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ALTERNATE SOURCE DEMONSTRATION

ASH POND

Plant Lansing Smith
Gulf Power Company
Bay County, Florida

Prepared for

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CERTIFICATION STATEMENT

Alternate Source Demonstration
Plant Lansing Smith
Ash Pond
Bay County, Florida
January 11, 2019

I, Todd Anderson, a qualified professional engineer registered in the State of Florida, certify that the above document was completed consistent with the requirements stipulated in 40 CFR 257.95(g)(3)(ii) and that the information contained herein is, to the best of my knowledge, accurate.

TODD D. ANDERSON
LICENSE
No. 51277
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

Digitally signed by Todd D. Anderson, PE
Date: 2019.01.11 13:11:09 -05'00'

Seal and Signature | Date

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1. INTRODUCTION

On behalf of Gulf Power Company (Gulf Power), Geosyntec Consultants Inc. (Geosyntec) has prepared this alternate source demonstration (ASD) report for the Ash Pond at Gulf Power's Plant Lansing Smith (Plant Smith) located in Bay County, Florida (Site) (**Figure 1**). This ASD has been prepared to meet the requirements of the U.S. Environmental Protection Agency's (USEPA's) Coal Combustion Residuals (CCR) Rule 40 CFR Part 257.95(g)(3)(ii) which states that the owner or operator may:

> *Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a qualified professional engineer. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section and may return to detection monitoring if the constituents in appendices III and IV to this part are at or below background as specified in paragraph (e) of this section. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by §257.90(e), in addition to the certification by a qualified professional engineer.*

1.1 Background

Pursuant to the CCR Rule, Gulf Power installed and certified a groundwater monitoring system for the Ash Pond at Plant Smith (**Figure 1**). Statistical analysis of data collected from the groundwater monitoring system through June 2018 indicated statistically significant levels (SSLs) of radium 226 and 228 combined (total radium) above the applicable groundwater protection standard (GWPS) at the following locations: MW-06, MW-07, MW-08, MW-09, MW-10, MW-11, MW-13 and MW-14).

1.2 Purpose

The purpose of this report is to demonstrate that (i) naturally-occurring sources of total radium are present at the Site, and (ii) that these naturally-occurring sources, not the Ash Pond, caused the SSLs detected.

2. ALTERNATE SOURCE DEMONSTRATION APPROACH

2.1 Overview

The CCR Rule does not establish specific requirements for an ASD. However, appropriate guidance is contained in the *USEPA Solid Waste Disposal Facility Criteria Technical Manual* (USEPA, 1993) for municipal solid waste landfills. The approach to this ASD is modeled on the USEPA guidance document (USEPA, 1993) and relies on three lines of evidence:

- analysis of ash stored in the Ash Pond at the Site;
- analysis of soils at the Site; and
- analysis of groundwater at the Site.

A brief description of the components of this ASD is presented below. An analysis of data and discussion is presented in Section 3. This report demonstrates that there is sufficient evidence to conclude that the Ash Pond at Plant Smith is not the source of total radium SSLs observed in the CCR groundwater monitoring system.

2.2 Analysis of Ash

The results from previous investigations on the leaching of total radium from ash at the Site were compiled and analyzed to determine the potential for ash managed in the Ash Pond to be the source of the detected SSLs of total radium. Leaching tests and groundwater data collected from within and beneath the Ash Pond were also evaluated. If observed, elevated total radium activity in the leaching tests and groundwater collected from within and beneath the Ash Pond could indicate that the Ash Pond was a potential source of total radium. Concentrations of total radium below the GWPS in these tests would confirm the presence of an alternate source of this constituent at the Site.

2.3 Analysis of Soils

Historical soil boring data were evaluated to determine the potential for naturally-occurring radionuclides on-Site. The decay of parent radionuclides, such as uranium (238) and thorium (232), results in the production of daughter radionuclides including radium (226) and radium (228). Therefore, the total radium evaluation focused on identifying the presence of parent radionuclides. The presence of parent radionuclides could indicate an alternate source of total radium at the Site. The absence of parent nuclides could indicate an anthropogenic source of radium in Site soils and groundwater.

