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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, Gulf Clean Energy Center, Ash Landfill No. 1, Pensacola, FL

INTRODUCTION

On behalf of Florida Power & Light Company ("FPL"), Geosyntec Consultants, Inc. ("Geosyntec") prepared this *2020 Groundwater Velocity Estimate Memorandum* ("Memo") for FPL's Gulf Clean Energy Center ("GCEC") Coal Combustion Residuals ("CCR") unit Ash Landfill No. 1 ("LF1"). The purpose of this Memo is to document the calculated horizontal groundwater velocities at LF1 in 2020. This Memo supplements the summary of CCR groundwater monitoring activities conducted in 2020 and reported in the *2020 Annual Groundwater Monitoring Report* (Geosyntec, 2021[1]), 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 geometric mean (geomean) hydraulic conductivity (47 feet per day [ft/day]) for LF1 documented in the *Groundwater Hydraulic Conductivity Evaluation, Ash Landfill Number 1 and Ash Landfill Number 2* (Geosyntec, 2023[2]).

[1] Geosyntec Consultants, 2021. *2020 Annual Groundwater Monitoring Report*, Gulf Power Company, Plant Crist, Ash Landfill No. 1. January 29, 2021.
[2] Geosyntec Consultants, Inc., 2023. *Groundwater Hydraulic Conductivity Evaluation, Ash Landfill Number 1 and Ash Landfill Number 2*, Florida Power & Light Company, July 2023

3. An estimated effective porosity of 0.25, based on the lithologic materials surrounding the screened interval (Sterrett, 2007[3]).

Input parameters and calculations are summarized in **Table 1**. Groundwater elevation maps from 2020 are included as **Figures 1 and 2**.

Horizontal hydraulic gradients between MW-101 and MW-109, a monitoring well-pair representative of groundwater flow near LF1, were calculated based on groundwater elevation data from both 2020 groundwater sampling events. The resulting horizontal gradients were approximately 0.0023 ft/ft and 0.0022 ft/ft in April and October 2020, respectively.

The geomean hydraulic conductivity for the uppermost aquifer adjacent to LF1 was estimated from pneumatic slug tests performed at six monitoring wells around LF1 (Geosyntec, 2023). The lithology of this aquifer generally consists of fine to coarse sand (SCS, 2017[4]); the geomean hydraulic conductivity (47 ft/day) is within the anticipated hydraulic conductivity range for a fine to coarse sand (Freeze and Cherry, 1979[5]).

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 (ft/ft); and

n_e = effective porosity (unitless).

The calculated horizontal groundwater flow velocities at LF1 were 0.44 ft/day (160 ft/year) in April 2020 and 0.41 ft/day (151 ft/year) in October 2020.

CLOSING

In accordance with the groundwater sampling and analysis requirements of 40 CFR Section 257.93(c), the horizontal groundwater velocities calculated for the selected well pair at LF1 (i.e., MW-101 and MW-109) were approximately 0.44 ft/day (160 ft/year) in April 2020 and 0.41 ft/day (151 ft/year) in

[3] Sterret, R.J., 2007. *Groundwater and Wells*, Third Edition, New Brighton, MN: Johnson Screens, A Weatherford Company.
[4] Southern Company Services, 2017. *Gulf Power Company, Plant Crist, Ash Landfill No. 1, Ash Landfill No. 2, and Gypsum Storage Area Well Design, Installation, Development and Decommissioning Report*, October.
[5] Freeze, R.A. and J.A. Cherry, 1979. *Groundwater*, Englewood Cliffs, NJ: Prentice Hall.

October 2020. The calculated horizontal groundwater velocities for 2020 are similar to those calculated previously (Geosyntec, 2023[6]). This Memo has been prepared under the supervision of a State of Florida licensed Professional Engineer and Professional Geologist with Geosyntec.

