TABLE OF CONTENTS

1. PURPOSE ....................................................................................................................... 1

2. SITE DESCRIPTION ..................................................................................................... 2
   2.1 Site ......................................................................................................................... 2
   2.2 CCR Units ............................................................................................................. 2

3. SITE CONCEPTUAL HYDROGEOLOGIC MODEL ....................................................... 3
   3.1 Regional Geology and Hydrogeology ................................................................. 3
   3.2 Site Geology and Hydrogeology ....................................................................... 3
   3.3 Aquifer System Description ............................................................................. 4
       3.3.1 Materials Comprising the Aquifer ............................................................ 4
       3.3.2 Groundwater Flow Direction ................................................................. 4
       3.3.3 Groundwater Flow Rates ....................................................................... 4

4. BACKGROUND WELLS .............................................................................................. 6

5. DETECTION MONITORING SYSTEM ....................................................................... 7

6. MONITORING WELL DESIGN & INSTALLATION REPORT ..................................... 8

7. CERTIFICATION ......................................................................................................... 9

8. REFERENCES ............................................................................................................. 10

LIST OF TABLES

Table 1. Summary of Calculated Hydraulic Conductivity Data
Table 2. CCR Monitoring Well Construction Details
Table 3. Summary of Detection and Assessment Monitoring Constituents

LIST OF FIGURES

Figure 1. Big Bend Station Location Map
Figure 2. EAPPS Location Map
Figure 3. Regional Potentiometric Surface Map for the Upper Floridan Aquifer
Figure 4. CCR Monitoring Well Locations – EAPPS
Figure 5. EAPPS Low Tide Potentiometric Surface Map – 6/24/2016
Figure 6. EAPPS High Tide Potentiometric Surface Map – 6/28/2016
LIST OF APPENDICES

Appendix A  Groundwater Monitoring System Certification
LIST OF ACRONYMS

BBS  Big Bend Power Station
bls  below land surface
CCR  Coal Combustion Residual
cm/s centimeters per second
CFR  Code of Federal Regulations
cy  cubic yards
EAPPS Economizer Ash and Pyrite Pond System
ft  feet
FGD  Flue gas desulfurization
ICU  Intermediate confining unit
msl Mean sea level
NAVD88 North Atlantic Vertical Datum of 1988
TEC  Tampa Electric Company
SAS Surficial aquifer system
UFAS Upper Floridan Aquifer System
1. PURPOSE

The following report was prepared to meet requirements of 40 CFR 257.91(a)(b)(c) or (d) as applicable, and (e). This report documents that the groundwater monitoring system for the Coal Combustion Residual (CCR) Economizer Ash and Pyrite Pond System (EAPPS) within the scope of 40 CFR 257.50 at Tampa Electric Company’s (TEC) Big Bend Power Station (BBS) in Gibsonton, Florida complies with these requirements.
2. SITE DESCRIPTION

2.1 Site

The BBS (or “Site”) is a coal-fired electrical power generation facility owned and operated by TEC. The Site is located on the eastern shore of Tampa Bay in Gibsonton, Florida in Sections 9, 10, 15, and 16, Township 31, Range 19 East in the Gibsonton Quadrangle, with the center of the facility at approximately 27°47′36″ north latitude and 82°24′16″ west longitude. Topography at the Site ranges from approximately sea level (along the western portion of the BBS) to approximately 10.5 feet (ft) relative to the North Atlantic Vertical Datum of 1988 (NAVD88) near the eastern portions of the property along U.S. Highway 41.

Construction of BBS began in the late 1960s on two dredge/fill peninsulas. The four coal-fired power generating units present at the BBS were placed in service in 1970, 1973, 1976, and 1985. Units 1, 2, and 3 are wet-bottom slag-tap type units that originally used saltwater slag-handling systems and electrostatic precipitators for stack gas emissions control. However, these units are now operating as freshwater systems, subsequently allowing more internal water recycling. Unit 4 is a dry-bottom unit with a closed-loop freshwater bottom ash-sluice system. All units are equipped with electrostatic precipitators, and stack gasses are treated with a limestone flue gas desulfurization (FGD) system.

