Prepared for

Santee Cooper Power
1 Riverwood Drive
Moncks Corner, South Carolina 29461

LOCATION RESTRICTIONS COMPLIANCE DEMONSTRATION

LANDFILL AREA 1
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

Prepared by

engineers | scientists | innovators

201 E. McBee Avenue, Suite 201
Greenville, South Carolina 29601

Project Number GSC5242.01BT

July 2018

Geosyntec
consultants

Certification Statement – Demonstration of Compliance with Location Restrictions

Federal CCR Rule: 40 CFR §257.60-64

CCR Unit: Landfill Area 1 of the WGS Class Three Landfill

Certification:

I, **Scott M. Graves**, a qualified professional engineer registered in the state of **South Carolina**, am the design engineer-of-record for the above-referenced coal combustion residual (CCR) Unit – the design of which is documented in the *Winyah Generating Station Class Three Landfill Permit Application* approved by the South Carolina Department of Health and Environmental Control (SCDHEC) on 15 September 2017 [Permit #LF3-00042]. Based on the evaluations presented in this Location Restrictions Compliance Demonstration Report, the above-referenced CCR Unit is, in my professional opinion, demonstrated to be in compliance with the United States Environmental Protection Agency (USEPA) minimum location restriction requirements for the siting criteria of 40 CFR §257.60-64 for new coal combustion residuals (CCR) landfills.

7/24/2018

Seal and Signature: _____ Firm Seal

Printed Name: Scott M. Graves

PE License Number: 33535 State: South Carolina

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1 INTRODUCTION

Geosyntec Consultants (Geosyntec) has prepared this *Location Restrictions Compliance Demonstration* on behalf of the South Carolina Public Service Authority doing business as (d.b.a.) Santee Cooper (Santee Cooper). The subject of this compliance demonstration is the coal combustion residual (CCR) unit known as "Landfill Area 1" at the Winyah Generation Station (WGS) located in Georgetown, South Carolina (Figure 1). The Landfill Area 1 is new CCR landfill, currently under construction and located in the area formerly occupied by the Unit 2 Slurry Pond at the WGS site.

On April 17, 2015, the Environmental Protection Agency (EPA) promulgated the federal Coal Combustion Residual Rule (CCR Rule) that establishes national minimum criteria for existing and new CCR landfills and surface impoundments. The landfill is subject to the CCR Rule as a new CCR landfill as defined in 40 CFR §257.53, and as such is required to make demonstrations documenting whether or not the CCR unit is in compliance with the location restriction requirements under 40 Code of Federal Regulations (CFR) §257.60 through §257.64. Initial waste placement within a new landfill cannot occur until these demonstrations have been completed and placed in the facility's operating record. This document serves as WGS's location restriction demonstrations for Landfill Area 1 at WGS.

1.1 Facility Location

The WGS is a coal-fired steam electric generating facility located at 661 Steam Plant Drive, Georgetown, SC 29440, owned and operated by Santee Cooper. The WGS site is located approximately 4 miles southwest of the city of Georgetown, South Carolina, and is accessed via US Hwy 17 to Pennyroyal Road. A general site vicinity map is presented on Figure 1 included with this report. The WGS includes an approximately 2,184-acre parcel for station operations and an adjacent approximately 344-acre parcel of land that is presently undeveloped.

The WGS generates CCRs during power generation and the air quality control process. The CCRs are recycled for beneficial use to the extent possible. Historically, some of the CCRs generated by the WGS have been disposed in six on-site ponds/surface impoundments. Santee Cooper intends to dispose of CCRs in an on-site landfill instead of using wet disposal into on-site ponds once plant upgrades are implemented, the on-site

landfill is constructed, and the ponds enter closure. Accordingly, Santee Cooper is constructing a landfill at the WGS which will be composed of two separate areas (i.e., units). The first area to be developed, and the subject of this report, is Landfill Area 1, which will have a lined area of 31.3 acres and a net airspace (waste disposal) volume of approximately 2,191,000 cubic yards. Landfill Area 1 is constructed in the vicinity of former Unit 2 Slurry Pond. Under the CCR Rule, Unit 2 Slurry Pond is considered an inactive CCR surface impoundment and Notification of Intent of Closure was submitted on 1 December 2015. Landfill Area 1 is shown on Figure 2.

1.2 Previous Investigations and Reports

Santee Cooper has implemented a number of hydrogeologic and geotechnical investigations at the WGS site to collect geologic, hydrogeologic, and geotechnical data. This includes previous investigations in and around the footprint of Landfill Area 1. This information was used in the studies, characterization reports, and engineering design of Landfill Area 1, which culminated in approval and issuance of a Class Three Landfill Permit by the South Carolina Department of Health and Environmental Control (SCDHEC) on September 15, 2017 [Permit #LF3-00042]. Through this permit application process, Landfill Area 1 was evaluated for siting criteria and designed in accordance with SCDHEC regulatory standards that are consistent with, and in some cases more stringent than, the Federal CCR Rule standards for siting and design of new CCR landfills. As such, this Federal CCR Rule Location Restrictions Compliance Demonstration is based on and supported by the detailed information contained in the approved SCDHEC permit application documents, which are as follows:

- *Landfill Siting Study*, Winyah Generating Station, Georgetown, South Carolina, April 2016, prepared by Geosyntec Consultants;
- *Site Hydrogeologic Characterization Study Report*, Winyah Generating Station, Georgetown, South Carolina, April 2016, prepared by Geosyntec Consultants; and
- *Class Three Landfill Permit Application,* Winyah Generating Station, Georgetown, South Carolina, August 2016, prepared by Geosyntec Consultants, (with revisions as contained in "Revised Technical Application received June 5, 2017" as approved by SCDHEC on September 15, 2017).

1.3 Site Geology and Hydrogeology

The WGS site is located within the Atlantic Coastal Plain physiographic province which is a wedge of unconsolidated to well-consolidated, Cretaceous to recent sediments. A review of South Carolina Coastal Plain hydrostratigraphy (Campbell and Coes, 2010) identifies several hydrostratigraphic layers (aquifers and confining units). In ascending order, they include the Gramling Aquifer and confining unit, Charleston Aquifer and confining unit, McQueen Branch Aquifer and confining unit, Crouch Branch Aquifer and confining unit, Gordon Aquifer and confining unit, and the surficial aquifer.

The aquifers of most interest at this site are the surficial aquifer and Gordon Aquifer. The surficial aquifer is the water-table aquifer and consists mainly of terrace sediments that were deposited during transgressions and regressions of a post-Miocene sea. The surficial aquifer is lithologically heterogeneous but generally consists of quartz gravel and sand, silt, clay, and shelly sand and unconformably overlies the Gordon aquifer, which is the lowermost aquifer of the Floridan Aquifer system. The Gordon Aquifer represents the permeable portion of the Williamsburg Formation (upper Chicora Member) in the vicinity of the site. As detailed in the *Site Hydrogeologic Characterization Study Report* (Geosyntec, 2016b), the surficial aquifer and Gordon Aquifer exhibit similar hydrogeologic properties and are not separated hydrogeologically. Therefore, the Gordon Aquifer and surficial aquifer are collectively termed the surficial aquifer in Geosyntec (2016b) and are designated as the uppermost aquifer at the site in accordance with 40 CFR §257.40.

