Prepared for

Santee Cooper
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2016 SURFACE IMPOUNDMENT PERIODIC STRUCTURAL STABILITY ASSESSMENT REPORT

ASH POND A

WINYAH GENERATING STATION GEORGETOWN, SOUTH CAROLINA

Prepared by

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engineers | scientists | innovators

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CERTIFICATION STATEMENT

This initial periodic structural stability assessment was conducted in accordance with the requirements of §257.73(d) of the Code of Federal Regulations Title 40, Part 257, Subpart D, and was prepared in accordance with current practices and the standard of care exercised by scientists and engineers performing similar tasks in the field of civil engineering, and no other warranty is provided in connection therewith. The contents of this report are based solely on the observations of the conditions observed by Geosyntec personnel and information provided to Geosyntec by Santee Cooper. Consistent with applicable professional standards of care, our opinions and recommendations were based in part on data furnished by others. Although we were not able to independently verify such data, we found that it was consistent with other information that we developed in the course of our performance of the scope of services. The information contained in this report is intended for use solely by Santee Cooper and their subconsultants.

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10/13/2016
Date

EXECUTIVE SUMMARY

The Winyah Generating Station (WGS or "Site") is a coal-fired, electric generating facility owned and operated by Santee Cooper and is located approximately four miles southwest of Georgetown, South Carolina (SC). Historically, WGS has utilized six surface impoundments designated for disposal of coal combustion residuals (CCR): Slurry Pond 3&4 (Slurry Pond), West Ash Pond, Unit 2 Slurry Pond, Ash Pond A, Ash Pond B, and the South Ash Pond.

On 17 April 2015, the United States Environmental Protection Agency (USEPA) published rules in 40 CFR (Code of Federal Regulations) Parts 257 and 261, regulating the design and management of existing and new CCR units (commonly referred to as the "CCR Rule"). The CCR Rule became effective on 17 October 2015. The CCR rule requires owners and operators of existing CCR surface impoundments to conduct periodic structural stability assessments in accordance with §257.73(d) of each surface impoundment and publish the results to the facility's operating record.

Ash Pond A at WGS is classified as an "existing CCR surface impoundment" by the CCR Rule. The *2016 Surface Impoundment Periodic Stability Assessment Report: Ash Pond A* (Stability Assessment Report) describes the first periodic (i.e., initial) structural stability assessment in accordance with the CCR Rule for Ash Pond A at WGS.

A hydrologic and hydraulic analysis (H&H Analysis) of Ash Pond A and its appurtenances was conducted to demonstrate the inflow design flood (IDF) can be managed and conveyed safely (i.e., without overtopping the perimeter dikes) during and after the rainfall event. Since Ash Pond A has been classified as a "Low Hazard Potential" surface impoundment, the 100-yr rainfall event with a rainfall duration of 72 hours was selected as the IDF. Ash Pond A drains stormwater through a culvert system southward into Ash Pond B. The free water level within Ash Pond B is maintained at an elevation of 34.9 ft National Geodetic Vertical Datum of 1929 (NGVD29) by a concrete riser structure which discharges westward into the Discharge Canal. The peak water level during and after the IDF within Ash Pond A was computed as 38.2 ft NGVD29, which is below the minimum dike crest of 38.8 ft NGVD29. Thus, Ash Pond A will adequately manage inflows during and following the peak discharge from the IDF in accordance with §257.73(d)(1)(v) of the CCR Rule.

In support of the periodic structural stability assessment, Geosyntec developed and performed geotechnical subsurface investigations and laboratory testing programs to characterize the dike and subsurface soils for Ash Pond A in 2013 and 2016. Boring logs, Cone Penetration Test (CPT) sounding data, and laboratory testing results have

been provided in Attachments 2, 3, and 4 of the *2016 Surface Impoundment Periodic Safety Factor Assessment Report: Ash Pond A* (Safety Factor Assessment Report), respectively, and the interpretation of the in-situ and laboratory data is described and presented in Attachment 5 of the Safety Factor Assessment Report.

Geosyntec reviewed the available data, performed the safety factor assessment, and inspected the perimeter dikes of Ash Pond A on 10 and 11 July 2016. From this evaluation and inspection, the condition of the foundation soils, the compaction of dike fill soils, the slope protection and vegetation of perimeter dike slopes, and existing pipe penetrations through the perimeter dikes were evaluated and found to meet the requirements listed in §257.73(d)(1)(i) through (vii). Therefore, Ash Pond A was considered to meet the periodic structural stability criteria for existing surface impoundments described within §257.73(d) of the CCR Rule.

1. INTRODUCTION

1.1 Project Background

The Winyah Generating Station (WGS or "Site") is an electric generating facility owned and operated by Santee Cooper. WGS is located between Pennyroyal and Turkey Creeks, tributaries to Sampit River, and is situated approximately four miles southwest of Georgetown, South Carolina (SC) (see Figures 1a and 1b for Site Location and Site Vicinity Maps). WGS has historically utilized six surface impoundments (Figure 2) designated for disposal of coal combustion residuals (CCR): Slurry Pond 3&4 (Slurry Pond), West Ash Pond, Unit 2 Slurry Pond, Ash Pond A, Ash Pond B, and the South Ash Pond.

On 17 April 2015, the United States Environmental Protection Agency (USEPA) published rules in 40 CFR Parts 257 and 261, regulating the design and management of existing and new CCR units (commonly referred to as the "CCR Rule"). The CCR Rule became effective on 17 October 2015. Within the CCR Rule, §257.73(d) outlines the structural stability criteria for existing CCR surface impoundments.

Ash Pond A is situated east of the power block and west of the Site's Cooling Pond. Ash Pond A manages CCR in the form of fly ash, boiler slag, and bottom ash as well as process water resulting from power generating activities. Ash Pond A is considered as an existing surface impoundment under the CCR Rule. The *2016 Surface Impoundment Periodic Stability Assessment Report: Ash Pond A* (Stability Assessment Report) has been prepared by Geosyntec Consultants (Geosyntec) on behalf of Santee Cooper to demonstrate that Ash Pond A meets criteria for periodic structural stability assessment in accordance with §257.73(d) of the CCR Rule.

1.2 Project Site and Construction History

Ash Pond A, an unlined surface impoundment spanning approximately 90 acres, is located east of the power block and immediately west of the Cooling Pond. It was commissioned in the early 1970s and is designated for the disposal of fly ash, bottom ash, and boiler slag. Ash Pond A is bounded by the Intake Canal to the north, the Discharge Canal to the west, Ash Pond B to the south, and the Cooling Pond to the east. Ash Ponds A and B were constructed simultaneously and are separated by a recompacted, earthen divider dike spanning west to east from the Discharge Canal to the Cooling Pond.