[6] Geosyntec Consultants, Inc., 2023. *2022 Annual Groundwater Monitoring Report*, Florida Power & Light Company, Gulf Clean Energy Center Ash Landfill No.1, January 31, 2023

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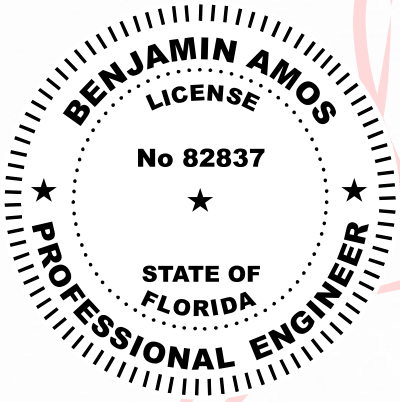

This document has been electronically signed and sealed by Benjamin Amos P.E. on 17 January 2024 using a SHA-1 authentication code. Printed copies of this document are not considered signed and sealed, and the SHA-1 authentication code must be verified on any electronic copies.
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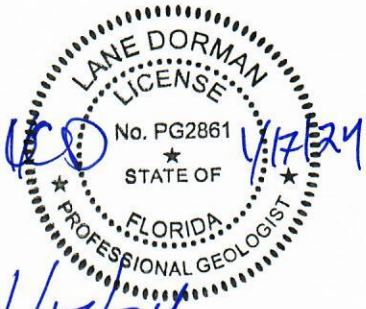
Benjamin K. Amos, Ph.D., P.E.
Florida Professional Engineer No. 82837

