Geosyntec consultants

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: 2019 Groundwater Velocity Estimate, Gulf Clean Energy Center,
Gypsum Storage Area, Pensacola, FL

INTRODUCTION

On behalf of Florida Power & Light Company ("FPL"), Geosyntec Consultants, Inc. ("Geosyntec") prepared this *2019 Groundwater Velocity Estimate Memorandum* ("Memo") for FPL's Gulf Clean Energy Center ("GCEC") Coal Combustion Residuals ("CCR") unit Gypsum Storage Area ("GSA"). The purpose of this Memo is to document the calculated horizontal groundwater velocities at the GSA in 2019. This Memo supplements the summary of CCR groundwater monitoring activities conducted in 2019 and reported in the *2019 Annual Groundwater Monitoring and Corrective Action Report* (Geosyntec, 2020[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 2019.

2. The geometric mean (geomean) hydraulic conductivity (64 feet per day [ft/day]) for the GSA documented in the *APT Well Installation, Development, and Testing Report, Crist Generating Plant* (Geosyntec, 2017[2]).

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[1] Geosyntec Consultants, 2020. *2019 Annual Groundwater Monitoring and Corrective Action Report*, Gulf Power Company, Plant Crist, Gypsum Storage Area. January 31, 2020.
[2] Geosyntec Consultants, 2017. *APT Well Installation, Development, and Testing Report, Crist Generating Plant*. November.

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 2019 are included as **Figures 1, 2, and 3**.

Horizontal hydraulic gradients between MW-204 and MW-206, a monitoring well-pair representative of groundwater flow near GSA, were calculated based on groundwater elevation data from 2019 groundwater sampling events. The resulting horizontal gradients were approximately 0.0027 ft/ft, 0.0021 ft/ft, and 0.0024 ft/ft in February, May, and October 2019, respectively.

The geomean hydraulic conductivity for the uppermost aquifer adjacent to the GSA was estimated from aquifer testing data from seven extraction wells around the GSA (Geosyntec, 2017). The lithology of this aquifer generally consists of fine to coarse sand (SCS, 2017[4]) and the geomean hydraulic conductivity (64 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 GSA were 0.70 ft/day (256 ft/year), 0.54 ft/day (197 ft/year), and 0.61 ft/day (224 ft/year) in February, May, and October 2019, respectively.

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 GSA (i.e., MW-204 and MW-206) were approximately 0.70 ft/day (256 ft/year), 0.54 ft/day (197 ft/year), and 0.61 ft/day (224

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[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.
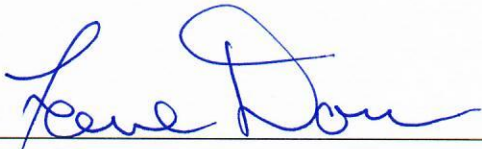[5] Freeze, R.A. and J.A. Cherry, 1979. *Groundwater*, Englewood Cliffs, NJ: Prentice Hall.

ft/year) in February, May, and October 2019, respectively. The calculated horizontal groundwater velocities for 2019 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.
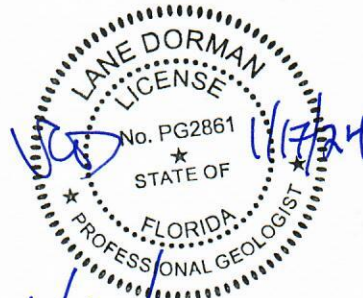
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[6] Geosyntec Consultants, Inc., 2023. *2022 Annual Groundwater Monitoring and Corrective Action Report*, Florida Power & Light Company, Gulf Clean Energy Center Gypsum Storage Area, January 31, 2023

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Benjamin K. Amos, Ph.D., P.E.   Date
Florida Professional Engineer No. 82837

Lane Dorman [signature]   [Florida Professional Geologist seal — LANE DORMAN, LICENSE No. PG2861, STATE OF FLORIDA, PROFESSIONAL GEOLOGIST] 1/17/24