Ash Pond A was constructed by recompacting excavated soils from the impoundment interior to form the perimeter dikes and a divider dike. Ash Pond A perimeter dikes are approximately 12 ft to 15 ft in height along the north and west sides and approximately 20 ft to 24.5 ft in height along the east side adjacent to the Cooling Pond (Thomas and Hutton, 2012). The upstream and downstream slopes of the perimeter dikes range from 2 Horizontal to 1 Vertical (2H:1V) to 3H:1V. The Ash Pond A dike crest is approximately 12- to 15-ft wide with an approximate elevation between 38.8 ft and 44.0 ft National Geodetic Vertical Datum of 1929 (NGVD29) (Thomas and Hutton, 2012).

Historically, free water within Ash Pond A has been routed southward via rim ditches and a series of culverts into Ash Pond B and subsequently into the Discharge Canal. Ash Ponds A and B are hydraulically connected through a 30-inch (in) diameter corrugated metal pipe (CMP), a 48-in diameter smooth steel pipe, and a 42-in diameter smooth steel pipe (Thomas and Hutton, 2016; Thomas and Hutton, 2012). Ponded water within Ash Pond B is regulated by a concrete riser structure, which discharges into the Discharge Canal through a 24-in diameter high density polyethylene (HDPE) pipe. Ash Pond A receives low volume wastewater, hydroveyor water, and bottom ash sluice water from electric generating Units 1 and 2. Bottom ash sluice water from Units 3 and 4 is also conveyed into Ash Pond A. Additionally, Ash Pond A receives contact water from the Unit 2 Slurry Pond after a rainfall event, which is pumped across the Intake Canal.

1.3 Report Organization

This Stability Assessment Report presents the first (i.e., initial) periodic structural stability assessment for Ash Pond A at WGS based on the results of subsurface investigations, hydrologic and hydrology (H&H) analysis, geotechnical engineering analyses, a site visit, and a review of available Site information. The remainder of this Stability Assessment Report is organized as follows:

- Descriptions of the hazard potential classification of Ash Pond A and corresponding performance of the hydraulic structures are presented in Section 2;

- Geotechnical subsurface investigations performed by Geosyntec are presented in Section 3;
- Subsurface conditions and geology at WGS are discussed in Section 4;
- The structural stability assessment of the Ash Pond A perimeter dikes is presented in Section 5; and
- The summary and general conclusions from the structural stability are presented in Section 6.

2. HYDROLOGIC AND HYDRAULIC EVALUATION

2.1 Hydrologic and Hydraulic Analysis

The following section discusses the regulatory framework, the methodology and assumptions, and the results of the H&H analysis for Ash Pond A and its appurtenances.

2.1.1 Regulatory Framework

The CCR Rule (§257.73(d)(1)) requires that the periodic stability assessment:

"…at minimum, document whether the CCR unit has been designed, constructed, and maintained with:

…

(v) a single spillway or a combination of spillways configured as specified in paragraph (d)(1)(v)(A) of this section. The combined capacity of all spillways must be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge event specified in paragraph (d)(1)(v)(B) of this section."

§257.73(d)(1)(v)(B)(3) states that the spillway or spillways must manage the peak discharge from the *"100-year flood for a low hazard potential CCR Surface Impoundment"*. Additionally, §257.73(d)(1)(v)(A) indicates that *"All spillways must be either:*

(1) Of non-erodible construction and designed to carry sustained flows; or

(2) Earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected."

The culverts hydraulically connecting Ash Ponds A and B through the divider dike are effectively considered spillways, which manage the discharge during and after the Inflow Design Flood (IDF). The IDF was selected as the 100-year flood because Ash Pond A has been assigned a "Low Hazard Potential" classification (Geosyntec, 2016a) since a potential failure would be contained within the property boundary and is not anticipated to migrate offsite. H&H analyses were performed to demonstrate that the Ash Pond A culverts are able to adequately manage flow during and following the

100-yr design rainfall (i.e., peak discharge event) without overtopping of perimeter dikes, meeting the criteria in §257.73(d)(1)(v).

2.1.2 Methodology and Assumptions

Details of the H&H analysis are provided in a calculation package titled *"Hydrologic and Hydraulic Analysis for Ash Pond A"*, which is included as Attachment 1 of the Safety Factor Assessment Report (Geosyntec 2016b) published in the operating record. The remainder of this section describes the assumptions, conditions, and results of the H&H analysis for Ash Pond A.

The culverts connecting Ash Pond A to Ash Pond B consist of: (i) a 30-in. diameter CMP with an upstream invert at 37.50 ft NGVD 29; (ii) a 48-in. diameter smooth steel pipe with an upstream invert at 35.49 ft NGVD 29; and (iii) a 42-in. diameter smooth steel pipe with an upstream invert at 36.20 ft NGVD 29 (Thomas and Hutton, 2016; Thomas and Hutton, 2012). These culverts allow for the southward conveyance of stormwater and process water from Ash Pond A to Ash Pond B.

Ash Pond A receives contact water from the Unit 2 Slurry Pond after rainfall events. The Unit 2 Slurry Pond is equipped with a 6JSVE Thompson pump operating at a maximum capacity of 2,600 gallons per minute (gpm) (5.79 ft^3/s), which was considered a base flow into Ash Pond A during this evaluation. Low volume wastewater, hydroveyor water, and bottom ash sluice water from Units 1 and 2 and bottom ash sluice water from Units 3 and 4 were considered to have a combined base inflow to Ash Pond A totaling 6,099 gpm (13.59 ft^3/s).

The operating level in Ash Pond B is maintained by a 4-ft by 4-ft concrete riser structure (or spillway) with a top stop log elevation of 34.9 ft NGVD 29 (Thomas and Hutton, 2016) and a 24-in. diameter smooth interior, corrugated HDPE pipe discharging to the Discharge Canal. The tailwater conditions associated with discharge from Ash Pond B into the Discharge Canal were modeled using a fixed water surface elevation within the Discharge Canal and Cooling Pond estimated by conservatively assuming 2.5-ft of free water overtopping the Cooling Pond emergency spillway during a significant rainfall event. The top of the stop log bolted to the top of the concrete spillway of the Cooling Pond is at elevation 21.65 ft NGVD 29 (Thomas and Hutton, 2015). The water surface of the Discharge Canal and Cooling Pond was assumed to be at 24.15 ft NGVD 29 (21.65 ft NGVD 29 plus an additional 2.5 ft of water) during the IDF.

