

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: 2020 Groundwater Velocity Estimate, Plant Smith, Ash Pond, Southport, FL

INTRODUCTION

On behalf of Florida Power & Light Company (“FPL”), Geosyntec Consultants, Inc. (“Geosyntec”) prepared this *2020 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 2020, 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 2020 and reported in the *2020 Annual Groundwater Monitoring and Corrective Action Report* (Geosyntec, 2021¹), 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 2020.
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, 2021. *2020 Annual Groundwater Monitoring and Corrective Action Report*, Gulf Power Company, Plant Smith Ash Pond, January 29, 2021.

² Geosyntec Consultants, 2022b. *Selection of Remedy Report*, Florida Power & Light Company, Plant Smith, Ash Pond, July 29, 2022.

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 2020 are included as **Figures 1 and 2**.

Horizontal hydraulic gradients were calculated based on groundwater elevation data from 2020 groundwater sampling events. For the May 2020 event, horizontal hydraulic gradients were calculated between MW-11 and MWI-12A and between MW-13 and PZ-14, monitoring well pairs representative of groundwater flow near MW-11 and MW-13, respectively.

Since MW-11, MW-13, and select other CCR wells were abandoned in August 2020 to allow for pre-closure activities (i.e., removal of the perimeter dike system) and not reinstalled until late 2021 or 2022, limited potentiometric data from the September 2020 groundwater sampling event are available to calculate horizontal hydraulic gradients. As such, the horizontal hydraulic gradients for September 2020 were estimated as follows:

- In the vicinity of MW-13, hydraulic gradients were estimated between PZ-14 and the east bank of Alligator Bayou;
- In the vicinity of MW-11, hydraulic gradients were estimated between MWI-12A and the northern bank of North Bay; and
- 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:

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

³ Sterret, 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.

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 flow velocities at the CCR unit ranges from 0.015 to 0.017 ft/day (5.5 to 6.2 ft/year) in the vicinity of MW-13 and 0.005 to 0.016 ft/day (1.7 to 5.9 ft/year) in the vicinity of MW-11 during the 2020 sampling events.

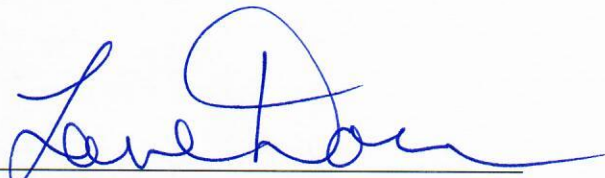
CLOSING

In accordance with groundwater sampling and analysis requirements of 40 CFR Section 257.93(c), the horizontal groundwater velocities at the Plant Smith Ash Pond ranged from 5.5 to 6.2 ft/year in the vicinity of MW-13 and 1.7 to 5.9 ft/year in the vicinity of MW-11 during the 2020 semi-annual groundwater sampling event. The calculated horizontal groundwater velocities for 2020 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/PR23044

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1/17/24
Date

TABLE

**Table 1. 2020 Groundwater Velocity Input Parameters and Calculations
Florida Power Light Company - Plant Smith Ash Pond, Bay County, Florida**

Flow Paths ^{1,2}	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/MWI-12A	May-20	7.16	4.46	521	0.0086	0.42	0.25	0.014	5.2
		2.70							
MW-11/MWI-12A	May-20	7.16	4.46	521	0.0086	0.47	0.25	0.016	5.9
		2.70							
MWI-12A to North Bay	Sep-20	3.07	0.88	311	0.0028	0.42	0.25	0.005	1.7
		2.19							
MWI-12A to North Bay	Sep-20	3.07	0.88	311	0.0028	0.47	0.25	0.005	1.9
		2.19							
MW-13/PZ-14	May-20	9.87	2.45	271	0.0090	0.42	0.25	0.015	5.5
		7.42							
MW-13/PZ-14	May-20	9.87	2.45	271	0.0090	0.47	0.25	0.017	6.2
		7.42							
PZ-14 to Alligator Bayou	Sep-20	7.93	5.74	658	0.0087	0.42	0.25	0.015	5.3
		2.19							
PZ-14 to Alligator Bayou	Sep-20	7.93	5.74	658	0.0087	0.47	0.25	0.016	6.0
		2.19							

Notes:

- 1a. PZ-14, MWI-12A, and MW-12 were the only wells available to estimate gradients in September 2020 because other CCR monitoring wells had been abandoned to facilitate CCR unit closure.
- 1b. 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



Path: (file:///C:/Users/.../Data/.../OGS/.../202010.GW_elev_05MAY2020_202010.mxd 14 Dec 2020 MAH)

Legend

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

Notes:

1. * indicates groundwater elevation not used for contouring.
2. CCR indicates Coal Combustion Residuals.
3. Water level measurements collected on 5 May 2020.
4. ft NAVD88 indicates feet North American Vertical Datum of 1988.
5. Source of 2020 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

