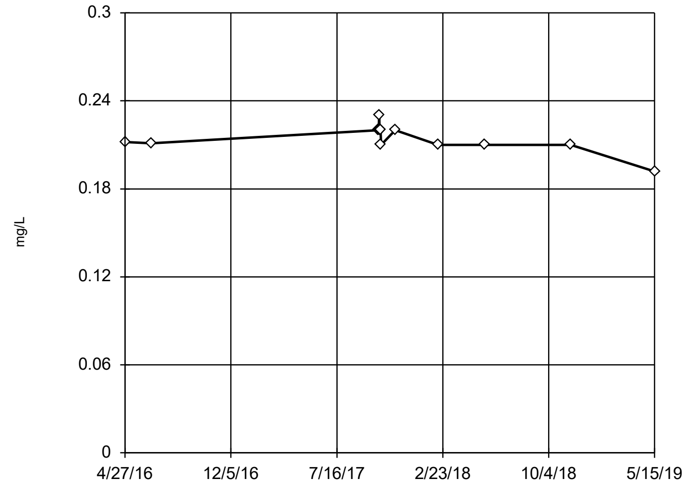
Constituent: Fluoride   Analysis Run 4/10/2020 10:51 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-8



n = 13

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.2411, low cutoff = 0.1196, based on IQR multiplier of 3.

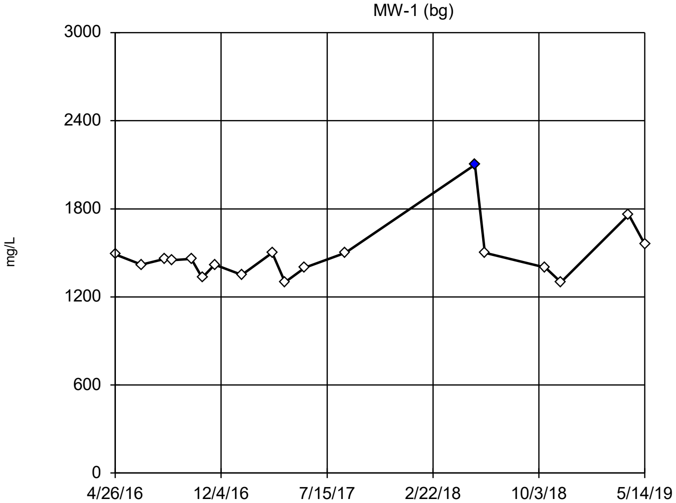
Constituent: Fluoride   Analysis Run 4/10/2020 10:51 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-1 (bg)



n = 18

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1948, low cutoff = 1058, based on IQR multiplier of 3.

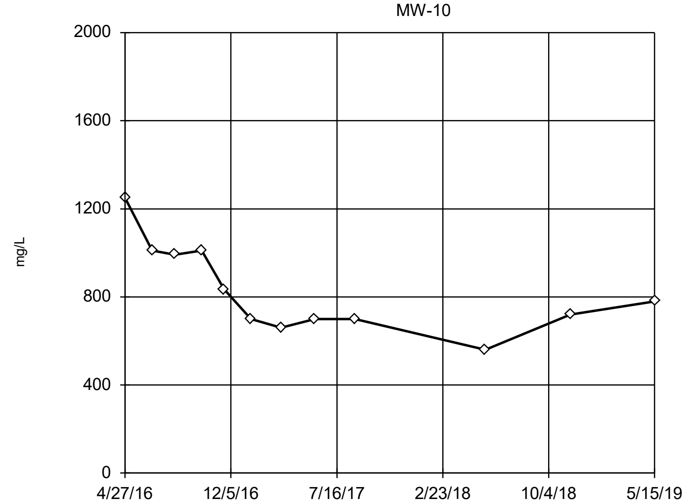
Constituent: Sulfate   Analysis Run 4/10/2020 10:51 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-10



n = 12

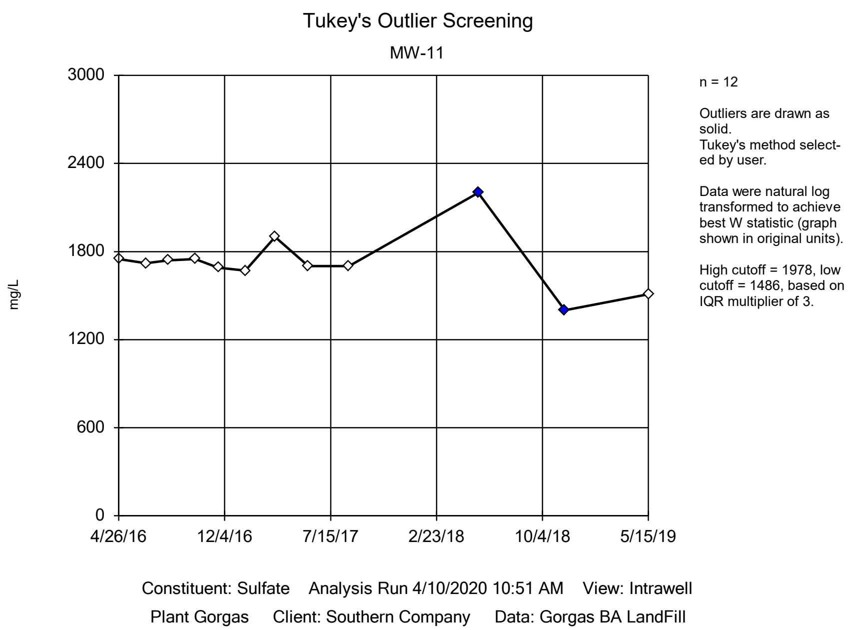
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

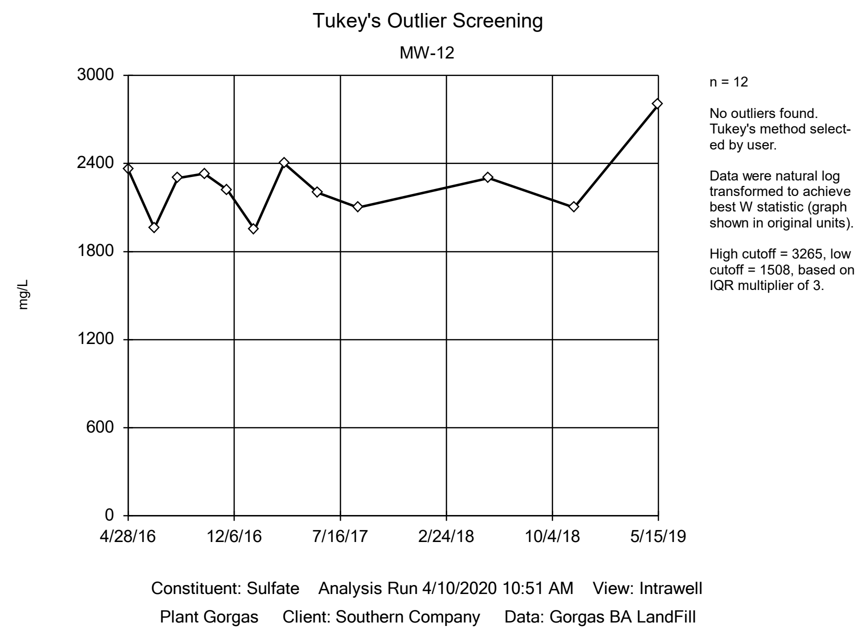
High cutoff = 2927, low cutoff = 239.4, based on IQR multiplier of 3.

Constituent: Sulfate   Analysis Run 4/10/2020 10:51 AM   View: Intrawell

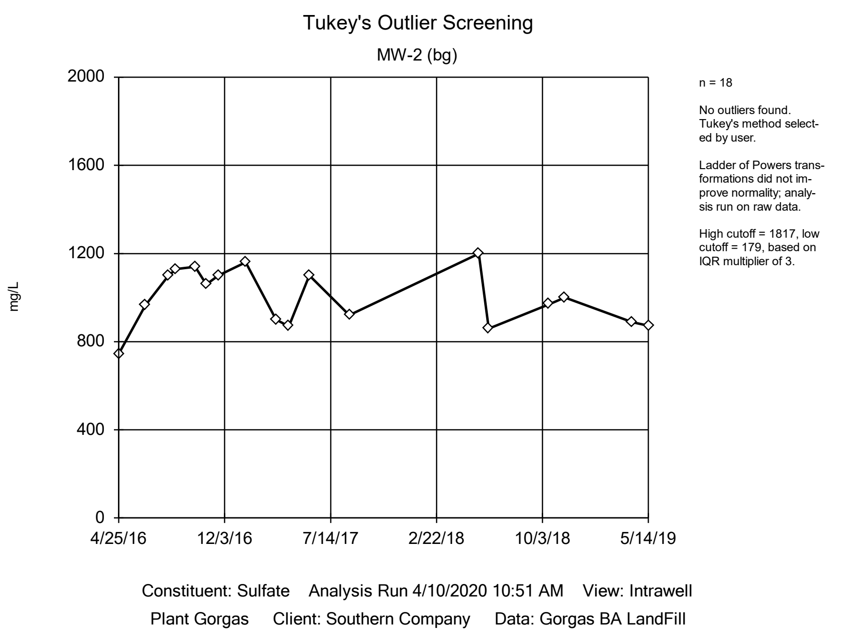
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill



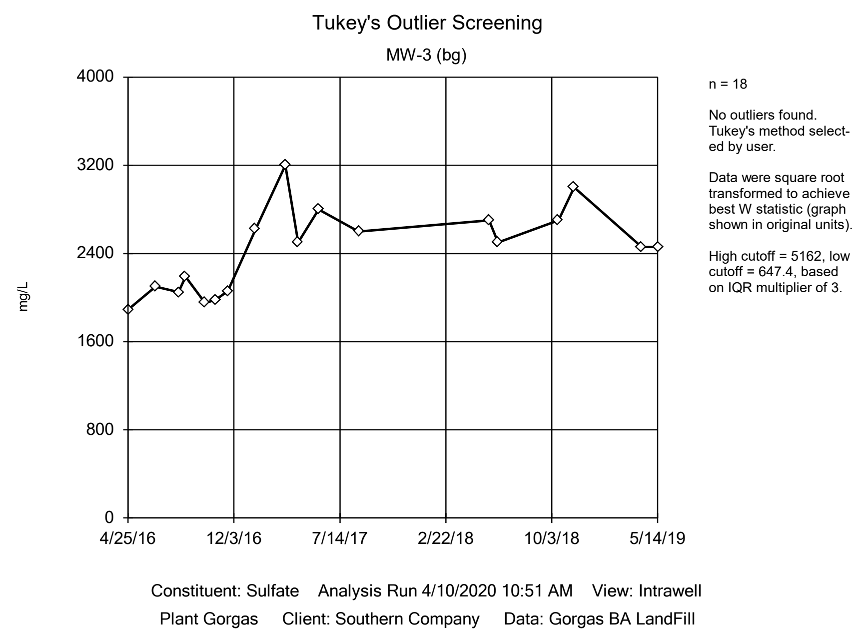
Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

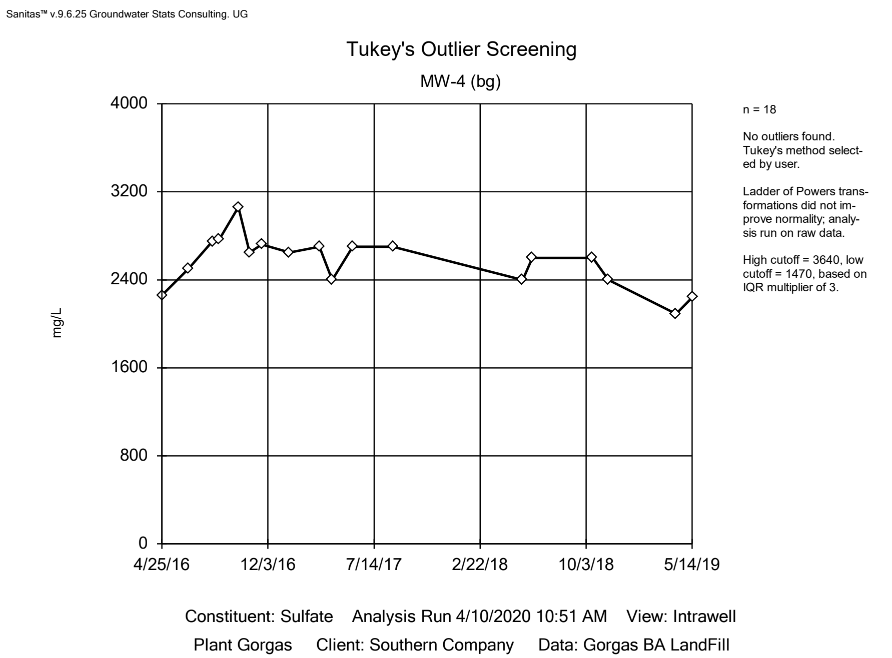


Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

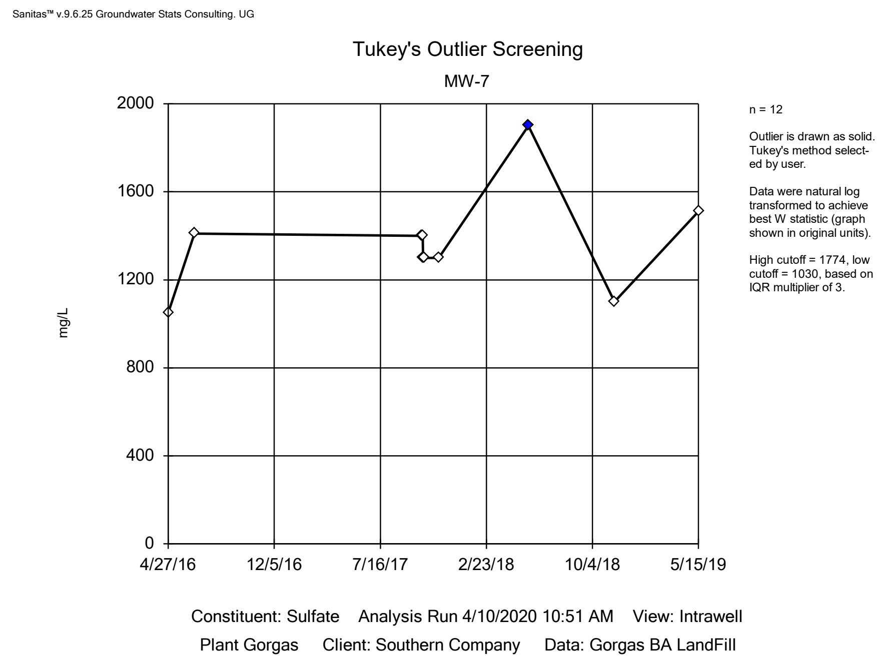


Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

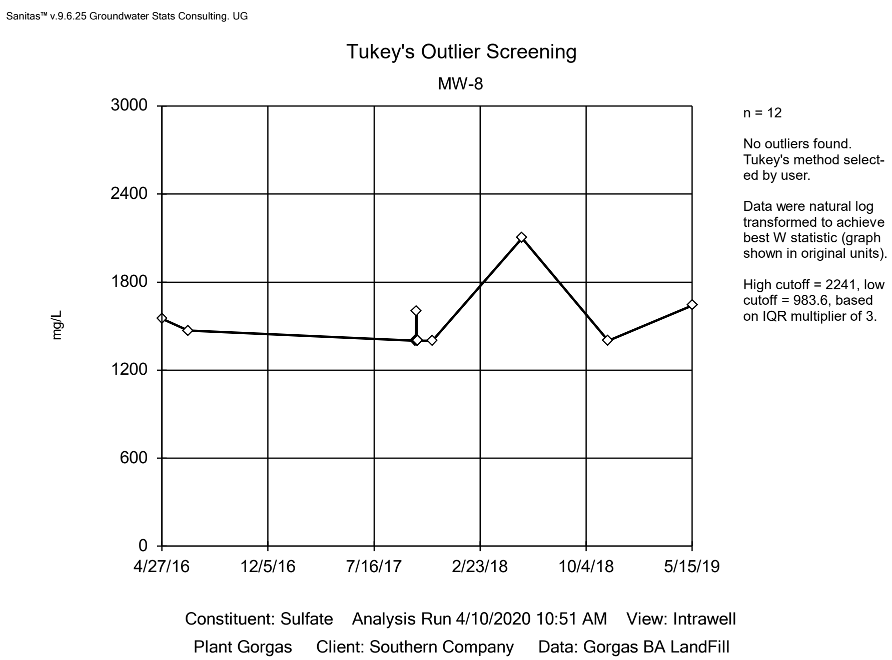




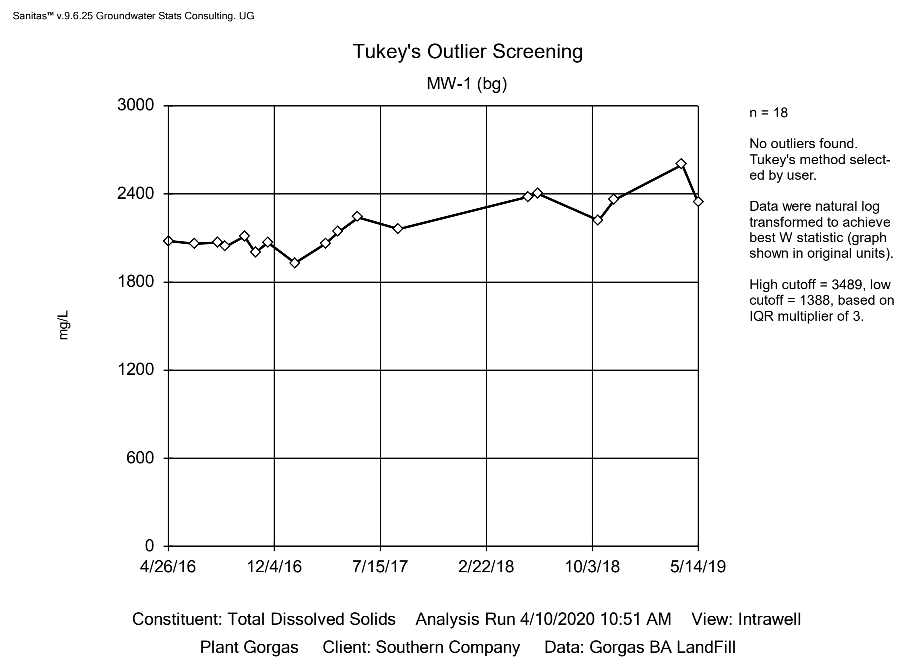
Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-4 (bg)
mg/L
4000
3200
2400
1600
800
0
4/25/16
12/3/16
7/14/17
2/22/18
10/3/18
5/14/19
n = 18
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 3640, low cutoff = 1470, based on IQR multiplier of 3.
Constituent: Sulfate Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



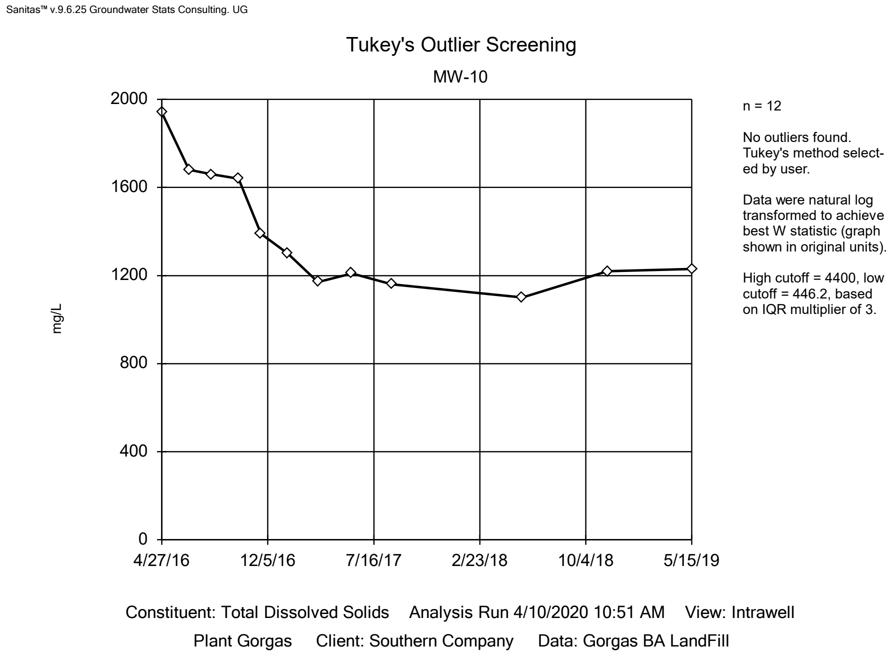
Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-7
mg/L
2000
1600
1200
800
400
0
4/27/16
12/5/16
7/16/17
2/23/18
10/4/18
5/15/19
n = 12
Outlier is drawn as solid. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 1774, low cutoff = 1030, based on IQR multiplier of 3.
Constituent: Sulfate Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



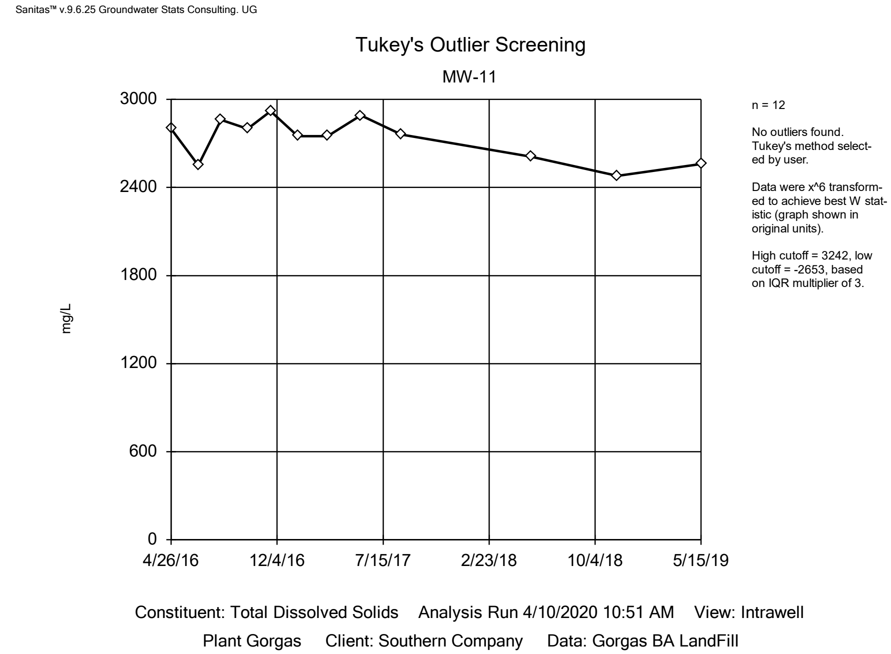
Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-8
mg/L
3000
2400
1800
1200
600
0
4/27/16
12/5/16
7/16/17
2/23/18
10/4/18
5/15/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 2241, low cutoff = 983.6, based on IQR multiplier of 3.
Constituent: Sulfate Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



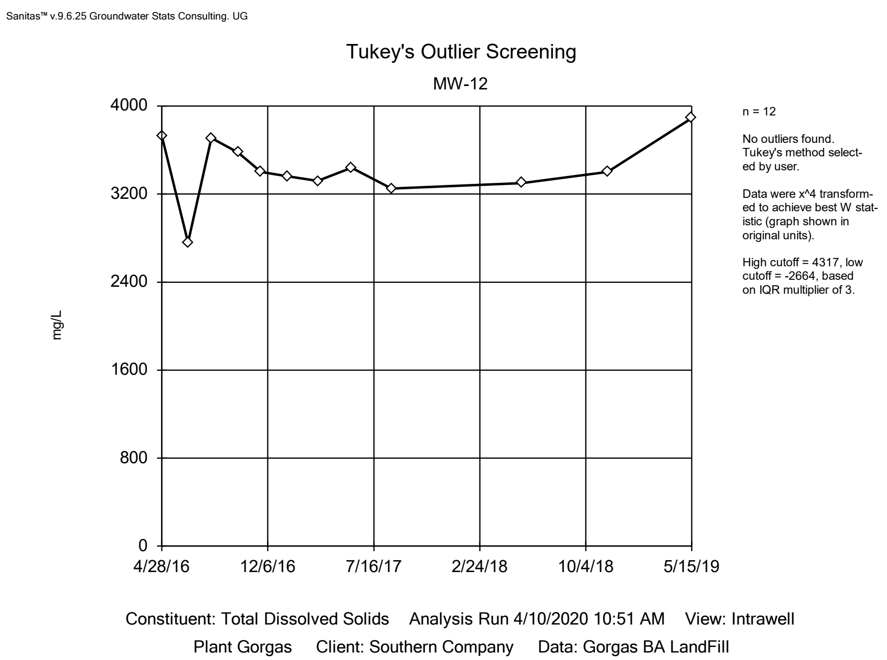
Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-1 (bg)
mg/L
3000
2400
1800
1200
600
0
4/26/16
12/4/16
7/15/17
2/22/18
10/3/18
5/14/19
n = 18
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 3489, low cutoff = 1388, based on IQR multiplier of 3.
Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



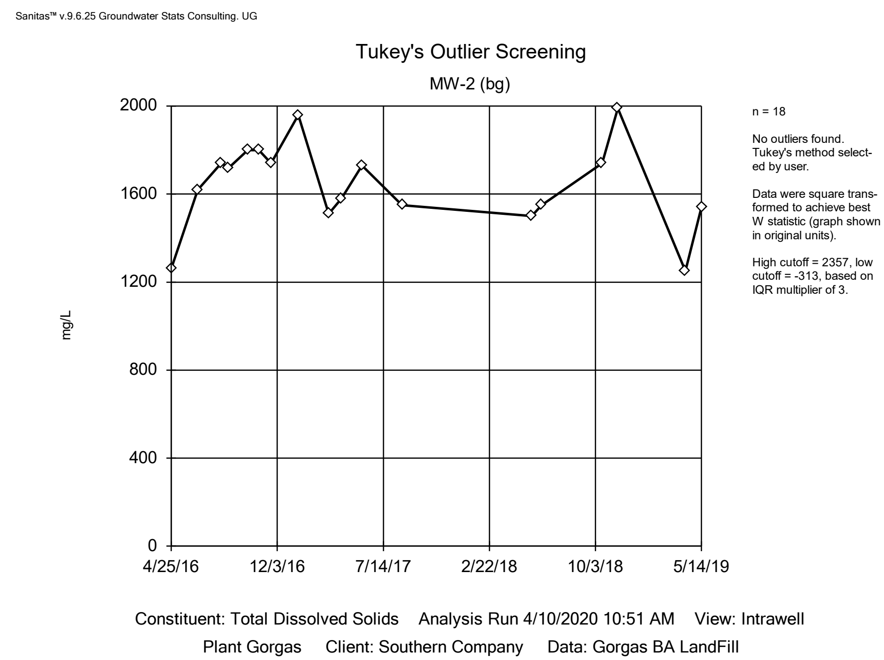
Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-10
mg/L
2000
1600
1200
800
400
0
4/27/16
12/5/16
7/16/17
2/23/18
10/4/18
5/15/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 4400, low cutoff = 446.2, based on IQR multiplier of 3.
Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-11
mg/L
3000
2400
1800
1200
600
0
4/26/16
12/4/16
7/15/17
2/23/18
10/4/18
5/15/19
n = 12
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 3242, low cutoff = -2653, based on IQR multiplier of 3.
Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-12
mg/L
4000
3200
2400
1600
800
0
4/28/16
12/6/16
7/16/17
2/24/18
10/4/18
5/15/19
n = 12
No outliers found. Tukey's method selected by user.
Data were x^4 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 4317, low cutoff = -2664, based on IQR multiplier of 3.
Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

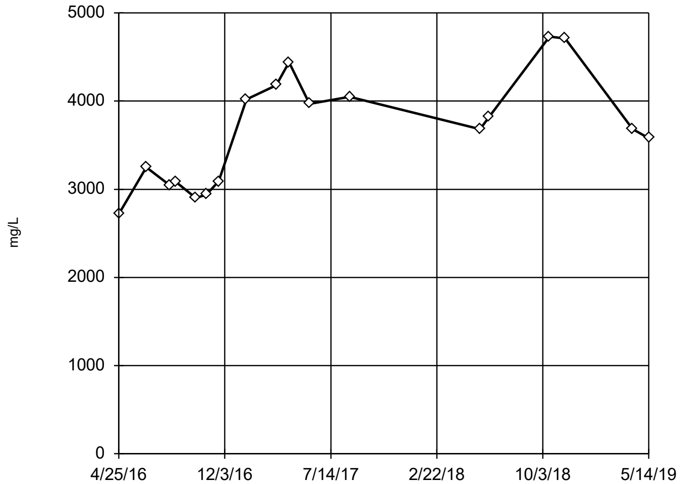


Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-2 (bg)
mg/L
2000
1600
1200
800
400
0
4/25/16
12/3/16
7/14/17
2/22/18
10/3/18
5/14/19
n = 18
No outliers found. Tukey's method selected by user.
Data were square transformed to achieve best W statistic (graph shown in original units).
High cutoff = 2357, low cutoff = -313, based on IQR multiplier of 3.
Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-3 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

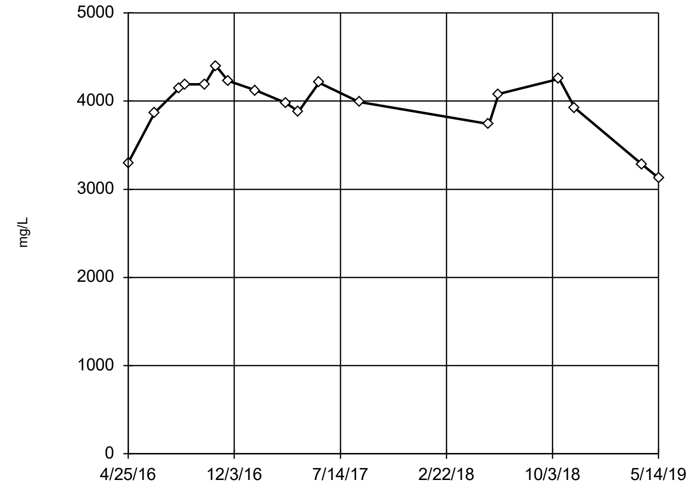
High cutoff = 9954, low cutoff = 1267, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-4 (bg)



n = 18

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

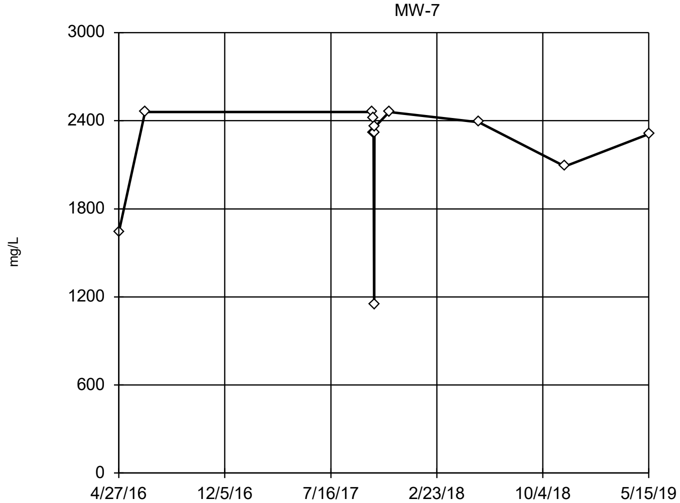
High cutoff = 4837, low cutoff = -4029, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-7



n = 12

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

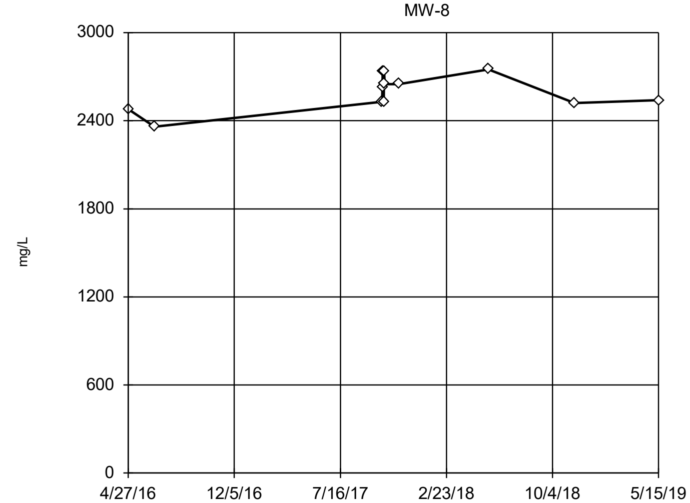
High cutoff = 2810, low cutoff = -2338, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-8



n = 12

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3152, low cutoff = 1925, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:51 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

FIGURE D.

Welch's t-test/Mann-Whitney - Significant Results

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill   Printed 4/10/2020, 10:59 AM

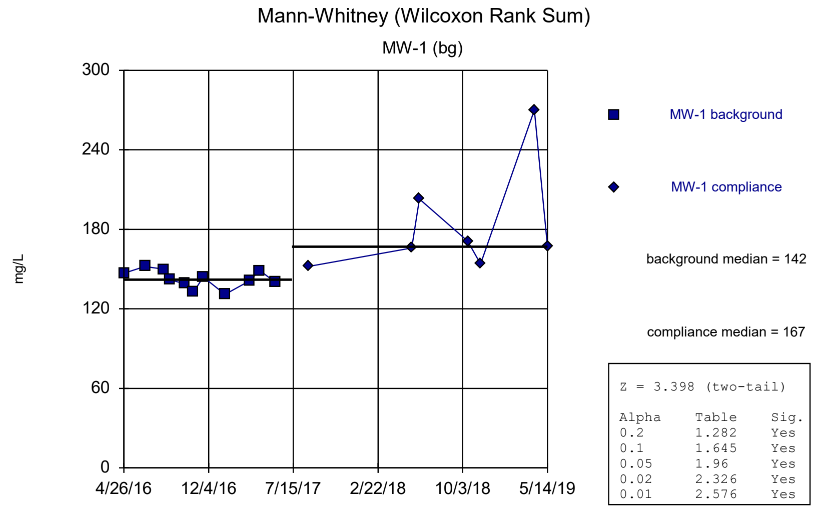
Constituent	Well	Calc.	0.01	Method
Calcium (mg/L)	**MW-1 (bg)**	**3.398**	**Yes**	**Mann-W**
Fluoride (mg/L)	**MW-2 (bg)**	**3.486**	**Yes**	**Mann-W**
Fluoride (mg/L)	**MW-4 (bg)**	**3.27**	**Yes**	**Mann-W**
Total Dissolved Solids (mg/L)	**MW-1 (bg)**	**3.264**	**Yes**	**Mann-W**

Welch's t-test/Mann-Whitney - All Results

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill Printed 4/10/2020, 10:59 AM

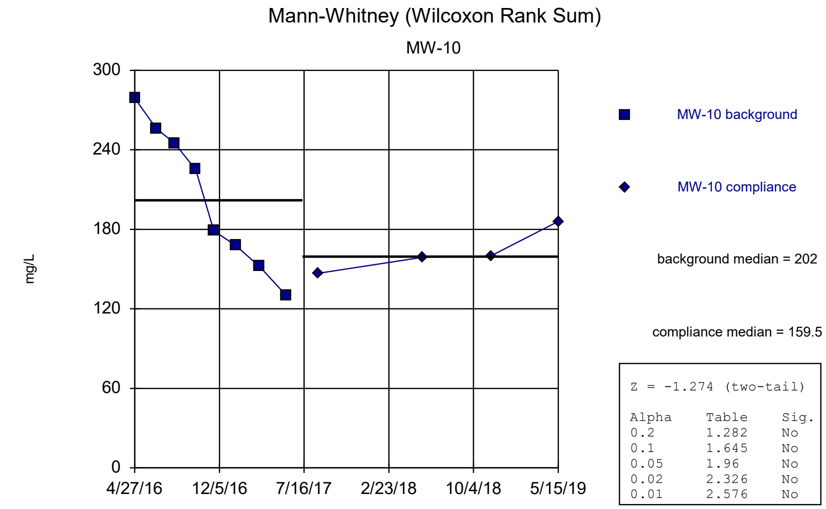
Constituent	Well	Calc.	0.01	Method
Calcium (mg/L)	**MW-1 (bg)**	**3.398**	**Yes**	**Mann-W**
Calcium (mg/L)	MW-10	-1.274	No	Mann-W
Calcium (mg/L)	MW-11	-1.531	No	Mann-W
Calcium (mg/L)	MW-12	0.6854	No	Mann-W
Calcium (mg/L)	MW-2 (bg)	1.271	No	Mann-W
Calcium (mg/L)	MW-3 (bg)	1.723	No	Mann-W
Calcium (mg/L)	MW-4 (bg)	0.2717	No	Mann-W
Fluoride (mg/L)	MW-1 (bg)	2.276	No	Mann-W
Fluoride (mg/L)	MW-10	1.686	No	Mann-W
Fluoride (mg/L)	MW-11	1.559	No	Mann-W
Fluoride (mg/L)	MW-12	1.979	No	Mann-W
Fluoride (mg/L)	**MW-2 (bg)**	**3.486**	**Yes**	**Mann-W**
Fluoride (mg/L)	MW-3 (bg)	1.693	No	Mann-W
Fluoride (mg/L)	**MW-4 (bg)**	**3.27**	**Yes**	**Mann-W**
Sulfate (mg/L)	MW-1 (bg)	1.728	No	Mann-W
Sulfate (mg/L)	MW-10	-1.456	No	Mann-W
Sulfate (mg/L)	MW-11	-1.023	No	Mann-W
Sulfate (mg/L)	MW-12	0	No	Mann-W
Sulfate (mg/L)	MW-2 (bg)	-1.089	No	Mann-W
Sulfate (mg/L)	MW-3 (bg)	1.678	No	Mann-W
Sulfate (mg/L)	MW-4 (bg)	-2.185	No	Mann-W
Total Dissolved Solids (mg/L)	**MW-1 (bg)**	**3.264**	**Yes**	**Mann-W**
Total Dissolved Solids (mg/L)	MW-10	-2.123	No	Mann-W
Total Dissolved Solids (mg/L)	MW-11	-1.96	No	Mann-W
Total Dissolved Solids (mg/L)	MW-12	-0.5104	No	Mann-W
Total Dissolved Solids (mg/L)	MW-2 (bg)	-1.272	No	Mann-W
Total Dissolved Solids (mg/L)	MW-3 (bg)	1.812	No	Mann-W
Total Dissolved Solids (mg/L)	MW-4 (bg)	-1.54	No	Mann-W

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



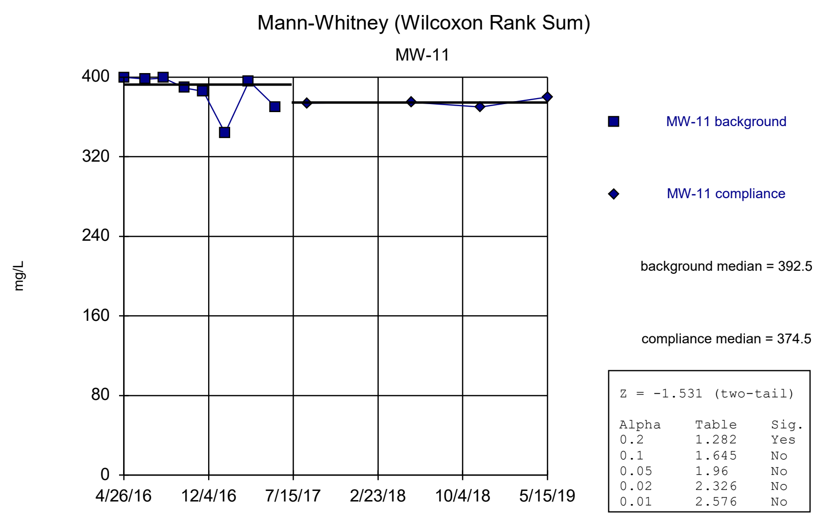
Constituent: Calcium Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



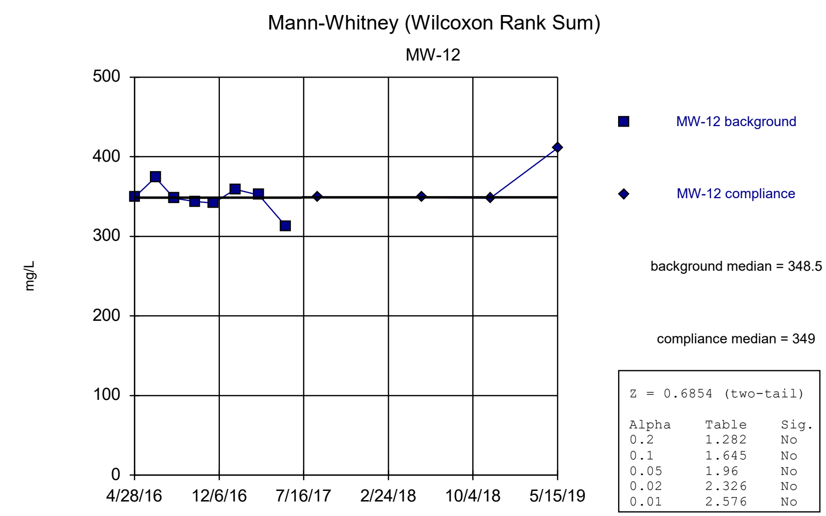
Constituent: Calcium Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



Constituent: Calcium Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

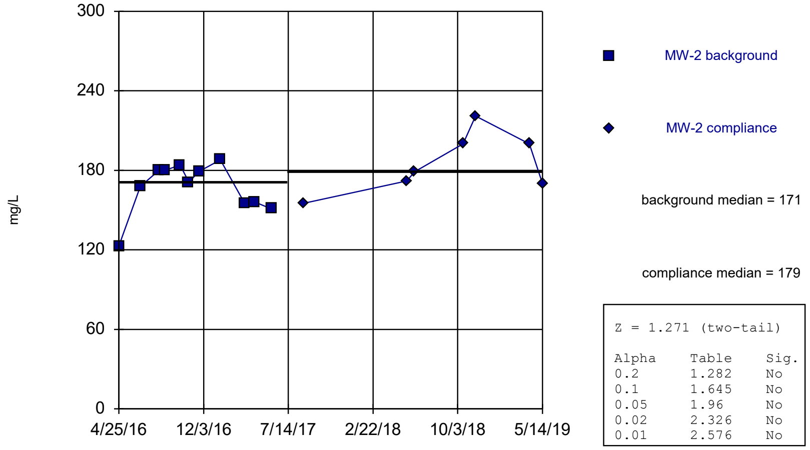


Constituent: Calcium Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-2 (bg)

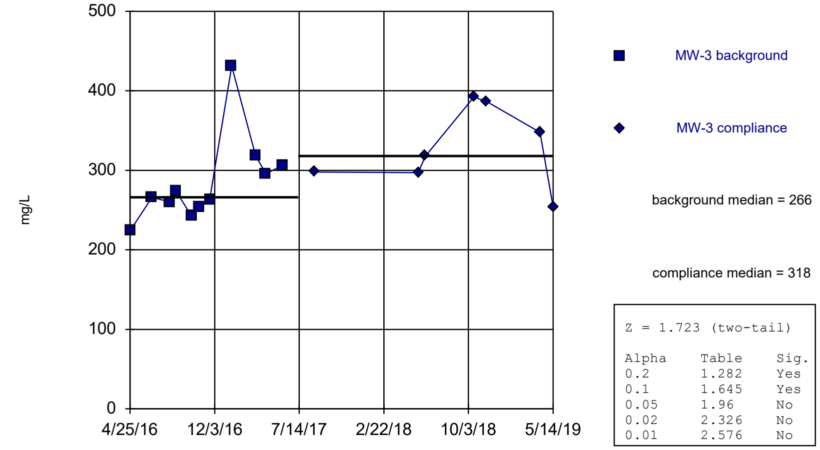


Constituent: Calcium Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-3 (bg)

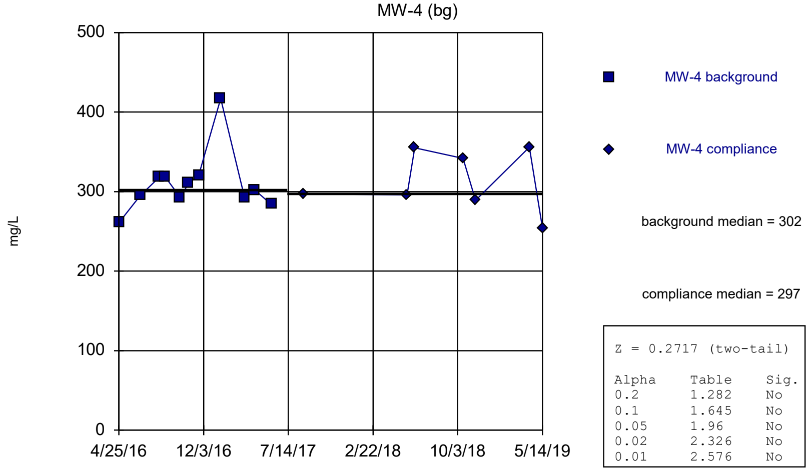


Constituent: Calcium Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4 (bg)

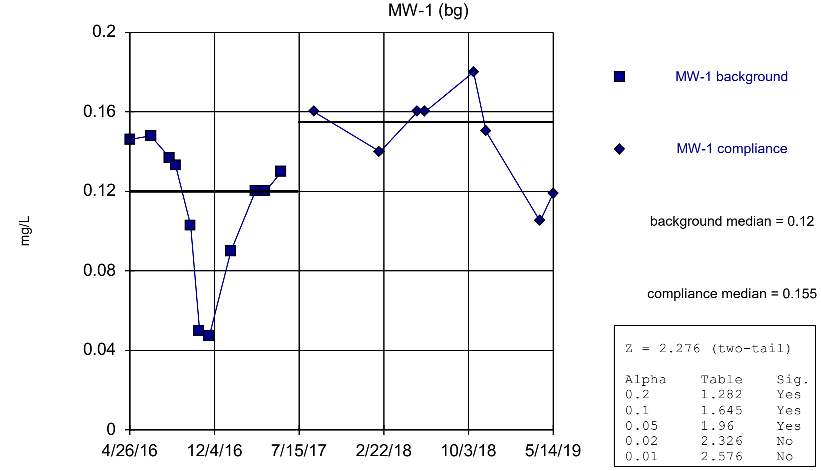


Constituent: Calcium Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

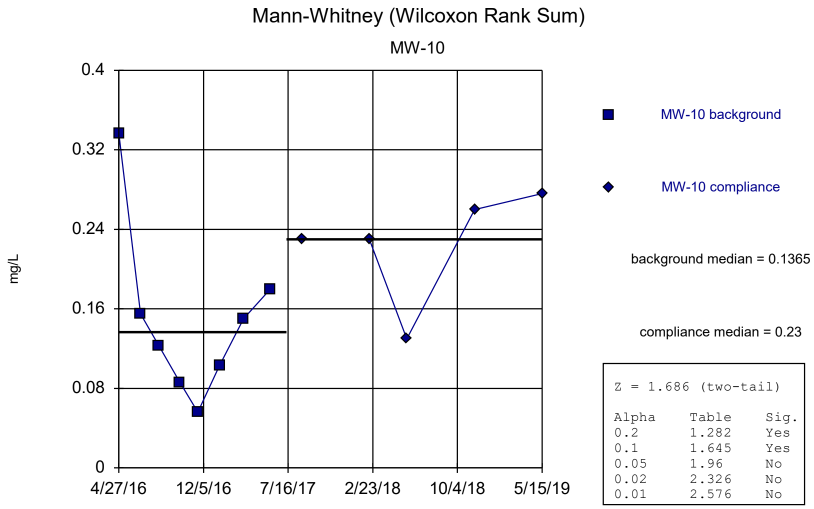
Mann-Whitney (Wilcoxon Rank Sum)

MW-1 (bg)



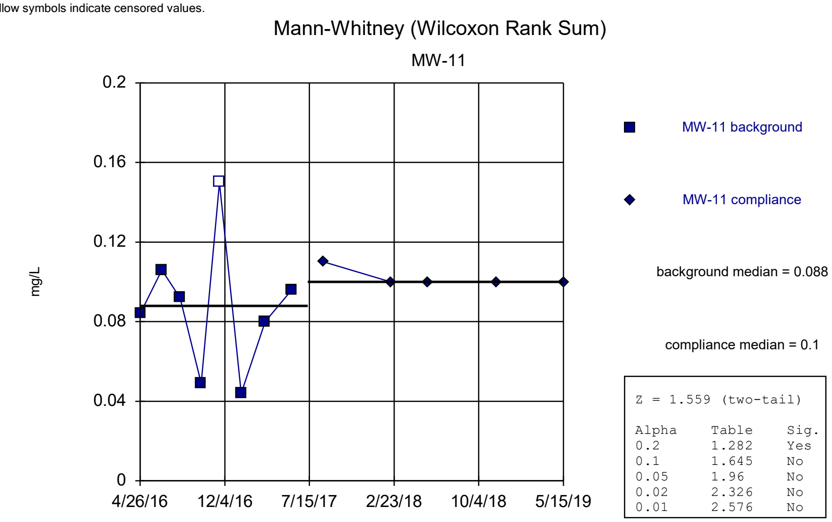
Constituent: Fluoride Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



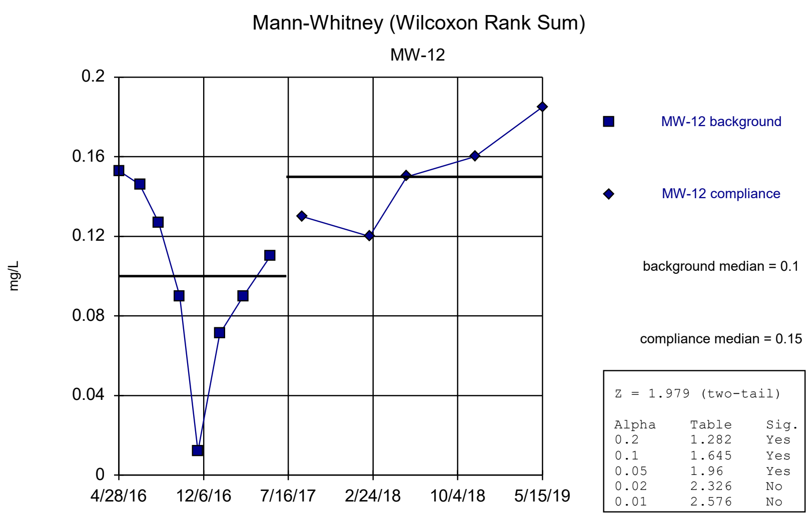
Constituent: Fluoride Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



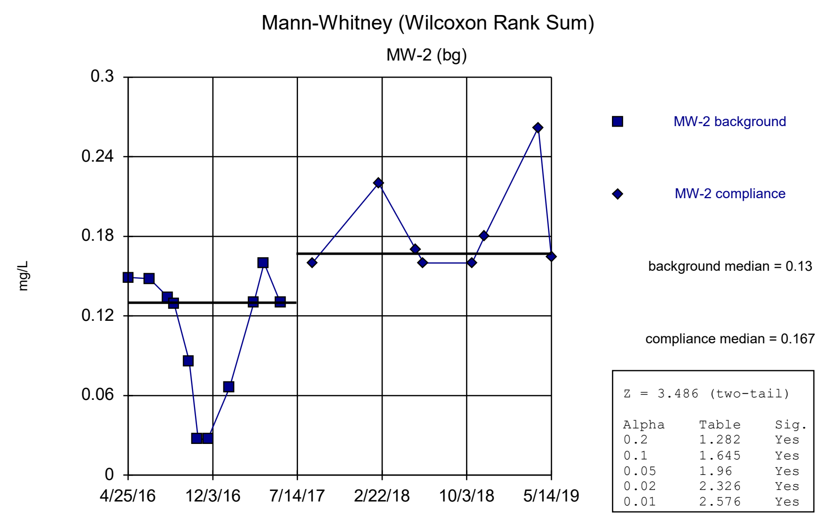
Constituent: Fluoride Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



Constituent: Fluoride Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

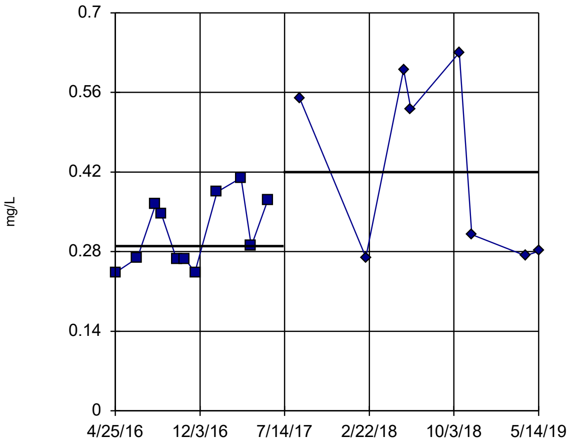


Constituent: Fluoride Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-3 (bg)



MW-3 background

MW-3 compliance

background median = 0.29

compliance median = 0.42

Z = 1.693 (two-tail)

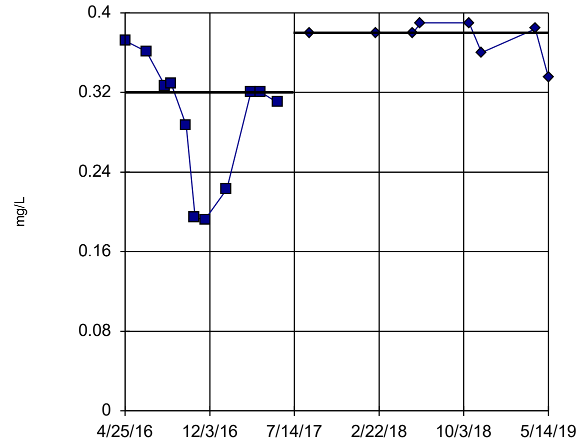
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Fluoride Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4 (bg)



MW-4 background

MW-4 compliance

background median = 0.32

compliance median = 0.38

Z = 3.27 (two-tail)

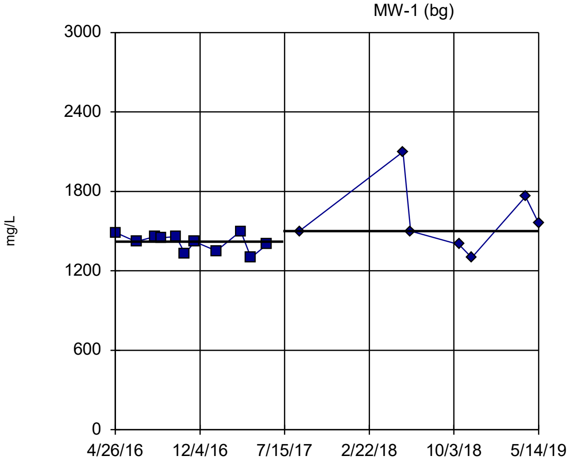
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Fluoride Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1 (bg)



MW-1 background

MW-1 compliance

background median = 1420

compliance median = 1500

Z = 1.728 (two-tail)

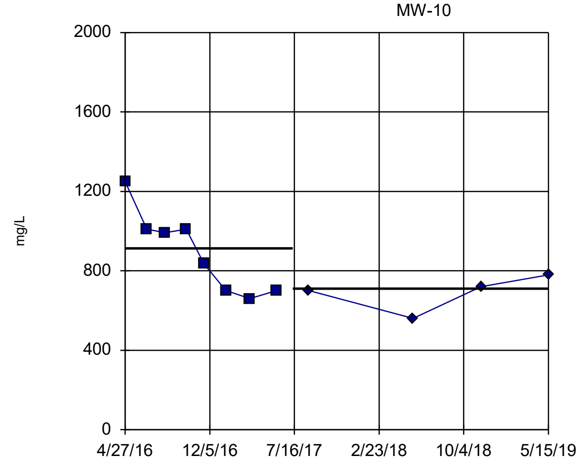
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-10



MW-10 background

MW-10 compliance

background median = 913

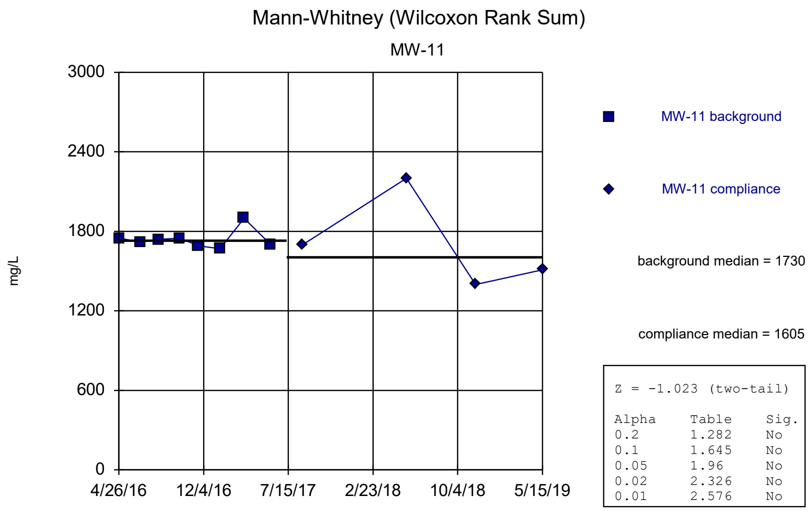
compliance median = 710

Z = -1.456 (two-tail)

Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

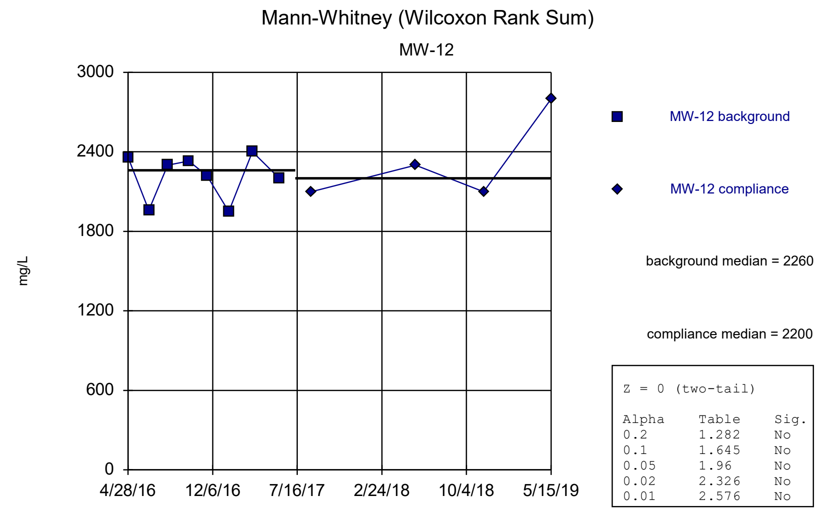
Constituent: Sulfate Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



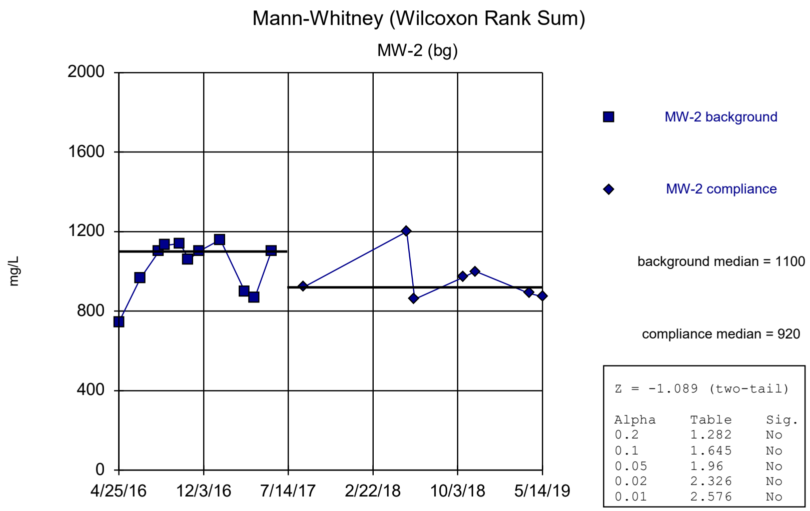
Constituent: Sulfate Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



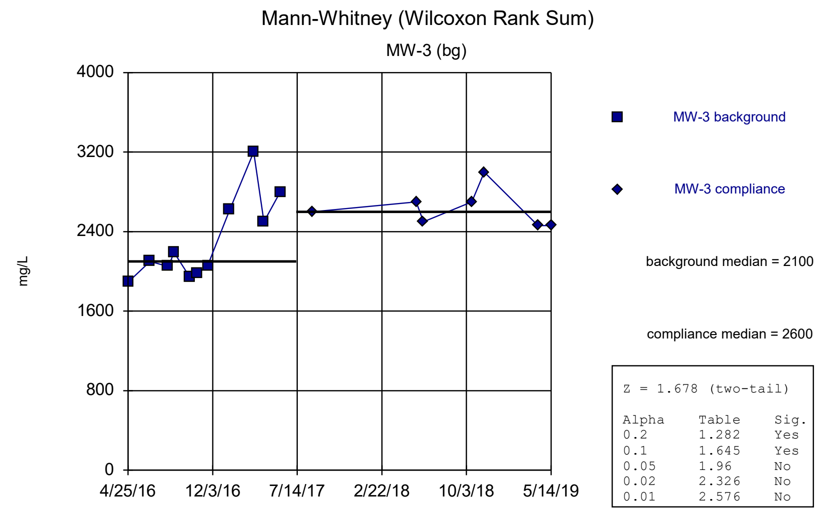
Constituent: Sulfate Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



Constituent: Sulfate Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

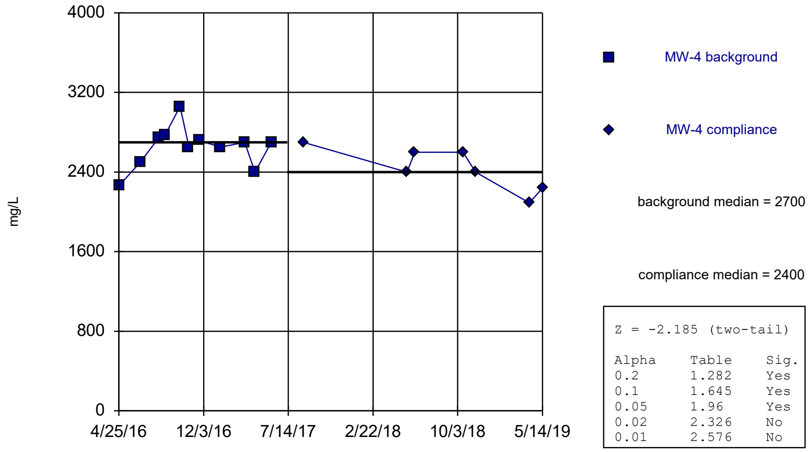


Constituent: Sulfate Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-4 (bg)



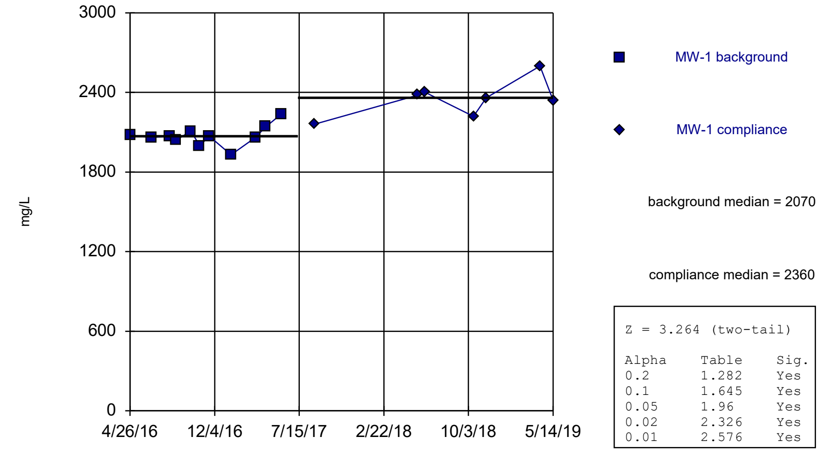
Constituent: Sulfate   Analysis Run 4/10/2020 10:58 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-1 (bg)



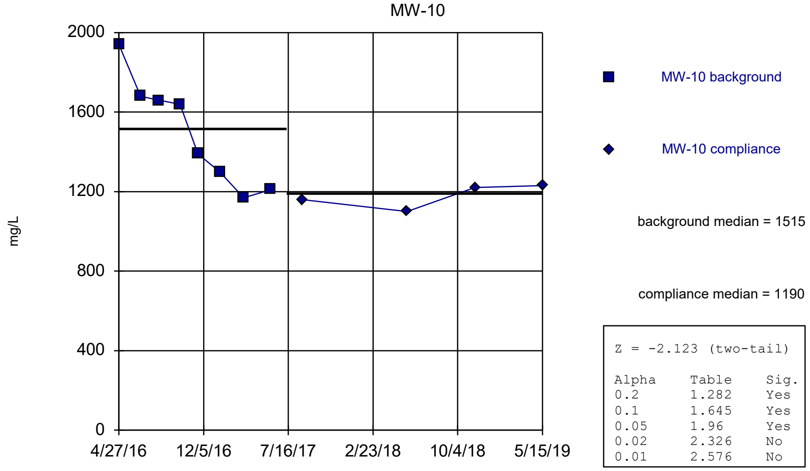
Constituent: Total Dissolved Solids   Analysis Run 4/10/2020 10:58 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

MW-10



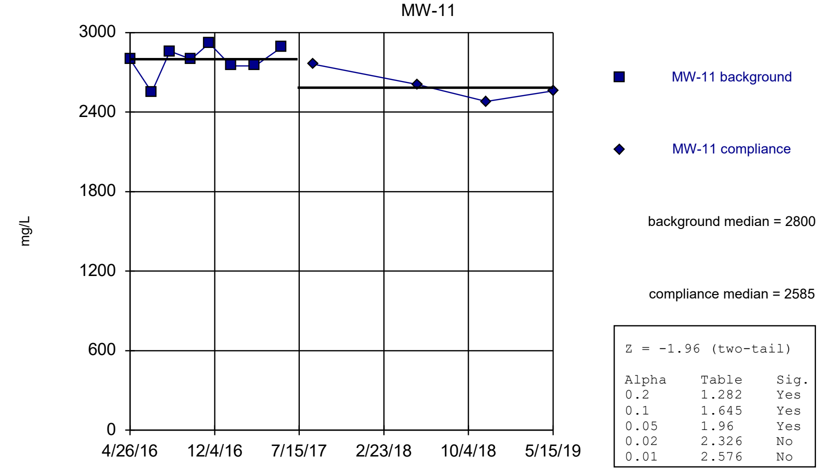
Constituent: Total Dissolved Solids   Analysis Run 4/10/2020 10:58 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

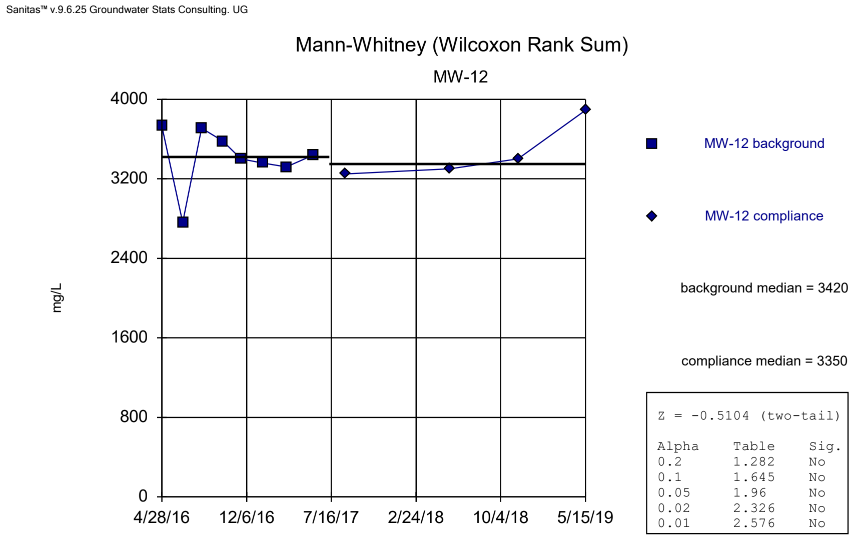
Mann-Whitney (Wilcoxon Rank Sum)

MW-11

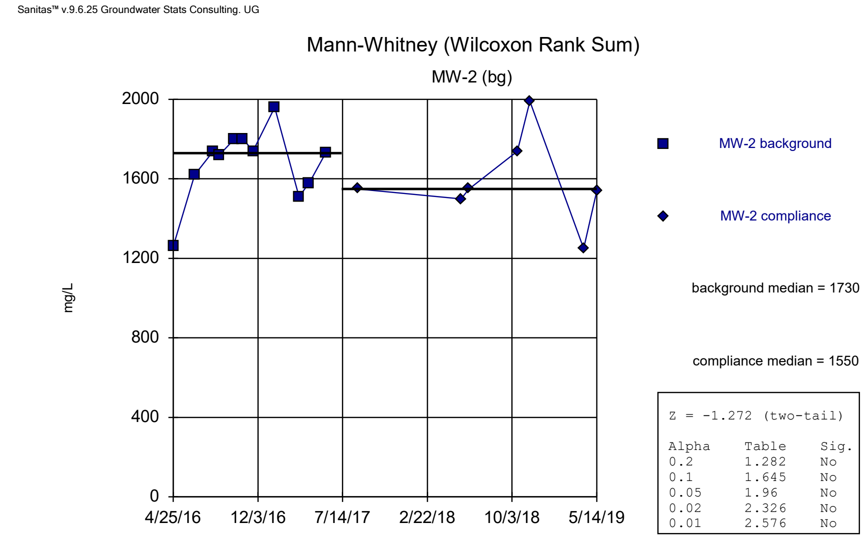


Constituent: Total Dissolved Solids   Analysis Run 4/10/2020 10:58 AM   View: Intrawell

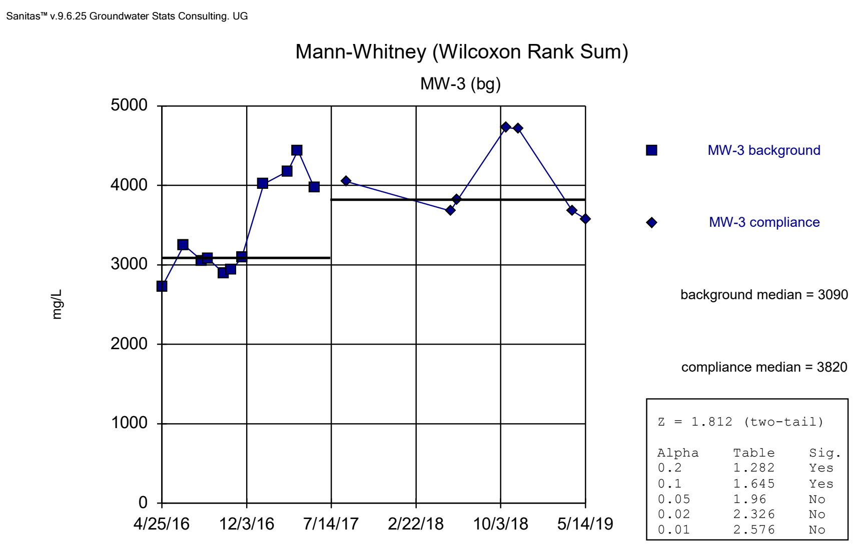
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill



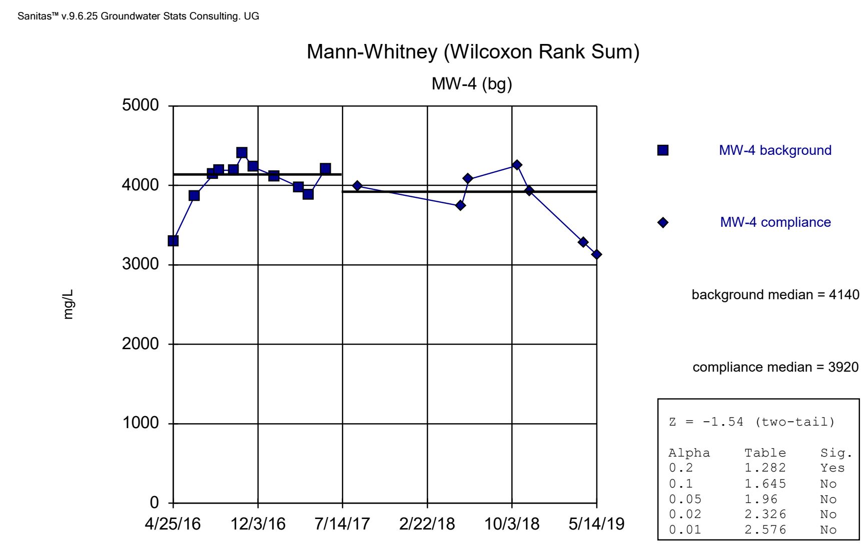
Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



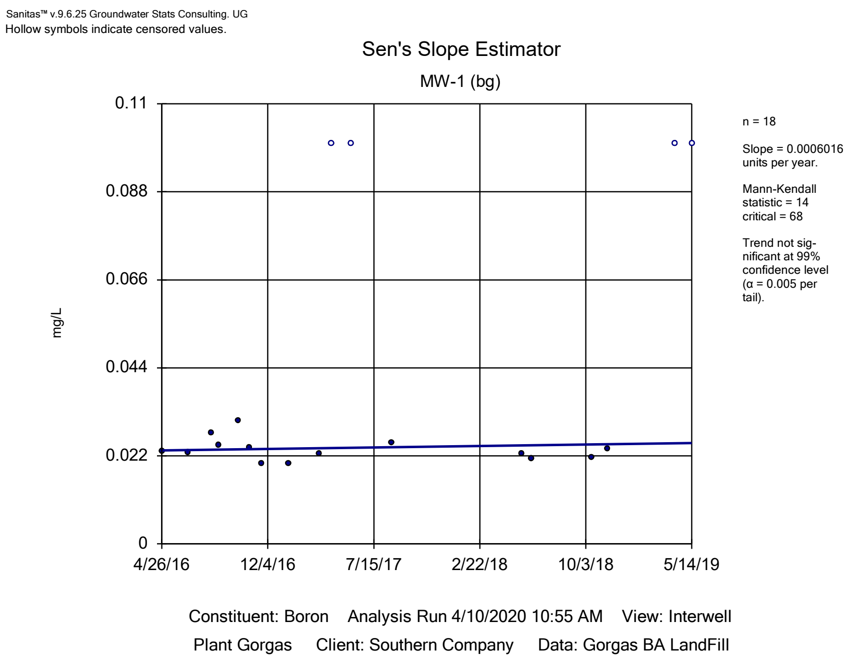
Constituent: Total Dissolved Solids Analysis Run 4/10/2020 10:58 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

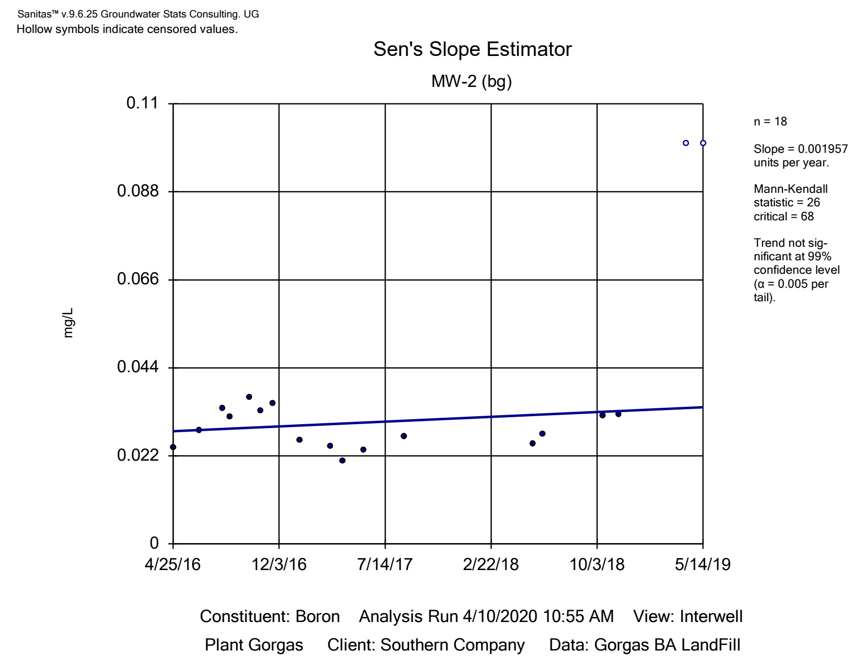
FIGURE E.

