# FEDERAL CCR CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
# AES PUERTO RICO LP, GUAYAMA, PUERTO RICO

OCTOBER 2023

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| | |
|---|---|
| AES-PR | AES Puerto Rico, LP |
| CAGWMP | Corrective Action Groundwater Monitoring Plan |
| CCR | Coal Combustion Residuals |
| CFR | Code of Federal Regulations |
| COC | Chain of Custody |
| DNA | DNA-Environment, LLC |
| EPA | Environmental Protection Agency |
| GWPS | Groundwater Protection Standard |
| LCS | Laboratory Control Sample |
| Ln | Natural Logarithm |
| MCL | Maximum Contaminant Level |
| mg/L | Milligrams per Liter |
| MNA | Monitored Natural Attenuation |
| MS/MSD | Matrix Spike and Matrix Spike Duplicate |
| N&E | Nature and Extent |
| PE | Professional Engineer |
| PQL | Practical Quantitation Limit |
| QC | Quality Control |
| RL | Reporting Limit |
| ROS | Regression of Order Statistics |
| RPD | Relative Percent Difference |
| § | Section |
| SSL(s) | Statistically Significant Level(s) |
| UCL | Upper Confidence Limit |
| USEPA | United States Environmental Protection Agency |
| UTL | Upper Tolerance Limit |

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# 1 INTRODUCTION

## 1.1 Purpose and Scope

AES Puerto Rico, LP (AES-PR; Guayama, PR) will implement a corrective action groundwater monitoring program under the United States Environmental Protection Agency's Coal Combustion Residuals (CCR) Rule, pursuant to 40 CFR §257.98, *Implementation of the Corrective Action Program*.

This Corrective Action Groundwater Monitoring Plan (CAGWMP) has been prepared to ensure compliance with 40 CFR §257.98 and specifically with 40 CFR §257.98(a)(1), which states that the CAGWMP must:

i. Meet the requirements of an assessment monitoring program under 40 CFR §257.95,

ii. Document the effectiveness of the corrective action remedy, and

iii. Demonstrate compliance with the groundwater protection standards (GWPS) pursuant to 40 CFR §257.98(c).

This CAGWMP contains the following components:

i. <u>Groundwater Sampling and Analysis</u> - describes the procedures for groundwater sampling, analysis, quality control, sample preservation, sample documentation, and chain-of-custody control for the constituents listed in Appendix III and Appendix IV to 40 CFR §257.

ii. <u>Documenting Corrective Action Effectiveness</u> - describes the procedures to document the effectiveness of the corrective action remedy.

iii. <u>Statistical Evaluation</u> - describes the statistical methods to evaluate the groundwater sample results collected under corrective action groundwater monitoring. As a supplemental document, **Appendix A** includes the Professional Engineer (PE) Certified Statistical Analysis Plan (the "2023 Statistical Analysis Plan"), which updates and replaces the procedures presented in the original statistical analysis plan prepared in 2017.[1]

## 1.2 Facility Operations and CCR Groundwater Monitoring System

AES-PR operates a coal-fired power plant located in the municipality of Guayama on the south coast of Puerto Rico (**Figure 1**; hereinafter the Facility or Site). The Facility utilizes bituminous coal for energy production and generates CCR, which are converted to a manufactured aggregate known as Agremax™ that is stored in a temporary staging area located at the southern portion of the Site (**Figure 2**).

[1] The original PE-Certified Statistical Analysis Plan for the CCR groundwater monitoring program at AES-PR was prepared in 2017 and included in the document entitled *Groundwater Monitoring System & Sampling and Analysis Program, AES Puerto Rico LP, Guayama, Puerto Rico* (DNA, August 2017).

The current monitoring network consists of five wells as follows: two monitoring wells located hydraulically upgradient of the Agremax™ staging area (*i.e.*, background wells MW-1 and MW-2), and three monitoring wells located immediately, hydraulically downgradient of the Agremax™ staging area (*i.e.*, downgradient wells MW-3, MW-4, and MW-5). The location of the CCR monitoring well system is shown in **Figure 2**.

Annual and semiannual groundwater sampling and analysis have been conducted for the Appendix III and Appendix IV constituents at the current CCR monitoring network at AES-PR since completion in 2017 of the initial eight rounds of detection monitoring events. Following assessment monitoring in 2018, a statistical evaluation completed in January 2019 identified statistically significant levels (SSLs) above the GWPS for lithium, molybdenum, and selenium in groundwater samples collected from certain downgradient monitoring wells. The corresponding notification was completed and posted to the AES-PR CCR website pursuant to 40 CFR §257.95(g) and §257.107(h)(6).

Nine additional temporary monitoring well points were installed in 2019 (TW-101 through TW-109; see **Figure 3**). The purpose of these temporary monitoring wells was to determine the nature and extent (N&E) of groundwater impacts following identification of SSLs for lithium (MW-4), molybdenum (MW-3 and MW-4), and selenium (MW-3) per 40 CFR §257.95. TW-101 through TW-103 were set at the Agremax™ staging area waste boundary; TW-104 through TW-109 were placed downgradient along the property boundary. Temporary monitoring wells have since been redeveloped and steps will be taken to convert the wells to permanent monitoring wells in 2023.