HydroCAD® (HydroCAD, 2011) software was utilized to apply the Soil Conservation Service (SCS) Technical Release 20 (TR-20) method (SCS, 1982) to compute the stormwater volume and to model the performance of the hydraulic structures of Ash Pond A during the 100-yr rainfall event. The 100-yr rainfall event was selected with a 72-hour (hr) duration precipitation event resulting in a rainfall depth of 12.8 inches (NOAA, 2006), and modeled within HydroCAD® using a SCS Type III rainfall distribution. The analysis was performed under the following assumptions, which were confirmed by WGS personnel:

- The Site will construct a 100-ft wide emergency spillway with an invert elevation of 37.0 ft NGVD 29 in the divider dike between Ash Ponds A and B by October 2016. The emergency spillway will be constructed with 10H:1V side slopes and will be located between the 48-in. diameter smooth steel pipe and the 42-in. diameter smooth steel pipe.

- Ash Ponds A and B effectively operate as a single surface impoundment with respect to hydraulic performance (i.e., the two ponds are "hydraulically connected").

2.1.3 Analysis Results

Under the conditions and assumptions described in Section 2.1.2, the maximum free water level or "maximum surcharge pool" level during and following the 100-yr rainfall event was computed as 38.2 ft NGVD29 occurring 36.2 hours into the rainfall event. The lowest elevation of the Ash Pond A perimeter dikes was surveyed as 38.8 ft NGVD29 (Thomas and Hutton, 2012). Thus, Ash Pond A will adequately contain and manage flow during and following the 100-yr rainfall event without overtopping the perimeter dikes and thus, meets the criteria listed in §257.73(d)(1)(v) of the CCR Rule.

3. GEOTECHNICAL SUBSURFACE INVESTIGATIONS

This section summarizes the geotechnical subsurface investigation programs performed in the vicinity of the Ash Pond A perimeter dikes at WGS. In the fall of 2013, Geosyntec conducted a focused geotechnical subsurface investigation program to obtain geotechnical data necessary to evaluate closure alternatives for the surface impoundment. Geosyntec returned to the Site in the spring of 2016 and performed an additional geotechnical subsurface investigation predominantly within the interiors of Ash Pond A, Ash Pond B, and the Unit 2 Slurry Pond to collect information in support of the design of closure options for each surface impoundment. Historically, borings were performed in the vicinity of Ash Pond A prior to construction of the surface impoundment; however, records (i.e., locations, boring logs, laboratory testing results, etc.) pertaining to these subsurface investigations were not available during the preparation of this Stability Assessment Report. Figure 3 presents the locations of soil test borings and Cone Penetration Test (CPT) soundings performed during these geotechnical subsurface investigations.

The geotechnical data obtained from the 2013 and 2016 geotechnical subsurface investigations, including soil borings, CPT sounding data, and laboratory test results, are included in Attachments 2, 3, and 4, respectively, of the Safety Factor Assessment Report (Geosyntec, 2016b). The interpretation of the subsurface stratigraphy and materials properties is presented in Attachment 5 of the Safety Factor Assessment Report (Geosyntec, 2016b). The following sections provide summaries of each of the geotechnical subsurface investigations in the vicinity of Ash Pond A.

3.1 <u>Geosyntec Investigations</u>

3.1.1 Fall 2013 Subsurface Investigation

In October 2013, Geosyntec mobilized to WGS to collect geotechnical subsurface data through additional soil borings and CPT soundings in support of evaluating preliminary and conceptual closure alternatives for each CCR surface impoundment at WGS. The subsurface investigation was focused in the vicinity of the South Ash Pond, Unit 2 Slurry Pond, Ash Pond A, and Ash Pond B. In the Ash Pond A area, Geosyntec advanced seven soil borings using the mud rotary wash drilling method and sixteen CPT soundings. Soil Consultants, Inc. (SCI), of Charleston, South Carolina, was the drilling contractor during this investigation. Mid-Atlantic Drilling, Inc. (MAD) from

Wilmington, North Carolina performed the CPT soundings. One soil boring and four CPT soundings were advanced within the interior of Ash Pond A and were terminated once native or foundation soils were encountered. The remaining soil borings and CPT soundings were performed on the perimeter and divider dikes and were terminated once refusal was encountered, which was defined as a SPT blow count of 50 blows per foot over an advancement of 6" or the inability to further advance the cone.

During each soil boring, split spoon samples were collected and SPT blow counts (i.e., N-values) were recorded typically in 5-ft depth intervals. Three Shelby tubes were pushed to collect samples in the cohesive foundation soils located in the northwest corner of Ash Pond A. Several other Shelby tubes were pushed to attempt to collect samples within the Ash Pond A perimeter dikes; however, the recompacted dike fill soils were found to be dense and cohesionless and thus, undisturbed samples were unable to be collected. In one soil boring (SPT-117), SCI utilized a tri-cone rotary wash drill bit instead of the side discharge flat drilling bit once the Chicora Member stratum was encountered to penetrate the unit and advance into the underlying formation (i.e., Williamsburg Formation Clay). In SPT-117, a Shelby tube was pushed to collect a sample of the underlying stiff clay for geotechnical laboratory testing. During this geotechnical subsurface investigation, shear wave velocities (V_S) were measured in 5-ft depth intervals at seven CPT soundings (CPT-135, 137, 140, 144, 145, 147, and 150). Additionally, dissipation tests were performed at five CPT soundings (CPT-138, 143, 146, 155, and 157) to evaluate the phreatic surface through the perimeter dikes and within Ash Pond A at the time of the investigation. Soil boring logs and CPT sounding data, including V_S and dissipation tests, are provided in Attachment 3 of the Safety Factor Assessment Report (Geosyntec, 2016b).

In November 2013, Geosyntec installed piezometers as part of the development of a hydrogeological model at WGS. Two piezometers (PPZW-8D and PPZW-9D) were installed by South Atlantic Environmental Drilling and Construction Co. Inc. (SAEDACCO) adjacent to Site monitoring wells (WAP-8 and WAP-9). Prior to installing these piezometers, subsurface soils were collected using a split spoon sampler and logged by a Geosyntec geologist. SPT N-values measured during this installation were interpreted and utilized as a part of this subsurface assessment.

3.1.2 Spring 2016 Subsurface Investigation

In the spring of 2016, Geosyntec performed a geotechnical subsurface investigation predominantly within the interior of Ash Pond A, Ash Pond B, and the Unit 2 Slurry Pond to collect information in support of the design of closure options for each surface impoundment. Within the Ash Pond A interior and along the divider dike, Terracon was subcontracted and performed twelve CPT soundings to evaluate the subsurface stratigraphy underlying the surface impoundments. Three additional CPT soundings (CPT-228, CPT-229, and CPT-229A) were advanced at the perimeter dike crest and dike toe adjacent to the Cooling Pond (east side of Ash Pond A). Additionally, Terracon advanced three soil borings (SPT-304, SPT-305, and SPT-306) within the Ash Pond A interior to collect soil samples for laboratory testing. The laboratory testing program for soil samples collected during this investigation consisted of particle size distribution analysis, moisture content tests, and Atterberg limits tests.