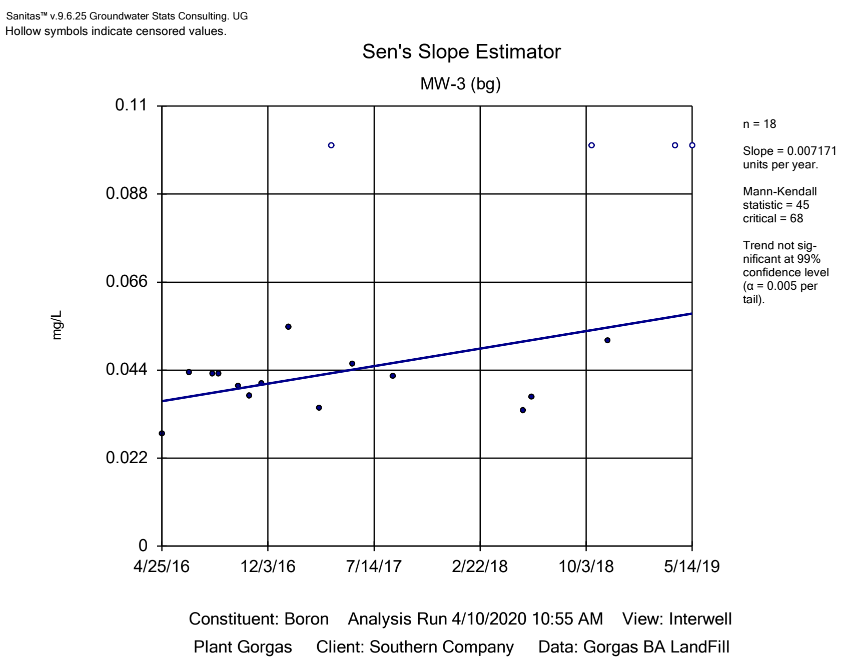
Trend Tests Summary Table - Interwell Parameters - All Results

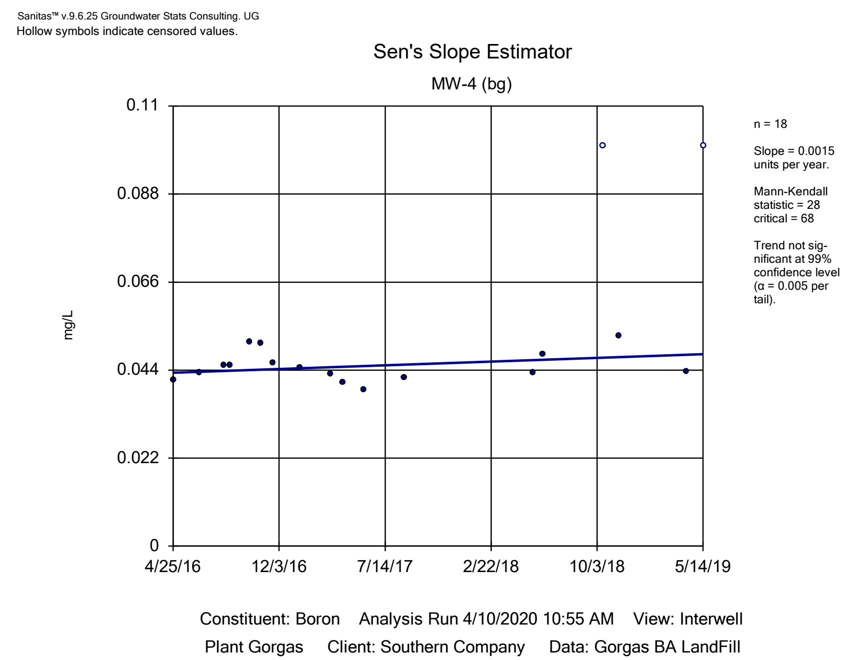
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill Printed 4/10/2020, 10:56 AM

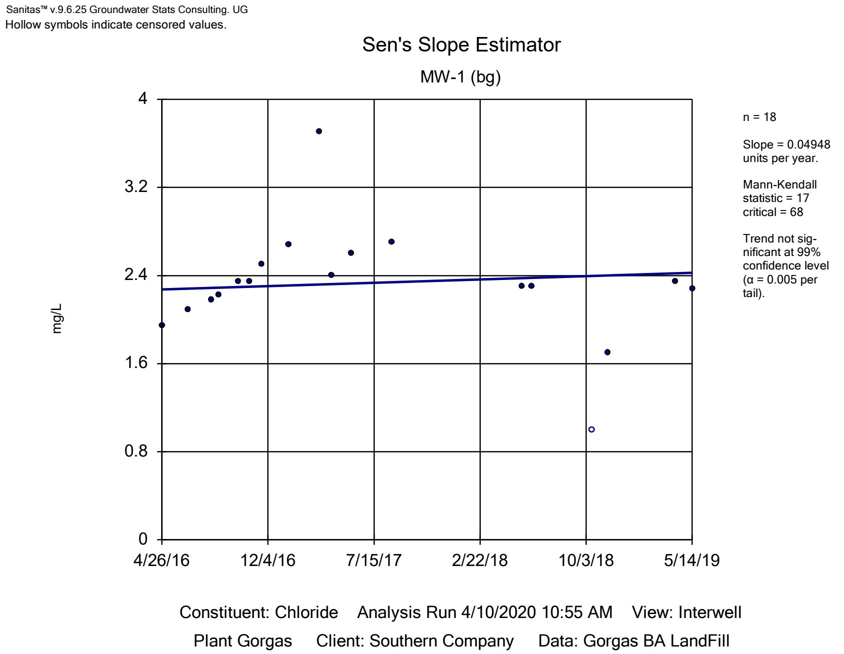
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron (mg/L)	MW-1 (bg)	0.0006016	14	68	No	18	22.22	n/a	n/a	0.01	NP
Boron (mg/L)	MW-2 (bg)	0.001957	26	68	No	18	11.11	n/a	n/a	0.01	NP
Boron (mg/L)	MW-3 (bg)	0.007171	45	68	No	18	22.22	n/a	n/a	0.01	NP
Boron (mg/L)	MW-4 (bg)	0.0015	28	68	No	18	11.11	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-1 (bg)	0.04948	17	68	No	18	5.556	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-2 (bg)	0.1043	4	68	No	18	0	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-3 (bg)	0.1053	36	68	No	18	11.11	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-4 (bg)	-0.07231	-23	-68	No	18	11.11	n/a	n/a	0.01	NP
pH (SU)	MW-1 (bg)	-0.01853	-54	-68	No	18	0	n/a	n/a	0.01	NP
pH (SU)	MW-2 (bg)	0.05407	57	68	No	18	0	n/a	n/a	0.01	NP
pH (SU)	MW-3 (bg)	-0.229	-39	-74	No	19	0	n/a	n/a	0.01	NP
pH (SU)	MW-4 (bg)	0.009631	32	74	No	19	0	n/a	n/a	0.01	NP

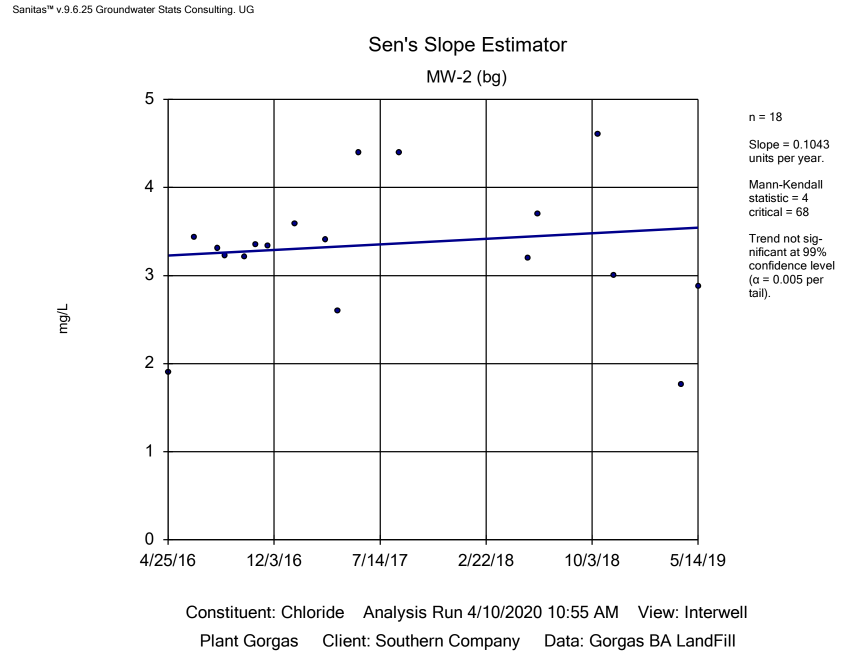

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-1 (bg)
mg/L
0.11
0.088
0.066
0.044
0.022
0
4/26/16
12/4/16
7/15/17
2/22/18
10/3/18
5/14/19
n = 18
Slope = 0.0006016 units per year.
Mann-Kendall statistic = 14 critical = 68
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron Analysis Run 4/10/2020 10:55 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

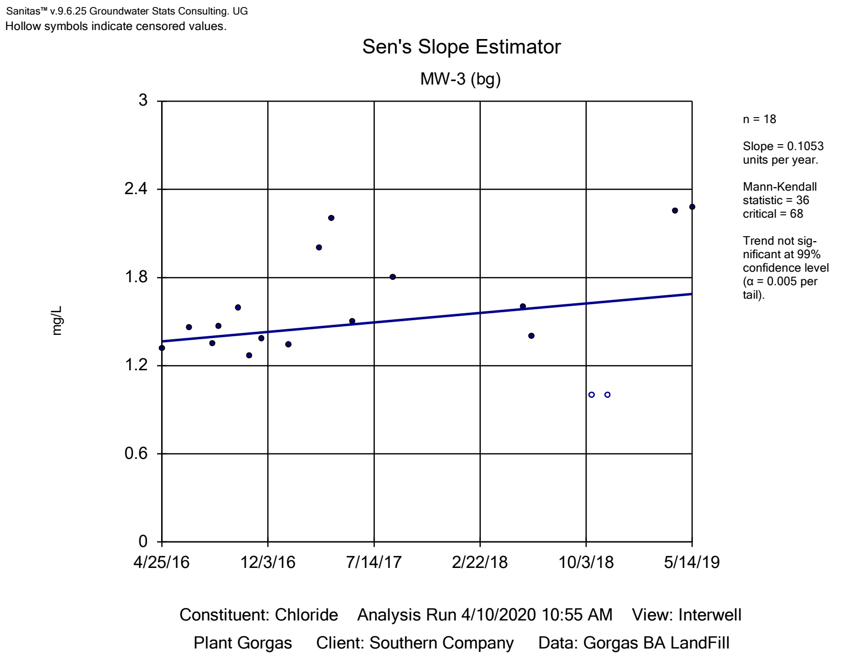

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-2 (bg)
mg/L
0.11
0.088
0.066
0.044
0.022
0
4/25/16
12/3/16
7/14/17
2/22/18
10/3/18
5/14/19
n = 18
Slope = 0.001957 units per year.
Mann-Kendall statistic = 26 critical = 68
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron Analysis Run 4/10/2020 10:55 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

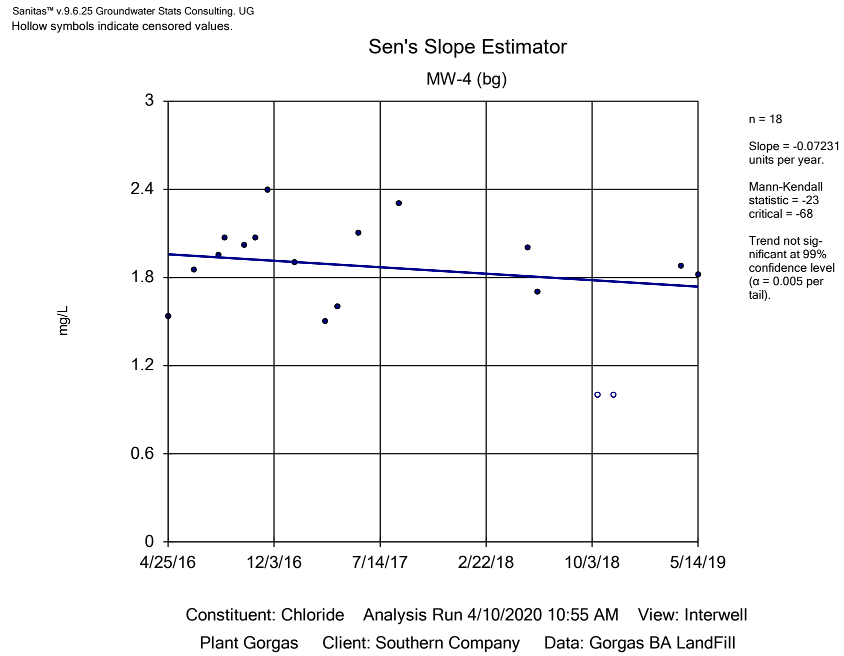

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-3 (bg)
mg/L
0.11
0.088
0.066
0.044
0.022
0
4/25/16
12/3/16
7/14/17
2/22/18
10/3/18
5/14/19
n = 18
Slope = 0.007171 units per year.
Mann-Kendall statistic = 45 critical = 68
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron Analysis Run 4/10/2020 10:55 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

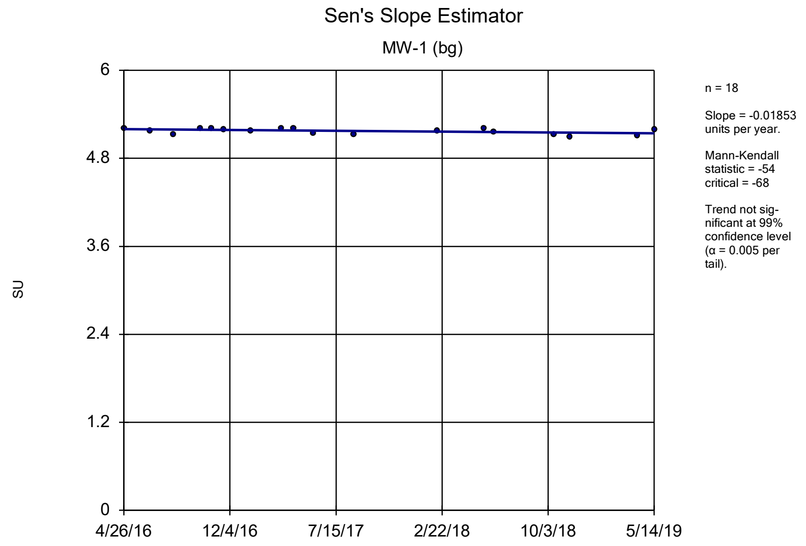

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-4 (bg)
mg/L
0.11
0.088
0.066
0.044
0.022
0
4/25/16
12/3/16
7/14/17
2/22/18
10/3/18
5/14/19
n = 18
Slope = 0.0015 units per year.
Mann-Kendall statistic = 28 critical = 68
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron Analysis Run 4/10/2020 10:55 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill


Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-1 (bg)
mg/L
4
3.2
2.4
1.6
0.8
0
4/26/16
12/4/16
7/15/17
2/22/18
10/3/18
5/14/19
n = 18
Slope = 0.04948 units per year.
Mann-Kendall statistic = 17 critical = 68
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Chloride Analysis Run 4/10/2020 10:55 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill


Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW-2 (bg)
mg/L
5
4
3
2
1
0
4/25/16
12/3/16
7/14/17
2/22/18
10/3/18
5/14/19
n = 18
Slope = 0.1043 units per year.
Mann-Kendall statistic = 4 critical = 68
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Chloride Analysis Run 4/10/2020 10:55 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

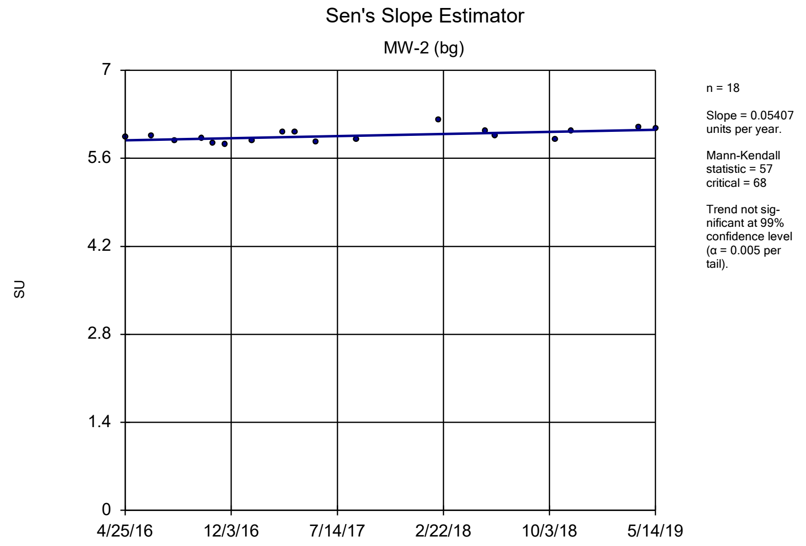

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-3 (bg)
mg/L
3
2.4
1.8
1.2
0.6
0
4/25/16
12/3/16
7/14/17
2/22/18
10/3/18
5/14/19
n = 18
Slope = 0.1053 units per year.
Mann-Kendall statistic = 36 critical = 68
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Chloride Analysis Run 4/10/2020 10:55 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill


Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-4 (bg)
mg/L
3
2.4
1.8
1.2
0.6
0
4/25/16
12/3/16
7/14/17
2/22/18
10/3/18
5/14/19
n = 18
Slope = -0.07231 units per year.
Mann-Kendall statistic = -23 critical = -68
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Chloride Analysis Run 4/10/2020 10:55 AM View: Interwell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



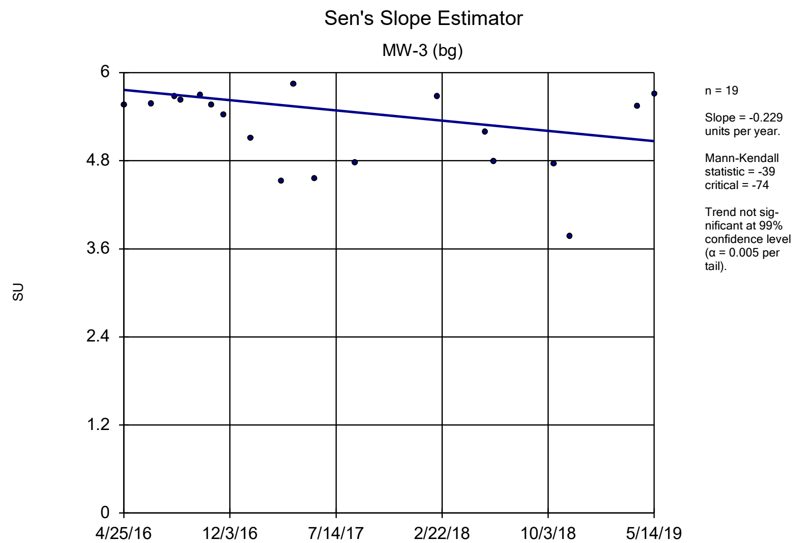
Constituent: pH   Analysis Run 4/10/2020 10:55 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



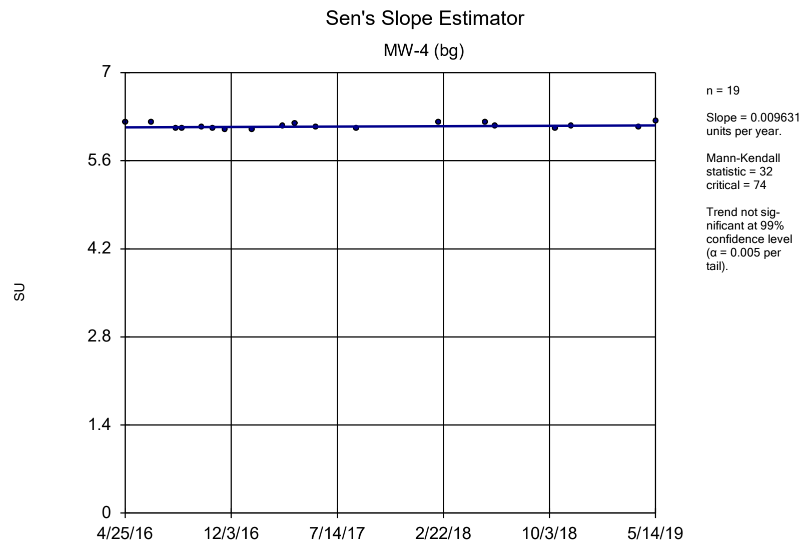
Constituent: pH   Analysis Run 4/10/2020 10:55 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



Constituent: pH   Analysis Run 4/10/2020 10:55 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG



Constituent: pH   Analysis Run 4/10/2020 10:55 AM   View: Interwell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

FIGURE F.

Interwell Prediction Limits Summary Table - All Results

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill Printed 4/10/2020, 11:23 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Alpha	Method
Boron (mg/L)	n/a	0.1	n/a	n/a	5 future	n/a	72	n/a	n/a	16.67	n/a	0.0003703	NP Inter (normality) 1 of 2
Chloride (mg/L)	n/a	3.904	n/a	n/a	5 future	n/a	72	1.474	0.2749	6.944	None	0.001504	Param Inter 1 of 2
pH (SU)	n/a	6.23	3.77	n/a	5 future	n/a	74	n/a	n/a	0	n/a	0.000705	NP Inter (normality) 1 of 2

FIGURE G.

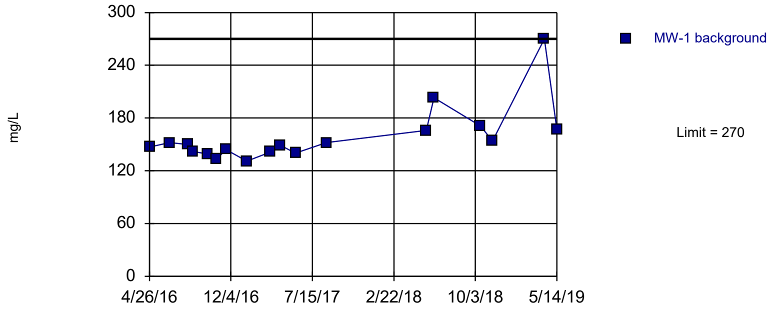
Intrawell Prediction Limits Summary Table - All Results

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill Printed 4/10/2020, 11:20 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Alpha	Method
Calcium (mg/L)	MW-1	270	n/a	n/a	1 future	n/a	18	n/a	n/a	0	n/a	0.005373	NP Intra (normality) 1 of 2
Calcium (mg/L)	MW-10	330.9	n/a	n/a	1 future	n/a	12	190.5	48.52	0	None	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-11	429.4	n/a	n/a	1 future	n/a	12	381.8	16.45	0	None	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-12	419.3	n/a	n/a	1 future	n/a	12	353.2	22.85	0	None	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-2	237.6	n/a	n/a	1 future	n/a	18	174	21.99	0	None	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-3	465.1	n/a	n/a	1 future	n/a	18	301.6	56.48	0	None	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-4	421.6	n/a	n/a	1 future	n/a	18	311.2	38.16	0	None	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-7	359.1	n/a	n/a	1 future	n/a	12	2.6e7	6944823	0	None	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-8	352.3	n/a	n/a	1 future	n/a	12	304.5	16.53	0	None	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-1	0.2288	n/a	n/a	1 future	n/a	19	0.1262	0.03546	0	None	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-10	0.4183	n/a	n/a	1 future	n/a	13	0.1782	0.08298	0	None	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-11	0.1702	n/a	n/a	1 future	n/a	13	0.09315	0.02661	7.692	None	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-12	0.2498	n/a	n/a	1 future	n/a	13	0.1188	0.04526	0	None	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-2	0.3077	n/a	n/a	1 future	n/a	19	0.1401	0.05792	0	None	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-3	0.8536	n/a	n/a	1 future	n/a	19	-1.063	0.3126	0	None	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-4	0.4691	n/a	n/a	1 future	n/a	19	0.1114	0.03754	0	None	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-7	0.223	n/a	n/a	1 future	n/a	13	0.1855	0.01295	0	None	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-8	0.2406	n/a	n/a	1 future	n/a	13	0.2142	0.009112	0	None	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-1	2100	n/a	n/a	1 future	n/a	18	n/a	n/a	0	n/a	0.005373	NP Intra (normality) 1 of 2
Sulfate (mg/L)	MW-10	1401	n/a	n/a	1 future	n/a	12	826.3	198.7	0	None	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-11	2290	n/a	n/a	1 future	n/a	12	1728	194.2	0	None	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-12	2911	n/a	n/a	1 future	n/a	12	2252	227.8	0	None	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-2	1373	n/a	n/a	1 future	n/a	18	998.9	129.3	0	None	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-3	3530	n/a	n/a	1 future	n/a	18	2431	379.6	0	None	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-4	3242	n/a	n/a	1 future	n/a	18	2566	233.5	0	None	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-7	1974	n/a	n/a	1 future	n/a	12	1356	213.5	0	None	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-8	2100	n/a	n/a	1 future	n/a	12	n/a	n/a	0	n/a	0.01077	NP Intra (normality) 1 of 2
Total Dissolved Solids (mg/L)	MW-1	2684	n/a	n/a	1 future	n/a	18	2181	173.6	0	None	0.001504	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-10	2173	n/a	n/a	1 future	n/a	12	1392	270.1	0	None	0.001504	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-11	3144	n/a	n/a	1 future	n/a	12	2728	144	0	None	0.001504	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-12	4265	n/a	n/a	1 future	n/a	12	3428	289.1	0	None	0.001504	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-2	2224	n/a	n/a	1 future	n/a	18	1643	200.5	0	None	0.001504	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-3	5480	n/a	n/a	1 future	n/a	18	3661	628.6	0	None	0.001504	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-4	4849	n/a	n/a	1 future	n/a	18	1.6e7	2719774	0	None	0.001504	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-7	2723	n/a	n/a	1 future	n/a	12	6.3e16	3.0e16	0	None	0.001504	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-8	2941	n/a	n/a	1 future	n/a	12	2593	120.2	0	None	0.001504	Param Intra 1 of 2

Prediction Limit

Intrawell Non-parametric, MW-1 (bg)

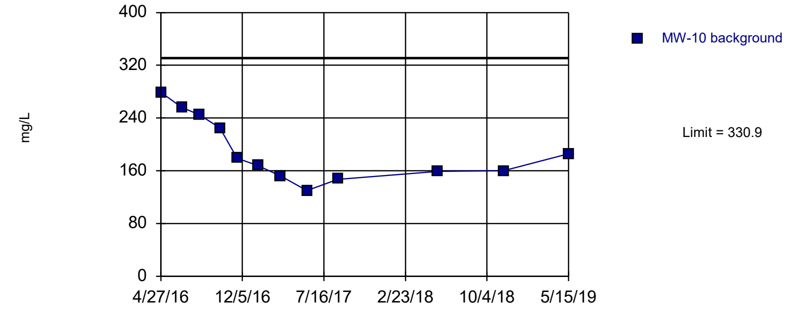


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Calcium   Analysis Run 4/10/2020 11:19 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Prediction Limit

Intrawell Parametric, MW-10

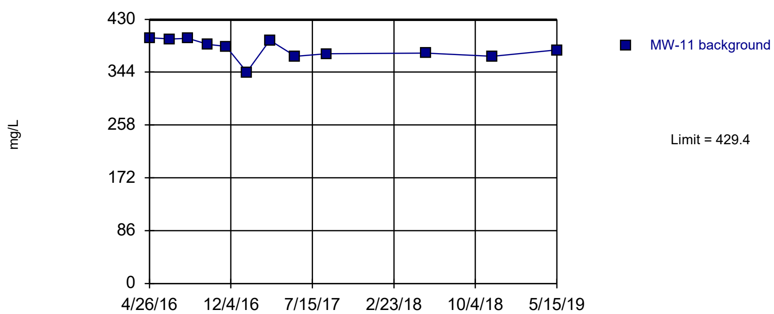


Background Data Summary: Mean=190.5, Std. Dev.=48.52, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.902, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Calcium   Analysis Run 4/10/2020 11:19 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Prediction Limit

Intrawell Parametric, MW-11

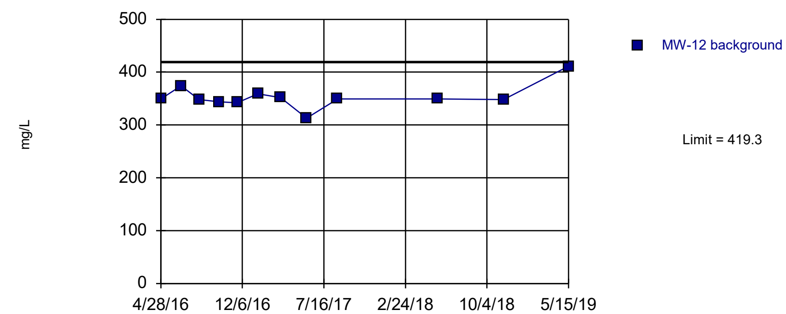


Background Data Summary: Mean=381.8, Std. Dev.=16.45, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9022, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Calcium   Analysis Run 4/10/2020 11:19 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Prediction Limit

Intrawell Parametric, MW-12



Background Data Summary: Mean=353.2, Std. Dev.=22.85, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8182, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Calcium   Analysis Run 4/10/2020 11:19 AM   View: Intrawell
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-1
4/26/2016	147
6/20/2016	152
8/8/2016	150
8/24/2016	142
10/3/2016	139
10/26/2016	133
11/21/2016	144
1/17/2017	131
3/22/2017	141
4/18/2017	149
5/30/2017	140
8/23/2017	152
5/22/2018	166
6/12/2018	203
10/17/2018	171
11/19/2018	154
4/10/2019	270
5/14/2019	167

Prediction Limit

Constituent: Calcium (mg/L) Analysis Run 4/10/2020 11:20 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-10
4/27/2016	279
6/23/2016	256
8/10/2016	245
10/5/2016	225
11/21/2016	179
1/17/2017	168
3/21/2017	152
5/31/2017	130
8/23/2017	147
5/24/2018	159
11/19/2018	160
5/15/2019	186

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-11
4/26/2016	400
6/22/2016	398
8/9/2016	399
10/4/2016	389
11/21/2016	386
1/17/2017	344
3/21/2017	396
5/30/2017	370
8/23/2017	374
5/22/2018	375
11/20/2018	370
5/15/2019	380

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-12
4/28/2016	349
6/22/2016	374
8/10/2016	348
10/5/2016	344
11/22/2016	342
1/18/2017	359
3/21/2017	352
5/31/2017	313
8/23/2017	349
5/24/2018	349
11/19/2018	348
5/15/2019	411

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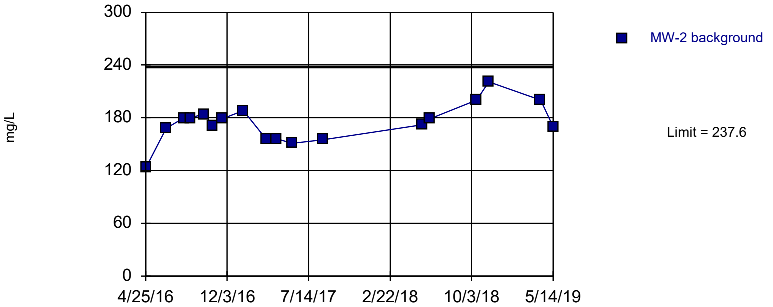
Prediction Limit

Intrawell Parametric, MW-2 (bg)



Background Data Summary: Mean=174, Std. Dev.=21.99, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9686, critical = 0.858. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Calcium Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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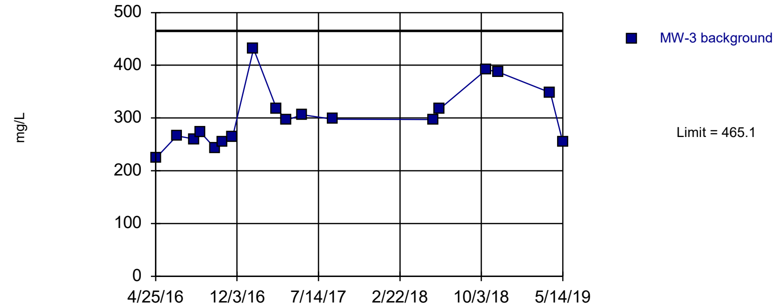
Prediction Limit

Intrawell Parametric, MW-3 (bg)



Background Data Summary: Mean=301.6, Std. Dev.=56.48, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9168, critical = 0.858. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Calcium Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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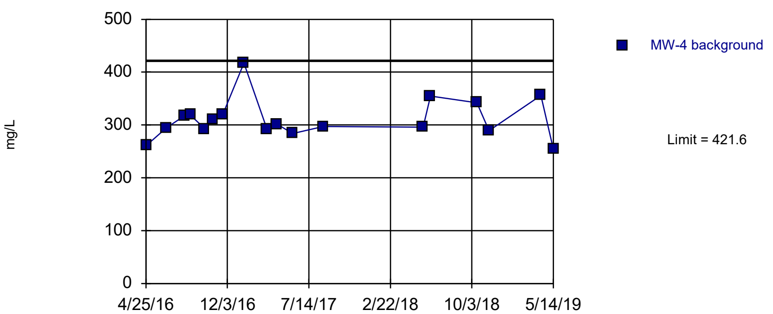
Prediction Limit

Intrawell Parametric, MW-4 (bg)



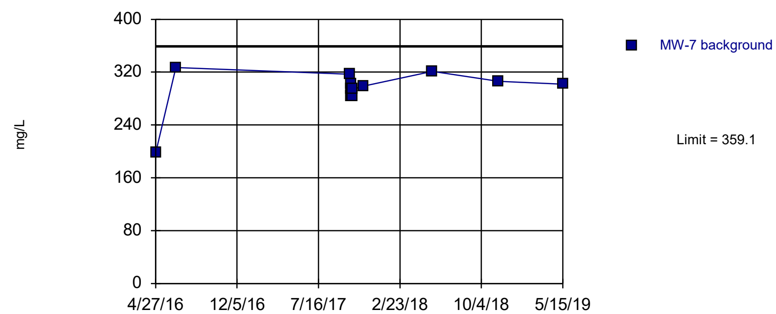
Background Data Summary: Mean=311.2, Std. Dev.=38.16, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9055, critical = 0.858. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Calcium Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-7



Background Data Summary (based on cube transformation): Mean=2.6e7, Std. Dev.=6944823, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8464, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Calcium Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-2
4/25/2016	123
6/20/2016	168
8/8/2016	180
8/24/2016	180
10/3/2016	184
10/26/2016	171
11/21/2016	179
1/17/2017	188
3/22/2017	155
4/18/2017	156
5/31/2017	151
8/23/2017	155
5/22/2018	172
6/12/2018	179
10/17/2018	200
11/19/2018	221
4/10/2019	200
5/14/2019	170

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-3
4/25/2016	224
6/22/2016	266
8/9/2016	260
8/24/2016	274
10/4/2016	243
10/26/2016	254
11/21/2016	263
1/18/2017	431
3/22/2017	318
4/18/2017	296
5/31/2017	306
8/23/2017	298
5/24/2018	297
6/12/2018	318
10/17/2018	392
11/19/2018	387
4/10/2019	348
5/14/2019	254

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-4
4/25/2016	261
6/20/2016	295
8/9/2016	318
8/24/2016	319
10/3/2016	293
10/26/2016	311
11/21/2016	320
1/18/2017	417
3/22/2017	292
4/18/2017	302
5/31/2017	284
8/23/2017	297
5/23/2018	296
6/12/2018	355
10/17/2018	342
11/19/2018	289
4/10/2019	356
5/14/2019	254

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-7
4/27/2016	198
6/21/2016	327
10/12/2017	317
10/13/2017	302
10/14/2017	283
10/15/2017	294
10/16/2017	284
10/17/2017	294
11/16/2017	299
5/23/2018	321
11/20/2018	306
5/15/2019	302

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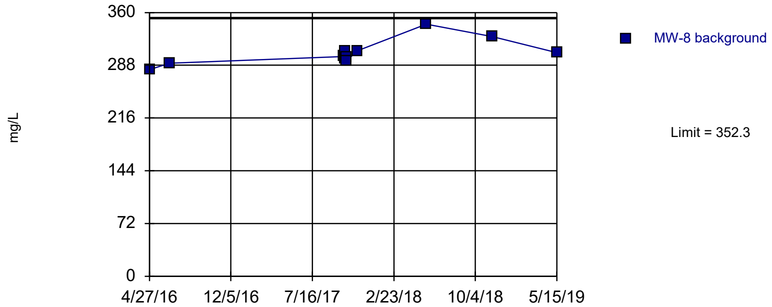
Prediction Limit

Intrawell Parametric, MW-8



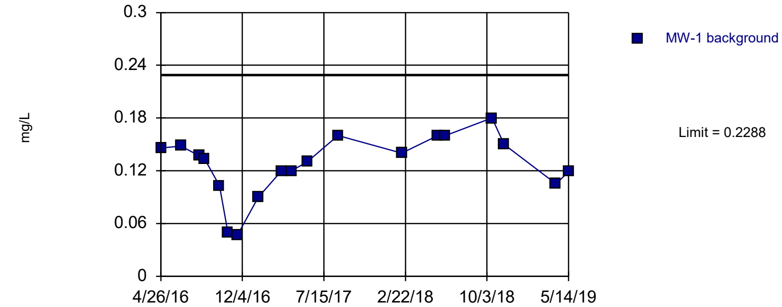
Background Data Summary: Mean=304.5, Std. Dev.=16.53, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8722, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Calcium Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1 (bg)



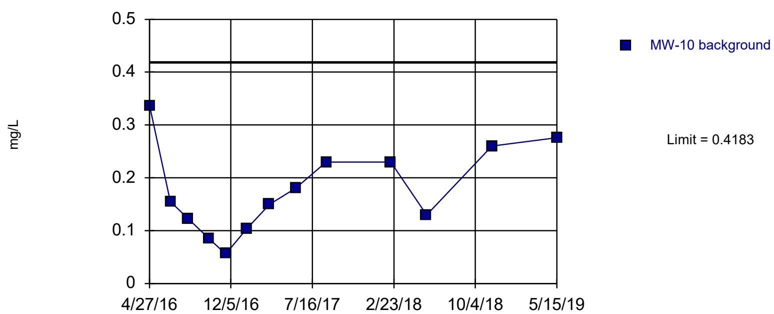
Background Data Summary: Mean=0.1262, Std. Dev.=0.03546, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9175, critical = 0.863. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Fluoride Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-10



Background Data Summary: Mean=0.1782, Std. Dev.=0.08298, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9658, critical = 0.814. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Fluoride Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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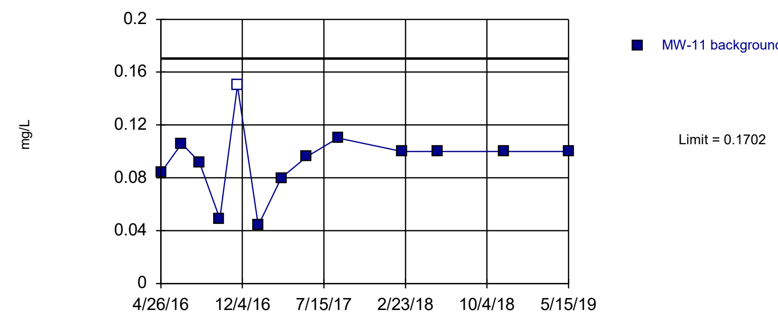
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, MW-11



Background Data Summary: Mean=0.09315, Std. Dev.=0.02661, n=13, 7.692% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8943, critical = 0.814. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Fluoride Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Prediction Limit

Constituent: Calcium (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-8
4/27/2016	282
6/21/2016	291
10/12/2017	300
10/13/2017	298
10/14/2017	299
10/15/2017	307
10/16/2017	299
10/17/2017	294
11/16/2017	308
5/23/2018	344
11/20/2018	327
5/15/2019	305

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-1
4/26/2016	0.146 (J)
6/20/2016	0.148 (J)
8/8/2016	0.137 (J)
8/24/2016	0.133 (J)
10/3/2016	0.103 (J)
10/26/2016	0.05 (J)
11/21/2016	0.047 (J)
1/17/2017	0.09 (J)
3/22/2017	0.12
4/18/2017	0.12
5/30/2017	0.13
8/23/2017	0.16
2/13/2018	0.14 (D)
5/22/2018	0.16
6/12/2018	0.16
10/17/2018	0.18
11/19/2018	0.15
4/10/2019	0.105
5/14/2019	0.119

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-10
4/27/2016	0.337
6/23/2016	0.155 (J)
8/10/2016	0.123 (J)
10/5/2016	0.086 (J)
11/21/2016	0.056 (J)
1/17/2017	0.103 (J)
3/21/2017	0.15
5/31/2017	0.18
8/23/2017	0.23
2/15/2018	0.23 (D)
5/24/2018	0.13
11/19/2018	0.26
5/15/2019	0.276

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-11
4/26/2016	0.084 (J)
6/22/2016	0.106 (J)
8/9/2016	0.092 (J)
10/4/2016	0.049 (J)
11/21/2016	<0.3
1/17/2017	0.044 (J)
3/21/2017	0.08 (J)
5/30/2017	0.096 (J)
8/23/2017	0.11
2/14/2018	0.1 (D)
5/22/2018	0.1
11/20/2018	0.1
5/15/2019	0.1

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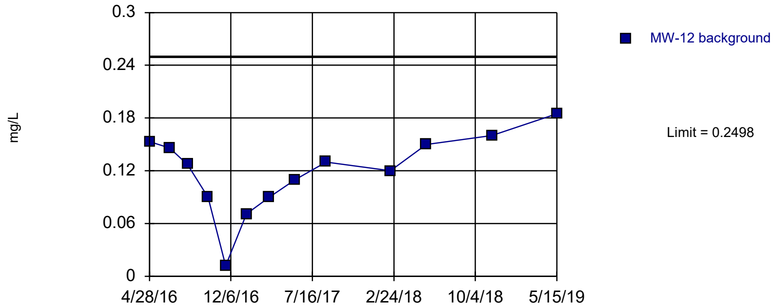
Prediction Limit

Intrawell Parametric, MW-12



Background Data Summary: Mean=0.1188, Std. Dev.=0.04526, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9427, critical = 0.814. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Fluoride Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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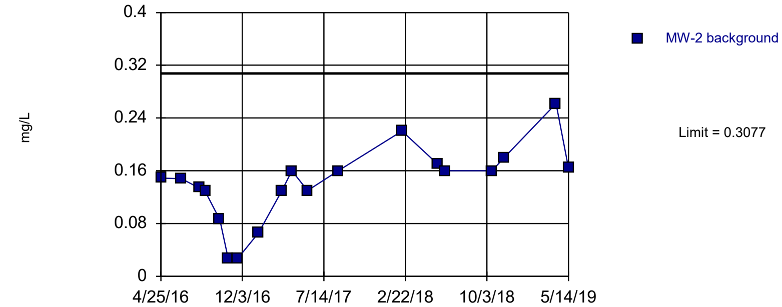
Prediction Limit

Intrawell Parametric, MW-2 (bg)



Background Data Summary: Mean=0.1401, Std. Dev.=0.05792, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9235, critical = 0.863. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Fluoride Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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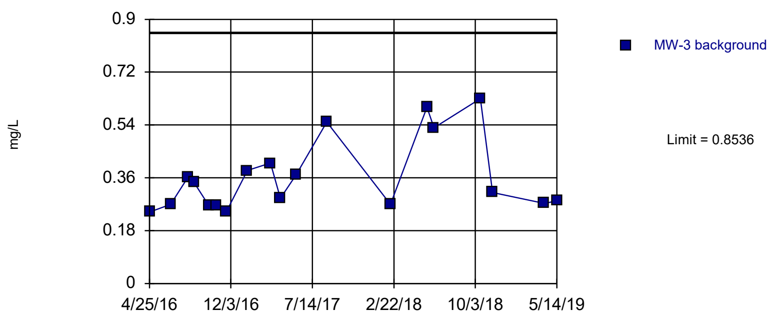
Prediction Limit

Intrawell Parametric, MW-3 (bg)



Background Data Summary (based on natural log transformation): Mean=-1.063, Std. Dev.=0.3126, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.875, critical = 0.863. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Fluoride Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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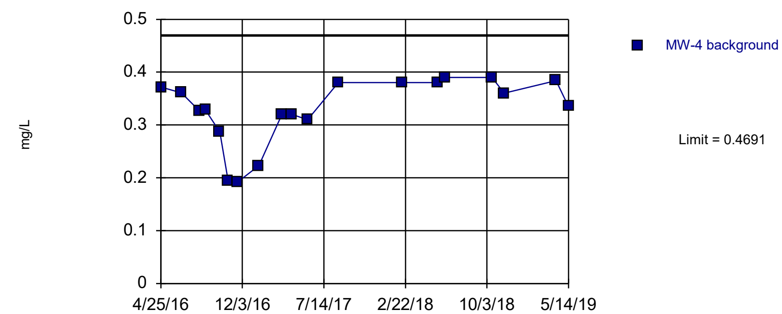
Prediction Limit

Intrawell Parametric, MW-4 (bg)



Background Data Summary (based on square transformation): Mean=0.1114, Std. Dev.=0.03754, n=19. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8742, critical = 0.863. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Fluoride Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Prediction Limit

Constituent: Fluoride (mg/L) Analysis Run 4/10/2020 11:20 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-12
4/28/2016	0.153 (J)
6/22/2016	0.146 (J)
8/10/2016	0.127 (J)
10/5/2016	0.09 (J)
11/22/2016	0.012 (J)
1/18/2017	0.071 (J)
3/21/2017	0.09 (J)
5/31/2017	0.11
8/23/2017	0.13
2/15/2018	0.12 (D)
5/24/2018	0.15
11/19/2018	0.16
5/15/2019	0.185

Prediction Limit

Constituent: Fluoride (mg/L) Analysis Run 4/10/2020 11:20 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-2
4/25/2016	0.149 (J)
6/20/2016	0.148 (J)
8/8/2016	0.134 (J)
8/24/2016	0.129 (J)
10/3/2016	0.086 (J)
10/26/2016	0.027 (J)
11/21/2016	0.027 (J)
1/17/2017	0.066 (J)
3/22/2017	0.13
4/18/2017	0.16
5/31/2017	0.13
8/23/2017	0.16
2/13/2018	0.22 (D)
5/22/2018	0.17
6/12/2018	0.16
10/17/2018	0.16
11/19/2018	0.18
4/10/2019	0.262
5/14/2019	0.164

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-3
4/25/2016	0.243 (J)
6/22/2016	0.269 (J)
8/9/2016	0.363
8/24/2016	0.346
10/4/2016	0.266 (J)
10/26/2016	0.266 (J)
11/21/2016	0.244 (J)
1/18/2017	0.385
3/22/2017	0.41
4/18/2017	0.29
5/31/2017	0.37
8/23/2017	0.55
2/13/2018	0.27 (D)
5/24/2018	0.6
6/12/2018	0.53
10/17/2018	0.63
11/19/2018	0.31
4/10/2019	0.273
5/14/2019	0.281

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-4
4/25/2016	0.372
6/20/2016	0.361
8/9/2016	0.326
8/24/2016	0.329
10/3/2016	0.287 (J)
10/26/2016	0.194 (J)
11/21/2016	0.192 (J)
1/18/2017	0.223 (J)
3/22/2017	0.32
4/18/2017	0.32
5/31/2017	0.31
8/23/2017	0.38
2/13/2018	0.38 (D)
5/23/2018	0.38
6/12/2018	0.39
10/17/2018	0.39
11/19/2018	0.36
4/10/2019	0.384
5/14/2019	0.335

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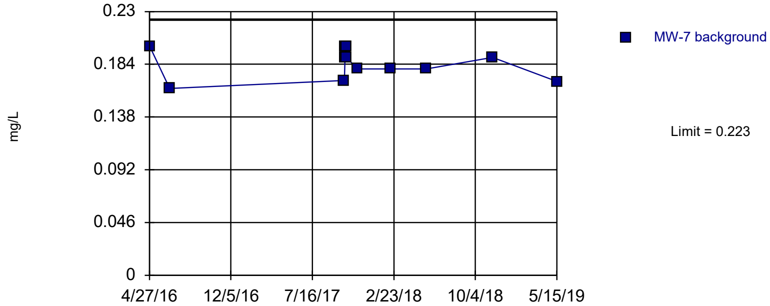
Prediction Limit

Intrawell Parametric, MW-7



Background Data Summary: Mean=0.1855, Std. Dev.=0.01295, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8949, critical = 0.814. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Fluoride Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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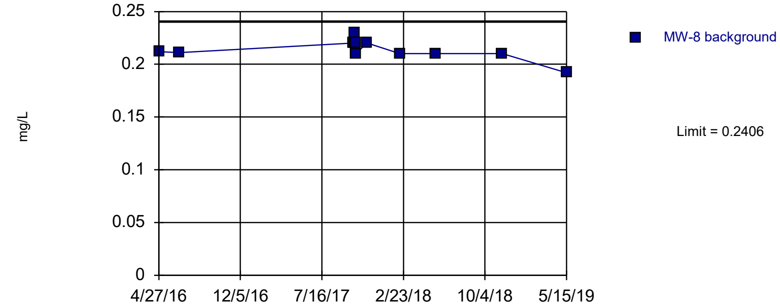
Prediction Limit

Intrawell Parametric, MW-8



Background Data Summary: Mean=0.2142, Std. Dev.=0.009112, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8671, critical = 0.814. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Fluoride Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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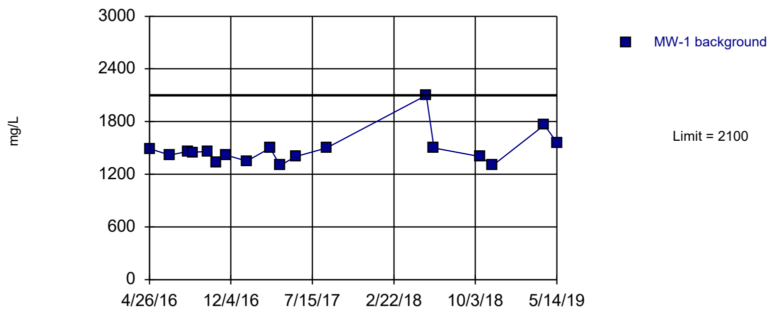
Prediction Limit

Intrawell Non-parametric, MW-1 (bg)



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 18 background values. Well-constituent pair annual alpha = 0.01072. Individual comparison alpha = 0.005373 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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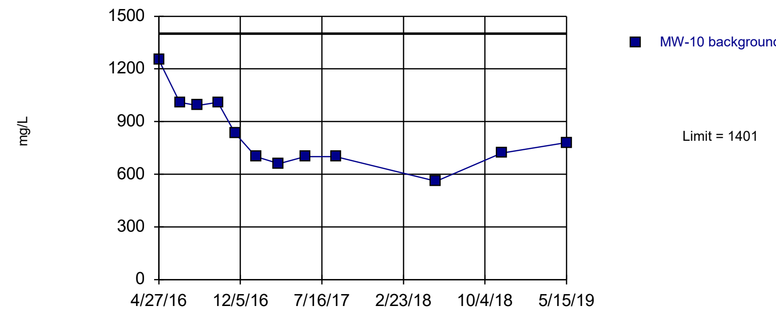
Prediction Limit

Intrawell Parametric, MW-10



Background Data Summary: Mean=826.3, Std. Dev.=198.7, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9061, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Sulfate Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-7
4/27/2016	0.2 (J)
6/21/2016	0.163 (J)
10/12/2017	0.17
10/13/2017	0.19
10/14/2017	0.2
10/15/2017	0.2
10/16/2017	0.2
10/17/2017	0.19
11/16/2017	0.18
2/14/2018	0.18 (D)
5/23/2018	0.18
11/20/2018	0.19
5/15/2019	0.169

Prediction Limit

Constituent: Fluoride (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-8
4/27/2016	0.212 (J)
6/21/2016	0.211 (J)
10/12/2017	0.22
10/13/2017	0.23
10/14/2017	0.22
10/15/2017	0.22
10/16/2017	0.22
10/17/2017	0.21
11/16/2017	0.22
2/14/2018	0.21 (D)
5/23/2018	0.21
11/20/2018	0.21
5/15/2019	0.192

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-1
4/26/2016	1490
6/20/2016	1420
8/8/2016	1460
8/24/2016	1450
10/3/2016	1460
10/26/2016	1330
11/21/2016	1420
1/17/2017	1350
3/22/2017	1500
4/18/2017	1300
5/30/2017	1400
8/23/2017	1500
5/22/2018	2100
6/12/2018	1500
10/17/2018	1400
11/19/2018	1300
4/10/2019	1760
5/14/2019	1560

Prediction Limit

Constituent: Sulfate (mg/L) Analysis Run 4/10/2020 11:20 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-10
4/27/2016	1250
6/23/2016	1010
8/10/2016	992
10/5/2016	1010
11/21/2016	834
1/17/2017	700
3/21/2017	660
5/31/2017	700
8/23/2017	700
5/24/2018	560
11/19/2018	720
5/15/2019	780

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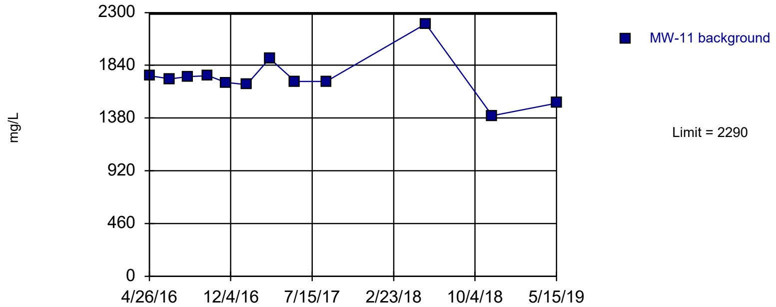
Prediction Limit

Intrawell Parametric, MW-11



Background Data Summary: Mean=1728, Std. Dev.=194.2, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8682, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Sulfate Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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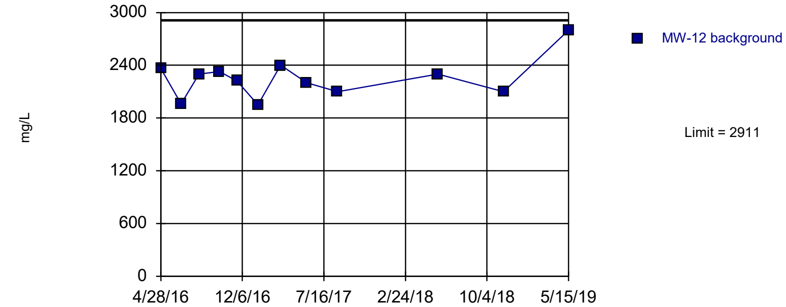
Prediction Limit

Intrawell Parametric, MW-12



Background Data Summary: Mean=2252, Std. Dev.=227.8, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.91, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Sulfate Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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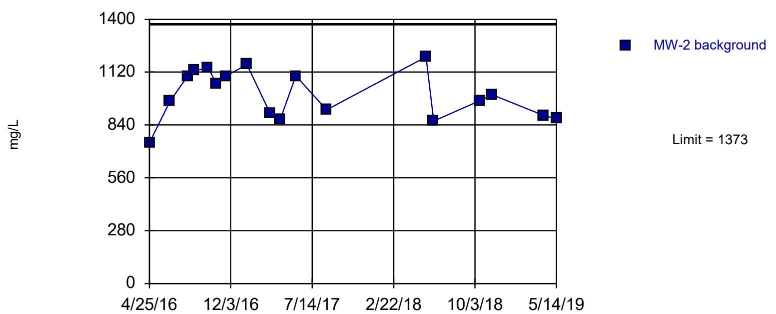
Prediction Limit

Intrawell Parametric, MW-2 (bg)



Background Data Summary: Mean=998.9, Std. Dev.=129.3, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9464, critical = 0.858. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Sulfate Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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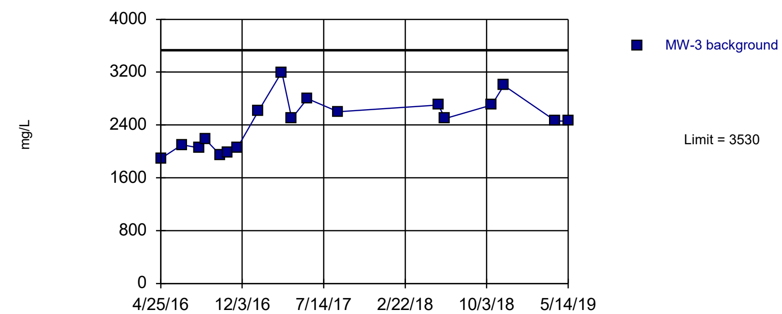
Prediction Limit

Intrawell Parametric, MW-3 (bg)



Background Data Summary: Mean=2431, Std. Dev.=379.6, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9476, critical = 0.858. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Sulfate Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-11
4/26/2016	1750
6/22/2016	1720
8/9/2016	1740
10/4/2016	1750
11/21/2016	1690
1/17/2017	1670
3/21/2017	1900
5/30/2017	1700
8/23/2017	1700
5/22/2018	2200
11/20/2018	1400
5/15/2019	1510

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-12
4/28/2016	2360
6/22/2016	1960
8/10/2016	2300
10/5/2016	2330
11/22/2016	2220
1/18/2017	1950
3/21/2017	2400
5/31/2017	2200
8/23/2017	2100
5/24/2018	2300
11/19/2018	2100
5/15/2019	2800

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-2
4/25/2016	745
6/20/2016	964
8/8/2016	1100
8/24/2016	1130
10/3/2016	1140
10/26/2016	1060
11/21/2016	1100
1/17/2017	1160
3/22/2017	900
4/18/2017	870
5/31/2017	1100
8/23/2017	920
5/22/2018	1200
6/12/2018	860
10/17/2018	970
11/19/2018	1000
4/10/2019	889
5/14/2019	873

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-3
4/25/2016	1890
6/22/2016	2100
8/9/2016	2050
8/24/2016	2190
10/4/2016	1950
10/26/2016	1980
11/21/2016	2060
1/18/2017	2620
3/22/2017	3200
4/18/2017	2500
5/31/2017	2800
8/23/2017	2600
5/24/2018	2700
6/12/2018	2500
10/17/2018	2700
11/19/2018	3000
4/10/2019	2460
5/14/2019	2460

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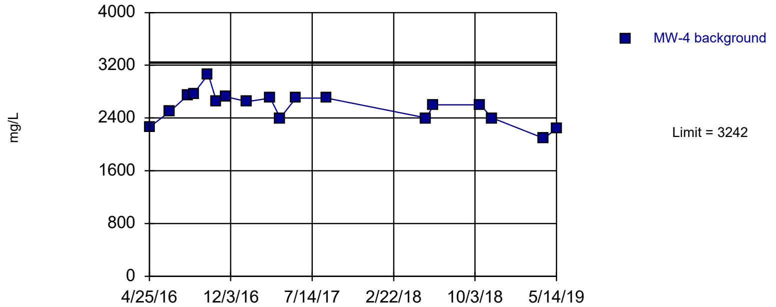
Prediction Limit

Intrawell Parametric, MW-4 (bg)



Background Data Summary: Mean=2566, Std. Dev.=233.5, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9529, critical = 0.858. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Sulfate Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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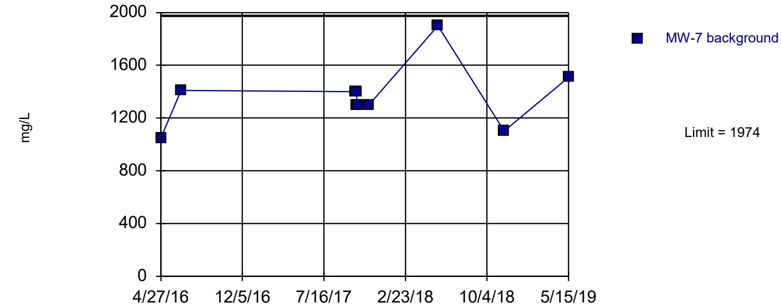
Prediction Limit

Intrawell Parametric, MW-7



Background Data Summary: Mean=1356, Std. Dev.=213.5, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8496, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Sulfate Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