Historical groundwater elevation measurements in the surficial aquifer at the site were influenced by the water levels in the slurry ponds and ash ponds. In recent years, some ponds have been closed. Once the new landfill is constructed, an engineered liner and leachate control system will eliminate recharge to the water table. For these reasons, Geosyntec (2016b) developed and presented a modeled seasonal high water table representing conditions after closure of the slurry ponds and ash ponds. In particular, this seasonal high water table includes conditions beneath the now-decommissioned Unit 2 Slurry Pond where Landfill Area 1 is located. A map of the seasonal high water table conditions used for this location restrictions evaluation as well as for the engineering design of Landfill Area 1, taken from the set of Engineering Drawings included in the *Class Three Landfill Permit Application* (Geosyntec, 2016c), is included in this report as Figure 3.

2 LOCATION RESTRICTIONS EVALUATION

The location restrictions under §257.60 through §257.64 include: (1) Placement above the uppermost aquifer; (2) wetlands; (3) fault areas; (4) seismic impact zones; and (5) unstable areas. Each of these locations is generally recognized as having the potential to impact the structure of any disposal unit.

2.1 Placement Above the Uppermost Aquifer

40 CFR §257.60(a) states that new CCR landfills "must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table)." The "uppermost aquifer" is defined by §257.40 as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. This definition includes a shallow, deep, perched, confined or unconfined aquifer, provided it yields usable water.

As mentioned, the uppermost aquifer at the site is the surficial aquifer, which is an unconfined aquifer consisting of mixtures of predominantly sand and minor amounts of silt and clay. A map of the modeled seasonal high water table is included in Figure 3 of this report. As shown, the groundwater elevations range from 22 feet above mean sea level (ft, MSL) in the northwestern portion of Landfill Area 1, to elevation 20 ft, MSL around the northeast, east, and southern portions of Landfill Area 1.

The groundwater map included in Appendix A, taken from the set of Engineering Drawings included in the *Class Three Landfill Permit Application* (Geosyntec, 2016c) also shows the Landfill Area 1 subgrade (bottom of liner system) grading plan (i.e., base of the CCR unit). An accompanying landfill cross section through Landfill Area 1 (Cross Section "B") is also included in Appendix A. Inspection of this information reveals that Landfill Area 1 is designed with a base that is located greater than 5-ft above the seasonal high water table, with the exception of the "sumps" (i.e., low points) of the landfill cells. To address this location restriction, the sumps will be equipped with a "clay plug under-liner" constructed beneath the base of the CCR unit – engineering details of which are included in Appendix A. This under-liner beneath the CCR unit will supplement the

landfill composite liner system present beneath all of Landfill Area 1 and will form the hydraulic barrier to prevent an intermittent, recurring, or sustained hydraulic connection between the sump areas (where the base is less than 5-ft above the seasonal high water table) and the uppermost aquifer.

For the foregoing reasons, Landfill Area 1 is judged to be in compliance with the requirements of 40 CFR §257.60 for placement above the uppermost aquifer.

2.2 Wetlands

40 CFR §257.61(a) states that new CCR landfills "must not be located in wetlands, as defined in §232.2 of this chapter, unless the owner or operator demonstrates…that the CCR unit meets the requirements of paragraph (a)(1) through (5) of this section." Wetlands, as defined in 40 CFR §232.2, means "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

As stated in the *Landfill Siting Study* (Geosyntec, April 2016a), the landfill is being constructed within the limits of the now closed Unit 2 Slurry Pond. Waste treatment systems, including treatment ponds designed to meet the requirements of the Clean Water Act (CWA), are not waters of the United States and are exempt from permitting under Section 404 of the CWA. Any wetlands that may exist within these boundaries are exempt from permitting because the CCR ponds are considered part of the existing waste treatment system which is permitted and operated under National Pollutant Discharge Elimination System (NPDES) Permit No. SC0022471. Therefore, Landfill Area 1 is judged to be in compliance with the requirements of 40 CFR §257.61 for wetlands. Because Landfill Area 1 is not located in wetlands, there is no need for the demonstrations to show that the CCR unit meets the requirements of paragraphs (a)(1) through (a)(5) of 40 CFR §257.61.

2.3 Fault Areas

40 CFR §257.62(a) states that new CCR landfills "must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates by the dates specified in paragraph (c) of

this section that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit."

A summary of the structural features in South Carolina are summarized in Maybin (1998) and is provided in the *Site Hydrogeologic Characterization Study* (Geosyntec, 2016b). From an assessment of this information, it is concluded that no structural features indicative of recent (Holocene-age) faulting have been identified within 20 miles of the WGS site. The lack of a nearby fault zone has been further confirmed through previous WGS site-specific subsurface investigations documented in Geosyntec (2016b), which have showed no evidence of recent faults (i.e., no linear features that could be indicative of surface expression of a fault and no evidence of any stratigraphic offsets at depth which could be suggestive of faulting).

For the foregoing reasons, Landfill Area 1 is judged to be in compliance with the requirements of 40 CFR §257.62 for fault areas.

2.4 Seismic Impact Zones

40 CFR §257.63(a) states that new CCR landfills must not be located in seismic impact zones unless the owner or operator makes certain demonstrations. A seismic impact zone is defined as "an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years." Seismic zones, which represent areas of the United States with the greatest seismic risk, are identified on U.S. Geological Survey (USGS) national seismic hazard maps as well as regional seismic hazard maps developed by local experts considering the regional geologic setting and seismicity.

As documented in the *Seismic Hazard Evaluation and Site Response Analysis (*Appendix D-1 of the *Class Three Landfill Permit Application* (Geosyntec, 2016c)), the WGS site is located in a seismic impact zone. Accordingly, 40 CFR §257.63(a) requires a demonstration that "all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site." This demonstration is made through the engineering analyses and design presented in the *Class Three Landfill Permit Application* (Geosyntec, 2016c) and summarized in the remainder of this section.

The first step to address this location restriction and design the landfill to resist the horizontal acceleration from the specified seismic event was to conduct a "site response analysis" to evaluate the effect of local site conditions on the expected seismic-induced ground motions at the site. The objective of the site response analysis is to calculate accelerations, shear strains, and shear stresses within the site soil profiles. The methodology for the site response analysis is summarized by the following approach: (i) evaluate published seismic hazard maps to assess the maximum horizontal acceleration in lithified earth material for the site area; (ii) develop the target response spectrum, including the peak ground acceleration (PGA), at a hypothetical firm ground outcrop at WGS corresponding to the appropriate seismic hazard level; (iii) select the earthquake magnitude that contributes predominantly to the seismic hazard at WGS; (iv) select a set of ground motion time histories that envelope the target spectrum, and are generally consistent with the source and path characteristics of expected ground motions at WGS; and (v) perform a "seismic site response" analysis using "DEEPSOIL®", a one-dimensional, nonlinear site response analysis program. The outcome of the site response analysis, provided in the *Seismic Hazard Evaluation and Site Response Analysis* presented in the *Class Three Landfill Permit Application* (Geosyntec, 2016c), was a set of calculated maximum horizontal equivalent acceleration (MHEA) vs. depth profiles and cyclic stress ratios (CSR), which were subsequently used in the seismic slope stability analysis and the liquefaction potential analysis described below.