2.4 Analysis of Groundwater

Gulf Power previously conducted an investigation in 1990 and 1991 to assess the temporal and spatial variability of total radium activity in groundwater at the Site. The presence of elevated total radium activity throughout the Site, independent of hydraulic connectivity to the Ash Pond, could indicate an alternate source of this constituent. In contrast, a localized source of total radium (such as the Ash Pond) would be indicated by the presence of elevated total radium activity in monitoring wells downgradient of the Ash Pond and the absence of elevated total radium activity in monitoring wells that are hydraulically disconnected from the Ash Pond.

3. ALTERNATE SOURCE DEMONSTRATION

3.1 Previous Site Investigations

Investigations of radiological activity in soil, groundwater, and ash at Plant Smith were previously conducted by Gulf Power between 1990 and 1997. A summary of these investigations, associated results, and conclusions is presented in this section. For detailed data presentation and interpretation, see Ardaman, 1990, 1991, and 1993, LBG-Guyton, 1997 and FDEP, 1997a and 1997b.

3.1.1 Extraction Tests on Ash

In 1990, extraction tests on samples of ash from the Plant Smith Ash Pond were conducted using deionized water and surface water from the Alligator Bayou (Ardaman, 1990) to evaluate the potential for the Ash Pond to be a source of elevated radiological activity in groundwater. The tests were conducted with pre-leach solutions of the deionized water and surface water from Alligator Bayou of different ionic strength and pH.

Results of the extraction testing indicated that the gross-alpha (gross-α) activities (a conservative proxy for total radium) for ash samples extracted with a salt water solution ranged from <1 pCi/L to 5 pCi/L and averaged 2.6 pCi/L (Ardaman, 1990). In addition, the tests demonstrated a limited correlation with ionic strength. These findings demonstrated that the ash did not generate a leachate with a significant gross-α activity (Ardaman, 1990). The report concluded, therefore, that an alternate source of radiological activity (i.e., natural sediments), not the Ash Pond, was likely.

3.1.2 Radiological Activity in Soils

In 1993, soil samples from three borings (TH-1, TH-2, and TH-5) were collected and analyzed for the activities of radium (226), radium (228), gross-α, gross-beta, uranium (238), thorium (232), and potassium (40) (Ardaman, 1990, 1993). Locations of the three borings are presented on **Figure 2**.

Parent radionuclides (uranium (238) and thorium (232)) and daughter radionuclides (radium (226), radium (228), gross-α, gross-beta) were detected in 18 soil samples collected from borings TH-1, TH-2, and TH-5 (Ardaman, 1993). Further, a strong correlation between the uranium, gross-α, and radium (226) activities was observed suggesting that the most likely source of the observed radioactivity in groundwater is the decay of naturally-occurring uranium (Ardaman, 1993). LBG-Guyton (1997) identified a similar correlation and reported coefficient of determination (R^2) values of 0.96 and 0.99 between uranium (238) and radium (226) and gross-α (a conservative proxy for total radium activity) activities, respectively. This strong correlation of uranium (238) and radium (226) indicates that natural radioactive decay processes affecting uranium (238) likely resulted in the observed radium (226) activity. Similarly, the correlation of uranium

(238) and gross-α indicates that natural radioactive decay processes affecting uranium (238) likely resulted in the observed gross-α activity.

Data compiled by Ardaman (1990, 1991, and 1993) and LBG-Guyton (1997) were used to develop a geochemical model. This model documented that the occurrence of radiological activity in groundwater is related to interactions between saline water (i.e., water with a high chloride concentration) and native sediments with naturally-occurring uranium and thorium. The results of the geochemical model suggest that the high ionic-strength saline water of the North Bay drives the release of radionuclides from the native sediments through competitive desorption. At Plant Smith, this desorption process mobilizes naturally-occurring radionuclides from mineral surfaces (LBG-Guyton, 1997).

Results of the investigations outlined above supported the conclusions that:

- the source of radioactivity in soils at Plant Smith is most likely the decay of naturally-occurring uranium and thorium;
- the interaction of saline water with the native soils at Plant Smith that are enriched in uranium and thorium drives reactions (e.g., dissolution and/or ion exchange) that release total radium; and
- elevated radiological activity is naturally-occurring and unrelated to the Ash Pond at Plant Smith (Ardaman, 1990, 1993; LBG-Guyton, 1997).