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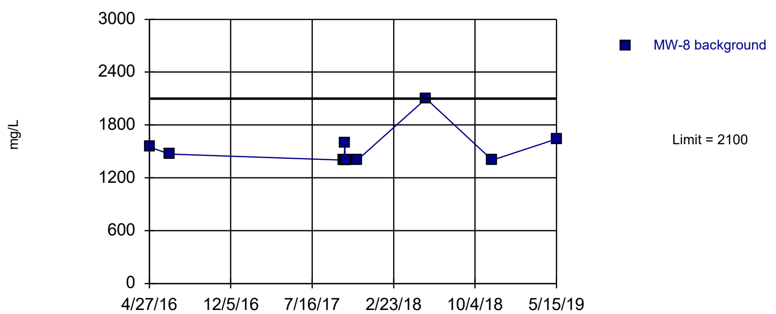
Prediction Limit

Intrawell Non-parametric, MW-8



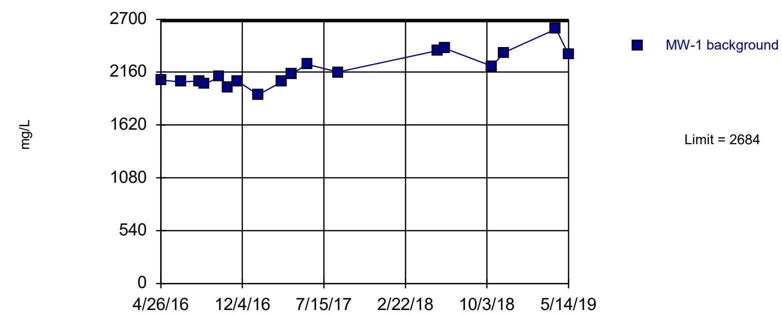
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1 (bg)



Background Data Summary: Mean=2181, Std. Dev.=173.6, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9208, critical = 0.858. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-4
4/25/2016	2260
6/20/2016	2500
8/9/2016	2750
8/24/2016	2770
10/3/2016	3060
10/26/2016	2650
11/21/2016	2720
1/18/2017	2650
3/22/2017	2700
4/18/2017	2400
5/31/2017	2700
8/23/2017	2700
5/23/2018	2400
6/12/2018	2600
10/17/2018	2600
11/19/2018	2400
4/10/2019	2090
5/14/2019	2240

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-7
4/27/2016	1050
6/21/2016	1410
10/12/2017	1400
10/13/2017	1400
10/14/2017	1300
10/15/2017	1300
10/16/2017	1300
10/17/2017	1300
11/16/2017	1300
5/23/2018	1900
11/20/2018	1100
5/15/2019	1510

Prediction Limit

Constituent: Sulfate (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-8
4/27/2016	1550
6/21/2016	1470
10/12/2017	1400
10/13/2017	1600
10/14/2017	1400
10/15/2017	1400
10/16/2017	1400
10/17/2017	1400
11/16/2017	1400
5/23/2018	2100
11/20/2018	1400
5/15/2019	1640

Prediction Limit

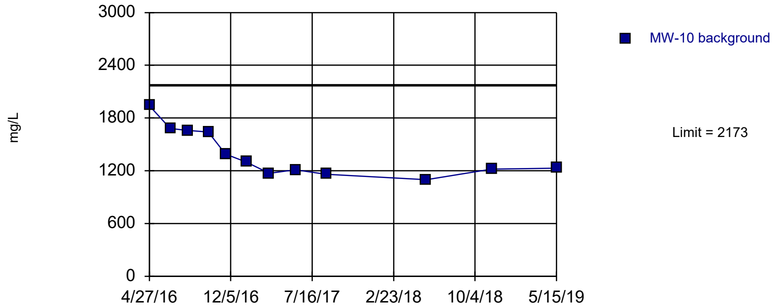
Constituent: Total Dissolved Solids (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-1
4/26/2016	2080 (D)
6/20/2016	2060 (D)
8/8/2016	2070 (D)
8/24/2016	2040 (D)
10/3/2016	2110 (D)
10/26/2016	2000 (D)
11/21/2016	2070 (D)
1/17/2017	1930 (D)
3/22/2017	2060 (D)
4/18/2017	2140 (D)
5/30/2017	2240 (D)
8/23/2017	2160 (D)
5/22/2018	2380 (D)
6/12/2018	2400
10/17/2018	2220 (D)
11/19/2018	2360 (D)
4/10/2019	2600 (D)
5/14/2019	2340 (D)

Prediction Limit

Intrawell Parametric, MW-10



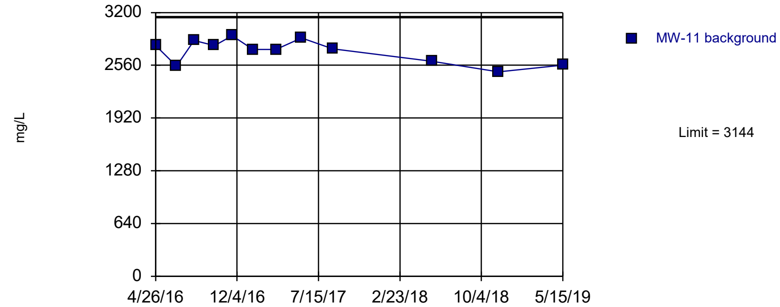
Background Data Summary: Mean=1392, Std. Dev.=270.1, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8665, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-11



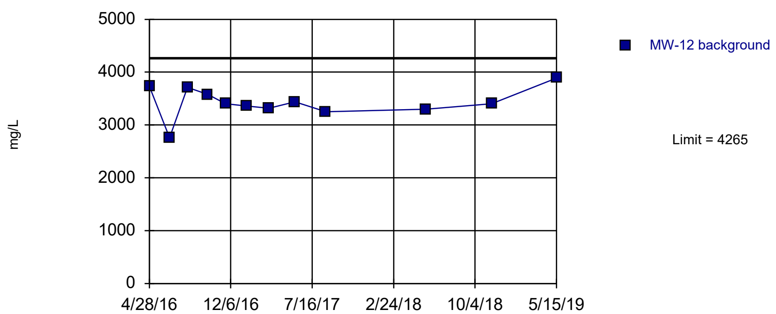
Background Data Summary: Mean=2728, Std. Dev.=144, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9248, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-12



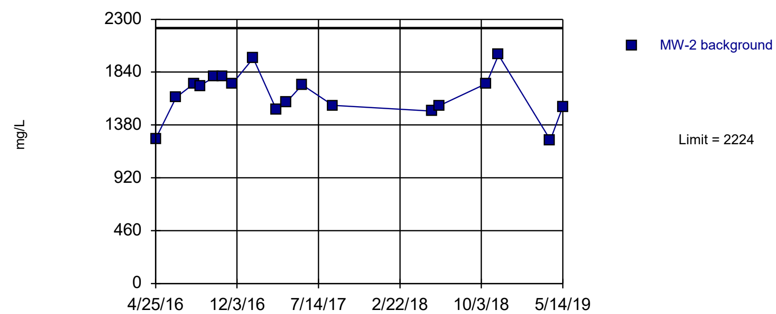
Background Data Summary: Mean=3428, Std. Dev.=289.1, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9267, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Sanitas™ v.9.6.25 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-2 (bg)



Background Data Summary: Mean=1643, Std. Dev.=200.5, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9458, critical = 0.858. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 4/10/2020 11:20 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-10
4/27/2016	1940
6/23/2016	1680
8/10/2016	1660
10/5/2016	1640
11/21/2016	1390
1/17/2017	1300
3/21/2017	1170
5/31/2017	1210
8/23/2017	1160
5/24/2018	1100
11/19/2018	1220
5/15/2019	1230

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 4/10/2020 11:20 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-11
4/26/2016	2800
6/22/2016	2550
8/9/2016	2860
10/4/2016	2800
11/21/2016	2920
1/17/2017	2750
3/21/2017	2750
5/30/2017	2890
8/23/2017	2760
5/22/2018	2610
11/20/2018	2480
5/15/2019	2560

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 4/10/2020 11:20 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

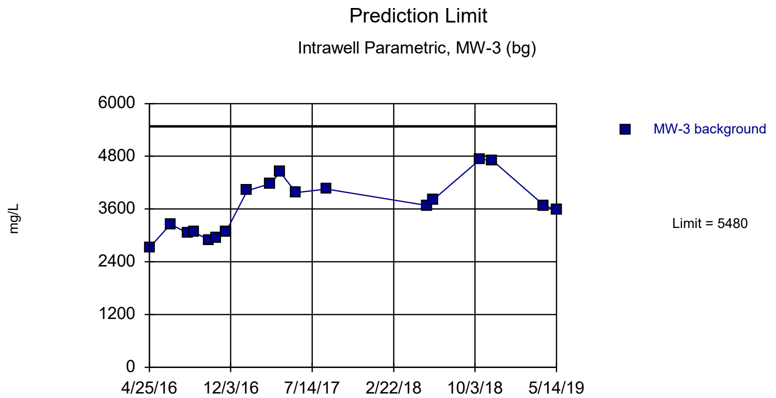
	MW-12
4/28/2016	3730
6/22/2016	2760
8/10/2016	3710
10/5/2016	3580
11/22/2016	3400
1/18/2017	3360
3/21/2017	3320
5/31/2017	3440
8/23/2017	3250
5/24/2018	3300
11/19/2018	3400
5/15/2019	3890

Prediction Limit

Constituent: Total Dissolved Solids (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

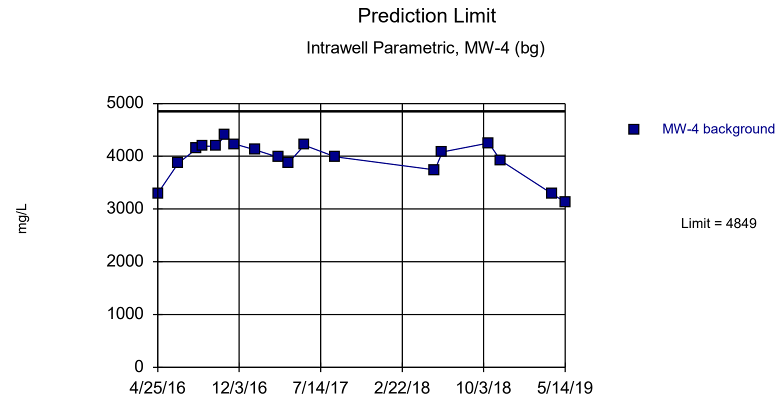
Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-2
4/25/2016	1260 (D)
6/20/2016	1620 (D)
8/8/2016	1740 (D)
8/24/2016	1720 (D)
10/3/2016	1800 (D)
10/26/2016	1800 (D)
11/21/2016	1740 (D)
1/17/2017	1960 (D)
3/22/2017	1510 (D)
4/18/2017	1580 (D)
5/31/2017	1730 (D)
8/23/2017	1550 (D)
5/22/2018	1500 (D)
6/12/2018	1550
10/17/2018	1740 (D)
11/19/2018	1990 (D)
4/10/2019	1250 (D)
5/14/2019	1540 (D)



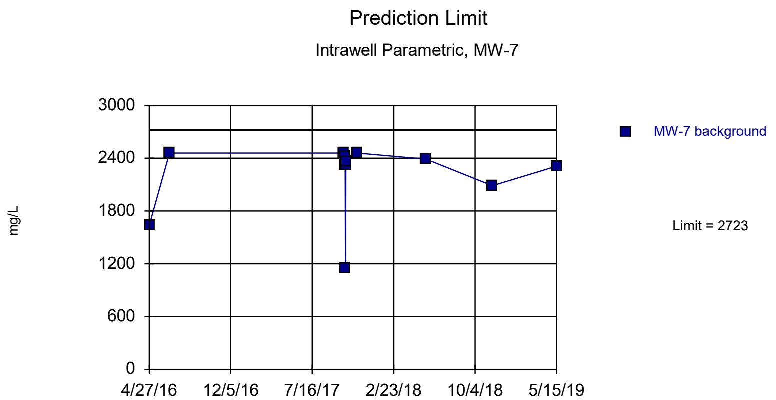
Background Data Summary: Mean=3661, Std. Dev.=628.6, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9455, critical = 0.858. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



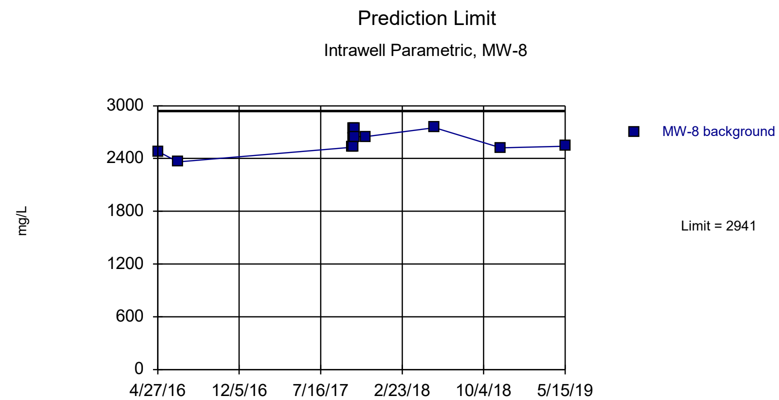
Background Data Summary (based on square transformation): Mean=1.6e7, Std. Dev.=2719774, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8799, critical = 0.858. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



Background Data Summary (based on x^5 transformation): Mean=6.3e16, Std. Dev.=3.0e16, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8216, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill



Background Data Summary: Mean=2593, Std. Dev.=120.2, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9303, critical = 0.805. Assumes 1 future value. Kappa overridden to 2.894.

Constituent: Total Dissolved Solids Analysis Run 4/10/2020 11:19 AM View: Intrawell
Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 4/10/2020 11:20 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-3
4/25/2016	2720 (D)
6/22/2016	3250 (D)
8/9/2016	3050 (D)
8/24/2016	3080 (D)
10/4/2016	2900 (D)
10/26/2016	2940 (D)
11/21/2016	3090 (D)
1/18/2017	4020 (D)
3/22/2017	4180 (D)
4/18/2017	4440 (D)
5/31/2017	3970 (D)
8/23/2017	4050 (D)
5/24/2018	3680 (D)
6/12/2018	3820
10/17/2018	4730
11/19/2018	4710 (D)
4/10/2019	3680
5/14/2019	3580 (D)

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 4/10/2020 11:20 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-4
4/25/2016	3300 (D)
6/20/2016	3870 (D)
8/9/2016	4140 (D)
8/24/2016	4190 (D)
10/3/2016	4190 (D)
10/26/2016	4400 (D)
11/21/2016	4230 (D)
1/18/2017	4120 (D)
3/22/2017	3980 (D)
4/18/2017	3880 (D)
5/31/2017	4210 (D)
8/23/2017	3990 (D)
5/23/2018	3740 (D)
6/12/2018	4080
10/17/2018	4250
11/19/2018	3920 (D)
4/10/2019	3280
5/14/2019	3130 (D)

Prediction Limit

Constituent: Total Dissolved Solids (mg/L)   Analysis Run 4/10/2020 11:20 AM   View: Intrawell

Plant Gorgas   Client: Southern Company   Data: Gorgas BA LandFill

	MW-7
4/27/2016	1640
6/21/2016	2460
10/12/2017	2460
10/13/2017	2420
10/14/2017	2320
10/15/2017	1150
10/16/2017	2320
10/17/2017	2360
11/16/2017	2460
5/23/2018	2390
11/20/2018	2090
5/15/2019	2310

Prediction Limit

Constituent: Total Dissolved Solids (mg/L) Analysis Run 4/10/2020 11:20 AM View: Intrawell

Plant Gorgas Client: Southern Company Data: Gorgas BA LandFill

	MW-8
4/27/2016	2480
6/21/2016	2360
10/12/2017	2530
10/13/2017	2740
10/14/2017	2630
10/15/2017	2530
10/16/2017	2740
10/17/2017	2650
11/16/2017	2650
5/23/2018	2750
11/20/2018	2520
5/15/2019	2540

Appendix C

WFG Low-Flow Groundwater Sampling TSOP

1. Purpose

1.1. The purpose of this Technical SOP (TSOP) is to discuss the process and requirements associated with conducting Low-Flow groundwater sampling.

1.2. This TSOP specifically describes using bladder pumps and peristaltic pumps to obtain groundwater samples collected for laboratory analysis by the Alabama Power Company (APC) Environmental Affairs (EA), Water Field Group (WFG).

2. Scope

2.1. This procedure is to be used by field personnel when collecting and handling groundwater samples using the Low-Flow groundwater collection method in the field.

2.2. The sampling equipment covered in this TSOP may be portable (well-to-well) or well-dedicated.

2.3. The sampling of SVOCs and VOCs should not be collected with the use of peristaltic pumps unless prior written customer approval is attained.

2.4. The procedure is designed to ensure that the samples collected are representative of the aquifer or target formation and that sample cross-contamination is eliminated during the sampling and handling process.

2.5. This procedure cannot replace education and experience. Professional judgment should be used in conjunction with this procedure.

3. Definitions/Abbreviations

3.1. Low-Flow (or micropurge) - Refers to the velocity with which water is withdrawn from the well. The objective of low-flow sampling is to extract fresh samples of the ambient groundwater from within the screened interval of the well with minimal impact to the zone of influence of the well.

3.2. Drawdown - Lowering of the water column within a well due to pumping. Typically associated with high-flow purging of a well for water sampling.

3.3. DI water – De-ionized water. Water that has been passed through a standard deionizing resin column. Water used for decontamination of field equipment.

3.4. Ultra-pure DI water- Water that is filtered and treated to the highest levels of purity. This water is used for the filling of blanks.

3.5. Phosphate-free soap or cleaner – A cleaner which contains, by weight, 0.5% or less of phosphates or derivatives of phosphates (Liquinox® or Luminox®).

3.6. Potable water- Water that is safe to consume. Can be used in detergent solution and first rinse during decontamination. Can be replaced by DI water.

3.7. PPE - Personal Protective Equipment.

3.8. NTU - Nephelometeric Turbidity Units. The unit of measure used when measuring the turbidity of water.

3.9. COC - Chain of Custody. A controlled document used to record sample information and transfer the samples to the laboratory after collection.

3.10. SVOCs and VOCs- Semi-volatile organic compounds and volatile organic compounds.

3.11. DO - Dissolved Oxygen

3.12. ORP - Oxidation Reduction Potential

3.13. SAP - Sampling and Analysis Plan

3.14. EDAS- Environmental Data Acquisition System

3.15. Artesian well- A well in which water rises under pressure from a permeable stratum overlaid by impermeable rock.

4. References

4.1. Internal Documents

4.1.1. WFG Groundwater Equipment Decontamination TSOP
4.1.2. WFG Groundwater Water Level and Total Depth Measurements TSOP
4.1.3. WFG General Water Sampling and Field Measurement TSOP
4.1.4. WFG Deployment and Maintenance of Dedicated Groundwater Equipment TSOP
4.1.5. WFG Turbidity TSOP
4.1.6. WFG Temperature TSOP
4.1.7. WFG Conductivity TSOP
4.1.8. WFG Luminescent Dissolved Oxygen (LDO) TSOP
4.1.9. WFG Oxidation-Reduction Potential (ORP) TSOP
4.1.10. WFG pH (TSOP-SM-4500H) TSOP
4.1.11. WFG Electronic Calibration Form
4.1.12. Groundwater Electronic Chain of Custody

4.1.13. Site specific SAP

4.2. External Documents

4.2.1. United States Environmental Protection Agency (U.S. EPA). Region 4, Groundwater Sampling. Document # SESDPROC-301-R4.

4.2.2. Florida Department of Environmental Protection (DEP). FS 2200 Groundwater Sampling. Document # DEP-SOP-001/01.

4.2.3. United States Environmental Protection Agency (U.S. EPA). Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. Document # EPA/540/S-95/504.

4.2.4. ASTM Standard D6771-18- Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations

5. Method Overview

5.1. Low flow sampling of groundwater from within the screened interval is accomplished by maintaining a low pump rate that minimizes drawdown of the water column while leaving the more stagnant water above the screened interval undisturbed.

5.2. Indicator parameters and water levels are measured at the beginning of and while micro-purging the well. Stabilization acceptance criteria for turbidity, pH, specific conductance and DO are found in the site specific SAP. Stabilization of these parameters indicates that the water is representative of ambient conditions and sample collection can begin. ORP and temperature measurements should also be collected but will not be used as indicators of stability.

5.3. Non-dedicated sampling equipment must be decontaminated prior to next use in a well to avoid cross contamination. Refer to and understand the Groundwater Equipment Decontamination TSOP prior to performing groundwater sampling.

6. Detection Limit

6.1. Some of the indicator parameter methods used to show equilibrium of the well water have minimum detection limits or other quality control requirements. Refer to the latest version of the TSOPs associated with these procedures (turbidity, pH, specific conductance, and DO).

6.2. Users of this procedure must study and be familiar with the applicable data acceptance criteria and required field measurements. Refer to the SAP for information on these parameters and other information.

7. Safety

7.1. Appropriate PPE should be worn and utilized when sampling groundwater wells in accordance with APC policies. Generally this includes safety glasses, hard hats, gloves and safety-toed boots. Plant-specific requirements may also apply and should be determined/known prior to arriving at the work location.

7.2. Refer to the WFG General Water Sampling and Field Measurement TSOP procedure for general safety requirements.

7.3. If using compressed Nitrogen gas for deep wells, always secure tanks when transporting and ensure protective cap is secured over valve. Take care to avoid exceeding the max pressure rating of the controller, air hose and pump.

8. Equipment and Materials

The following is a basic listing of the necessary reusable and expendable items that are required to complete this procedure.

8.1. Reusable Items

8.1.1. Field Book
8.1.2. Appropriate installation diagram and/or well construction data
8.1.3. Keys for well locks
8.1.4. Water level meter
8.1.5. Pump with parts (tubing grab plates, bladders, O-rings, etc.)
8.1.6. Pump controller
8.1.7. Peristaltic pump
8.1.8. Flow-through cell
8.1.9. iPad
8.1.10. InSitu™ multi-parameter probe
8.1.11. Handheld turbidity meter
8.1.12. Generator (min. 2,000 kW)
8.1.13. Air compressor and hose
8.1.14. Graduated cylinder
8.1.15. Tubing Weight (for peristaltic application)
8.1.16. Tubing caddy with counter unit or other measurement device
8.1.17. Decon/wash containers w/ lids (3)
8.1.18. Coolers for samples
8.1.19. Procedures & SAPs

8.2. Consumable/Disposable Items

8.2.1. Tubing (estimated for number of wells x well depths with extra)
8.2.2. Silicone tubing for peristaltic pump head
8.2.3. COCs (if electronic format is not suitable)
8.2.4. Plastic sheeting
8.2.5. Gasoline (in approved container)
8.2.6. Ice for samples
8.2.7. Sample Bottles
8.2.8. DI water (For decon)
8.2.9. Ultra-Pure DI water (For blanks collection)
8.2.10. Potable water (for decon)
8.2.11. Phosphate free detergent (e.g. Liquinox or Luminox®)
8.2.12. Support rope or coated safety cable
8.2.13. Calibration Standards
8.2.14. Disposal sample bags & trash bags
8.2.15. Paper towels

9. Reagents & Standards

9.1. This document describes the Low-Flow purging and sampling procedure and does not include method calibration procedures. Calibration procedures may be found in the associated method TSOP on the APC Qualtrax site. The instrument(s) used to measure indicator parameters must be verified daily using the below appropriate calibration standards (or equivalent).

9.1.1. ORP- ZoBell's ORP Solution
9.1.2. pH- 3-point calibration

9.1.2.1. 2.00 buffer standard for pH
9.1.2.2. 4.00 buffer standard for pH
9.1.2.3. 7.00 buffer standard for pH
9.1.2.4. 10.00 buffer standard for pH
9.1.2.5. 12.00 buffer standard for pH

9.1.3. DO - NA
9.1.4. Specific Conductance - 1,412 µS/cm, or appropriate conductivity standard
9.1.5. Turbidity – Zeroed with 0.00 standard and calibrated with 10.00 NTU standard

10. Calibration

10.1. Calibration and/or verification of water quality measurement equipment shall be performed at the start of each day and should be specific to the manufacturer's calibration instructions. A verification check of the instrument calibration will be performed after the calibration and at the end of each day with a standard of the same value but different lot number or manufacturer.

10.2. All calibration data, and initial and final LCS data, should be recorded electronically in the calibration log on EDAS.

10.3. Refer to the APC TSOP for each method to complete the instrument calibration (TSOPs: turbidity, pH, temperature, specific conductance, DO and ORP).

11. Procedure

<u>General Note</u>

At the start of each sampling event, a round of water levels from each well should be collected for use in generating a potentiometric surface map. This should be completed on the first day of the sampling event. Refer to the Groundwater Water Level and Total Depth Measurement TSOP for guidance.

11.1. Well lock keys are maintained by the plant compliance contact and must be obtained from the compliance office, if not already assigned a key, prior to beginning work

11.2. Inspect the well for any damage or tampering. If there is evidence of damage or tampering, immediately notify the Technical Manager or the Water Field Services Supervisor. Take photos of the site as documentation and make sure not to disturb the well. The damage/tampering and any discussions about a response should also be documented in the field logbook or electronically in the iPad.

11.3. If the well is in good condition, open the well head and if the well is non-dedicated and non-vented, remove the inner casing cap to allow for atmospheric equilibration. Begin setting up to sample by arranging/organizing the work zone.

11.4. Designate a clean work space or work surface used to provide a contaminant-free area to place sampling equipment during assembly.

11.5. Calibrate or verify all field parameter measurement equipment at the start of each day (this typically includes an InSitu multi-meter probe and a handheld turbidity meter if an inline turbidity sensor is not used). Refer to the appropriate method TSOP and calibration procedure for each instrument used.

11.6. All non-dedicated equipment that will, or could come into contact with groundwater (e.g. pump and water level meter) in the well must be decontaminated prior to each use. Refer to the Groundwater Equipment Decontamination TSOP for more details.

11.7. Using a properly functioning water level indicator, lower the probe into the well and obtain an initial water level measurement for the well (Refer to WFG Groundwater Water Level and Total Depth Measurements TSOP).

11.8. Measure and record all water levels to the nearest hundredth (0.01) foot at the reference point or survey mark on the well casing.

11.9. Refer to the WFG Deployment and Maintenance of Dedicated Groundwater Equipment TSOP for initial or re-deployment of dedicated pumps and for performing maintenance activities.

11.10. Dedicated Low-Flow – Bladder Pump

11.10.1. Connect the external compressor hose to the pump controller intake port using the quick-connect.

11.10.2. Connect the pump air supply line to the "Air Out" quick connect on the control box. Connect the other end of the air supply line to the air connection on the dedicated well cap.

11.10.3. Connect a short piece of tubing to the existing sample line on the dedicated well cap and then connect to the bottom of the flow-through cell for the InSitu multi-probe. Use care to ensure proper connection of the tubing.

11.10.4. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth. Ensure that the dedicated pump is still located below the water table, and at a suitable sampling depth.

11.10.5. Insert the InSitu multi-parameter probe into the flow-through cell and press the power button

11.10.6. Turn on the iPad and open the InSitu Low-Flow application (iSitu® or VuSitu® app). Enter the initial data needed to initiate the program or if a template is available, open the well specific template. Refer to the manufacturer's instructions for a step-by-step explanation of the Low-Flow app and the data input required.

11.10.7. Continue to fill in all appropriate information in the InSitu program using the parameter stabilization criteria set forth in the site-specific SAP. Always confirm with the Technical Manager that the current SAP is being used.

11.10.8. Place the generator as far away as possible from the well, preferable downwind. Start the generator and the air compressor to begin pumping. If the well is too deep for a traditional air compressor, use of compressed Nitrogen gas, high pressure controller and pressure regulator may be required.

11.10.9. Monitor the water level and adjust the flow rate on the pump controller to provide a constant water level in the well. Pump rates should not exceed three tenths of a foot (0.3) water level drawdown when sampling. During initial pump start-up, drawdown may exceed three tenths of a foot (0.3) while flow rate adjustments are being made or while water level stabilization occurs.

11.10.10. Use a graduated cylinder (or similar) to measure the flow rate in milliliters per minute (ml/min). Purge rates must fall between 100 and 500 ml/min or meet the specific requirements provided in the project SAP. If the minimum flow rate requirement of 100 ml/min cannot be achieved without water level drawdown exceeding three tenths of a foot (0.3), refer to section 16.1.

11.10.10.1. If the well has been previously purged and sampled, refer back to the most recent well record and make an effort to target that purge rate for consistency.

11.10.11. When a stable purge rate is attained, enter that flow rate in the InSitu program and set the measurement frequency to every 5 minutes. The Low-Flow application (iSitu® or VuSitu® app) will now be used to determine when groundwater samples can be taken. The Low-Flow app uses the previously entered SAP acceptance criteria and applies them to each measurement. When the criteria are met, the indicator parameter will be highlighted in green on the iPad screen, indicating equilibration.

11.10.12. Note the start time and other well information in the field log book and start the program.

11.10.13. Turbidity measurements may be taken with an inline turbidity sensor or with an external handheld unit. If using an external turbidity meter, readings must collected as close as possible to the time as the readings acquired from the InSitu meter.

11.10.14. Continue to measure water level and turbidity at the same measurement frequency as the indicator parameters, entering the values in the iPad InSitu application.

11.10.15. Once the water level and all field parameters have stabilized and turbidity is less than 10 NTU according to the criteria in the SAP, the well is considered equilibrated and sampling may take place. Refer to the site-specific SAP and Sections 16.2 and 16.3 of this procedure for direction on wells where 10 NTU are unattainable.

11.10.16. Tap the “**Finish Test**” button on the iPad and enter any relevant notes such as time sampled in the comment section. Email the data file to a secure company email address for storage and use. In the event that there is no data service to email the file and the iPad is damaged or lost before the field report can be sent, the well will be re-sampled.

11.10.17. **DO NOT** turn off the pump. Complete the labeling for all sample bottles and also record the same information for each sample in the field log book, and all electronic forms.

11.10.18. Put on nitrile or latex gloves and make sure that all bottles are preserved with the appropriate acid.

11.10.19. Carefully remove the sample line from the bottom of the flow-through cell. Cut the end off of the sample tubing and begin filling up the sample containers.

11.10.20. Do not adjust the flow rate when sampling.

11.10.21. Fill up the containers by placing the tubing in the mouth of the bottle, using care not to touch the mouth or sides of the container. Do not overfill sample bottles. Bottle should be filled to the top leaving a small amount of headspace, unless otherwise directed by the customer or lab.

11.10.22. Upon filling and capping all sample containers, place the samples in the sample cooler and ensure that the samples with temperature requirements are placed on ice.

11.10.23. Turn off the controller, air compressor and generator.

11.10.24. Remove the water level indicator from the well, making sure to decontaminate the wetted tape and probe portion.

11.10.25. Disconnect the airline tubing from the controller and make sure the sample line tubing is disconnected. Secure the dedicated tubing within the wellhead in such manner that the tubing stays clean and does not fall into the well. Close and secure the well.

11.11. Non- Dedicated Low Flow- Bladder Pump

11.11.1. Complete Steps 11.1 – 11.9 from the above procedure.

11.11.2. Assemble a clean pump system with a bladder, and connect the support rope or cable, sample line, and air line to the top of the pump assembly. Use care to ensure proper connection and positioning. Never lower a pump in a well without a support rope attached.

11.11.3. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth.

11.11.4. Slowly lower the pump assembly into the well, using care to minimize disturbance once the groundwater interface is reached. The tubing counter or other depth measurement devices can be used to aid in determining appropriate depth.

11.11.5. Recharge characteristics may dictate the need to place the pump intake slightly lower than the mid-screen depth if drawdown historically is unavoidable.

11.11.6. With the pump intake lowered to approximately mid-screen depth, secure the support rope or cable so that the pump is fixed and stationary in the well.

11.11.7. Cut the air line to an appropriate length and attach to the air hose on the pump controller. Next, cut the water line to an appropriate length and attach to the bottom of the flow-through cell.

11.11.8. Re-lower the water level meter into the well.

11.11.9. Follow above Steps 11.10.5 – 11.10.23.

11.11.10. Remove the pump and tubing from the well. Discard the used tubing and pump bladder. Never re-use disposable sampling equipment or tubing.

11.11.11. Place the well cap back on the well and close and lock the well lid.

11.12. Low Flow –Peristaltic Pumps

11.12.1. Complete steps 11.1 – 11.9 from the above procedures.

11.12.2. Peristaltic- Dedicated Well Tubing

11.12.2.1. Prepare an adequate length of clean silicon tubing that has the correct outside and inside dimensions to allow proper fit in the pump head. Insert into the pump head rollers and secure (refer to pump user manual for additional information).

11.12.2.2. Connect the vacuum end of the silicone tubing to the barb fitting on the dedicated well cap.

11.12.2.3. Attach the discharge end of the silicone tubing to the bottom of the flow through cell.

11.12.3. Peristaltic- Non-Dedicated Well Tubing

11.12.3.1. Attach the tubing weight to the end of clean polyethylene tubing.

11.12.3.2. Using data from the Field Logbook, SAP, or associated well construction data (See Section 15), determine the total well depth and the intake screen mid-point depth.

11.12.3.3. Using the tubing caddy or another tubing depth measurement device, slowly lower the tubing and weight to the mid-screen depth.

11.12.3.4. Once the tubing intake is at the correct depth, allow for excess tubing at the surface and insert into the pump head rollers and secure.

11.12.3.5. Allow for a short section (one to three feet) of tubing from the discharge side of the pump head. This may be used for both the purge discharge and to fill sample bottles upon stabilization.

11.12.3.6. Attach the discharge tubing to the intake (lower) port of the flow-through cell.

11.12.4. Insert the InSitu multi-parameter probe into the flow-through cell and press the power button on the battery pack.

11.12.5. Turn on the iPad and open the InSitu Low-Flow application (iSitu® or VuSitu® app). Enter the initial data needed to initiate the program or if a template is available, open the well-specific template. Refer to the manufacturer's instructions for a step-by-step explanation of the Low-Flow app and the data input required.

11.12.6. Make the necessary preparations to provide power to the pump. Turn on the peristaltic pump to produce a vacuum on the well side of the pump head and begin purging. Observe pump direction to ensure that the pump operation is applying a vacuum to the sample line (down-hole) tubing.

11.12.7. Monitor the water level and adjust the flow rate to provide a constant water level in the well. The pump rate will initially require adjustment based on the site and well properties. Pump rates should not exceed three tenths of a foot (0.3) water level drawdown when sampling. During initial pump start-up, drawdown may exceed three tenths of a foot (0.3) while flow rate adjustments are being made or while water level stabilization occurs. If the minimum flow rate requirement of 100 ml/min cannot be achieved without water level drawdown exceeding three tenths of a foot (0.3), refer to section 16.1.

11.12.8. Continue to fill in all appropriate information in the InSitu program using the parameter stabilization criteria set forth in the site-specific SAP. Always confirm with the Technical Manager that the current SAP data are being used.

11.12.9. Use a graduated cylinder (or similar) to measure the flow rate in milliliters per minute (ml/min). Purge rates must fall between 100 and 500 ml/min or meet the specific requirements provided in the project SAP.

11.12.9.1. If the well has been previously purged and sampled, refer back to the most recent well record and make an effort to match the purge rate for consistency.

11.12.10. When a stable purge rate is attained, enter that flow rate in the InSitu program and set the measurement frequency to 5 minutes. The Low-Flow application (iSitu® or VuSitu® app) will now be used to determine when groundwater samples can be taken. The Low-Flow app uses the previously entered SAP acceptance criteria and compares them to each measurement. When the criteria are met, the indicator parameter will be highlighted in green on the iPad screen, indicating equilibration.

11.12.11. Note the start time and other well information in the field log book and start the program.

11.12.12. Turbidity measurements may be taken with an inline turbidity sensor or with an external handheld unit. If using an external turbidity meter, readings must be collected as close as possible to the time as the readings acquired from the InSitu meter.

11.12.13. Continue to measure water level and turbidity at the same measurement frequency as the indicator parameters, entering the values in the iPad SmarTROLL™ application.

11.12.14. Once the water level and all field parameters have stabilized and turbidity is less than 10 NTU according to the criteria in the SAP, the well is considered equilibrated and sampling may take place. Refer to the site-specific SAP and Sections 16.2 and 16.3 of this procedure for wells where 10 NTU is unattainable.

11.12.15. Tap the "**Finish Test**" button on the iPad and enter any relevant notes such as time sampled in the comment section. Email the data file to a secure company email address for storage and use. In the event that there is no data service to email the file and the iPad is damaged or lost before the field report can be sent, the well will be re-sampled.

11.12.16. **DO NOT** turn off the pump. Complete the labeling for all sample bottles and also record the same information for each sample in the field log book and associated electronic forms.

11.12.17. Make sure that all bottles are preserved with the appropriate acid.

11.12.18. Carefully remove the sample line from the bottom of the flow-through cell. Cut the end off of the sample tubing and begin filling up the sample containers.

11.12.19. Do not adjust the flow rate when sampling.

11.12.20. Fill up the containers by placing the tubing in the mouth of the bottle, using care not to touch the mouth or sides of the container. Do not overfill sample bottles. Bottles should be filled to the top leaving a small amount of headspace unless otherwise directed by the customer or lab.

11.12.21. Upon filling and capping all sample containers, place the samples in the sample cooler and ensure that the samples with temperature requirements are placed on ice.

11.12.22. Stop the pump and reverse the flow direction so that the sample line is emptied of water.

11.12.23. Turn off the peristaltic pump and generator.

11.12.24. Remove the water level indicator from the well, making sure to decontaminate the wetted tape and probe.

11.12.25. For dedicated tubing, disconnect the silicone tubing piece from the pump and dedicated well cap and throw away. Close and secure the well. For non-dedicated tubing, disconnect the tubing from the pump and throw away.

11.13. Decontamination and Clean-Up – For all Reusable Components

11.13.1. Decontamination of any reusable components can be completed as a separate task at a later time but must not be re-used until decontaminated according to the WFG Groundwater Equipment Decontamination TSOP.

11.13.2. Do not re-use any disposable sampling equipment and throw away all non-dedicated tubing and bladders after use.

11.13.3. Pack up and secure all equipment and complete all sample information on the COC.

11.13.4. Reattach well cap (as appropriate) and close and lock the wellhead.

12. Calculations and Reports

12.1. Sample reports should be emailed in the field using the InSitu iPad application to a secure company email address.

13. Data Interpretation, Recording and Reporting

13.1. Data interpretation and reporting will be completed by personnel with Southern Company Services (SCS) and will subsequently be used to produce the compliance report per the Coal Combustion Residuals Rule [80 FR 21301] and respective state agency requirements.

13.2. Recording of field data used to support the interpretation and reporting process will be completed using field log books and/or sample reports that will be filled out each time groundwater monitoring activities are conducted. The field log book or sample report should contain the following information:

13.2.1. Well identification number
13.2.2. Well depth
13.2.3. Static water level depth, date & time
13.2.4. Pumping rate, drawdown, indicator parameter values, time at five minute intervals; calculated or measured total volume pumped
13.2.5. Time of sample collection
13.2.6. Field observations
13.2.7. Name of sample collectors
13.2.8. Weather conditions
13.2.9. QA/QC data for blanks (sample time and location)

13.3. Information on sample times, dates, analytical methods, personnel, etc. should be filled out on the COC for each sample and turned in with the samples to the proper lab.

14. Quality Control Acceptance Criteria and Corrective Actions for Failed QC

14.1. Any deviations or issues related to the well sampling process should be documented in the field log book or sample report.

14.2. One sample duplicate and one field blank shall be collected per every group of 10 wells sampled as specified in the SAP. An equipment rinsate blank should also be collected at a rate of 1 per every CCR storage unit. Refer to the site specific SAP for guidance. Ultra-pure DI water shall be used as the control water for all blanks.

14.3. Calibration acceptance criteria for field parameters may be found in the individual TSOP documents. Refer to individual TSOPs for guidance on initial and final LCS failures.

15. Diagrams

15.1. Well construction logs are maintained by SCS Earth Sciences and may be consulted to confirm total well depth and screened interval.

16. Deviations/Exceptions

16.1. The low-flow sampling method is not always feasible in some wells due to very slow recharge rates. Depending on the geology and conditions of water bearing zones, water levels may decline at rates greater than the accepted minimum drawdown limit of three tenths of a foot (0.3 ft) even with minimal flow rates. If this is the case, and the well has a dedicated pump, minimum purge sampling may be necessary. Follow the below steps for minimum purge sampling:

16.1.1. Calculate the total system volume (bladder, tubing & flow through cell) by inputting the necessary information in the InSitu program.
16.1.2. Purge 1-3 times the system volume, depending on the volume of the overhead water column.
16.1.3. Purge rates should occur at rates less than 100 ml/min.
16.1.4. Collect field readings after at least 1 system volume has been purged.
16.1.5. Commence sampling once system volume(s) have been purged.
16.1.6. Document field methodology, data, calculations and observations.

16.2. The target for monitoring turbidity is readings less than or equal to 5 NTUs, however this value is not mandatory (EPA, July 1996). In some instances, turbidity levels may exceed the recommended turbidity level due to natural aquifer conditions, changes in aquifer recharge, or other well characteristics. When these conditions are encountered, the following guidelines shall be considered:

16.2.1. If turbidity readings are greater than 5 NTU but less than 10 NTU and all other parameter criteria has been met, sampling can commence.
16.2.2. If turbidity readings are slightly above 10 NTU, but are trending downward, purging and monitoring shall continue.
16.2.3. If turbidity readings are greater than 10 NTUs and are stable within 10% for the final 3 consecutive readings and pumping has occurred for at least 2 hours, well sampling shall be based upon stabilization of critical indicator parameters (pH, Specific Conductance and DO).

16.2.3.1. In situations described in the above section, first collect a preserved sample set followed by an additional preserved sample set to be field filtered.
16.2.3.2. After the first sample set is collected, attach a 0.45 micron field filter to the end of the sample line. Allow for about 300 ml of sample water to pass through the filter prior to sample collection. Once filtered bottles have been filled, dispose of the filter. Ensure that the filtered sample set is properly denoted on the label.

16.3. Artesian Wells

16.3.1. For wells that are artesian, water may free flow out of the well casing before it reaches equilibrium. In such cases, a dedicated pump is not required. It is acceptable to collect the sample using traditional low flow criteria utilizing a special well cap fitted with control valve routed directly to the flow through cell. A minimum of 1 well volume should be purged before sample collection.

17. Client-Defined Specifications/Observations/Specialized Analysis

17.1. A project SAP is required on a groundwater sampling project and is available for review in the groundwater folder on EDAS. This document provides project-specific information regarding regulatory, sampling, containerization, chemical analysis, and data acceptance criteria requirements.

*****END OF DOCUMENT*****

APPENDIX 5
CLOSURE AND POST-CLOSURE CARE PLANS

AMENDED CLOSURE PLAN FOR BOTTOM ASH LANDFILL

Plant Gorgas
Alabama Power Company
Parrish, Alabama

July 2019

Contents

ATTACHMENTS

AMENDED CLOSURE PLAN
PLANT GORGAS BOTTOM ASH LANDFILL
ALABAMA POWER COMPANY
40 C.F.R. § 257.102(b)(3) and ADEM Admin. Code r. 335-13-15-.07(3)(b)3.
ADEM Admin. Code r. 335-13-4-.20

1. Introduction

This Amended Closure Plan has been prepared to support the permit application previously submitted to the Alabama Department of Environmental Management (ADEM) for the CCR Landfill known as the Plant Gorgas Bottom Ash Landfill, located near Parrish, Walker County, Alabama. The permit application was submitted in accordance with ADEM Admin. Code r. 335-13-15-.09(1)(c) and r. 335-13-5-.02. This Amended Closure Plan, along with other documents, is intended to supplement the previous submittal in response to the ADEM letter dated May 24, 2019 which provided response comments to the original application.

2. General

The Plant Gorgas Bottom Ash Landfill received and stored coal combustion residuals produced during the electric generating process at Plant Gorgas. CCR products were conditioned, transported by truck and then compacted in the landfill for storage. The landfill covers approximately 56 acres, and currently stores about 4,100,000 cubic yards of CCR.

The Bottom Ash Landfill at Plant Gorgas has been in operation for many years, and there are not formal design plans available related to the original construction. The Bottom Ash Landfill is formed by excavations in previously placed mine spoil material and natural hillsides, as well as low earthen embankments. The foundation materials beneath the CCR unit generally consist of previously placed mine spoils.

The Plant Gorgas Bottom Ash Landfill is not constructed with a liner nor a leachate collection system. Prior to ADEM's promulgation of its CCR rule, the Bottom Ash Landfill was not subject to solid waste regulation under state or federal law. Thus, the Bottom Ash Landfill was not required to operate with the design features described in ADEM Admin. Code r. 335-13-4-.18. Since that time, the federal CCR rule was enacted without requiring an existing CCR landfill to have a liner. *See* 40 C.F.R. § 257.70 (imposing design criteria for new CCR landfills and expansions of existing landfills, but not for existing landfills). This was not an oversight on EPA's part, but rather a recognition that "the potential for disruption in CCR disposal capacity . . . would be significant" if such facilities were required to retrofit, and such disruptions "are associated with significant risks to public health and the environment in their own right." 80 Fed. Reg. 21,301, 21,370 (Apr. 17, 2015). EPA also noted that existing landfills like the Bottom Ash Landfill at Plant Gorgas would be subject to other protective measures of the CCR rule, including groundwater monitoring and corrective action. *Id.* The text of the comparable design criteria in ADEM's regulations is the same in substance as § 257.70 of the federal regulations. *See* ADEM Admin. Code r. 335-13-15-.04(1). Therefore, it is our understanding that ADEM's CCR regulations do not require installation of additional design features at the Bottom Ash Landfill. If ADEM takes a different view of the requirements of its regulations, we will request a variance pursuant to r. 335-13-15-.15 on the grounds that such a determination is not any less stringent than the federal CCR rule and is protective of public health and the environment, which is supported by EPA's determination as expressed in the 2015 federal rule and preamble.

As of April 2019, Plant Gorgas has now been retired, and the Bottom Ash Landfill is being prepared for closure. The footprint will be consolidated, and the final cover system will be applied to the consolidated footprint of approximately 27 acres.

The final cover will be designed to minimize infiltration and erosion. Current plans are to have the cover system include a 60-mil geomembrane overlain with a geocomposite, both covered with 18 inches of protective soil and 6 inches of topsoil. The cover system to be used meets or exceeds the requirements of 40 CFR § 257.102(d)(3)(ii) and r. 335-13-4-.20(2)(b)1. in that the permeability of the final cover system will be less than or equal to the permeability of the subgrade beneath the landfill. Final design will ensure the disruption of the integrity of the final cover system is minimized through a design that accommodates settlement and subsidence, in addition to providing an erosion layer for protection from wind or water erosion.

The final cover system will be constructed to control, minimize or eliminate, to the maximum extent feasible, post closure infiltration of liquids into the waste and potential releases of CCR from the unit. This will be prevented by including sufficient grades and slopes as part of the final cover system which will: 1) preclude the probability of future impoundment of water, slurry, or sediment; 2) ensure slope and cover system stability; 3) minimize the need for further maintenance; and 4) be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.

Additional details regarding the cover system can be found in Sections 4.e. and 4.f. of this document. Cover system details are also shown on the attached design drawings.

3. Notification of Intent to Close

Notification of intent to close the Plant Gorgas Bottom Ash Landfill was placed in the plant's Operating Record on April 15, 2019. The notice of intent was subsequently submitted directly to ADEM. Closure of the landfill will be conducted under § 257.102(d) and r. 335-13-15-.07(3)(d), *closure performance standard when leaving CCR in place*. As described in more detail below, the landfill will be closed in a manner that will control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated runoff to the ground or surface waters or to the atmosphere. Closure will also preclude the probability of future impoundment of water, sediment or slurry. Measures will be taken during design and construction of the closure system that provide for major slope stability to prevent the sloughing or movement of the final cover system. Closure will also minimize the need for further maintenance of the CCR unit.

Major closure activities will commence following receipt of a CCR permit from ADEM pursuant to r. 335-13-15-.09.

4. Written Closure Plan – § 257.102(b)(1)(i),(iii) and r. 335-13-15-.07(3)(b)1.(i),(iii)

a. Overview

A written closure plan to comply with § 257.102(b) was posted to the Plant Gorgas Operating Record on October 17, 2016. A revised written closure plan incorporating reference to applicable ADEM Administrative Codes was submitted as a part of the original CCR Permit application.

As required by § 257.102(b)(3)(ii) and r. 335-13-15-.07(3)(b)3.(ii), the written closure plan must be amended whenever (i) there is a change in the operation of the CCR unit that would substantially affect the written closure plan or (ii) before or after closure activities have commenced when unanticipated events necessitate a revision of the written closure plan. The time frames for amendment to the written closure plan is in accordance with those specified in § 257.102(b)(3)(iii) and r. 335-13-15-.07(3)(b)3.(iii).

b. Closure Steps

The closure of the Plant Gorgas Bottom Ash Landfill will involve the following general activities:

- Installation of Erosion & Sediment Control/BMPs as part of site preparation activities
- Clearing and grubbing as part of site preparation activities
- General excavation and grading around the site
- CCR excavation, consolidation, and grading
- Installation of the final cover system
- Construction of final stormwater control and conveyance systems

Plant Gorgas formally ceased generation of electricity on April 15, 2019, and the Bottom Ash Landfill ceased receiving CCR on or before this date. A Notice of Intent to initiate closure was placed in the Plant Gorgas Operating Record on April 15, 2019.

A Contractor has been selected for the closure project and has mobilized to the site to begin preparation for closure. Their initial activities include installation of erosion and sediment control structures, followed by clearing and grubbing. Most of the site is relatively barren of vegetation, but there is a limited amount of vegetation scattered around the perimeter of the landfill, including an area of trees to the south that will need to be removed.

As this facility is a landfill containing dry stacking of CCR, there is no dewatering required to facilitate closure.

c. Procedures During Closure

i. Erosion and Sedimentation Control

Prior to initiation of closure activities, erosion and sedimentation controls will be established along with Best Management Practices. Erosion and sedimentation control details can be found on Drawings E720292 and E720293.

ii. Stormwater Management

The only stormwater generated within the Bottom Ash Landfill results from precipitation that falls within the Bottom Ash Landfill drainage basin. There is no current discharge from the Bottom Ash Landfill; water that collects within the cell at the southern end evaporates. As a part of the closure project, grading activities will develop new drainage patterns to drain stormwater to a new detention pond (to be installed in the early phases of the project.) The pond will have an outlet control structure. Stormwater collected during the project will be treated and/or rerouted to other Plant water treatment facilities prior to discharge.

Stormwater from adjoining areas will be diverted around the landfill and managed through existing stormwater facilities or NPDES permit points, as applicable.

iii. CCR Removal Activities and Verification

Closure construction is going to involve consolidation of the CCR footprint, which will involve excavation of ash from some areas, with the excavated ash placed and compacted in the consolidation footprint that will be beneath the final cover system. As previously stated, the Bottom Ash Landfill area will be reduced from approximately 56 acres to about 27 acres. CCR will be excavated from outside the consolidation footprint until all visual ash has been removed. CQA personnel will perform a visual inspection to note if any visible ash remains in these areas. If visible ash is noted, further excavation will be performed. If no visible ash is noted, a grid or other reference points will be established, and a survey of the area taken to document the excavated surface. Also, the exposed soils will be visually classified and photographed. The classification indicator will be gray to black, sand-to-gravel sized particles as this area was used predominately for bottom ash storage. If possible, visual classification will be supported by use of the Munsell color system. However, as this area was previously disturbed with surface mine activities, the Munsell color chart usage may not be fully viable. The area will then be overexcavated an additional 6 inches, with the excavated soil placed within the consolidation footprint. The bottom of the overexcavation area will also be surveyed to document the excavation took place over the entire excavation area. Hand auger borings, if possible, may also be performed to a depth of about 12 inches below the exposed surface to provide a further check against the presence of deeper ash. Hand auger borings will be performed at a frequency of approximately 1 per acre.

The Contractor selected for the closure construction project will retain the services of an engineering and testing firm to provide quality control (QC) services. Southern Company, on behalf of Alabama Power, will retain the services of an additional engineering and testing firm to provide quality assurance services during the closure project. The services of each firm are outlined in the attached Technical Specifications. The removal of ash from outside the consolidation footprint will be observed and documented by the Contractor, the QC firm and the QA firm, with records from this process included in the final closure certification report.

iv. CCR Placement

The new consolidated footprint will be in an area where dry stacking of ash has taken place for several years, so the area is relatively stable in its current condition. The subgrade will be assessed before the placement of any additional CCR using proofrolling or other similar techniques. Prior to any work in the area, erosion and sediment controls and other BMPs will be installed in accordance with the project plans and specifications.

As the area has been dry stacked for years, there is no dewatering involved in the closure process (either free water or interstitial water). The groundwater level is approximately 40 feet or more below the consolidated footprint.

CCR from the excavated area will be excavated using conventional earthmoving equipment and loaded in to trucks for transport to the consolidation area. The CCR is to be placed in loose lifts not exceeding 8-in thickness and compacted to a minimum of 95 percent of the materials standard Proctor maximum dry density. Following such measures will result in a compact and stabilized consolidation footprint.

v. Fugitive Dust Control Plan

Fugitive dust control will be performed in accordance with the previously established fugitive dust control plan for Plant Gorgas. During construction, water trucks and compaction will be used to minimize dust. Ash will be conditioned as needed for compaction and to minimize dust generation. Trucks transporting ash and other materials will be operated at speeds intended to reduce generation of dust along roadways and other travel paths.

On-site personnel will assess the effectiveness of the control measures by performing visual observations of the ash pond and surrounding areas and implementing appropriate corrective actions for fugitive dust, as necessary.

Should a complaint be received from a citizen regarding a CCR fugitive dust event at the facility, the complaint will be documented and investigated. Appropriate steps will be taken, including any corrective action, as appropriate.

vi. Surface Water Management

Water that accumulates within the Bottom Ash Landfill footprint during closure construction may be used for ash conditioning water to support compaction and dust suppression in conjunction with the Fugitive Dust Control Plan. Any water not used for such purposes will be conveyed to the Plant's permanent wastewater treatment system. Non-contact stormwater which will be diverted around the landfill during construction will be managed through the site's normal NPDES operations.

vii. Equipment Decontamination

Before moving a piece of equipment that has been in contact with CCR from the active work area, the equipment will be cleaned with water in a designated area. CCR generated from this cleaning process will be incorporated with other CCR within the consolidated footprint prior to construction of the final cover system. Water generated during this process will be managed as contact water using the methods described previously.

viii. Site Security

The Bottom Ash Landfill is located on Plant Gorgas property, and access to the Plant, and thereby the landfill, is restricted with security gates manned 24 hours a day. Public access is not allowed unless escorted by authorized personnel. Access to the construction area will be limited to authorized personnel only during the closure project.

ix. Groundwater Monitoring

A groundwater monitoring plan was submitted with the original Bottom Ash Landfill permit application. Please refer to Appendix 4 of the original permit application.

x. Operational Inspections

Inspections will be conducted by a Qualified Person at intervals not exceeding 7 days to look for appearances of structural weakness and for proper operation of all outlet structures maintained for use during closure. Furthermore, an annual inspection will continue to be conducted by a qualified Professional Engineer throughout the closure process.

d. Closure Design Features

The closure of the Gorgas Bottom Ash Landfill will include the consolidation of dry stacked ash within the landfill prior to the construction of the cover. The operational disposal footprint will be consolidated to reduce the acreage that will be under cover. A stormwater management pond will be constructed to manage non-contact runoff from the closed facility. Where needed, additional earthen berms will be constructed to separate the closed cell from the stormwater pond, contain the ash, and provide a berm for the closure geomembrane anchor trench. The cell is contained on many sides by existing berms. No special containment structures or slurry walls will be needed as a part of closure.

e. Final Cover System

As currently planned, the final cover system for the Bottom Ash Landfill will consist of a composite cover system incorporating a 60-mil HDPE geomembrane overlain with a geocomposite, both covered with 18 inches of protective soil and 6 inches of topsoil. This cover system meets the requirements of § 257.102(d)(3)(i)(I) and (II) and r. 335-13-15-.07(3)(d)3.(i)(I) and (II). Infiltration of liquids will be prevented by the presence of both an 18-in infiltration/protective layer and the 60-mil HDPE geomembrane. A minimum 6-in erosion layer of soil capable of sustaining native plant growth will cover the infiltration layer and provide erosion protection for the final cover system. The final cover system will be installed over the consolidated area, eliminating direct exposure of CCR to the surrounding environment.

Disruption of the integrity of the cover system will be minimized through a program of regular inspection and maintenance as outlined in the post-closure care plan.

f. Achievement of Closure Performance Standards

Closure of the Bottom Ash Landfill will meet the requirements of § 257.102(d) and r. 335-13-15-.07(3)(d). Details of how the cover system will meet the final cover system requirements of § 257.102(d)(3)(i) and r. 335-13-15-.07(3)(d)3.(i) were addressed in 4.e. above. [Consider including a reference to how the final cover system will meet 257.102(d)(1) and 335-13-15-.07(3)(d)1.]The site will be graded during closure to direct surface runoff to a central rip-rap lined conveyance channel discharging to the new detention pond located to the southwest of the closed landfill. Surface grades in the consolidated footprint will range from 25 percent to 3 percent. Therefore, Alabama Power will be requesting a variance from the minimum 5 percent grades. As the waste material will be compacted bottom ash, we do not anticipate significant settlement of the cap and cover that would create depressions or other impedances to surface flow of stormwater. Furthermore, with a majority of the slopes being approximately 6 percent or flatter, we have not incorporated benching into the design as required by r. 335-13-15-.07(3)(d)3.(i)(V).

g. Corrective Measures

Based on groundwater monitoring results and an Alternate Source Demonstration, submitted to the Department in July 2019, for the facility, no Assessment of Corrective Measures has been proposed for this facility and was therefore not incorporated into the closure design. However, site conditions will be monitored and, if necessary under § 257.96(a) and r. 335-13-15-.06(7)(a), corrective measures will be initiated.

h. Completion of Closure Activities

Closure of the facility is expected to be completed by November 2020. Pursuant to 335-13-15-.07(3)(f)2.(i), Alabama Power intends to submit a demonstration showing that it is not feasible to complete the closure of the CCR landfill within the 6 month timeframe contemplated by § 257.102(f)(1)(i) and r. 335-13-15-.07(3)(f)1.(i) . The timeline for closure is based on the volume of material to be moved and grading activities required to consolidate the closure footprint and construct the new detention pond.

5. Maximum Inventory of CCR– § 257.102(b)(1)(iv) and r. 335-13-15-.07(3)(b)1.(iv)

The maximum inventory of CCR stored in the Bottom Ash Landfill during its operation is approximately 4,100,000 cubic yards. The amount of CCR to be included in the consolidated footprint and under the cover system is approximately 3,800,000 cubic yards.

6. Largest Area Requiring Final Cover– § 257.102(b)(1)(v) and r. 335-13-15-.07(3)(b)1.(v)

The Gorgas Bottom Ash Landfill covers about 56 acres. The footprint will be consolidated, and the final cover system will be applied to the consolidated footprint of 27 acres.

7. Schedule for Completing Closure Activities – § 257.102(b)(1)(vi) and r. 335-13-15-.07(3)(b)1.(vi)

Notification of intent to initiate closure was placed in the Plant Gorgas Operating Record on April 15, 2019. A Contractor has been selected for the closure project and has mobilized to the site to begin preparation for closure. Their initial activities have included installation of erosion and sediment control structures, followed by clearing and grubbing. Initial excavation of CCR from the footprint of the new detention pond has also begun, with the excavated ash moved to the consolidated footprint. Closure construction is expected to be complete by November 2020. A detailed construction schedule is attached to this Amended Closure Plan.

8. Certification of Closure

In accordance with § 257.102(h) and r. 335-13-15-.07(3)(h), a notification of completion of closure will be prepared and placed in the Plant Gorgas Operating Record. The notification of completion of closure will include a certification by a qualified professional engineer licensed in the State of Alabama in accordance with § 257.102(f)(3) and r. 335-13-15-.07(3)(f)3. verifying that closure has been completed in accordance with the closure plan required by § 257.102(b) and r. 33-13-15-.07(3)(b).

APC will also submit confirmation that a notation on the property deed has been recorded in accordance with r. 335-13-15-.07(3)(h)(i).

9. Directional Informational Signs

Upon completion of closure, signs will be posted at the entrance to the facility notifying users that the landfill is closed. Contact information will be provided on the sign.

10. Vegetative Plan

The upper 6-in vegetative layer of the designed cover system is designed to promote vegetative growth while limiting erosion from wind and water. To promote the growth of vegetation, the vegetative layer of the cover system will be seeded and amended, as needed, with lime, fertilizer or similar products after installation. Details regarding the vegetative plan are shown on the closure design drawings.

Prior to the establishment of permanent vegetation, temporary stabilization measures will be incorporated as needed to limit erosion during closure construction completion.

11. Site Equipment Needed

The Contractor selected to perform closure construction will be responsible for all equipment needed during the construction period. For post-closure care, Alabama Power will provide all necessary company owned, leased or contracted equipment needed to perform maintenance and any necessary repairs.

12. Sediment Removal

On a periodic basis, accumulated sediment will be removed when necessary from drop inlets, drainage pipes, diversion ditches and other drainage structures.

13. Erosion and Sediment Control

Erosion and sediment control structures are included in the closure design structures and will be installed as a part of closure construction. Temporary erosion and sediment control and other BMP measures will be installed and maintained until construction is complete and permanent vegetation is established.

14. Cost of Closure

Through coordination with the engineering design team and the subcontractor selected to execute the closure activities, the estimated cost of closing Plant Gorgas's Bottom Ash Landfill is approximately $27.6 million. The estimate is considered to be at control level with a high level of project definition. However, due to the complexity, quantities, and duration of the overall project, some variability in costs is expected. Additional expenses of post closure care, maintenance, and corrective action are currently estimated at $6.6 million. Fully detailed long-term maintenance and corrective action strategies have not yet been determined which will have the potential to influence current estimates.

15. Closure Schedule

A construction schedule is attached to this Amended Closure Plan as Table 1.

16. Recordkeeping/Notification/Internet Requirements

As outlined in § 257.105 and r. 335-13-15-.08(1), each Owner or Operator of a CCR unit subject to the Department regulations must maintain files of certain information in an operating record at the facility. Each file is to be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record or study. Electronic storage of the records is acceptable. These records are to be made available to the Department upon request.

Certain notifications are to be made in accordance with the requirements of § 257.106 and r. 335-13-15-.08(2). In many instances, such notifications are to be placed in the facility's Operating Record. In certain instances, further notifications are to be made to the Department Directory within 30 days of placement of a notification into the Operating Records. Furthermore, a publicly accessible internet site must be established for posting of certain notifications and compliance information within 30 days of it being placed in the Operating Record.

Alabama Power and Plant Gorgas maintain an electronic Operating Record for the facility. In addition, a publicly accessible internet site has already been established for compliance with EPA's CCR Rule. Required notifications and compliance data, as outlined in § 257.105 through § 257.107 and r. 335-13-15-.08 and as applicable to the Plant Gorgas Bottom Ash Landfill, will be maintained in the electronic Operating Record, and as required, made available on the publicly accessible internet site within 30 days of placement in the Operating Record. Furthermore, required notifications will be made to the Department Director within 30 days of placement in the Operating Record.

Certain plans and assessments are required to be updated at specified intervals and/or upon modification of certain components of the facility. If and when applicable, updates will be made to the respective plans and assessments, and notifications placed in the Operating Record, posted to the publicly accessible internet site, and communicated in writing to the Department Director in accordance with the Department rules.

17. Written Post-Closure Plan

40 CFR § 257.104 and ADEM Administrative Code r. 335-13-15-.07(5) require the owner or operator of an existing CCR landfill that is closed in place to provide for post-closure care of the unit for a period of at least 30 years. Post-closure care includes maintenance of the facility, as well as groundwater monitoring in accordance with § 257.90 through § 257.98 and r. 335-13-15-.06(1) through r. 335-13-15-.06(9).

The Plant Gorgas Bottom Ash Landfill is currently expected to be closed in place under the performance standards outlined in § 257.102(d) and r. 335-13-15-.07(3)(d). Following closure, maintenance will be provided on the final cover system for the required post-closure care period so that the integrity and effectiveness of the final cover system will be maintained. Maintenance activities will include, as needed, repairs to the final cover to correct any effects related to settlement, subsidence, erosion or other events, and will be performed to prevent run-on or run-off from eroding or otherwise damaging the final cover. Maintenance tasks could include, but not be limited to, repair of erosion features, replacement of eroded cover soils and re-establishment of vegetation, where applicable. Maintenance will be performed on a semi-annual schedule, or more frequently if needed.

The groundwater monitoring system will be maintained throughout the required post-closure care period. Groundwater monitoring will be performed on a semiannual basis during the required post-closure care period as well.

The following office(s) can be contacted about the facility during the post-closure care period.

Gorgas Steam Plant
Compliance and Support Manager
460 Gorgas Road, Parrish, AL 35580-5715
1-205-686-2103
G2CCRPostGOR@southernco.com

At the present time, there is no planned use of the facility after closure. If current plans change, they will be noted in an amendment to the post-closure care plan. Any future use of the property after closure will not disturb the integrity of the final cover, liner or any other component of the containment system. Furthermore, the functionality of the groundwater monitoring system will be maintained.

No later than 60 days following completion of the post-closure care period of 30 years, Alabama Power Company will prepare a notification verifying completion of the post-closure care.

Table 1: Gorgas Bottom Ash Landfill Closure Milestones Schedule (335-13-15-.07(3)(b)1.(vi))

Closure Activity	Completion Date
Notice of Intent to Close	October 2016
Cease Receipt of Waste Streams/Initiate Construction Activities	April 2019
Initiate Free Water Dewatering Activities	n/a
Begin CCR Consolidation and Stabilization	May 2019
Begin Final Cover Cap Construction Activities	September 2019
End Final Cap Construction Activities	August 2020
Project Completion	December 2020

SOUTHERN COMPANY GENERATION
ENGINEERING AND CONSTRUCTION SERVICES

TECHNICAL SPECIFICATIONS
SECTION 31 21 00

FOR

EARTHWORK AND FINAL COVER INSTALLATION FOR CLOSURE OF BOTTOM ASH STORAGE AREA

FOR

PLANT GORGAS

ALABAMA POWER COMPANY

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TECHNICAL SPECIFICATIONS
EARTHWORK AND FINAL COVER INSTALLATION
FOR
CLOSURE OF BOTTOM ASH STORAGE AREA

1.0 GENERAL

1.1 These technical specifications will pertain to the closure of the Bottom Ash Storage Area located at Plant Gorgas near Parrish, Walker County, Alabama. The storage area will be closed under the applicable requirements of ADEM Admin. Code 335-13-15, known hereafter as the "ADEM Solid Waste Regulations."

1.1 These Specifications, and all related attachments and associated documents, cover the furnishing of all materials (unless otherwise noted), labor, and supervision required for the closure of the storage area, including installation of a final cover system for the storage area as described herein and presented on the Closure Drawings, and the technical and construction requirements, including notes, specifications, and design data contained in the Drawings. The Drawings and Notes are an integral part of these Specifications.

1.2 The following terms shall apply to these Technical Specifications ("Specifications"):

a) The term "Purchaser" means Alabama Power Company (APC).

b) The term "Contractor" means the entity awarded the contract to furnish the materials and perform the work as described herein, and to construct the final cover system as specified in the contract documents.

c) The term "Construction Site Manager" (CSM) means the on-site manager of the project or his designated representative. He is the authorized representative at the site for the Purchaser.

d) The term "Purchaser's Representative" means the representative designated by the CSM to perform certain activities under these Specifications.

e) The terms "Accepted, Acceptable, or Approved" denotes that of which must be acceptable, accepted or approved by the CSM or his authorized representative.

f) The terms "CQC Firm", "CQC Inspector", and "CQC Professional Engineer" refer to the Contractor's third-party firm responsible for construction quality control monitoring, testing and documentation for all work performed during the construction of the facility.

1.3 Any discrepancies between the Drawings noted in Section 3.1 and the provisions of the Specifications shall be brought to the attention of the Purchaser for resolution before the performance of the work. In the case of discrepancies between the scale dimensions on the Drawings and the written dimensions, the written dimensions shall govern.

1.4 The Contractor shall ensure that all work is performed in accordance with the Occupational Safety and Health Act of 1970 and other standards and codes listed herein (latest revision).

1.5 As necessary, the Purchaser will file for a National Pollutant Discharge Elimination System (NPDES) Construction General Permit for storm water discharge under ALR100000 (discharges from construction activities that result in a total land disturbance of one acre or greater and sites less than one acre but are part of a common plan of development or sale) from the Alabama Department of Environmental Management (ADEM). The Contractor shall be responsible for obtaining any other necessary permits for conducting the work covered by these Specifications.

