ALTERNATE SOURCE DEMONSTRATION – ECONOMIZER ASH AND PYRITE POND SYSTEM

Big Bend Power Station
13031 Wyandotte Road
Gibsonton, FL 33572

*Prepared for*

**Tampa Electric Company**
Tampa, Florida

*Prepared by*

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Project FR2814.01

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1. PURPOSE OF ALTERNATE SOURCE DEMONSTRATION REPORT

On behalf of the Tampa Electric Company (TEC), Geosyntec Consultants, Inc. (Geosyntec) has prepared this alternate source demonstration (ASD) for the economizer ash and pyrite pond system (EAPPS) at the TEC’s Big Bend Power Station (BBS) in Gibsonton, Florida. This ASD has been prepared to meet the requirements of the U.S. Environmental Protection Agency’s (USEPA) coal combustion residual (CCR) Rule 40 CFR Part 257.94(e)(2) which states:

The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report.

1.1 Regulatory Background

In June 2016, TEC implemented baseline groundwater sampling as part of closure requirements for the EAPPS. The monitoring well network consists of two background locations (BBS-CCR-BW1 and BBS-CCR-BW2) and three downgradient locations (BBS-CCR-1, BBS-CCR-2, and BBS-CCR-3) installed within the surficial aquifer at the EAPPS (Figure 1). Data from the 10 baseline monitoring events and the first detection monitoring events presented in Table 1.

In accordance with the provisions established in 40 CFR 257.93, background concentrations were established for each of the constituents listed in 40 CFR 257 Appendix III by analyzing the data from the two background wells present at EAPPS. A 95% upper prediction limit (UPL) was established for each constituent from the results of 10 baseline sampling events occurring between June 2016 and August 2017. For pH a lower prediction limit (LPL) was also determined since acidic water could potentially be an indicator of a release. The first detection monitoring event occurred in October 2017 and resulted in a statistically significant increase (SSI) in pH above the established UPL of 6.70 standard units (SU) in two of the three downgradient monitoring wells, namely 6.83 and 6.87 SU in BBS-CCR-1, and BBS-CCR-2, respectively. The pH SSIs were documented in a summary memorandum entitled “Summary of Statistical Analyses of Baseline Groundwater Samples” dated 15 January 2018 (Appendix A).

1.2 Objective of ASD

The purpose of this ASD is to document that the SSIs for pH are not associated with a release from the EAPPS. Although 40 CFR 257 does not contain requirements for an ASD beyond the requirements in 257.94(e)(2), the EPA document Solid Waste Disposal Facility Criteria Technical Manual EPA 530-R-93-017, November 1993, Subpart E provides guidance on what would be included in an ASD for a municipal solid waste landfill. Geosyntec’s approach has been modeled after Section 5.10 of Subpart E (excerpt provided in Appendix B) and the analytical techniques and methods presented in Guidelines for Development of Alternative Source Demonstrations at
Coal Combustion Residual Sites (EPRI, 2017). This ASD is based on the following three lines of evidence:

- There is inherent error present in the equipment used to measure pH in the field;
- There is natural variation within pH ranges from both BBS background wells and regional monitoring wells;
- A change in local groundwater flow direction will result in the influence from higher pH waters within the immediate vicinity of the EAPPS.

The approaches developed to evaluate the evidence is provided in Section 2 of this report. The justification and support for each approach is provided in Section 3 of this report.
2. ALTERNATE SOURCE DEMONSTRATION APPROACH

2.1 Evaluation of Inherent Error

Given that pH is a parameter that is collected in the field during groundwater sampling, a possible source of error exists in both the calibration of the measurement instrument and the inherent error present due to the accuracy limits of the instrument. Due to this possibility, a thorough investigation of the instrument calibration forms and groundwater sampling forms was conducted to verify that calibration and sampling were accomplished in accordance with standard operating procedures established by the Florida Department of Environmental Protection (FDEP) in FS 2200. A review of pertinent field logs was performed to identify if the pH probe used to collect the detection monitoring samples from wells BBS-CCR-1 and BBS-CCR-2 was properly calibrated, if the calibration drifted throughout the course of the sampling event, if an adequate amount of groundwater was withdrawn to obtain a representative sample from each monitoring well, and if pH readings were allowed to stabilize prior to sample collection. Additionally, the accuracy limitations of the instrument used to measure pH was assessed and compared to the baseline UPL to ascertain if the margin of error for the two pH measurements in question is below the UPL.

2.2 Evaluation of Natural Variation

Because no other Appendix III constituent exhibited a SSI in the October 2017 detection monitoring event, pH results in BBS-CCR-1 and BBS-CCR-2 are not believed to be the result of a release from the EAPPS, but are rather indicative of background levels in the surficial aquifer. To evaluate background pH, data collected from the TEC industrial wastewater (IWW) and remedial action plan (RAP) monitoring well network (Figure 2) were obtained for the period of August 2008 to November 2017 (Table 2). Three RAP wells within approximately 100 feet from the northwest, southwest, and southeast corners of the EAPPS (B-36, B-35, and B-17R, respectively) were selected for evaluation based on their upgradient proximity to the EAPPS monitoring well network as determined from groundwater elevations measured at the EAPPS (Figure 3 to Figure 7).

For comparison, monitoring wells B-4R, B-39, B-40, and B-41 have historically been designated as surficial aqufer background wells by TEC due to their locations upgradient of any TEC development along the perimeter of the property (Figure 2). Additionally, four surficial monitoring wells within the Southwest Florida Water Management District (SWFWMD) Regional Observation and Monitoring Program (ROMP) in the Tampa Bay, FL vicinity were identified for a regional background analysis based on available pH data (Figure 8). Historical ROMP data obtained by Geosyntec ranged from September 1985 to March 2003.

ProUCL version 5.1 (EPA, 2016) was utilized to generate a 95% upper confidence limit (UCL) of the arithmetic mean for pH values within each individual monitoring well and each dataset in general accordance with guidelines of Chapter 62-780.680 of the Florida Administrative Code (FAC). The most applicable data distribution provided by ProUCL was utilized. The 95% UCLs provide conservative estimates for the true arithmetic mean of each data set. These values were
compared to the October 2017 pH SSIs in BBS-CCR-1 and BBS-CCR-2 to determine if surficial groundwater pH in the vicinity of the EAPPS is exhibiting typical ranges of background variability.

2.3 Evaluation of Groundwater Flow Direction

Should the observed SSIs be the result of influence from background groundwater, a change in the flow direction of groundwater within the EAPPS would likely be observed. Potentiometric surface maps were generated from the baseline and detection monitoring events to compare the observed flow directions and determine if the SSIs could be the result of a change in flow direction.
3. DEMONSTRATION OF OTHER REASONS FOR STATISTICAL INCREASE

This section presents the results of the approaches discussed in Section 2 and provides support that the lines of evidence identified are plausible sources of the pH SSI.

3.1 Findings from Evaluation of Inherent Error

The sampling team used a YSI® multimeter for pH data collection (as well as temperature, specific conductivity, and dissolved oxygen) during monitoring well purging and sampling. Field forms from the October 2017 detection monitoring sampling event are provided in Appendix C. A review of the instrument calibration log recorded at 7:02 AM on 13 October 2017 reveals that a 3-point calibration for the pH probe was conducted in accordance with FDEP FS2200. Initial calibration verification (ICV) was conducted for a pH 7.0 SU buffer solution resulting in an acceptable reading of 7.03 SU at 7:06 AM. The continued calibration verification (CCV) performed at 2:29 PM upon the completion of the sampling activities resulted in an acceptable reading of 7.11 SU. Groundwater sampling forms documenting field parameter stabilization for BBS-CCR-1 and BBS-CCR-2 indicate that an adequate amount of water was withdrawn from each well prior to sampling to obtain a representative sample. Additionally, three consecutive pH readings were collected within ± 0.2 SU of each other signifying pH stabilization in each well.

A 0.08 SU drift in pH was observed in the post calibration verification but is not enough to explain why the pH concentrations of BBS-CCR-1 and BBS-CCR-2 (6.83 and 6.87 SU respectively) are outside of the background level of 6.70 SU. However, the error inherent to the instrument itself is accurate within ± 0.2 SU (YSI, 2009). As a result, the October 2017 pH values at BBS-CCR-1 and BBS-CCR-2 are more correctly stated as 6.83 ± 0.2 SU and 6.87 ± 0.2 SU, indicating that the 6.70 SU background level is within the accuracy limits of the instrument.

3.2 Findings from Evaluation of Natural Variation

Statistics for pH data from TEC surficial monitoring wells immediately upgradient of the EAPPS, BBS surficial background monitoring wells, and regional SWFWMD ROMP surficial monitoring wells are included in Table 2. Results from 95% UCL calculations are summarized below.

3.2.1 Anthropogenic Background Data – Surficial Aquifer

The pH data from the Economizer Ash and Long-Term Fly Ash Pond monitoring wells (B-17R, B-35, and B-36) indicates the following:

- pH values ranged between 6.60 and 6.96 SU between May 2011 and May 2017;
- 95% UCL values for individual monitoring wells ranged between 6.78 and 6.89 SU and
- The 95% UCL for pH within all three monitoring wells was calculated as 6.82 SU based on 35 total observations.
3.2.2 Natural Background Data – Surficial Aquifer

The pH data from TEC Big Bend IWW/RAP Background Monitoring Wells (B-4R, B-39, B-40, and B-41) indicates the following:

- pH values within the surficial TEC property background wells ranged from 5.81 to 7.31 SU between May 2011 to May 2017;
- 95% UCL values for individual monitoring wells ranged between 6.21 and 7.21 SU; and
- The 95% UCL for pH within all four monitoring wells calculated using 51 total observations is 6.85 SU.

The pH data from the SWFWMD ROMP Monitoring Wells indicates the following:

- pH values ranged between 5.59 and 7.42 SU between September 1985 and March 2003;
- Three of the four monitoring wells had an insufficient number of data points (< 8) to calculate a 95% UCL. Arithmetic mean values are reported for these wells instead. Arithmetic mean and 95% UCL values ranged between 5.77 and 7.25 SU within the individual ROMP wells; and
- The 95% UCL for pH within all four ROMP wells calculated using 34 total observations is 7.13 SU

A 95% UCL of 6.93 SU was also calculated using the combined TEC background and ROMP background well data (85 total observations) over an average range from 5.59 to 7.42 SU.