3.1.3 Laboratory Testing

During these geotechnical subsurface investigations, Geosyntec subcontracted Excel Geotechnical Testing, Inc. (EGT) of Roswell, Georgia (fall 2013) and Terracon (spring 2016) to conduct a geotechnical laboratory testing program on representative disturbed (i.e., bulk or split spoon) and undisturbed (i.e., Shelby tube) samples. The 2013 geotechnical laboratory testing program on dike fill and foundation soils included fourteen grain size distribution tests (four with hydrometer tests), fifteen fines content tests (to supplement the grain size distribution tests), nine Atterberg limits tests, twenty-nine natural water content tests, three shear strength tests (2- to 3-point consolidated-undrained (CU) triaxial tests), and two one dimensional (1-D) consolidation tests. Additionally, two CU triaxial tests and one 1-D consolidation tests (with index tests included) were performed on thin-walled Shelby tube samples of impounded fly ash collected from the interior of Ash Pond A. Several grain size distribution tests and one hydraulic conductivity test were performed on the Williamsburg Formation Clay collected from SPT-117. Samples collected during the spring 2016 geotechnical subsurface investigation were predominantly tested to evaluate select samples for particle size distribution, Atterberg limits, and natural moisture content. Laboratory testing results from each geotechnical subsurface investigation are provided in Attachment 4 and the interpretation of the laboratory testing program is discussed in Attachment 5 of the Safety Factor Assessment Report (Geosyntec, 2016b).

4. SUBSURFACE CONDITIONS AND GEOLOGY

This section presents subsurface conditions, phreatic surface and free water levels, and material properties for Ash Pond A based on the subsurface investigation program discussed in Section 3. A summary of the regional geology is also provided as a framework to develop the subsurface stratigraphy model. Additional information on the subsurface conditions and the material properties is presented in Attachment 5 of the Safety Factor Assessment Report (Geosyntec, 2016b).

4.1 Regional Geology

Georgetown County, SC is located in the Atlantic Coastal Plain physiographic province, which is characterized by Quaternary terrace deposits produced by fluctuating sea levels. Coastal Plain sediments are underlain by Tertiary and late Cretaceous sediments to a depth of approximately 2,200 ft below ground surface (bgs) in the Georgetown area. Descriptions of geologic units of interest in the area have been referenced from Campbell and Coes (2010) and are summarized below from top to bottom. The approximate thicknesses of each unit were estimated from several borings referenced in Campbell and Coes (2010). The specific borings used for this estimation include: 1) CHN-0820 located approximately 12 miles to the south of WGS; 2) GEO-0088 located approximately 7 miles to the southeast of WGS; and 3) GEO-0185 located less than 1.5 miles to the northwest of WGS.

- Undifferentiated Quaternary sediments consist of yellowish-brown and reddish-orange poorly sorted, very fine to very coarse, clayey sand and gravel. Accessory minerals include opaque heavy minerals, mica, and feldspar. The reported thickness of Undifferentiated Quaternary sediments ranges between 20 and 42 ft in the area.
- The Williamsburg Formation (Williamsburg) consists of gray to black interbedded clay and coarse quartz sand overlying shelly clay and calcareous clay. The Williamsburg can include sandy shale, fuller's earth, fossiliferous clayey sand (Lower Bridge Member), and fossiliferous clayey sand and mollusk-rich, bioclastic limestones (Chicora Member). The reported thickness of the Williamsburg in the vicinity of the site ranges between 30 and 90 ft.
- The Lang Syne Formation (Muthig and Colquhoun, 1988) was described as consisting of red and yellow (where weathered) or white, gray, and black

(where freshly exposed) interbedded sand, silt, and clay and thin beds of silicified shell debris. Opaline clay stone is the most characteristic lithology.
- The Rhems Formation which consists of light-gray to black shale interlaminated with thin seams of fine-grained sand and mica.
- The Peedee Formation which consists of a dark-green to gray, fossiliferous, glauconitic clayey sand and silt. The combined thickness of the Lang Syne and Rhems and Peedee Formations ranges between 185 and 378 ft in the vicinity of the WGS.

Additional late Cretaceous Formations are present to a depth of approximately 2,200 ft bgs in the area. These Formations, in descending order, include: Donoho Creek, Bladen, Coachman, Cane Acre, Caddin, Sheppard Grove, Pleasant Creek, Cape Fear and undifferentiated Cretaceous sediments. The most important geologic units for this report are the undifferentiated Quaternary and Williamsburg Formations, which are encountered within 60 to 100 ft bgs as described in detail by Doar (2012).

4.2 Perimeter Dike Subsurface Conditions

4.2.1 Subsurface Stratigraphy

The subsurface stratigraphy at the Site was developed from information obtained from geotechnical investigations at WGS and from regional geologic data. The information indicates that the subsurface soils primarily consist of four geotechnical units, within the depths of interest for the analyses presented in this Stability Assessment Report. A brief description on each unit is presented as follows:

- Dike Fill: Dike fill soils for the Ash Pond A perimeter dikes were generally observed to be medium dense to very dense poorly graded silty sands with uncorrected SPT blow counts typically ranging between 7 and 66 blows per foot and measured CPT tip resistances typically ranging between 100 and 450 tsf. Grain size distribution analyses indicated that these dike fill soils typically consist of 72 percent to 87 percent sand-sized particles (smaller than No. 4 sieve but greater than No. 200 sieve) and 6 percent to 28 percent silt and clay-sized particles (i.e., "fines" with diameters smaller than a No. 200 sieve), with most samples containing less than 15 percent fines.

- Foundation Soils: Foundation soils were observed to be variable across the Ash Pond A footprint. The foundation materials consist primarily of poorly graded silty sands with shells and a few isolated seams of clayey sand or high plasticity clay. Uncorrected SPT blow counts within foundation soils ranged between 0 and 61 blows per foot, with clayey material generally having a lower measured blow count then sandy material. Tip resistances generally ranged between 25 and 300 tsf (generally below 50 tsf).

- Chicora Member: A layer of dense to very dense soil consisting of partially cemented to heavily cemented shells was encountered beneath the foundations soils during subsurface investigations at WGS. SPT blow counts in this layer exceeded 50 blows over less than 6 in. of advancement with minimal sample recovery. The thickness of this layer, particularly the cemented layers of this material, varied across the Site. Based on review of historical and existing data (Doar, 2012), this layer is the upper portion of the overall Williamsburg Formation and is referred to as the "Chicora Member", "Coquina", or "Shell Hash". The term "Chicora Member" or "Chicora" is used to refer to this soil unit throughout this Stability Assessment Report. Boring and CPT refusal was typically encountered at the top of this stratum, though two borings within the Ash Pond A area penetrated this stratum.

