

Memorandum

Date: January 17, 2024
To: Billi Jo Huddleston, CHMM, Florida Power & Light Company
From: Ben Amos, Ph.D., P.E. and Lane Dorman, P.G., Geosyntec Consultants, Inc.
Subject: 2018 Groundwater Velocity Estimate, Plant Smith, Ash Pond, Southport, FL

INTRODUCTION

On behalf of Florida Power & Light Company (“FPL”), Geosyntec Consultants, Inc. (“Geosyntec”) prepared this *2018 Groundwater Velocity Estimate Memorandum* (“Memo”) for the Plant Smith Ash Pond Coal Combustion Residuals (“CCR”) unit (CCR unit). The purpose of this Memo is to document the calculated horizontal groundwater velocities at the CCR unit in 2018, specifically for MW-11 and MW-13 (i.e., the wells with statistically significant levels [SSLs]). This Memo supplements the summary of CCR groundwater monitoring activities conducted in 2018 and reported in the *2018 Annual Groundwater Monitoring Report* (Geosyntec, 2019¹), in accordance with groundwater sampling and analysis requirements of 40 Code of Federal Regulations (“CFR”) Section 257.93(c).

GROUNDWATER VELOCITY CALCULATIONS

Groundwater flow rates were calculated based on the following:

1. Horizontal hydraulic gradients estimated from groundwater elevations measured during each sampling event in 2018.
2. The hydraulic conductivity (0.42 to 0.47 feet per day [ft/day]) for the CCR unit documented in the *Selection of Remedy Report* (Geosyntec, 2022²).

¹ Geosyntec, 2019. *2018 Annual Groundwater Monitoring Report*, Gulf Power Company, Plant Smith, Ash Pond. January 31, 2019.

² Geosyntec Consultants, 2022. *Selection of Remedy Report*, Florida Power & Light Company, Plant Smith, Ash FR8308/PR23042

3. An estimated effective porosity of 0.25, based on the lithologic materials surrounding the screened interval (Sterrett, 2007³).

Input parameters and the calculations are summarized in **Table 1**. Groundwater elevations maps from 2018 are included as **Figures 1, 2 and 3**.

Horizontal hydraulic gradients were calculated based on groundwater elevation data from 2018 groundwater sampling events. Horizontal hydraulic gradients were estimated between MW-13 and the east bank of Alligator Bayou and between MW-11 and the northern bank of North Bay. The elevation of Alligator Bayou and North Bay were assumed to be the same as measured in MW-12, which is in close proximity to surface water.

The hydraulic conductivity for the uppermost aquifer adjacent to the CCR unit was estimated from pneumatic slug tests performed at MW-13 and PZ-14. Slug test methods and results were documented in the *Selection of Remedy Report* (Geosyntec, 2022). Based on slug test results, the estimated hydraulic conductivities at MW-13 and PZ-14 were 0.42 and 0.47 ft/day, respectively. The estimated hydraulic conductivities at MW-13 and PZ-14 are within the anticipated hydraulic conductivity range for the fine-grained sands observed at the CCR unit (Domenico and Schwartz, 1990⁴).

The horizontal groundwater flow velocity was calculated using a form of Darcy's Law:

$$V = (K*i)/n_e$$

Where:

V = groundwater velocity (ft/day);

K = hydraulic conductivity (ft/day);

i = horizontal hydraulic gradient (unitless); and

n_e = effective porosity (unitless), assumed to be 0.25.

The calculated horizontal groundwater flow velocities at the CCR unit ranged from 0.017 to 0.021 ft/day (6.3 to 7.8 ft/year) in the vicinity of MW-13 and 0.009 to 0.015 ft/day (3.4 to 5.5 ft/year) in the vicinity of MW-11 during the 2018 sampling events.

CLOSING

Pond, July 29, 2022.

³ Sterrett, R.J., 2007. *Groundwater and Wells*, Third Edition, New Brighton, MN: Johnson Screens, A Weatherford Company.

⁴ Domenico, P.A. and F.W. Schwartz, 1990. *Physical and Chemical Hydrogeology*, John Wiley & Sons, New York, 824 p.

In accordance with groundwater sampling and analysis requirements of 40 CFR Section 257.93(c), the horizontal groundwater velocity at the Plant Smith Ash Pond ranged from 6.3 to 7.8 ft/year in the vicinity of MW-13 and 3.4 to 5.5 ft/year in the vicinity of MW-11 during the 2018 groundwater sampling events. The calculated horizontal groundwater velocities for 2018 are similar to those calculated previously (Geosyntec, 2022, 2023⁵). This Memo has been prepared under the supervision of a State of Florida licensed Professional Engineer and Professional Geologist with Geosyntec.