The second step to address this location restriction and design the landfill to resist the horizontal acceleration from the specified seismic event was to conduct seismic stability analyses and liquefaction analyses of the foundation and structural components of Landfill Area 1. Details are provided in the *Static and Seismic Global Slope Stability Analysis* (Appendix D-2), and the *Liquefaction Analysis* (Appendix D-3) of the *Class Three Landfill Permit Application* (Geosyntec, 2016c), and the results are summarized below.

- Analyses were performed to evaluate seismic (as well as static) global slope stability of the landfill (critical cross section at Landfill Area 1). The term "global slope stability" refers to sliding scenarios that pass though (i) the waste mass only (Waste Slope Stability); (ii) the waste mass and foundation soils (Foundation Stability); and (iii) the waste mass and along the liner system interface (Waste-Block Liner Stability). Final cover system (on which the surface drainage features are placed) seismic stability was also analyzed. The analysis results demonstrate

that the minimum calculated factor of safety (FS) against failure under seismic loading conditions is greater than the required minimum, thereby showing that the structural components of the landfill are designed with adequate seismic stability (i.e., are designed to resist the maximum horizontal acceleration in lithified earth material for the site).

- Liquefaction analyses were performed to evaluate the potential for liquefaction of foundation soils during an earthquake event and the potential effect on the integrity of Landfill Area 1. The analysis used geotechnical information collected from standard penetration test (SPT) borings and cone penetration test (CPT) soundings advanced through the perimeter dikes and within areas proposed for waste disposal (i.e., the landfill footprint)) during previous site investigations. The factor of safety against liquefaction (FS_{Liq}) was computed at every depth interval where data was collected for SPT borings and CPT soundings. The results of the analyses indicate that liquefiable soils were not observed in the perimeter dikes or foundation soils beneath the perimeter dikes of Landfill Area 1. Beneath the proposed footprint of Landfill Area 1, zones of potentially liquefiable soils were identified in three borings under recently existing (pre-landfill) conditions (which represent a temporary condition prior to landfill construction); further analyses at these locations showed that the liquefaction resistance within the potentially liquefiable zones increased to acceptable levels with subsequent landfill construction and the placement of overlying waste material.

For the foregoing reasons, Landfill Area 1 is judged to be in compliance with the requirements of 40 CFR §257.63 for seismic impact zones.

2.5 Unstable Areas

40 CFR §257.64(a) indicates that new CCR landfills "must not be located in an unstable area unless the owner or operator demonstrates…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 means 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. To assess whether Landfill Area 1 may be situated in an unstable area, following factors were considered:

- On-site or local soil conditions that may result in differential settling;
- On-site or local geologic or geomorphologic features; and
- On-site or local human-made features or events (both surface and subsurface).

Landfill Area 1 has been sited in consideration of available site-specific and local/regional data from the previous *Landfill Siting Study* and *Site Hydrogeologic Characterization Study Report* (Geosyntec 2016a and 2016b, respectively). With respect to the potential presence of unstable areas, these reports reveal the following about Landfill Area 1:

- The site is not situated in an area of karst terrain.
- The site is not situated in an area with geologic features or the potential for geomorphically-induced phenomena that could be indicators of susceptibility to mass movements (i.e., landslides, avalanches, debris slides and flows, soil flocculation, block sliding, rock falls, or excessive surface erosion).
- The site is not situated in an area that could be subject to coastal or river erosion.
- The site is not situated in an area of known subsurface mines, or in an area experiencing significant water or mineral withdrawal, nor do there appear to be evidence of other human-made features or man-induced events that could result in the downslope transport of soil and rock material that would make the CCR unit susceptible to mass movements or otherwise impair the integrity of the unit.
- The site is not situated (as previously discussed) in an area of active faulting.

The *Class Three Landfill Permit Application* (Geosyntec, 2016c) presents analyses to address on-site or local soil conditions in and around Landfill Area 1. The resulting design includes structural components and features appropriately selected based on these calculations, which demonstrate that adequate performance is predicted. With respect to potentially unstable areas, the permitted landfill design reveals the following:

- The site does not appear to be situated on poor foundation conditions that could differentially settle significantly or provide inadequate foundation support to the extent that could make the CCR unit susceptible to mass movements or otherwise impair the integrity of the structural components. This is based on foundation settlement analyses, static slope stability calculations, and the aforementioned seismic analyses and liquefaction analyses – all presented in Geosyntec (2016c).

For the foregoing reasons, Landfill Area 1 is judged to be in compliance with the requirements of §257.64 for unstable areas.

3 CONCLUSIONS

Geosyntec is confident the data on which this report is based demonstrates compliance with location restrictions per 40CFR §257.60 through §257.64. A compliance summary of the CCR Rule location restrictions and design criteria requirements addressed in this document are provided in Table 1 below.

Table 1 Location Restriction Compliance Summary

Winyah Area 1 Landfill		Compliant?	
Regulation	**CCR Location Restriction**	**YES**	**NO**
257.60	Placement Above Uppermost Aquifer	X	
257.61	Wetlands	X	
257.62	Fault Areas	X	
257.63	Seismic Impact Zones	X	
257.64	Unstable Areas	X	

4 REFERENCES

Campbell, B.G., and Coes, A.L., eds., 2010. Groundwater Availability in the Atlantic Coastal Plain of North and South Carolina: U.S. Geological Survey Professional Paper 1773, 241 p., 7 pls.

Geosyntec Consultants (Geosyntec), 2016a. *Landfill Siting Study,* Winyah Generating Station, Georgetown, South Carolina. April, 2016.

Geosyntec, 2016b. *Site Hydrogeologic Characterization Study Report,* Winyah Generating Station, Georgetown, South Carolina. April, 2016.

Geosyntec, 2016c. *Class Three Landfill Permit Application,* Winyah Generating Station, Georgetown, South Carolina. August 2016 (with revisions as contained in "Revised Technical Application received June 5, 2017" as approved by SCDHEC on September 15, 2017).

Maybin, A.H., Clendenin, C.W., Jr., and Daniels, D.L., 1998. Structural Features of South Carolina: South Carolina Geological Survey General Geologic Map Series 4, 1:500,000.