1.4 All land disturbing activities shall be consistent with the minimum standards in the *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas,* latest revision.

1.5 Installation and maintenance of erosion and sediment control measures (e.g. "BMPs") and monitoring of surface waters during construction, if required, shall be performed by the Contractor in accordance with the NPDES Construction General Permit (Permit Number ALR100000) and the Construction Best Management Practices Plan (CBMPP), respectively.

1.6 The Contractor shall provide methods, means, and facilities to prevent contamination of the soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by the construction activities. Toxic liquids, chemicals, fuels, and lubricants shall be deposited into containers for subsequent removal offsite in accordance with all applicable federal, state, and local codes and standards.

1.7 The Contractor shall furnish and keep in good working condition at all times sufficient equipment of the proper design and capacity to do all work described under these Specifications and in accordance with the established schedule. The Purchaser's acceptance of the Contractor's list of equipment shall not be construed to mean that the listed equipment is adequate or sufficient to perform the work or that additional equipment shall not be required to maintain the schedule or perform the work specified herein.

1.8 The Contractor shall furnish appropriate equipment for minimizing fugitive dust. The Contractor shall continually take steps necessary to minimize dust created by all equipment, vehicles, work activities, or storage areas. These steps shall include, but not be limited to, watering roads and work areas. Open-bodied trucks handling sand, stone, gravel, or earth shall be covered if the truck is traveling off site. The Contractor shall not deposit dirt, mud, or debris on public roads, plant roads, or adjacent properties.

1.9 The Contractor is responsible for the unloading, handling, and storage of all materials supplied by him and shall ensure that all materials are handled and stored so as to prevent any damage. Materials damaged during handling, shipping, or storage shall be replaced at no cost to the Purchaser. The Contractor shall store materials only in areas as directed by the Purchaser. Any security measures taken for the protection of the Contractor's equipment shall be at the Contractor's expense.

1.10 Construction activities, except as shown on the Drawings, will not be performed within the areas designated as the Buffer Zone. This Buffer Zone is indicated on the Drawings. The Buffer Zone will be flagged and marked by the Contractor prior to construction.

1.11 The Contractor shall have the responsibility for obtaining third party QC testing for all work performed during the construction of the facility.

1.12 All earthwork, including ramps and access roads, done for the convenience of the Contractor, shall be done at his expense unless instructed to be completed by the purchaser. Such work will be restored to its original elevation at the Contractor's expense if the Purchaser so desires.

1.13 The Contractor shall install, at his expense unless expected to be completed by the purchaser, any drainage piping required because of the Contractor's mode of operation including ramps and roads.

1.14 Plant Gorgas is an active power generation site. The Contractor and the PCM, or his representative, shall mutually determine a designated path for vehicles that are used by the Contractor or that haul material to and within the site for the Contractor. The Contractor's vehicles outside the designated traffic path must not obstruct or hinder traffic flow on the site. The Contractor shall provide traffic control during roadway related construction activities and material deliveries. This shall be coordinated with other activities ongoing at the plant. If within active and congested areas around the plant, traffic control shall include flag persons, barriers, and other control aids to provide for the safe routing of traffic in the affected area.

1.15 At all times, the Contractor shall provide protection to prevent damage to existing facilities, roads, underground pipes, and other Purchaser's equipment and property that may be on site. The Contractor will be liable for any damages to APC property caused by the Contractor.

1.16 The Purchaser shall have the right to inspect the Contractor's work as deemed necessary. The Purchaser shall have the right to inspect the Contractor's work locations, to inspect the materials in use, to meet and discuss with the Contractor the progress of the work and the manner in which it is being done. The Purchaser shall have the authority to reject materials or suspend any work not performed in accordance with these Specifications. The Contractor shall be responsible for performing the work in strict accordance with these Specifications, and the presence of the Purchaser's Representative shall not relieve the Contractor and his subcontractors of that responsibility.

1.17 Piezometers and Groundwater Monitoring Wells located in the site area shall not be damaged or destroyed by construction activities. The Contractor shall provide Purchaser approved measures to protect the piezometers and wells in the site area. Any monitoring well(s) damaged or destroyed by the Contractor and/or his activities shall be replaced at no cost to the Purchaser.

1.18 Priority pollutant testing shall be performed of any off-site borrow materials or topsoil material. The Contractor shall provide the Purchaser notice at least three weeks before hauling begins so that the Purchaser can schedule a time for collecting soil samples for chemical analyses. No off-site borrow material may be brought onto the site until the Purchaser has reviewed the analytical results and approved the borrow source.

2.0 COVER SYSTEM AND CERTIFICATION

2.1 Cover System

Closure of the Bottom Ash Storage Area shall be accomplished by the installation of a final cover system designed to minimize infiltration and erosion. The cover system will be a composite system consisting of a 60-mil high density polyethylene (HDPE) textured geomembrane overlain by a geocomposite drainage material, a minimum 18 inches of protective cover soil, and a minimum 6 inches of topsoil.

2.2 Certification

The installation of the final cover system for the Storage Area shall be certified as being constructed in accordance with the applicable ADEM Solid Waste Regulations. This certification shall be performed by a professional engineer registered to practice in the State of Alabama and placed in the Bottom Ash Storage Area operating record within 60 days of the completion of all construction activities. This Certification will be provided by the Purchaser or the Purchaser's Representative.

3.0 APPLICABLE DOCUMENTS

3.1 Drawings

The Drawing List is contained on the Drawings.

3.2 Codes and Standards

The following Codes, Standards, Specifications, Publications, and/or Regulations shall be made part of these Specifications and will become part of the contract entered into for performance of the work covered herein. The latest edition in effect at the time of the contract shall apply. Other codes and standards shall be incorporated as referenced in this document. The omission of any Codes and/or Standards from this list does not relieve the Contractor of his responsibility to follow the latest revision of all applicable codes and standards for conducting the work.

If codes or standards are found to conflict with each other, it should be brought to the attention of the Purchaser to determine which is most applicable.

<u>Occupational Safety and Health Administration</u>

- Occupational Safety and Health Act of 1970

<u>ASTM International (ASTM)</u>

- ASTM C 117 - Standard Test Method for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C 136 – Standard Test Method for Sieve Analysis of fine and Coarse Aggregates
- ASTM D 422 – Standard Test Method for Particle-Size Analysis of Soils
- ASTM D 698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-

m/m^3))

- ASTM D 792 – Standard Test Methods for Density and Specific Gravity (relative density) and Density of Plastics by Displacement
- ASTM D 1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
- ASTM D 1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- ASTM D 1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique
- ASTM D 1603 - Standard Test Method for Carbon Black in Olefin Plastics
- ASTM D 1556 – Standard Test Method for Density and Unit Weight of Soil In - Place by the Sand Cone Method
- ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m^3))
- ASTM D 1587 - Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
- ASTM D 2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D 2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
- ASTM D 2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D 2488 - Description and Identification of Soils (Visual-Manual Procedure)
- ASTM D 2937 - Standard Test Method for Density of Soil In Place by the Drive Cylinder Method
- ASTM D 3017 – Standard Test Method for Water Content of Soil and Rock In Place Nuclear Methods (Shallow Depth)
- ASTM D 3895 - Standard Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry
- ASTM D 4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

- ASTM D 4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
- ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- ASTM D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
- ASTM D 4716 - Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
- ASTM D 4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile
- ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
- ASTM D 4959 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method
- ASTM D 5035 - Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
- ASTM D 5084 - Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
- ASTM D 5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- ASTM D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles
- ASTM D 5321 - Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
- ASTM D 5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- ASTM D 5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

- ASTM D 5721 - Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
- ASTM D 5885 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
- ASTM D 5994 - Standard Test Method for Measuring Core Thickness of Textured Geomembranes
- ASTM D 6392 – Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- ASTM D 6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- ASTM D 6938 Rev B - Standard Test Method for In-Place Density and Water Content of Soil and Soil – Aggregate In Place by Nuclear Methods (Shallow Depth)
- ASTM D 7005 - Determining the Bond Strength (Ply Adhesion) of Geocomposites
- ASTM D1204 -Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
- ASTM D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- ASTM D1907 - Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method
- ASTM D2256 -Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method
- ASTM D3218 -Standard Specification for Polyolefin Monofilaments
- ASTM D5323 – Standard Test Method for Determination of 2% Secant Modulus for Polyethylene Geomembranes
- ASTM D5617 – Standard Test Method for Multi-Axial Tension Test for Geosynthetics
- ASTM D6913 -Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- ASTM D7007 – Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials

Geosynthetic Research Institute GRI Standards

- GM 10 - The Stress Crack Resistance of HDPE Geomembrane Sheet
- GM 11 - Accelerated Weathering of Geomembranes using a Fluorescent UVA Device
- GM 12 - Asperity Measurement of Textured Geomembranes Using a Depth Gage
- GM 13 - Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Geomembranes
- GM 19 – Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes
- GRI-GM17 – Test Methods, Test Properties, and Testing Frequency and for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

United States Environmental Protection Guidance

- Environmental Protection Agency (EPA) regulations
- EPA/600/R-93/182, September 1993, 305 pgs.
- U. S. Environmental Protection Agency Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities"

Corps of Engineers EM-LST, Appendix VII, Falling-Head Permeability Test

Alabama Department of Environmental Management (ADEM) regulations

Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas

4.0 SITE CONDITIONS

4.1 The Contractor shall visit the site and acquaint himself with site conditions, utility locations, and the proposed scope of work.

4.2 The Contractor is responsible for acquiring and maintaining a dig permit per Alabama state law.

4.3 Vibratory equipment shall have vibratory devices mechanically disengaged and rendered inoperable while operating on dikes or the Bottom Ash Storage Area.

5.0 THIRD PARTY QUALITY CONTROL

5.1 The Contractor shall provide to the Purchaser, for the Purchaser’s acceptance and approval, the following documentation indicating that the Contractor’s Third Party Quality Control firm and personnel that will participate on this Project meets the minimum experience and qualifications indicated herein.

5.2 The Contractor shall provide to the Purchaser the qualifications of a third-party CQC Inspector for construction quality control (CQC) for the placement and compaction of the compacted structural fill.

5.3 The Contractor shall provide to the Purchaser the qualifications of a third-party CQC Inspector for construction quality control (CQC) of the ClosureTurf™ Final Cover System installation documenting the minimum requirements of Section 11.3.5 of these Specifications.

5.4 The Contractor shall provide to the Purchaser a statement of qualifications of a third-party CQC Inspector for construction quality control (CQC) of the geomembrane liner and drainage geocomposite installation documenting the minimum requirements of Section 11.3.3 of these Specifications.

5.5 The Contractor shall provide to the Purchaser the qualifications of the third party's soil testing laboratory contracted to perform the CQC testing for the structural earth fill.

6.0 LINES AND GRADES

The project shall be constructed to the elevations, lines, grades and cross sections shown on applicable Drawings. The Purchaser reserves the right to increase the foundation widths, change the embankment slopes, and to make such other changes in the embankment sections as conditions indicate are necessary for the construction of a safe and permanent structure. The Contractor shall be compensated for the changes in plan and/or sections resulting in changes in quantities of materials.

7.0 CLEAR, GRUBBING, AND STRIPPING

7.1 Prior to any clearing or grubbing operations, initial BMPs shall be installed. Erosion control measures and best management practices shown on the construction drawings shall be followed.

7.2 The footprint of the Bottom Ash Storage Area shall be cleared of any woody vegetation prior to excavation and/or fill operations. Grassy vegetation and grass mats are not required to be removed.

7.3 Trees, stumps, and brush cleared from the above areas shall be disposed of outside the closure areas by mulching or burning, if allowed by Purchaser. Mulch may be used as a temporary perimeter BMP, but shall ultimately be disposed of off-site.

7.4 Spoil material shall be disposed of outside the closure areas only in areas to be designated by the Purchaser. The Contractor shall slope the spoil area for drainage and provide silt fences and a perennial stand of vegetation.

7.5 Bottom ash laden roots on grubbed and stripped material may be cleaned as much as practical by screening and washing processes, or other approved methods, prior to leaving the site for disposal. Usable material, as approved by the Purchaser, may be stockpiled for future use at Purchaser designated locations.

7.6 Adequate erosion control measures shall be installed around the spoil and stockpile areas in accordance with details shown on the construction drawings.

7.7 Burning of brush and debris will not be allowed.

8.0 FOUNDATION AND SUBGRADE PREPARATION

8.1 Areas to Receive Fill

8.1.1 The Contractor shall prepare, install and maintain erosion and sediment control measures, as required by the construction drawings. If measures beyond those in the construction drawings are deemed necessary, contact the PCM to have those reviewed & approved by the engineer and the construction drawings updated PRIOR to the measures being installed.

8.1.2 Material suitable for topsoil, material to be used for the eighteen (18) inch protective soil layer, and the material to be used as structural earth fill shall be stockpiled separately in a location specified by the Purchaser's Representative.

8.1.3 Proof-roll the entire subgrade utilizing loaded, off-road trucks with a gross machine weight, including payload of 40 tons of soil. Any areas failing proof-roll shall be undercut and replaced with structural soil fill and re-rolled, or modified through the use of bridging layer as described in section 9.0.

8.1.4 Prior to receiving structural earth fill, the foundation areas shall be scarified by harrowing or other suitable means. The moisture content of the roughened surface shall be adjusted to within the limits provided in section 10.1.9. No fill shall be placed on any part of the subgrade until such areas have been conditioned, proof-rolled, inspected, and approved in writing by the Contractor's QC Inspector and the Purchaser.

8.1.5 Work flow shall be planned such that the first embankment fill lift is placed soon after subgrade compaction to minimize subgrade exposure to inclement weather.

8.2 Geomembrane

8.2.1 The Contractor shall maintain the subgrade suitability and integrity until the geomembrane installation is completed and accepted.

8.2.2 The Contractor shall repair rough areas and any damage to the subgrade caused by installation of the geomembrane.

8.2.3 Subgrade shall be smooth, uniform, firm and free from rocks or other debris. For deployment over soil subgrade, no rocks or protrusions greater than 1/2-inch in diameter shall be exposed at the subgrade surface.

8.2.4 The Contractor shall verify that the surface on which the geomembrane will be installed is acceptable. In so doing the Contractor shall assume full liability for the accepted surface.

8.2.5 The Contractor shall submit written certificates of subgrade acceptance, signed by the Contractor, CQC Inspector, and the Purchaser's Representative, for each area prepared for geomembrane placement.

8.2.6 The beginning of installation means acceptance of existing conditions. The Contractor shall be responsible for maintenance of the geomembrane covered subgrade once installation of geomembrane begins.

9.0 BRIDGING LAYER

9.1 Where it can be demonstrated that it is impracticable to proof-roll the subgrade as specified in section 8.1 or achieve the degree of compaction specified in section 10.1, a bridging layer may be placed.

9.2 The bridging layer shall be of sufficient thickness to allow the passage of earthmoving equipment with minimal surface heaving, but no more than four feet in thickness

9.3 The bridging layer shall be end-dumped and spread in a single layer. The compaction requirements of Section 10.1 will not apply to the bridging layer.

9.4 Acceptable materials for the construction of the bridging layer include structural earth fill as defined in Section 10.1, bottom ash fill, sand, and rock fill materials.

9.5 Any bottom ash fill used in the bridging lift must have been excavated from the Bottom Ash Storage Area and not at any point been transported out of the pond.

9.6 Geogrid reinforcement may be used as part of the bridging layer. All geogrid should be placed in accordance with the manufacturer's recommendations.

10.0 STRUCTURAL EARTH FILL AND BOTTOM ASH FILL

10.1 Structural Earth and Bottom Ash Fill

10.1.1 The Contractor shall provide third party CQC testing for all earth work performed for the closure of the Bottom Ash Storage Area.

10.1.2 Compacted earth fill should generally consist of sandy clays (CL), clayey silts (ML), clayey sands (SC), and clayey to silty sands (SC/SM) from a Purchaser approved borrow area.

10.1.3 No earth fill or bottom ash shall be placed on any part of the foundation until such areas have proof-rolled, inspected, and approved in writing by the soils CQC Inspector and the Purchaser's Representative.

10.1.4 Fill materials shall be placed in uniform layers of eight inches, nominal thickness, loose measurement, for one foot beyond the full width of the fill on each side. The thickness of each layer shall be kept uniform with the necessary grading equipment. Upon completion of compaction, the slopes shall be cut back to the final slope. Particular care must be used to obtain the required compaction along the edges of the fill slopes.

10.1.5 If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing, or as directed by the Purchaser's Representative, before the succeeding layer is placed.

10.1.6 During the dumping and spreading processes, the Contractor shall maintain at all times a force of men adequate for removal of roots and debris from all structural earth fill materials and all stones and clay clods greater than three inch maximum. Clay clod size may be reduced in size to meet this Specification by disking, tilling or other means. The distribution of materials throughout the structural fill shall be essentially uniform and free of any lenses, pockets, streaks, or layers of materials differing substantially in texture, moisture content, or gradation from the surrounding material.

10.1.7 The compacted structural fill and bottom ash subgrade beneath the HDPE component of the final cover shall be free of roots, debris, and all stones and clay clods greater than one-half ($^1/_2$) inch maximum. Clay clod size may be reduced in size to meet this Specification by disking, tilling or other means.

10.1.8 Structural earth fill and bottom ash material shall be compacted to a minimum of 95% of the relative maximum dry density as determined by the standard Proctor compaction test (ASTM D 698). The moisture content of the earth fill at the time of placement shall be within -2% and +2% of the optimum moisture obtained by standard Proctor compaction test.

10.1.9 When moisture content is too low, the moisture content shall be adjusted to within the above limits prior to compaction. Moisture adjustment shall be achieved by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and harrowing of the layer shall be done after deposition, but before compaction.

10.1.10 If the moisture content is too high, the Contractor will be permitted to disk in place or stockpile and disk the earth fill material to promote drying to bring it back within the allowable moisture range.

10.1.11 The Contractor will be required to remove any compacted material that does not comply with the compaction requirements and replace the compacted earth fill to comply with this Specification at his own expense.

10.1.12 Structural earth fill or bottom ash which cannot be compacted with roller equipment because of inadequate clearances shall be spread in four-inch layers and compacted with hand-guided power tampers to the extent required by these Specifications. Rocks two inches and greater, in any dimension, roots, and debris shall be removed from the fill and disposed of in an approved manner.

10.1.13 Field density and moisture content tests shall be performed daily in all types of material being placed. At a minimum, one in place density test shall be performed for each lift for each day fill material is placed.

10.1.14 For earth fill and bottom ash material, at least one field moisture content and density test shall be performed for every 1,000 cy of fill (one per acre of lift area) or more often if deemed necessary in the opinion of the Purchaser's Representative.

10.1.15 If an in-place density or moisture test fails to meet the requirements for compaction and/or moisture, the area shall be reworked and then retested. If, however, the second test fails to meet the criteria, the area failing the criteria shall be delineated, and reworked or removed, and then retested. The areas requiring reworking/recompacting shall be noted on record drawings and reported.

10.1.16 In the event of repeated failures, or water content and density test values plotting far from the Proctor curves used for comparison in computing percent compaction, it shall be the option of the Purchaser's Representative, to require one or two-point Proctor checks to verify that the proper Proctor curve is being referenced. If not, a new Proctor curve determined by a five-point test shall be required.

10.1.17 The surveyed location, lift designation, and elevation or depth of the field density and moisture tests (passing, failing, and retests) shall be recorded and noted on the respective test records. The locations of these tests shall be shown on a figure or drawing.

10.1.18 Excavations required for density and moisture tests shall be repaired by scarifying the walls of the excavation, backfilling, and compacting the fill material to the criteria specified above.

10.1.19 If the construction of the embankment is interrupted, the Contractor shall be required to shape and smooth the last layer of earth fill material placed on the fill to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the Contractor shall be required to level, scarify and compact the last layer of earth fill material before placing additional layers.

10.1.20 At least one Proctor compaction check plug shall be produced for each type of soil being placed during the day to ensure that the correct reference Proctor curves are being used for compaction check.

10.1.21 Earth fill areas, ditches, and other disturbed areas outside the cover area shall be grassed upon reaching final grade in accordance with these Specifications, the construction drawings and the Vegetation Schedule shown on the Drawings.

11.0 COMPOSITE COVER SYSTEM

11.1 General

11.1.1 The final bottom ash subgrade of the Bottom Ash Storage Area shall be covered with a 60 mil textured HDPE geomembrane overlain by a double sided geocomposite drainage layer with a minimum 18-inch protective soil cover. An erosion control layer consisting of a minimum of six inches of topsoil that will support vegetative growth shall be placed over the soil cover.

11.1.2 The HDPE and drainage material shall be placed in accordance with these Specifications, the manufacturer's recommendations, and the details indicated on the Drawings.

11.2 Submittals

11.2.1 The Contractor shall provide to the Purchaser the Manufacturer's Quality Control (CQC) Program and Manual, or descriptive documentation for manufacture of the geomembrane and geocomposite from the manufacturer.

11.2.2 The Contractor shall provide to the Purchaser, for review and approval, qualification statements from the geomembrane and geocomposite manufacturer, certified installer, and CQC Inspector documenting the minimum requirements of sections 11.3 and 11.11 of these Specifications.

11.2.3 The Contractor shall provide to Purchaser placement procedures and a panel layout for placement of the geomembrane and geocomposite panels over the area of installation fourteen days prior to the start of liner installation.

11.2.4 Upon each shipment, the Contractor shall furnish the geomembrane and geocomposite manufacturer's Quality Assurance/Quality Control (QA/QC) roll certifications, signed by a responsible party employed by the manufacturer, to verify that the materials supplied for the project are in accordance with the requirements of sections 11.4 and 11.13 this Specification. The certifications shall reference the lot and roll number as well as the manufacturer's name and address.

11.2.5 As installation proceeds, the Contractor shall submit certificates of subgrade acceptance, signed by the Contractor, the CQC Inspector, and the Purchaser's

Representative for each area that is covered by the geomembrane.

11.2.6 After installation, the Contractor shall submit a certification, signed by the Contractor and signed and sealed by the CQC Firm's Professional Engineer, that the geomembrane and geocomposite was placed in accordance with these Specifications.

11.2.7 The Contractor shall provide certification that all resin used in the manufacture of the geocomposite drainage geonet for this job meets the Specifications and provide a copy of the quality control certificates issued by the resin supplier.

11.3 Geomembrane Contractor Qualifications

11.3.1 The manufacturer of the geomembrane (HDPE) must have produced at least ten million square feet of product, with at least eight million square feet installed.

11.3.2 The geomembrane installer must either have installed at least one million square feet of product or must provide to Alabama Power satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the geomembrane will be installed in a competent, professional manner.

11.3.3 The Contractor shall provide, a third-party inspector for construction quality control (CQC) of the geomembrane installation. The inspector shall be an individual or company who is independent from the manufacturer and installer and shall be responsible for monitoring and documenting activities related to the CQA of the geomembrane throughout installation. The inspector shall have provided CQC services for the installation of the proposed or similar products for at least five completed projects totaling not less than one million square feet. The inspector should be an engineer registered to practice in the State of Alabama or a geosynthetics installation technician certified through the Inspector Certification Program (ICP) administered by the Geosynthetics Certification Institute (GCI). The Contractor shall provide the Purchaser with a statement of the inspector's qualifications with the bid.

11.3.4 A Manufacturer's Representative shall be on site during the initial phase of the geomembrane installation to provide assistance to the Contractor.

11.4 Geomembrane Material

11.4.1 The geomembrane shall be a 60 mil textured high density polyethylene (HDPE) with a minimum 23 feet seamless width. There shall be no factory seams. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance.

11.4.2 The geomembrane shall be manufactured of polyethylene resins and shall be compounded and manufactured specifically for the intended purpose. The Contractor shall submit a certification from the manufacturer of the geomembrane that the raw materials meet the physical property requirements indicated in the following table.

11.4.3 The surface of the geomembrane shall not have striations, roughness, pinholes, or bubbles and shall be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter except that, if in the opinion of the Purchaser's Representative, the blemish will not adversely affect properties and use of the liner.

11.4.4 The geomembrane shall be supplied in rolls; folds will not be permitted. Identify each roll with labels indicating lot number, roll number, thickness, length, width, manufacturer, and plant location.

11.4.5 Resin shall be HDPE, new, first quality, compounded and manufactured specifically for producing HDPE geomembrane.

11.4.6 Extrudate Rod or Bead shall be made from same resin as the geomembrane. Additives shall be thoroughly dispersed. The rods or beads shall be free of contamination by moisture or foreign matter.

11.4.7 The materials shall be stored in space allocated by the Purchaser.

11.4.8 The materials shall be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

11.4.9 The materials shall be stored on level prepared surface (not on wooden pallets).

11.4.10 The materials shall be stacked per Manufacturer's recommendation but no more than three rolls high.

11.4.11 Appropriate handling equipment shall be used to load, move or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader and roll bars for deployment. Dragging panels on ground surface will not be permitted.

11.4.12 The Installer is responsible for storage, and transporting material from storage area to installation area.

11.4.13 Damaged geomembrane will be documented by the Purchaser's Representative.

11.4.14 Damaged geomembrane may be repaired, if approved by the Purchaser's Representative, in accordance with these Specifications or shall be replaced at no additional cost to the Owner.

11.4.15 The geomembrane shall have the following properties:

TEXTURED HDPE GEOMEMBRANE - 60 mil			
Property	Frequency	Test Method	Minimum Average Value
Density	Once per 200,000 lbs of resin	ASTM D 792	Max. 0.940 g/cc
Melt Index	Once per 200,000 lbs of resin	ASTM D 1238,190˚C, 2.16kg	≤ 1.0 g/10 min.
Oxidative Induction Time (OIT) Standard OIT Or High Pressure OIT	Once per 200,000 lbs resin	ASTM D 3895 ASTM D 5885	100 min. (min. avg.) 400 min. (min. avg.)
Thickness: Nominal Minimum Average Minimum 8 of 10 Lowest individual	per roll	ASTM D 5994	 60 mil 57 mil 54 mil 51 mil
Asperity Height	Every 2nd Roll	ASTM D 7466 GRI GM12	10 mil
Tensile Properties (avg. both directions) (min. avg) Break Strength Break Elongation	20,000 lbs.	ASTM D 6693, Type IV	 ≥90 lb/in 100 %
Tear Resistance	45,000 lbs	ASTM D 1004	42 lb (min. avg.)
Puncture Resistance	45,000 lbs	ASTM D 4833	90 lb (min. avg.)
Carbon Black Content	20,000 lbs.	ASTM D 4218	2.0 % - 3.0 %
Carbon Black Dispersion[1]	45,000 lbs.	ASTM D 5596	See Note (1)
Oxidative Induction Time (OIT) Standard OIT Or High Pressure	200,000 lbs	 ASTM D 3895 ASTM D 5885	 100 min. (min. avg.) 400 min. (min. avg.)
Oven Aging @ 85° C Standard OIT (min. avg.) – % retained after 90 days High Pressure OIT min. avg.) – % retained after 90 days	Per Each Formulation	ASTM D 5721 ASTM D3895 ASTM D5885	 55% 80%
UV Resistance High Pressure OIT min. avg.) – % retained after 1600 hours	Per Each Formulation	GM11 ASTM D5885	 50%

Notes:
(1) Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than one (1) view from Category 3.

11.5 Equipment

11.5.1 Heavy vehicles shall not be permitted to operate directly on the liner material. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than six (6) psi.
11.5.2 In areas of heavy traffic, the geomembrane shall be protected by placing protective cover, with a minimum thickness of three (3) feet, over the geomembrane.
11.5.3 If the geomembrane is damaged by vehicular traffic, it shall be replaced at the

Contractor's expense.

11.6 Geomembrane Installation

11.6.1 The geomembrane shall be packaged and shipped by appropriate means to ensure that no damage is incurred. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, solvents, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement. Storage stacking of the rolls is allowed following manufacturer's recommendations.

11.6.2 The manufacturer assumes responsibility for initial loading the geomembrane. Off-loading and storage of the materials shall be the responsibility of the Contractor. The Contractor shall be responsible for replacing any damaged or unacceptable material at no cost to the Purchaser. No off-loading shall be done unless monitored by the Purchaser's Representative. Damage occurring during off-loading shall be documented by the Purchaser and the Contractor. The Purchaser shall be the final authority on determination of damage.

11.6.3 The installation of the geomembrane shall be in accordance with the manufacturer's recommendations and these Specifications. The Contractor shall submit a panel layout drawing and a detailed, written installation procedure for the Purchaser's review fourteen days prior to installation.

11.6.4 All seam and non-seam areas of the geomembrane shall be inspected by the CQC Inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

11.6.5 The anchor trench shall be excavated to the lines, grades, and widths shown on the project construction drawings, prior to liner system placement. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the geomembrane.

11.6.6 The Contractor is responsible for ensuring that the geomembrane is handled and installed in such a manner that it is not damaged.

11.6.7 The geomembrane shall not be deployed during precipitation, in the presence of excessive moisture, in areas of ponded water, in the presence of excessive winds, or in excessive heat or cold.

11.6.8 Each panel shall be marked with an "identification code" (number or letter) consistent with the layout plan. The identification code shall be simple and logical. Markings shall not be used that permanently alter the line, such as stampings, weld marks, hydrocarbon marks, etc. The number of panels deployed in one day shall be limited by the number of panels which can be seamed on the same day. All deployed panels shall be seamed to adjacent panels by the end of each day.

11.6.9 The rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the Purchaser's Representative. The equipment shall not damage the geomembrane by handling, trafficking, leakage of hydrocarbons, deployment or other means. The placement shall be observed by the CQC Inspector and the Purchaser's Representative.

11.6.10 The Contractor shall inspect the subgrade preparation prior to liner installation. The subgrade shall be compacted in accordance with the project specifications. Weak or compressible areas which cannot be satisfactorily compacted should be removed and replaced with properly compacted clay liner material. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, stones greater than one-half inch in diameter, or debris of any kind. The subgrade shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. The surface shall contain no rutting, cracks or tire tracks. Standing water or excessive moisture shall not be allowed.

11.6.11 The Contractor, on a daily basis, shall approve the surface on which the geomembrane will be installed. After the supporting soil surface has been approved, it shall be the Contractor's responsibility to indicate to the Purchaser any changes to its condition that may require repair work.

11.6.12 The Contractor shall submit written Certificates of Subgrade Acceptance, signed by the Contractor, CQC Inspector, and Purchaser's Representative, for each area prepared for geomembrane installation. This shall be done prior to commencing work.

11.6.13 Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.

11.6.14 Personnel working on the geomembrane shall not smoke or wear damaging shoes.

11.6.15 The method used to unroll the panels shall not cause scratches, crimps, or creases in the geomembrane.

11.6.16 Unroll panels with the spike down and the stud side up for the structured geomembrane to assure that the deployment method protects the geomembrane from scratches and crimps and protects soil surface.

11.6.17 Unroll panels with adequate tension to prevent undulations or wrinkles when placed on the ground. The spike side down prevents easy movement of the panel. Individual panels placed with more than 5 undulations greater than 2-inches in height shall be deployed again.

11.6.18 Use a method to minimize wrinkles, especially differential wrinkles between adjacent panels.

11.6.19 Place adequate hold-downs to prevent uplift by wind. Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

11.6.20 Protect geomembrane in heavy traffic areas by geotextile, extra geomembrane or other suitable materials.

11.6.21 Do not allow vehicular traffic on unprotected geomembrane surface.

11.6.22 Panels deployed on grades steeper than 12% shall extend a minimum of 3 feet beyond the crest or toe of that grade with no cross seams.

11.6.23 Visually inspect sheet surface during unrolling of geomembrane and mark faulty or suspect areas for repair or test. Replace faulty (requires more than one patch per 200 square feet) geomembrane stock at no additional cost to the Owner.

11.6.24 Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F measured 6 inches above the membrane surface. Placement can proceed below 32° F only after it has been verified by the CQC Inspector that the material can be seamed according to the Specification. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the installation supervisor.

11.6.25 After panel deployment and before welding, any horizontal wrinkles must be walked down or wiggled down the slope to minimize wrinkles after welding.

11.6.26 Limit maximum wrinkle height to 4 inches during warmer ambient temperatures and 2 to 3 inches in cooler temperatures.

11.6.27 Geomembrane wrinkles shall not be folded over.

11.6.28 After each panel welding, the sheet should be hand pulled in order to avoid the formation of ridging along the seams (snapping).

11.6.29 Physically remove wrinkles by walking them or by pretension pulling on the sheet after welding each panel.

11.7 Geomembrane Field Seaming

11.7.1 Field seams shall be made in accordance with the manufacturer's recommendations. The Contractor shall submit a copy of the proposed seaming procedures (both fusion and extrusion welding, including preparation procedures), prior to commencement of seaming, for the Purchaser's review and approval.

11.7.2 Remove studs and spikes from the structured geomembrane at butt weld locations. During the stud/spike removal operation, do not reduce the thickness of the barrier section of the geomembrane to less than the minimum thickness listed in section 12.4.

11.7.3 The only approved seaming processes are fusion and extrusion welding. On side slopes, seams shall be oriented in the general direction of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized. Cross seams will be allowed on slopes provided that cross seams are cut at 45º and adjacent cross seams are staggered. Cross seams shall be kept to the lower half of the slope. No more than one cross seam will be allowed per panel slope length.

11.7.4 No seam of any kind shall be closer than five feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a fishmouth or wrinkle is found, it shall be relieved and cap-stripped.

11.7.5 Geomembrane panels must have a finished minimum overlap of four inches for fusion welding and six inches for extrusion welding.

11.7.6 Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

11.7.7 Generators used to power welding/grinding apparatus shall be placed on a rub sheet and/or on a HDPE tub to prevent damages caused by vibrations/equipment leaks and to protect the liner during refueling of these generators.

11.7.8 The Installer shall non-destructively test all field seams over their full length using either Vacuum Box Testing for extrusion welds or Air Pressure Testing for double fusion seams.

11.8 Geomembrane Field Trial Seams

11.8.1 Field trial seams shall be made in accordance with the manufacturer's recommendations and these Specifications. The Contractor shall submit a copy of the proposed testing procedures for the Purchaser's review and approval.

11.8.2 Field trial seams shall be conducted, per seaming apparatus and per seamer, on the liner to verify that seaming conditions are satisfactory. Trial seams shall be conducted at the beginning of each seaming period, at least once every four hours for each seaming apparatus and personnel used that day. Additional field trial seams may be requested by and at the discretion of the Purchaser's Representative.

11.8.3 All trial seams shall be made in contact with the subgrade. Welding rod used for extrusion welding shall have the same properties as the resin used to manufacture the geomembrane.

11.8.4 Field trial seaming shall be conducted under the same ambient temperature and preheating conditions as the production seams.

11.8.5 Field trial seams shall be destructively tested in accordance with section 12.9.

11.9 Geomembrane Destructive Seam Testing for Fusion and Extrusion Seaming

11.9.1 Destructive seam testing should be minimized to preserve the integrity of the liner. The Contractor shall take one (1) destructive test sample once per 500 cumulative feet of seam length, per fusion welding device, from a location specified by the CQC Inspector. This frequency applies to extrusion seams as well. If the amount of extrusion seaming is < 500 feet then a minimum of one (1) extrusion destructive test shall be performed.

11.9.2 In order to obtain test results prior to completion of liner installation, samples shall be cut by the Installer as the seaming progresses. The Installer shall also record the date, location, and pass or fail description. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately patched and vacuum tested.

11.9.3 The samples shall be a minimum of 12 inches wide by 36 inches long with the seam centered lengthwise. The sample shall be cut into three equal-length pieces, one to be given to the Installer, one to be given to the Contractor's CQC Inspector, and one to the Purchaser.

11.9.4 The Installer shall test ten one-inch wide specimens from his sample; five specimens for shear strength and five for peel strength. The CQC Inspector shall submit samples to an independent laboratory for confirmation testing. Seam test results shall be evaluated using the current GRI Test Method GM19 which allows for four of five specimens meeting the required seam strength and the fifth specimen meeting 80% of the required strength. Additionally, peel separation shall not exceed 25%.

11.9.5 Seams shall be tested according to the following methodology:

Property	**Test Method**	**Minimum Average Value**
Seam Properties 1. Shear Strength 2. Peel Strength	ASTM D 6392 GM19	120 lb/in

• Hot Wedge • Extrusion Fillet		91 lb/in 78 lb/in

11.9.6 The Purchaser, at his discretion and expense, may send seam samples to a laboratory for testing. The test method and procedures to be used by the independent laboratory shall be the same as used in field testing.

11.9.7 The following procedures shall apply whenever a sample fails the field destructive test:

a) The installer shall cap strip the seam between the failed location and any passed test locations.

b) The installer shall retrace the welding path to a location (initially a minimum of 10 feet on each side of the failed seam location) to identify and isolate the failed seam in both previous and next direction of failed destructive, by taking two new samples, one from each direction. If these tests pass, then the seam shall be cap stripped between the passing tests. If the test fails, then the process is repeated.

c) Over the length of seam failure, the installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip.

d) All seams and non-seam areas of the geomembrane shall be inspected by the inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

e) Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the inspector. Each location that fails the non-destructive testing shall be marked by the inspector and repaired accordingly.

11.10 Geomembrane Repair Procedures

11.10.1 The geomembrane will be inspected before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be swept or washed by the Installer if surface contamination inhibits inspection. The Installer shall ensure that an inspection of the geomembrane precedes any seaming of that section.

11.10.2 Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

11.10.3 Repair, removal and replacement shall be at the Installers expense if the damage results from the Installer's activities.

11.10.4 Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. The Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the Purchaser's Representative and the Installer.

11.10.5 The following repair procedures shall apply:

a) Defective seams shall be cap stripped or replaced.
b) All holes of any size shall be patched.
c) Tears shall be repaired by patching. If the tear is on a slope or an area susceptible to stress and has a sharp end it must be rounded prior to patching.
d) Blisters, large cuts and undispersed raw materials shall be repaired by patches.
e) Patches shall be completed by extrusion welding. The weld area shall be ground no more than 10 minutes prior to welding. No more than 10% of the thickness shall be removed by grinding. Welding shall commence where the grinding started and must overlap the previous seam by at least two inches. Reseaming over an existing seam without regrinding shall not be permitted. The welding shall restart by grinding the existing seam and rewelding a new seam.
f) Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of six (6) inches beyond the edge of defects.
g) All T's and intersections shall be patched. Welding the excess overlap is not permitted.
h) Geomembrane surfaces to be repaired shall be abraded (extrusion welds only) no more than 1/2 hour prior to the repair.
i) All geomembrane surfaces shall be clean and dry at the time of repair.
j) The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the Owner's Representative.
k) Extend patches or caps at least 6 inches beyond the edge of the defect, i.e., be a minimum of 12 inches in diameter, and round all corners of material to be patched.
l) Bevel the edge of the patch and do not cut patch with repair sheet in contact with geomembrane. Temporarily bond the patch to the geomembrane with an approved method, extrusion weld the patch and then vacuum test the repair.

11.11 Verification of Repairs

11.11.1 Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.

11.11.2 The inspector shall keep daily documentation of all non-destructive and destructive testing. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested. (i.e., Test 1 followed by Test 1R1).

11.12 Geocomposite Contractor Qualifications

11.12.1 The drainage material manufacturer shall have successfully manufactured five (5) million square feet of polyethylene drainage material.

11.12.2 Installation of the drainage material shall be performed by the manufacturer or be a manufacturer-approved dealer/installer. The drainage material installer must either have installed at least one (1) million square feet of product, or must provide to the

Purchaser satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the respective geosynthetic will be installed in a competent, professional manner.

11.12.3 The installation supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the contract documents.

11.12.4 The Contractor shall provide a third-party inspector for CQC of the geocomposite installation. The inspector shall be an individual or company who is independent from the manufacturer and installer and shall be responsible for monitoring and documenting activities related to the CQC of the geocomposite throughout installation. The inspector who is on site monitoring the installation activities every day that they are taking place, shall have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The inspector should be an engineer registered to practice in the State of Georgia or a geosynthetics installation technician certified through the Inspector Certification Program (ICP) administered by the Geosynthetics Certification Institute (GCI). The Contractor shall provide the Purchaser with a statement of the inspector's qualifications prior to starting installation of the geocomposite.

11.12.5 A Manufacturer's Representative may be on site during the initial phase of the geocomposite installation to provide assistance to the Contractor.

11.13 Geocomposite Labeling, Delivery, Storage, and Handling Requirements

11.13.1 Each roll of material delivered to the site shall be wrapped and labeled by the manufacturer. The label shall contain the following information:

a) manufacturer's name
b) product identification
c) length and width
d) roll number

11.13.2 The material shall be stored as specified by the manufacturer in an area specified by the Purchaser. The storage will be free of materials capable of damaging the material.

11.13.3 Unloading of the drainage material from the delivery trucks will be performed by the Contractor. Unloading of the materials will be performed as directed by the manufacturer.

11.13.4 The rolls must be adequate for safe transportation to the point of delivery, offloading and storage. Storage measures will be taken as specifically stated by the manufacturer.

11.14 Geocomposite Material Properties

11.14.1 The geocomposite shall consist of one (1) layer of HDPE drainage net (geonet) connected between two (2) layers of non-woven geotextile to create a double-sided geocomposite.

11.14.2 The drainage net shall be manufactured of new first quality polyethylene resin and shall be compounded and manufactured specifically for the intended application.

11.14.3 The Contractor shall provide written certification from the manufacturer that all resin used in the manufacture of the drainage net for this job meets the Specifications which shall include a copy of the quality control certificates issued by the resin supplier.

11.14.4 The Contractor shall provide written certification from the manufacturer that the material was manufactured in accordance with this Specification, together with a report of test results, prior to material shipment.

11.14.5 The minimum average properties of the geocomposite shall be as follows:

DOUBLE-SIDED DRAINAGE GEOCOMPOSITE				
Tested Property	**Test Method**	**Frequency**	**Value(1)**	**Units**
Geonet Core (2)				
Raw Materials: Density Melt Index	 ASTM D792, B ASTM D1505 ASTM D1238	 Per lot Per lot	 0.94 ≤ 1.0	 g/cc g/ 10 min.
Thickness	ASTM D 5199	1/50,000 ft^2	300	mil
Density	ASTM D 1505	1/50,000 ft^2	0.94	g/cc
Carbon Black Content	ASTM D 4218	1/50,000 ft^2	2.0 – 3.0	%
Tensile Strength	ASTM D 5035	1/50,000 ft^2	75	lbs/inch
Transmissivity(3)	ASTM D 4716	1/50,000 ft^2	8×10^{-3}	m^2/sec
Geotextile (prior to lamination)4				
Mass per Unit Area	ASTM D 5261	1/100,000 ft^2	6.0	oz/yd^2
Grab Tensile	ASTM D 4632	1/100,000 ft^2	160	lbs
Flow Rate	ASTM D 4491	1/100,000 ft^2	110	gpm/ ft^2
Puncture Strength	ASTM D 4833	1/100,000 ft^2	95	lbs
Permittivity	ASTM D 4491	1/100,000 ft^2	1.5	Sec^{-1}
AOS	ASTM D 4751	1/100,000 ft^2	70 sieve	US Sieve
UV Resistance	ASTM D 4355	once per formulation	70	% retained
Geocomposite				
Transmissivity(3)	ASTM D 4716	1/500,000 ft^2	9×10^{-4}	m^2/sec
Peel Adhesion	ASTM D 7005	1/50,000 ft^2	1.0	lbs/in

Notes

1. These are minimum average roll values (MARV values) and are based on the cumulative results of specimens tested. AOS in mm units is a maximum average roll value.
2. Component properties prior to lamination.
3. Gradient of 0.1, normal load of 10,000 psf, water at 70° F, between stainless steel plates for 15 minutes
4. Refer to geotextile product data sheet for additional specifications.

11.15 Geocomposite Placement

11.15.1 The geocomposite roll shall be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the Purchaser's Representative.

11.15.2 In the presence of wind, all geocomposites shall be weighted down with sandbags or the equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.

11.15.3 Each component of the geocomposite will be secured or seamed to the like component at overlaps. Adjacent edges of the geonet along the length of the roll shall be placed with the edges of each geonet butted against each other. The overlaps shall be joined by tying the geonet structure with plastic cable ties spaced every five (5) feet along the roll length, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

11.15.4 Adjoining geocomposite rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite a minimum of twelve (12) inches across the roll width. The overlaps shall be joined by tying the geonet structure with plastic cable ties spaced every twelve (12) inches along the roll width, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

11.15.5 The geonet portion shall be tied every six (6) inches in the anchor trench, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

11.15.6 Prior to covering the deployed geocomposite, each roll shall be inspected for damage resulting from construction.

11.15.7 Any rips, tears or damaged areas on the deployed geocomposite shall be removed and patched. The patch shall be secured to the original geonet by tying every six (6) inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be joined in accordance with sections 11.14.3 and 11.14.4 above.

11.15.8 All geocomposite geotextile overlaps shall be sewn at the seams.

11.16 Anchor Trenches

11.16.1 As directed by the project Drawings and Specifications, the end of the geomembrane and geocomposite rolls shall be placed in an anchor trench. The front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench.

11.16.2 The geomembrane and geocomposite should cover the entire trench floor.

11.16.3 The anchor trench shall be backfilled by the earthwork contractor. Trench backfill material shall be well compacted by approved methods to minimize water intrusion or material pull-out.

11.16.4 The anchor trench shall be backfilled with soil meeting the requirements of Structural Fill as described in section 10.0 with the exception that the maximum particle size shall be limited to one (1) inch in the largest dimension.

11.16.5 Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane or geocomposite. If damage occurs, it shall be repaired prior to backfilling and at the Contractor's expense.

11.17 Protective Cover Soils

11.17.1 The protective soil cover material shall be free of angular stones or other foreign matter that could damage the geocomposite and the geomembrane. The first lift placed over the geocomposite shall have no particles in excess of 1 inch in maximum diameter. Subsequent lifts shall have no particles in excess of 4 inches in maximum diameter.

11.17.2 In applying the protective cover material, no equipment shall drive directly across the geocomposite. The specified fill material shall be placed in loose lifts no thicker than nine (9) inches and spread utilizing vehicles with a low ground pressure.

11.17.3 The protective soil cover shall be placed on the geocomposite in a manner that prevents damage to the geocomposite.

11.17.4 Soil cover should be placed in a manner that prevents the soil from entering the geocomposite overlap zones. Soil cover shall be pushed from the toe of slopes up, not from top of slopes down, to minimize tensile forces on the geocomposite and geomembrane.

11.17.5 The protective cover shall be placed over the geocomposite using low contact pressure, wide-tracked construction equipment that minimizes stresses on the geocomposite. The cover shall be placed and spread by making a minimum of four complete passes with the tracks of the equipment. Special care and attention shall be made by the Contractor to ensure that the underlying geocomposite is not damaged.

11.17.6 The protective cover soil shall be a minimum eighteen (18) inches thick. This thickness does not apply to frequently trafficked areas or roadways, for which a minimum thickness of three feet is required.

11.18 Topsoil

11.18.1 Topsoil material is generally defined as the upper surface of dark fertile soil, which contains decaying matter and roots. Topsoil shall be free of subsoil, clay, weeds, large roots, or foreign material that would interfere with seeding or maintenance.

11.18.2 Testing of samples of topsoil may be required to determine if any nutrients should be added to the soil in addition to the application of fertilizer and lime.

11.18.3 The topsoil cover shall be placed in a minimum loose lift thickness of six inches and then grassed. If erosion occurs before grassing operations, the area shall be repaired to the satisfaction of the PCM.

12.0 SEDIMENT AND EROSION CONTROL

12.1 Minimum sediment and erosion control measures are shown on the Drawings for the Plant Gorgas Bottom Ash Storage Area Closure. Additional measures shall be taken as required or as directed by the Purchaser to minimize erosion of soil.

12.2 During the course of this project, the Contractor shall plan and coordinate his work to minimize the amount of suspended soil particles entering rivers and streams or leaving the general work area and being deposited in undesirable places. Any property damage or fines resulting from the Contractor's negligence shall be borne by the Contractor.

12.3 The Contractor shall not excavate, uncover or denude areas of work until adequate erosion and sediment control measures are installed. The Contractor's earthmoving operations shall at all times be in full compliance with the requirements of the Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas

12.4 The Purchaser will inspect the sediment and erosion control practices (e.g. "BMPs") employed to evaluate their effectiveness. Any deficiencies shall be immediately corrected by the Contractor at no cost to the Purchaser.

12.5 Erosion and sediment control measures shall be utilized and maintained as indicated in the Plans.

13.0 VEGETATION

13.1 A minimum six-inch layer of topsoil shall be placed on all areas to be grassed.

13.2 Earth fill areas and other disturbed areas shall be grassed. Hydroseeding methods may be used.

13.3 The Contractor shall produce a satisfactory stand of perennial grass in accordance with the Vegetation Schedule as shown on the Drawings. If it is necessary to repeat any or all the work, including plowing, fertilizing, watering, mulching and seeding, the Contractor shall repeat these operations until a satisfactory stand is obtained.

13.4 A satisfactory stand of grass is defined as 100% of soil surface being uniformly covered in permanent vegetation with a density of 70% or greater, or landscaped according to the Plan (uniformly covered with landscaping materials in planned landscaped areas), or equivalent permanent stabilization measures as defined in the Handbook (excluding a crop of annual vegetation and a seeding of target crop perennials appropriate for the region).

13.5 Measures shall be taken to prevent erosion of the topsoil layer and vegetation until a full vegetative growth has been obtained. After seeding, an erosion control biodegradable straw blanket shall be installed on any slopes equal to or steeper than 3H:1V. This material shall be as indicated on the Drawings. The blanket shall be installed per manufacturer's installation instructions. However, the blanket shall be tacked as necessary to the ground to withstand the upward growth of grass and to permit the establishment of grass through the blanket. Failure to accomplish this will require that the affected area be re-grassed.

13.6 Water required to promote a satisfactory growth shall be furnished and applied by the Contractor as often as necessary to achieve the results outlined above.

13.7 The Contractor shall make daily inspections of the seeded areas and repair all eroded areas to the satisfaction of the Purchaser.

14.0 RECORDS

14.1 Quality Control Records

14.1.1 The quality control records of inspection and field quality control records shall be compiled by the Contractor's CQC Inspector and provided to the Purchaser on an ongoing basis or as directed. The final records will provide the background data necessary for the certification of the final cover construction. All records shall be forwarded to the Plant's permanent file to be retained as a permanent record of the project.

14.1.2 At the completion of the construction of the final cover, a Construction Quality Assurance Report (Construction Certification), prepared by the Purchaser, shall be submitted along with a registered engineer's certification that the final cover was constructed in accordance with the approved Closure/Post Closure drawings and the ADEM Solid Waste Regulations. The Contractor shall provide, at a minimum, the following information for preparation of the Certification Report:

a) Elevation Contour Drawings of the subgrade on a maximum 100ft. by 100ft. grid. Drawings to be signed and sealed by a land surveyor registered to practice in the State of Alabama.

b) For the Composite Cover System:

1. Final geomembrane panel layout
2. Final geocomposite panel layout
3. Elevation Contour Drawings of the top surface of the 18 inch Protective Soil Layer on a maximum 100ft. by 100ft. grid (as used for the subgrade). Protective Soil Cover thickness relative to the subgrade shall be indicated at the grid points. Drawings to be signed and sealed by a land surveyor registered to practice in the State of Alabama.
4. Finished Grade - elevation contour drawings with thickness of topsoil indicated on the same maximum 100 ft. x 100 ft. grid as the Protective Cover Soil Elevation Contour Drawing. Drawings to be signed and sealed by a land surveyor registered to practice in the State of Alabama.

c) All survey shots shall be "storage stacked" in order to properly verify the given layer's thickness. The use of interpolation or other computer generated methods to achieve point storage stacking are not acceptable.

d) Thickness determinations obtained at grid points on slopes shall be made normal to the slopes.

e) All survey and topographic information shall be submitted in both pdf and dwg file formats which are compatible with AutoCAD 2016.

f) A summary of major construction activities which shall include a description of the activity and schedule dates. This summary shall be based on daily logs provided by the on-site inspector. This shall also serve to document the presence of a qualified member of the inspection team during any construction activity involving structural fill or any component of the liner.

g) Project CQC summary reports including all field testing and inspection results. This summary shall be inclusive of all passing tests as well as failing tests and retests. This shall include at a minimum, all field moisture content and density tests, Proctor curves, Atterberg limits, particle size distribution, CQC resumes, CQC welding rod certificates, subgrade acceptance forms, HDPE panel deployment logs, fusion and extrusion trial seam logs, fusion and extrusion seam logs, HDPE repair logs, pressure and vacuum test logs, fusion and extrusion destructive test logs, concrete cylinder break reports, concrete pour cards, concrete tickets, rebar mill certification reports, and all daily field reports.

h) Copies of all field CQC reports for structural fill, bottom ash fill, and geosynthetic installation.

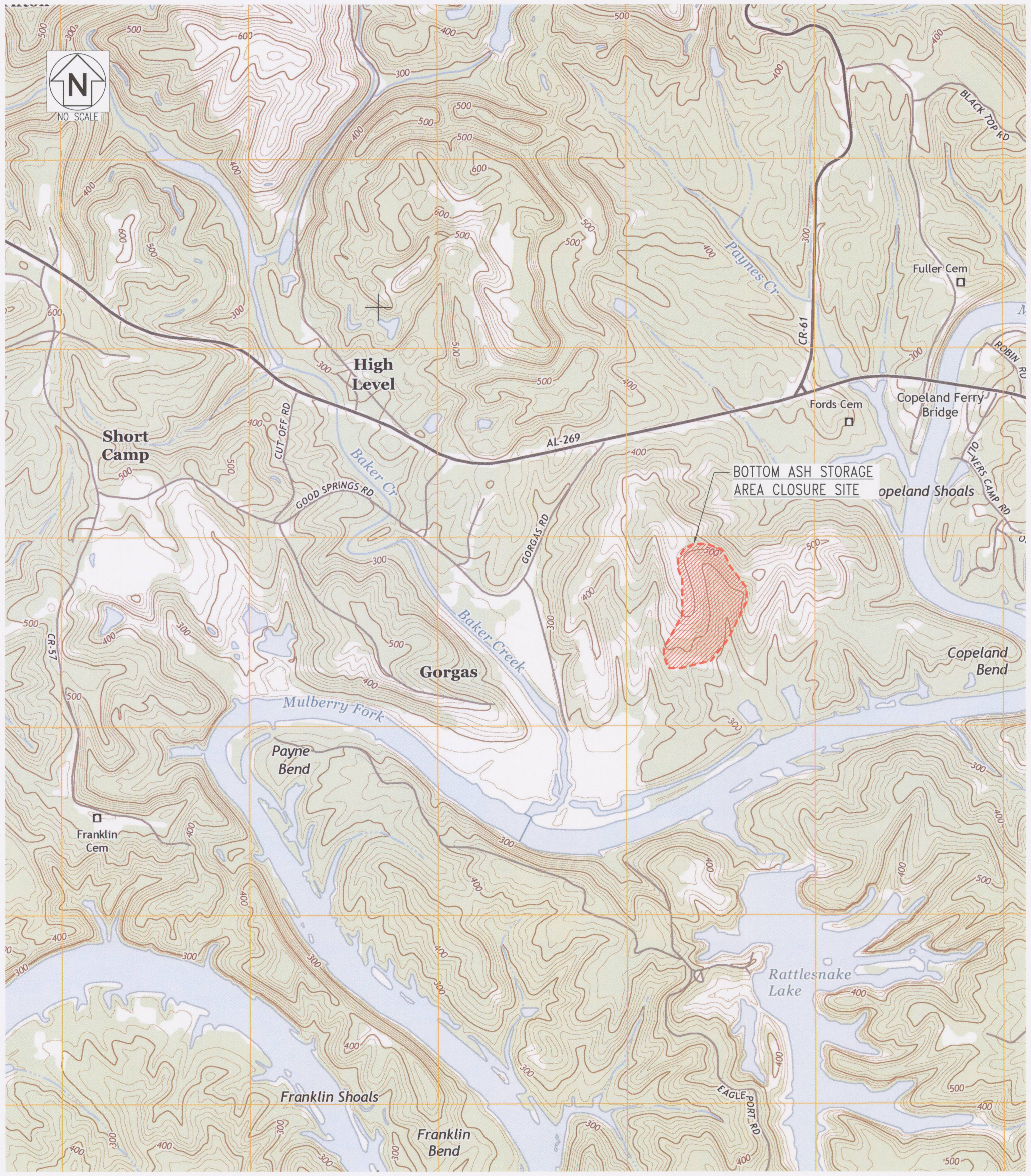
14.2 Record Topographic Survey

A record topographic survey will be performed by the Purchaser to fully document the lateral and vertical extent of the developed area. This survey will be maintained as part of the permanent record. Drawings to be signed and sealed by a land surveyor registered to practice in the State of Alabama.

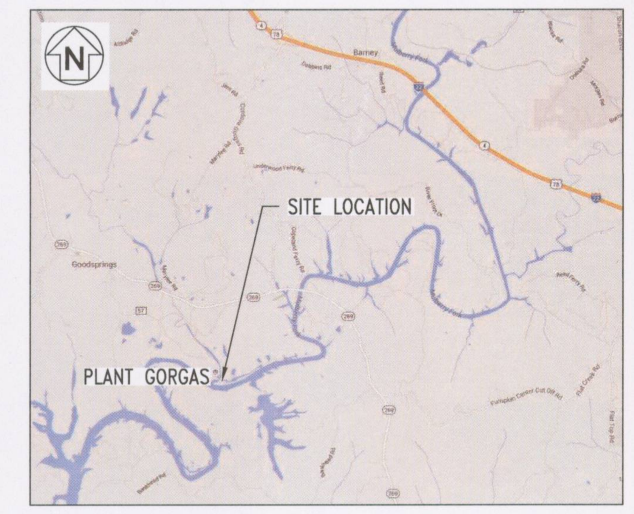
PLANT GORGAS BOTTOM ASH STORAGE AREA CLOSURE
SITEWORK CONSTRUCTION DRAWINGS
WALKER COUNTY, ALABAMA

SECTIONS 17 AND 20, TOWNSHIP 16 SOUTH, RANGE 6 WEST

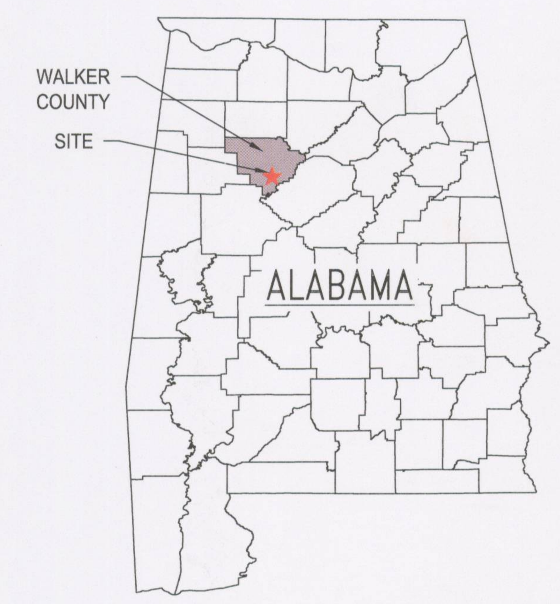
DRAWING INDEX



GOODSPRINGS, AL QUADRANGLE
2014



VICINITY MAP
NO SCALE



LOCATION MAP
NOT TO SCALE

LEGEND:

PROJECT AREA

PROJECT STREET/LOCATION

PLANT GORGAS
460 GORGAS ROAD
PARRISH, ALABAMA 35580

PERMITTEE:

ALABAMA POWER COMPANY
600 18TH STREET NORTH
BIRMINGHAM, ALABAMA 35203

PROJECT MANAGER:

SOUTHERN COMPANY SERVICES, INC.
DAVID B. PRATER
460 GORGAS ROAD
PARRISH, ALABAMA 35580-5715
TEL: (205) 992-7266
EMAIL: DBPRATER@SOUTHERNCO.COM

REVISION 0 DATE 11/30/18
ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

Southern Company Generation Engineering and Construction Services FOR

Alabama Power Company

PLANT GORGAS
SITEWORK
TITLE SHEET AND DRAWING INDEX

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	SCALE	DRAWING NUMBER	SHEET	CONT'D
WFW	CRU	JKB	XXX	XXX	MPB	JCP	NONE	**E720258**	1	FINAL

ANSI E: 4

TECHNICAL SPECIFICATION REFERENCE

1. REFER TO THE PROJECT TECHNICAL SPECIFICATIONS TITLED "TECHNICAL SPECIFICATIONS SECTION 31 20 00 FOR EARTHWORK AND FINAL COVER INSTALLATION" (LATEST REVISION).

SURVEY AND TOPOGRAPHY NOTES:

1. CONTOURS ARE A COMPOSITE OF AERIAL LIDAR AND GROUND SURVEY BY SOUTHERN COMPANY CIVIL – FIELD SERVICES AND SOUNDING DATA COLLECTED JULY 2015 – MAY 2018.
2. AERIAL LIDAR PROVIDED BY HALIS, LLC.
3. CONTOUR INTERVAL 1 FOOT @ 30 SCALE, 2 FOOT @ 100 SCALE.
4. CONTOURS WERE PRODUCED BY DIGITAL TERRAIN MODEL.

DEMOLITION NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGES TO EXISTING IMPROVEMENTS ON– OR OFF–SITE DUE TO THE CONSTRUCTION OF THIS PROJECT. ANY DAMAGE WILL BE REPAIRED AT THE CONTRACTOR'S EXPENSE AND TO THE PURCHASER'S SATISFACTION.
2. CONTRACTOR SHALL COORDINATE WITH PURCHASER PRIOR TO BEGINNING ANY AND ALL DEMOLITION OPERATIONS. CONTRACTOR SHALL COORDINATE DEMOLITION OPERATION PHASING WITH PURCHASER PRIOR TO AND THROUGHOUT THE PROJECT LIFE.
3. SOME EXISTING UTILITIES SCHEDULED TO REMAIN ARE LOCATED WITHIN PROPOSED DEMOLITION AREAS. CONTRACTOR SHALL USE EXTREME CAUTION WHILE WORKING IN THESE AREAS TO ASSURE NO UTILITY SERVICE INTERRUPTIONS. CONTRACTOR SHALL HAVE ANY AND ALL EXISTING UTILITIES LOCATED BY UTILITY LINE LOCATER SERVICE PRIOR TO ANY DEMOLITION AND/OR CONSTRUCTION OPERATIONS.
4. CONTRACTOR SHALL COORDINATE WITH PURCHASER PRIOR TO DISRUPTION OF ANY UTILITY SERVICE.
5. ALL UTILITY LOCATIONS, DIMENSIONS AND ELEVATIONS SHOWN ARE APPROXIMATE AND OTHER UTILITIES MAY EXIST.
6. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL/RELOCATION OF ALL ABOVE AND BELOW GROUND EXISTING IMPROVEMENTS THAT ARE IN CONFLICT WITH THE PROPOSED IMPROVEMENTS.
7. REMOVAL AND DISPOSAL OF ANY AND ALL MATERIALS FROM DEMOLITION ACTIVITIES WILL BE DONE IN ACCORDANCE WITH APPLICABLE ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT REGULATIONS AND REQUIREMENTS.
8. ALL EXISTING IMPROVEMENTS SHALL REMAIN UNLESS SPECIFICALLY NOTED, "TO BE REMOVED".

GENERAL CONSTRUCTION NOTES

1. GRID COORDINATE SYSTEM IS ALABAMA WEST STATE PLANE NAD 27.
2. SEE SURVEY AND TOPOGRAPHY NOTES, THIS DRAWING, FOR SURVEY INFORMATION.
3. CONTRACTOR TO USE CAUTION WHEN WORKING UNDER OR NEAR TRANSMISSION LINES. REQUIRED CLEARANCES FROM EQUIPMENT AND PERSONNEL PERFORMING WORK NEAR HIGH VOLTAGE POWER LINES ARE SPECIFIED IN OSHA 1910.333.
4. EXISTING ACCESS AND ROADS SHALL BE MAINTAINED AND REPAIRED AS NECESSARY DURING CONSTRUCTION BY THE CONTRACTOR TO THE SATISFACTION OF THE PURCHASER'S PROJECT CONSTRUCTION MANAGER, PCM.
5. THE CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING HIS OWN STANDARD QUALITY CONTROL AND QUALITY ASSURANCE PROGRAM OR PRACTICES AND SHALL INSTITUTE ANY ADDITIONAL CONTROLS OR PROCEDURES IN ACCORDANCE WITH PROVEN INDUSTRY PRACTICE TO ASSUME COMPLIANCE WITH THESE DRAWINGS AND TECHNICAL SPECIFICATIONS.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PLANNING AND OPERATING ANY DEWATERING, SURFACE WATER RUNOFF CONTROL, AND PROVISIONS FOR DRAINAGE OF EXCAVATIONS, AND FOR THE PLACEMENT OF MATERIALS. SUCH WORK SHALL BE AT NO ADDITIONAL EXPENSE TO THE PURCHASER.
7. ALL WORK SHALL BE IN STRICT COMPLIANCE WITH CURRENT OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS. CONTRACTOR IS RESPONSIBLE FOR ALL SHORING/CRIBBING REQUIRED FOR INSTALLATION OF PIPES AND APPURTENANCES INCLUDING ANY DEEP EXCAVATIONS REQUIRING AN ENGINEER'S DESIGN.
8. CONSTRUCTION ACTIVITIES INCLUDING MATERIAL STOCKPILING ARE NOT PERMITTED IN AREAS OUTSIDE OF THE DESIGNATED LIMITS OF DISTURBANCE UNLESS OTHERWISE SHOWN ON THE DRAWINGS OR AS APPROVED BY THE PCM.
9. CONSTRUCTION DEBRIS, FLOWABLE FILL, OLD SUPPORT MATERIALS OR OTHER REFUSE SHALL BE DISPOSED IN APPROVED LANDFILLS OFFSITE.
10. DRAINAGE FROM THE DISTURBED AREA WITHIN THE PROJECT LIMITS WILL DRAIN TO THE EXISTING WASTE WATER POND OR WILL BE CONTAINED AND REUSED ON–SITE. THE EXISTING WASTE WATER POND HAS A PERMITTED AND MONITORED DISCHARGE, THEREFORE IT DOES NOT REQUIRE A NOTICE OF INTENT (N.O.I.) OR A SET OF PERMITTED EROSION, SEDIMENT, AND POLLUTION CONTROL PLANS (ES&PCP). BEST MANAGEMENT PRACTICES (BMP'S) ARE TO BE INSTALLED AND MAINTAINED, AS SHOWN IN THE PLANS AND ASSOCIATED DETAILS, IN CONFORMANCE WITH THE "ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL, AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS" (LATEST EDITION).
11. SIX INCHES OF UNSETTLED TOPSOIL SHALL BE PLACED ON ALL AREAS THAT REQUIRE PERMANENT GRASSING PRIOR TO APPLICATION OF SEEDING. THE CONTRACTOR SHALL ADHERE TO PROPER SEEDING PROCEDURES AND SPECIFICATIONS, SPECIFICALLY, PAGE 119 THROUGH 127 OF THE "ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME I" LATEST EDITION. THE CONTRACTOR SHALL PERFORM SOIL TESTS TO IDENTIFY AND IMPLEMENT SITE–SPECIFIC FERTILIZER NEEDS OR OTHER SOIL AMENDMENTS FOR ALL AREAS THAT REQUIRE PERMANENT SEEDING.
12. SEVERAL APPLICATIONS OF TEMPORARY OR PERMANENT VEGETATION MAY BE REQUIRED DURING CONSTRUCTION IN ORDER TO ESTABLISH AN ACCEPTABLE FINAL VEGETATIVE COVER. THE CONTRACTOR SHALL ADJUST HIS/HER BID ACCORDINGLY TO ACCOUNT FOR THIS DURING CONSTRUCTION.
13. THE PROJECT LIMITS SHOWN ON THE CONSTRUCTION DRAWINGS FOR THIS PROJECT WILL ALSO ACT AS THE LIMITS OF DISTURBANCE.