Date



Lane Dorman, P.G.
Florida Professional Geologist No. PG2861

1/17/24

Date

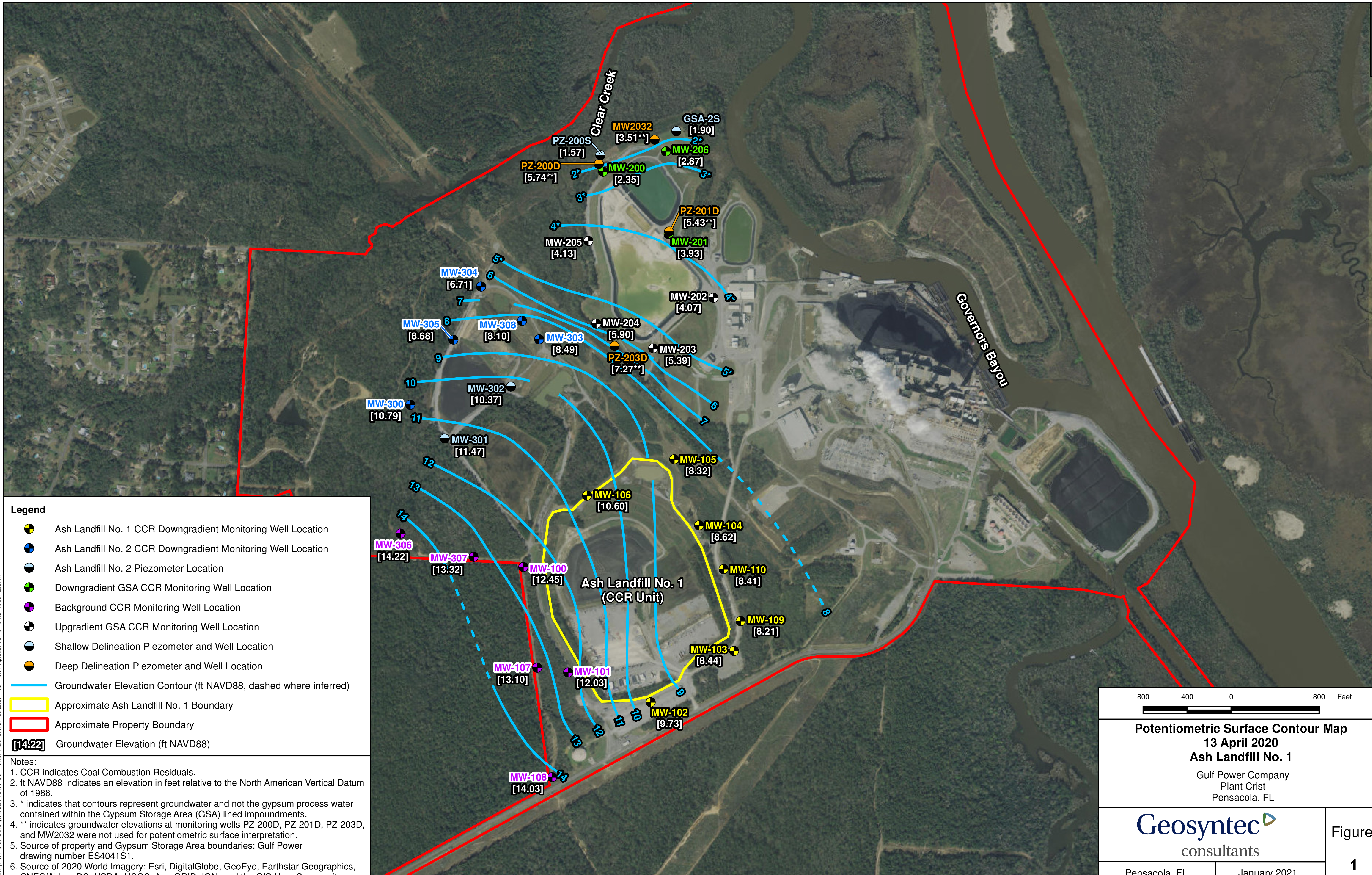
TABLE

Table 1. 2020 Groundwater Velocity Input Parameters and Calculations
Gulf Clean Energy Center, Landfill Number 1
Pensacola, FL

Flow Paths	Groundwater Elevation (ft)[1,2]		Change in Groundwater Elevation (Δh)[3] (ft)	Distance (Δl)[3] (ft)	Hydraulic Gradient ($\Delta h/\Delta l$)[3] (ft/ft)[4]	Hydraulic Conductivity[5], K (ft/day)[6]	Effective Porosity (n_e)	Linear Groundwater Velocity[7]	
								ft/day	ft/year[8]
MW-101/MW-109	Apr-20	12.03	3.82	1637	0.0023	47	0.25	0.44	160.1
		8.21							
MW-101/MW-109	Oct-20	12.44	3.59		0.0022			0.41	150.5
		8.85							

Notes:
1. Elevations are in feet relative to the North American Vertical Datum of 1988
2. ft = feet
3. Δh = Change in groundwater elevation, Δl= Distance along flow path
4. ft/ft = feet per foot
5. K values were calculated based on 2023 slug tests
6. ft/day = feet per day
7. Groundwater flow velocity equation = $(\Delta h/\Delta l * K)/n_e$
8. ft/year = feet per year

FIGURES



Legend

- Ash Landfill No. 1 CCR Downgradient Monitoring Well Location
- Ash Landfill No. 2 CCR Downgradient Monitoring Well Location
- Ash Landfill No. 2 Piezometer Location
- Downgradient GSA CCR Monitoring Well Location
- Background CCR Monitoring Well Location
- Upgradient GSA CCR Monitoring Well Location
- Shallow Delineation Piezometer and Well Location
- Deep Delineation Piezometer and Well Location
- Groundwater Elevation Contour (ft NAVD88, dashed where inferred)
- Approximate Ash Landfill No. 1 Boundary
- Approximate Property Boundary
- [14.22] Groundwater Elevation (ft NAVD88)

Notes:
1. CCR indicates Coal Combustion Residuals.
2. ft NAVD88 indicates an elevation in feet relative to the North American Vertical Datum of 1988.
3. * indicates that contours represent groundwater and not the gypsum process water contained within the Gypsum Storage Area (GSA) lined impoundments.
4. ** indicates groundwater elevations at monitoring wells PZ-200D, PZ-201D, PZ-203D, and MW2032 were not used for potentiometric surface interpretation.
5. Source of property and Gypsum Storage Area boundaries: Gulf Power drawing number ES4041S1.
6. Source of 2020 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Potentiometric Surface Contour Map
13 April 2020
Ash Landfill No. 1