3.3 Findings from Evaluation of Groundwater Flow Direction

Seasonal variations (e.g., wet and dry seasons) in groundwater flow direction from June 2016 to October 2017 (wet to dry seasons) are presented in Figure 3 (June 2016), Figure 4 (August 2015), Figure 5 (November 2016), Figure 6 (April 2017), and Figure 7 (October 2017). Since the installation of the EAPPS monitoring well network in May 2016, little variability in groundwater flow direction was observed during the baseline monitoring events with a predominately north-northeast flow direction observed from background wells BBS-CCR-BW1 and BBS-CCR-BW2 towards the three upgradient monitoring wells located along the northern and eastern borders of the EAPPS. Figures 3-6 illustrate that surficial groundwater was flowing towards the EAPPS monitoring wells from RAP monitoring well B-35 consistently and that B-36 has been cross to upgradient of BBS-CCR-1 periodically. Similarly, the location of B-17R is typically upgradient of the EAPPS and BBS-CCR-3 based on the northward flow direction observed at BBS-CCR-BW-1 throughout baseline sampling events.

However, noticeable change in groundwater elevations was observed during the October 2017 detection monitoring event, resulting in a more pronounced east-west component across the EAPPS (Figure 7). Additionally, a south-southwesterly component appears to be present based on the reversal of gradients observed between monitoring wells BBS-CCR-3 and BBS-CCR-BW-1. These westerly flow components are more aligned with the regional flow across BBS which follows a general east to west flow pattern towards Tampa Bay (Figure 9).
4. CONCLUSIONS AND RECOMMENDATIONS

Based on the data review and analysis presented in this ASD, Geosyntec concludes the following regarding the pH SSIs observed in October 2017:

- The margin of error in the pH instrument of ± 0.2 SU means that the background pH level of 6.70 SU is also between 6.50 and 6.90 SU. As a result, the pH values at BBS-CCR-1 and BBS-CCR-2 of 6.83 and 6.87 SU, respectively, are within the margin of error of the instrument and should not be considered SSIs.

- The range of pHs in background adjacent to the EAPPs (6.78 SU to 6.89 SU with a total 95% UCL of 6.82 SU) and BBS to regional background (5.59 to 7.42 SU with a total 95% UCL of 6.93 SU) encompasses the range of pH values (6.30 and 6.70 SU) observed at the EAPPs.

- Subtle changes in groundwater flow direction at the EAPPs (observed in October 2017 during the detection monitoring event) indicates that groundwater originating from the southeast and northwest migrates towards the EAPPs, thus providing for mixing of background groundwater (both anthropogenic and natural) with local groundwater.

This ASD documents that the statistically significant increase in pH at two downgradient monitoring wells is from a source other than the EAPPs. Therefore, the EAPPs will remain in the detection monitoring program.
5. REFERENCES


Table 1: TECO Big Bend EAPPS Analytical Groundwater Results

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**Appendix III Parameters**

- **Boron**: mg/L, 1.4**, 54.6
- **Calcium**: mg/L, NA, 997.5
- **Chloride**: mg/L, 250, 1088
- **Fluoride**: mg/L, 4***, 0.664
- **Sulfate**: mg/L, 250, 1677

**Appendix IV Parameters**

- **Antimony**: ug/L, 6, 1.47
- **Arsenic**: ug/L, 10, 8.89
- **Barium**: mg/L, 2000, 106
- **Beryllium**: mg/L, 4, 0.215
- **Cadmium**: mg/L, 5, 0.235
- **Chromium**: mg/L, 100, 2.45
- **Cobalt**: ug/L, 140**, 1.61
- **Lead**: ug/L, 15, 0.265
- **Lithium**: ug/L, 140**, 19
- **Molybdenum**: ug/L, 35**, 12.8
- **Radium 226/228 pCi/L**: 1, 38.2
- **Selenium**: ug/L, 50, 2.08
- **Thallium**: ug/L, 2, 0.229

Notes and Abbreviations provided on Page 6.
### Geosyntec Consultants, Inc.

**FR2184/TECO Big Bend ASD Report**

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**Notes and Abbreviations provided on Page 6.**
### Table 1: TECO Big Bend EAPPS Analytical Groundwater Results

**TECO, Big Bend Facility**  
**Apollo Beach, Florida**

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<td>Specific Conductivity (field)</td>
<td>umhos/cm</td>
<td>NA</td>
<td>--</td>
</tr>
<tr>
<td>pH (field)</td>
<td>SU</td>
<td>6.5 - 8.5</td>
<td>--</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>mg/L</td>
<td>NA</td>
<td>--</td>
</tr>
<tr>
<td>Redox Potential</td>
<td>mV</td>
<td>NA</td>
<td>--</td>
</tr>
<tr>
<td>Turbidity (field)</td>
<td>NTU</td>
<td>NA</td>
<td>--</td>
</tr>
</tbody>
</table>

| Total Dissolved Solids           | mg/L  | 500 | 5418   |

#### Appendix III Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boron</td>
<td>mg/L</td>
<td>0.662</td>
</tr>
<tr>
<td>Calcium</td>
<td>mg/L</td>
<td>187</td>
</tr>
<tr>
<td>Fluoride</td>
<td>mg/L</td>
<td>0.313</td>
</tr>
<tr>
<td>Sulfate</td>
<td>mg/L</td>
<td>474</td>
</tr>
</tbody>
</table>

#### Appendix IV Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>ug/L</td>
<td>0.600</td>
</tr>
<tr>
<td>Arsenic</td>
<td>ug/L</td>
<td>1.23</td>
</tr>
<tr>
<td>Barium</td>
<td>mg/L</td>
<td>65.3</td>
</tr>
<tr>
<td>Beryllium</td>
<td>mg/L</td>
<td>0.200</td>
</tr>
<tr>
<td>Cadmium</td>
<td>mg/L</td>
<td>0.100</td>
</tr>
<tr>
<td>Chromium</td>
<td>mg/L</td>
<td>1.60</td>
</tr>
<tr>
<td>Cobalt</td>
<td>mg/L</td>
<td>0.0125</td>
</tr>
<tr>
<td>Lead</td>
<td>mg/L</td>
<td>0.125</td>
</tr>
<tr>
<td>Lithium</td>
<td>mg/L</td>
<td>3.7</td>
</tr>
<tr>
<td>Mercury</td>
<td>mg/L</td>
<td>0.0500</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>mg/L</td>
<td>4.09</td>
</tr>
<tr>
<td>Radium</td>
<td>pCi/L</td>
<td>10.3</td>
</tr>
<tr>
<td>Selenium</td>
<td>mg/L</td>
<td>0.262</td>
</tr>
<tr>
<td>Tellurium</td>
<td>mg/L</td>
<td>0.100</td>
</tr>
</tbody>
</table>

Notes and Abbreviations provided on Page 6.
Table 1: TECO Big Bend EAPPS Analytical Groundwater Results
TECO, Big Bend Facility
Apollo Beach, Florida

<table>
<thead>
<tr>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. U: Laboratory qualifier - Indicates that the compound was not detected above the reporting limit.</td>
</tr>
<tr>
<td>2. I: Laboratory qualifier - The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit; estimated value</td>
</tr>
<tr>
<td>3. J(:): Laboratory qualifier - The reported value is an estimated value.</td>
</tr>
<tr>
<td>4. J: Data validation qualifier - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.</td>
</tr>
<tr>
<td>5. UJ: Data validation qualifier - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.</td>
</tr>
<tr>
<td>6. J - : Data validation qualifier - The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.</td>
</tr>
<tr>
<td>7. V: Analyte detected in the method blank.</td>
</tr>
<tr>
<td>8. Q: Laboratory qualifier - Re-analysis of sample beyond the accepted holding time.</td>
</tr>
<tr>
<td>9. J3: Laboratory qualifier - Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria.</td>
</tr>
<tr>
<td>9. MCLs - EPA Maximum Contaminant Levels; primary enforceable standards shown unless otherwise noted. Secondary (non-enforceable) standards shown in italics.</td>
</tr>
<tr>
<td>10. Detections shown in bold text and highlighted yellow when above background levels or enforceable federal MCLs or Florida Groundwater Cleanup Target Levels (GCTL) if background is less.</td>
</tr>
<tr>
<td>11. * Background concentration determined as two times the mean from BBS-CCR-BW1 and BBS-CCR-BW2 in accordance with FDEP Guidance Document &quot;Guidance for Comparing Background and Site Chemical Concentrations in Groundwater&quot; (July 2013). Non-detects taken as 1/2 the reporting limit. Yellow shading indicates above background.</td>
</tr>
<tr>
<td>12. ** Florida GCTLs per FDEP Chapter 62-777 of the Florida Administrative Code.</td>
</tr>
<tr>
<td>13. *** Secondary MCL for fluoride is 2 mg/L but not enforceable.</td>
</tr>
<tr>
<td>15. Concentrations in red considered anomalous (July 2016).</td>
</tr>
</tbody>
</table>

Abbreviations:
- Q - Data qualifier
- C - Celsius
- ft BTOC - feet below top of well casing
- mg/L - milligrams per liter
- SU - Standard units
- ft NAVD 88 - feet elevation in North American Vertical Datum 1988
- ug/L - micrograms per liter
- umhos/cm - micromhos per centimeter
## Table 2: Statistical Comparison of Background Groundwater pH in the Surficial Aquifer

TECO Big Bend Station
13031 Wyandotte Road, Gibsonton, FL 33572

### Monitoring Well Units Adjacent to EAPPS

<table>
<thead>
<tr>
<th>TECO Big Bend Unit Name</th>
<th>Monitoring Wells</th>
<th>Period of Record</th>
<th>Number of Observations</th>
<th>pH(^1) Minimum</th>
<th>pH(^1) Maximum</th>
<th>95% UCL(^2)</th>
<th>Statistic(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 20 (Economizer and Long Term Fly Ash Pond)</td>
<td>B-17R</td>
<td>5/11 - 11/13</td>
<td>11</td>
<td>6.70</td>
<td>6.89</td>
<td>6.89</td>
<td>95% Student's-t UCL</td>
</tr>
<tr>
<td></td>
<td>B-35</td>
<td>5/11 - 5/17</td>
<td>12</td>
<td>6.60</td>
<td>6.92</td>
<td>6.78</td>
<td>95% Student's-t UCL</td>
</tr>
<tr>
<td></td>
<td>B-36</td>
<td>5/11 - 5/17</td>
<td>12</td>
<td>6.70</td>
<td>6.96</td>
<td>6.85</td>
<td>95% Student's-t UCL</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>5/11 - 5/17</td>
<td>35</td>
<td>6.60</td>
<td>6.96</td>
<td>6.82</td>
<td>95% Adjusted Gamma UCL</td>
</tr>
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</table>