3.1.3 Radionuclides in Groundwater

In 1990 and 1991, samples of groundwater were collected from monitoring wells upgradient and downgradient of the Ash Pond, and from monitoring wells screened beneath and within the Ash Pond (Ardaman, 1990, 1991, and 1993; and LBG-Guyton, 1997). Data on the activities of radium (226), radium (228), and gross-α (a conservative proxy for total radium activity) from these wells were evaluated relative to the concentration of chloride and groundwater pH. **Figure 2** depicts the Site layout in 1997 and locations of monitoring wells that were sampled as part of the above-cited studies.

The concentration of chloride with respect to the activities of total radium and gross-α from previous investigations is presented in **Figure 3** and **Figure 4**, respectively. In general, the lowest total radium activities were associated with wells upgradient or screened within the Ash Pond (Ardaman, 1990). Specifically, the lowest total radium activities were associated with in-pond well A-5, beneath-pond wells A-8 and A-9, and downgradient well 9-12A (**Figure 3**). Wells with gross-α consistently less than the 15 picocuries per liter (pCi/L) maximum contaminant level (MCL) were upgradient wells M-1 and 9-4, in-pond wells A-4 and A-5, and beneath-pond wells A-8 and A-9 (**Figure 4**). A wide range of activities were reported for wells located downgradient of the Ash Pond (Ardaman, 1990). Several downgradient wells with elevated gross-α activity were

screened in a naturally-occurring saline wedge (based on elevated chloride concentrations) between the Ash Pond and North Bay in an area unaffected by the ash pond, suggesting the potential for a naturally-occurring, alternate source of gross-α activity (Ardaman, 1990).

The high activity of gross-α and total radium observed in wells A-6 and A-6A (which are hydraulically separated areas from Site activities) was significant. Of all wells, the highest observed concentration of total radium of 115 pCi/L was observed in well A-6A. Both wells A-6 and A-6A are located west of Alligator Bayou and not hydraulically connected to the Plant Smith Ash Pond. The elevated radium and gross-α measurements of these wells cannot be accounted for by the flow of groundwater from the Ash Pond due to the presence of the Alligator Bayou, which acts as an effective barrier to groundwater flowing from the Ash Pond (Ardaman, 1990; LBG-Guyton 1997). Therefore, the radiological activity in these wells cannot be attributed the Ash Pond, but to an alternate source of total radium.

The investigations and results described above were documented in a report (LBG-Guyton, 1997) and submitted to the Florida Department of Environmental Protection (FDEP). This report provides descriptions of groundwater flow, radionuclide levels, and statistical data, which indicate that natural sediments are the source of the radionuclides in groundwater, not the Ash Pond. FDEP agreed that gross-α and total radium levels in groundwater and surface water represent natural conditions; specifically, an apatite layer within the native soils and sediments rich in radionuclides is influenced by ion exchange processes resulting from interactions with the bay waters, which contain elevated concentrations of chlorides (FDEP, 1997a and 1997b).

The results of these investigations demonstrate that:

- elevated levels of radium and gross-α observed in monitoring wells can be traced to naturally-occurring sources of radium in the Site's sediments as evidenced by the elevated radioactivity in wells that are hydraulically disconnected from the Ash Pond; and
- the Ash Pond is not the source of elevated radioactivity in CCR groundwater monitoring wells, as evidenced by concentrations of total radium below the GWPS in wells screened within and beneath the Ash Pond.

3.2 CCR Groundwater Data

Groundwater data compiled after 1997 were primarily from monitoring wells installed in conjunction with a FDEP program to assess compliance of the facility with the National Pollutant Discharge Elimination System (NPDES) permit (FL0002267). Total radium activity was observed to be lowest in upgradient CCR wells MW-02 and MW-03. The

concentration of chloride in each of these wells is less than 20 milligrams per liter (mg/L). The relatively low chloride concentrations in groundwater near MW-02 and MW-03 may limit the release of naturally-occurring radionuclides and result in lower observed total radium activity in the groundwater at these monitoring wells.