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Lane Dorman, P.G.   1/17/24
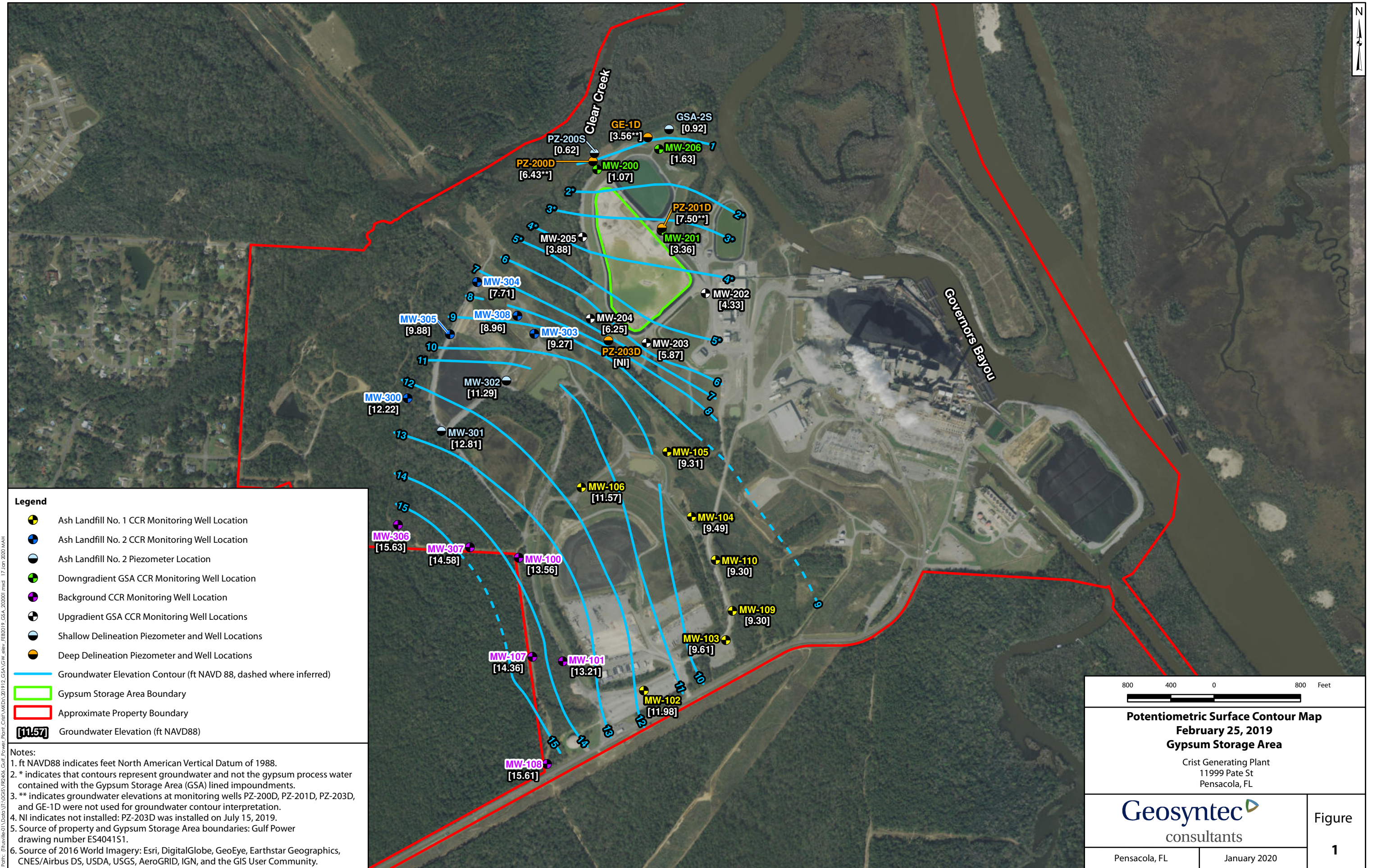Florida Professional Geologist No. PG2861   Date