500 250 0 500 Feet

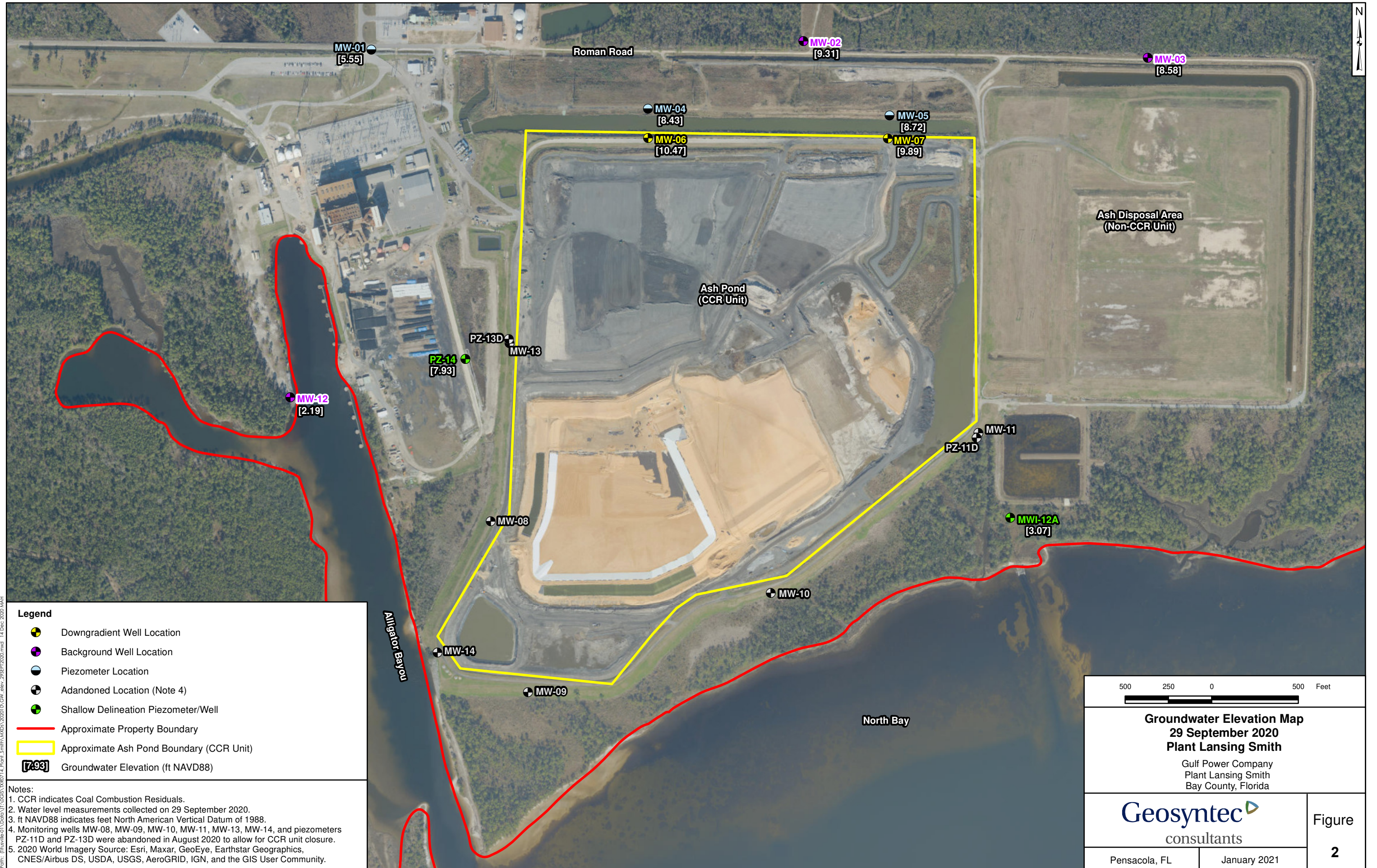
Potentiometric Surface Contour Map
 5 May 2020
Plant Lansing Smith
 Gulf Power Company
 Plant Lansing Smith
 Bay County, Florida

Geosyntec
consultants

Figure
1

Pensacola, FL

January 2021



Path: (file:///C:/Users/.../Data/.../OGS/.../202010_GW_elev_29SEP2020.mxd 14 Dec 2020 MAH)

Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Adandoned Location (Note 4)
- Shallow Delineation Piezometer/Well
- Approximate Property Boundary
- Approximate Ash Pond Boundary (CCR Unit)
- 7.93 Groundwater Elevation (ft NAVD88)

Notes:

1. CCR indicates Coal Combustion Residuals.
2. Water level measurements collected on 29 September 2020.
3. ft NAVD88 indicates feet North American Vertical Datum of 1988.
4. Monitoring wells MW-08, MW-09, MW-10, MW-11, MW-13, MW-14, and piezometers PZ-11D and PZ-13D were abandoned in August 2020 to allow for CCR unit closure.
5. 2020 World Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

<p>500 250 0 500 Feet</p>	
<p>Groundwater Elevation Map 29 September 2020 Plant Lansing Smith Gulf Power Company Plant Lansing Smith Bay County, Florida</p>	
<p>Geosyntec consultants</p>	
<p>Pensacola, FL</p>	<p>January 2021</p>
<p>Figure 2</p>	