Once N&E was defined per 40 CFR §257.95(g)(1), an assessment of corrective measures was initiated for the Agremax™ staging area in April 2019. This assessment of corrective measures was completed in September 2019, and a public meeting was held in December 2019. A remedy was selected pursuant to 40 CFR §257.97 in June 2020.

AES-PR is currently implementing the selected groundwater remedies (Corrective Action or Action) required by the CCR Rule, as described in the June 2020 *Report on Selection of Remedy, AES Puerto Rico – AGREMAX™ STAGING AREA,* which is available at AES-PR's public CCR Website at https://www.aespuertorico.com/en/ccr. The selected remedy is to prevent Agremax™ contact with the ground by installation of a synthetic liner and to employ Monitored Natural Attenuation (MNA).

## 2 CAGWMP - GROUNDWATER SAMPLING AND ANALYSIS

Corrective action groundwater monitoring will begin following the substantial completion of the installation of the synthetic liner at the Agremax™ staging area. Corrective action groundwater monitoring is required at any monitoring well within the facility's groundwater monitoring system where a constituent has been detected at an SSL above the associated GWPS (as established under 40 CFR Part 257).

Sampling and analysis requirements during corrective action groundwater monitoring are similar to those under assessment monitoring. During both monitoring programs, an annual groundwater sampling event is required for the analysis of all Appendix IV constituents [40 CFR §257.95(b)], and semiannual sampling events are required for the analysis of Appendix III and previously detected Appendix IV constituents [40 CFR §257.95(d)(1)]. As with assessment monitoring, the annual sampling event will be scheduled to coincide with the first semiannual sampling event during the implementation of the corrective action groundwater monitoring program at AES-PR.

The CAGWMP network will consist of fourteen monitoring wells (**Table 1**). All upgradient and downgradient wells will be sampled as described in the previous paragraph, with the exception of two downgradient wells (TW-104 and TW-109), which will only be gauged for water level information and geochemical field parameters to inform groundwater flow dynamics at the site.

**Table 1**. Corrective Action Groundwater Monitoring Program Well Network Summary

| Well ID | Location | Appendix III[1] | Appendix IV[2] | Geochemical Field Parameters[3] | Water Level |
|---|---|---|---|---|---|
| MW-1 | Upgradient | X | X | X | X |
| MW-2 | Upgradient | X | X | X | X |
| MW-3 | Downgradient – SAB[4] | X | X | X | X |
| MW-4 | Downgradient – SAB | X | X | X | X |
| MW-5 | Downgradient – SAB | X | X | X | X |
| TW-101 | Downgradient – SAB | X | X | X | X |
| TW-102 | Downgradient – SAB | X | X | X | X |
| TW-103 | Downgradient – SAB | X | X | X | X |
| TW-104 | Downgradient – Flow Dynamics | | | X | X |
| TW-105 | Downgradient | X | X | X | X |
| TW-106 | Downgradient | X | X | X | X |
| TW-107 | Downgradient | X | X | X | X |
| TW-108 | Downgradient | X | X | X | X |
| TW-109 | Downgradient - Flow Dynamics | | | X | X |

[1] Appendix III to 40 CFR Part 257; see Table 2 for additional details.
[2] Appendix IV to 40 CFR Part 257; see Table 2 for additional details.
[3] Geochemical Field Parameters will include: temperature, pH, conductivity, redox potential, dissolved oxygen, and turbidity.
[4] SAB = Staging Area Boundary

The rationale for well selection and sampling approach is as follows:

- **Achieving compliance with GWPS at the downgradient boundary of the Agremax™ staging area**: wells MW-3, TW-102, MW-4, and TW-103 are located immediately downgradient from the staging area and have shown concentrations above the applicable GWPS. Wells TW-101 and MW-5 are downgradient/proximal to the staging area boundary. Although no SSL has been detected in these wells, they will be monitored to demonstrate GWPS compliance at the CCR Unit waste boundary. Sampling of these wells will include measuring field parameters (as discussed in Section 2.2) and analysis of Appendix III and Appendix IV constituents.
- **Demonstrating plume stability and concentrations:** wells TW-105, TW-106, TW-107, and TW-108 are located at the downgradient property limit and downgradient from MW-3, TW-102, MW-4, and TW-103. Groundwater data from these wells will be used to demonstrate plume stability and that GWPS are being met throughout the plume. These wells will be sampled and analyzed as above.
- **Monitoring groundwater flow dynamics due to corrective action remedy implementation:** The static water level will be gauged in all wells and piezometers shown in **Figure 3** to assess if and how groundwater flow dynamics are modified after the installation of the composite liner at the staging area. TW-104 and TW-109 will be used to monitor groundwater levels and field parameters (see **Table 1**).