TABLE

Table 1. 2019 Groundwater Velocity Input Parameters and Calculations
Gulf Clean Energy Center, Gypsum Storage Area
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-204/ MW-206	Feb-19	6.25 / 1.63	4.62	1687	0.0027	64	0.25	0.70	255.8
MW-204/ MW-206	May-19	6.15 / 2.59	3.56		0.0021			0.54	197.1
MW-204/ MW-206	Oct-19	5.38 / 1.34	4.04		0.0024			0.61	223.7

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 is the geometric mean of 2017 aquifer testing results from seven extraction wells around the gypsum storage area.

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

Potentiometric Surface Contour Map
February 25, 2019
Gypsum Storage Area

Crist Generating Plant
11999 Pate St
Pensacola, FL

Geosyntec▷
consultants

Pensacola, FL | January 2020

Figure
1

Legend

- Ash Landfill No. 1 CCR Monitoring Well Location
- Ash Landfill No. 2 CCR 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 Locations
- Shallow Delineation Piezometer and Well Locations
- Deep Delineation Piezometer and Well Locations
- —— Groundwater Elevation Contour (ft NAVD 88, dashed where inferred)
- —— Gypsum Storage Area Boundary
- —— Approximate Property Boundary
- [11.57] Groundwater Elevation (ft NAVD88)

Notes:
1. ft NAVD88 indicates feet North American Vertical Datum of 1988.
2. * indicates that contours represent groundwater and not the gypsum process water contained with the Gypsum Storage Area (GSA) lined impoundments.
3. ** indicates groundwater elevations at monitoring wells PZ-200D, PZ-201D, PZ-203D, and GE-1D were not used for groundwater contour interpretation.
4. NI indicates not installed: PZ-203D was installed on July 15, 2019.
5. Source of property and Gypsum Storage Area boundaries: Gulf Power drawing number ES4041S1.
6. Source of 2016 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