The Economizer Ash and Pyrite Pond System (EAPPS) was built in the early 1980s to support the operation of Big Bend Unit 4 and consists of three lined ponds, as described in Section 2.2. The location of the Site and the components of the EAPPS, including the north and south economizer ash ponds and the suction pond, are shown on Figure 1 and Figure 2.

2.2 CCR Units

The EAPPS comprises three ponds that are considered one CCR unit by 40 CFR 257.53 and are located approximately 1,000 feet southeast of the active power generating units (Figure 1). The north economizer ash pond and economizer ash suction pond are still in operation. The south economizer ash pond has been converted to dry storage of material excavated from the south recycle pond when it was reconstructed and lined in 2010.

The pond bottom and dike crest elevations for each pond are reportedly 5.5 ft and 31 ft, respectively; however, the elevation datum is unknown (Geosyntec, 2016). The South Economizer Ash Pond contains an estimated 337,400 cubic yards (cy) of CCR material over a surface area of 7.2 acres. The north pond contains an estimated 90,000 cy of CCR material (Geosyntec, 2016) over a surface area of 5.4 acres. The suction pond has a surface area of 1.6 acres, receives decant water from the north and south economizer ash ponds, and contains no CCR material.
3. SITE CONCEPTUAL HYDROGEOLOGIC MODEL

3.1 Regional Geology and Hydrogeology

The general hydrogeologic units that form the hydrogeologic framework in the region include the surficial aquifer system (SAS), the intermediate confining unit (ICU) and the upper Floridan aquifer system (UFAS). Based on Site-specific data as well as hydrogeologic studies of west-central Florida (Tihanksy and Knochenmus, 2001), the intermediate aquifer system has not been identified as being present at this location.

The SAS sediments comprise Pleistocene shell deposits and terrace sands. Thicknesses of the SAS deposits vary considerably due to the irregular surface of the underlying limestone, but typically range between 20 to 30 ft thick near the Site (SWFWMD, 2010). The shell deposits are typically overlain by surface sands.

The ICU resides within the undifferentiated Hawthorn Group. Due to the absence of the intermediate aquifer system, the permeable strata are absent and consequently the less permeable, fine grained clastic clay units are generally more prevalent. These clay units with varying silt, sand content, and marls make up the semi-confining unit that separates the surficial and Floridan Aquifer systems. The occurrence and composition of these clay and marl units vary laterally and vertically (ECT, 2007).

The UFAS consists of a continuous series of carbonate units. The UFAS is composed of the limestone sequences that occur in the Tampa Member of the Arcadia Formation of the Hawthorn Group as well as the underlying Suwannee Limestone and other carbonate strata. The Tampa Member encompasses sandy limestone containing varying amounts of clays and marls. The upper portion of the Suwanee Limestone is a finely crystalline limestone that consists of minor amounts of quartz sand and shell fragments. Figure 3 shows regional groundwater elevations of the UFAS in the vicinity of the BBS in September 2014 based on data obtained from the Southwest Florida Water Management District. Groundwater in the UFAS generally flows regionally from east to west toward Tampa Bay.

3.2 Site Geology and Hydrogeology

The water table across the Site exists within the SAS where the groundwater flow direction is influenced by ponds, drainage ditches, canals, and small creeks. Historical trends from data collected on Site (ECT, 2003) identified an upward vertical flow gradient from the UFAS to the SAS, with certain wells occasionally exhibiting artesian conditions (ECT, 2007) with a potentiometric surface ranging from 0 to 10 ft above msl. This elevated potentiometric pressure inhibits downward seepage of groundwater from the SAS to the UFAS. Seasonal fluctuations in the water levels and potentiometric surface may allow for temporary, localized downward
flow gradients (ECT, 2007). Hydraulic flow gradients and local hydrogeologic conditions identify Tampa Bay as the discharge point for flow within the SAS.