FIGURES

Vicinity Map

Santee Cooper Winyah Generation Station
Georgetown, South Carolina

Geosyntec consultants

PROJECT NO. GSC5242 | April 2016

Figure 1

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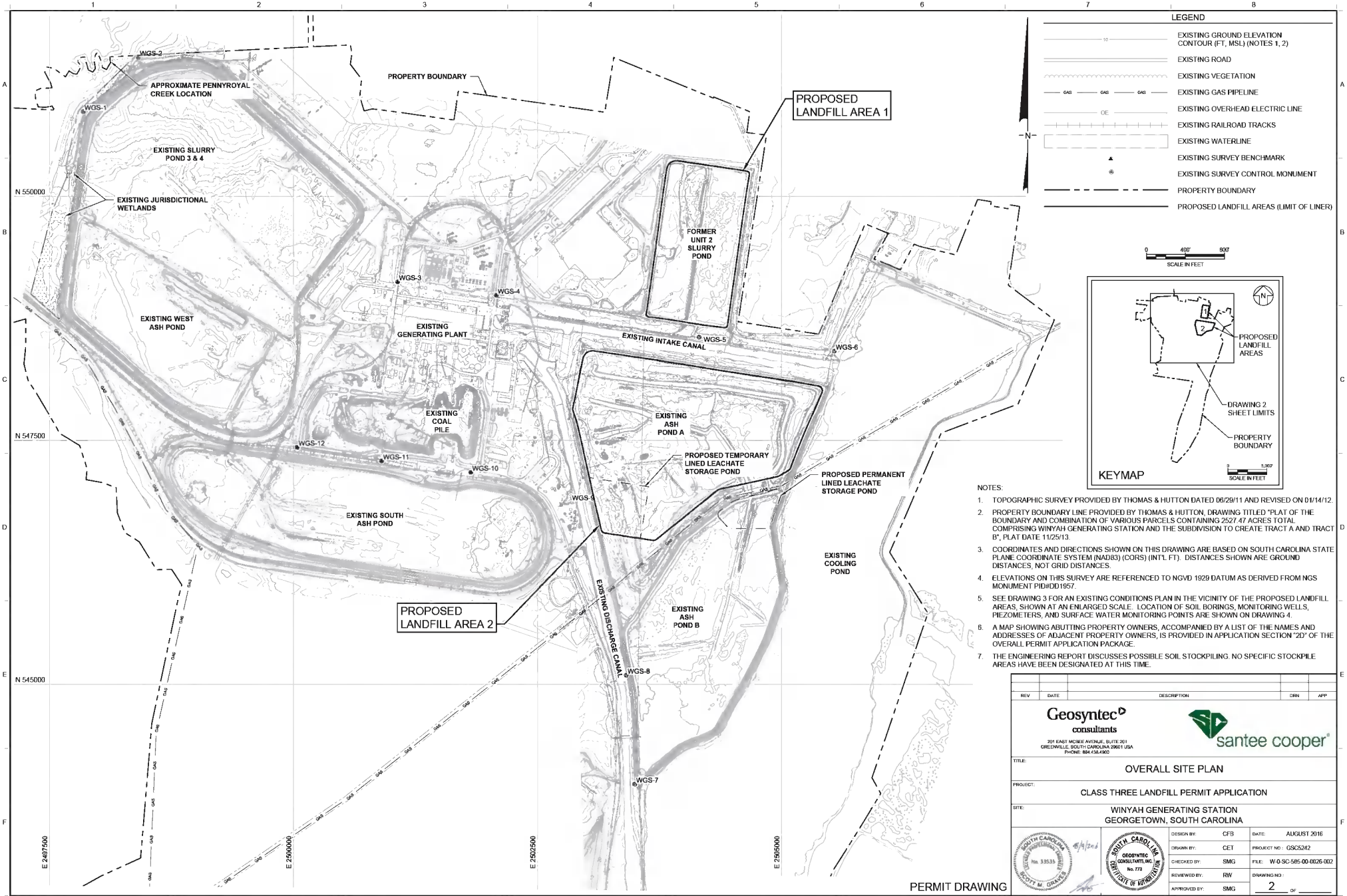


NOTES:

1. TOPOGRAPHIC SURVEY PROVIDED BY THOMAS & HUTTON DATED 06/29/11 AND REVISED ON 01/14/12.
2. PROPERTY BOUNDARY LINE PROVIDED BY THOMAS & HUTTON, DRAWING TITLED "PLAT OF THE BOUNDARY AND COMBINATION OF VARIOUS PARCELS CONTAINING 2527.47 ACRES TOTAL COMPRISING WINYAH GENERATING STATION AND THE SUBDIVISION TO CREATE TRACT A AND TRACT B", PLAT DATE 11/25/13.
3. COORDINATES AND DIRECTIONS SHOWN ON THIS DRAWING ARE BASED ON SOUTH CAROLINA STATE PLANE COORDINATE SYSTEM (NAD83) (CORS) (INT'L FT). DISTANCES SHOWN ARE GROUND DISTANCES, NOT GRID DISTANCES.
4. ELEVATIONS ON THIS SURVEY ARE REFERENCED TO NGVD 1929 DATUM AS DERIVED FROM NGS MONUMENT PID#DD1957.
5. SEE DRAWING 3 FOR AN EXISTING CONDITIONS PLAN IN THE VICINITY OF THE PROPOSED LANDFILL AREAS, SHOWN AT AN ENLARGED SCALE. LOCATION OF SOIL BORINGS, MONITORING WELLS, PIEZOMETERS, AND SURFACE WATER MONITORING POINTS ARE SHOWN ON DRAWING 4.
6. A MAP SHOWING ABUTTING PROPERTY OWNERS, ACCOMPANIED BY A LIST OF THE NAMES AND ADDRESSES OF ADJACENT PROPERTY OWNERS, IS PROVIDED IN APPLICATION SECTION "2D" OF THE OVERALL PERMIT APPLICATION PACKAGE.
7. THE ENGINEERING REPORT DISCUSSES POSSIBLE SOIL STOCKPILING. NO SPECIFIC STOCKPILE AREAS HAVE BEEN DESIGNATED AT THIS TIME.

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants
201 EAST MCBEE AVENUE, SUITE 201
GREENVILLE, SOUTH CAROLINA 29601 USA
PHONE: 864.438.4900