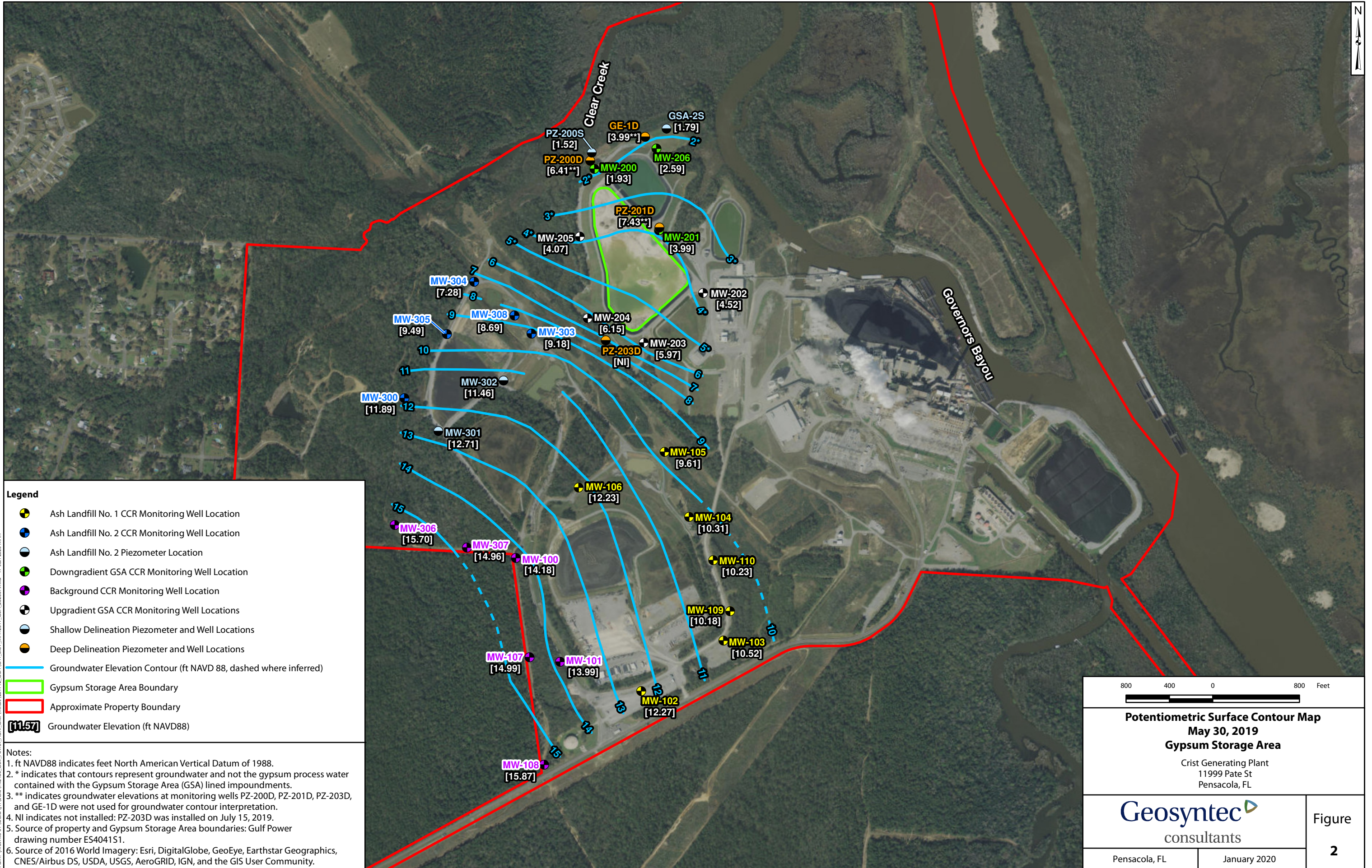Path: [Ifksville-01\Data\U1\GGS\P6240a_Gulf_Power_Point_Crist\KK00A\201912_GSA_GW_elev_FEB2019_GSA_20200.mxd 17 Jan 2020 MAH

Legend

◕	Ash Landfill No. 1 CCR Monitoring Well Location
◑	Ash Landfill No. 2 CCR Monitoring Well Location
◐	Ash Landfill No. 2 Piezometer Location
◕	Downgradient GSA CCR Monitoring Well Location
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Potentiometric Surface Contour Map
May 30, 2019
Gypsum Storage Area