- Williamsburg Formation Clay: The Williamsburg Formation Clay was encountered beneath the Chicora Member. The Williamsburg Formation Clay is described as stiff to very hard, dark gray to black, medium to high plasticity clay or silt with sand. The Williamsburg Formation Clay has historically been referred to as "Black Mingo Clay" or the "Black Mingo Formation" at the Site. The term "Williamsburg Formation Clay" is the most recent geological term for this stratum and is used throughout this Stability Assessment Report. The Williamsburg Formation Clay was found to be between 30-ft and 90-ft thick in the vicinity of WGS based on a review of the regional geology.

5. STRUCTURAL STABILITY ASSESSMENT

This section presents a summary of the structural stability assessment for the perimeter dikes surrounding Ash Pond A, demonstrating that Ash Pond A meets the requirements of 257.73(d)(1)(i) through (iii) and (vi) to (vii) of the CCR Rule. Section 2 of this Stability Assessment Report presents the analysis demonstrating that Ash Pond A meets the requirements of 257.73(d)(1)(v) of the CCR Rule.

5.1 Site Visit

Geosyntec visited WGS on 10 and 11 July 2016 to inspect the condition of the CCR surface impoundment dikes regulated by the CCR Rule. Prior to the dike inspection, weekly and annual dike inspection reports and available historical engineering reports were reviewed to develop an understanding of the operational and maintenance history of Ash Pond A. During the inspection, Geosyntec observed the condition of the upstream slopes, downstream slopes, stormwater features, pond appurtenances, and pipe penetrations through the dikes of Ash Pond A. Geosyntec observed that the Ash Pond A perimeter dikes were generally operated and maintained in accordance with commonly accepted engineering practice and did not observe evidence of a deficiency to the structural integrity of the surface impoundment.

5.2 Stable Foundations and Abutments

The CCR Rule (§257.73(d)(1)) requires that the periodic structural stability assessment:

"...at minimum, document whether the CCR unit has been designed, constructed, and maintained with: (i) Stable foundations and abutments;"

Based on the observations made during the subsurface investigations (Section 3) and the results of the safety factor assessment (Geosyntec, 2016b), the Ash Pond A appears to have been designed, constructed, and maintained with stable foundations. Potential slip surfaces through the foundation soils of the perimeter dikes were evaluated under the static and seismic loading conditions in accordance with §257.73(e) and were found to meet or exceed the required safety factors under the CCR Rule. Details of the slope stability analysis are provided in the Safety Factor Assessment Report (Geosyntec, 2016b).

5.3 Condition of Perimeter Dike Slopes

The CCR Rule (§257.73(d)(1)) requires that the periodic stability assessment:

"...at minimum, document whether the CCR unit has been designed, constructed, and maintained with:

...

(ii) Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;

The interior (upstream) side slopes of the Ash Pond A perimeter dikes have generally been lined with rip-rap slope protection. Over time, sluiced fly ash has been deposited and some vegetation (i.e., phragmites) has flourished within the voids of the rip-rap slope protection during the operations of the surface impoundment. The riprap armor provides protection from surface erosion and wave action generated during rainfall events and periods of high wind. Grass has been established and is routinely maintained on the downstream 2H:1V to 3H:1V perimeter dike slopes. WGS facility personnel cut the vegetation as a part of routine maintenance of the perimeter dikes. Since the surface impoundment has been filled nearly to capacity with CCR and three culverts passively drain free water into Ash Pond B, a significant volume of ponded water is unable to accumulate or be drawn down rapidly within Ash Pond A. Thus, the Ash Pond A dikes have been constructed, operated, and maintained in accordance with §257.73(d)(1) (ii) of the CCR Rule. Note that §257.73(d)(1)(iv) was vacated by the USEPA in 2016 and is no longer a requirement of the CCR rule. However, WGS continues to cut the grass on a routine basis as a part of regular maintenance activities.

5.4 Compaction of Dike Fill Materials

The CCR Rule (§257.73(d)(1)) requires that the periodic stability assessment:

"...at minimum, document whether the CCR unit has been designed, constructed, and maintained with:

...

(iii) Dike mechanically compacted to a density sufficient to withstand the range of loading."

Design reports, technical specifications, or construction quality assurance (CQA) certification reports for the construction of Ash Pond A were not available at the time of this Stability Assessment Report. However, a design drawing (CV-511) provides design cross sections for the construction of the Ash Pond A perimeter dikes. The design cross sections indicate that the perimeter dikes consist of *"Compacted Fill"* and that *"Organic Material"* at the base of the structure shall be removed from the area. Burns and Roe and Lockwood-Greene, the engineering and design firms for Ash Pond A, also designed the surface impoundments constructed subsequently at WGS for which compaction specifications were developed. It is anticipated that compaction specifications were drafted and utilized for Ash Pond A, but are not available at this time.

Soil borings and CPT soundings during various geotechnical subsurface investigation programs have been spaced at approximately 500 ft intervals along the perimeter dike crest (not considering the divider dike) in general accordance with the United States Army Corps of Engineers (USACE) EM-1110-2-1913 engineering manual (USACE, 2000). Typically, the perimeter dikes of Ash Pond A were found to consist of medium dense to dense, poorly graded to silty sands with uncorrected SPT blow counts ranging between 7 and 66 blows per foot (typically greater than 15 to 20 blows per foot) and measured CPT tip resistances greater than 100 tsf. Based on interpretation of in-situ data (i.e., CPT soundings and SPT N-values) presented in Attachment 5 of the Safety Factor Assessment Report (Geosyntec, 2016b), the perimeter dikes of Ash Pond A appear to have been mechanically compacted to sufficient densities to withstand the range of anticipated loading conditions.

5.5 Hydraulic Structures Underlying the CCR Unit

The CCR Rule (§257.73(d)(1)) requires that the periodic stability assessment:

"...at minimum, document whether the CCR unit has been designed, constructed, and maintained with:

...

(vi) Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris, which may negatively affect the operation of the hydraulic structure"

As described within Section 2, Ash Pond A manages and routes stormwater and process water through three culverts into Ash Pond B. These culverts penetrate the divider dike at depths between 6 and 8 ft bgs, and spill directly into rim ditches within Ash Pond B. These culverts are routinely inspected and have been found to meet the criteria listed in §257.73(d)(1)(vi).

Design documents for Ash Pond A show Drawdown Structure I (Drawing CV-511) and Drawdown Structure II (Drawing CV-508) penetrating the divider dike and perimeter dike, respectively, in the southwest corner of Ash Pond A north of the intersection with the perimeter dike and the divider dike. Drawdown Structure I penetrated the divider dike to Ash Pond B via an 18-in. diameter reinforced concrete pipe (RCP; Drawing CV-511). Drawing CV-508 indicates that Drawdown Structure II discharges to the Discharge Canal via a 24-in. diameter reinforce concrete pipe beneath the divider dike which transitions into a 24-in. diameter corrugated metal pipe (CMP) until it reaches the Discharge Canal. Anti-seepage collars were provided along the alignment of these two pipes exiting Drawdown Structure II.