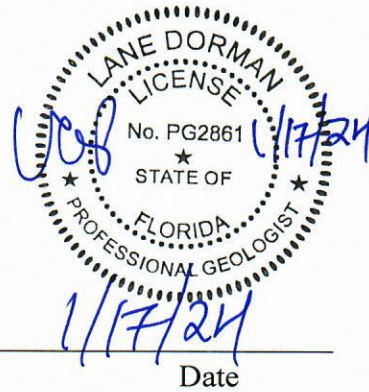
⁵ Geosyntec, 2023. *2022 Annual Groundwater Monitoring and Corrective Action Report*, Plant Smith, Ash Pond, January 31, 2023.
FR8308/PR23042

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Date



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Florida Professional Geologist No. PG2861



Date

TABLE

**Table 1. 2018 Groundwater Velocity Input Parameters and Calculations
Florida Power Light Company - Plant Smith Ash Pond, Bay County, Florida**

| Flow Paths ¹ | Groundwater Elevation (ft) ^{2,3} | | Change in Groundwater Elevation (Δh) ⁴ (ft) | Distance (Δl) ⁴ (ft) | Hydraulic Gradient ($\Delta h/\Delta l$) ⁴ (ft/ft) ⁵ | Hydraulic Conductivity ⁶ , K (ft/day) ⁷ | Effective Porosity (n_e) | Linear Groundwater Velocity ⁸ | |
|--------------------------|---|-------|--|---|--|---|------------------------------|--|----------------------|
| | | | | | | | | ft/day ⁷ | ft/year ⁹ |
| MW-11 to North Bay | Mar-18 | 6.12 | 4.39 | 795 | 0.0055 | 0.42 | 0.25 | 0.009 | 3.4 |
| | | 1.73 | | | | | | | |
| MW-11 to North Bay | Mar-18 | 6.12 | 4.39 | | | | | | |
| | | 1.73 | | | | | | | |
| MW-11 to North Bay | Jun-18 | 7.65 | 6.34 | | | | | | |
| | | 1.31 | | | | | | | |
| MW-11 to North Bay | Jun-18 | 7.65 | 6.34 | | | | | | |
| | | 1.31 | | | | | | | |
| MW-11 to North Bay | Nov-18 | 6.92 | 5.66 | | | | | | |
| | | 1.26 | | | | | | | |
| MW-11 to North Bay | Nov-18 | 6.92 | 5.66 | | | | | | |
| | | 1.26 | | | | | | | |
| MW-13 to Alligator Bayou | Mar-18 | 11.80 | 10.07 | 935 | 0.0108 | 0.42 | 0.25 | 0.018 | 6.6 |
| | | 1.73 | | | | | | | |
| MW-13 to Alligator Bayou | Mar-18 | 11.80 | 10.07 | | | | | | |
| | | 1.73 | | | | | | | |
| MW-13 to Alligator Bayou | Jun-18 | 11.93 | 10.62 | | | | | | |
| | | 1.31 | | | | | | | |
| MW-13 to Alligator Bayou | Jun-18 | 11.93 | 10.62 | | | | | | |
| | | 1.31 | | | | | | | |
| MW-13 to Alligator Bayou | Nov-18 | 10.89 | 9.63 | | | | | | |
| | | 1.26 | | | | | | | |
| MW-13 to Alligator Bayou | Nov-18 | 10.89 | 9.63 | | | | | | |
| | | 1.26 | | | | | | | |

Notes:

1. The elevation of Alligator Bayou and North Bay were assumed to be the same as measured in MW-12, which is in close proximity to surface water.
2. Elevations are in feet relative to the North American Vertical Datum of 1988.
3. ft = feet
4. Δh = Change in groundwater elevation, Δl = Distance along flow path
5. ft/ft = feet per foot
6. K values were calculated based on 2020 slug tests.
7. ft/day = feet per day
8. Groundwater flow velocity equation = $(\Delta h/\Delta l * K)/n_e$
9. ft/year = feet per year

FIGURES



Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Inferred Groundwater Elevation Contour (ft NAVD88)
- Approximate Ash Pond Boundary (CCR Unit)
- Approximate Property Boundary
- Groundwater Elevation (ft NAVD88)

Notes:

1. * indicates groundwater elevation not used for contouring.
2. CCR indicates Coal Combustion Residuals.
3. Water level measurements collected between 21 March 2018.
4. ft NAVD88 indicates feet North American Vertical Datum of 1988.
5. Source of 2016 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