The 2002 Revised Groundwater Monitoring Plan reported horizontal hydraulic conductivity values at the Site ranging from 1.7x10^-3 to 1.1x10^-5 centimeters per second (cm/s) for tests completed in the upper 25 feet of the SAS (Schreuder, Inc. 2002). Additional data from a previous study referenced within Schreuder (2002) reported an average field horizontal hydraulic conductivity of 1.2x10^-3 cm/s in the upper 16 ft. of the SAS and a field vertical hydraulic conductivity of 3.9x10^-5 cm/s at a depth of 25 ft. b.s. Laboratory hydraulic conductivity tests were performed for the least permeable aquifer materials including silty sands and lower clay layers above the limestone. These low permeability materials comprise the Tampa Member of the Arcadia Formation of the Hawthorn Group. Hydraulic conductivity values from the clay layers ranged from 3x10^-7 to 6x10^-8 cm/s.

Hydraulic conductivity values for the SAS and ICU are presented in Table 1.

3.3 Aquifer System Description

3.3.1 Identification of Uppermost Aquifer

The uppermost aquifer is defined by 40 CFR 257.53 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. The upper limit is measured at a point closest to the natural ground surface to which the aquifer rises during the wet season. As described in Section 3.2, the uppermost aquifer at the Site is the SAS.

3.3.2 Groundwater Flow Direction

A surface water feature, Jackson Branch, to the north/northeast of the EAPPS appears to influence local groundwater flow toward the stream in contrast to the general groundwater flow direction at the BBS, which is east to west. The groundwater flow direction near the EAPPS is generally north/northeast.

3.3.3 Groundwater Flow Rates

On 24 and 28 June 2016, Geosyntec collected groundwater elevation data from Site monitoring wells during high and low tide events, respectively, to evaluate groundwater flow conditions in the SAS. Groundwater elevation contours were developed using the water level measurements and indicated an average horizontal hydraulic gradient near the EAPPS of 2.0 x 10^-3 ft/ft during both low and high tides (Figure 5 and Figure 6). The primary sediments of the SAS are fine sand to silty sand. Assuming an effective porosity of 20% and the measured hydraulic conductivity values for the SAS (Table 1), it is possible to calculate the average linear velocity of groundwater using the equation below:
\[ q = K \left( \frac{i}{n_e} \right) \]

where \( q \) is the average groundwater linear velocity, \( K \) is the hydraulic conductivity (Table 1), \( i \) is the hydraulic gradient, and \( n_e \) is the effective porosity. Using the average \( K \) value from Seaburn and Robertson \((1.2 \times 10^{-3} \text{ cm/s})\) and values described above, the average linear velocity of groundwater ranges from 0.2 to 0.6 ft/day, which corresponds to a potential range of flow velocities from approximately 7 to 22 feet per year toward Jackson Branch.
4. BACKGROUND WELLS

The CCR Rule requires a minimum of one background well where water quality has not been affected by CCR constituents. Background wells for CCR monitoring at the EAPPS include BBS-CCR-BW-1 and BBS-CCR-BW-2, as shown on Figure 4 and were designed to monitor the water quality of the upper SAS upgradient of the EAPPS. These upgradient wells are intended to be used for statistical comparison to groundwater data from downgradient monitoring wells. The documentation for the design, installation, and development of these wells is found in Groundwater Monitoring Well Design, Installation, Development, and Decommissioning Report, October 2017. A well construction summary is provided in Table 2.
5. DETECTION MONITORING SYSTEM

The detection monitoring network was designed to monitor the water quality of the upper SAS downgradient of the EAPPS (BBS-CCR1, BBS-CCR-2, and BBS-CCR-3). The detection monitoring wells at the waste boundary are located at the “hydraulically downgradient perimeter (i.e., the edge) of the CCR unit or at the closest practical distance from this location” [80 FR 21400]. The screen intervals are at or below the actual depth of CCR material in the upper portion of the SAS and therefore meet the performance standards specified in 257.91(a) through (d). Monitoring well locations are shown on Figure 4.