In 2011, Dewberry and Davis performed a site walk to assess the condition of the CCR impoundments at WGS as part of USEPA's programmatic survey of coal-fired power plants. During a discussion during the site visit, it was identified that Drawdown Structure I was "abandoned in-place" and Drawdown Structure II was "bladder plugged and abandoned" (Dewberry and Davis, 2011). In 2011, Santee Cooper used Controlled Low Strength Material (CLSM) to abandon the 24-in. RCP from Drawdown Structure II while the CMP section of the outfall pipe was excavated and removed (Santee Cooper, 2011). Excavated material during the removal of the CMP was recompacted as backfill during project completion. The record drawing indicates that the concrete drainage structure was filled above the pipe crown with CLSM, and the remainder of the structure was filled using fill composed mostly of CCR found in Ash Pond A. These structures have been properly abandoned and meet the criteria listed in §257.73(d)(1)(vi).

5.6 Sudden Drawdown of Adjacent Water Body

The CCR Rule (§257.73(d)(1)) requires that the periodic stability assessment:

"...at minimum, document whether the CCR unit has been designed, constructed, and maintained with:

...

(vii) For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream, or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body of sudden drawdown of the adjacent water body."

Ash Pond A is located adjacent to the Cooling Pond for WGS and the free water within this pond is maintained by a concrete riser structure and emergency spillway. As generating activities are reliant on a minimum water level for process water cooling, sudden drawdown or structural stability during the low pool was not considered a potential failure mechanism and was not evaluated within this Stability Assessment Report.

6. SUMMARY AND GENERAL CONDITIONS

The following section provides a summary and general conclusions of the structural stability assessment presented in this Stability Assessment Report:

- The hydrologic and hydraulic performance of Ash Pond A during the 100-yr rainfall event was evaluated. Based on the evaluation results, Ash Pond A will adequately contain and manage (i.e., without overtopping the perimeter dikes) the flow during and following the 100-yr rainfall event in compliance with §257.73(d)(1)(v) of the CCR Rule.

- A desktop review of site history and engineering reports (when available), geotechnical subsurface investigations, and laboratory testing programs was carried out to evaluate the construction history, characterize the dike and subsurface soils, and understand the existing conditions of Ash Pond A. Based on the information available at the time of this Stability Assessment Report, Ash Pond A appears to have been designed, operated, and maintained with mechanically compacted dikes and stable foundations under static and seismic conditions and slope protection in accordance with §257.73(d)(1)(i) through (iii) of the CCR Rule.

- The influence of hydraulic structures underlying and penetrating the perimeter dikes was evaluated and found to meet the requirements of §257.73(d)(1)(vi).

Based on the evaluations presented within this Stability Assessment Report, Ash Pond A at WGS satisfies the periodic structural stability criteria for existing surface impoundments described within §257.73(d) of the CCR Rule.