EARTHWORK AND CONSTRUCTED FILL

1. REFER TO THE PROJECT TECHNICAL SPECIFICATIONS TITLED "TECHNICAL SPECIFICATIONS SECTION 31 20 00 FOR EARTHWORK AND FINAL COVER INSTALLATION" (LATEST REVISION).
2. EARTH FILL MATERIAL SHALL BE OBTAINED FROM APPROVED BORROW AREAS AS DESIGNATED OR APPROVED BY THE PURCHASER. MATERIAL SHALL BE CLEAN/UNCONTAMINATED AND FREE OF CULTURAL RESOURCES AND APPROVED PRIOR TO USE.
3. PROPOSED GRADES INDICATED ON THIS PLAN ARE TO FINISH GRADE. CONTRACTOR SHALL MAKE SUBGRADE ADJUSTMENTS FOR TOPSOIL, PAVING, BUILDING PAD, ETC. FOR DELINEATION OF FINISHED GRADE ELEVATIONS, SEE DRAWINGS E720263–E720265 AND E720275–E720287.
4. ALL EARTHWORK CONSTRUCTION SHALL BE DONE TO THE LINES, GRADES, AND CROSS SECTIONS SHOWN ON THE DRAWINGS. THE CONTRACTOR WILL ESTABLISH ALL NECESSARY BENCHMARKS AND BASE LINES REQUIRED FOR THE WORK.
5. BORROW SITE OR SITES FOR STOCKPILING FILL DIRT SHALL BE PROHIBITED WITHIN 50 FEET OF STREAM BANKS AND WETLANDS. NORMAL GRADING ACTIVITIES SUCH AS CUT/FILL OPERATIONS WITHIN THIS 50 FEET SHALL BE PERMITTED IF DELINEATED AS SUCH BY THE DISTURBANCE LIMITS SHOWN ON THE DRAWINGS.
6. MAXIMUM SLOPES SHALL BE 4–FEET HORIZONTAL TO 1–FOOT VERTICAL UNLESS SHOWN OTHERWISE.

CONCRETE

1. DESIGN, MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE FOLLOWING LATEST STANDARDS AND SPECIFICATIONS UNLESS OTHERWISE MODIFIED ON THE DESIGN DRAWINGS.
   - –ACI–318 BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE.
   - –ACI–315 MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES.
   - –ACI–347R RECOMMENDED PRACTICE FOR CONCRETE FORMWORK.
   - –CRSI RECOMMENDED PRACTICE FOR PLACING REINFORCING STEEL.
2. ALL CAST–IN–PLACE CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI IN 28 DAYS, UNLESS OTHERWISE NOTED.
3. USE A TYPE I/II PORTLAND CEMENT AND A W/C RATIO OF 0.45.
4. CONCRETE MIX USING FLY ASH SHALL HAVE A FLY ASH CONTENT EQUAL TO 15–30% OF THE TOTAL CEMENTITIOUS MATERIAL, UNLESS OTHERWISE APPROVED BY THE ENGINEER. FLY ASH SHALL CONFORM TO REQUIREMENTS OF ASTM C618, CLASS F.
5. IF READY–MIX CONCRETE IS USED FROM AN APPROVED SUPPLIER, ALL CONCRETE SHALL BE PLACED WITHIN 1½ HOURS AFTER MIXING.
6. CONCRETE SLABS SHALL HAVE A LIGHT BROOM FINISH.
7. REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO ASTM A615, GRADE 60. WELDED STEEL WIRE FABRIC SHALL BE ASTM A185 PLAIN TYPE.
8. CHAMFER ALL EXPOSED EXTERNAL CORNERS OF CONCRETE WITH A 45 DEGREE CHAMFER, UNLESS OTHERWISE NOTED.
9. PROVIDE A MINIMUM COVER OF 3" FOR ALL REINFORCING STEEL.
10. EMBEDMENT AND SPLICE LENGTHS FOR REINFORCING STEEL SHALL CONFORM TO ACI–318, UNLESS OTHERWISE NOTED.
11. ALL REINFORCING BAR HOOKS SHOWN ON DRAWINGS SHALL BE ACI STANDARD 90 DEGREE HOOKS, UNLESS OTHERWISE NOTED.
12. REBAR FABRICATOR SHALL OBTAIN APPROVAL OF HIS DETAIL DRAWINGS BEFORE BEGINNING FABRICATION, UNLESS OTHERWISE NOTED IN PURCHASE ORDER.

FLOWABLE FILL

1. A FLY ASH/CEMENT FLOWABLE FILL MIX SHALL CONSIST OF THE FOLLOWING:
   2000 LBS OF CLASS "F" FLY ASH
   150 LBS OF CEMENT
   200 LBS OF CONCRETE SAND(OPTIONAL)
   87 GALLONS OF WATER(POTABLE)
2. ALL FLOWABLE FILL TO SET 72 HOURS PRIOR TO PLACING COMPACTED SOIL BACKFILL ON FLOWABLE FILL.
3. TO PREVENT FLOTATION, HOLD DOWN STRAPS SHALL BE USED ON HDPE PIPES PRIOR TO PLACING FLOWABLE FILL.
4. PIPE SUPPORT MATERIAL FOR FLOWABLE FILL CONSTRUCTION SHALL BE CONCRETE BLOCKS OR BRICKS. WOODEN SUPPORTS ARE NOT ALLOWED.
5. COMPRESSION TESTING OF FLOWABLE FILL INCLUDING MAKING OF TEST CYLINDERS IS NOT REQUIRED FOR THIS PROJECT.

STORM DRAINAGE PIPES/APPURTENANCES GENERAL INFORMATION & NOTES

1. PIPE LENGTHS AND SLOPES ARE CALCULATED FROM THE WORK POINTS OF THE PIPES/STRUCTURES.
   WORK POINTS FOR PIPES/STRUCTURES:
   MANHOLES – CENTER OF MANHOLE
   PIPES WITH SLOPE PAVED HEADWALL – END OF PIPE/FACE OF CONCRETE.
2. ALL MANHOLES SHALL CONTAIN STEPS INSTALLED IN ACCORDANCE WITH OSHA REGULATIONS AND SHALL BE SEALED AT JOINTS AND PIPE ENTRY/EXIT POINTS TO PROVIDE A WATERTIGHT STRUCTURE.
3. THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS ON ALL STORM PIPE MATERIALS AND STRUCTURES TO THE PROJECT CONSTRUCTION MANAGER PRIOR TO INSTALLATION AND/OR FABRICATION.
4. STORM DRAINAGE SYSTEMS SHALL BE CONSTRUCTED FROM DOWNSTREAM TO UPSTREAM.
5. THE CONTRACTOR SHALL VERIFY ALL EXISTING AND NEW STORM PIPE GRADES AND CONNECTION POINTS PRIOR TO INSTALLATION. THE PURCHASER SHALL BE NOTIFIED OF ANY DEVIATIONS PRIOR TO CONSTRUCTION.
6. ALL STORM PIPES SHALL BE BEDDED IN A MINIMUM OF 6" OF CRUSHED AGGREGATE (ALDOT #57 STONE OR APPROVED EQUAL).
7. STORM PIPES SHALL BE HANCOR BLUE SEAL OR ADS DUAL WALL, N–12 WTIB HDPE PIPE OR AN EQUAL APPROVED BY ENGINEERING. THE PIPES SHALL HAVE A SMOOTH INTERIOR AND ANGULAR EXTERIOR CORRUGATIONS. PIPE JOINTS SHALL BE GASKETED WATER TIGHT.

ABBREVIATIONS:

ACI — AMERICAN CONCRETE INSTITUTE
A.S.T.M. — AMERICAN SOCIETY OF TESTING MATERIALS
BP — BEGIN POINT
DWG. — DRAWING
EL. — ELEVATION
EP — END POINT
EX. — EXISTING
F.B. — FLAT BOTTOM
G.A.B. — GRADED AGGREGATE BASE
GRD. BRK. — GRADE BREAK
HDPE — HIGH DENSITY POLYETHYLENE
HP — HIGH POINT
IE. — INVERT ELEVATION
LF — LINEAR FEET
LP — LOW POINT
MAX. — MAXIMUM
MIN. — MINIMUM
N.T.S. — NOT TO SCALE
PI — POINT OF INTERSECTION
PC — POINT OF CURVE
PCC — POINT OF COMPOUND CURVE
PT — POINT OF TANGENT
PVI — POINT OF VERTICAL INTERSECTION
R — RADIUS
TYP — TYPICAL

LEGEND

Symbol	Description
300	FINISH GRADE CONTOURS (MAJOR)
301	FINISH GRADE CONTOURS (MINOR)
x715.50	EXISTING SPOT ELEVATION
x715.50	FINISH GRADE SPOT ELEVATION
300	℄ NEW DITCHES
	EXISTING ROADS
x	EXISTING FENCE
x	FENCE
	AGGREGATE ROADS
	RIPRAP
GP	GUARDPOST
	PROJECT LIMITS
	CLOSURE CAP LIMITS
	EXISTING STORM DRAINAGE PIPE
	STORM DRAINAGE PIPE
	STORM PIPE WITH CONCRETE HEADWALL
	STORM PIPE WITH RISER SECTION
715	EXISTING CONTOURS (MAJOR)
715	EXISTING CONTOURS (MINOR)
	EXISTING WATER
OHE	OVERHEAD ELECTRICAL

EROSION CONTROL LEGEND

Symbol	Description
DC	DUST CONTROL
ECB	EROSION CONTROL BLANKET
LG	LAND GRADING
OP	OUTLET PROTECTION
PS	PERMANENT SEEDING
RS	RIPRAP–LINED SWALE 2
SB	SILT FENCE
TS	TEMPORARY SEEDING
TSG	TOPSOILING
MU	MULCHING

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.

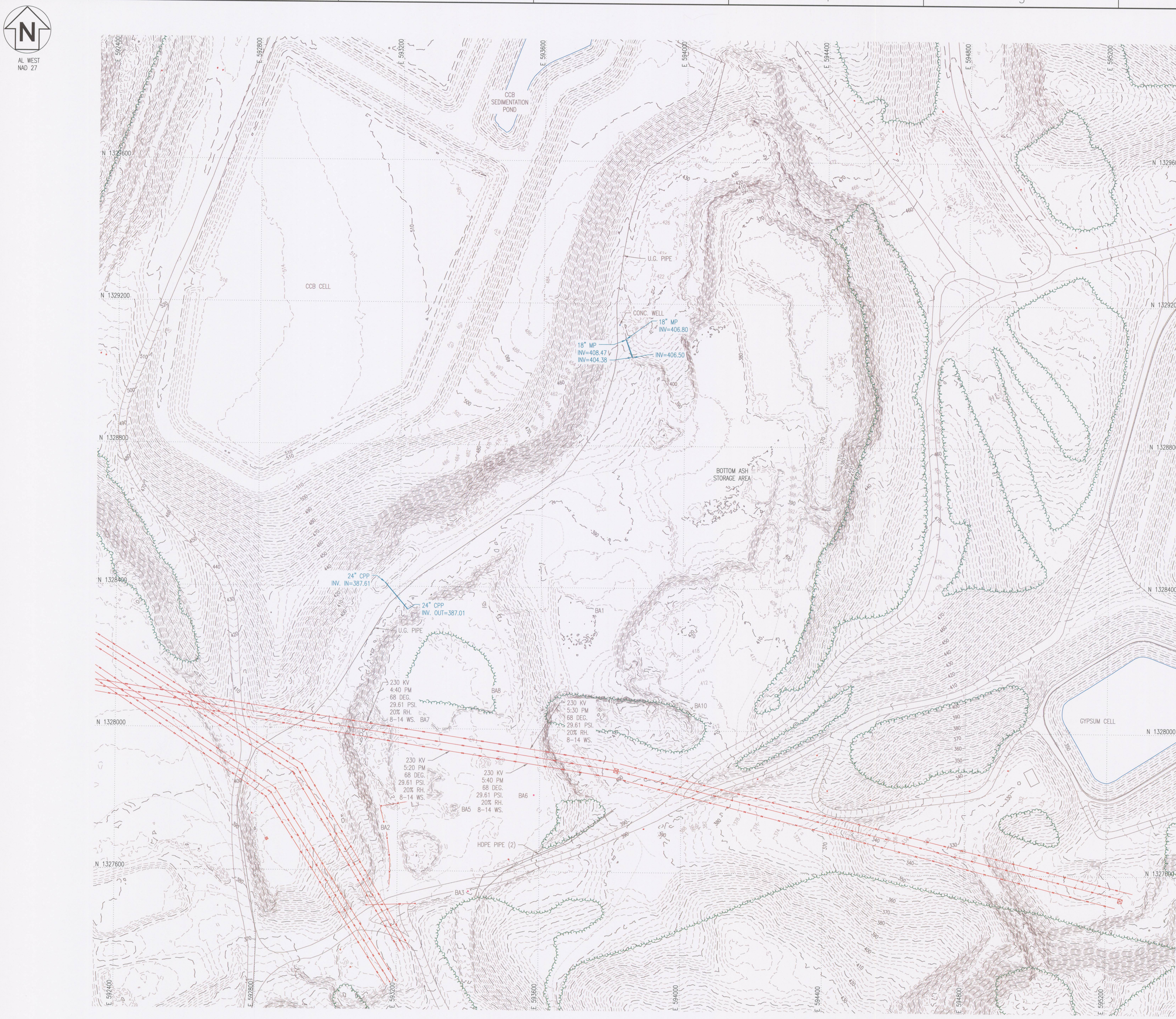
REVISION	DATE	DESCRIPTION	PROJ ID	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
2	01/24/2019	ADDED RIPRAP-LINED SWALE AND SILT FENCE TO EROSION CONTROL LEGEND	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JKB	AES	JKB	XXX	XXX	XXX	JWM
1	01/16/2019	REVISED SPECIFICATION TITLE AND NUMBER.	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	AES	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	WFW	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
GENERAL NOTES, ABBREVIATIONS AND LEGEND

SCALE	DRAWING NUMBER	SHEET	CONT'D
NONE	E720259	1	FINAL

ANSI E: 4



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE

REVISION 0 DATE 11/30/18

ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

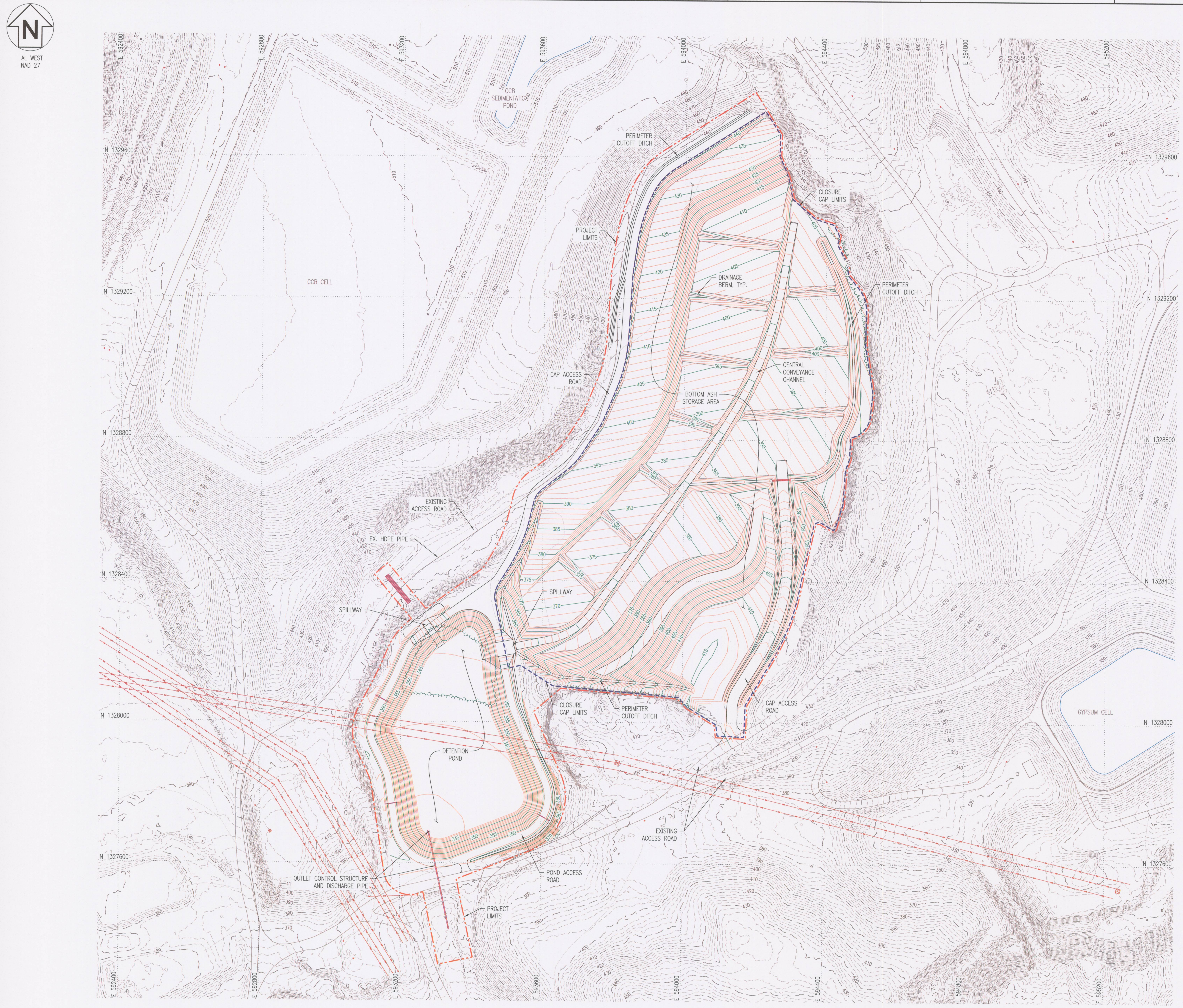
Southern Company Generation Engineering and Construction Services FOR

Alabama Power Company

PLANT GORGAS
SITEWORK
EXISTING TOPOGRAPHIC MAP

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR	SCALE	DRAWING NUMBER	SHEET	CONT'D
WFW	CRU	JKB	XXX	XXX	MPB	JCP	1" = 100'	**E720260**	1	FINA

ANSI E



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEG

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

REVISION	DATE
REVISION 1	DATE 02/26/19
REVISED CENTRAL CONVEYANCE CHANNEL, POND SPILLWAYS, WEST SLOPES	
PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	
REVISION 0	DATE 11/30/18
ISSUED FOR CONSTRUCTION	
PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	

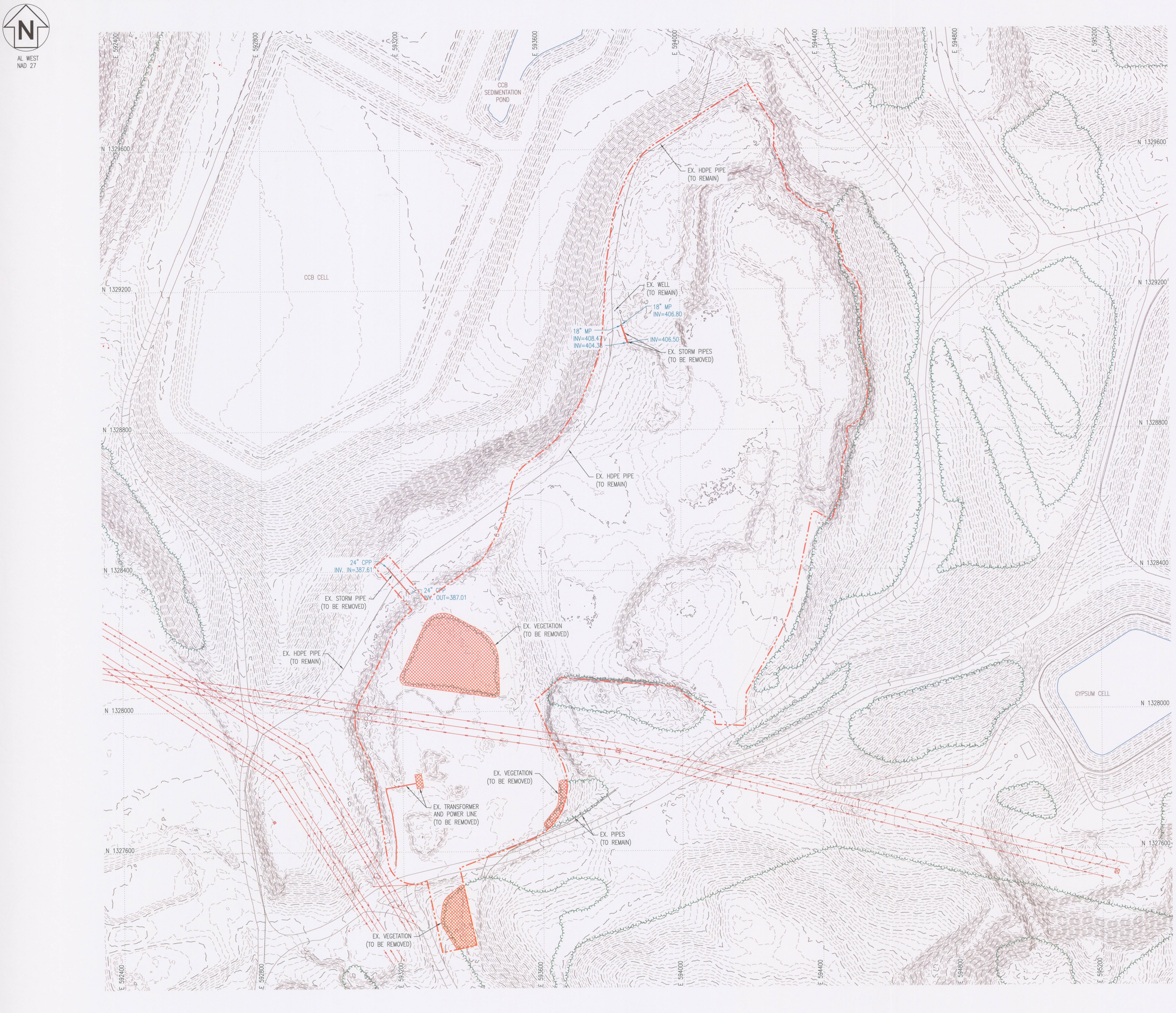
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
AES	CRU	JKB	XXX	XXX	XXX	JWM
WFW	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation Engineering and Construction Services
FOR
Alamba Power Company

PLANT GORGAS
SITEWORK
GENERAL ARRANGEMENT
AND PROJECT LIMITS

SCALE	DRAWING NUMBER	SHEET	CONT'D
1" = 100'	E720261	1	FINAL

ANSI E



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
DEMOLITION PLAN

REVISION	DATE
0	11/30/18

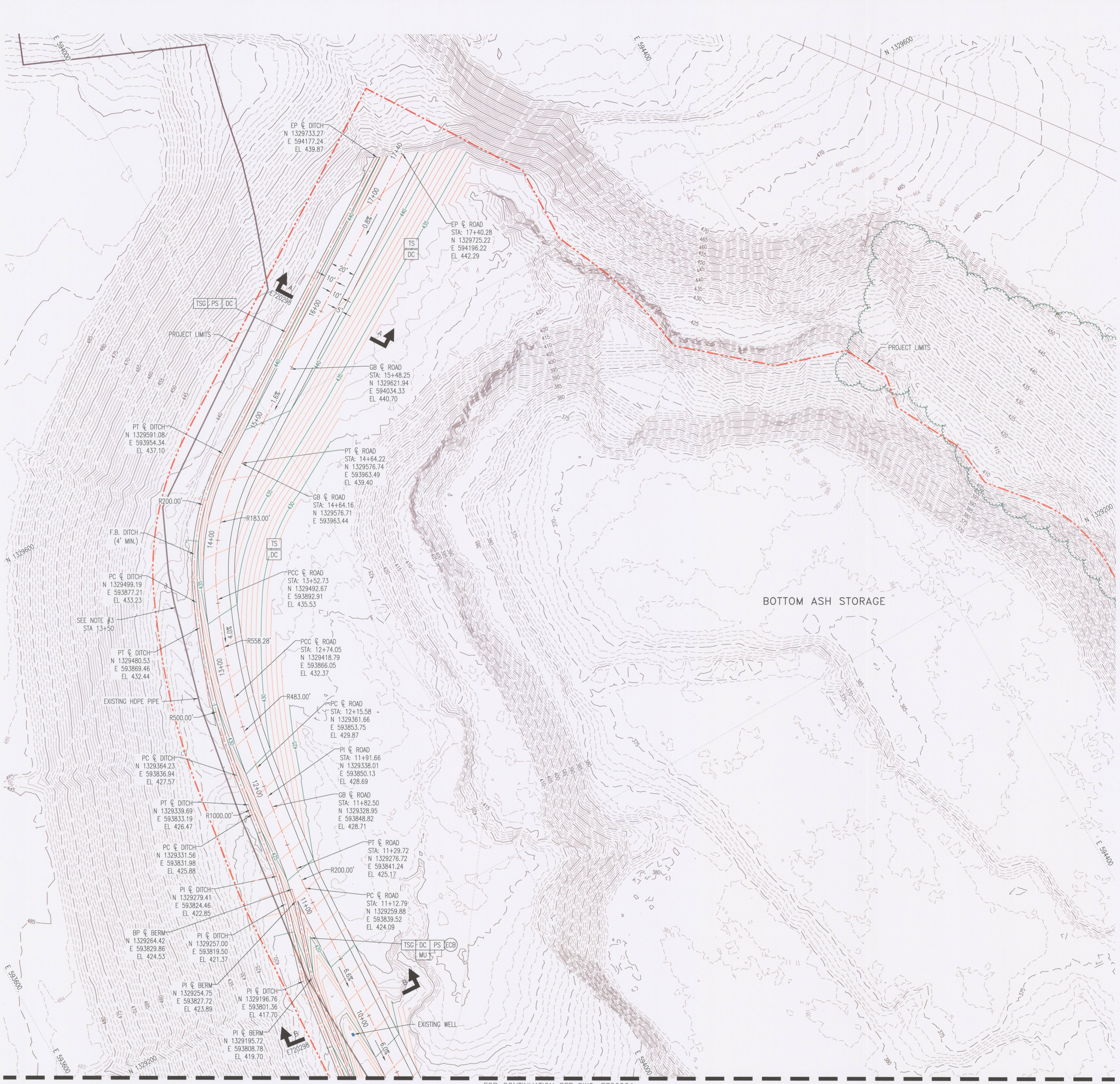
ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
WFW	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D
1" = 100'	E720262	1	FINAL

ANSI E: 44



FOR CONTINUATION SEE DWG. E720264

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LE
3. BETWEEN STATIONS 8+00 AND 13+50, CONTRACTOR S
REMOVE ALL ASH ABOVE EXISTING HDPE PIPE AND BA
WITH STRUCTURAL FILL.

REVISION	DATE
0	11/30/18

ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JAA	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation
Engineering and Construction Services
FOR

Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH INITIAL LAYOUT AND GRADING
SHEET 1

SCALE	DRAWING NUMBER	SHEET	CONT
1" = 30'	E720263	1	FIN

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND L
3. BETWEEN STATIONS 8+00 AND 13+50, CONTRACTOR REMOVE ALL ASH ABOVE EXISTING HDPE PIPE AND E WITH STRUCTURAL FILL.

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR

REVISION 0 DATE 11/30/18

ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JAA	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation Engineering and Construction Services FOR

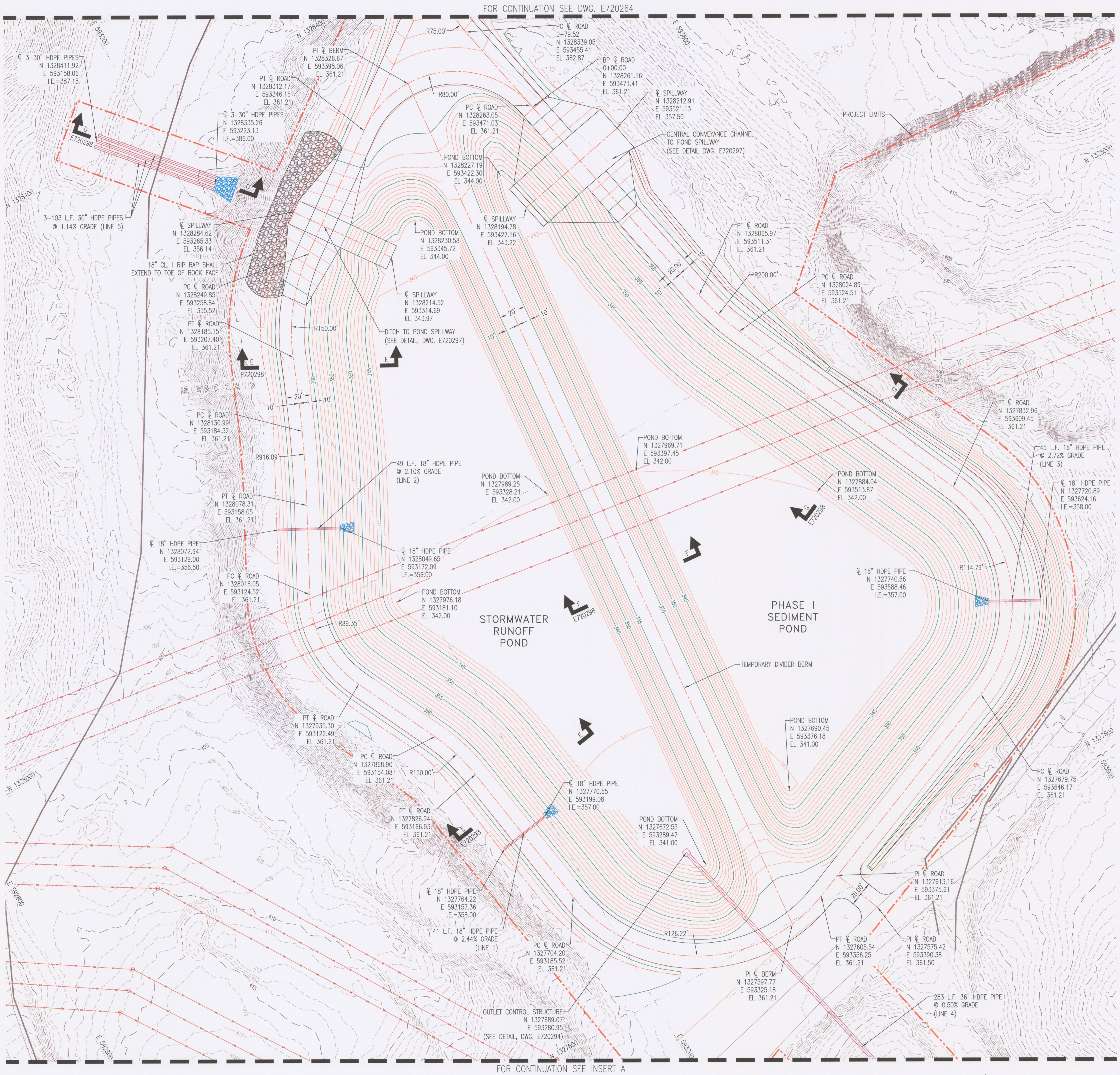
Alabama Power Company

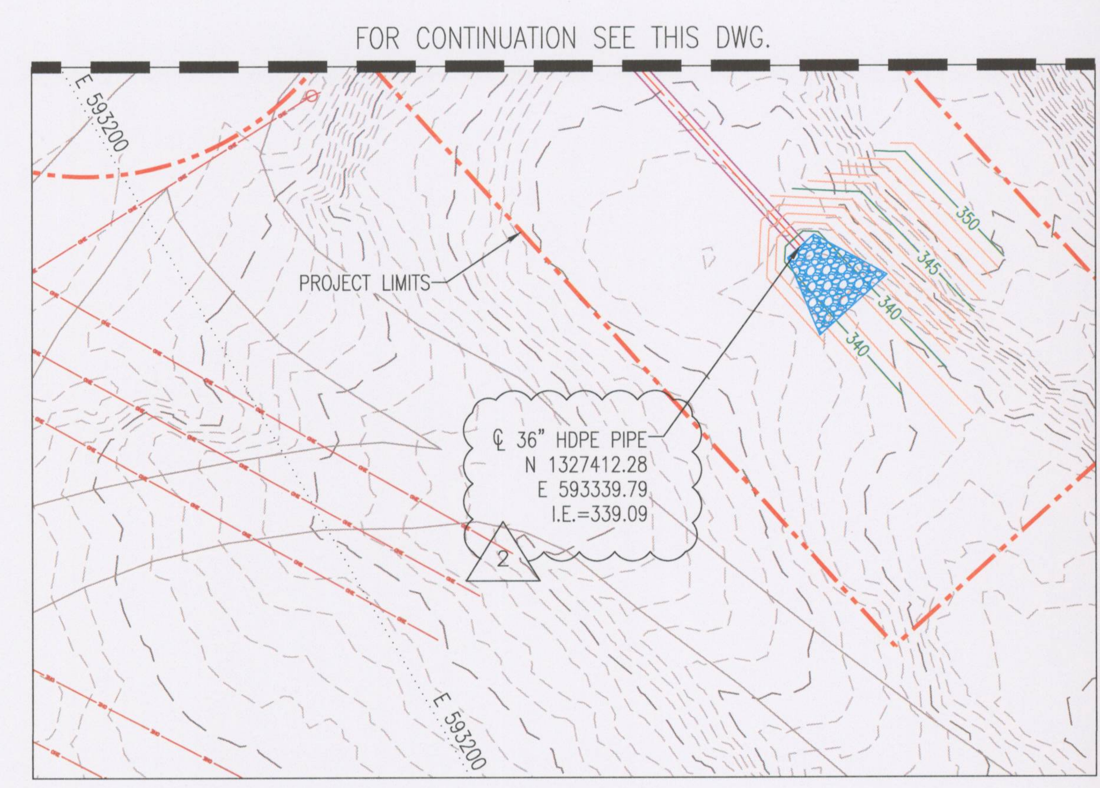
PLANT GORGAS
SITEWORK
BOTTOM ASH INITIAL LAYOUT AND GRADING
SHEET 2

SCALE	DRAWING NUMBER	SHEET	CON
1" 30'	E720264	1	FIN

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEN





INSERT A

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

Southern Company Generation Engineering and Construction Services FOR

Alabama Power Company

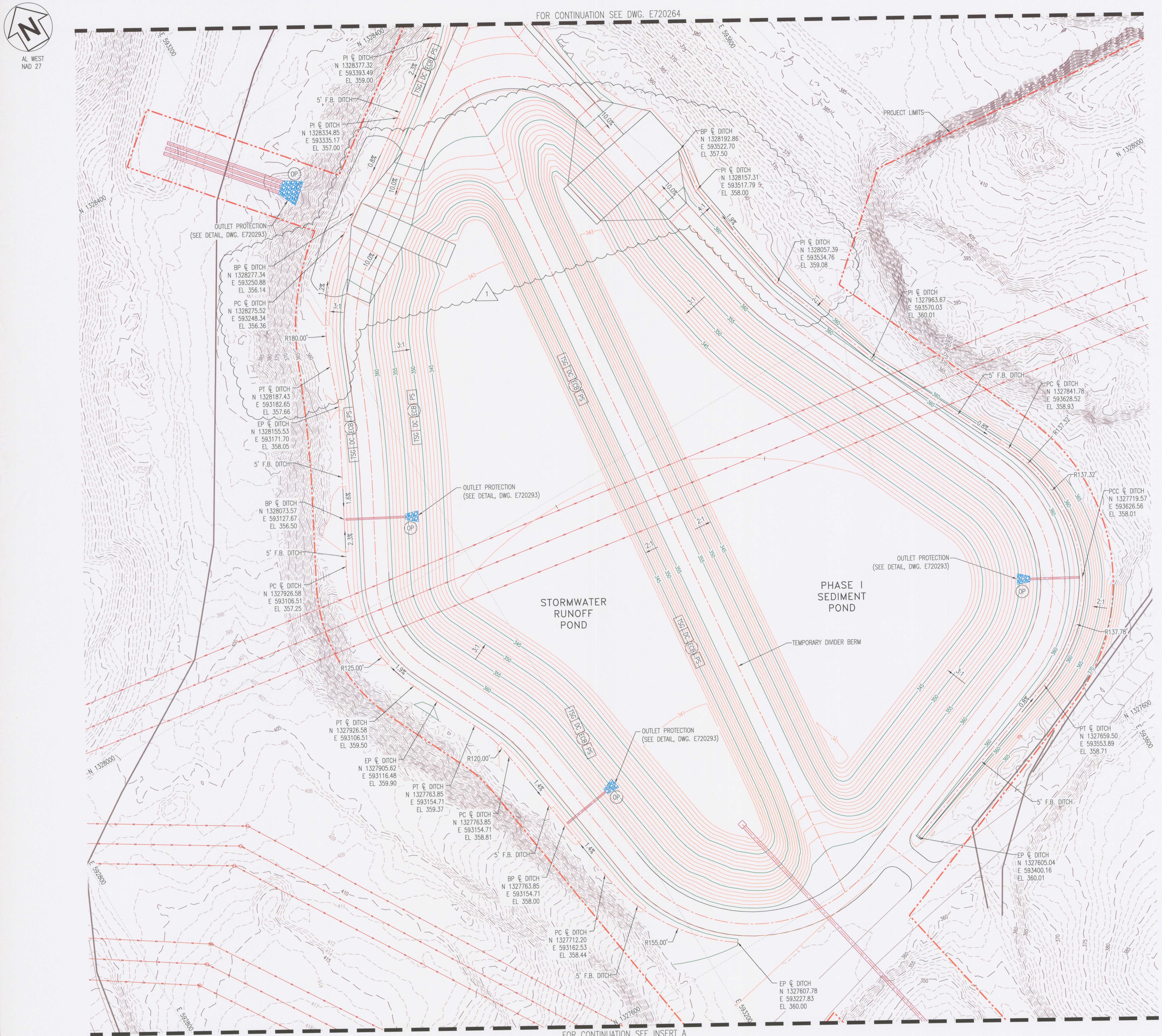
PLANT GORGAS
SITEWORK
BOTTOM ASH INITIAL LAYOUT PLAN
SHEET 3

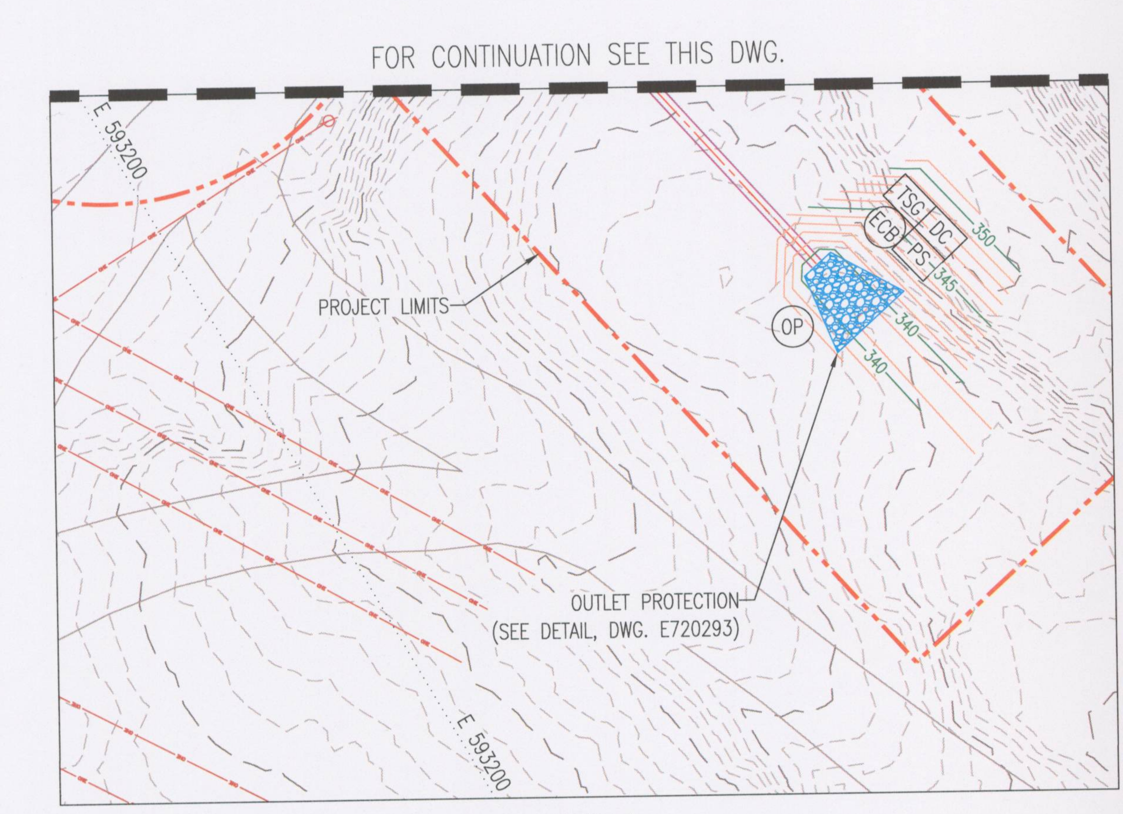
REVISION	DATE	DESCRIPTION	PROJ	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
2	03/29/19	REVISED PIPE DIAMETER	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
1	02/26/19	REVISED POND SPILLWAYS	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D
1" = 30'	E720265	1	FINAL

ANSI E

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.





INSERT A

GRAPHIC SCALE
30 0 15 30 60 120
(IN FEET)
1 inch = 30 ft.

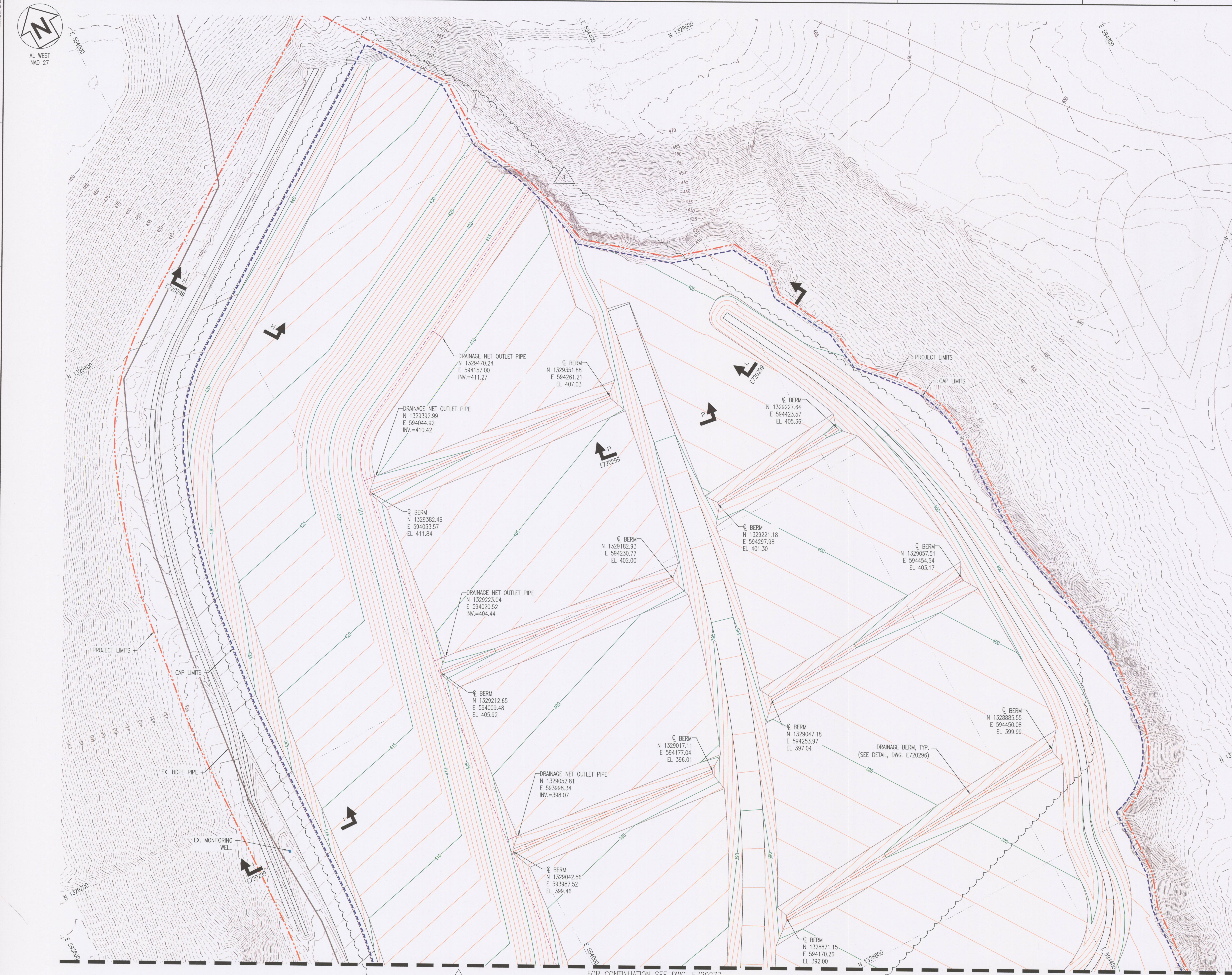
Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH INITIAL GRADING PLAN
SHEET 3

REVISION	DATE	DESCRIPTION	PROJ	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
1	02/26/19	REVISED POND SPILLWAYS	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT
1" = 30'	E720266	1	FINA

ANSI E



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

REVISION	DATE			
REVISION 1	DATE 02/26/19	REVISED CENTRAL CONVEYANCE CHANNEL AND WEST SLOPES	PROJ ID: GOR18003	BOTTOM ASH STORAGE AREA CLOSURE
REVISION 0	DATE 11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003	BOTTOM ASH STORAGE AREA CLOSURE

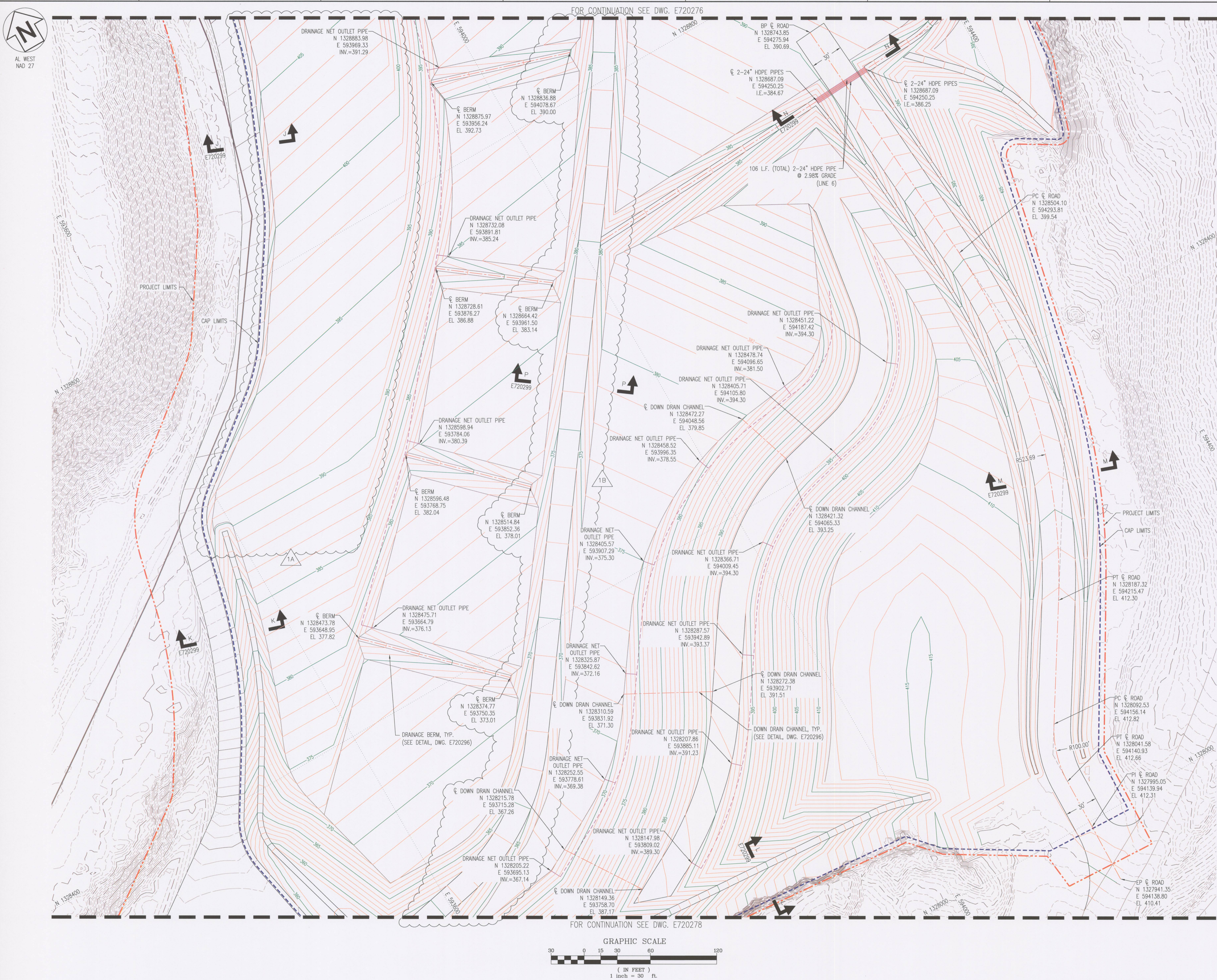
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
AES	CRU	JKB	XXX	XXX	XXX	JWM
JAA	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL LAYOUT PLAN
SHEET 1

SCALE	DRAWING NUMBER	SHEET
1" = 30'	E720276	1

ANSI



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGE

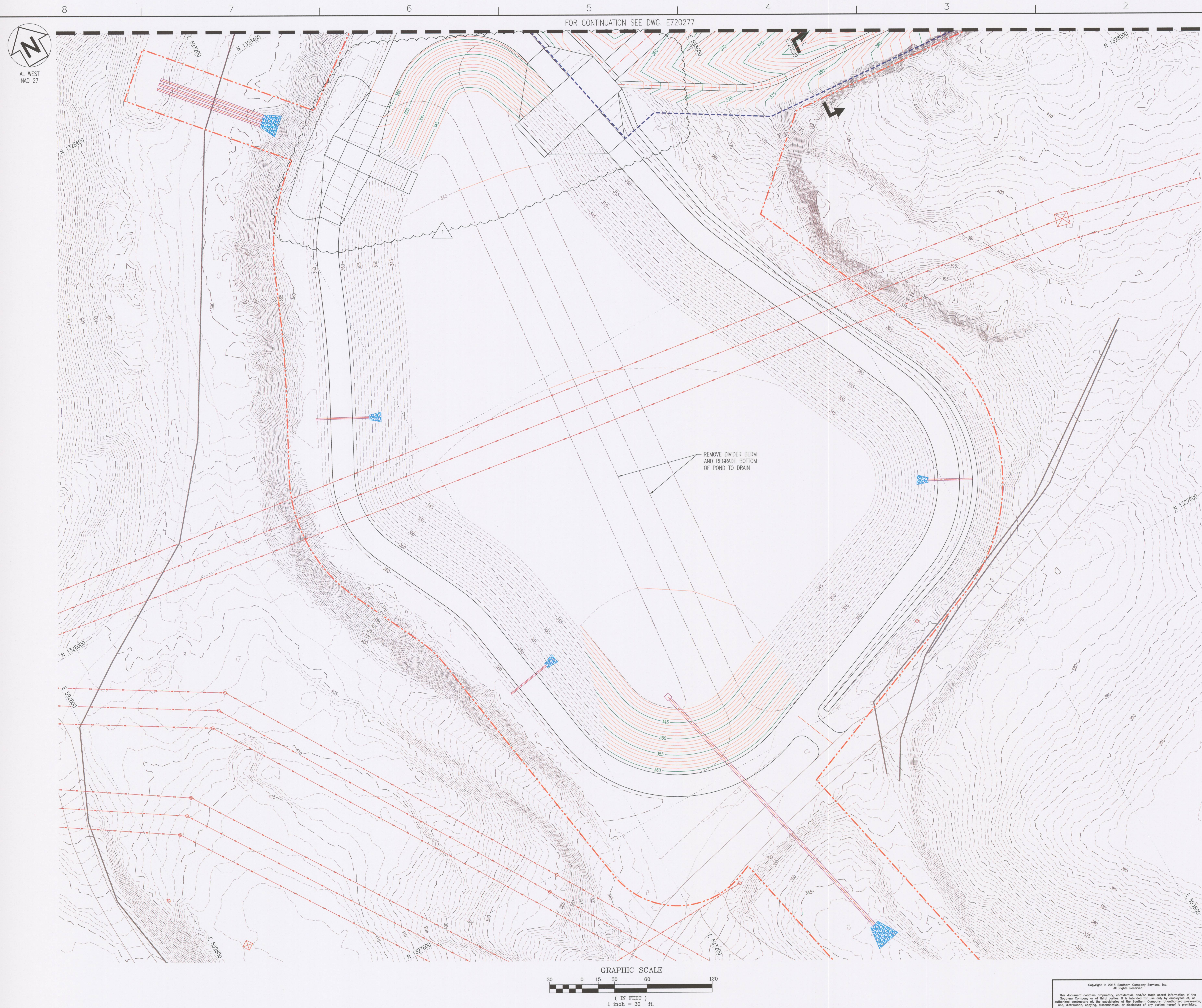
Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL LAYOUT PLAN
SHEET 2

REVISION	DATE	DESCRIPTION	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
1	02/26/19	A. REVISED WEST SLOPES B. REVISED CENTRAL CONVEYANCE CHANNEL PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D
1" = 30'	E720277	1	FINAL

ANSI E:



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND

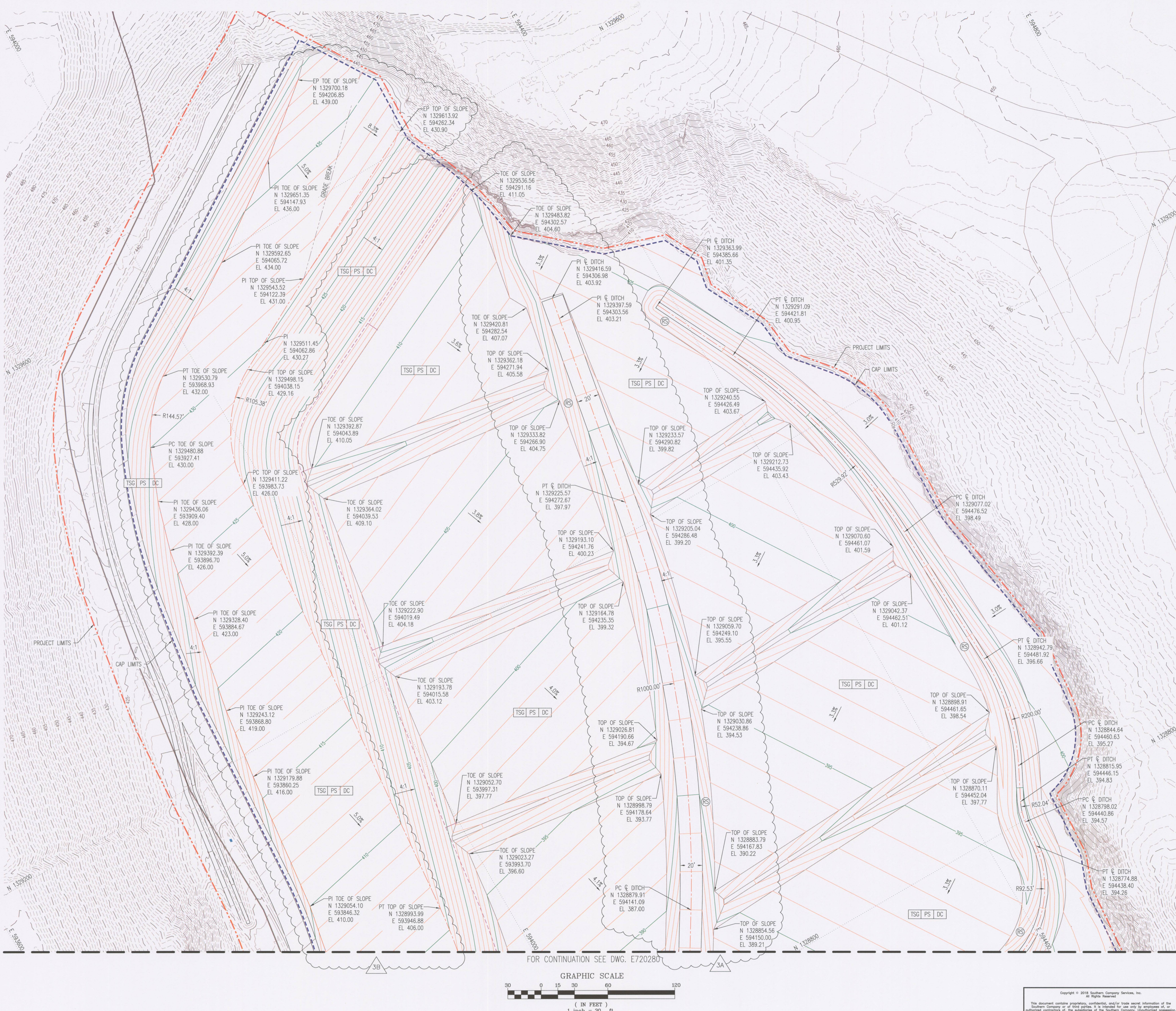
REVISION	DATE	DESCRIPTION	PROJ ID	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
1	02/26/19	REVISED POND SPILLWAYS	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL LAYOUT PLAN
SHEET 3

SCALE	DRAWING NUMBER	SHEET	CONT'D
1" = 30'	E720278	1	FINAL

ANSI E



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEG

Southern Company Generation
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FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL GRADING PLAN
SHEET 1

REVISION	DATE	DESCRIPTION	PROJ	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
3	02/26/2019	A. REVISED CENTRAL CONVEYANCE CHANNEL B. REVISED WEST SLOPES	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
2	01/24/2019	ADDED EROSION CONTROL LABELS	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JKB	AES	JKB	XXX	XXX	XXX	JWM
1	01/16/2019	ADDED EROSION CONTROL LABELS.	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	AES	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	CRU	JKB	XXX	XXX	MPB	JCP

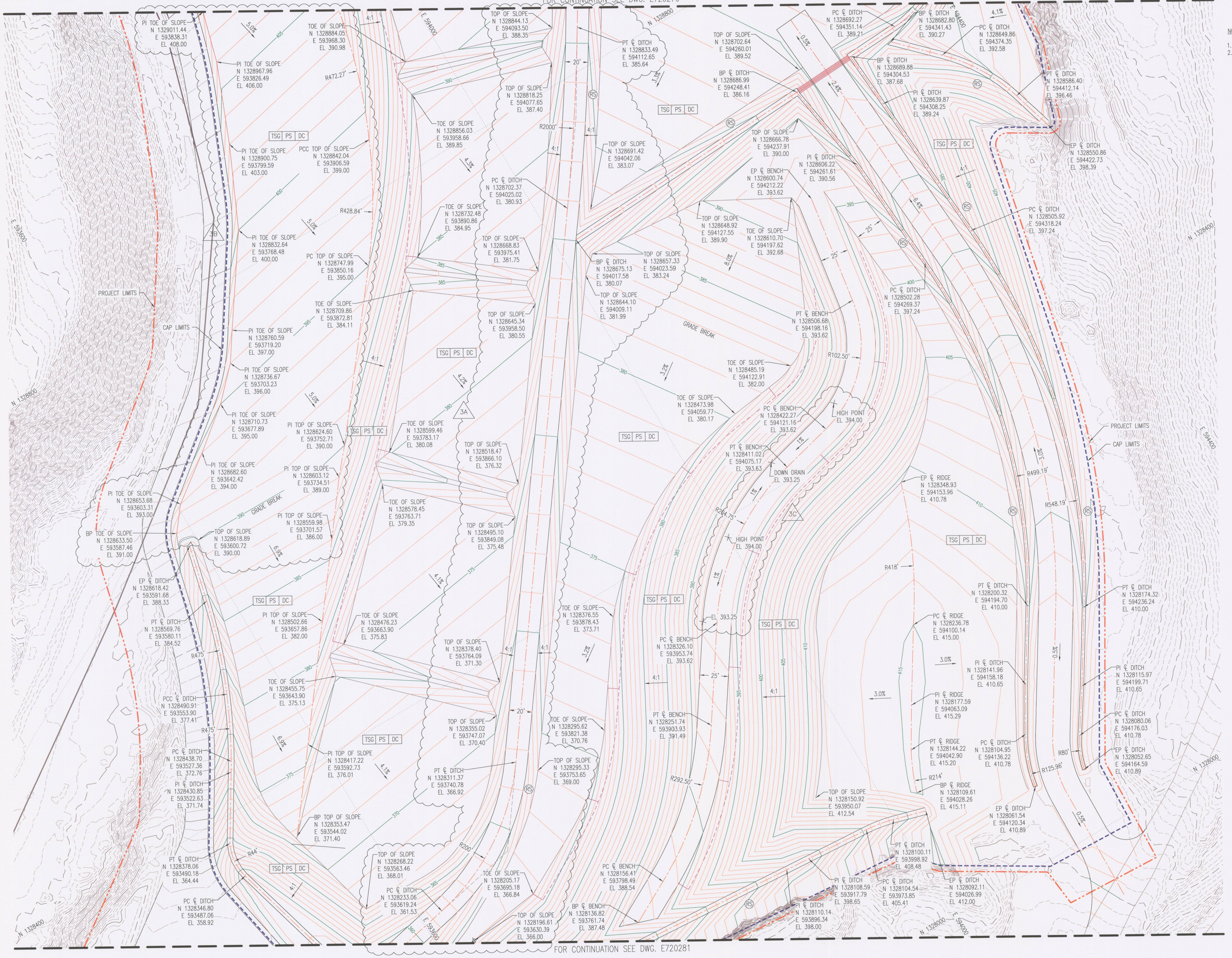
SCALE	DRAWING NUMBER	SHEET	CONT
1" = 30'	E720279	1	FINA

ANSI E

NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

FOR CONTINUATION SEE DWG. E720279



FOR CONTINUATION SEE DWG. E720281

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

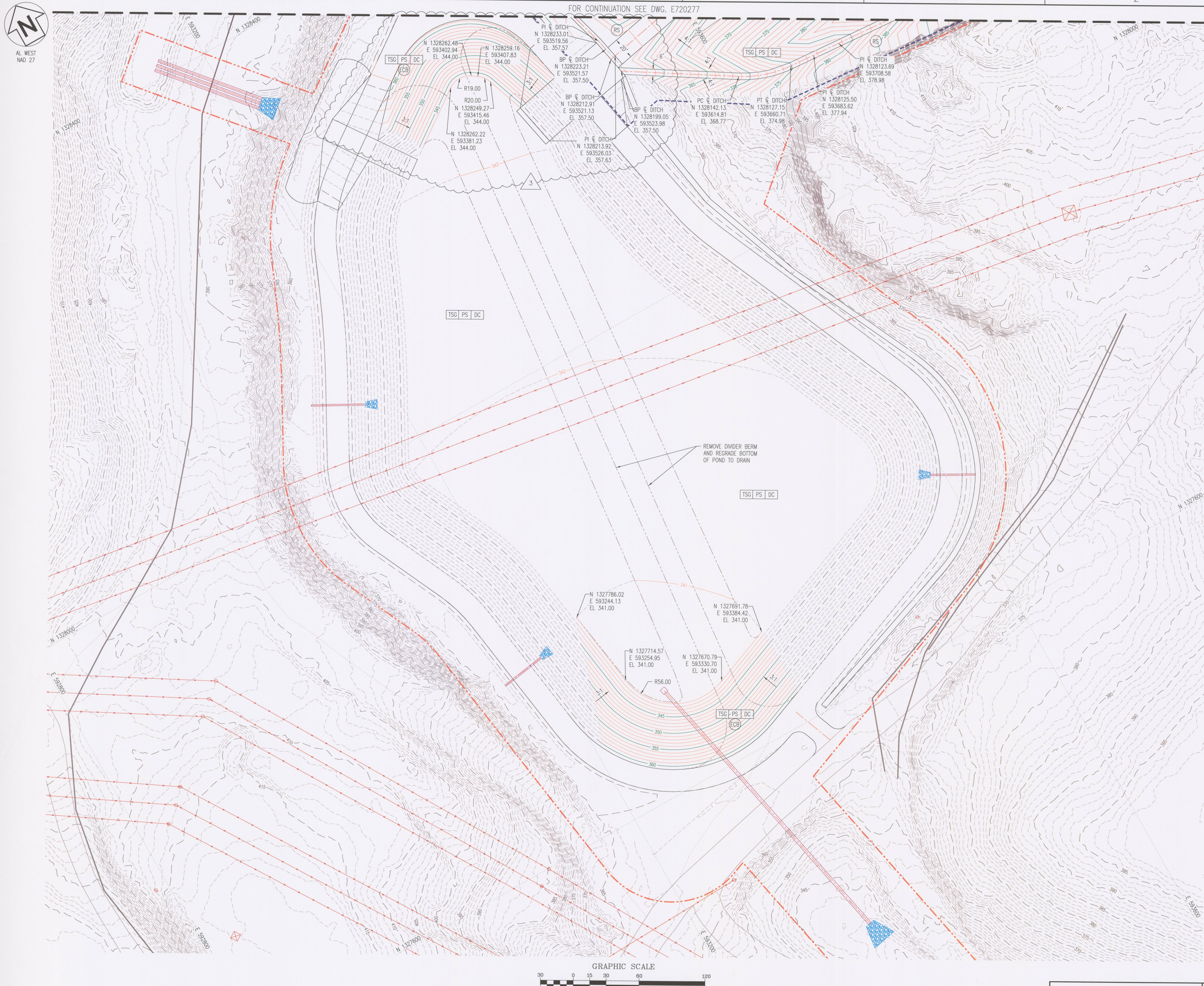
Southern Company Generation Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL GRADING PLAN
SHEET 2

REVISION	DATE	DESCRIPTION	PROJ ID	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
3	02/26/2019	A. REVISED CENTRAL CONVEYANCE CHANNEL B. REVISED WEST SLOPES C. REVISED BENCH	GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
2	01/24/2019	ADDED EROSION CONTROL LABELS	GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JKB	AES	JKB	XXX	XXX	XXX	JWM
1	01/16/2019	A. ADDED EROSION CONTROL LABELS B. ADDED ELEVATIONS AT TOE OF SLOPE.	GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	AES	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D
1" = 30'	E720280	1	FINAL

ANSI E



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

REVISION	DATE	DESCRIPTION	PROJ ID	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
0	11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	CRU	JKB	XXX	XXX	MPB	JCP
1	01/16/2019	ADDED EROSION CONTROL LABELS	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	AES	JKB	XXX	XXX	XXX	JWM
2	01/24/2019	ADDED EROSION CONTROL LABELS	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JKB	AES	JKB	XXX	XXX	XXX	JWM
3	02/26/2019	REVISED POND SPILLWAYS	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
BOTTOM ASH FINAL GRADING PLAN
SHEET 3

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 30'	E720281	1	FINAL	3

ANSI E: 44x34

TOPSOILING IS THE REMOVAL OF A DESIRABLE SOIL SURFACE, REFERRED TO AS TOPSOIL, AT A SITE PRIOR TO CONSTRUCTION AND USING IT ON AREAS TO BE VEGETATED. TOPSOILING A SITE USUALLY IMPROVES THE QUALITY OF THE PLANT GROWTH MEDIUM AT THE SITE AND INCREASES THE LIKELIHOOD OF SUCCESSFUL PLANT ESTABLISHMENT AND PERFORMANCE. THIS PRACTICE APPLIES TO SITES THAT ARE TO BE DISTURBED BY EXCAVATION, COMPACTION OR FILLING, AND TO OTHER AREAS WHERE THE SUBSOIL IS UNSUITABLE FOR PLANT GROWTH.

DESIGN CRITERIA
MATERIALS
FIELD EVALUATION OF THE SITE SHOULD BE MADE TO DETERMINE IF THERE IS SUFFICIENT SURFACE SOIL OF GOOD QUALITY TO JUSTIFY STRIPPING. TOPSOIL SHALL BE FRIABLE AND LOAMY (LOAM, SANDY LOAM, SILT LOAM, SANDY CLAY LOAM, AND CLAY LOAM). IT SHALL BE RELATIVELY FREE OF DEBRIS, TRASH, STUMPS, ROCKS, ROOTS AND NOXIOUS WEEDS, AND SHALL GIVE EVIDENCE OF BEING ABLE TO SUPPORT HEALTHY VEGETATION. IT SHALL CONTAIN NO SUBSTANCE THAT IS POTENTIALLY TOXIC TO PLANT GROWTH.