During the initial groundwater sampling phase of Detection Monitoring, wells listed in Table 2 and depicted on Figure 4 are to be sampled for Appendix III and Appendix IV constituents a minimum of eight times prior to 17 October 2017 [40 CFR 257.94(b)] (USEPA, April 2015). Sample results will be used to develop Site-specific background concentrations for each Appendix III and Appendix IV constituent (Table 3). During groundwater sampling activities, water levels will be measured at each well to generate potentiometric maps of monitored hydrogeologic zones [40 CFR 257.93(c)] (USEPA, April 2015). Water levels used for preparation of groundwater elevation contour maps are to be collected during a single 24 to 48-hour period. Field parameters listed on Table 3 will also be measured during well purging and immediately before samples are collected for laboratory analysis.

An alternative (reduced) detection monitoring frequency may be implemented if favorably supported by an evaluation of the results that considers the following factors [40 CFR 257.94(d)] (USEPA, April 2015):

- Lithology of the aquifer and unsaturated zone;
- Hydraulic conductivity of the aquifer and unsaturated zone;
- Groundwater flow rates; and
- Information documenting that the alternative frequency is no less effective in ensuring that any leakage from the CCR unit is discovered within a timeframe that will not materially delay establishment of an assessment monitoring program.
6. MONITORING WELL DESIGN & INSTALLATION REPORT

The documentation for the design, installation, and development of the wells in the CCR monitoring system is found in *Groundwater Monitoring Well Design, Installation, Development, and Decommissioning Report, October 2017*. This document complies with 40 CFR 257.91(e)(1).
7. CERTIFICATION

The CCR rule requires that the owner must obtain certification from a qualified engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. The certification is based on the information provided and referenced in this document. A copy of the signed and sealed certification is included as Appendix A.
8. REFERENCES


TABLES
### Table 1: Summary of Calculated Hydraulic Conductivity Data

TEC Big Bend Station Economizer Ash and Pyrite Pond System

Apollo Beach, FL

<table>
<thead>
<tr>
<th>Source</th>
<th>Aquifer System</th>
<th>Horizontal Hydraulic Conductivity (cm/sec)</th>
<th>Vertical Hydraulic Conductivity (cm/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone and Webster</td>
<td>SAS</td>
<td>1.7E-03 to 1.1E-05</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>ICU</td>
<td>3E-07 to 7E-07</td>
<td>--</td>
</tr>
<tr>
<td>Seaburn and Stone</td>
<td>SAS</td>
<td>1.2E-03*</td>
<td>3.9E-05</td>
</tr>
<tr>
<td>and Robertson</td>
<td>ICU</td>
<td>4E-8 to 6E-8</td>
<td>--</td>
</tr>
</tbody>
</table>

**Notes:**

1. cm/s = centimeters per second
2. SAS indicates surficial aquifer system
3. ICU indicates intermediate confining unit
4. * = average value of three field aquifer tests
Table 2: CCR Monitoring Well Construction Details
TEC Big Bend Station Economizer Ash and Pyrite Pond System
Apollo Beach, FL

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BBS-CCR-BW1</td>
<td>2</td>
<td>Background</td>
<td>1256638.34</td>
<td>528461.95</td>
<td>29.10</td>
<td>33.40</td>
<td>40</td>
<td>30-40</td>
<td>-0.90</td>
<td>-10.90</td>
</tr>
<tr>
<td>BBS-CCR-BW2</td>
<td>2</td>
<td>Background</td>
<td>1256966.67</td>
<td>527897.28</td>
<td>7.70</td>
<td>12.54</td>
<td>19</td>
<td>9-19</td>
<td>-1.30</td>
<td>-11.30</td>
</tr>
<tr>
<td>BBS-CCR-1</td>
<td>2</td>
<td>Detection</td>
<td>1257433.85</td>
<td>528211.74</td>
<td>5.00</td>
<td>9.82</td>
<td>17.5</td>
<td>7.5-17.5</td>
<td>-2.50</td>
<td>-12.50</td>
</tr>
<tr>
<td>BBS-CCR-2</td>
<td>2</td>
<td>Detection</td>
<td>1257429.29</td>
<td>528769.31</td>
<td>5.00</td>
<td>9.34</td>
<td>17.5</td>
<td>7.5-17.5</td>
<td>-2.50</td>
<td>-12.50</td>
</tr>
<tr>
<td>BBS-CCR-3</td>
<td>2</td>
<td>Detection</td>
<td>1257154.61</td>
<td>529023.26</td>
<td>4.90</td>
<td>9.20</td>
<td>18.5</td>
<td>8.5-18.5</td>
<td>-3.60</td>
<td>-13.60</td>
</tr>
</tbody>
</table>