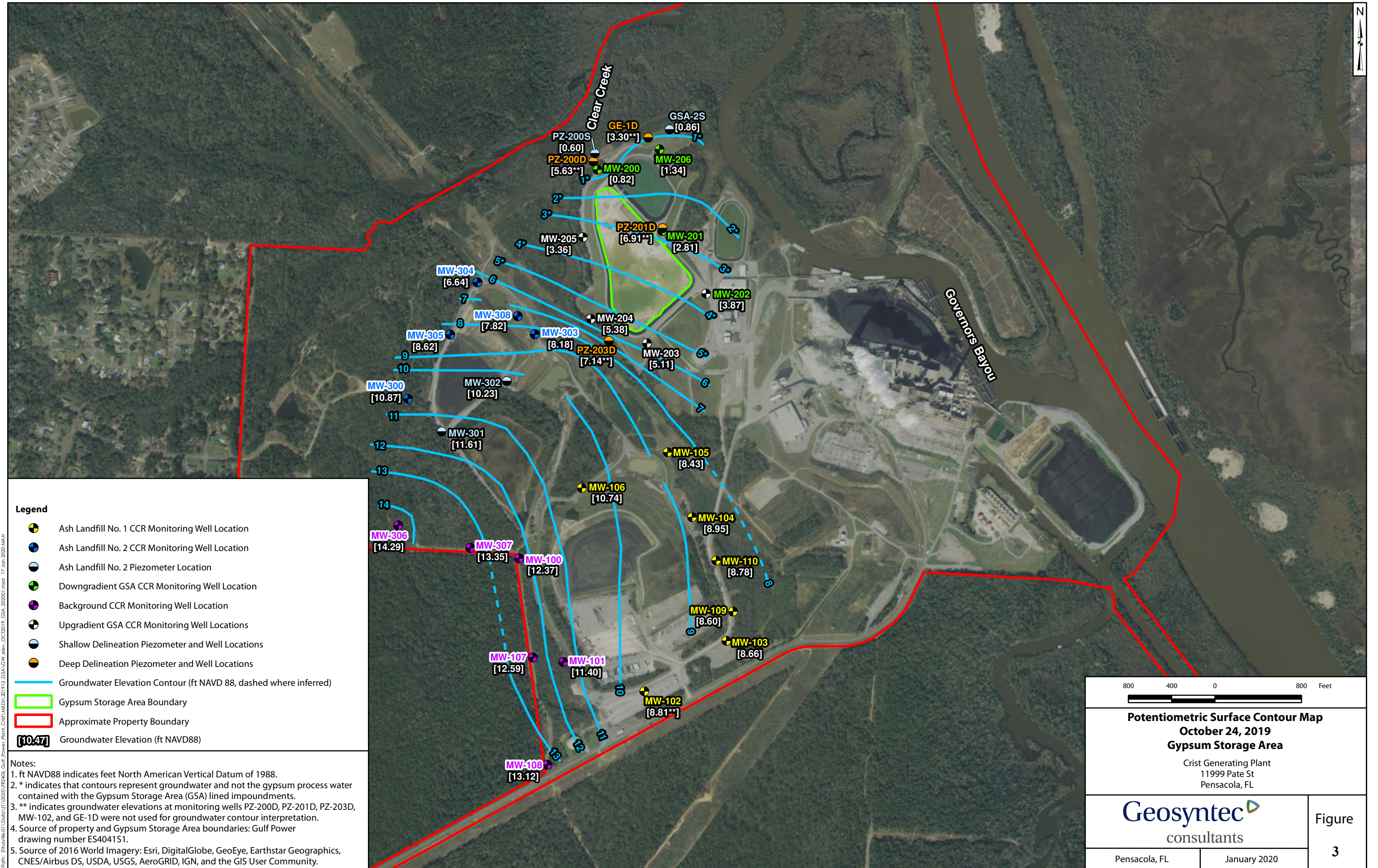Crist Generating Plant
11999 Pate St
Pensacola, FL

Geosyntec ▷
consultants

Pensacola, FL	January 2020

Figure

2

800   400   0   800   Feet

Clear Creek

Governors Bayou

GE-1D [3.30**]
GSA-2S [0.86]
PZ-200S [0.60]
PZ-200D [5.63**]
MW-200 [0.82]
MW-206 [1.34]
MW-205 [3.36]
PZ-201D [6.91**]
MW-201 [2.81]
MW-304 [6.64]
MW-202 [3.87]
MW-308 [7.82]
MW-305 [8.62]
MW-303 [8.18]
MW-204 [5.38]
PZ-203D [7.14**]
MW-203 [5.11]
MW-300 [10.87]
MW-302 [10.23]
MW-301 [11.61]
MW-105 [8.43]
MW-106 [10.74]
MW-104 [8.95]
MW-306 [14.29]
MW-307 [13.35]
MW-100 [12.37]
MW-110 [8.78]
MW-109 [8.60]
MW-107 [12.59]
MW-101 [11.40]
MW-103 [8.66]
MW-108 [13.12]
MW-102 [8.81**]

N

Legend

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Path: [titusville-01\Data\v1\UGSI\UGS\I.R240s_Gulf_Power Plant_Crist.VaR\DtV201912_GSA\GW_elev_OCT2019_GSA_20200.mxd 17 Jan 2020 MAH

800 400 0 800 Feet