Total radium activity in the upgradient monitoring well MW-12, located near the west bank of Alligator Bayou, ranged from 1.84 pCi/L to 4.64 pCi/L, and the concentration of chloride ranged from 140 mg/L to 230 mg/L. However, this well is outside the influence of the naturally-occurring saline wedge that dominates the groundwater along the shoreline of North Bay (locations downgradient of the Ash Pond). Therefore, the lower chloride concentrations in MW-12 are also likely a limiting factor in the release of naturally-occurring radionuclides.

Total radium levels in CCR wells surrounding the Ash Pond are greater than 5 pCi/L, and the concentration of chloride in these monitoring wells range from 1,400 mg/L to 5,400 mg/L. The presence of elevated chloride concentrations in these locations is consistent with previous investigations (Ardaman, 1990; LBG-Guyton, 1997) and suggests that the interaction of high chloride groundwater with naturally-occurring radionuclides in native sediments at the Site results in the elevated levels of radiological activity in these wells.

Based on the above, the data indicates that the source of SSLs for total radium in the Site's CCR groundwater monitoring wells is from naturally-occurring radionuclides, as documented by LBG-Guyton (LBG-Guyton, 1997), and concurred with by FDEP (FDEP, 1997a and 1997b).

4. CONCLUSIONS

This ASD was prepared pursuant to 40 CFR 257.95(g)(3)(ii) and demonstrates the following:

- the parent radionuclides that decay into total radium are naturally-occurring constituents in native sediments at Plant Smith;
- the interaction between saline groundwater and native sediments enriched in uranium and thorium (parent radionuclides to total radium) mobilizes total radium into groundwater; and
- the results of the extraction tests conducted on ash from the Plant Smith Ash Pond demonstrate that the Ash Pond was not the source of the SSLs for total radium reported in groundwater monitored by the Site's CCR monitoring wells.

This ASD documents that the SSLs reported for total radium are from a source other than the Ash Pond at Plant Smith. Accordingly, assessment of corrective measures or remedial action will not be performed for total radium at this time. Assessment and/or detection monitoring for total radium, as applicable, will continue for the Ash Pond.

5. REFERENCES

Ardaman & Associates, Inc. (Ardaman), June 1990. *Supplemental PCAR, Ash Pond, Lansing Smith Generating Plant, Gulf Power Company, Bay County, Florida.*

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Florida Department of Environmental Protection (FDEP), 6 June 1997a. *Radionuclides at Gulf Power Lansing Smith Plant.*

Florida Department of Environmental Protection (FDEP), 9 June 1997b. *Comments concerning "Factors Affecting the Distribution of Radiological Activity in Groundwater in the Vicinity of Plant Lansing Smith, Bay County, Florida.*

LBG-Guyton Associates, May 1997. *Factors Affecting the Distribution of Radiological Activity in Ground Water in the Vicinity of Plant Lansing Smith, Bay County, Florida.*

United States Environmental Protection Agency (EPA), November 1993. *EPA Solid Waste Disposal Facility Criteria Technical Manual.*

FIGURES

Legend

- Property Line
- Ash Pond (CCR Unit)
- CCR Monitoring Well
- Piezometer

Note: CCR = Coal Combustion Residuals

N

0 1,500 Feet

Site Layout

Plant Smith
Bay County, Florida

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Figure 1

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Legend

- Soil Boring
- NPDES Well
- Presumed Abandoned
- Property Line

Notes:
1. Monitoring wells that are presumed to be abandoned were georeferenced from Figure 1 in the Addendum to Supplemental PCAR dated May 1991 prepared by Ardaman & Associates, Inc. Soil Borings TH-1, TH-2, and TH-5 georeferenced from "Site and Boring Location Map", Ardaman & Associates, Inc., 1993.
2. NPDES indicates National Pollutant Discharge Elimination System.