Notes
1. in = Inches
2. ft bls = Feet Below Land Surface
5. *Top of casing elevations were revised in September 2016 during final aboveground well completions. The additional PVC stickup was measured in the field and added to the surveyed top of casing elevation.
<table>
<thead>
<tr>
<th>Constituent</th>
<th>Constituent Reference</th>
<th>Analytical Methods(s)</th>
<th>EPA Primary or Secondary MCL (ug/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic (Total)</td>
<td>X</td>
<td>EPA 200.8 or 6020</td>
<td>10</td>
</tr>
<tr>
<td>Antimony (Total)</td>
<td>X</td>
<td>EPA 200.8 or 6020</td>
<td>6</td>
</tr>
<tr>
<td>Barium (Total)</td>
<td>X</td>
<td>EPA 6010</td>
<td>2,000</td>
</tr>
<tr>
<td>Beryllium (Total)</td>
<td>X</td>
<td>EPA 6010</td>
<td>4</td>
</tr>
<tr>
<td>Boron (Total)</td>
<td>X</td>
<td>EPA 6010</td>
<td>NA</td>
</tr>
<tr>
<td>Cadmium (Total)</td>
<td>X</td>
<td>EPA 200.8 or 6020</td>
<td>5</td>
</tr>
<tr>
<td>Calcium (Total)</td>
<td>X</td>
<td>EPA 6010</td>
<td>NA</td>
</tr>
<tr>
<td>Chloride</td>
<td>X</td>
<td>EPA 300.0</td>
<td>250,000</td>
</tr>
<tr>
<td>Chromium (Total)</td>
<td>X</td>
<td>EPA 6010</td>
<td>100</td>
</tr>
<tr>
<td>Cobalt (Total)</td>
<td>X</td>
<td>EPA 6010</td>
<td>NA</td>
</tr>
<tr>
<td>Fluoride</td>
<td>X</td>
<td>EPA 300.0</td>
<td>4,000</td>
</tr>
<tr>
<td>Lead (Total)</td>
<td>X</td>
<td>EPA 200.8</td>
<td>15</td>
</tr>
<tr>
<td>Lithium (Total)</td>
<td>X</td>
<td>EPA 6010</td>
<td>NA</td>
</tr>
<tr>
<td>Mercury (Total)</td>
<td>X</td>
<td>EPA 7470</td>
<td>2</td>
</tr>
<tr>
<td>Molybdenum (Total)</td>
<td>X</td>
<td>EPA 6010</td>
<td>NA</td>
</tr>
<tr>
<td>pH</td>
<td>X</td>
<td>Field</td>
<td>6.5-8.5 (STD Units)</td>
</tr>
<tr>
<td>Radium 226 and 228 (Total)</td>
<td>X</td>
<td>EPA 903</td>
<td>5 (pCi/L)</td>
</tr>
<tr>
<td>Sulfate</td>
<td>X</td>
<td>EPA 200.8 or 6020</td>
<td>50</td>
</tr>
<tr>
<td>TDS</td>
<td>X</td>
<td>SM2540C</td>
<td>500,000</td>
</tr>
<tr>
<td>Thallium (Total)</td>
<td>X</td>
<td>EPA 6020</td>
<td>2</td>
</tr>
</tbody>
</table>

Notes
1. EPA = US Environmental Protection Agency
2. MCL = Maximum Contaminant Level
3. ug/L = Micrograms per liter
4. STD Units = Standard Units
5. pCi/L = picoCuries per liter
FIGURES
Big Bend Station Location Map

Notes:
1. Site boundary provided by Tampa Electric Company.