### TECO Big Bend and Regional Surficial Aquifer Background Monitoring Wells

<table>
<thead>
<tr>
<th>Background Source</th>
<th>Monitoring Wells</th>
<th>Period of Record</th>
<th>Number of Observations</th>
<th>pH(^1) Minimum</th>
<th>pH(^1) Maximum</th>
<th>95% UCL(^2)</th>
<th>Statistic(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TECO Big Bend IWW/RAP(^4) Background Wells</td>
<td>B-4R</td>
<td>5/11 - 5/17</td>
<td>15</td>
<td>5.81</td>
<td>6.5</td>
<td>6.21</td>
<td>95% Student's-t UCL</td>
</tr>
<tr>
<td></td>
<td>B-39</td>
<td>5/11 - 5/17</td>
<td>12</td>
<td>6.87</td>
<td>7.31</td>
<td>7.21</td>
<td>95% Student's-t UCL</td>
</tr>
<tr>
<td></td>
<td>B-40</td>
<td>5/11 - 5/17</td>
<td>12</td>
<td>6.70</td>
<td>7.10</td>
<td>7.00</td>
<td>95% Student's-t UCL</td>
</tr>
<tr>
<td></td>
<td>B-41</td>
<td>5/11 - 5/17</td>
<td>12</td>
<td>6.60</td>
<td>7.10</td>
<td>6.97</td>
<td>95% Student's-t UCL</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>5/11 - 5/17</td>
<td>51</td>
<td>5.81</td>
<td>7.31</td>
<td>6.85</td>
<td>95% Student's-t UCL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWFWMD(^5) Regional Observation and Monitoring Program</th>
<th>Monitoring Wells</th>
<th>Period of Record</th>
<th>Number of Observations</th>
<th>pH(^1) Minimum</th>
<th>pH(^1) Maximum</th>
<th>95% UCL(^2)</th>
<th>Statistic(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR 9-2</td>
<td>9/93 - 3/03</td>
<td>4</td>
<td>5.59</td>
<td>5.96</td>
<td>5.77*</td>
<td>Arithmetic Mean</td>
<td></td>
</tr>
<tr>
<td>TR 9-3</td>
<td>9/85 - 3/03</td>
<td>19</td>
<td>6.75</td>
<td>7.42</td>
<td>7.25*</td>
<td>95% Student's-t UCL</td>
<td></td>
</tr>
<tr>
<td>TR 10-2</td>
<td>6/93 - 3/03</td>
<td>7</td>
<td>6.71</td>
<td>7.16</td>
<td>7.00*</td>
<td>Arithmetic Mean</td>
<td></td>
</tr>
<tr>
<td>TR12-1</td>
<td>9/93 - 3/03</td>
<td>4</td>
<td>7.15</td>
<td>7.33</td>
<td>7.24*</td>
<td>Arithmetic Mean</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>9/85 - 3/03</td>
<td>34</td>
<td>5.59</td>
<td>7.42</td>
<td>7.13</td>
<td>95% Student's-t UCL</td>
<td></td>
</tr>
</tbody>
</table>

| COMBINED\(^6\) | 9/85 - 5/17 | 85 | 5.59 | 7.42 | 6.93 | 95% Student's-t UCL |

### Notes:
1. All results are reported for pH in standard units (SU).
2. 95% UCL = 95% of the Upper Confidence Limit of the arithmetic mean of the data set.
3. Statistics reported are the most appropriate based on the underlying distribution of each data set.
4. IWW and RAP refer to TECO's Industrial Wastewater and Remedial Action Plan monitoring well networks respectively.
5. SWFWMD = Southwest Florida Water Management District
6. Combined statistic represents the combination of both SWFWMD Regional Observation and Monitoring (ROMP) monitoring wells and TECO Big Bend background monitoring wells.

* Insufficient number of observations to calculate a 95% UCL; arithmetic mean reported instead.
FIGURES
Figure 1

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

TEC Big Bend Station
Gibsonton, FL

Notes:
1. Site boundary as provided by Tampa Electric Company.
2. * indicates background monitoring well.
3. R indicates replacement monitoring well.
4. UF indicates monitoring well screen interval located in Upper Floridan Aquifer system.
5. Prior to abandonment, MWC-19 was converted to an intermediate well and the designation changed to MWI-19.

Legend:
- Industrial Wastewater Well Location
- Remedial Action Plan Well Location
- Upper Floridan Industrial Wastewater Well Location
- Upper Floridan Remedial Action Plan Well Location
- Well Location Abandoned in 2015

Approximate Site Boundary

1. Long Term Fly Ash Pond/Reclaimed Water Pond (lined) (#22)
2. South Economizer Ash Pond (lined) (#20)
3. North Economizer Ash Pond (lined) (#20)
4. Economizer Ash Suction Pond (lined) (#20)
5. South Bottom Ash Pond (lined) (#19)
6. North Bottom Ash Pond (lined) (#19)
7. Bottom Ash Suction Pond (lined) (#19)
8. Settlement Basins (concrete) (#17/18)
9. South Recycle Pond (lined) (#17/18)
10. North Recycle Pond (lined) (#17/18)
11. Sedimentation Pond (lined) (#17/18)
12. Storm Water Pond
13. Coal Field
14. BB Ares Unit CT4
15. Rail Car Unloading
16. Gypsum Storage Area (#21)
17. Slag Dewatering Bins
18. Long Term Bottom Ash Area (#23)
19. Dredge Disposal Area (Aa-2) (#11/2)
20. Former Spray Field (#16)
21. Limestone and FGD Area (#13/14)

Source of 2011 Aerials: Florida Department of Transportation, Surveying and Mapping Office.
North Economizer Ash Pond (Lined)

CCR-SG2

4.57

B-17R

CCR-PZ1

CCR-PZ2

CCR-PZ3

CCR-PZ4

CCR-PZ5

CCR-PZ6

MWB-35

3.5

2.5

CCR-PZ6

[4.57]

CCR-PZ1

[2.61]

CCR-SG1

[2.30]

CCR-PZ2

[2.73]

CCR-SG2

[3.28]

CCR-PZ3

[3.68]

MWB-35

[5.25]

Economizer Suction Pond (Lined)

South Economizer Ash Pond (Lined)

North Economizer Ash Pond (Lined)

Economizer Ash and Pyrite Pond System

Surficial Aquifer Potentiometric Surface - June 2016

Tampa, FL
March 2018

Figure 3

Notes:
2. NM indicates not measured.
3. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.
North Economizer Ash Pond (Lined)

BBS-CCR-1 [2.73]

BBS-CCR-2 [2.79]

BBS-CCR-3 [3.30]

BBS-CCR-BW1 [4.35]

BBS-CCR-BW2 [4.57]

BBS-CCR-BW3 [4.57]

MWB-36 [NM]

MWB-35 [NM]

B-17R [NM]

South Economizer Ash Pond (Lined)

Economizer Suction Pond (Lined)

Jackson Branch

Economizer Ash and Pyrite Pond System
Surficial Aquifer Potentiometric Surface - August 2016

TEC Big Bend Station
Gibsonton, FL

Geosyntec consultants

Tampa, FL
March 2018

Legend

- Existing Monitoring Well Locations
- Background Well Location
- CCR Monitoring Well Location

- Potentiometric Surface Elevation (ft NAVD88)
- Groundwater Flow Direction
- Groundwater Elevation (ft NAVD)

Notes:
2. NM indicates not measured.
3. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.
Economizer Ash and Pyrite Pond System
Surficial Aquifer Potentiometric Surface - November 2016

TEC Big Bend Station
Gibsonton, FL

Geosyntec consultants

Notes:
2. NM indicates not measured.
3. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.
Figure 6

Legend
- Existing Monitoring Well Locations
- Background Well Location
- CCR Monitoring Well Location

Potentiometric Surface Elevation (ft NAVD88)
Groundwater Flow Direction
Groundwater Elevation (ft NAVD)

Notes:
2. NM indicates not measured.
3. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.

Economizer Ash and Pyrite Pond System
Surficial Aquifer Potentiometric Surface - April 2017
TEC Big Bend Station
Gibsonton, FL

Geosyntec consultants
Tampa, FL
March 2018

180 90 0 180 Feet
North Economizer Ash Pond (Lined)

BBS-CCR-1 [2.59]

Economizer Suction Pond (Lined)

BBS-CCR-3 [3.11]

BBS-CCR-BW1 [2.99]

BBS-CCR-BW2 [5.16]

MWB-33 [NM]

Economizer Ash and Pyrite Pond System

South Economizer Ash Pond (Lined)

BBS-CCR-2 [2.46]

MWB-36 [NM]

Big Bend Road

Jackson Branch

North Economizer Ash Pond (Lined)

BBS-CCR-BW1 [2.99]

BBS-CCR-3 [3.11]

Potentiometric Surface Elevation (ft NAVD88)

Groundwater Flow Direction

Groundwater Elevation (ft NAVD)

Legend

Existing Monitoring Well Locations

Background Well Location

CCR Monitoring Well Location

Notes:
2. NM indicates not measured.
3. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.
Regional Surficial Aquifer Monitoring Well Locations

TEC Big Bend Station
Gibsonton, FL

Notes:
1. ROMP locations were obtained from the Southwest Florida Water Management District (SWFWMD) Regional Observation and Monitoring Program (ROMP): https://www.swfwmd.state.fl.us/data/hydrologic/.
Notes:
1. ft NGVD29 indicates feet National Geodetic Vertical Datum of 1929.
2. Site boundary as provided by Tampa Electric Company.
3. * indicates background monitoring well.
4. R indicates replacement monitoring well.
5. UF indicates monitoring well screen interval located in Upper Floridan Aquifer system.
6. The following monitoring wells were abandoned in 2015: B-5, B-10, B-11, B-13R, B-14R, B-17R, B-51, and B-60.
7. Prior to abandonment, MWC-19 was converted to an intermediate well and the designation changed to MWI-19.

Figure 9
Surficial Aquifer Groundwater Potentiometric Surface Map
August 2014
TEC Big Bend Station
Apollo Beach, FL
APPENDIX A
SUMMARY OF STATISTICAL ANALYSES OF BASELINE GROUNDWATER SAMPLES
On April 17, 2015, the United States Environmental Protection Agency (USEPA) published 40 Code of Federal Regulations (CFR) Parts 257 and 261: Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residues from Electric Utilities; Final Rule (USEPA, 2015). This regulation addresses the safe disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) and is referred to herein as the CCR Rule. The CCR Rule became effective on October 14, 2015. The rule provides national minimum criteria for “the safe disposal of CCR in new and existing CCR landfills, surface impoundments, and lateral expansions, design and operating criteria, groundwater monitoring and corrective action, closure requirements and post closure care, and recordkeeping, notification, and internet posting requirements.”