TOPSOIL SHOULD MEET THE FOLLOWING CRITERIA:
- PH RANGE SHOULD BE FROM 6.0–7.0. IF PH IS LESS THAN 6.0, LIME SHOULD BE ADDED IN ACCORDANCE WITH SOIL TEST RESULTS OR IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE VEGETATIVE ESTABLISHMENT PRACTICE BEING USED.
- SOLUBLE SALTS SHALL NOT EXCEED 500 PPM.
- IF ADDITIONAL OFF-SITE TOPSOIL IS NEEDED, IT SHOULD MEET THE STANDARDS STATED ABOVE.
- THE DEPTH OF MATERIAL MEETING THE ABOVE QUALIFICATIONS SHOULD BE AT LEAST 4". SOIL FACTORS SUCH AS ROCK FRAGMENTS, SLOPE, DEPTH TO WATER TABLE, AND LAYER THICKNESS AFFECT THE EASE OF EXCAVATION AND SPREADING OF TOPSOIL.

GENERALLY, THE UPPER PART OF THE SOIL, WHICH IS RICHEST IN ORGANIC MATTER, IS MOST DESIRABLE; HOWEVER, MATERIAL EXCAVATED FROM DEEPER LAYERS MAY BE WORTH STORING IF IT MEETS THE OTHER CRITERIA LISTED ABOVE.

STRIPPING
STRIP ONLY THOSE AREAS THAT WILL BE AFFECTED BY CONSTRUCTION OR DEVELOPMENT. A NORMAL STRIPPING DEPTH IS 4–6" BUT DEEPER DEPTHS MAY BE SATISFACTORY IF THE SOIL IS SUITABLE AND UNDERCUTTING IS ALLOWABLE IN LOCATIONS SUCH AS BUILDINGS, WATER IMPOUNDMENT STRUCTURES, ROADWAYS, ETC. APPROPRIATE SEDIMENT CONTROL MEASURES SUCH AS SEDIMENT BARRIERS, SEDIMENT BASINS, INLET PROTECTION, ETC., SHOULD BE IN PLACE BEFORE THE TOPSOIL IS STRIPPED. STRIPPING SHOULD NOT BE DONE ON AREAS INTENDED TO SUPPORT CONVENTIONAL ON-SITE EFFLUENT DISPOSAL LINES (FIELD LINES).

STOCKPILING
THE STOCKPILE LOCATION SHOULD BE OUT OF DRAINAGEWAYS AND TRAFFIC ROUTES. STOCKPILES SHOULD NOT BE PLACED ON STEEP SLOPES WHERE UNDUE EROSION WILL TAKE PLACE. MEASURES SHOULD BE TAKEN TO PREVENT EROSION OF THE STOCKPILES. THESE WOULD INCLUDE:
- MULCHING THE STOCKPILE WHEN IT IS LEFT INACTIVE FOR OVER 13 DAYS.
- PLANTING TEMPORARY VEGETATION WHEN THE STOCKPILE IS TO BE INACTIVE OVER 30 DAYS.
- COVERING THE STOCKPILE WITH PLASTIC WHENEVER THE PILES ARE SMALL AND ANY SOIL LOSS WOULD PROVIDE SEDIMENT TO DAMAGE EXISTING BUILDINGS OR FACILITIES OR ENTER WATERS.
- PLANTING PERMANENT VEGETATION WHEN THE STOCKPILE USE WILL BE INACTIVE OVER 12 MONTHS.
- IN CASES WHERE THE STOCKPILE IS SMALL AND WILL BE REMOVED IN LESS THAN 14 DAYS, IT MAY BE MORE PRACTICAL TO USE A SEDIMENT BARRIER THAN AN EROSION CONTROL PRACTICE.

SITE PREPARATION
AREAS TO BE COVERED WITH TOPSOIL SHALL BE EXCAVATED, GRADED, FILLED AND SHAPED TO THE PROPER LINES, GRADES AND ELEVATIONS BEFORE TOPSOIL PLACEMENT IS STARTED.
THE SUBGRADES SHOULD BE CHECKED FOR PH AND LIMED IF IT IS LESS THAN 6.0. LIMING SHALL BE DONE IN ACCORDANCE WITH SOIL TESTS AND IN RELATION TO THE SEEDING MIXTURE TO BE PLANTED. INCORPORATE LIME TO A DEPTH OF AT LEAST 2" BY DISKING.

APPLYING TOPSOIL
THE SUBSOIL SHOULD BE DISKED OR CHISELED TO A DEPTH OF 2" OR MORE TO ENHANCE BONDING OF THE SUBSOIL AND TOPSOIL, IMMEDIATELY BEFORE PLACEMENT OF TOPSOIL. TOPSOIL SHOULD BE UNIFORMLY SPREAD TO A MINIMUM COMPACTED DEPTH OF 4". REQUIRED VOLUMES OF TOPSOIL MAY BE DETERMINED USING TABLE TSG-1.

TABLE TSG-1 VOLUME OF SOIL NEEDED FOR TOPSOILING

DEPTH TO SPREAD (INCHES)	CUBIC YARDS PER 1000 SQ. FT.	CUBIC YARDS PER ACRE
1	3.1	134
2	6.2	268
3	9.3	403
4	12.4	537
5	15.5	672
6	18.6	806

WHEN APPLYING TOPSOIL, MAINTAIN NEEDED EROSION CONTROL PRACTICES SUCH AS DIVERSIONS, GRASSED SWALES, LINED SWALES, ETC. TOPSOIL SHOULD NOT BE SPREAD WHEN IT OR THE SUBGRADE IS FROZEN OR MUDDY.

PRECAUTIONS SHOULD BE TAKEN TO PREVENT LAYERING OF THE TOPSOIL OVER THE SUBSOIL.
MIXING AND BONDING OF THE TWO SOILS SHOULD BE ENHANCED.

SETTLING OF THE TOPSOIL IS NECESSARY TO BOND THE SOILS TOGETHER, BUT EXCESSIVE COMPACTION SHOULD BE PREVENTED. LIGHT COMPACTION IS NECESSARY TO INCREASE SOIL STRENGTH, REDUCE EROSION AND ENHANCE VEGETATION ESTABLISHMENT.

EXCESSIVE COMPACTION SHOULD BE PROHIBITED AS IT INCREASES RUNOFF AND INHIBITS SEED GERMINATION AND ROOT DEVELOPMENT.

SURFACE IRREGULARITIES THAT WOULD IMPEDE DRAINAGE, INCREASE EROSION OR OTHERWISE DAMAGE THE SITE SHOULD BE REMOVED IN FINAL GRADING.

MAINTENANCE
INSPECT TOPSOILED AREAS FREQUENTLY UNTIL VEGETATION IS ESTABLISHED.

REPAIR ERODED OR DAMAGED AREAS AND REVEGETATE.

REPAIR SLOUGHING ON STEEP SLOPES – REMOVE TOPSOIL, ROUGHEN SUBGRADE AND RESPREAD TOPSOIL. CONSULT WITH QUALIFIED DESIGN PROFESSIONAL IF DRAINAGE (WETNESS CAUSED BY SEEPAGE) OR SHALLOWNESS TO BEDROCK (LESS THAN 24") IS INVOLVED.

TOPSOILING (TSG)

TEMPORARY SEEDING IS THE ESTABLISHMENT OF FAST-GROWING ANNUAL VEGETATION FROM SEED ON DISTURBED AREAS. TEMPORARY VEGETATION PROVIDES ECONOMICAL EROSION CONTROL FOR UP TO A YEAR AND REDUCES THE AMOUNT OF SEDIMENT MOVING OFF THE SITE. THIS PRACTICE APPLIES WHERE SHORT-LIVED VEGETATION CAN BE ESTABLISHED BEFORE FINAL GRADING OR IN A SEASON NOT SUITABLE FOR PLANTING THE DESIRED PERMANENT SPECIES. IT HELPS PREVENT COSTLY MAINTENANCE OPERATIONS ON OTHER PRACTICES SUCH AS SEDIMENT BASINS AND SEDIMENT BARRIERS. IN ADDITION, IT REDUCES PROBLEMS OF MUD AND DUST PRODUCTION FROM BARE SOIL SURFACES DURING CONSTRUCTION. TEMPORARY OR PERMANENT SEEDING IS NECESSARY TO PROTECT EARTHEN STRUCTURES SUCH AS DIKES, DIVERSIONS, GRASS-LINED CHANNELS AND THE BANKS AND DAMS OF SEDIMENT BASINS.

DESIGN CRITERIA
PLANT SELECTION
SELECT PLANTS THAT CAN BE EXPECTED TO MEET PLANTING OBJECTIVES. TO SIMPLIFY PLANT SELECTION, USE TABLE TS-1 ON THIS DRAWING AND FIGURE TS-1, GEOGRAPHICAL AREAS FOR SPECIES ADAPTATION AND SEEDING DATES, AS FOUND ON PAGE 159 IN THE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1. SEEDING MIXTURES COMMONLY SPECIFIED BY THE ALABAMA DEPARTMENT OF TRANSPORTATION ARE AN APPROPRIATE ALTERNATIVE FOR PLANTINGS ON RIGHTS-OF-WAYS. **NOTE: JEFFERSON COUNTY IS LOCATED IN THE NORTH GEOGRAPHICAL AREA FOR SPECIES ADAPTATION AND SEEDING DATES** (FIGURE TS-1).

TABLE TS-1 COMMONLY USED PLANTS FOR TEMPORARY COVER

SPECIES	SEEDING RATES/AC PLS	NORTH	CENTRAL	SOUTH
		SEEDING DATES		
MILLET, BROWNTOP, OR GERMAN	40 LBS	MAY 1–AUG 1	APR 1–AUG 15	APR 1–AUG 15
RYE	3 BU	SEP 1–NOV 15	SEP 15–NOV 15	SEP 15–NOV 15
RYEGRASS	30 LBS	AUG 1–SEP 15	SEP 1–OCT 15	SEP 1–OCT 15
SORGHUM-SUDAN HYBRIDS	40 LBS	MAY 1–AUG 1	APR 15–AUG 1	APR 1–AUG 15
SUDANGRASS	40 LBS	MAY 1–AUG 1	APR 15–AUG 1	APR 1–AUG 15
WHEAT	3 BU	SEP 1–NOV 1	SEP 15–NOV 15	SEP 15–NOV 15
COMMON BERMUDAGRASS	10 LBS	APR 1–JULY 1	MAR 15–JULY 15	MAR 1–JULY 15
CRIMSON CLOVER	10 LBS	SEP 1–NOV 1	SEP 1–NOV 1	SEP 1–NOV 1

PLS MEANS PURE LIVE SEED AND IS USED TO ADJUST SEEDING RATES. FOR EXAMPLE, TO PLANT 10 LBS PLS OF A SPECIES WITH GERMINATION OF 80% AND PURITY OF 90%, PLS=0.8X0.9=72%.
10 LBS PLS=10/0.72=13.9 LBS OF THE SPECIES TO BE PLANTED.

SITE PREPARATION AND SOIL AMENDMENTS
COMPLETE GRADING AND SHAPING BEFORE APPLYING SOIL AMENDMENTS IF NEEDED TO PROVIDE A SURFACE ON WHICH EQUIPMENT CAN SAFELY AND EFFICIENTLY BE USED TO APPLY SOIL AMENDMENTS AND ACCOMPLISH SEEDBED PREPARATION AND SEEDING.

LIME
APPLY LIME ACCORDING TO SOIL TEST RECOMMENDATIONS. IF A SOIL TEST IS NOT AVAILABLE, USE 1 TON OF AGRICULTURAL LIMESTONE OR EQUIVALENT PER ACRE ON COARSE TEXTURED SOILS AND 2 TONS PER ACRE ON FINE TEXTURED SOILS. DO NOT APPLY LIME TO ALKALINE SOILS OR TO AREAS WHICH HAVE BEEN LIMED DURING THE PRECEDING 2 YEARS. OTHER LIMING MATERIALS THAT MAY BE SELECTED SHOULD BE PROVIDED IN AMOUNTS THAT PROVIDE EQUAL VALUE TO THE CRITERIA LISTED FOR AGRICULTURAL LIME OR BE USED IN COMBINATION WITH AGRICULTURAL LIMESTONE OR SELMA CHALK TO PROVIDE EQUIVALENT VALUES TO AGRICULTURAL LIMESTONE.

FERTILIZER
APPLY FERTILIZER ACCORDING TO SOIL TEST RESULTS. IF A SOIL TEST IS NOT AVAILABLE, APPLY 8-24-24 FERTILIZER.

WHEN VEGETATION HAS EMERGED TO A STAND AND IS GROWING, 30 TO 40 LBS/ACRE (APPROXIMATELY 0.8 LBS/1000 FT^2) OF ADDITIONAL NITROGEN FERTILIZER SHOULD BE APPLIED.

NOTE: FERTILIZER CAN BE BLENDED TO MEET EXACT FERTILIZER RECOMMENDATIONS. TAKE SOIL TEST RECOMMENDATIONS TO LOCAL FERTILIZER DEALER FOR BULK FERTILIZER BLENDS. THIS MAY BE MORE ECONOMICAL THAN BAGGED FERTILIZER.

APPLICATION OF SOIL AMENDMENTS
INCORPORATE LIME AND FERTILIZER INTO THE TOP 6" OF SOIL DURING SEEDBED PREPARATION.

SEEDBED PREPARATION
GOOD SEEDBED PREPARATION IS ESSENTIAL TO SUCCESSFUL PLANT ESTABLISHMENT. A GOOD SEEDBED IS WELL PULVERIZED, LOOSE, AND SMOOTH. IF SOILS BECOME COMPACTED DURING GRADING, LOOSEN THEM TO A DEPTH OF 6" TO 8" USING A RIPPER OR CHISEL PLOW. **IF RAINFALL HAS CAUSED THE SURFACE TO BECOME SEALED OR CRUSTED, LOOSEN IT JUST PRIOR TO SEEDING BY DISKING, RAKING, HARROWING, OR OTHER SUITABLE METHODS. WHEN HYDROSEEDING METHODS ARE USED, THE SURFACE SHOULD BE LEFT WITH A MORE IRREGULAR SURFACE OF CLODS.**

PLANTING METHODS
SEEDING
EVENLY APPLY SEED USING A CYCLONE SEEDER (BROADCAST), DRILL SEEDER, CULTIPACKER SEEDER, OR HYDROSEEDER. BROADCAST SEEDING AND HYDROSEEDING ARE APPROPRIATE FOR STEEP SLOPES WHERE EQUIPMENT CANNOT OPERATE SAFELY. SMALL GRAINS SHOULD BE PLANTED NO MORE THAN 1" DEEP, AND GRASSES AND LEGUMES NO MORE THAN ½" DEEP. SEED THAT ARE BROADCAST MUST BE COVERED BY RAKING OR CHAIN DRAGGING, AND THEN LIGHTLY FIRMED WITH A ROLLER OR CULTIPACKER.

HYDROSEEDING
SURFACE ROUGHENING IS PARTICULARLY IMPORTANT WHEN HYDROSEEDING, AS A ROUGHENED SLOPE WILL PROVIDE SOME NATURAL COVERAGE FOR LIME, FERTILIZER, AND SEED. THE SURFACE SHOULD NOT BE COMPACTED OR SMOOTH. FINE SEEDBED PREPARATION IS NOT NECESSARY FOR HYDROSEEDING OPERATIONS; LARGE CLODS, STONES, AND IRREGULARITIES PROVIDE CAVITIES IN WHICH SEEDS CAN LODGE.
MIX SEED, INOCULANT IF REQUIRED, AND A SEED CARRIER WITH WATER AND APPLY AS A SLURRY UNIFORMLY OVER THE AREA TO BE TREATED. THE SEED CARRIER SHOULD BE A CELLULOSE FIBER, NATURAL WOOD FIBER OR OTHER APPROVED FIBER MULCH MATERIAL WHICH IS DYED AN APPROPRIATE COLOR TO FACILITATE UNIFORM APPLICATION OF SEED. USE THE CORRECT LEGUME INOCULANT AT 4 TIMES THE RECOMMENDED RATE WHEN ADDING INOCULANT TO A HYDROSEEDER SLURRY. THE MIXTURE SHOULD BE APPLIED WITHIN ONE HOUR AFTER MIXING TO REDUCE DAMAGE TO SEED.
FERTILIZER SHOULD NOT BE MIXED WITH THE SEED-INOCULANT MIXTURE BECAUSE FERTILIZER SALTS MAY DAMAGE SEED AND REDUCE GERMINATION AND SEEDLING VIGOR. FERTILIZER MAY BE APPLIED WITH A HYDROSEEDER AS A SEPARATE OPERATION AFTER SEEDLINGS ARE ESTABLISHED.

MULCHING
THE USE OF APPROPRIATE MULCH PROVIDES INSTANT COVER AND HELPS ENSURE ESTABLISHMENT OF VEGETATION UNDER NORMAL CONDITIONS AND IS ESSENTIAL TO SEEDING SUCCESS UNDER HARSH SITE CONDITIONS (SEE MULCHING PRACTICE FOR GUIDANCE). HARSH SITE CONDITIONS INCLUDE THE FOLLOWING: SLOPES STEEPER THAN 3:1 AND ADVERSE SOILS (SOILS THAT ARE SHALLOW TO ROCK, ROCKY, OR HIGH IN CLAY OR SAND). AREAS WITH CONCENTRATED FLOW SHOULD BE TREATED DIFFERENTLY AND REQUIRE A HYDROMULCH FORMULATED FOR CHANNELS OR AN APPROPRIATE EROSION CONTROL BLANKET.

MAINTENANCE
RESEEDING
INSPECT SEEDINGS WEEKLY UNTIL A STAND IS ESTABLISHED AND THEREAFTER AT LEAST MONTHLY FOR STAND SURVIVAL AND VIGOR. ALSO, INSPECT THE SITE FOR EROSION.
ERODED AREAS SHOULD BE ADDRESSED APPROPRIATELY BY FILLING AND/OR SMOOTHING, AND REAPPLICATION OF LIME, FERTILIZER, SEED AND MULCH.
A STAND SHOULD BE UNIFORM AND DENSE FOR BEST RESULTS. STAND CONDITIONS, PARTICULARLY THE COVERAGE, WILL DETERMINE THE EXTENT OF REMEDIAL ACTIONS SUCH AS SEEDBED PREPARATION AND RESEEDING. A QUALIFIED DESIGN PROFESSIONAL SHOULD BE CONSULTED TO ADVISE ON REMEDIAL ACTIONS. CONSIDER DRILL SEEDING WHEN DOING A REMEDIAL PLANTING.

FERTILIZING
IF VEGETATION FAILS TO GROW, HAVE THE SOIL TESTED TO DETERMINE WHETHER pH IS IN THE CORRECT RANGE OR NUTRIENT DEFICIENCY IS A PROBLEM.
SATISFACTORY ESTABLISHMENT MAY REQUIRE REFERTILIZING THE STAND, ESPECIALLY IF THE PLANTING IS MADE EARLY IN THE PLANTING SEASON. FOLLOW SOIL TEST RECOMMENDATIONS OR THE SPECIFICATIONS PROVIDED TO ESTABLISH THE PLANTING.

MOWING
TEMPORARY PLANTINGS MAY BE MOWED AND BALED OR SIMPLY MOWED TO COMPLIMENT THE USE OF THE SITE.
MILLET, SORGHUM-SUDAN HYBRIDS, SUDANGRASS, RYE AND WHEAT MAY BE MOWED, BUT NO LOWER THAN 6" (CLOSER MOVING MAY DAMAGE THE STAND).
RYEGRASS IS TOLERANT OF MOST MOWING REGIMES AND MAY BE MOWED OFTEN AND AS CLOSE AS 4" TO 6" IF THIS REGIME IS STARTED BEFORE IT ATTAINS TALL GROWTH (OVER 8").
BERMUDAGRASS IS TOLERANT OF MOST MOWING REGIMES AND CAN BE MOWED OFTEN AND CLOSE, IF SO DESIRED, DURING ITS GROWING SEASON.

TEMPORARY SEEDING (TS) (TS)

PERMANENT SEEDING IS THE ESTABLISHMENT OF PERENNIAL VEGETATION ON DISTURBED AREAS FROM SEED. PERMANENT VEGETATION PROVIDES ECONOMICAL LONG-TERM EROSION CONTROL AND HELPS PREVENT SEDIMENT FROM LEAVING THE SITE. THIS PRACTICE IS USED WHEN VEGETATION IS DESIRED AND APPROPRIATE TO PERMANENTLY STABILIZE THE SOIL.

DESIGN CRITERIA
PLANT SELECTION
SELECT PLANTS THAT CAN BE EXPECTED TO MEET PLANTING OBJECTIVES. TO SIMPLIFY PLANT SELECTION, USE FIGURE PS-1 GEOGRAPHICAL AREAS FOR SPECIES ADAPTATION AND SEEDING DATES FOUND ON PAGE 121 OF THE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1, AND TABLE PS-1 ON THIS DRAWING, COMMONLY USED PLANTS FOR PERMANENT COVER. MIXTURES COMMONLY SPECIFIED BY THE ALABAMA DEPARTMENT OF TRANSPORTATION ARE AN APPROPRIATE ALTERNATIVE FOR PLANTINGS ON RIGHTS-OF-WAYS.

THE PLANTS USED FOR TEMPORARY VEGETATION MAY BE USED FOR COMPANION PLANTS PROVIDED THE SEEDING RATE IS REDUCED BY ONE HALF. SEE THE TEMPORARY SEEDING PRACTICE FOR ADDITIONAL INFORMATION ON ESTABLISHING TEMPORARY VEGETATION. RYEGRASS OR OTHER HIGHLY COMPETITIVE PLANTS SHOULD NOT BE USED AS A COMPANION PLANT.

TABLE PS-1 COMMONLY USED PLANTS FOR PERMANENT COVER WITH SEEDING RATES AND DATES

SPECIES	SEEDING RATES/AC PLS	NORTH	CENTRAL	SOUTH
		SEEDING DATES		
BAHIAGRASS, PENSACOLA	40 LBS	--	MAR 1–JULY 1	FEB 1–NOV 1
BERMUDAGRASS, COMMON	10 LBS	APR 1–JULY 1	MAR 15–JULY 15	MAR 1–JULY 15
BAHIAGRASS, PENSACOLA BERMUDAGRASS, COMMON	30 LBS 5 LBS	--	MAR 1–JULY 1	MAR 1–JULY 15
BERMUDAGRASS, HYBRID (LAWN TYPES)	SOLID SOD	ANYTIME	ANYTIME	ANYTIME
BERMUDAGRASS, HYBRID (LAWN TYPES)	SPRIGS 1/SQ FT	MAR 1–AUG 1	MAR 1–AUG 1	FEB 15–SEP 1
FESCUE, TALL	40–50 LBS	SEP 1–NOV 1	SEP 1–NOV 1	--
SERICEA	40–60 LBS	MAR 15–JULY 15	MAR 1–JULY 15	FEB 15–JULY 15
SERICEA & COMMON BERMUDAGRASS	40 LBS 10 LBS	MAR 15–JULY 15	MAR 1–JULY 15	FEB 15–JULY 15
SWITCHGRASS, ALAMO	4 LBS	APR 1–JUN 15	MAR 15–JUN 15	MAR 15–JUN 15

PLS MEANS PURE LIVE SEED AND IS USED TO ADJUST SEEDING RATES. FOR EXAMPLE, TO PLANT 10 LBS PLS OF A SPECIES WITH GERMINATION OF 80% AND PURITY OF 90%, PLS = 0.8 X 0.9 = 72%. 10 LBS PLS = 10/0.70 = 13.9 LBS. OF THE SPECIES TO BE PLANTED.

SEEDBED REQUIREMENTS
ESTABLISHMENT OF VEGETATION SHOULD NOT BE ATTEMPTED ON SITES THAT ARE UNSUITABLE DUE TO COMPACTION OR INAPPROPRIATE SOIL TEXTURE, POOR DRAINAGE, CONCENTRATED OVERLAND FLOW, OR STEEPNESS OF SLOPE UNTIL MEASURES HAVE BEEN COMPLETED TO CORRECT THESE PROBLEMS. TO MAINTAIN A GOOD STAND OF VEGETATION, THE SOIL MUST MEET CERTAIN MINIMUM REQUIREMENTS AS A GROWTH MEDIUM. A GOOD GROWTH MEDIUM SHOULD HAVE THESE ATTRIBUTES:
- SUFFICIENT PORE SPACE TO PERMIT ROOT PENETRATION.
- ENOUGH FINE-GRAINED SOIL MATERIAL (SILT AND CLAY) TO MAINTAIN ADEQUATE MOISTURE AND NUTRIENT SUPPLY.
- SUFFICIENT DEPTH OF SOIL TO PROVIDE AN ADEQUATE ROOT ZONE. THE DEPTH TO ROCK OR IMPERMEABLE LAYERS SUCH AS HARDPANS SHOULD BE 12" FOR MORE, EXCEPT ON SLOPES STEEPER THAN 2:1 WHERE TOPSOILING IS NOT FEASIBLE.
- A FAVORABLE pH RANGE FOR PLANT GROWTH, USUALLY 6.0–6.5.
- SUFFICIENT NUTRIENTS (NITROGEN, PHOSPHORUS AND POTASSIUM) FOR INITIAL PLANT ESTABLISHMENT.
- FREEDOM FROM LARGE ROOTS, BRANCHES, STONES, OR LARGE CLODS. CLODS AND STONES MAY BE LEFT ON SLOPES STEEPER THAN 3:1 IF THEY ARE TO BE HYDROSEEDED.

IF ANY OF THE ABOVE ATTRIBUTES ARE NOT MET: I.E., IF THE EXISTING SOIL IS TOO DENSE, COARSE, SHALLOW OR ACIDIC TO FOSTER VEGETATION – CHISELING, TOPSOIL, OR SPECIAL AMENDMENTS SHOULD BE USED TO IMPROVE SOIL CONDITIONS. THE SOIL CONDITIONERS DESCRIBED BELOW MAY BE BENEFICIAL OR TOPSOIL MAY BE APPLIED (FOR GUIDANCE ON TOPSOILING SEE TOPSOILING PRACTICE). THESE AMENDMENTS SHOULD ONLY BE NECESSARY WHERE SOILS HAVE LIMITATIONS THAT MAKE THEM POOR FOR PLANT GROWTH OR FOR ESTABLISHMENT.
- PEAT – APPROPRIATE TYPES ARE SPHAGNUM MOSS PEAT, REED-SEDGE PEAT, OR PEAT HUMUS, ALL FROM FRESH-WATER SOURCES. PEAT SHOULD BE SHREDDED AND CONDITIONED IN STORAGE PILES FOR AT LEAST 6 MONTHS AFTER EXCAVATION.
- SAND – SHOULD BE CLEAN AND FREE OF TOXIC MATERIALS.
- VERMICULITE – USE HORTICULTURAL GRADE.
- ROTTED MANURE – USE STABLE OR CATTLE MANURE NOT CONTAINING UNDUE AMOUNTS OF STRAW OR OTHER BEDDING MATERIALS.
- THOROUGHLY ROTTED SAWDUST – SHOULD BE FREE OF STONES AND DEBRIS. ADD 6 LBS OF NITROGEN TO EACH CUBIC YARD.

SOIL AMENDMENTS
LIMING MATERIALS
LIME (AGRICULTURAL LIMESTONE) SHOULD HAVE A NEUTRALIZING VALUE OF NOT LESS THAN 90 PERCENT CALCIUM CARBONATE EQUIVALENT AND 90 PERCENT WILL PASS THROUGH A 10 MESH SIEVE AND 50 PERCENT WILL PASS THROUGH A 60 MESH SIEVE.

SELMA CHALK SHOULD HAVE A NEUTRALIZING VALUE OF NOT LESS THAN 80 PERCENT CALCIUM CARBONATE EQUIVALENT AND 90 PERCENT WILL PASS THROUGH A 10 MESH SIEVE.

OTHER LIMING MATERIALS THAT MAY BE SELECTED SHOULD BE PROVIDED IN AMOUNTS THAT PROVIDE EQUAL VALUE TO THE CRITERIA LISTED FOR AGRICULTURAL LIME OR BE USED IN COMBINATION WITH AGRICULTURAL LIMESTONE OR SELMA CHALK TO PROVIDE EQUIVALENT VALUES TO AGRICULTURAL LIMESTONE.

PLANT NUTRIENTS
COMMERCIAL GRADE FERTILIZERS THAT COMPLY WITH CURRENT ALABAMA FERTILIZER LAWS SHOULD BE USED TO SUPPLY NUTRIENTS REQUIRED TO ESTABLISH VEGETATION.

LIME AND FERTILIZER NEEDS SHOULD BE DETERMINED BY SOIL TESTS. SOIL TESTING IS PERFORMED BY THE AUBURN UNIVERSITY SOIL TESTING LABORATORY AND PROVIDES RECOMMENDATIONS BASED ON FIELD TESTS ON ALABAMA SOILS. THE LOCAL COUNTY COOPERATIVE EXTENSION SERVICE CAN PROVIDE INFORMATION ON OBTAINING SOIL TESTS. COMMERCIAL LABORATORIES THAT MAKE RECOMMENDATIONS BASED ON SOIL ANALYSIS MAY BE USED.

WHEN SOIL TESTS ARE NOT AVAILABLE, USE THE FOLLOWING RATES FOR APPLICATION OF SOIL AMENDMENTS.

SANDY SOILS: USE 1 TON/ACRE (EXCEPTION ON SANDY SOILS – IF THE COVER WILL BE TALL FESCUE AND CLOVER USE 2 TONS/ACRE).
CLAYEY SOILS: 2 TONS/ACRE
(DO NOT APPLY LIME TO ALKALINE SOILS).

GRASSES ALONE: USE 400 LBS/ACRE OF 8-24-24 OR THE EQUIVALENT. APPLY 30 LBS OF ADDITIONAL NITROGEN WHEN GRASS HAS EMERGED AND BEGUN GROWTH (APPROXIMATELY 0.8 LBS/1000 FT^2).
GRASS-LEGUME MIXTURES: USE 800 TO 1200 LBS/ACRE OF 5-10-10 OR THE EQUIVALENT.
LEGUMES ALONE: USE 400 TO 600 LBS/ACRE OF 0-20-20 OR THE EQUIVALENT.

NOTE: FERTILIZER CAN BE BLENDED TO MEET EXACT FERTILIZER RECOMMENDATIONS. TAKE SOIL TEST RECOMMENDATIONS TO LOCAL FERTILIZER DEALER FOR BULK FERTILIZER BLENDS. THIS MAY BE MORE ECONOMICAL THAN BAGGED FERTILIZER.

APPLICATION OF SOIL AMENDMENTS
APPLY LIME AND FERTILIZER EVENLY AND INCORPORATE INTO THE TOP 6" OF SOIL BY DISKING, CHISELING OR OTHER SUITABLE MEANS DURING SEEDBED PREPARATION. OPERATE MACHINERY ON THE CONTOUR. ON SITES TOO STEEP FOR SEEDBED PREPARATION, FERTILIZER AND LIME CAN BE APPLIED WITH A HYDROSEEDER.

SEEDBED PREPARATION
IF NEEDED, GRADE AND SHAPE TO PROVIDE A SURFACE ON WHICH EQUIPMENT CAN SAFELY AND EFFICIENTLY BE USED FOR SEEDBED PREPARATION AND SEEDING.

INSTALL NECESSARY SEDIMENT CONTROL PRACTICES BEFORE SEEDBED PREPARATION AND COMPLETE GRADING ACCORDING TO THE APPROVED PLAN.

PREPARE A FRIABLE SEEDBED WITH TILLAGE TO A DEPTH OF AT LEAST 6". BREAK UP LARGE CLODS, ALLEVIATE COMPACTION, AND SMOOTH AND FIRM THE SOIL INTO A UNIFORM SURFACE. FILL IN OR LEVEL DEPRESSIONS THAT CAN COLLECT WATER.

PLANTING METHODS
SEEDING
USE CERTIFIED SEED FOR PERMANENT SEEDING WHENEVER POSSIBLE. CERTIFIED SEED IS INSPECTED BY THE ALABAMA CROP IMPROVEMENT ASSOCIATION TO MEET HIGH QUALITY STANDARDS AND WILL BE TAGGED WITH A "CERTIFIED SEED" TAG. (NOTE: ALL SEED SOLD IN ALABAMA IS REQUIRED BY LAW TO BE TAGGED TO IDENTIFY SEED PURITY, GERMINATION, AND PRESENCE OF WEED SEEDS. SEED MUST MEET STATE STANDARDS FOR CONTENT OF NOXIOUS WEEDS).

SEEDING DATES ARE DETERMINED USING TABLE PS-1 FOUND ON THIS DRAWING AND FIGURE PS-1 GEOGRAPHICAL AREAS FOR SPECIES ADAPTATION AND SEEDING DATES FOUND ON PAGE 121 OF THE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1. **NOTE: JEFFERSON COUNTY IS LOCATED IN THE NORTH GEOGRAPHICAL AREA FOR ADAPTATION AND SEEDING.**

INOCULATE LEGUME SEED WITH THE RHIZOBIUM BACTERIA APPROPRIATE TO THE SPECIES OF LEGUME. DETAILS OF LEGUME INOCULATION ARE LOCATED IN CHAPTER 2 IN THE PART ON VEGETATION FOR EROSION AND SEDIMENT CONTROL UNDER INOCULATION OF LEGUMES.

PLANT SEED UNIFORMLY WITH A CYCLONE SEEDER, A DRILL SEEDER, A CULTIPACKER SEEDER, OR BY HAND ON A FRESH, FIRM, FRIABLE SEEDBED. IF THE SEEDBED HAS BEEN SEALED BY RAINFALL, IT SHOULD BE DISKED SO THE SEED WILL BE SOWN INTO A FRESHLY PREPARED SEEDBED.

WHEN USING BROADCAST-SEEEDING METHODS, SUBDIVIDE THE AREA INTO WORKABLE SECTIONS AND DETERMINE THE AMOUNT OF SEED NEEDED FOR EACH SECTION. APPLY ONE-HALF THE SEED WHILE MOVING BACK AND FORTH ACROSS THE AREA, MAKING A UNIFORM PATTERN; THEN APPLY THE SECOND HALF IN THE SAME WAY, BUT MOVING AT RIGHT ANGLES TO THE FIRST PASS.

COVER BROADCAST SEED BY RAKING OR CHAIN DRAGGING; THEN FIRM THE SURFACE WITH A ROLLER OR CULTIPACKER TO PROVIDE GOOD SEED CONTACT. SMALL GRAINS SHOULD BE PLANTED NO MORE THAN 1" DEEP AND GRASSES AND LEGUME SEED NO MORE THAN ½" DEEP.

HYDROSEEDING
SURFACE ROUGHENING IS PARTICULARLY IMPORTANT WHEN HYDROSEEDING, AS A ROUGHENED SLOPE WILL PROVIDE SOME NATURAL COVERAGE FOR LIME, FERTILIZER, AND SEED. THE SURFACE SHOULD NOT BE COMPACTED OR SMOOTH. FINE SEEDBED PREPARATION IS NOT NECESSARY FOR HYDROSEEDING OPERATIONS; LARGE CLODS, STONES, AND IRREGULARITIES PROVIDE CAVITIES IN WHICH SEEDS CAN LODGE.

MIX SEED, INOCULANT IF REQUIRED, AND A SEED CARRIER WITH WATER AND APPLY AS A SLURRY UNIFORMLY OVER THE AREA TO BE TREATED. THE SEED CARRIER SHOULD BE A CELLULOSE FIBER, NATURAL WOOD FIBER OR OTHER APPROVED FIBER MULCH MATERIAL WHICH IS DYED AN APPROPRIATE COLOR TO FACILITATE UNIFORM APPLICATION OF SEED. USE THE CORRECT LEGUME INOCULANT AT 4 TIMES THE RECOMMENDED RATE WHEN ADDING INOCULANT TO A HYDROSEEDER SLURRY. THE MIXTURE SHOULD BE APPLIED WITHIN ONE HOUR AFTER MIXING TO REDUCE DAMAGE TO SEED.

FERTILIZER SHOULD NOT BE MIXED WITH THE SEED-INOCULANT MIXTURE BECAUSE FERTILIZER SALTS MAY DAMAGE SEED AND REDUCE GERMINATION AND SEEDLING VIGOR.

FERTILIZER MAY BE APPLIED WITH A HYDROSEEDER AS A SEPARATE OPERATION AFTER SEEDLINGS ARE ESTABLISHED.

LIME IS NOT NORMALLY APPLIED WITH A HYDRAULIC SEEDER BECAUSE IT IS ABRASIVE BUT IF NECESSARY IT CAN BE ADDED TO THE SEED SLURRY AND APPLIED AT SEEDING OR IT MAY BE APPLIED WITH THE FERTILIZER MIXTURE. ALSO LIME CAN BE BLOWN ONTO STEEPER SLOPES IN DRY FORM.

SPRIGGING
HYBRID BERMUDAGRASS CANNOT BE GROWN FROM SEED AND MUST BE PLANTED VEGETATIVELY. VEGETATIVE METHODS OF ESTABLISHING COMMON AND HYBRID BERMUDAGRASS, CENTIPEDEGRASS AND ZOYSIA INCLUDE SODDING, PLUGGING AND SPRIGGING (SEE SODDING PRACTICE).

WHEN SPRIGS ARE PLANTED WITH A SPRIGGING MACHINE, FURROWS SHOULD BE 4–6" DEEP AND 2 FEET APART. PLACE SPRIGS NO FARTHER THAN 2 FEET APART IN THE ROW AND SO THAT AT LEAST ONE ROOTING NODE IS IN THE FURROW.

WHEN BROADCASTING IS USED FOR SPRIG PLANTING, BROADCAST SPRIGS AT THE SPECIFIED RATE (TABLE PS-1). PRESS INTO THE TOP ½" TO 2" OF SOIL WITH A CULTIPACKER OR WITH A DISK SET NEARLY STRAIGHT SO THAT THE SPRIGS ARE NOT BROUGHT BACK TO THE SURFACE. A MULCH TACKING MACHINE MAY BE USED TO PRESS SPRIGS INTO THE SOIL.

MULCHING
THE USE OF MULCH PROVIDES INSTANT COVER AND HELPS ENSURE ESTABLISHMENT OF VEGETATION UNDER NORMAL CONDITIONS AND IS ESSENTIAL TO SEEDING SUCCESS UNDER HARSH SITE CONDITIONS (SEE MULCHING PRACTICE). HARSH SITE CONDITIONS INCLUDE: SLOPES STEEPER THAN 3:1 AND ADVERSE SOILS (SHALLOW, ROCKY, OR HIGH IN CLAY OR SAND). AREAS WITH CONCENTRATED FLOW SHOULD BE TREATED DIFFERENTLY AND REQUIRE SOD, A HYDROMULCH FORMULATED FOR CHANNELS OR AN APPROPRIATE EROSION CONTROL BLANKET.

IRRIGATION
MOISTURE IS ESSENTIAL FOR SEED GERMINATION AND VEGETATION ESTABLISHMENT. SUPPLEMENTAL IRRIGATION CAN BE VERY HELPFUL IN ASSURING ADEQUATE STANDS IN DRY SEASONS OR TO SPEED DEVELOPMENT OF FULL COVER. IT IS A REQUIREMENT FOR ESTABLISHMENT OF VEGETATION FROM SOD AND SPRIGS AND SHOULD BE USED ELSEWHERE WHEN FEASIBLE. HOWEVER, IRRIGATION IS RARELY CRITICAL FOR LOW-MAINTENANCE VEGETATION PLANTED AT THE APPROPRIATE TIME OF THE YEAR.

WATER APPLICATION RATES MUST BE CAREFULLY CONTROLLED TO PREVENT RUNOFF. INADEQUATE OR EXCESSIVE AMOUNTS OF WATER CAN BE MORE HARMFUL THAN NO SUPPLEMENTAL WATER.

MAINTENANCE
GENERALLY, A STAND OF VEGETATION CANNOT BE DETERMINED TO BE FULLY ESTABLISHED UNTIL SOIL COVER HAS BEEN MAINTAINED FOR 1 FULL YEAR FROM PLANTING. INSPECT VEGETATED AREAS FOR FAILURE AND MAKE NECESSARY REPAIRS AND VEGETATE AS SOON AS POSSIBLE.

RESEEDING
INSPECT SEEDINGS MONTHLY FOR STAND SURVIVAL AND VIGOR. ALSO, INSPECT THE SITE FOR EROSION.
IF A STAND IS INADEQUATE, IDENTIFY THE CAUSE OF FAILURE (CHOICE OF PLANT MATERIALS, LIME AND FERTILIZER QUANTITIES, POOR SEEDBED PREPARATION OR WEATHER) AND TAKE CORRECTIVE ACTION. IF VEGETATION FAILS TO GROW, HAVE THE SOIL TESTED TO DETERMINE WHETHER Ph IS IN THE CORRECT RANGE OR NUTRIENT DEFICIENCY IS A PROBLEM.

STAND CONDITIONS, PARTICULARLY THE COVERAGE, WILL DETERMINE THE EXTENT OF REMEDIAL ACTIONS SUCH AS SEEDBED PREPARATION AND RESEEDING. A QUALIFIED DESIGN PROFESSIONAL SHOULD BE CONSULTED TO ADVISE ON REMEDIAL ACTIONS. CONSIDER DRILL SEEDING WHERE POSSIBLE.

ERODED AREAS SHOULD BE ADDRESSED APPROPRIATELY BY FILLING AND/OR SMOOTHING, AND REAPPLICATION OF LIME, FERTILIZER, SEED AND MULCH.

FERTILIZING
SATISFACTORY ESTABLISHMENT MAY REQUIRE FERTILIZING THE STAND IN THE SECOND GROWING SEASON. FOLLOW SOIL TEST RECOMMENDATIONS OR THE SPECIFICATIONS PROVIDED TO ESTABLISH AND MAINTAIN THE PLANTING. AFTER THE SECOND YEAR, FERTILIZING IS OFTEN NEEDED ANNUALLY OR PERIODICALLY TO MAINTAIN A HEALTH STAND AND COVER SUFFICIENT FOR EROSION CONTROL.

MOWING
MOW VEGETATION ON STRUCTURAL PRACTICES SUCH AS EMBANKMENTS AND GRASS-LINED CHANNELS TO PREVENT WOODY PLANTS FROM INVADING.

OTHER AREAS SHOULD BE MOWED TO COMPLIMENT THE USE OF THE SITE.

CERTAIN SPECIES CAN BE WEAKENED BY MOWING REGIMES THAT SIGNIFICANTLY REDUCE THEIR FOOD RESERVES STORED FOR THE NEXT GROWING SEASON: FESCUE SHOULD NOT BE MOWED CLOSE DURING THE SUMMER; SERICEA SHOULD NOT BE MOWED CLOSE IN LATE SUMMER.

BERMUDAGRASS AND BAHIAGRASS ARE TOLERANT OF MOST MOWING REGIMES AND CAN BE MOWED OFTEN AND CLOSE, IF SO DESIRED, DURING THEIR GROWING SEASON.

PERMANENT SEEDING (PS)

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 1

REVISION 0 DATE 11/30/18
ISSUED FOR CONSTRUCTION

PROJ ID: GOR18003
BOTTOM ASH STORAGE AREA CLOSURE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JMH	CRU	JKB	XXX	XXX	MPB	JCP

SCALE: NONE
DRAWING NUMBER: E720292
SHEET: 1
FIN

ANSI

EROSION CONTROL BLANKETS ARE USED TO AID IN CONTROLLING EROSION ON CRITICAL AREAS BY PROVIDING A PROTECTIVE COVER MADE OF STRAW, JUTE, WOOD OR OTHER PLANT FIBERS; PLASTIC NYLON, PAPER OR COTTON. THIS PRACTICE IS BEST UTILIZED ON SLOPES AND CHANNELS WHERE THE EROSION HAZARD IS HIGH, AND PLANT GROWTH IS LIKELY TO BE SLOW TO PROVIDE ADEQUATE PROTECTIVE COVER. EROSION CONTROL BLANKETS ARE TYPICALLY USED AS AN ALTERNATIVE TO MULCHING BUT CAN ALSO BE USED TO PROVIDE STRUCTURAL EROSION PROTECTION. SOME IMPORTANT FACTORS IN THE CHOICE OF A BLANKET ARE: SOIL CONDITIONS, STEEPNESS OF SLOPE, LENGTH OF SLOPE, TYPE AND DURATION OF PROTECTION REQUIRED TO ESTABLISH DESIRED VEGETATION, AND PROBABLE SHEER STRESS.

DESIGN CRITERIA

GENERAL

ALL BLANKETS SHALL BE NONTOXIC TO VEGETATION AND TO THE GERMINATION OF SEED AND SHALL NOT BE INJURIOUS TO THE UNPROTECTED SKIN OF HUMANS. EROSION CONTROL PRODUCTS SHALL BE OF SUFFICIENT STRENGTH TO HOLD THE PREPARED GROUND AND, IF APPLICABLE, COVER MATERIAL (MULCH, SOD, ETC.) IN PLACE UNTIL AN ACCEPTABLE GROWTH OF NATURAL OR PLANTED MATERIAL IS ESTABLISHED.

EROSION CONTROL PRODUCTS SHALL BE IDENTIFIED BY A CLASSIFICATION DESIGNATION (CLASS 1.A, 1.B, 1.C, ETC.) WHERE THE CLASSIFICATION IS BASED ON THE PHYSICAL PROPERTIES OF THE PRODUCT.

TABLE ECB-1 TEMPORARY EROSION CONTROL BLANKET CLASSES AND APPLICATIONS

CLASS	APPLICATION
1.C	DESIGNED FOR USE ON GEOTECHNICALLY STABLE SLOPES WITH GRADIENTS UP TO 3:1 AND CHANNELS WITH SHEAR STRESSES UP TO 1.5 POUNDS PER SQUARE FOOT.

CLASS DESIGNATIONS AND DURABILITY

EROSION CONTROL PRODUCTS SHALL HAVE THE CONFIGURATIONS AND DURABILITY AS SHOWN IN TABLES ECB-3 AND ECB-4.

TABLE ECB-3 TYPICAL CONFIGURATION AND DURABILITY OF TEMPORARY EROSION CONTROL BLANKETS

CLASS DESIGNATION	USUAL CONFIGURATION	TYPICAL DURABILITY
1.C ULTRA-SHORT TERM SINGLE NET EROSION CONTROL BLANKET OR OPEN WEAVE TEXTILE	AN EROSION CONTROL BLANKET COMPOSED OF PROCESSED DEGRADABLE NATURAL AND/OR POLYMER FIBERS MECHANICALLY BOUND TOGETHER BY A SINGLE RAPIDLY DEGRADING, SYNTHETIC OR NATURAL FIBER NETTING TO FORM A CONTINUOUS MATRIX. OR AN OPEN WEAVE TEXTILE COMPOSED OF PROCESSED RAPIDLY DEGRADING NATURAL OR POLYMER YARNS OR TWINES WOVEN INTO A CONTINUOUS MATRIX.	3 MONTHS

PRODUCT PLACEMENT

THE EROSION CONTROL PRODUCT SHOULD BE PLACED IMMEDIATELY AFTER COMPLETION OF THE PREPARATION OF THE AREA WHERE THE PRODUCT WILL BE PLACED.
FOLLOW THE MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION OR USE THE FOLLOWING INSTRUCTIONS. IF THERE IS A CONFLICT, FOLLOW THE MANUFACTURER'S RECOMMENDATIONS. STRIPS SHALL BE ROLLED OUT PARALLEL TO THE DIRECTION OF FLOW, IN FLUMES AND DITCHES. ON STEEP SLOPES, STRIPS SHALL BE ROLLED OUT IN THE DIRECTION OF FLOW TO REDUCE RILL EROSION. WHEN 2 OR MORE STRIPS ARE REQUIRED TO COVER AN AREA, THEY SHALL OVERLAP AT LEAST 3" (75 MM); HOWEVER, SOME TYPE BLANKETS WILL NOT REQUIRE LAPPING BUT ARE TO BE BUTTED TOGETHER AND STAPLED WITH HALF OF EACH STAPLE LOCATED IN EACH OF THE ADJOINING BLANKETS. ENDS OF STRIPS SHALL OVERLAP AT LEAST 6" (150 MM) WITH THE UPGRADE SECTION ON TOP. THE UPSLOPE END (ANCHOR SLOT) OF EACH STRIP SHALL BE BURIED IN 6" (150 MM) VERTICAL SLOTS, AND SOIL TAMPED FIRMLY AGAINST IT. WHEN, IN THE OPINION OF THE QUALIFIED DESIGN PROFESSIONAL, THAT CONDITIONS WARRANT, ANY OTHER EDGE EXPOSED TO EXCESSIVE FLOW SHALL BE BURIED AS NOTED ABOVE. THE EROSION CONTROL PRODUCT SHALL BE SPREAD EVENLY AND SMOOTHLY, AND MOST IMPORTANTLY, SHALL BE IN CONTACT WITH THE SOIL AT ALL POINTS. THE PRODUCT SHOULD NOT BE STRETCHED TIGHT IN SUCH A MANNER THAT THE MATERIAL "TENTS" OVER THE SOIL SURFACE. IF THE MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION OF THE EROSION CONTROL PRODUCT ARE DIFFERENT THAT THOSE GIVEN HERE, THE CONTRACTOR WILL BE REQUIRED TO FOLLOW THE MORE STRINGENT OF THE TWO.

TABLE ECB-5 MINIMUM PHYSICAL REQUIREMENTS FOR EROSION CONTROL BLANKETS

CLASS	MINIMUM TENSILE STRENGTH (POUNDS/FT.) (ASTM D4594) [1]	MINIMUM PERMISSIBLE SHEAR STRESS (POUNDS/SQ. FT.) (ASTM D 6460) [2, 5]	MAXIMUM "C" FACTOR FOR TEMPORARY PRODUCTS (ASTM D 6459) [3, 5]	UV STABILITY (MINIMUM % TENSILE RETENTION) FOR PERMANENT PRODUCTS (ASTM D 4355) (500 HOUR EXP.)	MINIMUM THICKNESS (INCHES) FOR PERMANENT PRODUCTS (ASTM D 6525) [4]
1.C	50	1.50	0.15 @ 3:1	N/A	N/A

1 **MINIMUM AVERAGE ROLL VALUES, MACHINE DIRECTION. FOR TURF REINFORCEMENT MATS USED IN FIELD CONDITIONS WITH HIGH LOADING AND/OR HIGH SURVIVABILITY REQUIREMENTS TENSILE STRENGTHS OF 3000 POUNDS/FT OR GREATER.**
2 **MINIMUM SHEAR STRESS THE ROLLED EROSION CONTROL PRODUCTS OR TURF REINFORCEMENT MATS CAN SUSTAIN WITHOUT PHYSICAL DAMAGE OR EXCESS EROSION** (>.5" OF SOIL LOSS) DURING A 30 MINUTE FLOW EVENT IN LARGE SCALE TESTING. THESE PERFORMANCE TEST VALUES SHOULD BE SUPPORTED BY PERIODIC BENCH SCALE TESTING UNDER SIMILAR TEST CONDITIONS AND FAILURE CRITERIA USING EROSION CONTROL TECHNOLOGY COUNCIL TEST METHOD NO. 3. FOR TEMPORARY PRODUCTS THE PERMISSIBLE SHEAR STRESS LEVELS WERE ESTABLISHED FOR EACH CLASS BASED ON HISTORICAL EXPERIENCE WITH PRODUCTS CHARACTERIZED BY MANNING'S ROUGHNESS COEFFICIENTS IN THE RANGE OF 0.03 TO 0.05.
3 "C" FACTOR CALCULATED AS RATIO OF SOIL LOSS FROM ROLLED EROSION CONTROL PRODUCT PROTECTED SLOPE (TESTED AT THE SPECIFIED GRADIENT) TO SOIL LOSS FROM UNPROTECTED (CONTROL) PLOT IN LARGE SCALE TESTING. THESE PERFORMANCE TEST VALUES SHOULD BE SUPPORTED BY PERIODIC BENCH SCALE TESTING UNDER SIMILAR TEST CONDITIONS AND FAILURE CRITERIA USING EROSION CONTROL TECHNOLOGY COUNCIL TEST METHOD NO.2.
4 MINIMUM AVERAGE ROLL VALUES.
5 OTHER LARGE SCALE TEST METHODS MAY BE DETERMINED ACCEPTABLE.

CHECK SLOTS SHALL BE PLACED SO THAT ONE CHECK SLOT, JUNCTION SLOT, OR ANCHOR SLOT OF THE EROSION CONTROL PRODUCT OCCURS EVERY 50 FEET (15 M) OF SLOPE. CHECK SLOTS SHALL BE MADE BY BURYING A TIGHT FOLD OF THE PRODUCT VERTICALLY IN THE SOIL A MINIMUM OF 6" (150 MM) DEEP, AND TAMPING AND STAPLING THE FOLD IN PLACE. IF THE MANUFACTURER'S RECOMMENDATIONS FOR THE INSTALLATION OF CHECK SLOTS ARE DIFFERENT THAN THOSE GIVEN HERE, THE CONTRACTOR WILL BE REQUIRED TO FOLLOW THE MORE STRINGENT OF THE TWO.

EACH STRIP SHALL BE STAPLED IN 3 ROWS, AT EACH EDGE AND THE CENTER, WITH STAPLES SPACED NOT MORE THAN 3 FEET (900 MM) LONGITUDINALLY. CHECK SLOTS AND ENDS OF STRIPS SHALL BE STAPLED AT 9" (225 MM) INTERVALS ACROSS THEIR WIDTH.

FOR TEMPORARY BLANKETS, STAPLES SHOULD BE U-SHAPED WIRE WITH AN 11 GAUGE THICKNESS OR GREATER. STAPLES SHOULD BE OF SUFFICIENT THICKNESS FOR SOIL PENETRATION WITHOUT UNDUE DISTORTION. THE LEGS OF THE STAPLES SHALL BE AT LEAST 6" LONG WITH A CROWN OF 1". APPROPRIATE BIODEGRADABLE STAPLES CAN BE USED IN LIEU OF WIRE STAPLES.

MAINTENANCE

INSPECT AFTER STORM EVENTS UNTIL VEGETATION IS ESTABLISHED FOR EROSION OR UNDERMINING BENEATH THE BLANKETS. IF ANY AREA SHOWS EROSION, PULL BACK THAT PORTION OF THE BLANKET, ADD TAMPED SOIL AND RESEED; THEN RESECURE THE BLANKETS.

IF BLANKETS SHOULD BECOME DISLOCATED OR DAMAGED, REPAIR OR REPLACE AND RESECURE IMMEDIATELY.

EROSION CONTROL BLANKET (ECB)

THIS PRACTICE IS DESIGNED TO PREVENT EROSION AT THE OUTLET OF A CHANNEL OR CONDUIT BY REDUCING THE VELOCITY OF FLOW AND DISSIPATING THE ENERGY. OUTLET PROTECTION MEASURES USUALLY CONSIST OF A RIPRAP-LINED APRON, A REINFORCED CONCRETE FLUME WITH CONCRETE BAFFLES, A REINFORCED CONCRETE BOX WITH CHAMBERS OR BAFFLES AND POSSIBLY PRE-MANUFACTURED PRODUCTS. THIS PRACTICE APPLIES WHEREVER HIGH VELOCITY DISCHARGE MUST BE RELEASED ON ERODIBLE MATERIAL.

DESIGN CRITERIA

STRUCTURALLY LINED APRONS AT THE OUTLETS OF PIPES AND PAVED CHANNEL SECTIONS SHALL BE DESIGNED ACCORDING TO THE FOLLOWING CRITERIA:

CAPACITY

THE STRUCTURALLY LINED APRON SHOULD HAVE THE CAPACITY TO CARRY THE PEAK STORMFLOW FROM THE 25-YEAR 24-HOUR FREQUENCY STORM OR THE STORM SPECIFIED IN STATE LAWS OR LOCAL ORDINANCES OR THE DESIGN DISCHARGE OF THE WATER CONVEYANCE STRUCTURE, WHICHEVER IS GREATEST.

TAILWATER DEPTH

THE DEPTH OF THE TAILWATER IMMEDIATELY BELOW THE PIPE OUTLET MUST BE DETERMINED FOR THE DESIGN CAPACITY OF THE PIPE. MANNING'S EQUATION MAY BE USED TO DETERMINE TAILWATER DEPTH. MANNING'S EQUATION MAY BE FOUND IN THE PRACTICE GRASS SWALES. IF THE TAILWATER DEPTH IS LESS THAN HALF THE DIAMETER OF THE OUTLET PIPE, IT SHALL BE CLASSIFIED AS A MINIMUM TAILWATER CONDITION. IF THE TAILWATER DEPTH IS GREATER THAN HALF THE PIPE DIAMETER, IT SHALL BE CLASSIFIED AS A MAXIMUM TAILWATER CONDITION. PIPES WHICH OUTLET ONTO FLAT AREAS, WITH NO DEFINED CHANNEL, MAY BE ASSUMED TO HAVE A MINIMUM TAILWATER CONDITION.

APRON LENGTH

THE APRON LENGTH SHOULD BE DETERMINED FROM FIGURE OP-2 OR OP-3 FOUND IN THE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1, PAGES 232 AND 233, ACCORDING TO THE TAILWATER CONDITION.

APRON THICKNESS

THE APRON THICKNESS SHOULD BE DETERMINED BY THE MAXIMUM STONE SIZE (DMAX), WHEN THE APRON IS LINED WITH RIPRAP. THE MAXIMUM STONE SIZE SHALL BE 1.5 X d_{50} (MEDIAN STONE SIZE), AS DETERMINED FROM FIGURE OP-2 OR OP-3 FOUND IN THE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1, PAGES 232 AND 233. THE APRON THICKNESS SHALL BE 1.5 X DMAX.

WHEN THE APRON IS LINED WITH CONCRETE, THE MINIMUM THICKNESS OF THE CONCRETE SHALL BE 4".

APRON WIDTH

IF THE PIPE DISCHARGES DIRECTLY INTO A WELL-DEFINED CHANNEL, THE APRON SHOULD EXTEND ACROSS THE CHANNEL BOTTOM AND UP THE CHANNEL BANKS TO AN ELEVATION ONE FOOT ABOVE THE MAXIMUM TAILWATER DEPTH OR TO THE TOP OF THE BANK, WHICHEVER IS THE LEAST.

IF THE PIPE DISCHARGES ONTO A FLAT AREA WITH NO DEFINED CHANNEL, THE WIDTH OF THE APRON SHALL BE DETERMINED AS FOLLOWS:

- THE UPSTREAM END OF THE APRON, ADJACENT TO THE PIPE, SHOULD HAVE A WIDTH 3 TIMES THE DIAMETER OF THE OUTLET PIPE.
- FOR A MINIMUM TAILWATER CONDITION, THE DOWNSTREAM END OF THE APRON SHOULD HAVE A WIDTH EQUAL TO THE PIPE DIAMETER PLUS THE LENGTH OF THE APRON OBTAINED FROM THE FIGURES.
- FOR A MAXIMUM TAILWATER CONDITION, THE DOWNSTREAM END SHALL HAVE A WIDTH EQUAL TO THE PIPE DIAMETER PLUS 0.4 TIMES THE LENGTH OF THE APRON FROM FIGURES OP-2 OR OP-3. (SEE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1, PAGES 232 AND 233)

BOTTOM GRADE

THE APRON SHALL BE CONSTRUCTED WITH NO SLOPE ALONG ITS LENGTH (0.0% GRADE). THE INVERT ELEVATION OF THE DOWNSTREAM END OF THE APRON SHALL BE EQUAL TO THE ELEVATION OF THE INVERT OF THE RECEIVING CHANNEL. THERE SHALL BE NO OVERFALL AT THE END OF THE APRON.

SIDE SLOPE

IF THE PIPE DISCHARGES INTO A WELL-DEFINED CHANNEL, THE SIDE SLOPES OF THE CHANNEL SHALL NOT BE STEEPER THAN 2:1 (HORIZONTAL:VERTICAL).

ALIGNMENT

THE APRON SHALL BE LOCATED SO THAT THERE ARE NO BENDS IN THE HORIZONTAL ALIGNMENT.

GEOTEXTILE

WHEN RIPRAP IS USED TO LINE THE APRON, GEOTEXTILE SHOULD BE USED AS A SEPARATOR BETWEEN THE GRADED STONE, THE SOIL SUBGRADE, AND THE ABUTMENTS. GEOTEXTILE SHOULD BE PLACED IMMEDIATELY ADJACENT TO THE SUBGRADE WITHOUT ANY VOIDS BETWEEN THE FABRIC AND THE SUBGRADE. THE GEOTEXTILE WILL PREVENT THE MIGRATION OF SOIL PARTICLES FROM THE SUBGRADE INTO THE GRADED STONE. THE GEOTEXTILE SHALL BE OF THE STRENGTH AND DURABILITY REQUIRED FOR THE PROJECT TO ENSURE THE AGGREGATE AND SOIL BASE ARE STABLE. GENERALLY, THE NON-WOVEN GEOTEXTILE SHOULD MEET THE REQUIREMENTS FOUND IN ASSHTO M288.

MATERIALS

THE APRON MAY BE LINED WITH LOOSE ROCK RIPRAP, GROUTED RIPRAP, OR CONCRETE. THE MEDIAN SIZED STONE FOR RIPRAP SHOULD BE DETERMINED FROM THE CURVES ON FIGURE OP-2 AND OP-3 ACCORDING TO THE TAILWATER CONDITION. (SEE 2014 ALABAMA HANDBOOK FOR EROSION CONTROL, SEDIMENT CONTROL AND STORMWATER MANAGEMENT ON CONSTRUCTION SITES AND URBAN AREAS, VOLUME 1, PAGES 232 AND 233)

AFTER THE MEDIAN STONE SIZE IS DETERMINED, THE GRADATION OF ROCK TO BE USED SHOULD BE SPECIFIED USING TABLES OP-2 AND OP-3. TABLE OP-2 IS USED TO DETERMINE THE WEIGHT OF THE MEDIAN STONE SIZE (d_{50}). USING THIS MEDIAN WEIGHT, A GRADATION CAN BE SELECTED FROM TABLE OP-3, WHICH SHOWS THE COMMERCIALLY AVAILABLE RIPRAP GRADATIONS AS CLASSIFIED BY THE ALABAMA DEPARTMENT OF TRANSPORTATION.

STONE FOR RIPRAP SHOULD CONSIST OF FIELD STONE OR ROUGH UNHEWN QUARRY STONE OF APPROXIMATELY RECTANGULAR SHAPE. THE STONE SHOULD BE HARD AND ANGULAR AND OF SUCH QUALITY THAT IT WILL NOT DISINTEGRATE ON EXPOSURE TO WATER OR WEATHERING AND IT SHALL BE SUITABLE IN ALL OTHER RESPECTS FOR THE PURPOSE INTENDED. THE SPECIFIC GRAVITY OF THE INDIVIDUAL STONES SHOULD BE AT LEAST 2.5.

WHEN THE APRON IS LINED WITH CONCRETE, THE CONCRETE SHOULD HAVE A MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS OF 3000 POUNDS PER SQUARE INCH. AMERICAN CONCRETE INSTITUTE GUIDELINES SHOULD BE USED TO DESIGN CONCRETE STRUCTURES AND REINFORCEMENT. AS A MINIMUM, THE CONCRETE SHOULD BE REINFORCED WITH STEEL WELDED WIRE FABRIC.

MAINTENANCE

INSPECT RIPRAP OUTLET STRUCTURES AFTER HEAVY RAINS TO SEE IF ANY EROSION AROUND OR BELOW THE RIPRAP HAS TAKEN PLACE OR IF STONES HAVE BEEN DISLODGED. CHECK CONCRETE STRUCTURES FOR CRACKS AND MOVEMENT. IMMEDIATELY MAKE ALL NEEDED REPAIRS TO PREVENT FURTHER DAMAGE.

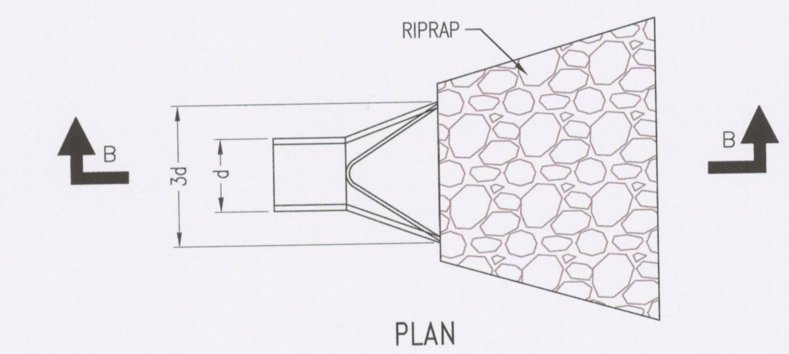
TABLE OP-2 SIZE OF RIPRAP STONES

WEIGHT	MEAN SPHERICAL DIAMETER (FEET)	RECTANGULAR SHAPE LENGTH	RECTANGULAR SHAPE WIDTH, HEIGHT (FEET)
50	0.8	1.4	0.5
100	1.1	1.75	0.6
150	1.3	2.0	0.67
300	1.6	2.6	0.9
500	1.9	3.0	1.0
1000	2.2	3.7	1.25
1500	2.6	4.7	1.5
2000	2.75	5.4	1.8
4000	3.6	6.0	2.0
6000	4.0	6.9	2.3
8000	4.5	7.6	2.5
20000	6.1	10.0	3.3

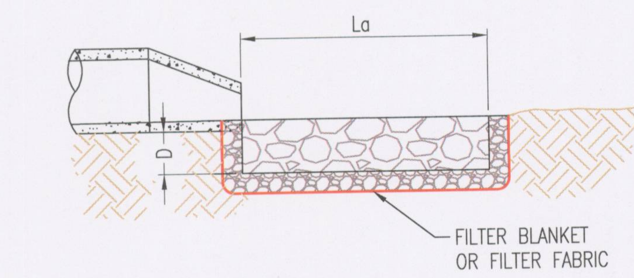
TABLE OP-3 GRADED RIPRAP

CLASS	WEIGHT (LBS.) d_{10}	d_{15}	d_{25}	d_{50}	d_{75}	d_{90}
1	10	–	–	50	–	100
2	10	–	–	80	–	200
3	–	25	–	200	–	500
4	–	–	50	500	1000	–
5	–	–	200	1000	–	2000

NOTES:
1. La IS THE LENGTH OF THE RIPRAP APRON.
2. D = 1.5 TIMES THE MAXIMUM STONE DIAMETER, BUT NOT LESS THAN 6".
3. IN A WELL-DEFINED CHANNEL, EXTEND THE APRON UP THE CHANNEL BANKS TO AN ELEVATION OF 6" ABOVE THE MAXIMUM TAILWATER DEPTH OR TO THE TOP OF THE BANK, WHICHEVER IS LESS.
4. A FILTER BLANKET OR FILTER FABRIC SHOULD BE INSTALLED BETWEEN THE RIPRAP AND SOIL FOUNDATION.

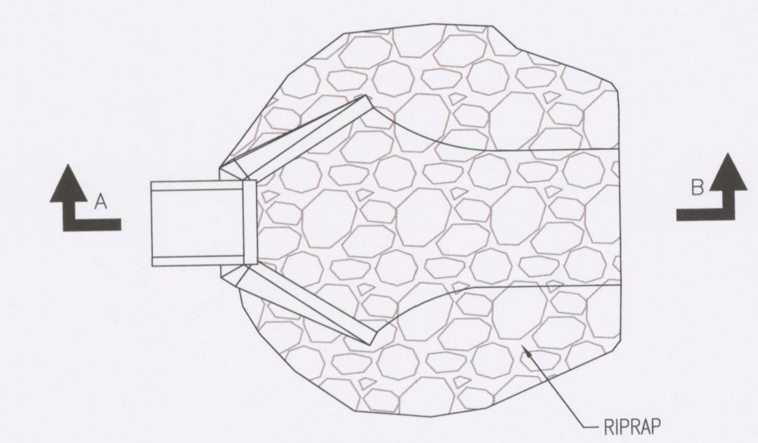


PLAN

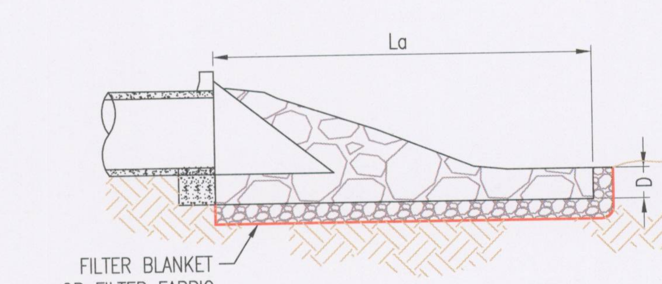


SECTION B-B

PIPE OUTLET TO FLAT AREA – NO WELL-DEFINED CHANNEL



PLAN



SECTION A-A

PIPE OUTLET TO WELL-DEFINED CHANNEL

CULVERT OUTLET RIPRAP DETAILS

LOCATION	PIPE DIA.	PIPE TYPE	INLET INVERT EL.	OUTLET INVERT EL.	PIPE LENGTH	La	W1	W2	DEPTH	RIP RAP	FILTER BEDDING STONE
LINE 1	18"	HDPE	358.00'	357.00'	41'	9.0'	4.5'	10.5'	0.68'	ALDOT CL. 1	ALDOT #57 STONE
LINE 2	18"	HDPE	356.50'	356.00'	49'	9.0'	4.5'	10.5'	0.68'	ALDOT CL. 1	ALDOT #57 STONE
LINE 3	18"	HDPE	358.00'	357.00'	45'	9.0'	4.5'	10.5'	0.68'	ALDOT CL. 1	ALDOT #57 STONE
LINE 4	36"	HDPE	340.50'	339.09'	283'	20.0'	9.0'	23.0'	1.35'	ALDOT CL. 1	ALDOT #57 STONE
LINE 5	3-30"	HDPE	387.15'	386.00'	101' EA. (303' TOTAL)	16.0'	22.5'	55.5'	1.13'	ALDOT CL. 1	ALDOT #57 STONE

1

OUTLET PROTECTION (OP)

N.T.S.