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0 1,500 Feet

1997 Site Map

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Figure 2

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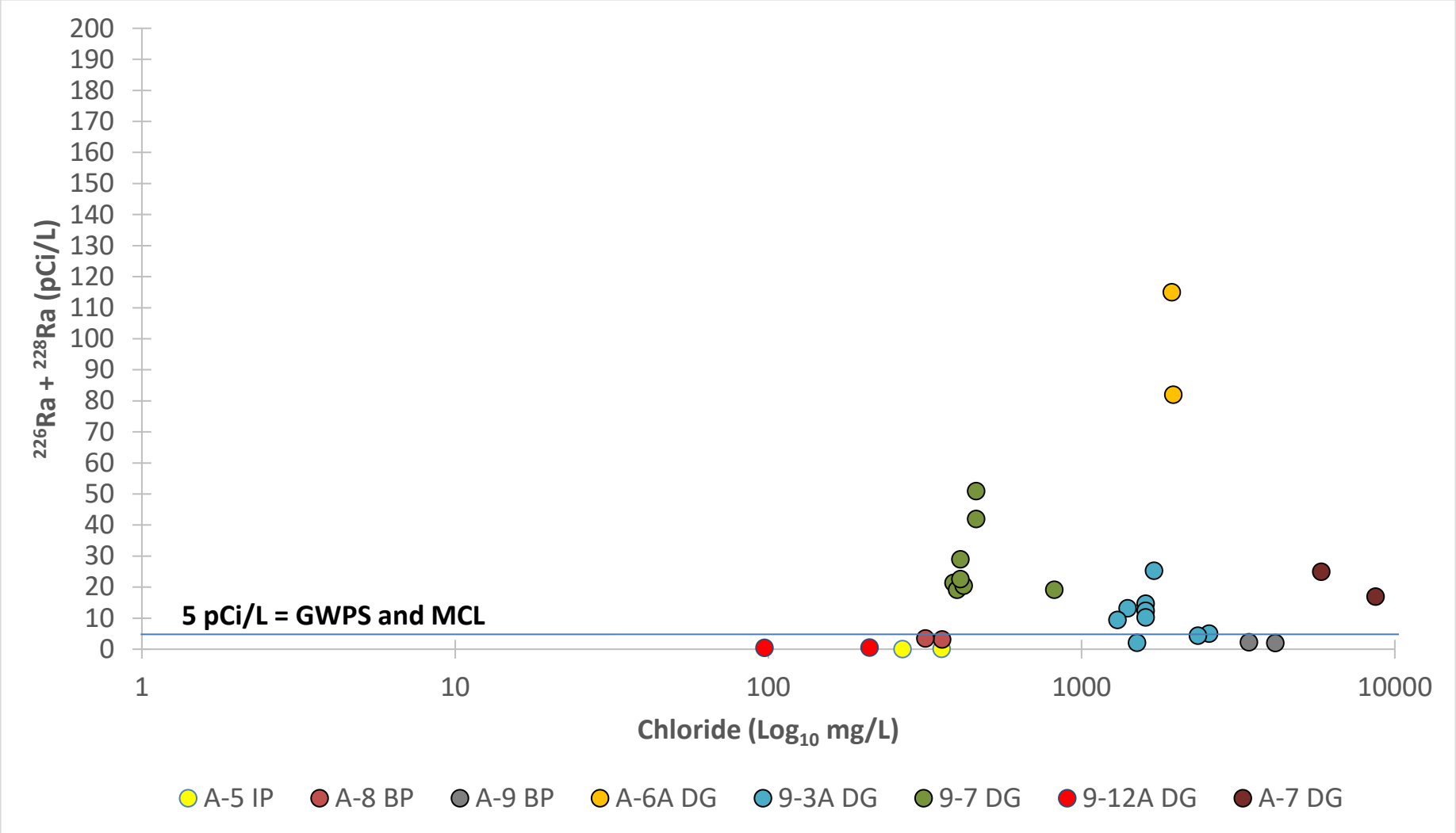

Notes
IP = in-pond
BP = beneath-pond
DG = downgradient
pCi/L = picocuries per liter
mg/L = milligrams per liter
^{226}Ra = radium-226
^{228}Ra = radium-228
GWPS = Groundwater Protection Standard
MCL = Maximum Contaminant Level