The groundwater monitoring requirements of the CCR Rule apply to the economizer ash and pyrite pond system (EAPPS) at Tampa Electric Company’s (TEC) Big Bend Power Station (BBS) in southeast Hillsborough County in Gibsonton, Florida.

Geosyntec Consultants (Geosyntec) has prepared this technical memorandum to summarize the statistical analyses performed on the baseline groundwater samples collected from the groundwater monitoring system (GMS) established at the EAPPS. These activities have been undertaken by TEC to comply with the requirements set forth in 40 CFR 257.50 “Standards for the Disposal of Coal Combustion Residues in Landfills and Surface Impoundments” pertaining to the EAPPS. TEC installed
a groundwater monitoring system at the EAPPs that complies with 40 CFR 257.91 and performed baseline groundwater sampling events in accordance with 40 CFR 257.93. Geosyntec’s statistical analyses were performed in accordance with the Statistical Analysis Plan dated 15 October 2017.

BACKGROUND

The groundwater monitoring system (GMS) was installed at the EAPPs in May 2016 and consists of two background monitoring wells, BBS-CCR-BW1 and BBS-CCR-BW2, and three downgradient monitoring wells, BBS-CCR-1, BBS-CCR-2, and BBS-CCR-3. TEC conducted eleven baseline groundwater sampling events from the GMS between June 2016 and October 2017 and analyzed the samples for Appendix III and Appendix IV constituents as required in 40 CFR 257.93. The inorganic data were reviewed based on the following: CCR Groundwater Monitoring Program Plan, Big Bend Power Station, Apollo Beach, Florida, September 2016, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, August 2014 (OSWER 9355.0-131, EPA 540-R-013-001), as well as by the pertinent methods referenced by the data package and professional and technical judgment.

Geosyntec prepared a Statistical Analysis Plan to provide details on the selection of statistical methods in accordance with the provisions set forth in 40 CFR 257.93 “Groundwater sampling and analysis requirements.” These statistical methods were used to establish background conditions and to evaluate groundwater monitoring data collected during detection monitoring (40 CFR 257.94) to evaluate if the CCR units at the BBS are adversely impacting groundwater quality.

METHODOLOGY AND APPROACH

The statistical approach used to evaluate groundwater monitoring data was selected from a suite of methods provided in 40 CFR 257.93(f) (1 through 5) and performed in accordance with a set of performance standards provided in 40 CFR 257.93(g), when applicable.

The approach included the following steps for each Appendix III constituent:

1. Graphical display of data and assessment of equal variance;
2. Evaluate trends and seasonality in the background dataset for each constituent.
3. Identify potential outliers;
4. Evaluate the population distribution of the background dataset for each constituent;
5. Calculate the frequency of non-detects (NDs), and summary statistics (e.g., minimum, maximum, and mean) of the background dataset for each constituent;
6. Calculate appropriate upper limits (95%-95% upper tolerance limit [UTL] and a 95% upper prediction limit [UPL]); and

7. Compare upper limits to the most recent concentrations in the compliance (or downgradient) wells to determine if a statistically significant increase (SSI) above background has occurred.

Assumptions:

• The laboratory reporting limit was substituted for non-detects in all datasets.
• The laboratory reported value for estimated (J-flagged) concentrations were retained in all datasets.
• When a duplicate sample was collected at a background monitoring well, only the higher of the primary and duplicate sample concentrations were included in the aggregated dataset.

BACKGROUND GROUNDWATER QUALITY STATISTICS

The results of the Appendix III constituents (e.g., boron, calcium, chloride, fluoride, pH, sulfate, and total dissolved solids) detected in groundwater samples from the two background monitoring wells were used to establish background concentrations for these constituents (Table 1). Based on professional judgment, the sulfate concentration of 41.7 milligrams per liter (mg/L) detected in BBS-CCR-BW2 on 7/20/17 was deemed an analytical error and was removed from the dataset.

Potential outliers:

• A sulfate concentration of 217 mg/L at BBS-CCR-BW1 was identified as a potential low concentration outlier but was retained in the dataset.

• The TDS concentration of 5,050 mg/L at BBS-CCR-BW1 was identified as a potential high concentration outlier but was retained in the dataset.

Increasing trends:

• An increasing pH trend is statistically present at BBS-CCR-BW2 based on the non-parametric Mann Kendall analysis.

Each of the Appendix III constituents exhibited a non-parametric distribution among the two background wells. The two background wells did show spatial variability for all the Appendix III constituents. An intra-well comparison is often used in these circumstances; however, this approach is not appropriate for the EAPPS since there is no groundwater data representative of pre-operational conditions (e.g., prior to
EAPPS) and therefore no information if the background wells may have already been impacted prior to their construction. Consequently, the data from the two background monitoring wells were aggregated for each constituent to create a single pooled background dataset, consisting of 22 observations (11 events x 2 monitoring wells). Two non-parametric upper limits were calculated for each constituent: a 95%-95% upper tolerance limit (UTL) and a 95% upper prediction limit (UPL), both of which result in the maximum detected concentration among both background wells. However, the 95%-95% UTL could not achieve a confidence level above 67%, but the UPL did achieve 95% confidence. As such, the 95% UPL was used to evaluate SSI for each constituent.

**DETECTION MONITORING**

Groundwater samples were collected from the GMS in October 2017 to serve as the first detection monitoring event. The comparison of the detection monitoring results to the background values for the Appendix III constituents is shown in Table 2. A statistically significant increase (SSI) over background was observed for pH in two compliance monitoring wells (BBS-CCR-1 and BBS-CCR-2).

**CONCLUSIONS**

As specified in 40 CFR 257.94(3) (e), TEC will either provide (i) a demonstration that the SSI is due to sampling or analysis error, another source, or natural variability or (ii) commence with assessment monitoring within 90 days of this SSI (e.g., by 15 April 2018). The pH values of 6.83 and 6.87 identified as SSIs are within the natural range of groundwater at BBS based on historical values which have been measured across BBS. In the absence of SSIs for other Appendix III constituents, the SSIs for pH do not appear to be attributable to a release from the EAPPS, but are instead attributable to natural variability. Therefore, TEC will continue with detection monitoring as applicable for the EAPPS.

* * * * *
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Number of Samples</th>
<th>Number of NDs</th>
<th>Percent NDs</th>
<th>Minimum Result</th>
<th>Average Result</th>
<th>Maximum Result</th>
<th>Potential Outlier?</th>
<th>Trend?</th>
<th>Background Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boron</td>
<td>mg/L</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>3.27</td>
<td>27.32</td>
<td>59.1</td>
<td>None</td>
<td>No</td>
<td>NP 59.1</td>
</tr>
<tr>
<td>Calcium</td>
<td>mg/L</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>237</td>
<td>499</td>
<td>781</td>
<td>None</td>
<td>No</td>
<td>NP 781</td>
</tr>
<tr>
<td>Chloride</td>
<td>mg/L</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>84.9</td>
<td>543.8</td>
<td>1140</td>
<td>None</td>
<td>No</td>
<td>NP 1140</td>
</tr>
<tr>
<td>Fluoride</td>
<td>mg/L</td>
<td>22</td>
<td>1</td>
<td>5</td>
<td>&lt;0.01</td>
<td>0.332</td>
<td>0.559</td>
<td>None</td>
<td>No</td>
<td>NP 0.559</td>
</tr>
<tr>
<td>pH (field)</td>
<td>STD</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>6.38</td>
<td>6.55</td>
<td>6.70</td>
<td>None</td>
<td>Yes (BBS-CCR-BW2)</td>
<td>NP (6.38, 6.70)</td>
</tr>
<tr>
<td>Sulfate</td>
<td>mg/L</td>
<td>21 1</td>
<td>0</td>
<td>0</td>
<td>217</td>
<td>876</td>
<td>1550</td>
<td>None</td>
<td>No</td>
<td>NP 1547</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>mg/L</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>966</td>
<td>2709</td>
<td>5050</td>
<td>5050 (BBS-CCR-BW1)</td>
<td>No</td>
<td>NP 5050</td>
</tr>
</tbody>
</table>

Notes:
- < - concentration not detected at or above the adjusted reporting limit
- mg/L - milligrams per litre
- ND - non-detect
- NP - non-parametric
- STD - standard units
- UTL - upper tolerance limit
- UPL - upper prediction limit

1 - A concentration of 41.7 mg/L detected at BBS-CCR-BW1 on 7/20/17 was removed from the data set as a laboratory error based on professional judgment.
2 - The 95% UPL was calculated based on either a normal, lognormal, or Gamma distribution. If data did not follow a discernible distribution, then a non-parametric 95% UPL was calculated. A two-sided prediction interval was calculated for pH.
### TABLE 2 - DETECTION MONITORING RESULTS, TEC BIG BEND STATION ECONOMIZER ASH AND PYRITE POND SYSTEM, APOLLO BEACH, FL

<table>
<thead>
<tr>
<th>Analytical Parameter</th>
<th>Boron, total</th>
<th>Calcium, total</th>
<th>Chloride, total</th>
<th>Fluoride, total</th>
<th>pH (field)</th>
<th>Sulfate, total</th>
<th>Total Dissolved Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>mg/L</td>
<td>mg/L</td>
<td>mg/L</td>
<td>mg/L</td>
<td>STD</td>
<td>mg/L</td>
<td>mg/L</td>
</tr>
<tr>
<td>Background Concentration Value</td>
<td>59.1</td>
<td>781</td>
<td>1140</td>
<td>0.559 (6.38, 6.70)</td>
<td>1550</td>
<td>5050</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well ID</th>
<th>Sample Collection Date</th>
<th>October 2017 Detection Monitoring Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBS-CCR-1</td>
<td>10/13/2017</td>
<td>19.9</td>
</tr>
<tr>
<td>BBS-CCR-2</td>
<td>10/13/2017</td>
<td>0.888</td>
</tr>
<tr>
<td>BBS-CCR-3</td>
<td>10/13/2017</td>
<td>0.373</td>
</tr>
</tbody>
</table>

**Notes:**
- Bold, highlighted text indicates statistically significant increase above background concentration values.
- < - concentration not detected at or above the adjusted reporting limit.
- mg/L - milligrams per liter
- STD - standard units
Individual Well Comparisons

When only two wells (e.g., a single background and a single compliance point well) are being compared, owners or operators should not perform the parametric or nonparametric ANOVA. Instead, a parametric t-test, such as Cochran's Approximation to the Behrens-Fisher Students' t-test, or a nonparametric test should be performed. When a single compliance well group is being compared to background data and a nonparametric test is needed, the Wilcoxin Rank-Sum test should be performed. These tests are discussed in more detail in standard statistical references and in USEPA (1992b).