7. REFERENCES

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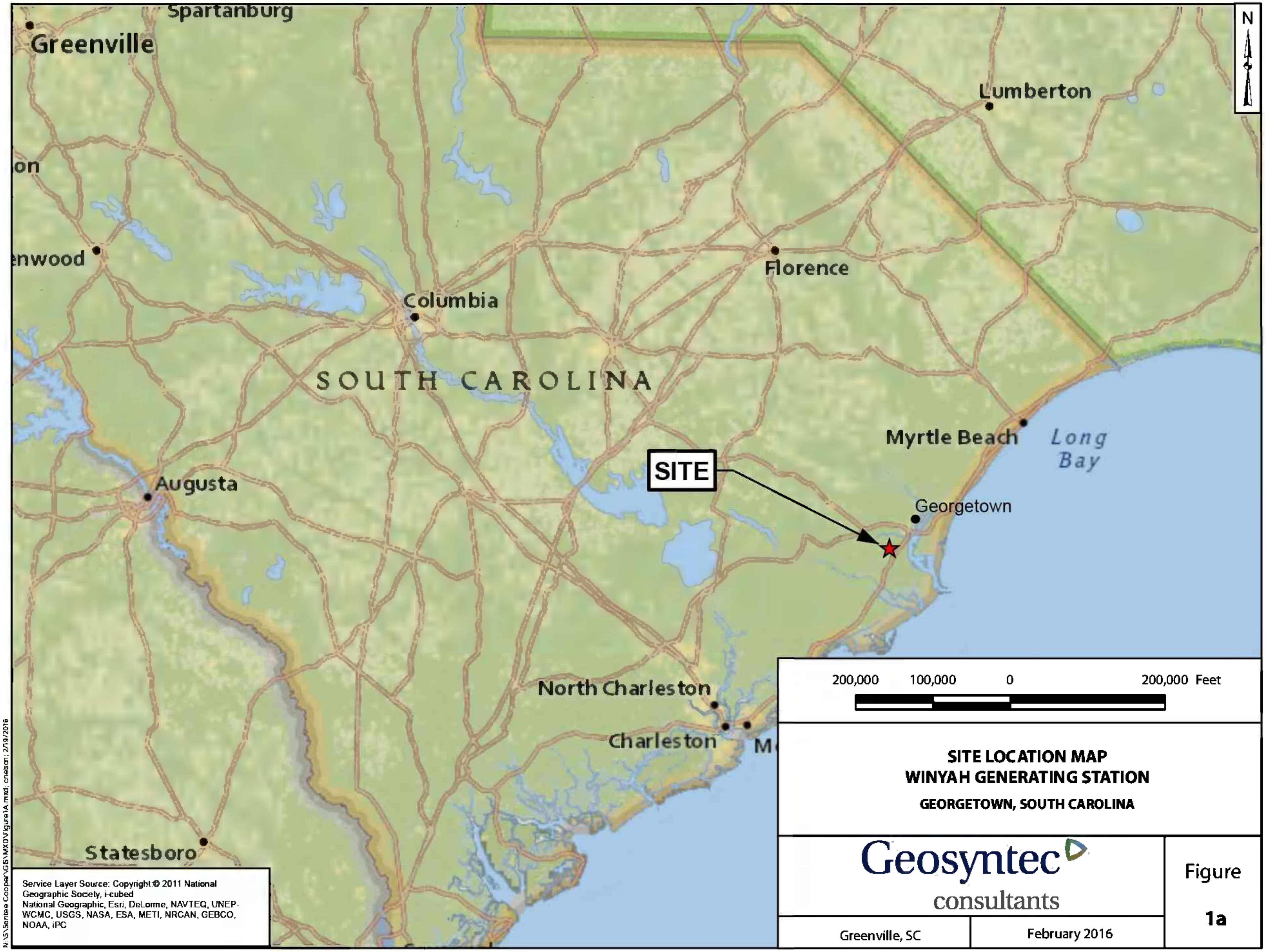
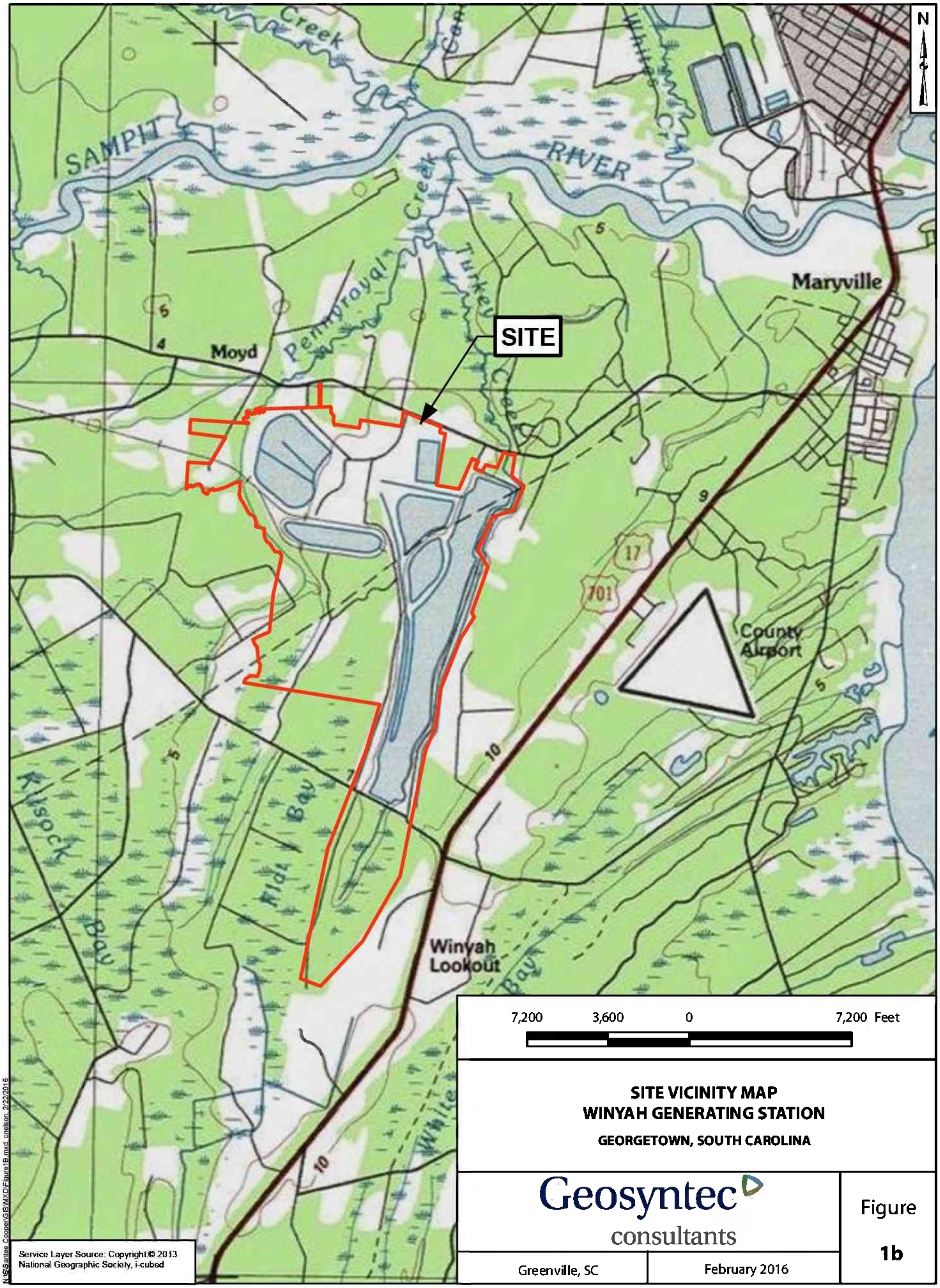
FIGURES



SITE LOCATION MAP
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

Figure 1a

N:\S\Santee Cooper\GIS\MXD\Figure1A.mxd; cnelson; 2/19/2016



SITE VICINITY MAP
WINYAH GENERATING STATION

GEORGETOWN, SOUTH CAROLINA

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Figure **1b**

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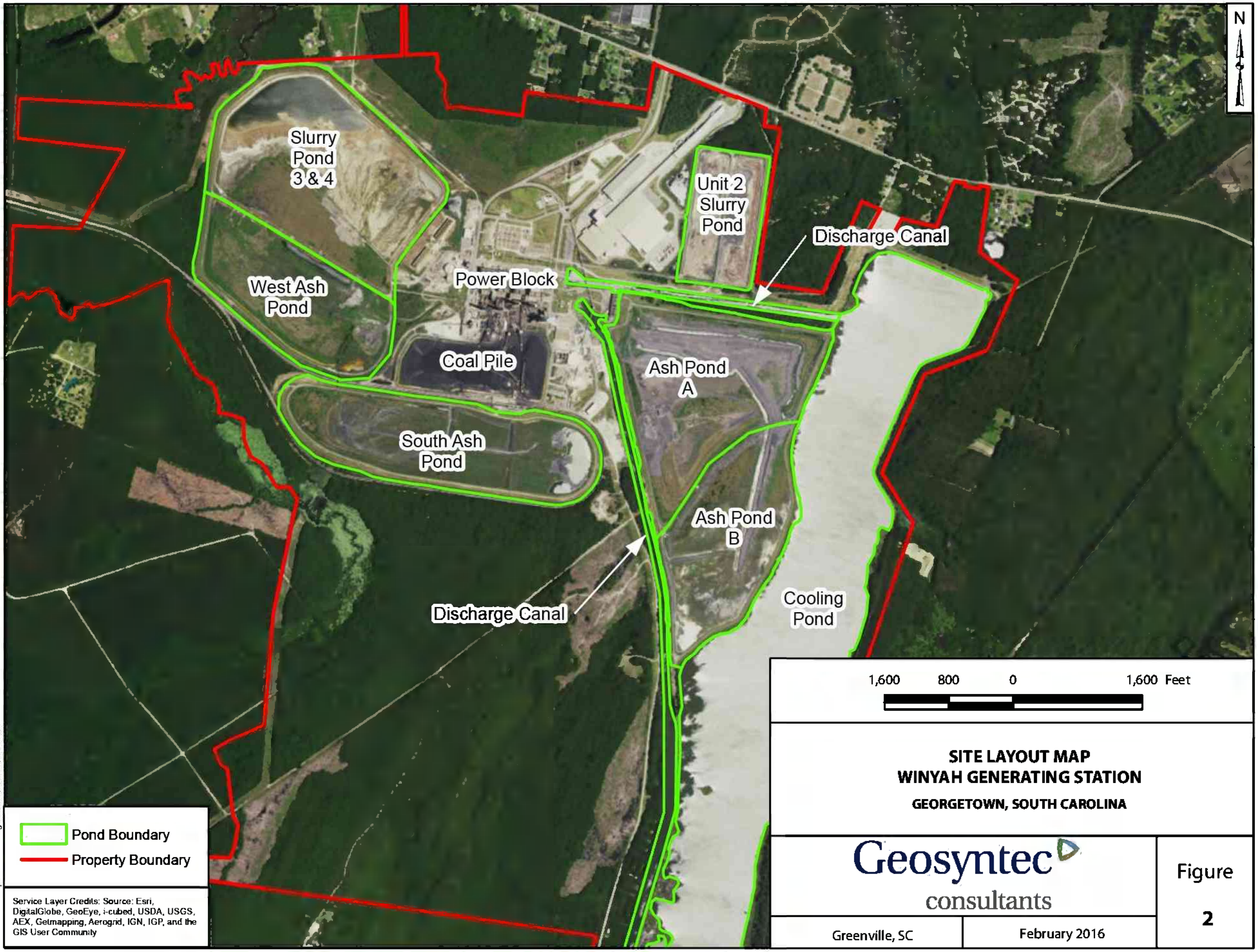