DUST CONTROL INCLUDES A WIDE RANGE OF TECHNIQUES THAT PREVENT OR REDUCE MOVEMENT OF WIND-BORNE SOIL PARTICLES (DUST) DURING LAND DISTURBING ACTIVITIES. THIS PRACTICE APPLIES TO CONSTRUCTION ROUTES AND OTHER DISTURBED AREAS WHERE ON-SITE AND OFF-SITE DAMAGE OR HAZARDS MAY OCCUR IF DUST IS NOT CONTROLLED.

DESIGN CRITERIA

PERMANENT METHODS:

VEGETATIVE COVER: FOR DISTURBED AREAS NOT SUBJECT TO TRAFFIC, VEGETATION PROVIDES THE MOST PRACTICAL METHOD OF DUST CONTROL. ESTABLISH VEGETATIVE COVER ACCORDING TO THE PERMANENT SEEDING OR TEMPORARY SEEDING PRACTICE

TOP SOILING: THIS ENTAILS COVERING THE SURFACE WITH LESS EROSIVE SOIL MATERIAL. SEE TOPSOILING PRACTICE FOR GUIDANCE.

STONE: STONE USED TO STABILIZE CONSTRUCTION ROADS CAN ALSO BE EFFECTIVE FOR DUST CONTROL. STONE SHOULD BE SPREAD A MINIMUM OF 6" THICK OVER CONSTRUCTION ROADS IN THE DISTURBED AREA. FOR HEAVILY TRAVELED ROADS OR ROADS SUBJECTED TO HEAVY LOADS THE STONE THICKNESS SHOULD BE 8" TO 10". A NON-WOVEN GEOTEXTILE MEETING THE REQUIREMENTS of ASSHTO M288 SHOULD BE USED UNDER THE STONE.

TEMPORARY METHODS:

MULCHES: MULCH OFFERS A FAST, EFFECTIVE MEANS OF CONTROLLING DUST WHEN PROPERLY APPLIED. SEE MULCHING PRACTICE FOR GUIDELINES FOR PLANNING AND INSTALLING THE PRACTICE.

TEMPORARY VEGETATIVE COVER: FOR DISTURBED AREAS WHERE NO ACTIVITY IS ANTICIPATED FOR 14 DAYS OR LONGER, TEMPORARY SEEDING CAN EFFECTIVELY CONTROL DUST. ESTABLISH VEGETATIVE COVER ACCORDING TO TEMPORARY SEEDING PRACTICE GUIDELINES.

CALCIUM CHLORIDE: CALCIUM CHLORIDE MAY BE APPLIED BY MECHANICAL SPREADER AS LOOSE, DRY GRANULES OR FLAKES AT A RATE THAT KEEPS THE SURFACE MOIST BUT NOT SO HIGH AS TO CAUSE WATER POLLUTION OR PLANT DAMAGE. SITES MAY NEED TO BE RETREATED BECAUSE THE PRODUCT DEGRADES OVER TIME.

SPRAY-ON ADHESIVES: SPRAY-ON ADHESIVES MAY BE USED ON MINERAL SOILS FOR DUST CONTROL. TRAFFIC MUST BE KEPT OFF TREATED AREAS TO PREVENT THE PRODUCT FROM BECOMING INEFFECTIVE. EXAMPLES OF SPRAY-ON ADHESIVES FOR USE IN DUST CONTROL ARE LISTED IN TABLE DC-1.

TABLE DC-1 SPRAY-ON ADHESIVES FOR DUST CONTROL ON MINERAL SOIL

MATERIAL	WATER DILUTION	TYPE OF NOZZLE	APPLY GAL/AC
ANIONIC ASPHALT EMULSION	7:1	COARSE SPRAY	1,200
LATEX EMULSION	12.5:1	FINE SPRAY	235
RESIN IN WATER	4:1	FINE SPRAY	300

CHEMICAL STABILIZATION (CHS): CHEMICAL PRODUCTS MAY BE USED ON MINERAL SOILS FOR DUST CONTROL. TRAFFIC MUST BE KEPT OFF TREATED AREAS TO PREVENT THE PRODUCT FROM BECOMING INEFFECTIVE. THE MANUFACTURER OF SUPPLIER SHALL PROVIDE WRITTEN APPLICATION METHODS. THE APPLICATION METHOD SHALL ENSURE UNIFORM COVERAGE TO THE TARGET AND AVOID DRIFT TO NON-TARGET AREAS INCLUDING WATERS OF THE STATE. THE MANUFACTURER OR SUPPLIER SHALL ALSO PROVIDE WRITTEN INSTRUCTIONS TO ENSURE PROPER SAFETY, STORAGE, AND MIXING OF THE PRODUCT. REFER TO THE PLANNING CONSIDERATIONS FOR CHEMICAL STABILIZATION PRACTICE FOR PLANNING CONSIDERATION BEFORE DECIDING TO USE THIS PRODUCT.

SPRINKLING OR IRRIGATION: SPRINKLING IS ESPECIALLY EFFECTIVE FOR DUST CONTROL ON HAUL ROADS AND OTHER TRAFFIC ROUTES. SPRINKLE THE SITE UNTIL THE SURFACE IS WET. REPEAT AS NEEDED. ALSO BARE AREAS MAY BE KEPT WET WITH IRRIGATION TO CONTROL DUST AS AN EMERGENCY TREATMENT.

TILLAGE: TILLAGE IS USED TO ROUGHEN THE SITE AND BRING CLODS AND MOIST SOIL TO THE SURFACE. THIS IS A TEMPORARY EMERGENCY MEASURE THAT CAN BE USED ON LARGE OPEN DISTURBED AREAS AS SOON AS SOIL BLOWING STARTS. BEGIN TILLING ON THE WINDWARD EDGE OF THE SITE. THE DEPTH OF TILLAGE IS DETERMINED BY THE DEPTH TO MOIST SOIL AND THE AMOUNT OF MOIST SOIL DESIRED AT THE SURFACE. IN SANDY SOILS, THE DEPTH TO MOIST SOIL MAY MAKE TILLAGE IMPRACTICAL.

BARRIERS: A BOARD FENCE, WIND FENCE, SEDIMENT FENCE, HAY BALES, OR SIMILAR BARRIERS CAN CONTROL AIR CURRENTS AND BLOWING SOIL. PLACE BARRIERS PERPENDICULAR TO PREVAILING AIR CURRENTS AT INTERVALS ABOUT 15 TIMES THE BARRIER HEIGHT.

MAINTENANCE: CHECK CONSTRUCTION SITE DURING VEHICULAR TRAFFIC OR WINDY CONDITIONS TO SEE IF MEASURES ARE WORKING ADEQUATELY. MAINTAIN DUST CONTROL MEASURES CONTINUOUSLY THROUGHOUT DRY WEATHER PERIODS, UNTIL ALL DISTURBED AREAS HAVE BEEN STABILIZED.

DUST CONTROL (DC)

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

REVISION	DATE	DESCRIPTION	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
1	01/16/2019	REVISED CULVERT OUTLET RIPRAP DETAILS TABLE. PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	AES	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JMH	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation Engineering and Construction Service FOR

Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 2

SCALE	DRAWING NUMBER	SHEET
NONE	E720293	1

LAND GRADING IS RESHAPING OF THE GROUND SURFACE TO PROVIDE SUITABLE TOPOGRAPHY FOR BUILDINGS, FACILITIES AND OTHER LAND USES, TO CONTROL SURFACE RUNOFF, AND TO MINIMIZE SOIL EROSION AND SEDIMENTATION BOTH DURING AND AFTER CONSTRUCTION. THIS PRACTICE APPLIES TO SITES WHERE THE EXISTING TOPOGRAPHY MUST BE MODIFIED TO PREPARE FOR ANOTHER LAND USE, OR WHERE ADAPTING PROPOSED DEVELOPMENT TO THE EXISTING LANDSCAPE CAN REDUCE THE EROSION POTENTIAL OF THE SITE AND THE COST OF INSTALLING EROSION AND SEDIMENT CONTROL MEASURES. IN SOME INSTANCES OTHER PRACTICES SUCH AS DIVERSIONS OR BENCHES CAN BE USED TO REDUCE THE LENGTH OF CONTINUOUS SLOPES AND REDUCE EROSION POTENTIAL.

DESIGN CRITERIA
SITE PREPARATION
A DETAILED SURVEY OF THE CONSTRUCTION SITE SHOULD BE PERFORMED BY A QUALIFIED SURVEYOR PRIOR TO GRADING PLAN DEVELOPMENT. THIS SURVEY SHOULD INCLUDE EXISTING TOPOGRAPHIC INFORMATION A THE SITE INCLUDING EXISTING ELEVATIONS, EXISTING DRAINAGE PATTERNS, LOCATIONS OF EXISTING OVERHEAD AND UNDERGROUND UTILITIES, AND CONSTRUCTION LIMIT BOUNDARIES.

THE GRADING PLAN SHOULD REQUIRE THAT THE EXISTING TOPSOIL AT SITES TO BE GRADED BY REMOVED AS THE FIRST STEP IN THE GRADING PROCESS. THE PLAN SHOULD INCLUDE A LOCATION ON THE CONSTRUCTION SITE WHERE TOPSOIL WILL BE STOCKPILED. STOCKPILED TOPSOIL SHOULD BE PROTECTED BY TEMPORARY VEGETATION (SEE TEMPORARY VEGETATION PRACTICE) FOR OTHER APPROPRIATE TEMPORARY COVER, SUCH AS PLASTIC, UNTIL IT IS USED TO COVER DISTURBED AREAS IN ADVANCE OF PERMANENT VEGETATION OF THE SITE.

THE GRADING PLAN SHOULD INCLUDE A SCHEDULE OF DISTURBANCE ACTIVITIES THAT MINIMIZES THE AREA DISTURBED AT ANY POINT IN TIME USING SEQUENCING AND STAGING CONCEPTS. IN AREAS WHERE CLEARING OF EXISTING VEGETATION IS PLANNED, THE AREA SHOULD BE CLEARED AND GRUBBED BY REMOVING REES, VEGETATION, ROOTS AND OTHER DEBRIS SUCH AS TRASH. IN AREAS TO BE FILLED ALL LOOSE OR WEAK SOIL AND OVERSIZED ROCKS SHOULD BE REMOVED FROM THE AREA. THE FOUNDATION OF THE AREA TO BE FILLED SHOULD CONSIST OF SOIL OR ROCK MATERIAL OF ADEQUATE STRENGTH TO SUPPORT THE PROPOSED FILL MATERIAL AND THE STRUCTURES TO BE BUILT AT THE SITE. THE EXACT DEPTH OF MATERIAL TO BE REMOVED SHOULD BE DETERMINED BY A QUALIFIED GEOTECHNICAL PROFESSIONAL ACCORDING TO ACCEPTED ENGINEERING STANDARDS.

GRADING
A PLAN FOR PLACEMENT OF FILL SHOULD BE DEVELOPED BY A QUALIFIED GEOTECHNICAL PROFESSIONAL. THE PLAN SHOULD SPECIFY THE SOURCE OF FILL MATERIALS, WHICH SHOULD BE OBTAINED ON SITE IF POSSIBLE. MATERIALS USED FOR FILL, WHEN PLACED ACCORDING TO THE PLANS AND SPECIFICATIONS, SHOULD PROVIDE SUFFICIENT STRENGTH TO SUPPORT STRUCTURES PLANNED FOR CONSTRUCTION AT THE LOCATION.

LOOSE FILL MATERIAL SHOULD BE PLACED IN LAYERS NOT EXCEEDING 9" IN THICKNESS. THE MATERIALS SHOULD BE COMPACTED TO A MOISTURE CONTENT AND TO A DR4Y DENSITY THAT WILL PRODUCE THE DESIGN BEARING STRENGTH REQUIRED FOR STRUCTURES PLANNED AT THE SITE. A QUALIFIED GEOTECHNICAL ENGINEER SHOULD PROVIDE FILL PLACEMENT SPECIFICATIONS USING STANDARD ACCEPTED ENGINEERING PRACTICES.
LONG AND/OR STEEP SLOPE LENGTHS CAN RESULT IN RILL AND GULLY EROSION ON SLOPES. EROSION ON THESE TYPE SLOPES CAN BE MINIMIZED BY BREAKING THE SLOPE WITH DIVERSIONS OR BENCHES (SEE DIVERSION PRACTICE). DIVERSION WIDTHS SHOULD BE COMPATIBLE WITH THE EXPECTED MAINTENANCE EQUIPMENT. CARE IS NEEDED IN LOCATING OUTLETS THAT WILL BE STABLE AND NOT CAUSE GULLY EROSION. THE FOLLOWING TABLE GIVES GENERAL GUIDANCE ON THE HORIZONTAL SPACING OF SLOPE BREAKS:

TABLE LG-1 GUIDELINES FOR SPACING SLOPE BREAKS[1]

SLOPE (H:V)	HORIZONTAL SPACING (FT)
1:1	20
2:1	40
3:1	60
4:1 AND 5:1	80
6:1 TO 9:1	120
10:1 OR FLATTER	200

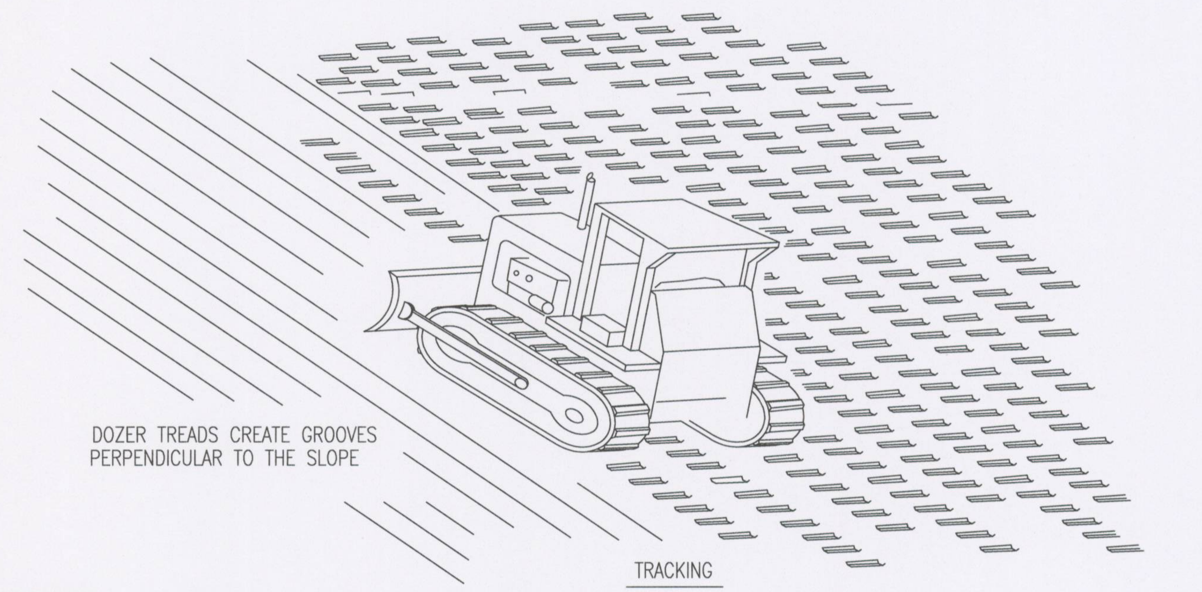
IN AREAS WHERE SEEPAGE AND GROUND WATER ARE PRESENT, SUBSURFACE DRAINS SHOULD BE INSTALLED TO IMPROVE SLOPE STABILITY OF SOIL BEARING CAPACITY (SEE SUBSURFACE DRAIN PRACTICE).

STEEP SLOPES SHOULD BE AVOIDED IF POSSIBLE. SLOPES THAT ARE TO BE VEGETATED SHOULD BE 2 HORIZONTAL TO 1 VERTICAL OR FLATTER. IF THE SLOPE IF TO BE MAINTAINED BY TRACTOR OR OTHER EQUIPMENT THE SLOPE SHOULD BE 3 HORIZONTAL TO 1 VERTICAL OR FLATTER. SLOPES SHOULD BE DESIGNED TO BLEND WITH SURROUNDING TOPOGRAPHY AS MUCH AS POSSIBLE.

EROSION CONTROL
THE GRADING PLAN SHOULD INCLUDE PROVISIONS FOR STABILIZATION OF GRADED AREAS IMMEDIATELY AFTER FINAL GRADING IS COMPLETED. ON AREAS THAT WILL HAVE NO ADDITIONAL DISTURBANCE, PERMANENT VEGETATION SHOULD BE APPLIED IMMEDIATELY TO THE SITE (SEE PERMANENT SEEDING PRACTICE) IF GRADING IS FINISHED DURING THE PLANTING SEASON. IF GRADING IS FINISHED OUTSIDE OF THE RECOMMENDED PLANTING DATES A TEMPORARY COVER SHOULD BE INSTALLED USING A TEMPORARY SEEDING OR OTHER APPROPRIATE COVER AND THE PERMANENT SEEDING PLANNED FOR THE NEXT PLANTING PERIOD. ON AREAS WHERE WORK IS TO BE INTERRUPTED OR DELAYED FOR 14 CALENDAR DAYS OR LONGER, SUCH AS TOPSOIL STOCKPILES, THE AREA SHOULD BE STABILIZED USING MULCH OR TEMPORARY SEEDING (SEE MULCHING OR TEMPORARY SEEDING PRACTICE). OTHER STABILIZATION MEASURES SUCH A HYDRAULIC MULCH OR EROSION CONTROL BLANKETS SHOULD BE USED IN EXTREME CONDITIONS, SUCH AS STEEP SLOPES AND CHANNELS.

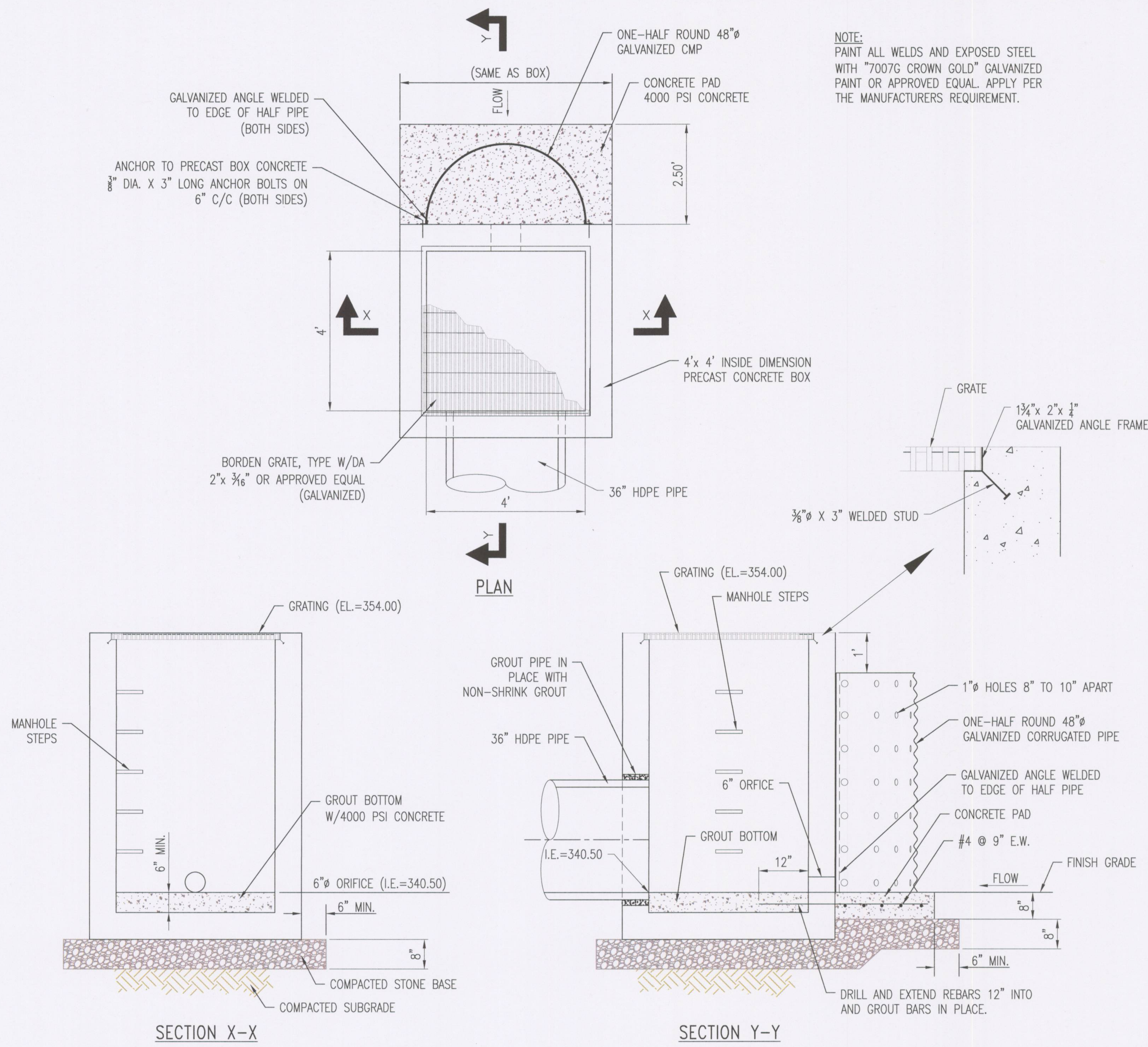
WHERE PRACTICAL, RUNOFF FROM UNDISTURBED OFF-SITE AREAS SHOULD BE DIVERTED AROUND THE CONSTRUCTION SITE TO PREVENT EROSION ON THE DISTURBED AREAS (SEE DIVERSION PRACTICE).

SEDIMENT CONTROL
REQUIRED SEDIMENT CONTROL PRACTICES SHOULD BE INSTALLED BEFORE LAND DISTURBANCE ACTIVITIES IN THE DRAINAGE AREA OF THE SEDIMENT CONTROL PRACTICES. UNTIL DISTURBED AREAS CAN BE STABILIZED, APPROPRIATE SEDIMENT CONTROL MEASURES WILL BE MAINTAINED TO MINIMIZE SEDIMENT DELIVERY OFF-SITE. MEASURES SHOULD INCLUDE AS A MINIMUM:
- SEDIMENT BARRIERS – PLACED ALONG TOES OF SLOPES (SEE SEDIMENT BARRIER PRACTICE)
- SEDIMENT BASINS – DIVERT SEDIMENT LADEN RUNOFF TO BASINS AS NEEDED TO MINIMIZE OFF-SITE SEDIMENTATION (SEE SEDIMENT BASIN PRACTICE).
- INLET PROTECTION – WHERE SEDIMENT-LADEN RUNOFF IS DIVERTED TO ON-SITE STORMWATER DRAIN INLETS, THE INLETS SHOULD BE PROTECTED WITH AN APPROPRIATE SEDIMENT CONTROL PRACTICE.
- STABILIZED OUTLETS – ALL RUNOFF FROM THE SITE SHOULD BE CONVEYED IN STABILIZED CHANNELS (SEE GRASSED SWALE, LINED SWALE, RIP-RAP LINED SWALE, OR OTHER APPROPRIATE CHANNEL STABILIZATION).



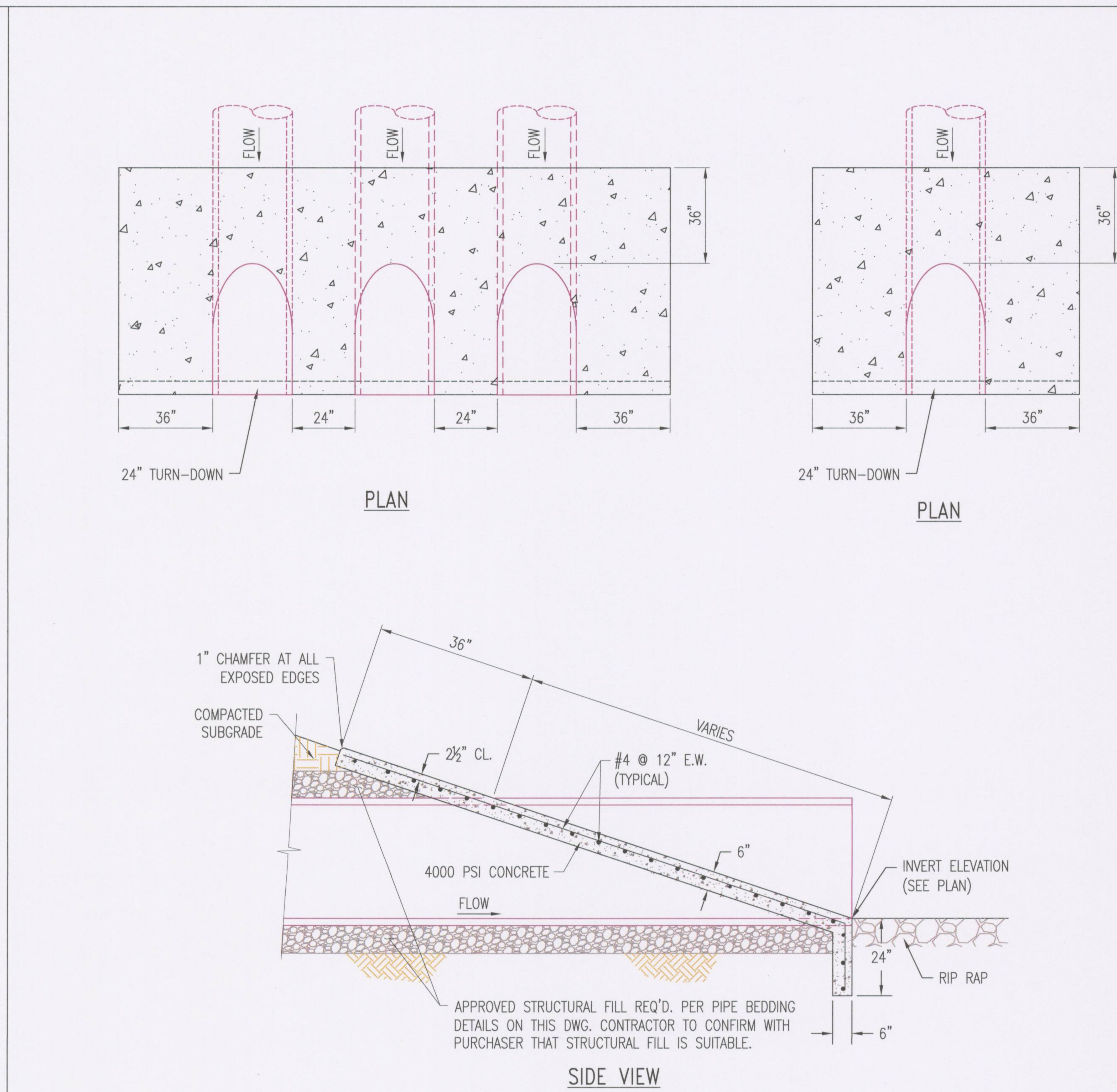
MAINTENANCE
PERIODICALLY CHECK ALL GRADED AREAS AND THE RELATED EROSION AND SEDIMENT CONTROL PRACTICES FOR DAMAGE BY EQUIPMENT AND ESPECIALLY AFTER HEAVY RAINFALLS FOR DAMAGE BY RUNOFF. REPAIR SILT FENCES AND OTHER TEMPORARY SEDIMENT CONTROL MEASURES. CLEAN SEDIMENT OUT OF ADJACENT DIVERSIONS AND OTHER STRUCTURES AS NEEDED. REPAIR ANY FAILURES THAT OCCUR IN SURFACE MEASURES SUCH AS PLANTINGS.

LAND GRADING (LG)

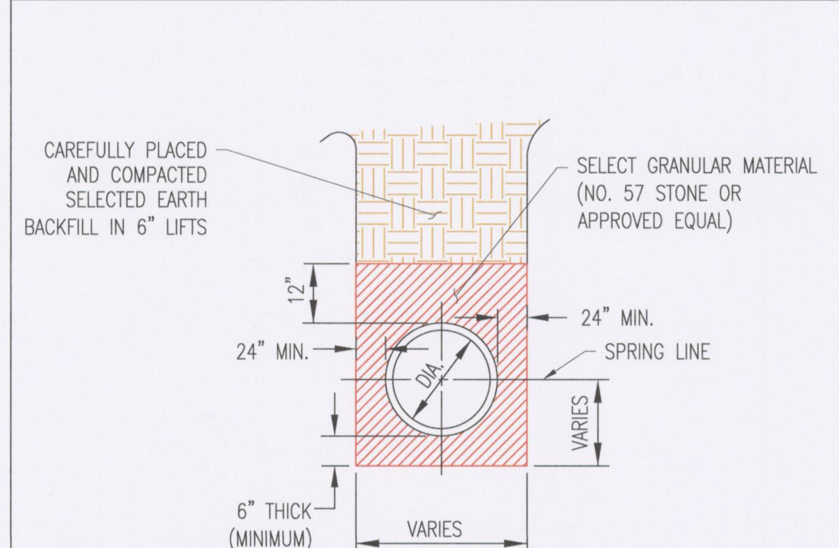


OUTLET CONTROL STRUCTURE DETAIL
N.T.S.

NOTE:
PAINT ALL WELDS AND EXPOSED STEEL WITH "7007G CROWN GOLD" GALVANIZED PAINT OR APPROVED EQUAL. APPLY PER THE MANUFACTURERS REQUIREMENT.

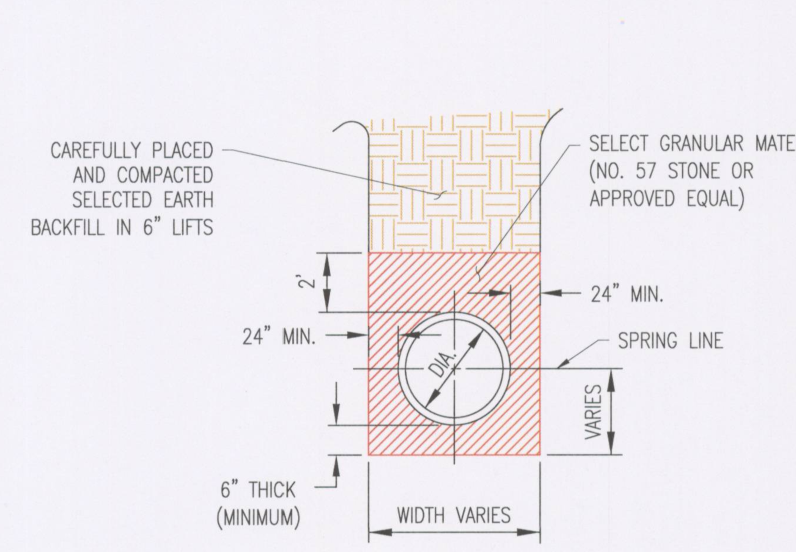


SLOPED CONCRETE HEADWALL
N.T.S.



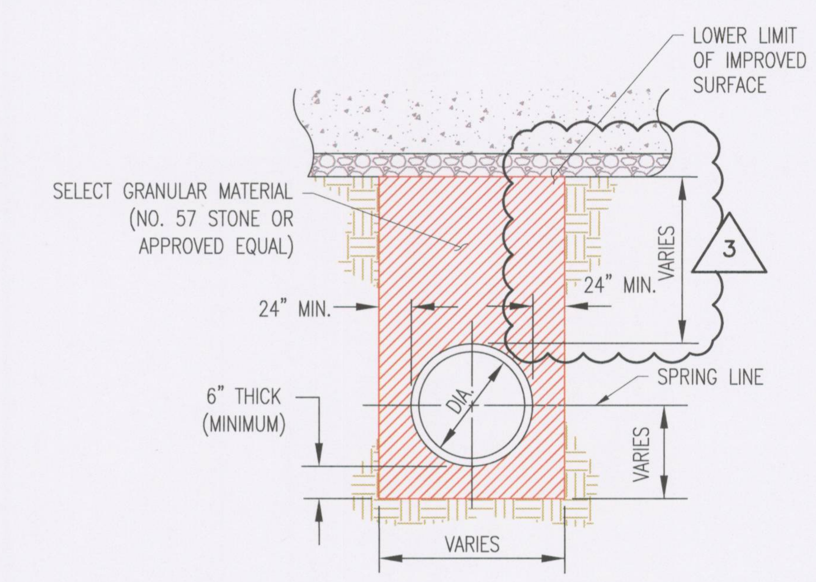
NOTE:
1. BACKFILL DETAILS SHALL BE USED FOR REINFORCED CONCRETE AND HIGH DENSITY POLYETHYLENE STORM DRAINAGE PIPE.
2. CONTRACTOR SHALL COMPACT MATERIAL IN DEEPER FILL AREAS TO A MINIMUM OF 1 FT ABOVE TOP OF PIPE PRIOR TO EXCAVATING PIPE INSTALLATION TRENCH.

TYPICAL PIPE BEDDING AND INITIAL BACKFILL DETAIL (0-8 FT COVER)
N.T.S.



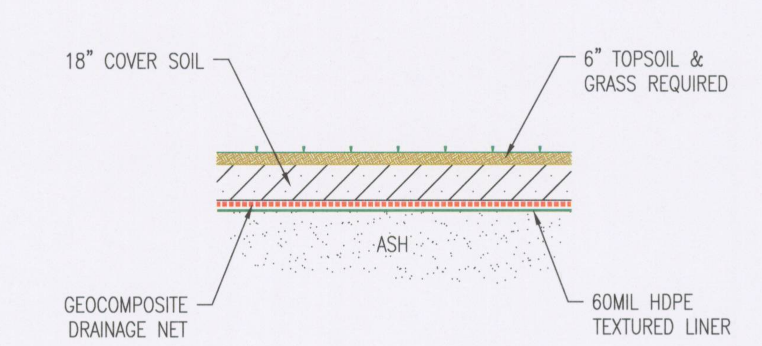
NOTE:
1. BACKFILL DETAILS SHALL BE USED FOR REINFORCED CONCRETE AND HIGH DENSITY POLYETHYLENE STORM DRAINAGE PIPE.
2. CONTRACTOR SHALL COMPACT MATERIAL IN DEEPER FILL AREAS TO A MINIMUM OF 1 FT ABOVE TOP OF PIPE PRIOR TO EXCAVATING PIPE INSTALLATION TRENCH.

TYPICAL PIPE BEDDING AND INITIAL BACKFILL DETAIL (8 FT+ COVER)
N.T.S.

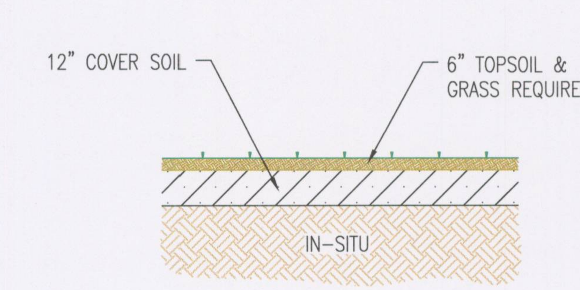


NOTE:
1. BACKFILL DETAILS SHALL BE USED FOR REINFORCED CONCRETE AND HIGH DENSITY POLYETHYLENE STORM DRAINAGE PIPE.
2. CONTRACTOR SHALL COMPACT MATERIAL IN DEEPER FILL AREAS TO A MINIMUM OF 1 FT ABOVE TOP OF PIPE PRIOR TO EXCAVATING PIPE INSTALLATION TRENCH.

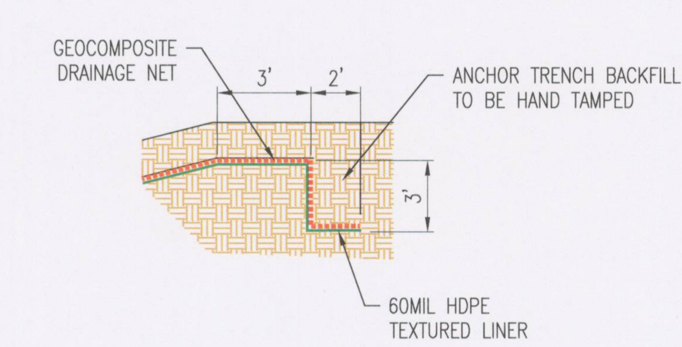
TYPICAL PIPE BEDDING AND BACKFILL UNDER IMPROVED SURFACES
N.T.S.



CAP COVER DETAIL
N.T.S.



POND COVER DETAIL
N.T.S.



ANCHOR TRENCH DETAIL
N.T.S.

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 3

REVISION	DATE	DESCRIPTION	PROJECT	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
3	03/29/2019	ADDED PIPE BEDDING DIMENSION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
2	02/26/2019	ADDED BOLT DIMENSIONS	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
1	01/16/2019	REMOVED PERMEABILITY REQUIREMENT.	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	AES	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JMH	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT
NONE	E720294	1	FINA

ANSI

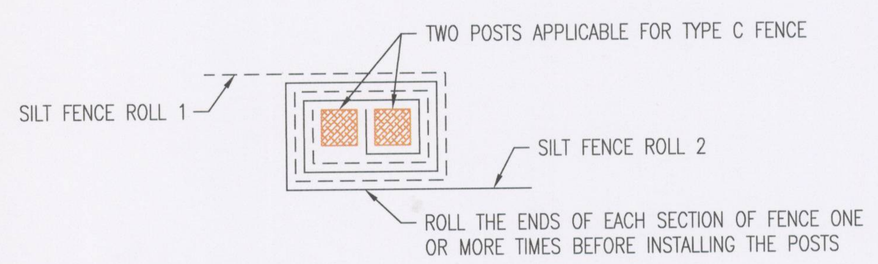
TABLE SB-1 SLOPE LIMITATIONS FOR SILT FENCE

LAND SLOPE (PERCENT)	MAXIMUM LENGTH OF SLOPE ABOVE FENCE (FEET)
<2	100
2 TO 5	75
5 TO 10	50
10 TO 20*	25
>20	15

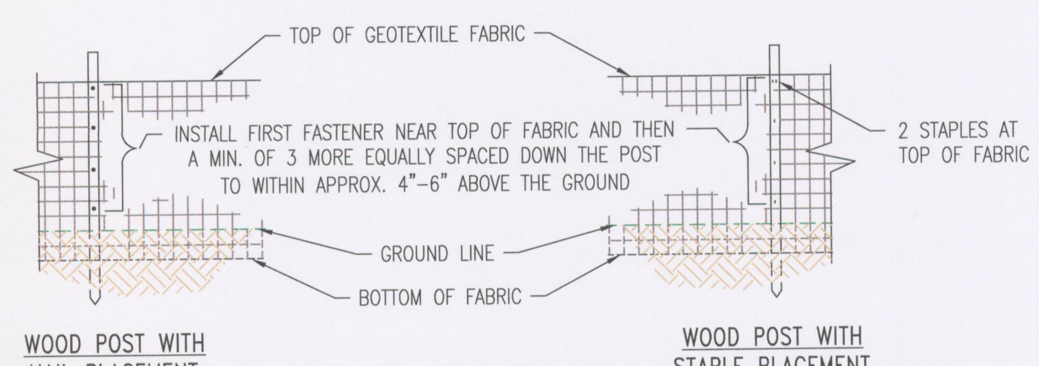
*IN AREAS WHERE THE SLOPE IS GREATER THAN 10%, A FLAT AREA LENGTH OF 10 FEET BETWEEN THE TOE OF THE SLOPE TO THE FENCE SHOULD BE PROVIDED.

TABLE SB-2 POST SIZE FOR SILT FENCE

	MINIMUM LENGTH	TYPE OF POST	SIZE OF POST
TYPE C	3'	SOFT WOOD OAK	2" DIA. OR 2X2 1" X 1"



ROLL JOINT FOR JOINING TWO ADJACENT SILT FENCES SECTIONS
N.T.S.

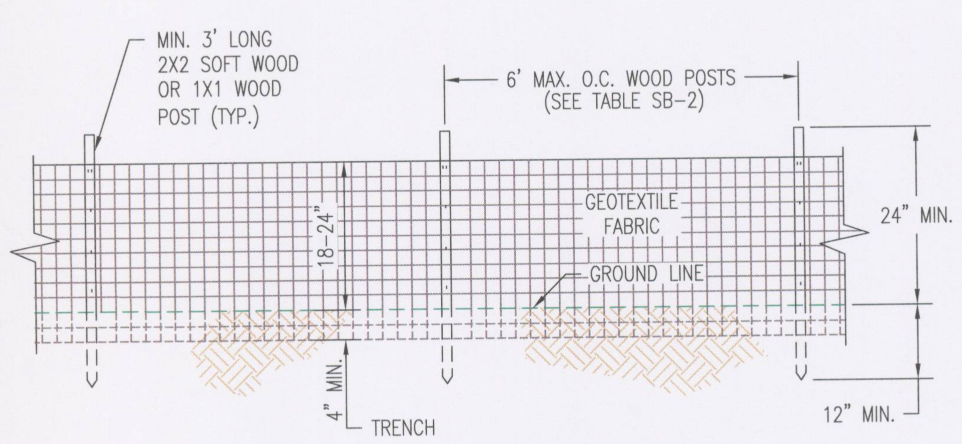


WOOD POST WITH NAIL PLACEMENT
N.T.S.

WOOD POST WITH STAPLE PLACEMENT
N.T.S.

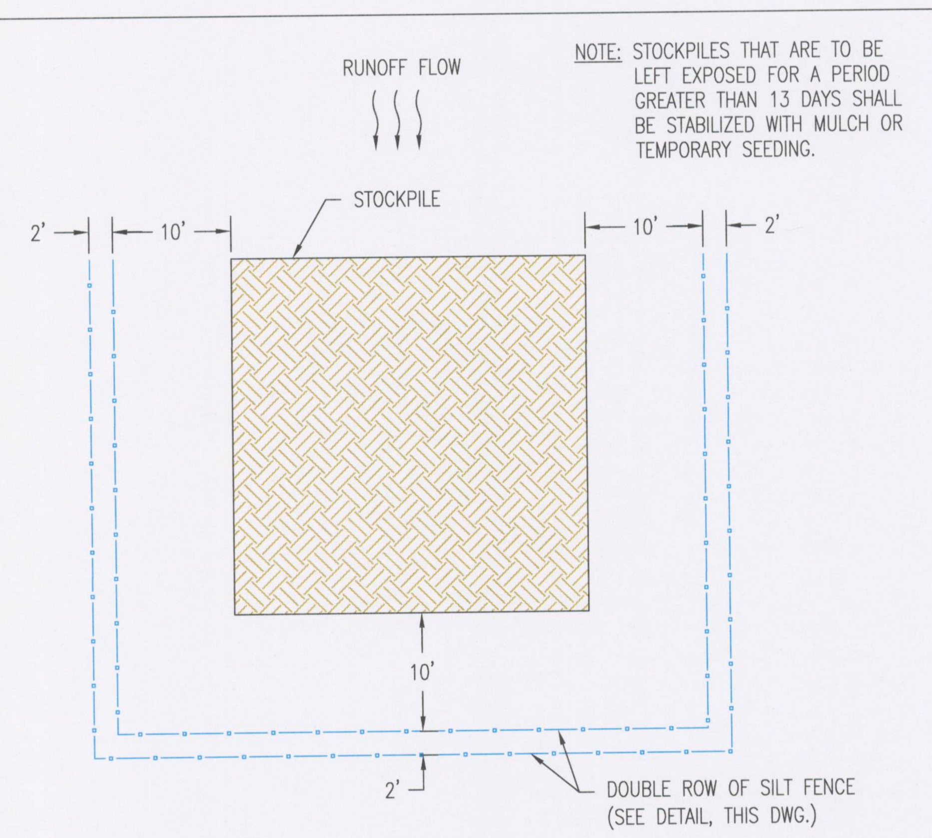
FRONT VIEW

FASTENERS FOR SILT FENCES
N.T.S.



FRONT VIEW
N.T.S.

TYPE "C" SILT FENCE SEDIMENT BARRIER (SB)
N.T.S.



NOTE: STOCKPILES THAT ARE TO BE LEFT EXPOSED FOR A PERIOD GREATER THAN 13 DAYS SHALL BE STABILIZED WITH MULCH OR TEMPORARY SEEDING.

STOCKPILE DETAIL
N.T.S.

TABLE SB-3 WOOD POST FASTENERS FOR SILT FENCE

	GAUGE	CROWN	LEGS	STAPLES/POST
WIRE STAPLES	17 MIN.	3/4" WIDE	1/2" LONG	5 MIN.
	GAUGE	LENGTH	BUTTON HEADS	NAIL/POST
NAILS	14 MIN.	1"	3/4" LONG	4 MIN.

A SEDIMENT BARRIER IS A TEMPORARY STRUCTURE USED ACROSS A LANDSCAPE MOSTLY ON THE CONTOUR TO REDUCE THE QUANTITY OF SEDIMENT THAT IS MOVING DOWN SLOPE. THE MOST COMMONLY USED BARRIER IS A SILT FENCE (A GEOTEXTILE FABRIC WHICH IS TRENCHED INTO THE GROUND AND ATTACHED TO SUPPORTING POSTS AND POSSIBLY WIRE FENCE). OTHER BARRIER MATERIALS COULD INCLUDE SAND BAGS, WATTLES, AND VARIOUS MAN-MADE MATERIALS AND DEVICES THAT CAN BE USED IN A SIMILAR MANNER AS A SILT FENCE.

NOTES:
1. GEOTEXTILE FABRIC SHALL BE SECURELY FASTENED TO THE WOVEN WIRE FENCING.
2. SILT FENCE FABRIC SHALL CONFORM TO THE REQUIREMENTS OF GEOTEXTILE MEETING THE REQUIREMENTS FOUND IN ASSHTO M288.
3. MACHINE TRENCHED GEOTEXTILE SHALL BE TRENCHED VERTICAL AT LEAST 4" DEEP.
4. STAKED TIE BACKS ON EACH END MAY BE NECESSARY TO PREVENT OVERTURNING.
5. PROVIDE A RIPRAP SPLASH PAD OR OTHER OUTLET PROTECTION DEVICE FOR ANY POINT WHERE FLOW MAY OVERTOP THE SEDIMENT FENCE.
6. THE DRAINAGE AREA BEHIND THE SILT FENCE SHOULD NOT EXCEED 1/4 ACRE PER 100 LINEAR FEET OF SILT FENCE FOR NON-REINFORCED FENCE AND 1/2 ACRE PER 100 FEET OF WIRE REINFORCED FENCE. WHEN ALL RUNOFF FROM THE DRAINAGE AREA IS TO BE STORED BEHIND THE FENCE (I.E. THERE IS NO STORMWATER DISPOSAL SYSTEM IN PLACE) THE MAXIMUM SLOPE LENGTH BEHIND THE FENCE SHOULD NOT EXCEED THOSE SHOWN IN TABLE SB-1.

MAINTENANCE
INSPECT SILT FENCES AT LEAST ONCE A WEEK AND AFTER EACH SIGNIFICANT RAIN EVENT.

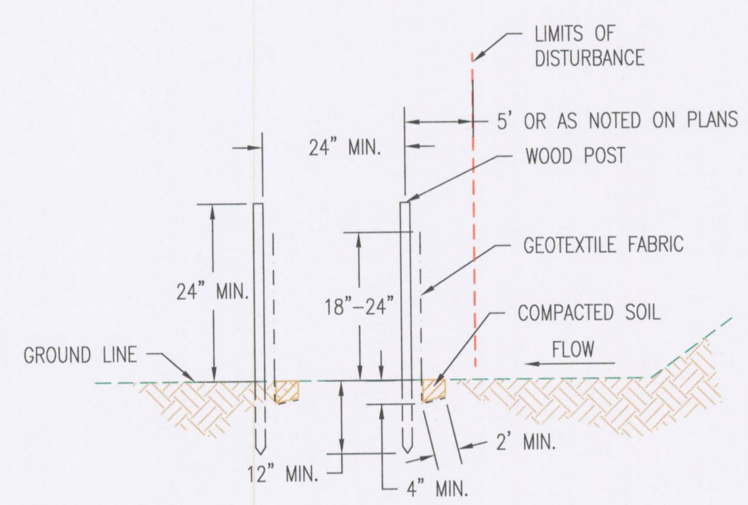
MAKE REQUIRED REPAIRS IMMEDIATELY.

SHOULD THE FABRIC OF SILT FENCE COLLAPSE, TEAR, DECOMPOSE OR BECOME INEFFECTIVE, REPLACE IT PROMPTLY.

REMOVE SEDIMENT DEPOSITS WHEN THEY REACH 15" OR ½ THE HEIGHT OF THE FENCE AS INSTALLED TO PROVIDE ADEQUATE STORAGE VOLUME FOR THE NEXT RAIN AND TO REDUCE PRESSURE ON THE FENCE.

AFTER THE CONTRIBUTING DRAINAGE AREA HAS BEEN PROPERLY STABILIZED, REMOVE ALL BARRIER MATERIALS AND UNSTABLE SEDIMENT DEPOSITS, BRING THE AREA TO GRADE AND STABILIZE IT WITH VEGETATION.

INSPECTION NOTE:
THE SILT FENCE SHALL BE INSPECTED PERIODICALLY AND PROMPTLY REPAIRED OR REPLACED AS REQUIRED. FILTER FABRIC SHALL BE REPLACED WHENEVER IT HAS DETERIORATED TO SUCH AN EXTENT THAT IT REDUCES THE EFFECTIVENESS OF THE FABRIC.



SIDE VIEW (DOUBLE ROW)
N.T.S.

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation Engineering and Construction Services FOR

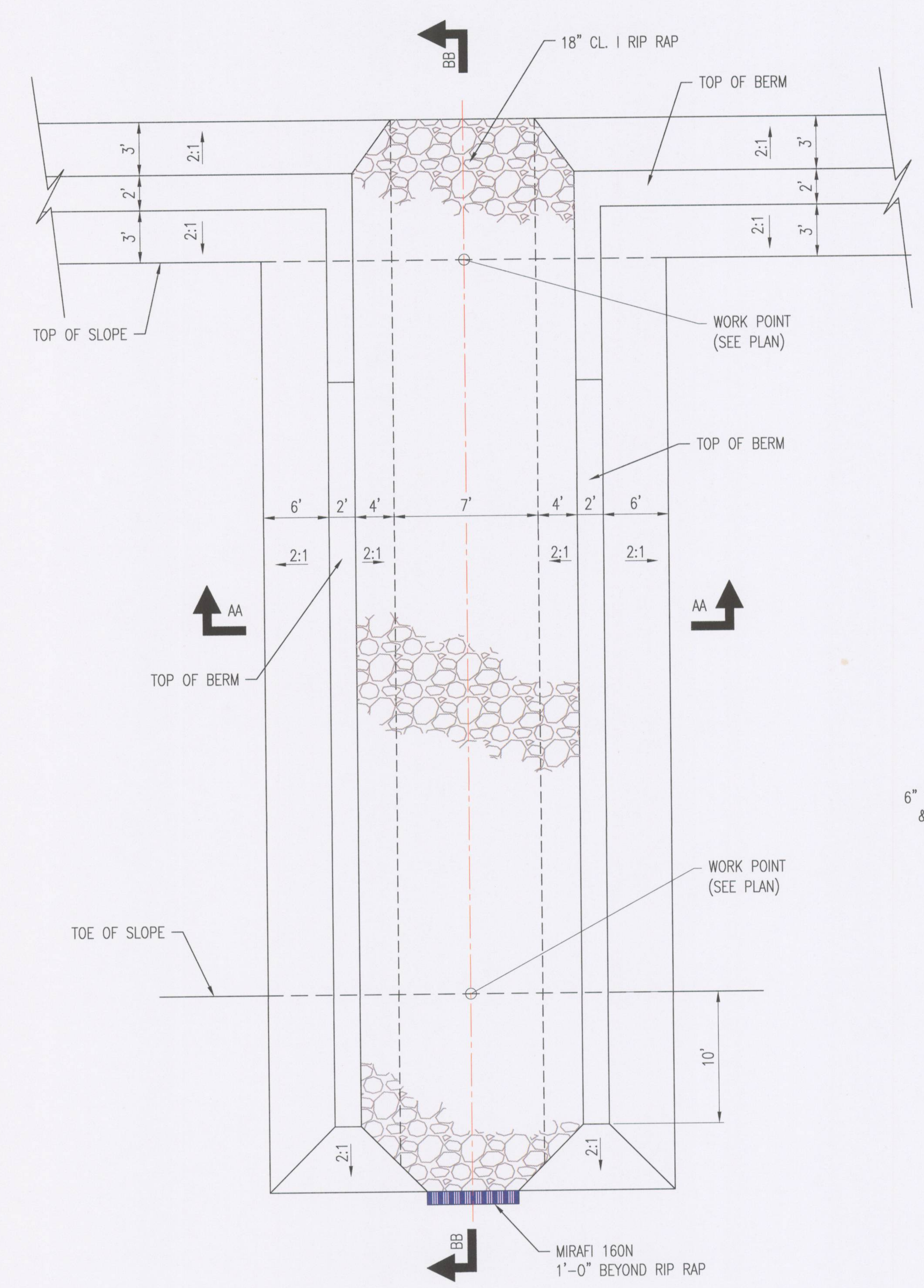
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 4

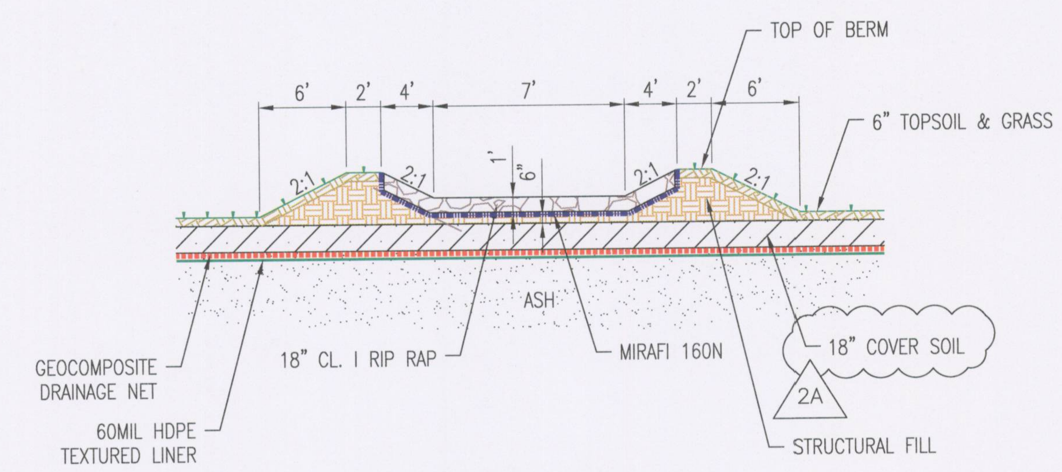
REVISION	DATE	DESCRIPTION	PROJ ID	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
2	01/24/2019	REMOVED CHAINLINK FENCE DETAIL AND ADDED SEDIMENT BARRIER AND STOCKPILE DETAILS	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JKB	AES	JKB	XXX	XXX	XXX	JWM
1	01/16/2019	A. REVISED NOTE 12. B. REVISED FENCE POST CALLOUT.	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	AES	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JMH	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET	CONT'D
NONE	E720295	1	FINAL

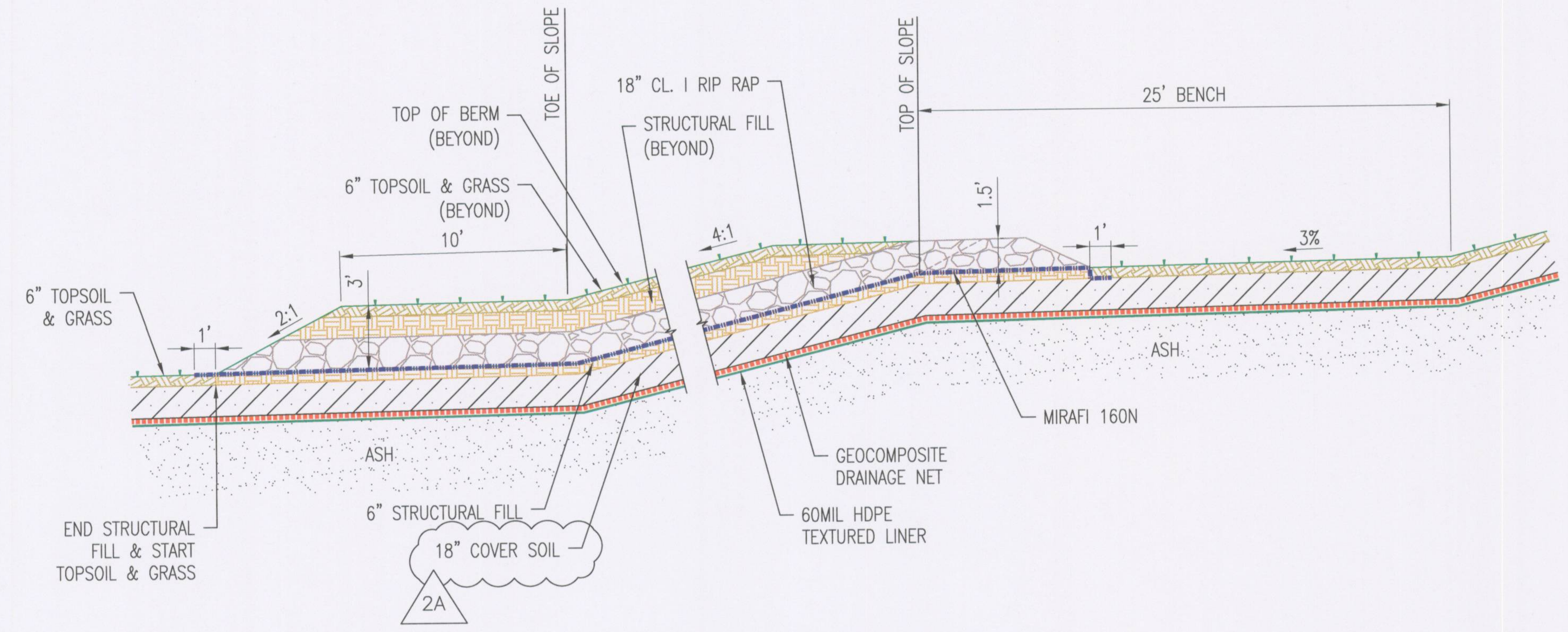
ANSI



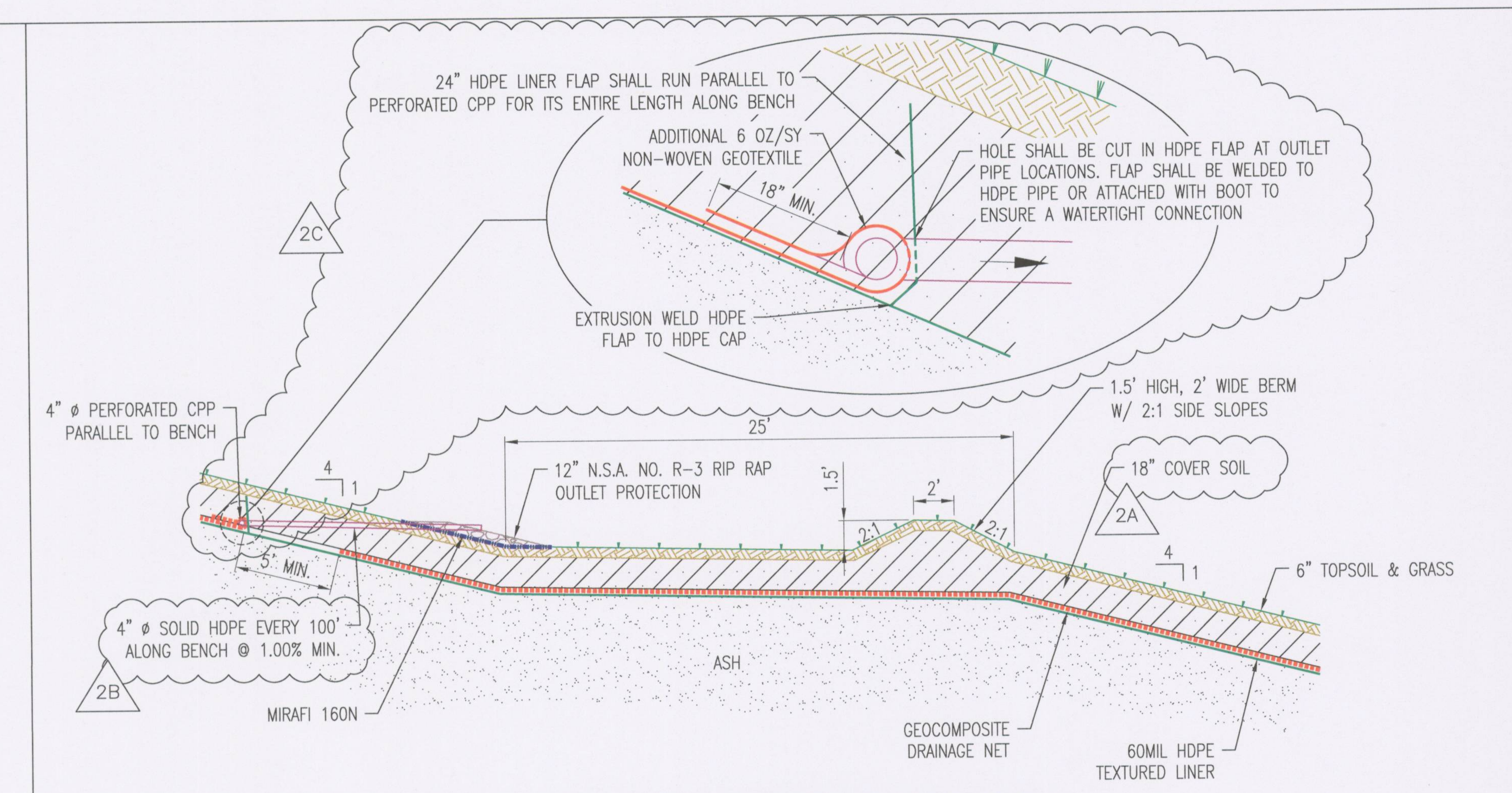
DOWN DRAIN CHANNEL DETAIL
N.T.S.



SECTION AA-AA
N.T.S.

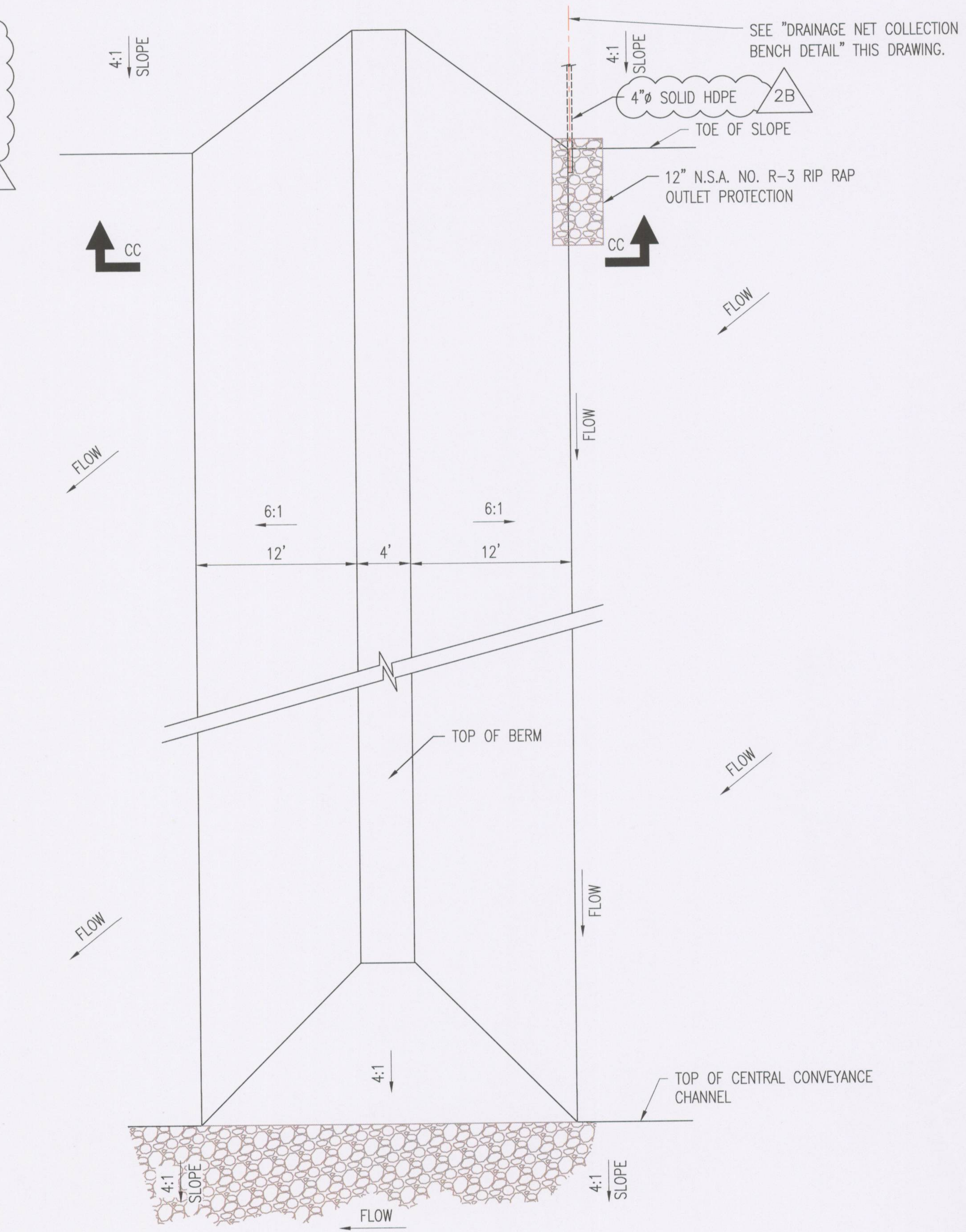


SECTION BB-BB
N.T.S.

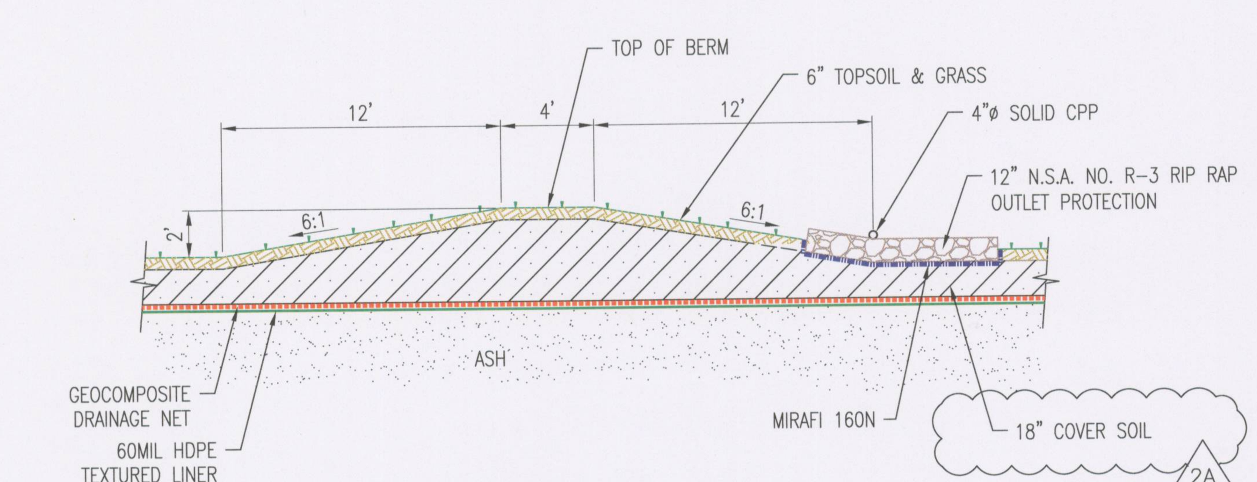


DRAINAGE NET COLLECTION ON BENCH DETAIL
N.T.S.