Intra-Well Comparisons

Intra-well comparisons, where data of one well are evaluated over time, are useful in evaluating trends in individual wells and for identifying seasonal effects in the data. The intra-well comparison methods do not compare background data to compliance data. Where some existing facilities may not have valid background data, however, intra-well comparisons may represent the only valid comparison available. In the absence of a true background well, several monitoring events may be required to determine trends and seasonal fluctuations in ground-water quality.

Control charts may be used for intra-well comparisons but are only appropriate for uncontaminated wells. If a well is intercepting a release, then it is already in an "out-of-control" state, which violates the principal assumption underlying control chart procedures. Time series analysis (i.e., plotting concentrations over time) is extremely useful for identifying trends in monitoring data. Such data may be adjusted for seasonal effects to aid in assessing the degree of change over time. Guidance for and limitations of intra-well comparison techniques are provided in USEPA (1989) and USEPA (1992b).

Treatment of Non-Detects

The treatment of data below the detection limit of the analytical method (non-detects) used depends on the number or percentage of non-detects and the statistical method employed. Guidance on how to treat non-detects is provided in USEPA (1992b).

5.10 DETECTION MONITORING PROGRAM
40 CFR §258.54

5.10.1 Statement of Regulation

(a) Detection monitoring is required at MSWLF units at all ground-water monitoring wells defined under §§258.51(a)(1) and (a)(2) of this part. At a minimum, a detection monitoring program must include the monitoring for the constituents listed in Appendix I of this part.

1) The Director of an approved State may delete any of the Appendix I monitoring parameters for a MSWLF unit if it can be shown that the removed constituents are not reasonably expected to be in or derived from the waste contained in the unit.

2) The Director of an approved State may establish an alternative list of inorganic indicator parameters for a MSWLF unit, in lieu of some or all of
the heavy metals (constituents 1-15 in Appendix I), if the alternative parameters provide a reliable indication of inorganic releases from the MSWLF unit to the ground water. In determining alternative parameters, the Director shall consider the following factors:

(i) The types, quantities, and concentrations of constituents in wastes managed at the MSWLF unit;

(ii) The mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the MSWLF unit;

(iii) The detectability of indicator parameters, waste constituents, and reaction products in the ground water; and

(iv) The concentration or values and coefficients of variation of monitoring parameters or constituents in the background ground-water.

(b) The monitoring frequency for all constituents listed in Appendix I, or the alternative list approved in accordance with paragraph (a)(2), shall be at least semiannual during the active life of the facility (including closure) and the post-closure period. A minimum of four independent samples from each well (background and downgradient) must be collected and analyzed for the Appendix I constituents, or the alternative list approved in accordance with paragraph (a)(2), during the first semiannual sampling event. At least one sample from each well (background and downgradient) must be collected and analyzed during subsequent semiannual sampling events. The Director of an approved State may specify an appropriate alternative frequency for repeated sampling and analysis for Appendix I constituents, or the alternative list approved in accordance with paragraph (a)(2), during the active life (including closure) and the post-closure care period. The alternative frequency during the active life (including closure) shall be no less than annual. The alternative frequency shall be based on consideration of the following factors:

1) Lithology of the aquifer and unsaturated zone;

2) Hydraulic conductivity of the aquifer and unsaturated zone;

3) Ground-water flow rates;

4) Minimum distance between upgradient edge of the MSWLF unit and downgradient monitoring well screen (minimum distance of travel); and

5) Resource value of the aquifer.

(c) If the owner or operator determines, pursuant to §258.53(g) of this part, that there is a statistically significant increase over background for one or more of the constituents listed in Appendix I or the alternative list approved in accordance with paragraph (a)(2), at any monitoring well at the boundary specified under §258.51(a)(2), the owner or operator:

1) Must, within 14 days of this finding, place a notice in the operating record indicating which constituents have shown statistically significant changes from
Subpart E

background levels, and notify the State Director that this notice was placed in the operating record; and

(2) Must establish an assessment monitoring program meeting the requirements of §258.55 of this part within 90 days, except as provided for in paragraph (3) below.

(3) The owner/operator may demonstrate that a source other than a MSWLF unit caused the contamination or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in ground-water quality. A report documenting this demonstration must be certified by a qualified ground-water scientist or approved by the Director of an approved State and be placed in the operating record. If a successful demonstration is made and documented, the owner or operator may continue detection monitoring as specified in this section. If after 90 days, a successful demonstration is not made, the owner or operator must initiate an assessment monitoring program as required in §258.55.

5.10.2 Applicability

Except for the small landfill exemption and the no migration demonstration, detection monitoring is required at existing MSWLF units, lateral expansions of units, and new MSWLF units. Monitoring must occur at least semiannually at both background wells and downgradient well locations. The Director of an approved State may specify an alternative sampling frequency. Monitoring parameters must include all Appendix I constituents unless an alternative list has been established by the Director of an approved State.

During the first semiannual monitoring event, the owner or operator must collect at least four independent ground-water samples from each well and analyze the samples for all constituents in the Appendix I or alternative list. Each subsequent semiannual event must include, at a minimum, the collection and analysis of one sample from all wells. The monitoring requirement continues throughout the active life of the landfill and the post-closure care period.

If an owner or operator determines that a statistically significant increase over background has occurred for one or more Appendix I constituents (or constituents on an alternative list), a notice must be placed in the facility operating record (see Table 5-2). The owner or operator must notify the State Director within 14 days of the finding. Within 90 days, the owner or operator must establish an assessment monitoring program conforming to the requirements of §258.55.

If evidence exists that a statistically significant increase is due to factors unrelated to the unit, the owner or operator may make a demonstration to this effect to the Director of an approved State or place a certified demonstration in the operating record. The potential reasons for an apparent statistical increase may include:

- A contaminant source other than the landfill unit
- A natural variation in ground-water quality
- An analytical error
• A statistical error

• A sampling error.

The demonstration that one of these reasons is responsible for the statistically significant increase over background must be certified by a qualified ground-water scientist or approved by the Director of an approved State. If a successful demonstration is made and documented, the owner or operator may continue detection monitoring.

If a successful demonstration is not made within 90 days, the owner or operator must initiate an assessment monitoring program. A flow chart for a detection monitoring program in a State whose program has not been approved by EPA is provided in Figure 5-5.

5.10.3 Technical Considerations

If there is a statistically significant increase over background during detection monitoring for one or more constituents listed in Appendix I of Part 258 (or an alternative list of parameters in an approved State), the owner or operator is required to begin assessment monitoring. The requirement to conduct assessment monitoring will not change, even if the Director of an approved State allows the monitoring of geochemical parameters in lieu of some or all of the metals listed in Appendix I. If an owner or operator suspects that a statistically significant increase in a geochemical parameter is caused by natural variation in ground-water quality or a source other than a MSWLF unit, a demonstration to this effect must be documented in a report to avoid proceeding to assessment monitoring.

Independent Sampling for Background

The ground-water monitoring requirements specify that four independent samples be collected from each well to establish background during the first semiannual monitoring event. This is because almost all statistical procedures are based on the assumption that samples are independent of each other. In other words, independent samples more accurately reflect the true range of natural variability in the ground water, and statistical analyses based on independent samples are more accurate. Replicate samples, whether field replicates or lab splits, are not statistically independent measurements.

It may be necessary to gather the independent samples over a range of time sufficient to account for seasonal differences. If seasonal differences are not taken into account, the chance for false positives increases (monitoring results indicate a release, when a release has not occurred). The sampling interval chosen must ensure that sampling is being done on different volumes of ground water. To determine the appropriate interval between sample collection events that will ensure independence, the owner or operator can determine the site’s effective porosity, hydraulic conductivity, and hydraulic gradient and use this information to calculate ground-water velocity (USEPA, 1989). Knowing the velocity of the ground water should enable an owner/operator to establish an interval that ensures the four samples are being collected from four different volumes of water. For additional information on establishing sampling interval, see Statistical Analysis of Groundwater Monitoring Data at RCRA.
Semiannual Monitoring for all Appendix I

- First semiannual monitoring—Four independent samples from each well (background and downgradient)
- Subsequent semiannual monitoring—One sample from each well (background and downgradient)

Subsequent significant increase over background for one or more Appendix 1 constituents?

YES

- Within 14 days notify State director that notice placed in record
- Within 90 days establish assessment monitoring program
- May demonstrate other source responsible or an error in sampling/analysis/statistics

NO

Continue semiannual monitoring

Figure 5-5. Detection Monitoring Program
Alternative List/Removal of Parameters

An alternative list of Appendix I constituents may be allowed by the Director of an approved State. The alternative list may use geochemical parameters, such as pH and specific conductance, in place of some or all of the metals (Parameters 1 through 15) in Appendix I. These alternative parameters must provide a reliable indication of inorganic releases from the MSWLF unit to ground water. The option of establishing an alternative list applies only to Parameters 1 through 15 of Appendix I. The list of ground-water monitoring parameters must include all of the volatile organic compounds (Appendix I, Parameters 16 through 62).

A potential problem in substituting geochemical parameters for metals on the alternative list is that many of the geochemical parameters are naturally occurring. However, these parameters have been used to indicate releases from MSWLF units. Using alternative geochemical parameters is reasonable in cases where natural background levels are not high enough to mask the detection of a release from a MSWLF unit. The decision to use alternative parameters also should consider natural spatial and temporal variability in the geochemical parameters.

The types, quantities, and concentrations of wastes managed at the MSWLF unit play an important role in determining whether removal of parameters from Appendix I is appropriate. If an owner or operator has definite knowledge of the nature of wastes accepted at the facility, then removal of constituents from Appendix I may be acceptable. Usually, a waste would have to be homogeneous to allow for this kind of determination. The owner or operator may submit a demonstration that documents the presence or absence of certain constituents in the waste. The owner or operator also would have to demonstrate that constituents proposed for deletion from Appendix I are not degradation or reaction products of constituents potentially present in the waste.

Alternative Frequency

In approved States, 40 CFR §258.54(b) allows the Director to specify an alternative frequency for ground-water monitoring. The alternative frequency is applicable during the active life, including the closure and the post-closure periods. The alternative frequency can be no less than annual.