santee cooper

TITLE: OVERALL SITE PLAN

PROJECT: CLASS THREE LANDFILL PERMIT APPLICATION

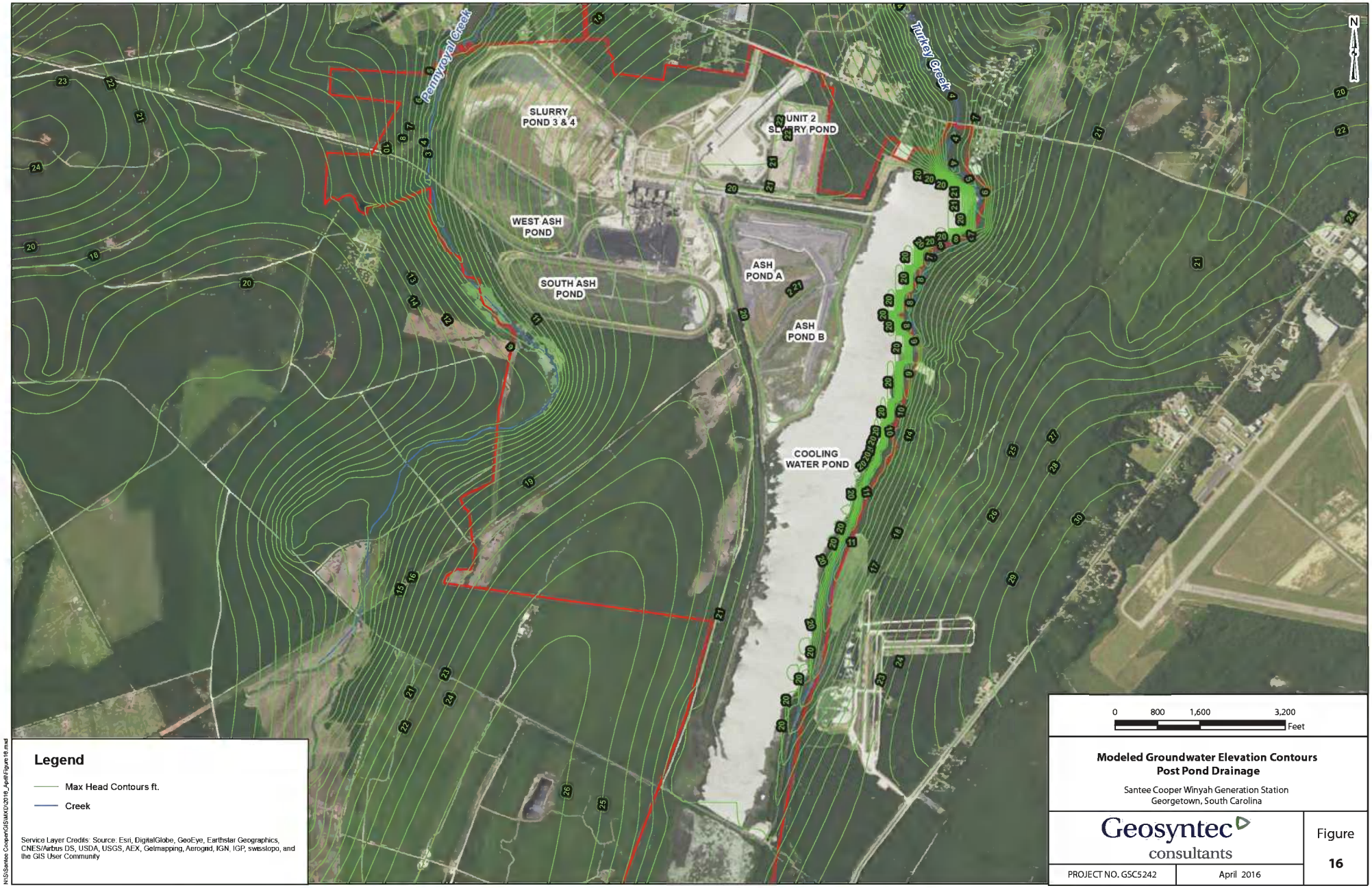
SITE: WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 33535 SCOTT M. GRAVES 6/9/2016

SOUTH CAROLINA GEOSYNTEC CONSULTANTS, INC. No. 773 CERTIFICATE OF AUTHORIZATION

DESIGN BY:	CFB	DATE:	AUGUST 2016
DRAWN BY:	CET	PROJECT NO.:	GSC5242
CHECKED BY:	SMG	FILE:	W-0-SC-585-00-0026-002
REVIEWED BY:	RW	DRAWING NO.:	2 OF
APPROVED BY:	SMG		

PERMIT DRAWING



Modeled Groundwater Elevation Contours
Post Pond Drainage

Santee Cooper Winyah Generation Station
Georgetown, South Carolina

Geosyntec consultants

PROJECT NO. GSC5242 | April 2016

Figure 16

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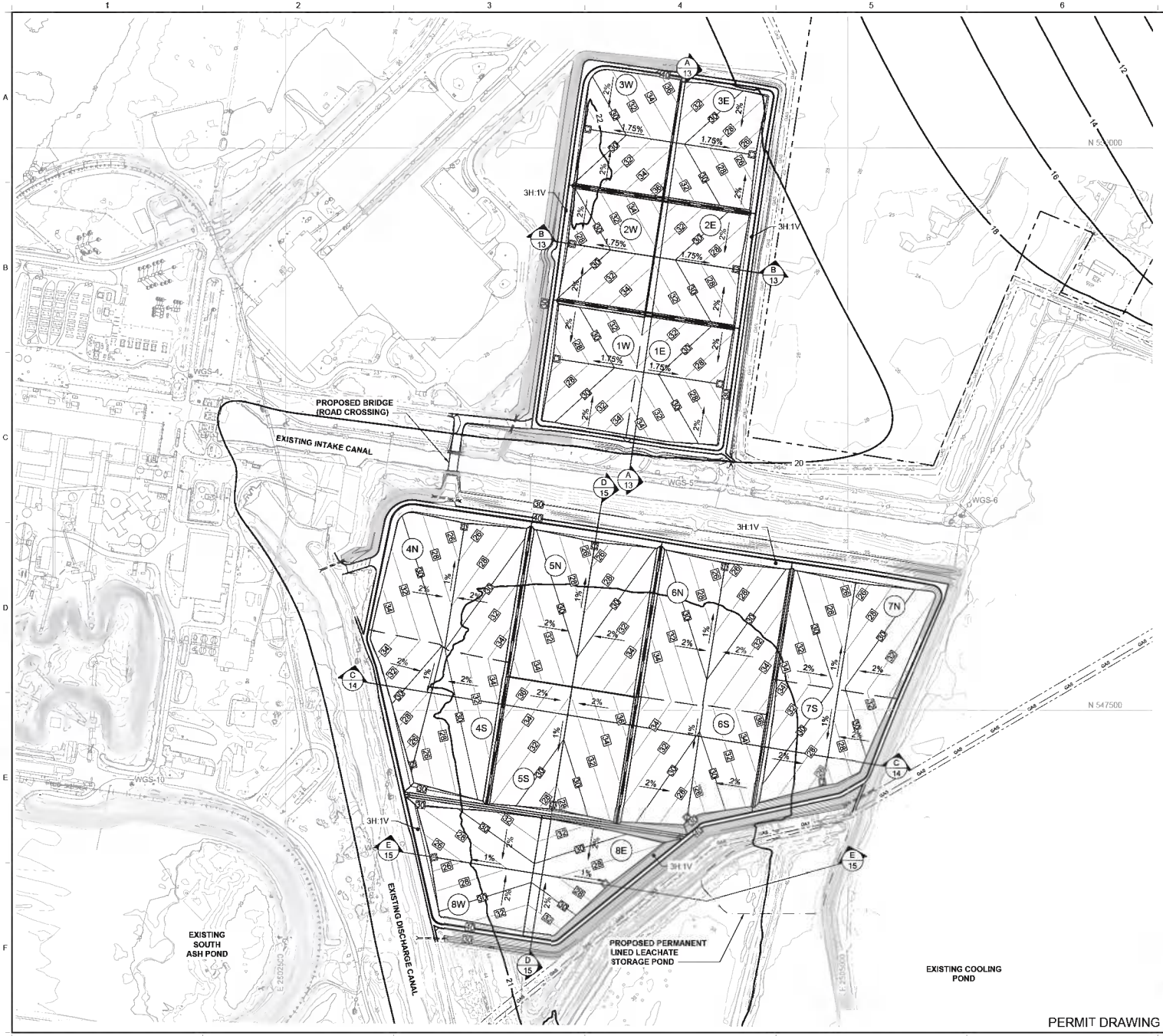
Geosyntec consultants