1997 Total Radium vs. Chloride Concentrations
Plant Smith
Bay County, Florida

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Figure 3

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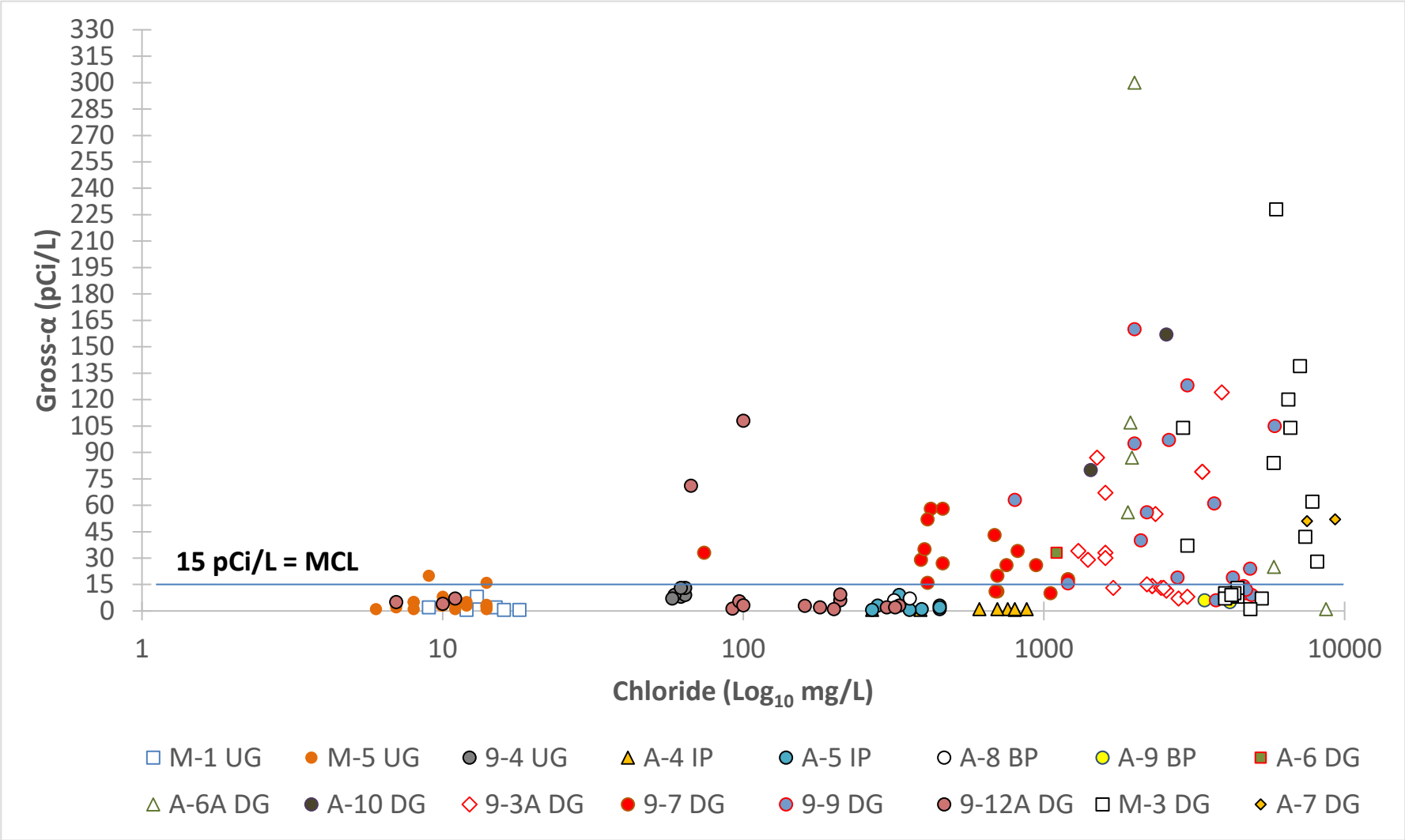

Notes
UG = upgradient
IP = in-pond
BP = beneath-pond
DG = downgradient
pCi/L = picocuries per liter
mg/L = milligrams per liter
Gross-α = gross alpha
MCL = Maximum Contaminant Level

Gross Alpha vs. Chloride Concentrations
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Figure 4

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