The need to vary monitoring frequency must be evaluated on a site-specific basis. For example, for MSWLF units located in areas with low ground-water flow rates, it may be acceptable to monitor ground water less frequently. The sampling frequency chosen must be sufficient to protect human health and the environment. Depending on the ground-water flow rate and the resource value of the aquifer, less frequent monitoring may be allowable or more frequent monitoring may be necessary. An approved State may specify an alternative frequency for repeated sampling and analysis of Appendix I constituents based on the following factors:

1) Lithology of the aquifer and the unsaturated zone
Subpart E

2) Hydraulic conductivity of the aquifer and the unsaturated zone

3) Ground-water flow rates

4) Minimum distance between the upgradient edge of the MSWLF unit and the downgradient well screen

5) The resource value of the aquifer.

Approved States also can set alternative frequencies for monitoring during the post-closure care period based on the same factors.

Notification

The notification requirement under 40 CFR §258.54(c) requires an owner or operator to 1) place a notice in the operating record that indicates which constituents have shown statistically significant increases and 2) notify the State Director that the notice was placed in the operating record. The constituents can be from either Appendix I or from an alternative list.

Demonstrations of Other Reasons For Statistical Increase

An owner or operator is allowed 90 days to demonstrate that the statistically significant increase of a contaminant/constituent was caused by statistical, sampling, or analytical errors or by a source other than the landfill unit. The demonstration allowed in §258.54(c)(3) may include:

1) A demonstration that the increase resulted from another contaminant source

2) A comprehensive audit of sampling, laboratory, and data evaluation procedures

3) Resampling and analysis to verify the presence and concentration of the constituents for which the increase was reported.

A demonstration that the increase in constituent concentration is the result of a source other than the MSWLF unit should document that:

- An alternative source exists.
- Hydraulic connection exists between the alternative source and the well with the significant increase.
- Constituent(s) (or precursor constituents) are present at the alternative source or along the flow path from the alternative source prior to possible release from the MSWLF unit.
- The relative concentration and distribution of constituents in the zone of contamination are more strongly linked to the alternative source than to the MSWLF unit when the fate and transport characteristics of the constituents are considered.
- The concentration observed in ground water could not have resulted from the MSWLF unit given the waste constituents and concentrations in the MSWLF unit leachate and wastes, and site hydrogeologic conditions.
- The data supporting conclusions regarding the alternative source are historically consistent with hydrogeologic
The demonstration must be documented, certified by a qualified ground-water scientist, and placed in the operating record of the facility.

**Demonstrations of Other Sources of Error**

A successful demonstration that the statistically significant change is the result of an error in sampling, analysis, or data evaluation may include the following:

- Clear indication of a transcription or calculation error
- Clear indication of a systematic error in analysis or data reduction
- Resampling, analysis, and evaluation of results
- Corrective measures to prevent the recurrence of the error and incorporation of these measures into the ground-water monitoring program.

If resampling is necessary, the sample(s) taken must be independent of the previous sample. More than one sample may be required to substantiate the contention that the original sample was not representative of the ground-water quality in the affected well(s).

**5.11 ASSESSMENT MONITORING PROGRAM**

40 CFR §258.55(a)-(f)

**5.11.1 Statement of Regulation**

(a) Assessment monitoring is required whenever a statistically significant increase over background has been detected for one or more of the constituents listed in Appendix I or in the alternate list approved in accordance with § 258.54(a)(2).

(b) Within 90 days of triggering an assessment monitoring program, and annually thereafter, the owner or operator must sample and analyze the ground water for all constituents identified in Appendix II of this part. A minimum of one sample from each downgradient well must be collected and analyzed during each sampling event. For any new constituent detected in the downgradient wells as a result of the complete Appendix II analysis, a minimum of four independent samples from each well (background and downgradient) must be collected and analyzed to establish background for the new constituents. The Director of an approved State may specify an appropriate subset of wells to be sampled and analyzed for Appendix II constituents during assessment monitoring. The Director of an approved State may delete any of the Appendix II monitoring parameters for a MSWLF unit if it can be shown that the removed constituents are not reasonably expected to be contained in or derived from the waste contained in the unit.
APPENDIX C

GROUNDWATER SAMPLING AND CALIBRATION FORMS - OCTOBER 13, 2017
### PURGING DATA

<table>
<thead>
<tr>
<th>TIME</th>
<th>VOLUME PURGED (GALLONS)</th>
<th>CUMUL. VOLUME PURGED (GALLONS)</th>
<th>PURGE RATE (GPM)</th>
<th>DEPTH TO WATER (FEET)</th>
<th>TEMPERATURE (ºC)</th>
<th>CONDUCTIVITY (µmhos/cm OR µS/cm)</th>
<th>DISSOLVED OXYGEN (circle mg/l or %saturation)</th>
<th>TURBIDITY (NTUs)</th>
<th>COLOR (describe)</th>
<th>ODOR (describe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:28</td>
<td>1.10</td>
<td>1.10</td>
<td>1.10</td>
<td>0.10</td>
<td>7.41</td>
<td>6.83</td>
<td>26.47</td>
<td>4268</td>
<td>0.20</td>
<td>1.86</td>
</tr>
<tr>
<td>11:30</td>
<td>0.21</td>
<td>1.31</td>
<td>1.31</td>
<td>0.11</td>
<td>7.40</td>
<td>6.83</td>
<td>26.53</td>
<td>4261</td>
<td>0.24</td>
<td>0.97</td>
</tr>
<tr>
<td>11:32</td>
<td>0.20</td>
<td>1.51</td>
<td>1.51</td>
<td>0.10</td>
<td>7.41</td>
<td>6.83</td>
<td>26.57</td>
<td>4258</td>
<td>0.24</td>
<td>0.89</td>
</tr>
</tbody>
</table>

### SAMPLING DATA

- **SAMPLED BY**: RAB
- **SAMPLED BY (PRINT) / AFFILIATION**: TECO
- **SAMPLER (S) SIGNATURES**:  
- **SAMPLING INITIATED AT**: 11:32
- **SAMPLING ENDED AT**: 11:50
- **PUMP OR TUBING DEPTH IN WELL (feet)**: 17.3
- **SAMPLE PUMP FLOW RATE (mL per minute)**: 383
- **TUBING MATERIAL CODE**: PE/S
- **FIELD DECONTAMINATION**: Y N ☑
- **FILTER SIZE**: μm
- **DUPLICATE**: Y N ☑

<table>
<thead>
<tr>
<th>SAMPLE CONTAINER SPECIFICATION</th>
<th>TOTAL VOL. ADDED IN FIELD (ml)</th>
<th>FINAL pH</th>
<th>INTENDED ANALYSIS AND/OR METHOD</th>
<th>SAMPLING EQUIPMENT CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>@Ino-500</td>
<td>500ml</td>
<td>N/A</td>
<td>inorganics</td>
<td>PP</td>
</tr>
<tr>
<td>@Meta-250</td>
<td>250ml</td>
<td>&lt;2</td>
<td>Metals</td>
<td>PP</td>
</tr>
<tr>
<td>@Rad-1L</td>
<td>1L</td>
<td>&lt;2</td>
<td>Radiologicals</td>
<td>PP</td>
</tr>
</tbody>
</table>

**NOTES:**
1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
   - pH: ± 0.2 units
   - Temperature: ± 0.2 ºC
   - Specific Conductance: ± 5%
   - Dissolved Oxygen: all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
   - Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or 10% (whichever is greater)

**REMARKS:**
(1) Sample bottles pre-preserved at laboratory prior to sample collection.
## GROUNDWATER SAMPLING LOG

### Site Information
- **Name:** Big Bend
- **Location:** Apollo Beach, FL.
- **Well No:** BBS-CCR-2
- **Sample ID:** L17J115-02 A
- **Date:** 10/13/17

### Purging Data

<table>
<thead>
<tr>
<th>Time</th>
<th>Volume Purged (Gallons)</th>
<th>Cumul. Volume Purged (Gallons)</th>
<th>Purge Rate (GPM)</th>
<th>Depth to Water (Feet)</th>
<th>Temp. (°C)</th>
<th>Cond. (µmhos/cm or µS/cm)</th>
<th>Dissolved Oxygen % Saturation</th>
<th>Turbidity (NTUs)</th>
<th>Color</th>
<th>Odor</th>
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</thead>
<tbody>
<tr>
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<td>0.80</td>
<td>0.10</td>
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<td>6.87</td>
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<tr>
<td>10:58</td>
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<td>1.00</td>
<td>0.10</td>
<td>6.94</td>
<td>6.86</td>
<td>26.45</td>
<td>1350</td>
<td>0.16</td>
<td>Lt. Yellow</td>
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<tr>
<td>11:00</td>
<td>0.20</td>
<td>1.20</td>
<td>0.10</td>
<td>6.95</td>
<td>6.87</td>
<td>26.46</td>
<td>1350</td>
<td>0.20</td>
<td>Lt. Yellow</td>
<td>None</td>
</tr>
</tbody>
</table>

### Sampling Data

<table>
<thead>
<tr>
<th>Sampled By (Print)/Affiliation</th>
<th>RAB</th>
<th>TECO</th>
<th>Sampler (s) Signatures</th>
<th>Sampling Initiated At:</th>
<th>Sampling Ended At:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11:00</td>
<td>11:10</td>
</tr>
</tbody>
</table>

### Purge Pump or Tubing Depth in Well (Feet): 16.8

### Field Decontamination:
- Y N YES
- Filter Size: µm
- Duplicate: Y N YES

### Sample Container Specification

<table>
<thead>
<tr>
<th>Sample ID Code</th>
<th>Containers</th>
<th>Material Code</th>
<th>Volume</th>
<th>Preservative</th>
<th>Preserved</th>
<th>Total Vol. Added in Field (ml)</th>
<th>Final pH</th>
<th>Intended Analysis and/or Method</th>
<th>Sampling Equipment Code</th>
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</thead>
<tbody>
<tr>
<td>@Ino-500</td>
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<td>PE</td>
<td>500ml</td>
<td>NONE</td>
<td>NONE</td>
<td>N/A</td>
<td></td>
<td>Inorganics</td>
<td>PP</td>
</tr>
<tr>
<td>@Met-250</td>
<td>2</td>
<td>PE</td>
<td>250ml</td>
<td>HNO3</td>
<td>1ml</td>
<td>&lt;2</td>
<td></td>
<td>Metals</td>
<td>PP</td>
</tr>
<tr>
<td>@Rad-1L</td>
<td>2</td>
<td>PE</td>
<td>1L</td>
<td>HNO3</td>
<td>5ml</td>
<td>&lt;2</td>
<td></td>
<td>Radiologics</td>
<td>PP</td>
</tr>
</tbody>
</table>