APPENDIX A

SUPPORTING DOCUMENTATION



LEGEND

- EXISTING GROUND ELEVATION CONTOUR (FT, MSL) (NOTES 1, 3)
- EXISTING DIRT/GRAVEL ROAD
- EXISTING VEGETATION
- EXISTING BUILDING
- EXISTING GAS PIPELINE AND EASEMENT LIMITS (NOTE 1)
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING RAILROAD TRACKS
- EXISTING WATERLINE
- PROPERTY BOUNDARY (NOTE 1)
- PROPOSED LANDFILL AREAS (LIMIT OF LINER)
- CELL BOUNDARY
- 2E — CELL DESIGNATION
- 28 — PROPOSED LINER SUBGRADE ELEVATION CONTOUR (FT, MSL) (NOTE 4)
- 20 — SEASONAL HIGH WATER TABLE (GROUNDWATER ELEVATION) CONTOUR (FT, MSL) (NOTE 5)
- PROPOSED LEACHATE COLLECTION SUMP
- PROPOSED DRAINAGE CULVERT

N

0 200' 400'
SCALE IN FEET

NOTES:

1. EXISTING SITE CONDITIONS AND PROPERTY BOUNDARY TAKEN FROM DRAWING 3.
2. COORDINATES AND DIRECTIONS SHOWN ON THIS DRAWING ARE BASED ON SOUTH CAROLINA STATE PLANE COORDINATE SYSTEM (NAD83) (CORS) (INT'L FT). DISTANCES SHOWN ARE GROUND DISTANCES, NOT GRID DISTANCES.
3. ELEVATIONS ON THIS SURVEY ARE REFERENCED TO NGVD 1929 DATUM AS DERIVED FROM NGS MONUMENT PID#DD1957.
4. WITHIN THE LIMIT OF LINER, PROPOSED CONTOURS REFER TO THE LANDFILL LINER SUBGRADE (BOTTOM OF CLAY COMPONENT OF THE LINER SYSTEM). OUTSIDE THE LIMIT OF LINER, PROPOSED CONTOURS REFER TO FINISHED GRADE.
5. GROUNDWATER ELEVATION CONTOURS ARE MODELED POST-POND DRAINAGE AS PRESENTED IN GEOSYNTEC CONSULTANTS 2016: "SITE HYDROGEOLOGIC CHARACTERIZATION STUDY REPORT", FIGURES 16A AND 16B FOR CONDITIONS IN AND AROUND LANDFILL AREAS 1 AND 2, RESPECTIVELY.

REV	DATE	DESCRIPTION	DRN	APP
1	JUNE 2017	UPDATED SECTION E LINE	CET	SMG

Geosyntec consultants
201 EAST MCBEE AVENUE, SUITE 201
GREENVILLE, SOUTH CAROLINA 29601 USA
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santee cooper

TITLE: SUBGRADE (BOTTOM OF LINER SYSTEM) GRADING PLAN

PROJECT: CLASS THREE LANDFILL PERMIT APPLICATION

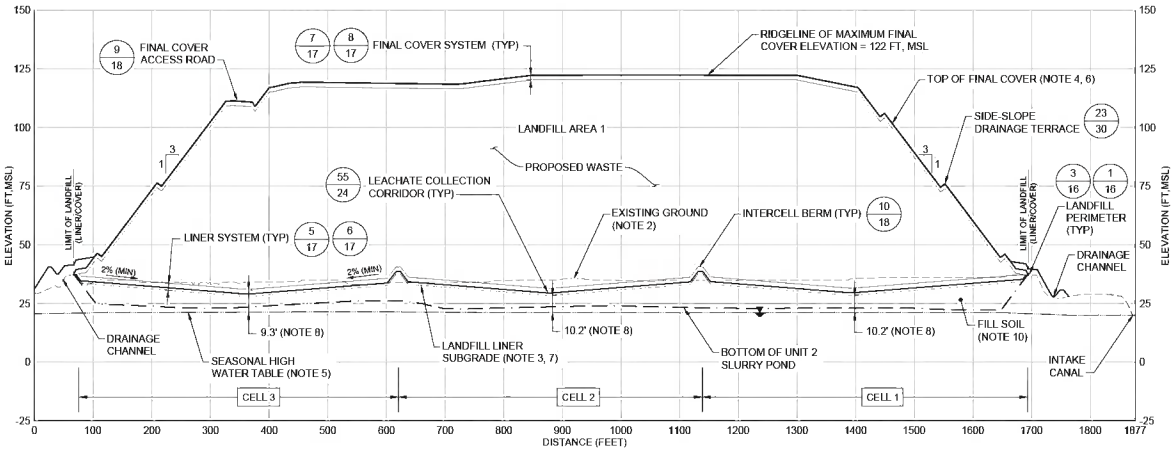
SITE: WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

DESIGN BY:	CFB	DATE:	AUGUST 2016
DRAWN BY:	CET	PROJECT NO.:	GSC5242
CHECKED BY:	SMG	FILE:	W-0-SC-585-00-0026-004
REVIEWED BY:	RW	DRAWING NO.:	6 OF 33
APPROVED BY:	SMG		

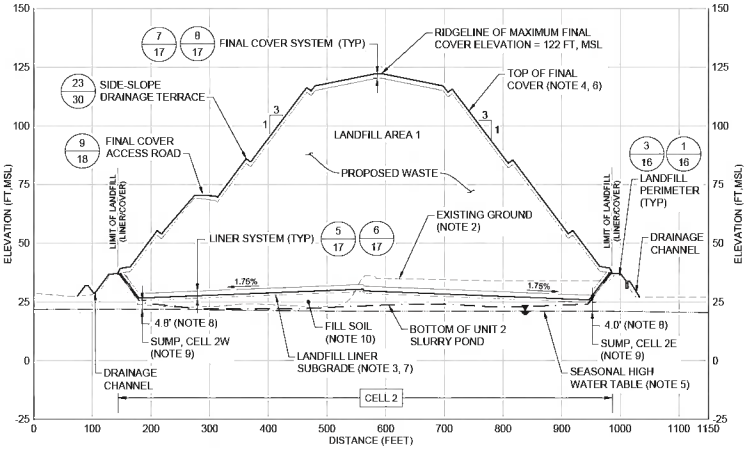
SOUTH CAROLINA PROFESSIONAL ENGINEER No. 33535 SCOTT M. GRAVES 6/5/17

SOUTH CAROLINA GEOSYNTEC CONSULTANTS, INC. No. 773 CERTIFICATE OF AUTHORIZATION

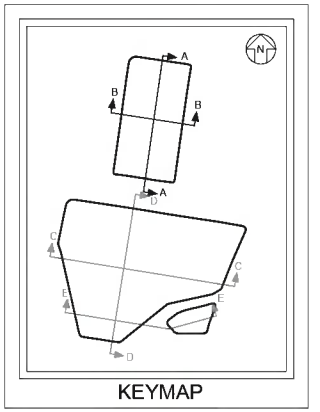
PERMIT DRAWING



A/6 SECTION
LANDFILL CROSS SECTION A
SCALE: 1"=4'
XREF: W-0-SC-585-00-00026-104



B/6 SECTION
LANDFILL CROSS SECTION B
SCALE: 1"=4'
XREF: W-0-SC-585-00-00026-104



NOTES:

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (FT, MSL).
2. EXISTING GROUND SHOWN ON THIS DRAWING IS TAKEN FROM THE TOPOGRAPHIC BASE MAP SHOWN ON DRAWING 3.
3. LANDFILL LINER SUBGRADE (BOTTOM OF CLAY COMPONENT OF THE LINER SYSTEM) SHOWN ON THIS DRAWING IS TAKEN FROM DRAWING 6.
4. TOP OF FINAL COVER SHOWN ON THIS DRAWING IS TAKEN FROM DRAWING 12.
5. SEASONAL HIGH WATER TABLE REFERS TO POST-POND DRAINAGE MODELED GROUNDWATER ELEVATION SURFACE TAKEN FROM DRAWING 6, WHICH IS THE HIGH WATER TABLE PRESENTED IN GEOSYNTEC CONSULTANTS 2016 "SITE HYDROGEOLOGIC CHARACTERIZATION REPORT".
6. TOP OF FINAL COVER GRADES ARE SLOPED AT 3H:1V ON LANDFILL SIDESLOPES BETWEEN DRAINAGE TERRACES, AND FIVE PERCENT ON THE LANDFILL TOP AREAS. SLOPES AND FINAL COVER SYSTEM LAYER THICKNESS MAY APPEAR DISTORTED ON THESE CROSS SECTIONS DUE TO THE EXAGGERATED VERTICAL SCALE AND WHAT MAY BE A SKEWED ANGLE AT WHICH THESE SECTIONS WERE CUT COMPARED TO THE THREE-DIMENTIONAL TRUE SLOPE DIRECTIONS.
7. LINER GRADES ARE SLOPED AT 3H 1V ON LINER SIDESLOPES, AND AT A MINIMUM OF TWO PERCENT TOWARDS THE LEACHATE COLLECTION CORRIDORS ON THE LANDFILL FLOOR AREAS. LEACHATE COLLECTION CORRIDORS ARE SLOPED AT A MINIMUM OF ONE PERCENT TOWARDS THE SUMPS. LINER THICKNESS SHOWN ON THESE CROSS SECTIONS IS FOR THE PROPOSED OPTION 2 LINER SYSTEM WHICH USES A ONE-FOOT THICK COMPACTED CLAY LAYER. SLOPES AND LAYER THICKNESS MAY APPEAR DISTORTED ON THESE CROSS SECTIONS DUE TO THE EXAGGERATED VERTICAL SCALE AND WHAT MAY BE A SKEWED ANGLE AT WHICH THESE SECTIONS WERE CUT COMPARED TO THE THREE-DIMENTIONAL TRUE SLOPE DIRECTIONS.
8. WATER TABLE SEPARATION DISTANCES LABELED ON THIS DRAWING REFER TO THE AS-DESIGNED PRE-SETTLEMENT DISTANCE TO THE HIGH WATER TABLE FROM THE BOTTOM OF THE LINER SYSTEM (LINER SUBGRADE) AS SHOWN ON DRAWING 6. REFER TO THE SETTLEMENT CALCULATIONS THAT ACCOMPANY THIS PERMIT APPLICATION FOR DETAILED CALCULATIONS OF LANDFILL BASE GRADE SETTLEMENT AND DEMONSTRATION THAT A MINIMUM POST-SETTLEMENT SEPARATION OF THREE FEET BETWEEN THE BASE OF THE LINER SYSTEM AND THE HIGH WATER TABLE IS PREDICTED TO BE MAINTAINED.
9. REFER TO TABLE ON DRAWING 23 FOR POST-SETTLEMENT ELEVATIONS AND WATER TABLE SEPARATION DISTANCES AT BOTTOM OF EACH SUMP.
10. FOLLOWING REMOVAL OF EXISTING ASH MATERIAL (TO APPROXIMATE BOTTOM OF SLURRY POND / ASH POND AS SHOWN ON CROSS SECTIONS), STRUCTURAL FILL SOIL SHALL BE PLACED AND COMPACTED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS AS NEEDED TO ACHIEVE THE LANDFILL LINER SUBGRADE ELEVATIONS AND GRADES.

VERTICAL SCALE IN FEET: 0, 25', 50'
HORIZONTAL SCALE IN FEET: 0, 100', 200'

REV	DATE	DESCRIPTION	DRN	APP
2	JUNE 2017	ADDED NOTE 10 AND REVISED SLOPE LABELS	CET	SMG
1	FEB 2017	ADDED NOTE 9 AND GROUNDWATER SEPARATION INFO	CET	SMG