500 250 0 500 Feet

Potentiometric Surface Contour Map
March 20, 2018
Plant Lansing Smith

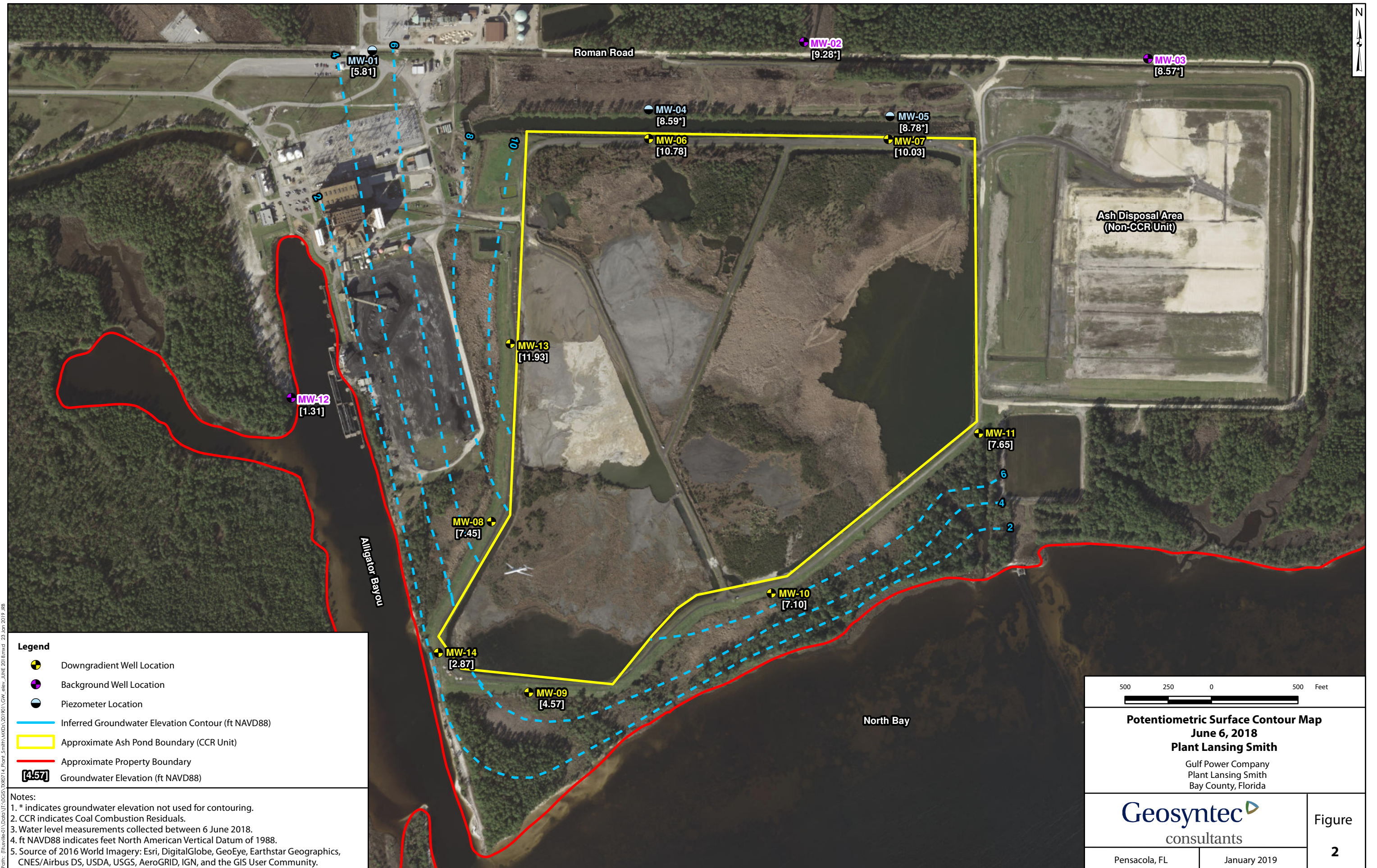
Gulf Power Company
 Plant Lansing Smith
 Bay County, Florida

Geosyntec
 consultants

Pensacola, FL January 2019

Figure
1

Path: (I:\Utilities\01_Data\GIS\OGS\TR0714_Pref_5m\HYM\MDX\201901\GW_elev_MAR_2018.mxd 23 Jan 2019 10:08



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Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Inferred Groundwater Elevation Contour (ft NAVD88)
- Approximate Ash Pond Boundary (CCR Unit)
- Approximate Property Boundary
- [4.57] Groundwater Elevation (ft NAVD88)

Notes:

1. * indicates groundwater elevation not used for contouring.
2. CCR indicates Coal Combustion Residuals.
3. Water level measurements collected between 6 June 2018.
4. ft NAVD88 indicates feet North American Vertical Datum of 1988.
5. Source of 2016 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