### Remarks:
1. Sample bottles pre-preserved at laboratory prior to sample collection.

### Notes:
1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.
2. Stabilization criteria for range of variation of last three consecutive readings (see FS 2212. Section 3):
   - pH: ± 0.2 units
   - Temperature: ± 0.2 °C
   - Specific Conductance: ± 5%
   - Dissolved Oxygen: all readings ≤ 20% saturation
   - Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or 10% (whichever is greater)
### GROUNDWATER SAMPLING LOG

**SITE NAME:** Big Bend  
**SITE LOCATION:** Apollo Beach, FL.

**WELL NO:** BBS-CCR-3  
**SAMPLE ID:** L17J115-03 A  
**DATE:** 10/13/17

#### PURGING DATA

<table>
<thead>
<tr>
<th>TIME</th>
<th>VOLUME PURGED (GALLONS)</th>
<th>CUMUL. VOLUME PURGED (GALLONS)</th>
<th>PURGE RATE (GPM)</th>
<th>DEPTH TO WATER (FEET)</th>
<th>TEMP. (ºC)</th>
<th>pH (standard units)</th>
<th>COND. (µmhos/cm OR µS/cm)</th>
<th>DISSOLVED OXYGEN (circle mg/l or % saturation)</th>
<th>TURBIDITY (NTUs)</th>
<th>COLOR (describe)</th>
<th>ODOR (describe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:22</td>
<td>0.43</td>
<td>0.43</td>
<td>0.05</td>
<td>6.72</td>
<td>6.47</td>
<td>27.31</td>
<td>1785</td>
<td>0.36</td>
<td>1.59</td>
<td>Yellow</td>
<td>Mild</td>
</tr>
<tr>
<td>10:24</td>
<td>0.10</td>
<td>0.53</td>
<td>0.05</td>
<td>6.72</td>
<td>6.45</td>
<td>27.20</td>
<td>1763</td>
<td>0.50</td>
<td>1.13</td>
<td>Yellow</td>
<td>Mild</td>
</tr>
<tr>
<td>10:26</td>
<td>0.10</td>
<td>0.63</td>
<td>0.05</td>
<td>6.71</td>
<td>6.44</td>
<td>27.18</td>
<td>1747</td>
<td>0.37</td>
<td>2.39</td>
<td>Yellow</td>
<td>Mild</td>
</tr>
</tbody>
</table>

**WELL CAPACITY:** (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88

**TUBING INSIDE DIA. CAPACITY:** (Gal./Ft.): 1/8" = 0.00006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016

#### SAMPLING DATA

**SAMPLED BY (PRINT) / AFFILIATION:** RAB  
**TECO:** TECO  
**SAMPLER’S SIGNATURES:**  
**SAMPLING INITIATED AT:** 10:26  
**SAMPLING ENDED AT:** 10:42

**PUMP OR TUBING DEPTH IN WELL (feet):** 18.2

**FIELD DECONTAMINATION:** Y  
**FIELD-FILTERED: **N  
**FILTER SIZE:** µm

**SAMPLE CONTAINER SPECIFICATION**

<table>
<thead>
<tr>
<th>SAMPLE ID CODE</th>
<th># CONTAINERS</th>
<th>CONTAINERS</th>
<th>MATERIAL CODE</th>
<th>VOLUME</th>
<th>PRESERVATIVE USED</th>
<th>TOTAL VOL. ADDDED IN FIELD (ml)</th>
<th>FINAL pH</th>
<th>INTENDED ANALYSIS AND/OR METHOD</th>
<th>SAMPLING EQUIPMENT CODE</th>
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</thead>
<tbody>
<tr>
<td>@Ino-500</td>
<td>1</td>
<td>PE</td>
<td>500ml</td>
<td>NONE</td>
<td>NONE</td>
<td>N/A</td>
<td>Inorganics</td>
<td>PP</td>
<td></td>
</tr>
<tr>
<td>@Met-250</td>
<td>2</td>
<td>PE</td>
<td>250ml</td>
<td>HNO3</td>
<td>1ml</td>
<td>&lt;2</td>
<td>Metals</td>
<td>PP</td>
<td></td>
</tr>
<tr>
<td>@Rad-1L</td>
<td>2</td>
<td>PE</td>
<td>1L</td>
<td>HNO3</td>
<td>5ml</td>
<td>&lt;2</td>
<td>Radiologicals</td>
<td>PP</td>
<td></td>
</tr>
</tbody>
</table>

**REMARKS:**

1. Sample bottles pre-preserved at laboratory prior to sample collection.

### NOTES:

1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212. SECTION 3)

   - pH: ± 0.2 units
   - Temperature: ± 0.2 ºC
   - Specific Conductance: ± 5%
   - Dissolved Oxygen: all readings ± 20% saturation (see Table FS 2200-2), optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
   - Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or 10% (whichever is greater)

**MATERIAL CODES:** AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; B = Silicone; T = Teflon; O = Other (Specify)

**SAMPLING/PURGING EQUIPMENT CODES:** APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)
GROUNDBOARD SAMPLING LOG

WELL NO: BBS-CCR-BW-1
SAMPLE ID: L17J115-04 A
DATE: 10/13/17

PURGING DATA

WELL VOLUME PURGE:
(only fillout if applicable)
1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY

EQUIPMENT VOLUME PURGE:
(only fillout if applicable)
1 EQUIPMENT VOLUMES = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 39.30
FINAL PUMP OR TUBING DEPTH IN WELL (feet): 39.30
PURGE INITIATED AT: 9:49
PURGEENDED AT: 10:01
TOTAL VOLUME PURGED (gallons): 8.23

TIME VOLUME PURGED (GALLONS) DEPTH TO WATER (FEET) PH TEMP. COND. DISSOLVED OXYGEN TURBIDITY COLOR ODOR
9:57 5.49 30.43 6.55 27.81 4384 0.87 7.30 Clear None
9:59 1.37 30.42 6.55 27.81 4499 0.57 4.40 Clear None
10:01 1.37 30.41 6.55 27.86 4570 0.40 2.51 Clear None

WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 6.88
TUBING INSIDE DIA. CAPACITY (Gal/FT): 1/8" = 0.00006; 1/16" = 0.00014; 1/4" = 0.00038; 5/16" = 0.00064; 3/8" = 0.0006; 1/2" = 0.010; 5/8" = 0.016

SAMPLING DATA

SAMPLED BY (PRINT)/AFFILIATION: RAB TECO
SAMPLER (S) SIGNATURES: 
SAMPLING INITIATED AT: 10:01
SAMPLING ENDED AT: 10:04
PUMP OR TUBING DEPTH IN WELL (feet): 39.3
SAMPLE PUMP FLOW RATE (mL per minute): 2600
TUBING MATERIAL CODE: PE
FIELD DECONTAMINATION: Y ☑ N ☑ FIELD-FILTERED: ☑ FILTER SIZE: µm DUPLICATE: Y ☑ N ☑ FILTER EQUIPMENT TYPE:

SAMPLE CONTAINER SPECIFICATION

SAMPLE ID CODE # CONTAINERS MATERIAL CODE MATERIAL CODE VOLUME PRESERVATIVE USED TOTAL VOL ADDED IN FIELD (mL) pH FINAL INTENDED ANALYSIS AND/OR METHOD SAMPLING EQUIPMENT CODE
@Ino-500 1 PE 500ml NONE NONE N/A Inorganics ESP
@Met-250 2 PE 250ml HNO3 1ml <2 Metals ESP
@Rad-1L 2 PE 1L HNO3 5ml <2 Radiologial ESP

REMARKS:
(1) Sample bottles pre-preserved at laboratory prior to sample collection.

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)
SAMPLING/PURGING CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)

NOTES:
1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
   pH: ± 0.2 units Temperature: ± 0.2 ºC Specific Conductance: ± 5%. Dissolved Oxygen: all readings ± 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) Turbidity: all readings ± 20 NTU; optionally ± 5 NTU or 10% (whichever is greater)
### PURGING DATA

<table>
<thead>
<tr>
<th>TIME</th>
<th>VOLUME PURGED (GALLONS)</th>
<th>CONTROL VOLUME PURGED (GALLONS)</th>
<th>PURGE RATE (GPM)</th>
<th>DEPTH TO WATER (FEET)</th>
<th>pH (standard units)</th>
<th>TEMP. (ºC)</th>
<th>COND. (µmhos/cm or µS/cm)</th>
<th>DISSOLVED OXYGEN (circled in % saturation)</th>
<th>TURBIDITY (NTUs)</th>
<th>COLOR (describe)</th>
<th>ODOR (describe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:28</td>
<td>1.75</td>
<td>0</td>
<td>0.13</td>
<td>7.61</td>
<td>6.68</td>
<td>27.92</td>
<td>1706</td>
<td>0.39 (Lt. Yellow)</td>
<td>4.98</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>9:30</td>
<td>0.26</td>
<td>2.01</td>
<td>0.13</td>
<td>7.62</td>
<td>6.69</td>
<td>27.95</td>
<td>1702</td>
<td>0.31 (Lt. Yellow)</td>
<td>6.12</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>9:32</td>
<td>0.26</td>
<td>2.27</td>
<td>0.13</td>
<td>7.62</td>
<td>6.70</td>
<td>27.98</td>
<td>1699</td>
<td>0.28 (Lt. Yellow)</td>
<td>3.96</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

**WELL CAPACITY (Gallons Per Foot):**
0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 6.88

**TUBING INSIDE DIAM. CAPACITY (Gal./Ft.):**
1/8" = 0.00066; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016

### SAMPLING DATA

<table>
<thead>
<tr>
<th>SAMPLED BY (PRINT) / AFFILIATION:</th>
<th>RAB</th>
<th>TECO</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUMP OR TUBING DEPTH IN WELL (feet):</td>
<td>18.5</td>
<td></td>
</tr>
<tr>
<td>SAMPLE PUMP FLOW RATE (mL per minute):</td>
<td>503</td>
<td></td>
</tr>
<tr>
<td>TUBING MATERIAL CODE:</td>
<td>PE/S</td>
<td></td>
</tr>
<tr>
<td>FIELD DECONTAMINATION:</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>SAMPLE CONTAINER SPECIFICATION:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAMPLE ID CODE</td>
<td>@Ino-500</td>
<td>@Met-250</td>
</tr>
<tr>
<td># CONTAINERS</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>MATERIAL CODE</td>
<td>PE</td>
<td>PE</td>
</tr>
<tr>
<td>VOLUME</td>
<td>500ml</td>
<td>250ml</td>
</tr>
<tr>
<td>PRESERVATIVE USED</td>
<td>NONE</td>
<td>HNO3</td>
</tr>
<tr>
<td>TOTAL VOL ADDED IN FIELD (mL):</td>
<td></td>
<td>1ml</td>
</tr>
<tr>
<td>FINAL pH</td>
<td></td>
<td>&lt;2</td>
</tr>
<tr>
<td>INTENDED ANALYSIS AND/OR METHOD:</td>
<td></td>
<td>Metals</td>
</tr>
<tr>
<td>SAMPLING EQUIPMENT CODE</td>
<td></td>
<td>PP</td>
</tr>
</tbody>
</table>

**REMARKS:**
(1) Sample bottles pre-preserved at laboratory prior to sample collection.

**MATERIAL CODES:**
AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify).

**SAMPLING/PURGING EQUIPMENT CODES:**
APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submisible Pump; PP = Peristaltic Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify).