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santee cooper

TITLE: LANDFILL CROSS SECTIONS I

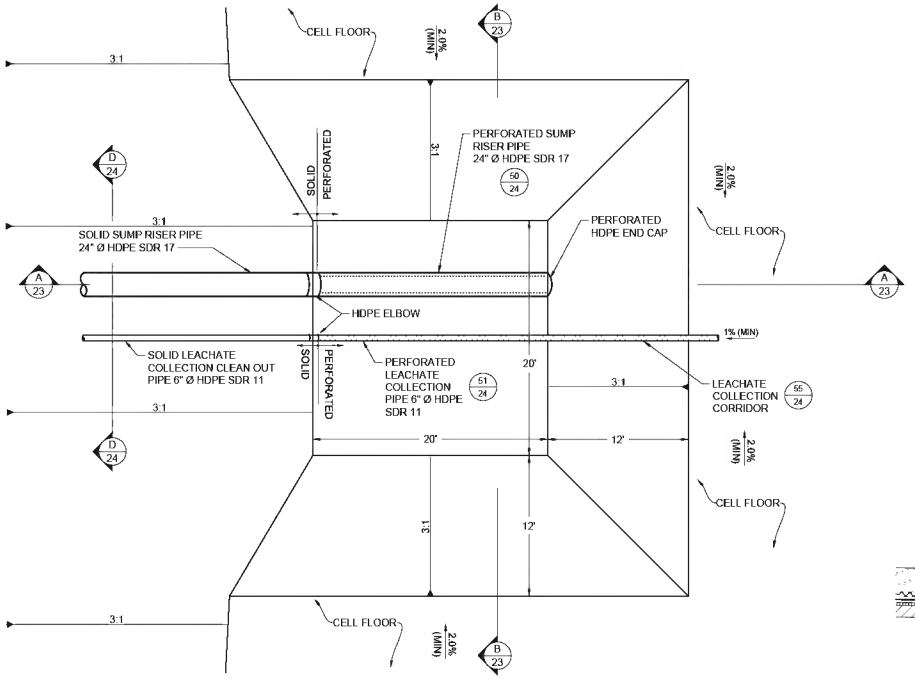
PROJECT: CLASS THREE LANDFILL PERMIT APPLICATION

SITE: WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

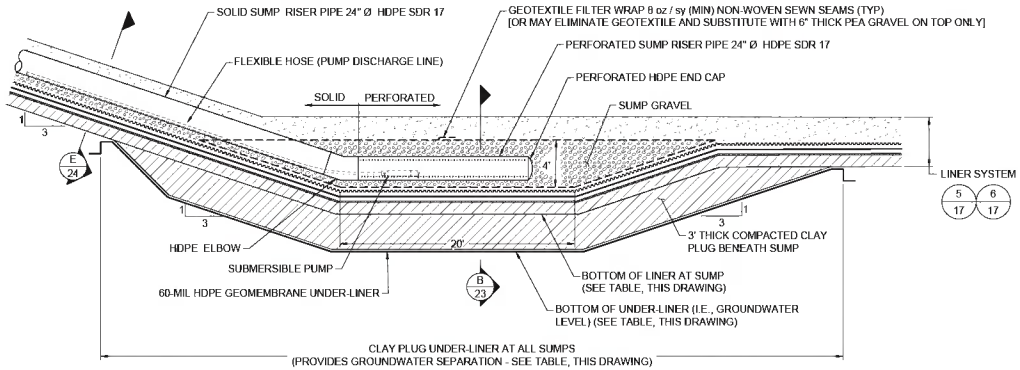
DESIGN BY:	CFB	DATE:	AUGUST 2016
DRAWN BY:	CET	PROJECT NO.:	GSC5242
CHECKED BY:	SMG	FILE:	W-0-SC-585-00-0026-012
REVIEWED BY:	RW	DRAWING NO.:	13 OF 33
APPROVED BY:	SMG		

SOUTH CAROLINA No. 33535 SCOTT M. GRAVES 6/9/2017
GEOSYNTEC CONSULTANTS, INC. No. 773 SOUTH CAROLINA CERTIFICATE OF AUTHORIZATION

PERMIT DRAWING



34 / --- PLAN
LEACHATE COLLECTION SUMP
SCALE: NTS



A / 23 SECTION
LEACHATE COLLECTION SUMP
SCALE: N.T.S
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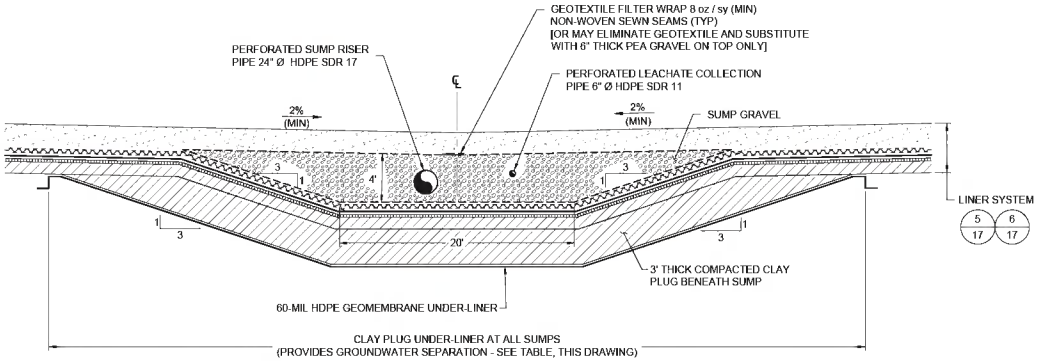

B / 23 SECTION
LEACHATE COLLECTION SUMP
SCALE: N.T.S
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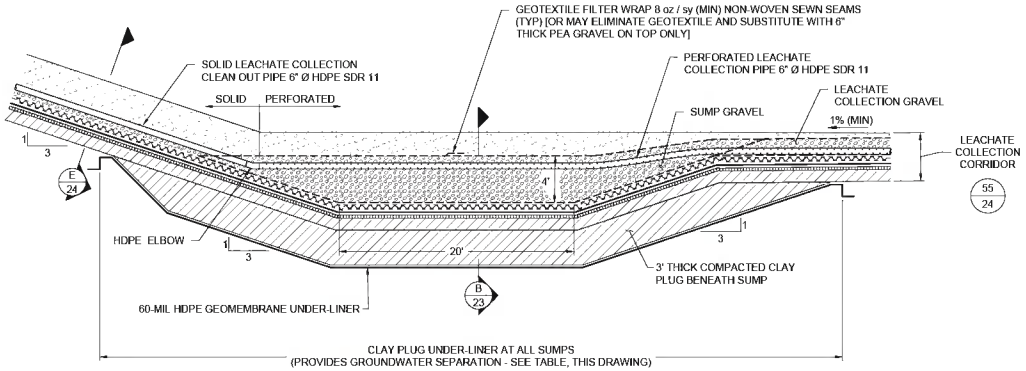

C / 23 SECTION
LEACHATE COLLECTION SUMP
SCALE: N.T.S.

SUMP ID	POST-SETTLEMENT GROUNDWATER SEPARATION AT SUMP LOCATIONS		
	BOTTOM OF SUMP ELEVATION (FT, MSL)	BOTTOM OF CLAY PLUG (I.E., WATER TABLE) ELEVATION (FT, MSL)	GROUNDWATER SEPARATION (FT)
1W	21.6	18.6	3.0
1E	21.3	18.3	3.0
2W	23.1	20.1	3.0
2E	21.4	18.4	3.0
3W	23.1	20.1	3.0
3E	20.8	17.8	3.0
4N	20.7	17.7	3.0
4S	20.6	17.6	3.0
5N	21.2	18.2	3.0
5S	23.3	20.3	3.0
6N	21.2	18.2	3.0
6S	22.3	19.3	3.0
7N	21.2	18.2	3.0
7S	21.4	18.4	3.0
8W	21.0	18.0	3.0
8E	22.2	19.2	3.0

NOTES:

1. ALL SUMP RISERS SHALL BE PROVIDED WITH SEALABLE BLIND FLANGES AS APPROVED BY THE ENGINEER. ALL FLANGES FOR ALL PIPE SIZES SHALL HAVE RED RUBBER GASKETS. THE NUTS, BOLTS, AND WASHERS USED TO SECURE THE BLIND FLANGES SHALL BE ZINC PLATED.
2. ALL PIPE PENETRATIONS THROUGH LINER SYSTEM SHALL BE DOUBLE BANDED WITH NON-ADJUSTABLE STAINLESS STEEL CLAMPS (SEE SHEET 25 FOR DETAIL).
3. DETAILS ARE DRAWN SHOWING THE "OPTION 2" LINER SYSTEM WHICH IS ANTICIPATED TO BE USED. IF "OPTION 1" LINER SYSTEM IS USED, MAINTAIN CONSISTENCY WITH THE CONCEPTS SHOWN ON THESE DETAILS.

REV	DATE	DESCRIPTION	DRN	APP
2	JUNE 2017	UPDATED SLOPE LABELS	CET	SMG
1	FEB 2017	REVISED SUMP DETAILS	CET	SMG

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santee cooper

TITLE: LEACHATE SUMP PLAN

PROJECT: CLASS THREE LANDFILL PERMIT APPLICATION

SITE: WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

DESIGN BY:	CFB	DATE:	AUGUST 2016
DRAWN BY:	CET	PROJECT NO:	GSC5242
CHECKED BY:	SMG	FILE:	W-0-SC-585-00-0026-024
REVIEWED BY:	RW	DRAWING NO:	23 OF 33
APPROVED BY:	SMG		

PERMIT DRAWING