SITE LAYOUT MAP
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

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Figure 2

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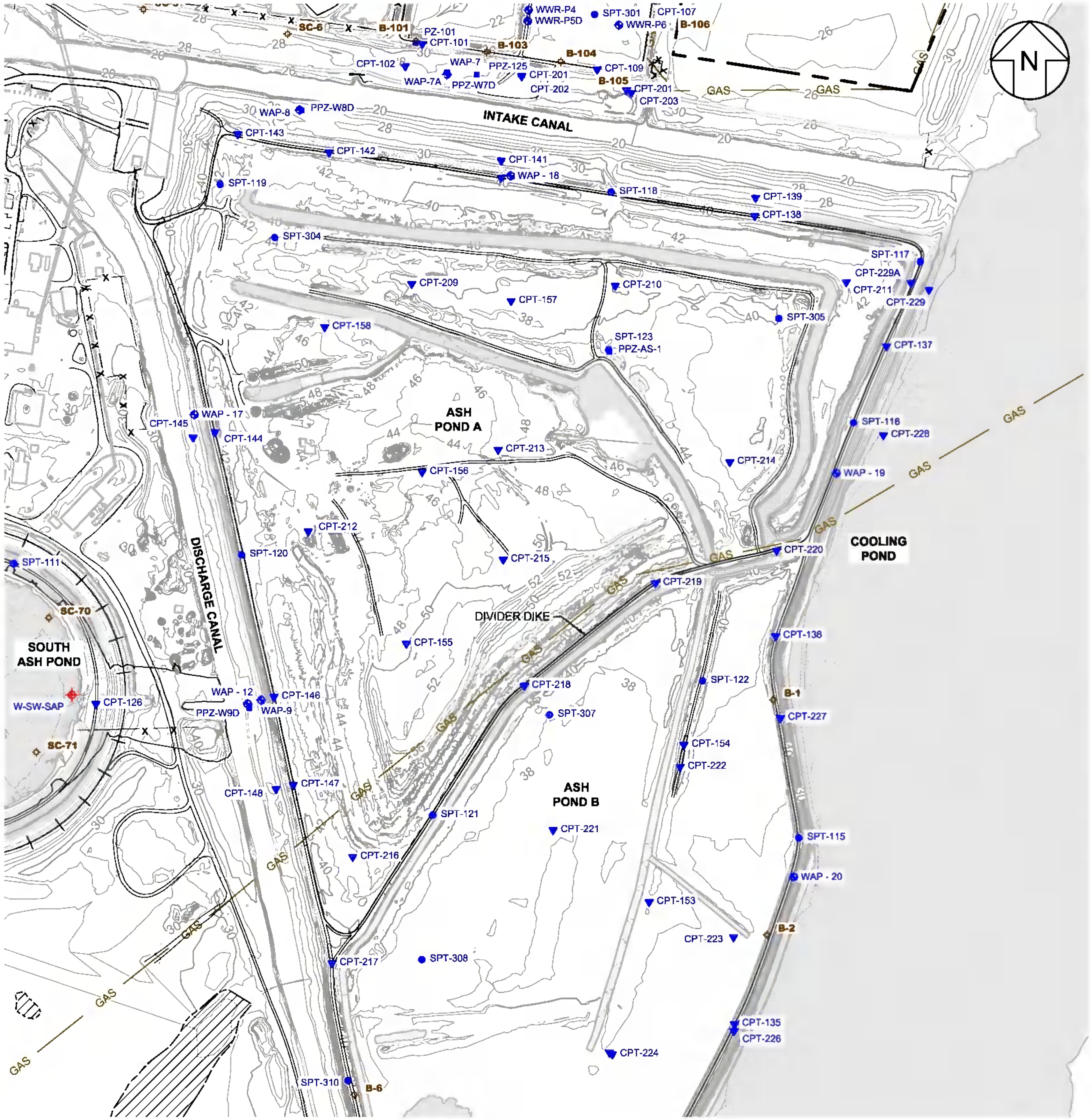

LEGEND

GAS —— GAS	EXISTING GAS LINE
—— 20 ——	EXISTING MAJOR GRADE CONTOUR
—+—+—+—	EXISTING RAILROAD
(shaded)	EXISTING PONDED WATER
W-SW-SAP	EXISTING STAFF GAUGE
CPT-101	GEOSYNTEC CONE PENETRATION TEST
SPT-111	GEOSYNTEC SOIL BORING
B-1	HISTORICAL BORING
WAP-7, WWR-P4	MONITORING WELL
PPZ-125, PPZ-AS-1, PZ-101	PIEZOMETER

NOTES:

1. TOPOGRAPHIC SURVEY PROVIDED BY THOMAS & HUTTON DATED 06/29/11 AND REVISED ON 01/14/12.
2. ELEVATIONS FROM THIS SURVEY ARE REFERENCED TO NGVD 1929 DATUM AS DERIVED FROM NGS MONUMENT PID#DD1957.
3. THE POSITION OF UNDERGROUND UTILITIES SHOWN ON THIS DRAWING IS BASED UPON THE LOCATION OF SURFACE APPURTENANCES AND/OR SURFACE MARKINGS AND SHOULD BE CONSIDERED APPROXIMATE.

0 400' 800'

SCALE IN FEET

ASH POND A
BORING LOCATION MAP

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FIGURE 3

PROJECT NO: GSC5242

OCTOBER 2016

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