Approximate Site Boundary
Economizer Ash and Pyrite Pond System (EAPPS)

Legend
1. Long Term Fly Ash Pond/Reclaimed Water Pond (lined)
2. South Economizer Ash Pond (lined)
3. North Economizer Ash Pond (lined)
4. Economizer Ash Suction Pond (lined)
5. South Bottom Ash Pond (lined)
6. North Bottom Ash Pond (lined)
7. Bottom Ash Suction Pond (lined)
8. Settling Basins (concrete)
9. Settling Pond (lined)
10. South Recycle Pond (lined)
11. North Recycle Pond (lined)
12. Storm Water Pond
13. BB Aero Unit CT4
14. Rail Car Unloading
15. Coal Field
16. Gypsum Storage Area
17. Slag Dewatering Bins
18. Dredge Disposal Area DA-2
19. Former Spray Field
20. Limestone and FGD Area
21. Former Spray Field

Figure 1

Notes:
1. Site boundary provided by Tampa Electric Company.

Approximate Site Boundary
Economizer Ash and Pyrite Pond System (EAPPS)
Economizer Ash and Pyrite Pond System Location Map

TEC Big Bend Station
Gibsonton, FL

Tampa, FL

September 2017

Legend

- **Jackson Branch**
- **Economizer Ash and Pyrite Pond System (EAPPS)**

Note: Source of 2014 Aerials: Florida Department of Transportation, Surveying and Mapping Office.
Regional Potentiometric Surface Map for the Upper Floridan Aquifer

Notes:
1. NGVD 29 indicates potentiometric contours presented in feet relative to National Geodetic Vertical Datum 1929.
2. Site boundary as provided by Tampa Electric Company (TEC).
3. Potentiometric contour for Upper Floridan Aquifer provided by Southwest Florida Water Management District (SWFWMD) dated September 2014.

Legend:
- Upper Floridan Aquifer Potentiometric Surface
- Approximate Site Boundary

Figure 3
TEC Big Bend Station
Gibsonton, FL

Tampa, FL
September 2017
North Economizer Ash Pond (Lined)

BBS-CCR-1

BBS-CCR-BW1

Economizer Suction Pond (Lined)

North Economizer Ash Pond (Lined)

BBS-CCR-BW2

South Economizer Ash Pond (Lined)

BBS-CCR-BW1

Long Term Fly Ash Pond (Lined)

Legend

- CCR Background Well Location
- CCR Monitoring Well Location
- Jackson Branch
- Economizer Ash and Pyrite Pond System (EAPPS)

Note:
2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.

Figure 4

CCR Monitoring Well Locations
Economizer Ash and Pyrite Pond System

TEC Big Bend Station
Gibsonton, FL

Geosyntec consultants
Tampa, FL

September 2017
North Economizer Ash Pond (Lined)
CCR-SG1
CCR-PZ1
CCR-PZ2
CCR-PZ3
CCR-PZ4
CCR-PZ5
CCR-PZ6
MWB-35
MWB-36

Economizer Suction Pond (Lined)

South Economizer Ash Pond (Lined)

Long Term Fly Ash Pond (Lined)

North Economizer Ash Pond (Lined)

Big Bend Road

Jackson Branch

Economizer Ash and Pyrite Pond System
Low Tide Potentiometric Surface Map 6/24/16
TEC Big Bend Station
Gibsonton, FL

Legend
- Existing Monitoring Well Locations
- CCR Compliance Piezometer Locations
- Surface Water Staff Gauge Locations
- Potentiometric Surface Elevation (ft NAVD)
- Groundwater Flow Direction
- Groundwater Elevation (ft NAVD)

Notes:
2. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.
APPENDIX A
Groundwater Monitoring System Certification
FINAL CERTIFICATION

I, Todd D. Anderson, being a Registered Professional Engineer, in accordance with the State of Florida Professional Engineer's Registration, possessing the technical knowledge and experience to make the specific technical certifications required under 40 C.F.R Part 257, Subpart D, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments, and being licensed in the state where the CCR unit is located, do hereby certify to the best of my knowledge, information, and belief, that the groundwater monitoring system that is the subject of this certification has been designed and constructed to meet the requirements of 40 C.F.R. § 257.91.

[Signature]

State of Florida License No.

[Date]