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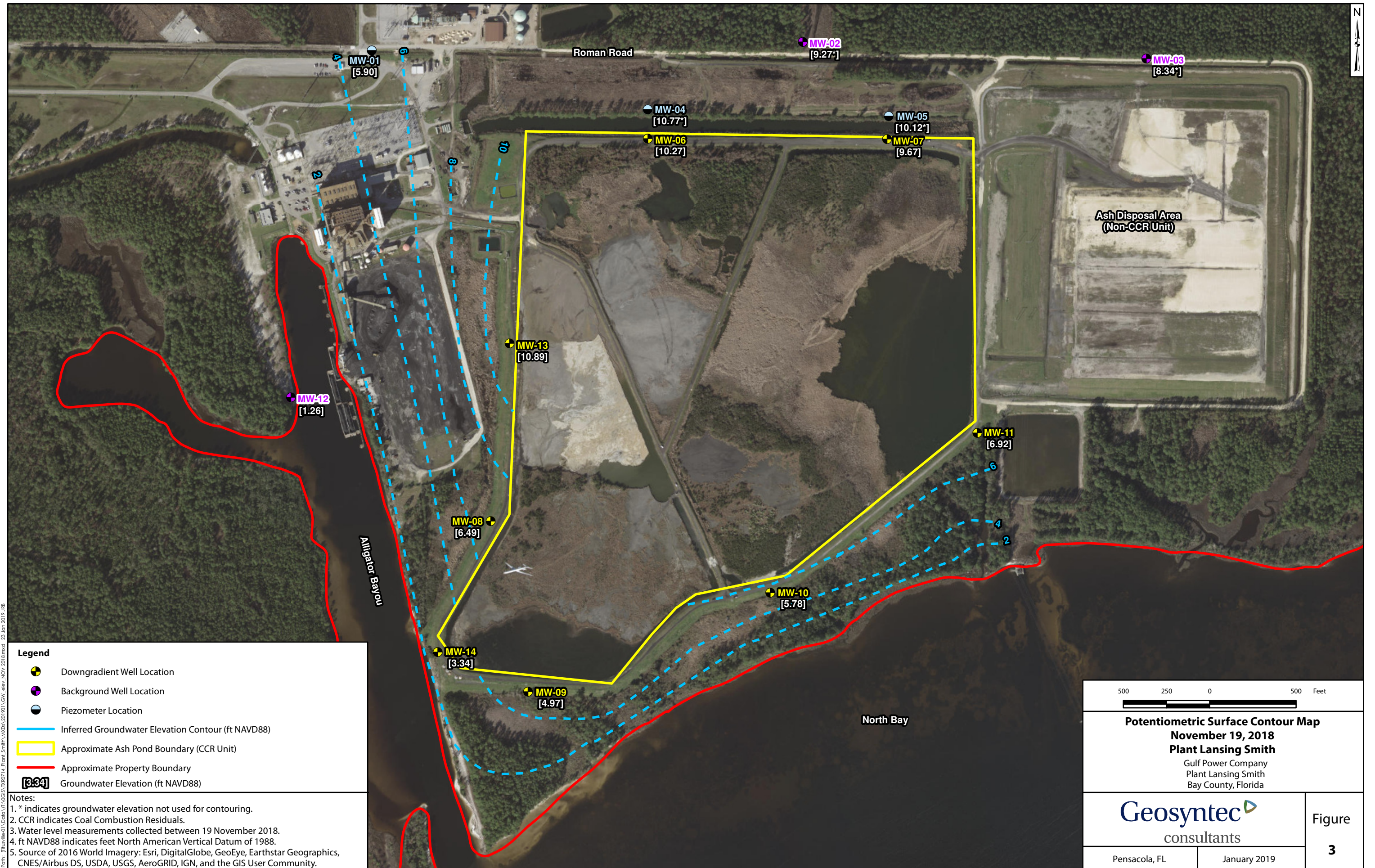
Potentiometric Surface Contour Map
June 6, 2018
Plant Lansing Smith
 Gulf Power Company
 Plant Lansing Smith
 Bay County, Florida

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 consultants

Figure
2

Pensacola, FL

January 2019



Path: (file:///C:/Users/01/OneDrive/Desktop/Projects/Plant_Lansing_Smith/MapDocs/20190114_Potential_Surface_Map/20190114_Potential_Surface_Map.mxd) [GW_elev_NOV_2018.mxd] 23 Jan 2019 1:08 PM

Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Inferred Groundwater Elevation Contour (ft NAVD88)
- Approximate Ash Pond Boundary (CCR Unit)
- Approximate Property Boundary
- Groundwater Elevation (ft NAVD88)

Notes:

1. * indicates groundwater elevation not used for contouring.
2. CCR indicates Coal Combustion Residuals.
3. Water level measurements collected between 19 November 2018.
4. ft NAVD88 indicates feet North American Vertical Datum of 1988.
5. Source of 2016 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

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| <p>Potentiometric Surface Contour Map November 19, 2018 Plant Lansing Smith Gulf Power Company Plant Lansing Smith Bay County, Florida</p> | |
| | |
| Pensacola, FL | January 2019 |
| Figure 3 | |