NOTES:
1. HDPE PIPE NOT AT ALL DRAINAGE BERM LOCATIONS. SEE PLAN.
2. IN LOCATION WITH HDPE PIPE, PIPE TO BE ON UP HILL SIDE OF DRAINAGE BERM.
2B



PLAN
N.T.S.



SECTION CC-CC
N.T.S.

DRAINAGE BERM DETAIL
N.T.S.

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

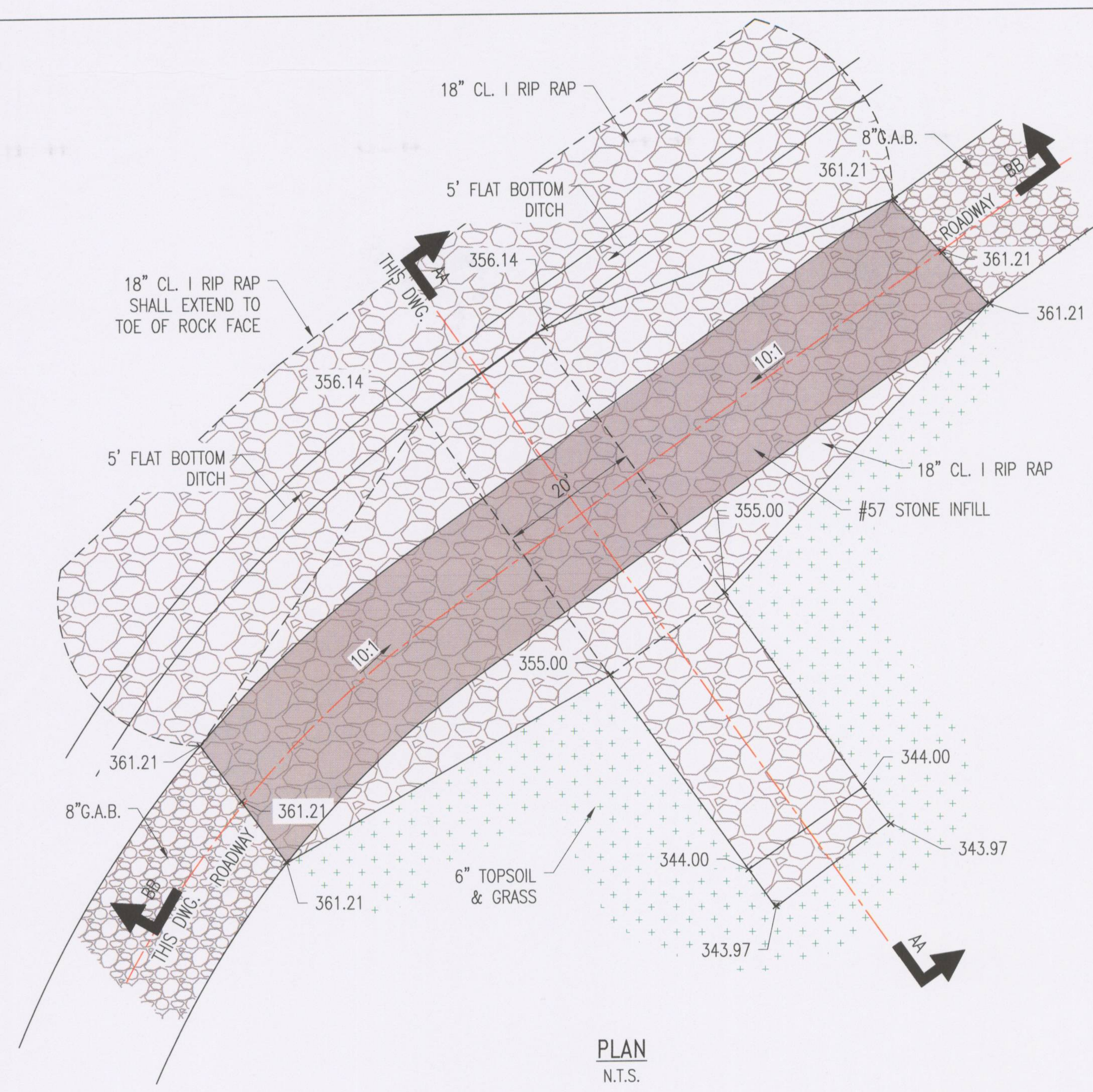
Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 5

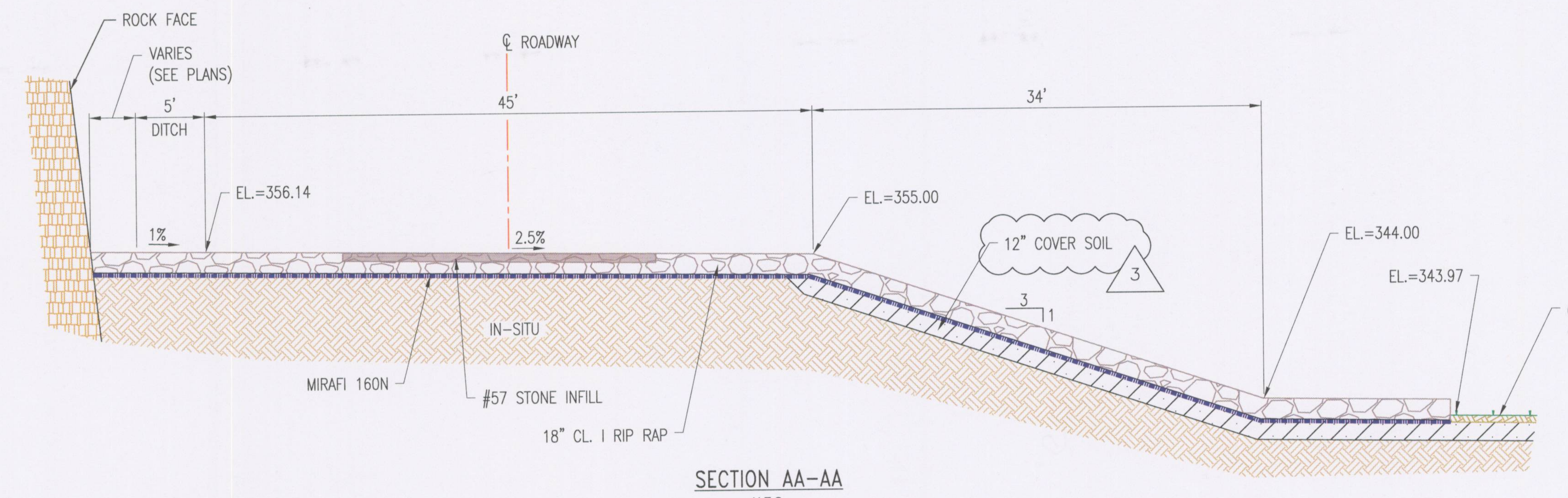
REVISION	DATE	DESCRIPTION	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
0	11/30/18	ISSUED FOR CONSTRUCTION. PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JMH	CRU	JKB	XXX	XXX	MPB	JCP
1	02/26/19	REVISED RIP RAP GRADATION. PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
2	03/29/19	A. REMOVED PERMEABILITY REQUIREMENT B. REVISED SOLID CPP TO SOLID HDPE C. ADDED HDPE FLAP ALONG DRAINAGE NET COLLECTION PIPE. PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM

SCALE	DRAWING NUMBER	SHEET	CON
NONE	E720296	1	FIN

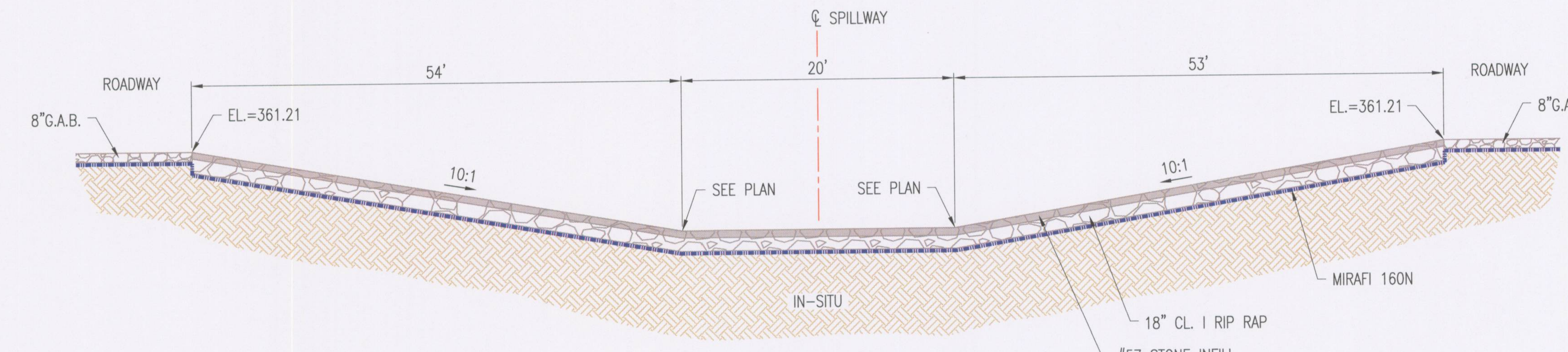
ANSI



PLAN
N.T.S.

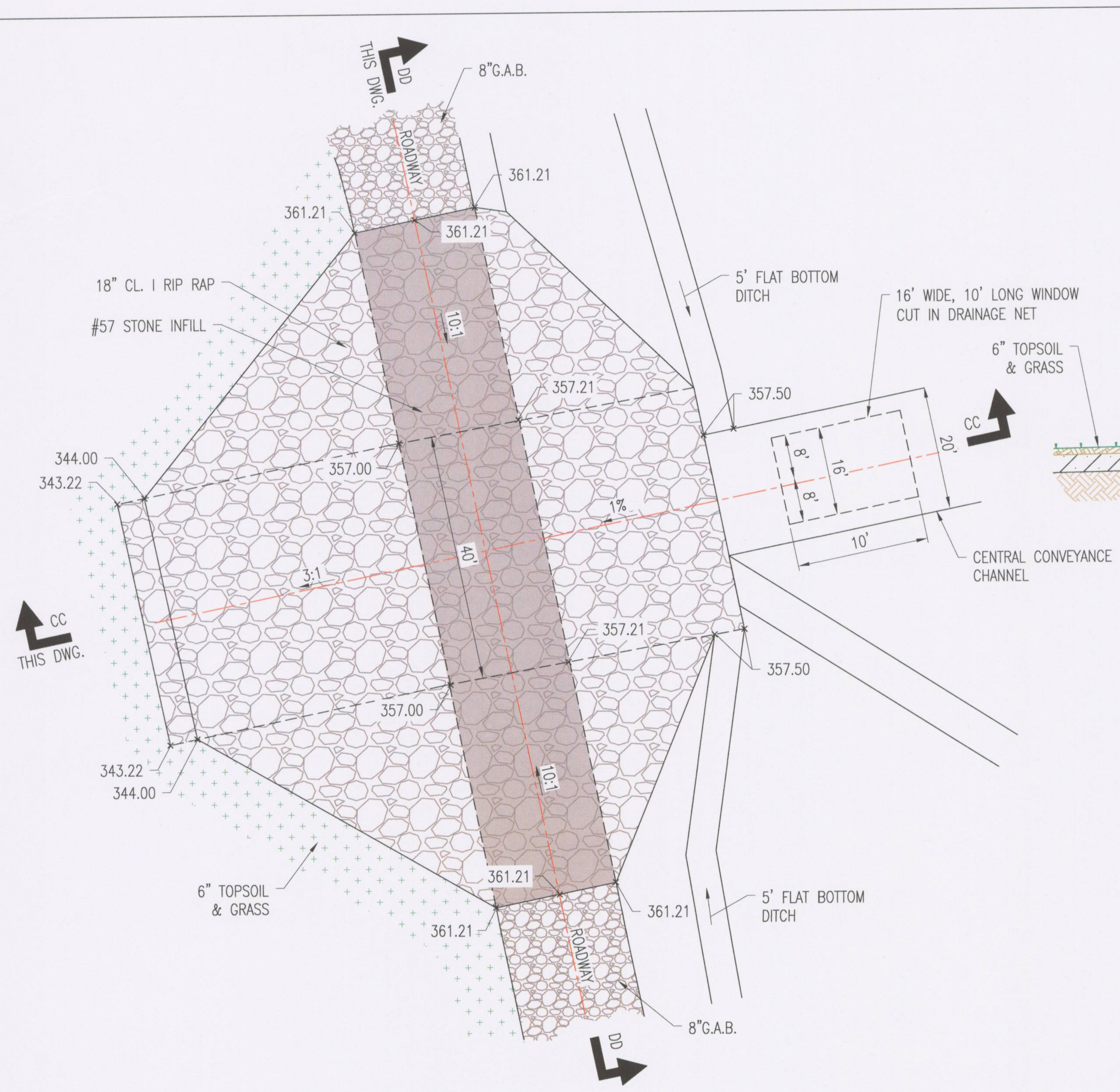


SECTION AA-AA
N.T.S.

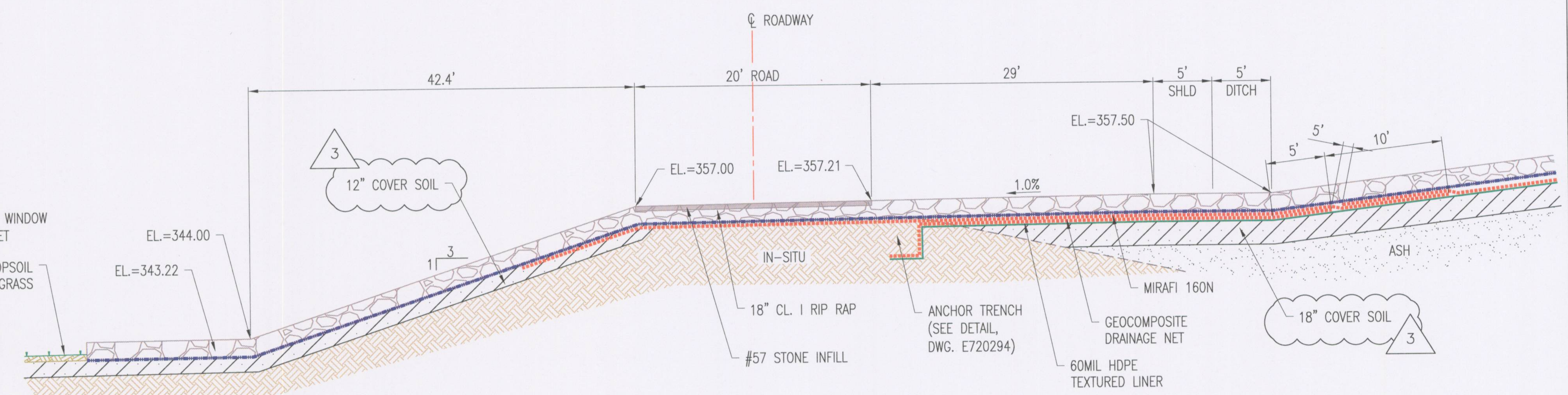


SECTION BB-BB
N.T.S.

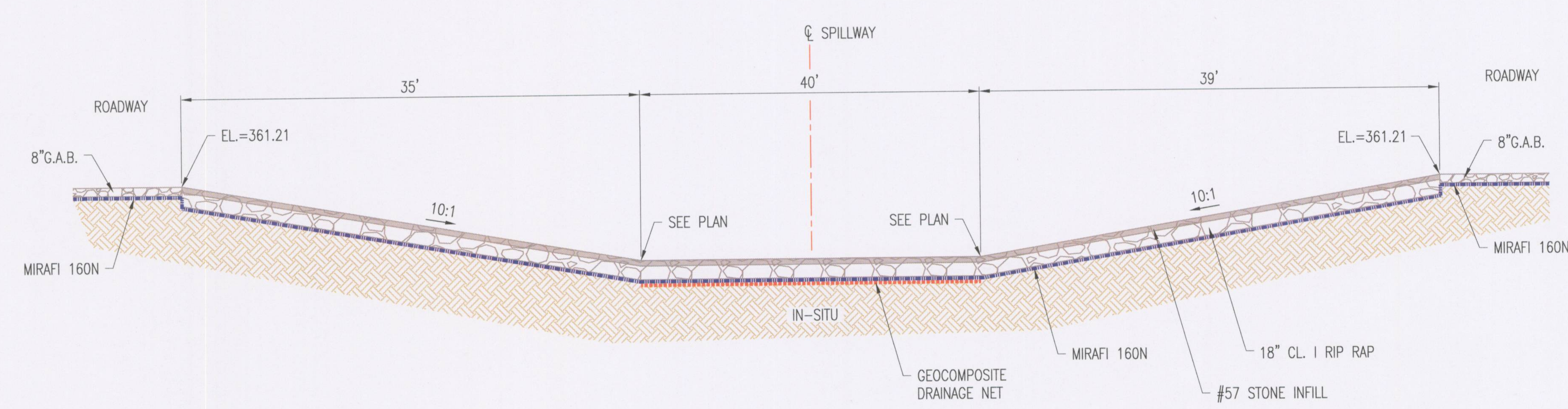
DITCH TO POND SPILLWAY DETAIL
N.T.S.



PLAN
N.T.S.



SECTION CC-CC
N.T.S.



SECTION DD-DD
N.T.S.

CENTRAL CONVEYANCE CHANNEL
TO POND SPILLWAY DETAIL
N.T.S.

NOTES:

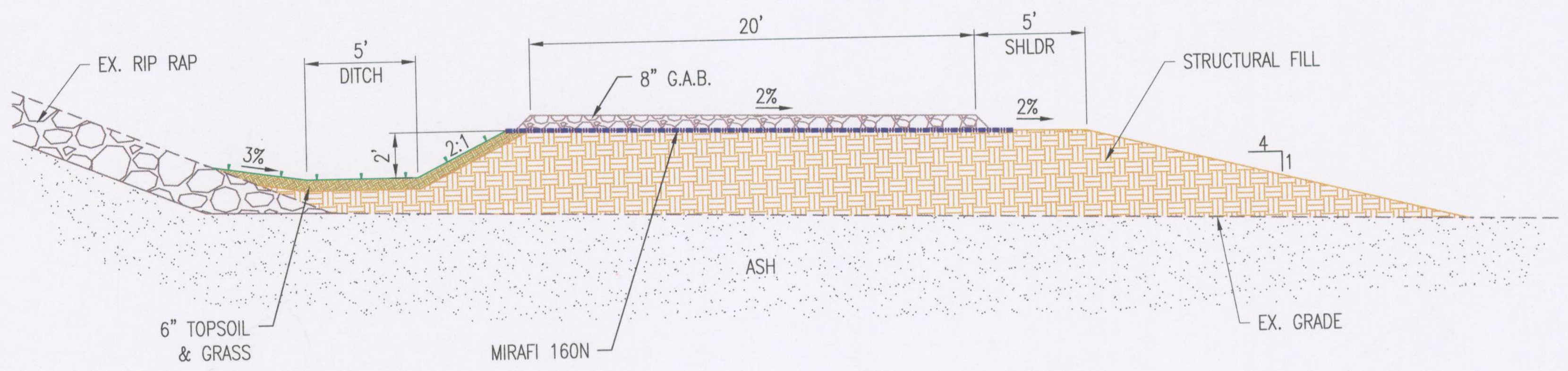
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

Southern Company Generation
Engineering and Construction Servi
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 6

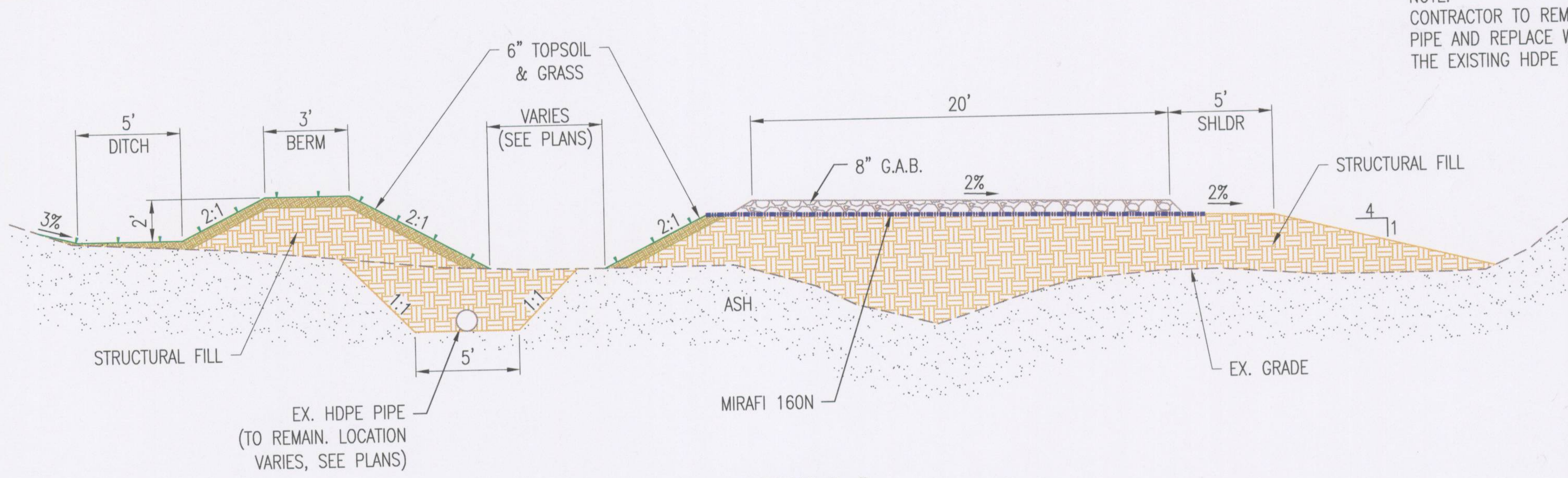
REVISION	DATE	DESCRIPTION	PROJ ID	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
3	03/29/19	REMOVED PERMEABILITY REQUIREMENT	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
2	02/26/19	REVISED POND SPILLWAYS	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
1	01/24/18	REMOVED CHAINLINK FENCE	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JKB	AES	JKB	XXX	XXX	XX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JMH	CRU	JKB	XXX	XXX	MPB	JCP

SCALE	DRAWING NUMBER	SHEET
NONE	E720297	1



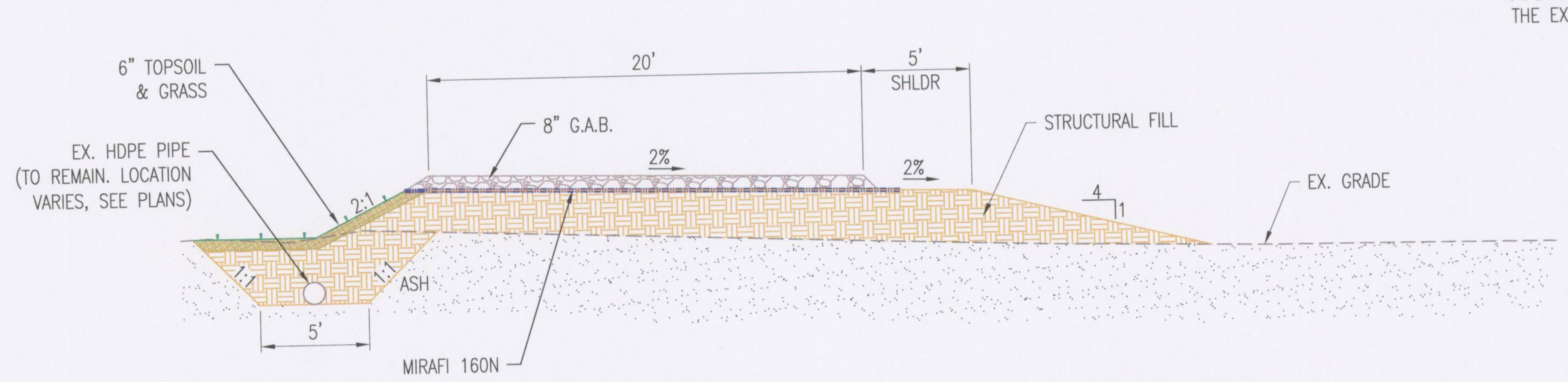
SECTION A–A
N.T.S.

NOTE:
CONTRACTOR TO REMOVE ASH ABOVE EXISTING HDPE PIPE AND REPLACE WITH STRUCTURAL FILL. ASH UNDER THE EXISTING HDPE PIPE MAY REMAIN IN PLACE.



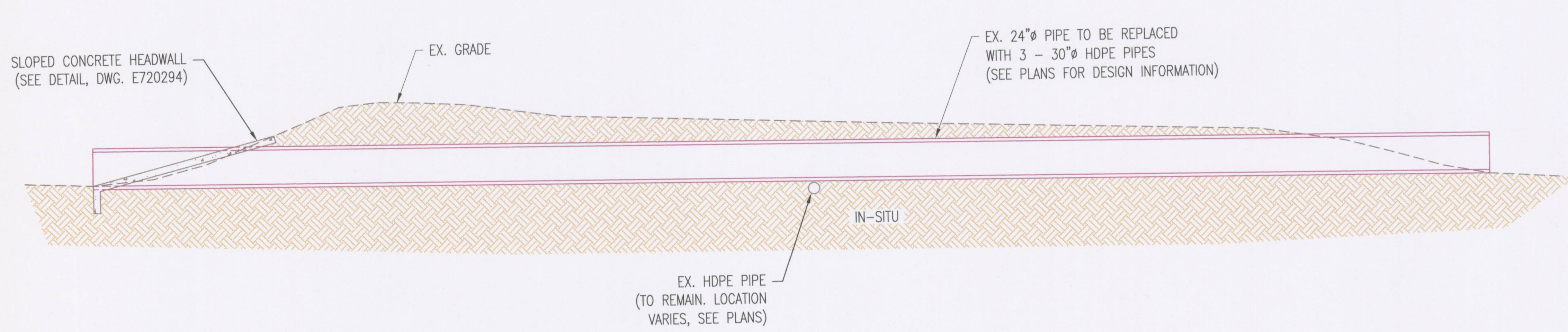
SECTION B–B
N.T.S.

NOTE:
CONTRACTOR TO REMOVE ASH ABOVE EXISTING HDPE PIPE AND REPLACE WITH STRUCTURAL FILL. ASH UNDER THE EXISTING HDPE PIPE MAY REMAIN IN PLACE.



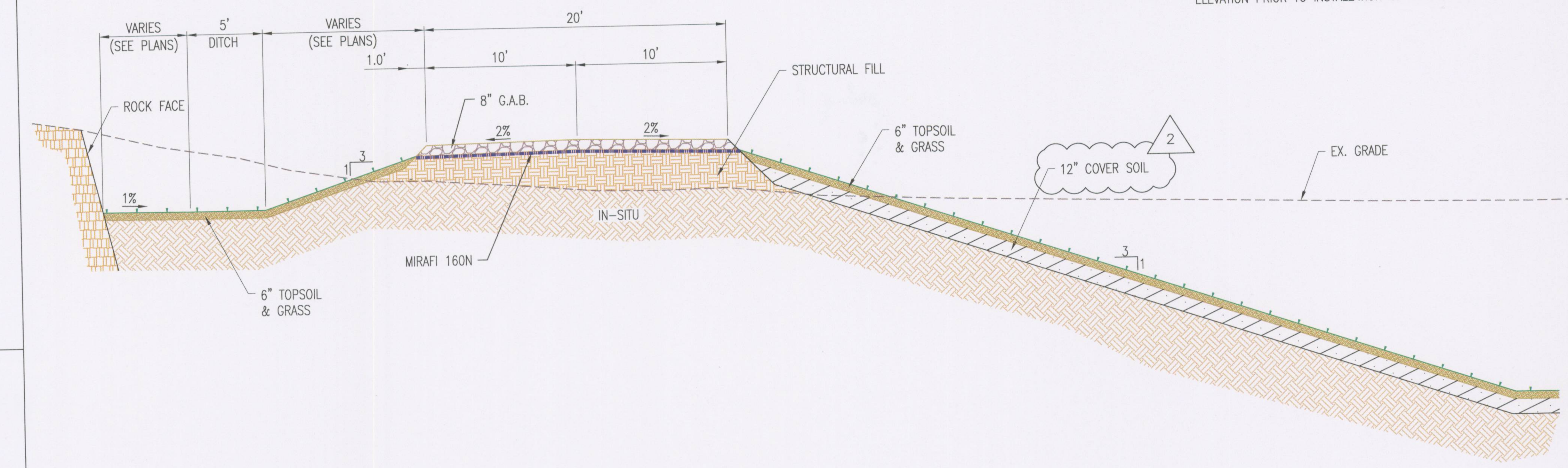
SECTION C–C
N.T.S.

NOTE:
CONTRACTOR SHALL VERIFY LOCATION OF EXISTING HDPE PIPE PRIOR TO REPLACEMENT OF EXISTING 24"Ø STORM DRAINAGE PIPE WITH THREE (3) 30"Ø STORM DRAINAGE PIPES. CONTRACTOR TO USE EXTREME CAUTION TO NOT DAMAGE EXISTING HDPE PIPE.
CONTRACTOR TO NOTIFY ENGINEER WITH ANY CONFLICTS.



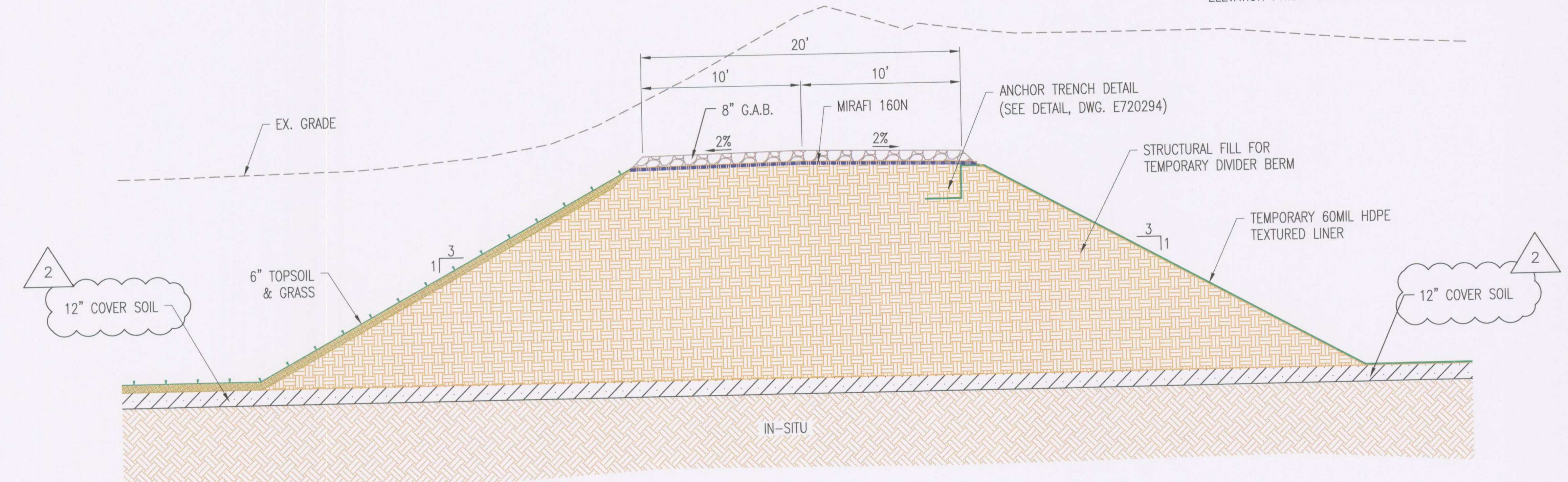
SECTION D–D
N.T.S.

NOTE:
CONTRACTOR TO ENSURE ALL ASH IS REMOVED FROM THE POND AREA PRIOR TO INSTALLATION OF IMPROVEMENTS. STRUCTURAL FILL SHALL BE USED TO BRING SUBGRADE UP TO CORRECT ELEVATION PRIOR TO INSTALLATION OF POND COVER.



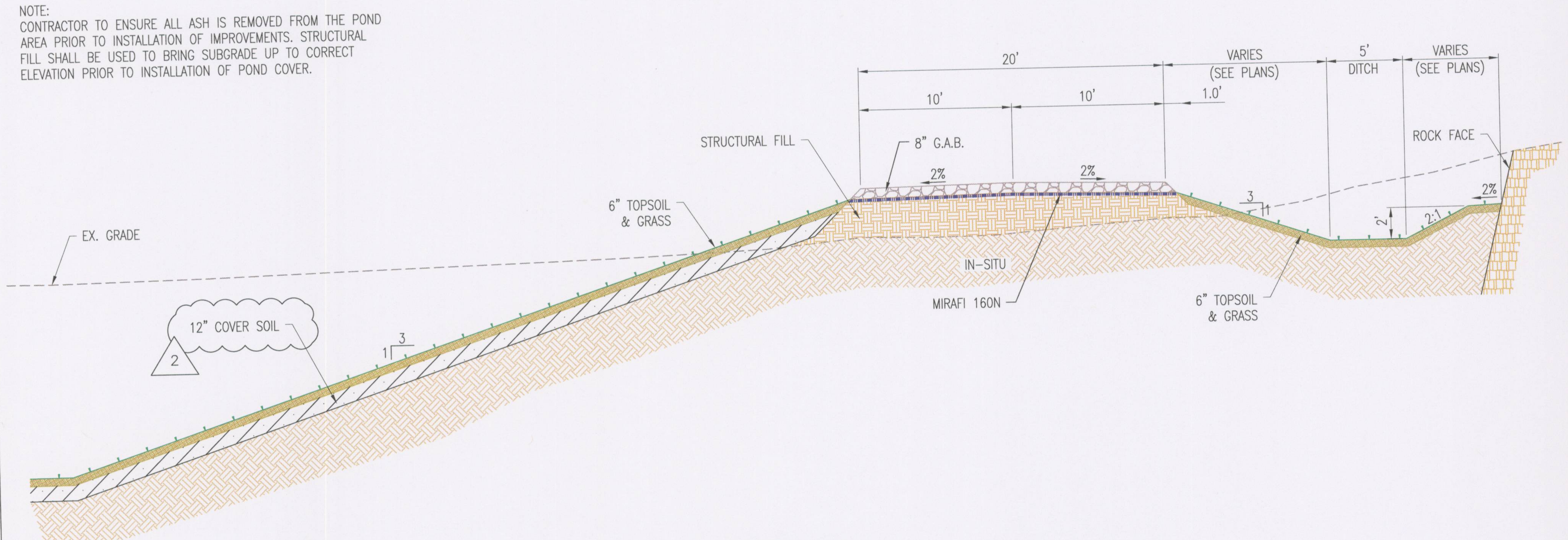
SECTION E–E
N.T.S.

NOTE:
CONTRACTOR TO ENSURE ALL ASH IS REMOVED FROM THE POND AREA PRIOR TO INSTALLATION OF IMPROVEMENTS. STRUCTURAL FILL SHALL BE USED TO BRING SUBGRADE UP TO CORRECT ELEVATION PRIOR TO INSTALLATION OF POND COVER.



SECTION F–F
N.T.S.

NOTE:
CONTRACTOR TO ENSURE ALL ASH IS REMOVED FROM THE POND AREA PRIOR TO INSTALLATION OF IMPROVEMENTS. STRUCTURAL FILL SHALL BE USED TO BRING SUBGRADE UP TO CORRECT ELEVATION PRIOR TO INSTALLATION OF POND COVER.



SECTION G–G
N.T.S.

NOTES:
1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

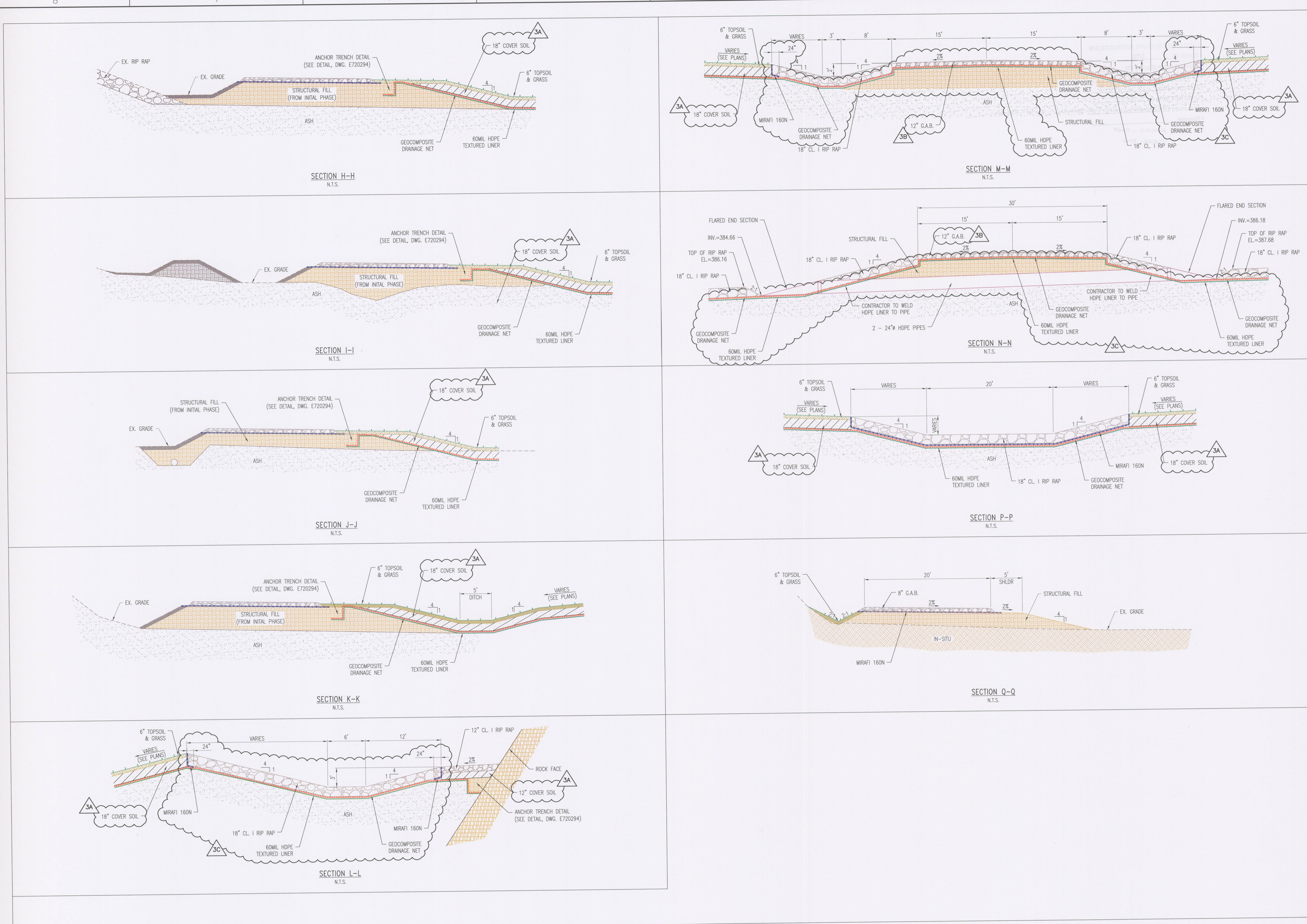
REVISION	DATE	DESCRIPTION	PROJ ID	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
2	03/19/19	REMOVED PERMEABILITY REQUIREMENT	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XX	JWM
1	01/24/18	REMOVED CHAINLINK FENCE	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JKB	AES	JKB	XXX	XXX	XX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	PROJ ID: GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JMH	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation
Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 7

SCALE	DRAWING NUMBER	SHEET
NONE	E720298	1

ANSI



NOTES:

1. SEE DRAWING E720258 FOR DRAWING INDEX.
2. SEE DRAWING E720259 FOR GENERAL NOTES AND LEGEND.

REVISION	DATE	DESCRIPTION	PROJ ID	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
3	03/29/2019	A. REMOVED PERMEABILITY REQUIREMENT B. REVISED SECTION M-M AND N-N G.A.B. THICKNESS C. REMOVED MIRAFI 160N FROM SECTION & ADDED GEOCOMPOSITE DRAINAGE LAYER	GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
2	02/26/2019	REVISED DETAIL P-P	GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	AES	CRU	JKB	XXX	XXX	XXX	JWM
1	01/16/2019	REVISED DETAIL M-M AND N-N.	GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JAA	AES	JKB	XXX	XXX	XXX	JWM
0	11/30/18	ISSUED FOR CONSTRUCTION	GOR18003 BOTTOM ASH STORAGE AREA CLOSURE	JMH	CRU	JKB	XXX	XXX	MPB	JCP

Southern Company Generation Engineering and Construction Services
FOR
Alabama Power Company

PLANT GORGAS
SITEWORK
SECTIONS AND DETAILS
SHEET 8

SCALE	DRAWING NUMBER	SHEET	CONT'D
NONE	E720299	1	FINAL

ANSI E

POST-CLOSURE CARE PLAN
PLANT GORGAS BOTTOM LANDFILL
ALABAMA POWER COMPANY

The Alabama Department of Environmental Management Solid Waste Program Division 13 regulations (ADEM Admin. Code r. 335-13-4-.20) requires the owner or operator of an existing CCR landfill that is closed in place to provide for post-closure care of the unit for a period of at least 30 years. Post-closure care includes maintenance of the facility, as well as groundwater monitoring in accordance Department regulations.

The Bottom Ash Landfill located at Alabama Power Company's Plant Gorgas is currently expected to be closed in place under the provisions of r. 335-13-4-.20. Following closure, maintenance will be provided on the final cover system for the required post-closure care period so that the integrity and effectiveness of the final cover system will be maintained. The leachate collection and removal systems in the lined disposal cells will also be maintained. Maintenance activities will include, as needed, repairs to the final cover to correct any effects related to settlement, subsidence, erosion or other events, and will be performed to prevent run-on or run-off from eroding or otherwise damaging the final cover. Maintenance tasks could include, but not be limited to, repair of erosion features, replacement of eroded cover soils and re-establishment of vegetation, where applicable.

Post-closure maintenance will include quarterly inspections and any problems identified will be corrected in a timely manner. All eroded areas or areas having extensive surface cracks will be filled with suitable soil cover and appropriate cover established. Areas where ponding of water occurs will be maintained and regraded to reduce the potential for future ponding. Signs will be posted stating the facility is closed. Any required monitoring devices and pollution control equipment will be maintained.

The groundwater monitoring system will be maintained throughout the required post-closure care period. Groundwater monitoring will be performed on a semiannual basis during the required post-closure care period as well.

During the post closure care period, the following office (s) can be contacted about the facility during the post-closure care period.

Gorgas Steam Plant
Compliance and Support Manager
460 Gorgas Road, Parrish, AL 35580-5715
1-205-686-2103
G2CCRPostGOR@southernco.com

At the present time, there is no planned use of the facility after closure. If current plans change, they will be noted in an amendment to this post-closure care plan. Any future use of the property after closure will not disturb the integrity of the final cover, liner or any other component of the containment system. Furthermore, the functionality of the groundwater monitoring system will be maintained.

No later than 60 days following completion of the post-closure care period of 30 years, Alabama Power Company will prepare a notification verifying completion of the post-closure care.

I hereby certify that this post-closure care plan has been prepared in accordance with the requirements of r. 335-13-4-.20(3).

12/4/18

ALABAMA LICENSED 16516 PROFESSIONAL ENGINEER JAMES C. PEGUES, JR.

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

APPENDIX 6
OPERATIONS PLAN

OPERATION PLAN
PLANT GORGAS BOTTOM ASH LANDFILL

William Crawford Gorgas Electric Generating Plant (Plant Gorgas) is located in southeastern Walker County, Alabama, approximately fifteen miles south of Jasper, at 460 Gorgas Road Parrish, AL 35580. Plant Gorgas, the oldest operating fossil plant in Alabama, came on-line in 1917 when the first of ten generating units had been completed; three of these generating units are still active.

The Bottom Ash Landfill is located on Plant Gorgas property (owned by Alabama Power Company) and receives coal combustion residuals in the form of bottom ash from Alabama Power operations.

Cover

Daily and intermediate cover is not expected to be a requirement for the CCR disposal areas, particularly for the working face of the cell. As backslopes of the cells achieve planned finished grade, temporary soil cover will be placed, as needed, and vegetation will be established. Intermediate cover will not be routinely utilized on the active face of the CCR disposal areas. Any exposed area of the CCR disposal area materials that will not receive ash or gypsum for three months will be covered with temporary soil cover.

Leachate Ponds Operational Information

The Bottom Ash Landfill is unlined and does not contain a leachate collection system. Therefore, there is no dedicated leachate pond. Stormwater runoff is routed to a sedimentation pond. Discharges from the pond are interconnected to the Plant Gorgas wastewater treatment system and covered under the facility's National Pollutant Discharge Elimination System (NPDES) Permit No AL0002909.

Access

Plant Gorgas and Alabama Power will control access to the facility and prevent unauthorized vehicular traffic and illegal dumping of wastes through the use of artificial barriers, natural barriers, or both, as appropriate.

Operational Standards

Coal combustion residuals in the form of bottom ash accepted at the facility originate only from Alabama Power Company. No prohibited wastes will be disposed of in the facility, including Hazardous or PCB waste, regulated medical wastes or liquid waste streams.

Random inspections of incoming loads to the disposal facility will be conducted to insure no prohibited wastes are disposed of in the facility. Plant personnel assigned to operations within the landfill are routinely trained to identify such waste streams.

Open burning of wastes within the permitted limits of the landfill will not be conducted. If burning of trees and stumps associated with landfill construction activities is needed within the permitted boundary, such activities will be properly permitted through the Department and the Alabama Forestry Commission.

All waste will be confined to as small a space as possible. The CCR materials are conditioned with moisture prior to transport and disposal at the landfill, and/or as a part of placement and compaction activities. In order to minimize the potential for fugitive dust, the area of exposed CCR in the working area of the stacks shall be limited. Conditioned CCR waste shall be spread in continuous uniformly thick and relative horizontal layers. The maximum loose thickness of each lift shall not exceed 12 inches (nominal loose thickness).

The CCR materials will be compacted with suitable earthmoving equipment to achieve a minimum 90% of its maximum dry density determined in accordance with ASTM D 698. Density tests shall be performed periodically on a compacted CCR lift to determine the required number of equipment passes to achieve compaction. Moisture contents shall be adjusted appropriately by wetting or drying methods to maintain suitable compaction moisture.

If the surface of a CCR lift is expected to be exposed for longer than 24 hours, the surface shall be rolled with a smooth drum roller to seal the surface to reduce infiltration and to prevent ponding of precipitation. Any exposed area of the CCR materials that will not receive ash or gypsum for three months shall be covered with temporary soil cover.

As some CCR materials are suitable for beneficial reuse and the market for reuse of these materials fluctuates, it may be desirable to salvage CCR wastes from the landfill after disposal. All such salvaging will be closely controlled.

The volume of available airspace associated with the Bottom Ash Landfill is approximately 4,000,000 cubic yards.

<u>Recordkeeping</u>

Alabama Power will maintain an operating record at Plant Gorgas that contains the following information:

- A copy of the Solid Waste Disposal Permit as issued by the Department
- The permit application, operational narrative and engineering drawings
- Reports or documentation generated during the normal operation of the facility

Each report or other documentation generated during the normal operation of the facility will be retained for at least a period of five years follow the date of each occurrence, measurement, maintenance, corrective action, report, record or study.

All information in the operating record will be furnished upon request to ADEM and will be made available at reasonable times for inspection by ADEM.

In accordance with the requirements of 335-13-15 [per 335-13-5-.02(1)(h)5.], all required plans and assessments periodically required for CCR landfills will be updated when conditions change that modify such updates. Amended plans and assessments will be placed in the Plant Gorgas Operating Record, posted to the public internet website and notifications will be made to the Director of the Department.

APPENDIX 7
ADJACENT PROPERTY OWNERS

No other landowners adjoin the surveyed facility boundary for this CCR Unit.

APPENDIX 8
UNSTABLE AREA DEMONSTRATION

LOCATION RESTRICTION DEMONSTRATION
UNSTABLE AREAS (40 C.F.R. 257.64 and ADEM Admin. Code r. 335-13-15-.03(5))
PLANT GORGAS BOTTOM ASH LANDFILL
ALABAMA POWER COMPANY

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities" Final Rule (40 C.F.R. Part 257, Subpart D) and the State of Alabama's ADEM Admin. Code Chapter 335-13-15 require the owner or operator of an existing CCR surface impoundment to make a demonstration that the facility meets certain location restrictions. Per § 257.64 and ADEM Admin. Code r. 335-13-15-.03(5), the owner or operator must demonstrate that the facility is not located within an unstable area; otherwise, a demonstration must be made that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. An unstable area is defined in the regulations as a location that is susceptible to natural or human induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movements and karst terrains.

The CCR landfill located at Alabama Power Company's Plant Gorgas referred to as the Plant Gorgas Bottom Ash Landfill is located on Plant Gorgas property, near Parrish, Walker County, Alabama. The CCR landfill is formed by excavations in previously placed mine spoil material as well as the construction of earthen embankments. The foundations beneath the embankments and the CCR unit generally consist of previously placed mine spoils. There has been no visible evidence of instability in the landfill, and there are no structural components associated with the landfill that would be adversely impacted by settlements that may have occurred over the years of operation. Furthermore, the CCR unit is not located within karst terrain, and the site and its surrounding areas are not subject to mass movements (e.g. landslides).

I hereby certify that the unstable area location restriction demonstration was conducted in accordance with 40 C.F.R. Part 257.64 and ADEM Admin. Code r. 335-13-15-.03(5).

10/17/18

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

ALABAMA LICENSED 16516 PROFESSIONAL ENGINEER JAMES C. PEGUES, JR.

APPENDIX 9
RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

RUN-ON AND RUN-OFF CONTROL PLAN
PLANT GORGAS BOTTOM ASH LANDFILL
ALABAMA POWER COMPANY

Section 257.81 of EPA's regulations requires the owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill to prepare a run-on and run-off control system plan to document how these control systems have been designed and constructed to meet the applicable requirements of this section of the rule. Each plan is to be supported by appropriate engineering calculations.

The Bottom Ash Landfill is located at Alabama Power Company's Plant Gorgas within the permitted boundaries of the Plant's overall landfill facility. Bottom ash is dry stacked in this area after decanting of the ash at a remote location. The Bottom Ash Stack covers approximately 56 acres.

The storm water flows have been calculated using the Natural Resources Conservation Service method (also known as the Soil Conservation Service (SCS)) method using 24 hour storm events. The storm water detention system has been designed in accordance with the Alabama Soil and Water Conservation Committee requirements as well as other local, city, and government codes. The post developed storm water discharge was designed to be less than the pre-developed storm water discharge in accordance with the requirements of the State of Alabama.

Runoff curve number data was determined using Table 2-2A from the Urban Hydrology for Small Watersheds (TR-55). Appendix A and B from the TR-55 were used to determine the rainfall distribution methodology. Precipitation values were determined from NOAA's Precipitation Frequency Data Server (Atlas-14).

The NRCS provided information on the soil characteristics and hydrologic groups present at the site. It was determined that the site contains areas with hydrological soil groups "A", "B", and "D". A composite curve number was created based on the land use and soil type of the entire drainage area. This information was placed into Hydraflow Hydrographs and used to generate appropriate precipitation curves and storm basin runoff values.

The Plant Gorgas Bottom Ash Landfill is designed and constructed with perimeter berms and drainage ditches around the cells that prevent storm water run-on during the peak discharge of a 24-hr, 25-yr storm from flowing onto the active portion of the landfill.

There are no discharge structures present within the Plant Gorgas Bottom Ash Landfill. Water entering the cell naturally percolates the soil or evaporates so there is not a normal pool within the cell. Calculations were made to determine if there was sufficient volume available to store the design storm. These calculations indicate that rainfall occurring during a 24-hr, 25-yr storm is safely stored and passed.

The facility is operated subject to and in accordance with § 257.3-3 of EPA's regulations.

I hereby certify that the run-on and run-off control system plan meets the requirements of 40 C.F.R. Part 257.81.

10/7/16

ALABAMA LICENSED 16516 PROFESSIONAL ENGINEER JAMES C. PEGUES, JR.

James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516

Run-on and Run-off Control System Plan for Landfills: Calculation Summary

for

Plant Gorgas CCR Bottom Ash Landfill

Prepared by:

Southern Company Services
Technical Services

Originator: ______________________ 10/6/16
Curtis R. Upchurch Date

Reviewer: ______________________ 10/11/16
Jason S. Wilson Date

Approval: ______________________ 10/12/16
James C. Pegues Date

1.0 Purpose of Calculation

The purpose of this report is to demonstrate the run-on and run-off controls of the subject CCR landfill in order to prepare a run-on and run-off control system plan as required by the United States Environmental Protection Agency's (EPA) final rule for Disposal of CCR from Electric Utilities (EPA 40 CFR 257).

2.0 Summary of Conclusions

2.1 Site Overview

The Plant Gorgas CCR Bottom Ash Landfill is located approximately 9 miles west of Birmingham, Alabama on Plant Gorgas property northeast of the plant. The total drain basin area is approximately 78 acres and the area occupied by the CCR landfill is approximately 42 acres. There are no off-site areas draining into the landfill and only stormwater runoff from rain falling directly in the storage area must be collected and controlled. The perimeter of the cell is bounded by high steep slopes on the north, east and west sides and to south by a lower raised roadbed/dike. The storage area is an unlined cell with various soils of hydrologic groups type A, B and D. Water entering the cell naturally percolates the soil or evaporates so there is not a normal pool within the cell.

An overview of Cell 2A is provided in Table 1 below.

Table 1—Landfill site characteristics

Pond Description	Bottom Ash Cell
Size (Acres)	42 +/-
Outlet Type	No spillway structure. Runoff into the site percolates into soil or evaporates.
Outlets To	Subgrade. Overtopping of south road/dike would flow into channel to Black Warrior River

2.2 Run-on Control System Plan

There is no stormwater run-on into the landfill due to the natural hilly terrain surrounding the area. This storage cell is located in a valley and the only stormwater runoff entering the landfill is from rainfall on the outer slopes leading up to the ridge lines or falling directly into the cell. The terrain to the south of the cell falls steeply away preventing any runoff from flowing into the cell.

2.3 Run-off Control System Plan

A hydrologic and hydraulic model was developed for the Plant Gorgas CCR Bottom Ash Landfill to determine the hydraulic capacity of the Cell. The design storm for the purposes of run-off control system plans is the 24-hour, 25-year rainfall event. The results of routing the design storm event through the landfill are presented in Table 2 below:

Table 2-Flood Routing Results for Plant Gorgas CCR Bottom Ash Landfill

Plant Gorgas	Normal Pool El (ft)	Top of embankment El (ft)	Peak Water Surface Elevation (ft)	Freeboard* (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)
CCR Landfill	N/A No Pool	362.0	360.8	1.2	300	0

*Freeboard is measured from the top of embankment to the peak water surface elevation

3.0 Methodology

3.1 HYDROLOGIC ANALYSES

The design storm for all run-on/run-off analyses is a 24-hour, 25-year rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Table 3.

Table 3. Plant Gorgas CCR Bottom Ash Landfill Design Storm Distribution

Return Frequency (years)	Storm Duration (hours)	Rainfall Total (Inches)	Rainfall Source	Storm Distribution
25	24	7.15	NOAA Atlas 14	SCS Type III

The drainage area for the Plant Gorgas Dry Gypsum Sedimentation Pond was determined based on a composite of Aerial Topo from March 2003, Field Topo August 2008 and Lidar Topo December 2011. Runoff characteristics were developed based on the Soil Conservation Service (SCS) methodologies as outlined in TR-55. An overall SCS curve number for the drainage area was developed based on methods prescribed in TR-55. Soil types were obtained from the Natural Resources Conservation Service. Land use areas were delineated based on aerial photography. Time of Concentration was also developed based on methodologies prescribed in TR-55.
A table of the pertinent basin characteristics of the landfill is provided below in Table 4.

Table 4—Landfill Hydrologic Information (Bottom Ash Landfill)

Drainage Basin Area (acres)	77.9
Hydrologic Curve Number, CN	74
Hydrologic Methodology	SCS Method
Time of Concentration (minutes)	13.4
Hydrologic Software	Hydroflow Hydrographs

Runoff values were determined by importing the characteristics developed above into a hydrologic model in Hydraflow Hydrographs Extension of AutoCad Civil 3D, 2013.

3.2 HYDRAULIC ANALYSES

Storage values for the landfill were determined by developing a stage-storage relationship utilizing contour data. There is no spillway system for runoff leaving the landfill area. All runoff from this drainage basin will flow south to a raised roadbed/dike area. There is no defined channel within the landfill area.

Based on the basin attributes including stage/storage information a rating curve was developed and inserted into Hydraflow Hydrographs software to analyze the depth of possible ponding during the design storm. Exfiltration in the landfill area has not been address in these calculations due to the lack of geotechnical information. Results are shown in Table 2.

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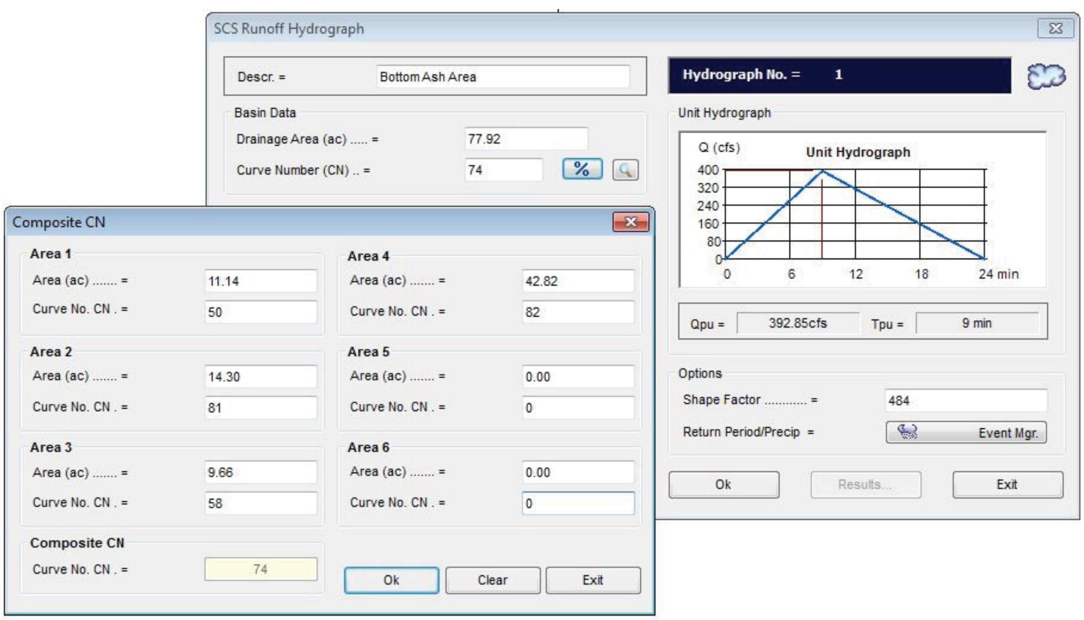
4.0 SUPPORTING INFORMATION

4.1 CURVE NUMBER
BOTTOM ASH LANDFILL



4.2 STAGE-STORAGE TABLE
BOTTOM ASH LANDFILL

Pond Name: Bottom Ash Cell Detention Area

Row	Stage	Elevation	Contour Area	Incremental Storage	Total Storage	Total Discharge
	(ft)	(ft)	(sqft)	(cuft)	(cuft)	(cfs)
0	0.00	355.00	n/a	n/a	0.00	0.000
1	1.00	356.00	n/a	48,492	48,492	0.000
2	2.00	357.00	n/a	176,391	224,883	0.000
3	3.00	358.00	n/a	216,891	441,774	0.000
4	4.00	359.00	n/a	244,161	685,935	0.000
5	5.00	360.00	n/a	253,584	939,519	0.000
6	6.00	361.00	n/a	285,795	1,225,314	0.000
7	7.00	362.00	n/a	300,780	1,526,094	120.84
8						
9						
10						
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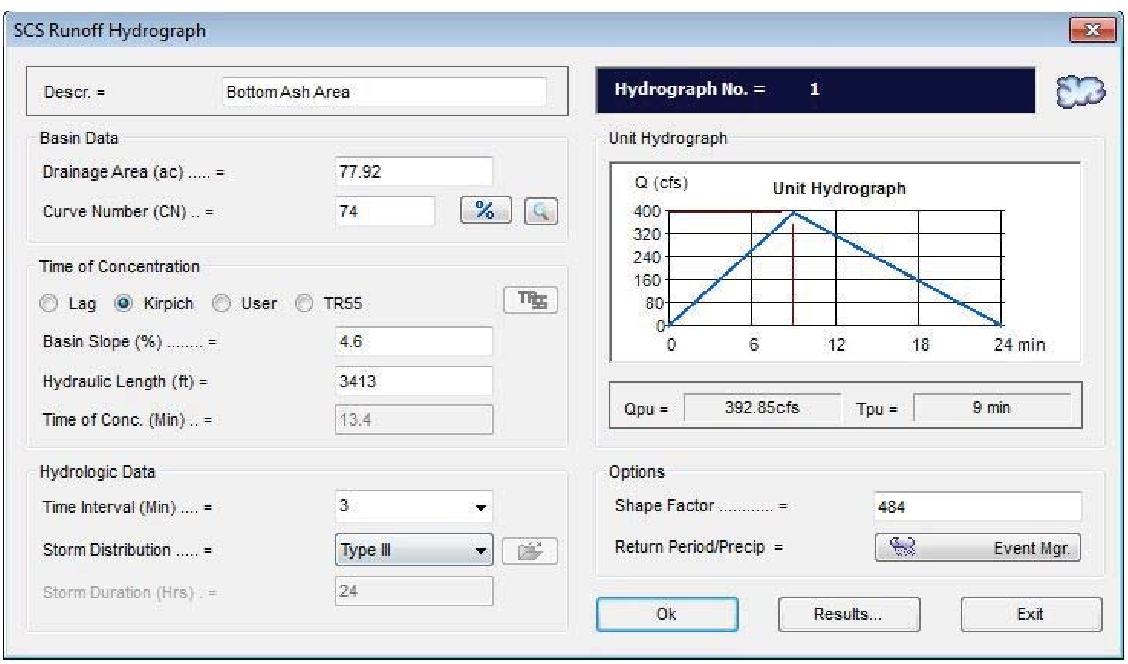
4.3 TIME OF CONCENTRATION
BOTTOM ASH LANDFILL



4.4 RESULTS

4.4.1 BOTTOM ASH LANDFILL

Hydrograph Report

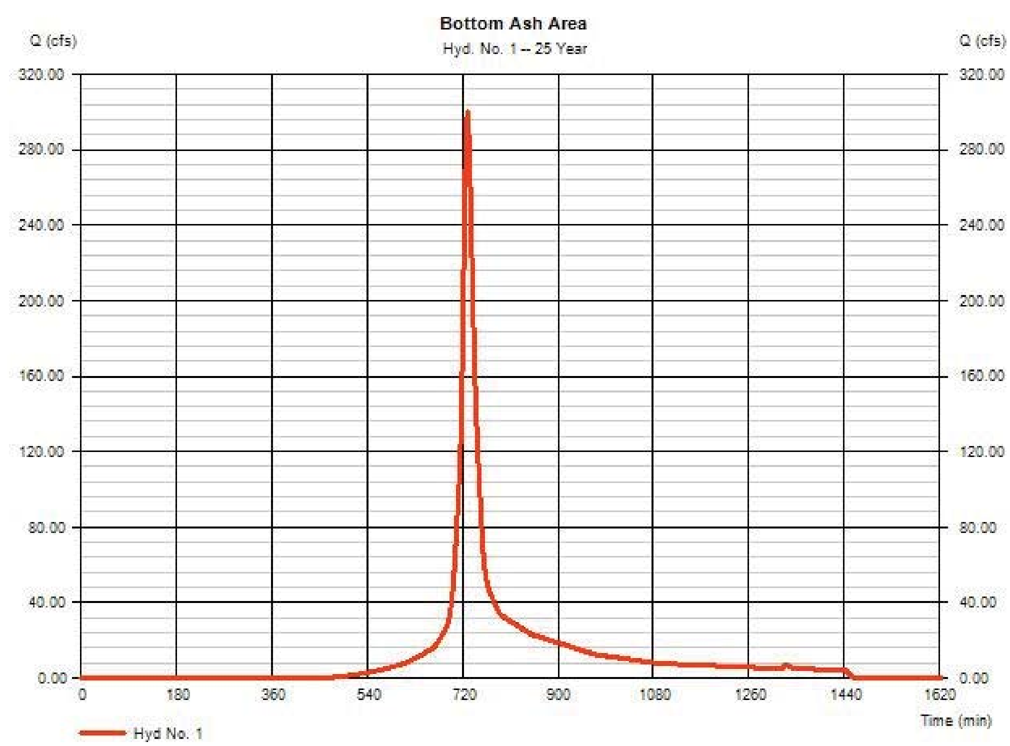
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Saturday, 10 / 1 / 2016

Hyd. No. 1

Bottom Ash Area

Hydrograph type	= SCS Runoff	Peak discharge	= 300.06 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 3 min	Hyd. volume	= 1,180,365 cuft
Drainage area	= 77.920 ac	Curve number	= 74*
Basin Slope	= 4.6 %	Hydraulic length	= 3413 ft
Tc method	= KIRPICH	Time of conc. (Tc)	= 13.41 min
Total precip.	= 7.15 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(11.140 x 50) + (14.300 x 81) + (8.660 x 58) + (42.820 x 82)] / 77.920



4.4.2 BOTTOM ASH LANDFILL DETENTION (NO DISCHARGE)

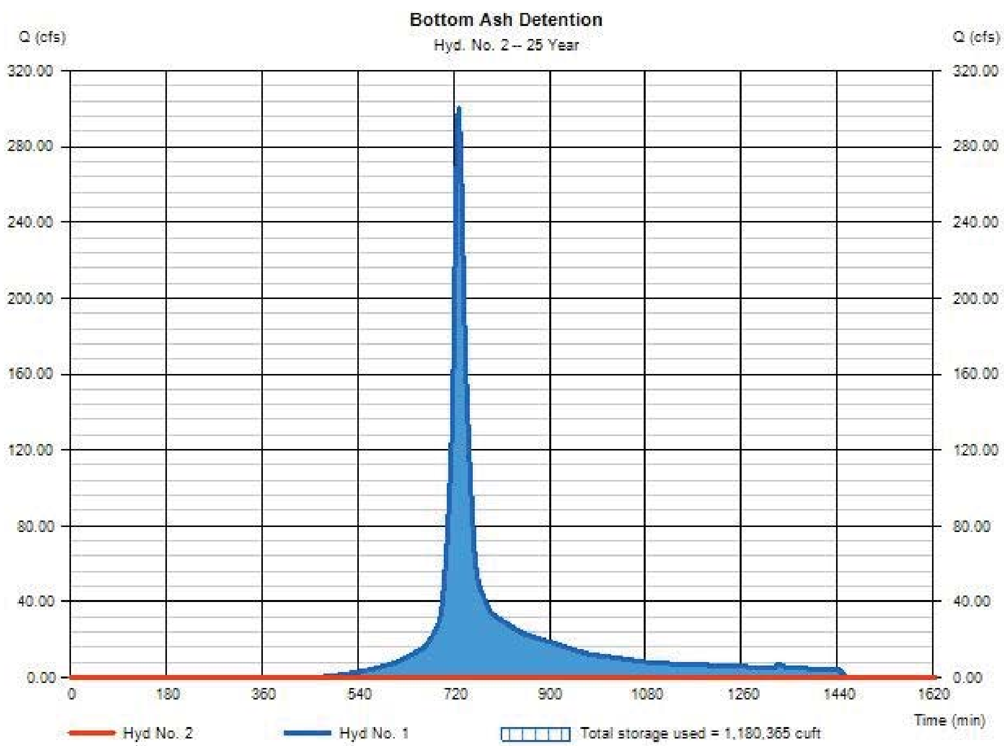
Hydrograph Report

Hyd. No. 2

Bottom Ash Detention

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= n/a
Time interval	= 3 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 1 - Bottom Ash Area	Max. Elevation	= 360.84 ft
Reservoir name	= Bottom Ash Cell Detention Area	Max. Storage	= 1,180,365 cuft

Storage Indication method used.



4.5 DRAINAGE BASIN