Gulf Power Company
Plant Crist
Pensacola, FL

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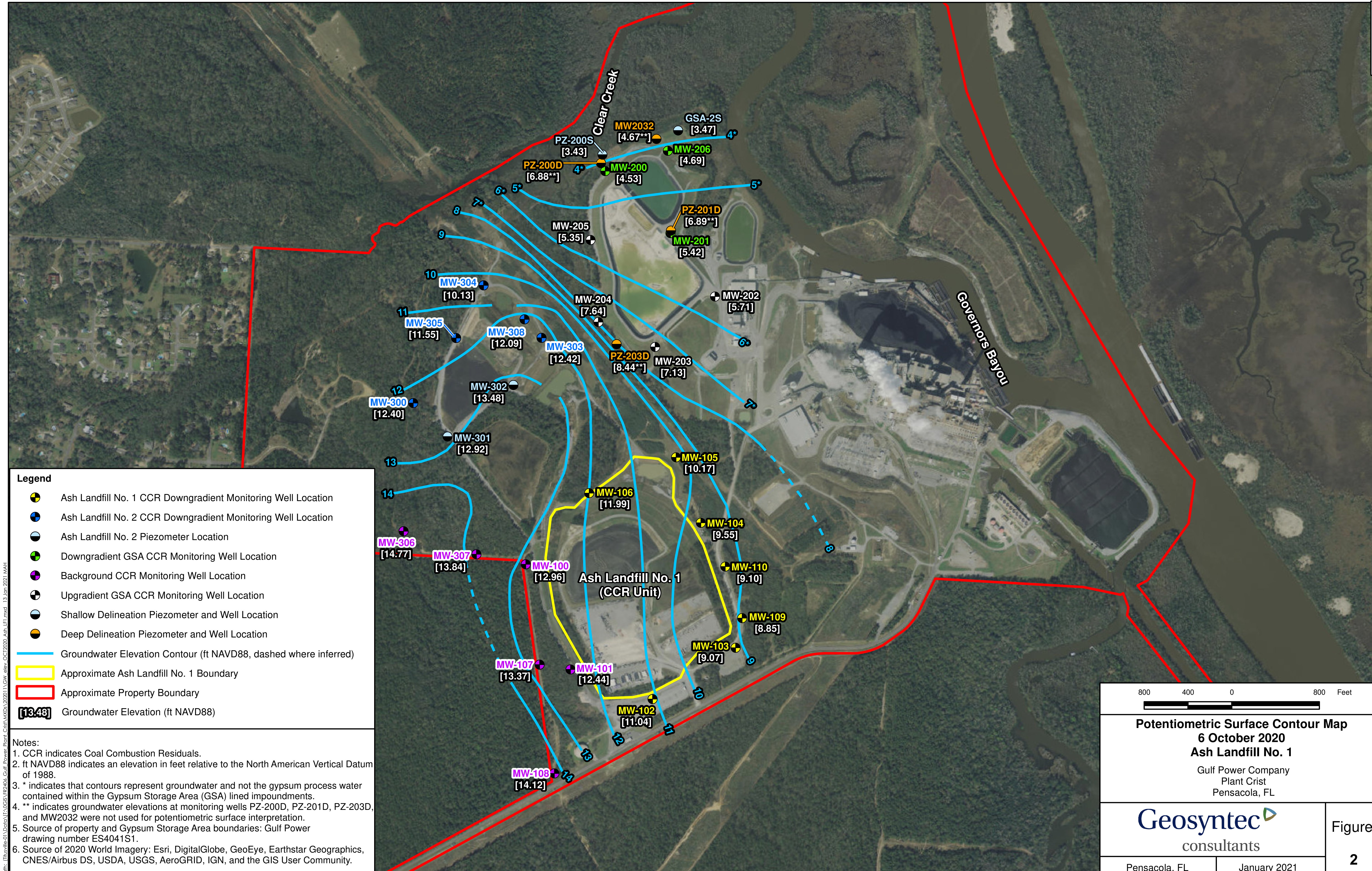
Figure **1**

Pensacola, FL	January 2021



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- Ash Landfill No. 1 CCR Downgradient Monitoring Well Location
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- Groundwater Elevation Contour (ft NAVD88, dashed where inferred)
- Approximate Ash Landfill No. 1 Boundary
- Approximate Property Boundary
- [13.48] Groundwater Elevation (ft NAVD88)

Notes:
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Potentiometric Surface Contour Map
6 October 2020
Ash Landfill No. 1

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Figure 2