**NOTES:**
1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.
2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212. SECTION 3)
   - pH ± 0.2 units
   - Temperature ± 0.2 ºC
   - Specific Conductance ± 5%.
   - Dissolved Oxygen: all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater)
   - Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or 10% (whichever is greater)
<table>
<thead>
<tr>
<th>Site:</th>
<th>Big Bend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>10/13/17</td>
</tr>
<tr>
<td>File Name:</td>
<td>101317_Wells_RAB</td>
</tr>
<tr>
<td>Weather:</td>
<td>Partly Cloudy &amp; Warm</td>
</tr>
<tr>
<td>Sample(s) / initials:</td>
<td>RAB / TECO</td>
</tr>
</tbody>
</table>

### Purging Information

<table>
<thead>
<tr>
<th>Well #</th>
<th>Diam/Comp</th>
<th>Screen Interval (ft)</th>
<th>Intake Depth (ft)</th>
<th>Water Depth (ft)</th>
<th>DO (mg/L)</th>
<th>Turbidity (NTU)</th>
<th>Redox (mv)</th>
<th>pH (SU)</th>
<th>Stability Values</th>
<th>Purge Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBS-CCR-1</td>
<td>2</td>
<td>10</td>
<td>17.32</td>
<td>22.32</td>
<td>7.32</td>
<td>15.00</td>
<td>0.16</td>
<td>2.40</td>
<td>20.0000</td>
<td>23.3</td>
</tr>
</tbody>
</table>

#### Purge Method

- **1A**
  - Time: 11:28
  - Rate (mil/min): 380
  - Volume (gal): 1.10
  - Water Depth (ft): 1.10
  - pH (SU): 7.41
  - Temp (°C): 26.47
  - DO (mg/L): 4285
  - Turbidity (NTU): 0.2
  - pH: 2
  - Level Meter: MPM08
  - Pump: PP
  - Tubing: PE/S

- **11:32**
  - Time: 11:32
  - Rate (mil/min): 380
  - Volume (gal): 0.21
  - Water Depth (ft): 1.51
  - pH (SU): 6.83
  - Temp (°C): 26.57
  - DO (mg/L): 4285
  - Turbidity (NTU): 0.24
  - pH: 0.89
  - Level Meter: MPM08
  - Pump: PP
  - Tubing: PE/S

### Purge Complete At

- **11:18** Gallons to Purge: 0.12
- Stability Values: 8.67
- DO (mg/L): 4285
- Turbidity (NTU): 0.24
- Redox (mv): 0.89

### Purging Information

<table>
<thead>
<tr>
<th>Well #</th>
<th>Diam/Comp</th>
<th>Screen Interval (ft)</th>
<th>Intake Depth (ft)</th>
<th>Water Depth (ft)</th>
<th>DO (mg/L)</th>
<th>Turbidity (NTU)</th>
<th>Redox (mv)</th>
<th>pH (SU)</th>
<th>Stability Values</th>
<th>Purge Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBS-CCR-2</td>
<td>2</td>
<td>10</td>
<td>16.84</td>
<td>21.84</td>
<td>6.88</td>
<td>14.96</td>
<td>0.16</td>
<td>2.39</td>
<td>20.0000</td>
<td>22.84</td>
</tr>
</tbody>
</table>

#### Purge Method

- **1A**
  - Time: 11:00
  - Rate (mil/min): 380
  - Volume (gal): 0.80
  - Water Depth (ft): 0.80
  - pH (SU): 6.87
  - Temp (°C): 26.44
  - DO (mg/L): 1348
  - Turbidity (NTU): 0.19
  - pH: 2
  - Level Meter: MPM08
  - Pump: PP
  - Tubing: PE/S

### Purge Complete At

- **10:49** Gallons to Purge: 0.12
- Stability Values: 8.67
- DO (mg/L): 4285
- Turbidity (NTU): 0.24
- Redox (mv): 3.03

**Comments:**
- Total Time: Total Miles
<table>
<thead>
<tr>
<th>Method</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductivity Meter Calibration</td>
<td>Standard ID: TM07, Std Value: 5.56, Cal: 4, Time: 7:02, A checked box indicates ICV / CCV passed</td>
</tr>
<tr>
<td>Turbidity Meter Calibration</td>
<td>Standard ID: 018808E, Std Value: 1000, Cal: 10, Acceptability Range: 10.00, ICV: 7.18, CCV: 9791, Time: 14.01, Meter ID: MPM08, 14.42</td>
</tr>
<tr>
<td>Purge Meth</td>
<td>Time: 10:22, Rate (ml/min): 180, Volume (gal): 0.43, pH (Stabil): 6.72, Cond (uMHOS): 6.47, Temp °C: 27.31, DO (mg/L): 1785, Color: Yellow, Odor: Mild, Status: Stable</td>
</tr>
</tbody>
</table>

Comments: Total Time: 10:18, Total Miles: 7.60
### Big Bend

#### Date: 10/13/17

<table>
<thead>
<tr>
<th>Site: Big Bend</th>
<th>File Name: 101317 Wells RAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather: Partly Cloudy &amp; Warm</td>
<td>Sampler(s) / initials: RAB / TECO</td>
</tr>
<tr>
<td>Samples On Site</td>
<td>Overall Comments:</td>
</tr>
</tbody>
</table>

### Purging Information

#### Well Capacities (gallons/ft): 2 = 0.16  4 = 0.65

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BBS-CCR-BW-1</td>
<td>2</td>
<td>10</td>
<td>39.3</td>
<td>44.3</td>
<td>25.60</td>
<td>16.0</td>
<td>0.16</td>
<td>2.35</td>
<td>0.0026</td>
<td>100</td>
<td>0</td>
<td>0.06</td>
<td>0.32</td>
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</table>

#### Purge Meth: 1A

<table>
<thead>
<tr>
<th>Time</th>
<th>Rate</th>
<th>Minimum Volume (gal)</th>
<th>Total Volume (gal)</th>
<th>Water Depth (ft)</th>
<th>pH (st)</th>
<th>Cond (uMHOS)</th>
<th>DO (mg/L)</th>
<th>pH (mv)</th>
<th>Turbidity (NTU)</th>
<th>Purge Criteria</th>
<th>Status</th>
<th>Equipment ID</th>
<th>Tubing</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:57</td>
<td>2600</td>
<td>5.49</td>
<td>5.49</td>
<td>30.43</td>
<td>65.55</td>
<td>27.81</td>
<td>4384</td>
<td>0.87</td>
<td>3.30</td>
<td>pH +/- 0.2</td>
<td>STABLE</td>
<td>Level Meter: WLM08</td>
<td></td>
</tr>
<tr>
<td>9:49</td>
<td>10:01</td>
<td>2600</td>
<td>1.37</td>
<td>8.31</td>
<td>64.55</td>
<td>27.86</td>
<td>4570</td>
<td>0.40</td>
<td>2.41</td>
<td>DO % Sat +/-</td>
<td>STABLE</td>
<td>Tubing: PE</td>
<td></td>
</tr>
<tr>
<td>9:01</td>
<td>10:01</td>
<td>2600</td>
<td>1.37</td>
<td>8.31</td>
<td>64.55</td>
<td>27.86</td>
<td>4570</td>
<td>0.40</td>
<td>2.41</td>
<td>DO % Sat +/-</td>
<td>STABLE</td>
<td>Tubing: PE</td>
<td></td>
</tr>
</tbody>
</table>

#### Purge Complete At 9:49 Gallons to Purge 0.32

| Stability Values | 6.55 | 27.86 | 4570 | 0.40 | 2.51 |

### Purging Information

#### Well Capacities (gallons/ft): 2 = 0.16  4 = 0.65

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>BBS-CCR-BW-2</td>
<td>2</td>
<td>10</td>
<td>18.49</td>
<td>23.84</td>
<td>7.38</td>
<td>16.46</td>
<td>0.16</td>
<td>2.63</td>
<td>0.0026</td>
<td>24.64</td>
<td>0</td>
<td>0.06</td>
<td>0.12</td>
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#### Purge Meth: 1A

<table>
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<tr>
<th>Time</th>
<th>Rate</th>
<th>Minimum Volume (gal)</th>
<th>Total Volume (gal)</th>
<th>Water Depth (ft)</th>
<th>pH (st)</th>
<th>Cond (uMHOS)</th>
<th>DO (mg/L)</th>
<th>pH (mv)</th>
<th>Turbidity (NTU)</th>
<th>Purge Criteria</th>
<th>Status</th>
<th>Equipment ID</th>
<th>Tubing</th>
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</thead>
<tbody>
<tr>
<td>9:28</td>
<td>510</td>
<td>1.75</td>
<td>1.75</td>
<td>7.61</td>
<td>6.68</td>
<td>27.92</td>
<td>1706</td>
<td>0.39</td>
<td>4.98</td>
<td>pH +/- 0.2</td>
<td>STABLE</td>
<td>Level Meter: WLM08</td>
<td></td>
</tr>
<tr>
<td>9:15</td>
<td>320</td>
<td>0.26</td>
<td>0.26</td>
<td>7.62</td>
<td>6.69</td>
<td>27.95</td>
<td>1702</td>
<td>0.31</td>
<td>6.12</td>
<td>pH +/- 0.2</td>
<td>STABLE</td>
<td>Tubing: PE/ES</td>
<td></td>
</tr>
<tr>
<td>9:15</td>
<td>320</td>
<td>0.26</td>
<td>0.26</td>
<td>7.62</td>
<td>6.69</td>
<td>27.95</td>
<td>1702</td>
<td>0.31</td>
<td>6.12</td>
<td>pH +/- 0.2</td>
<td>STABLE</td>
<td>Tubing: PE/ES</td>
<td></td>
</tr>
</tbody>
</table>

#### Purge Complete At 9:15 Gallons to Purge 0.12

| Stability Values | 6.70 | 27.98 | 1699 | 0.28 | 3.96 |