For additional information on the technical evaluation for this approach, see **Appendix B**.

The field and laboratory procedures described in the following sections are applicable to all groundwater monitoring phases at AES-PR (*i.e.*, detection, assessment, and corrective action groundwater monitoring).

## 2.1 Sample Containers, Identification and Documentation

Groundwater and quality control samples will be collected in laboratory-supplied containers to which the analytical laboratory has added the required sample preservative. Sample containers will have pre-affixed labels indicating the required analytical methods. The type of sample container will be compatible with the sample matrix and analyses to be performed. The laboratory will also provide chain-of-custody forms and coolers for sample packing and shipment.

Prior to sample collection, the following information will be recorded using a permanent ink marker:

- Sample Identification Number
- Date and Time of Sample Collection
- Sampler's Name
- Matrix Type

Errors will be corrected by drawing a single line through the original entry and writing the persons´ initials next to the new entry.

Samples will be identified using the following nomenclature: "*Site Identification - Sampling Location – Collection Date*." An example of a sample identification number is as follows: *AES-MW1-101823*. This sample identification number would correspond to a groundwater sample collected at the AES-PR Site from monitoring well MW-1 on October 18, 2023. Samples collected for quality control purposes will be identified in a similar manner. For example, *AES-FB-101823* will identify a field blank collected at the AES Site on October 18, 2023.

Field activities and site conditions will be annotated in a field notebook using a permanent ink pen.

## 2.2 Sample Collection, Handling and Shipping

Sampling personnel will wear disposable nitrile gloves during monitoring well purging, sampling and sample handling. A new pair of gloves will be used between each sampling location.

Groundwater purging and sampling will be conducted using the *Low Stress* (*Low Flow*) *Purging and Sampling Procedure* in accordance with USEPA Region 2 (USEPA, 1998). Low-flow purging and sampling will be conducted using a peristaltic pump and flow through cell attached to a handheld multi-parameter meter (to monitor pH, conductivity, dissolved oxygen, oxidation-reduction potential, and temperature). Turbidity measurements will be collected using a turbidimeter. The peristaltic pump will be set at a flow rate not to exceed 150 milliliters/minute to attain laminar flow of groundwater inside the well screen. The pump tubing will be set at a depth corresponding to the vertical mid-section of the well screen. Purging will proceed until field parameters have stabilized, after which the groundwater sample will be collected. The detailed Low-Flow Purging and Sampling procedure is included in **Appendix C**.

The multi-parameter meter and turbidimeter will be calibrated in the morning before each day of groundwater sampling. Instrument calibration will be performed per the manufacturers' instructions. Instrument calibration date, time and calibration readings will be recorded on an instrument calibration sheet. Similarly, field parameter measurements collected during monitoring well purging and sampling will be recorded on field parameter sheets. **Appendix D** includes copies of the field sheets that will be used to record the results of instrument calibration and field parameters.

All sampling equipment in contact with the sample will be dedicated and disposable. Therefore, sampling equipment decontamination will not be required.

Groundwater samples for metal analyses will not be field filtered so as to measure the "total recoverable metals" present in the particulate and dissolved fractions of the sample.

All samples for analyses requiring cooling will be kept on ice, inside chest coolers, until samples are delivered to the analytical laboratory to ensure sample integrity. Samples for Radium 226 and 228 analyses will be packed inside chest coolers without ice (as cooling is not required for these analyses). Samples will be packed and shipped via overnight carrier to the analytical laboratory following chain-of-custody protocols.

### 2.2.1 Analytical Laboratories

Samples will be submitted to Eurofins Environment Testing (formerly Eurofins Test America) laboratory facilities in Chicago, Illinois. The shipping address and phone number are provided below.

Eurofins Chicago
2417 Bond Street
University Park, IL
Phone (708) 534-5200

The CCR groundwater monitoring program is a long-term project, other qualified providers of analytical services may also be considered and used.

## 2.3 Chain of Custody Record

A chain-of-custody record (COC Record) will be maintained to ensure that samples have not been mishandled throughout sample handling and analysis processes. A copy of the field COC Record that will be used in the groundwater monitoring program is provided in **Appendix E**.

The COC Record will be filled out completely and legibly (in print) with permanent ink. Errors will be corrected by drawing a single line through the initial entry and initialing the change. All sample transfers will be recorded on the COC Record in the “relinquished by” and “received by” sections.

The field sampling technician will be responsible for maintaining sample custody, and for delivering all sample-containing coolers to FedEx for overnight shipping to the analytical laboratory.

## 2.4 Analytical Methods

**Table 2** summarizes the analytical methods and testing requirements for groundwater and quality control samples for the constituents listed in Appendix III and Appendix IV to 40 CFR Part 257.

**Table 2**. Analytical Methods and Testing Requirements for Groundwater and Quality Control Samples

| Parameter | Testing Method | Holding Time Before Extraction | Container Type | Preservation |
|---|---|---|---|---|
| *Appendix III to 40 CFR Part 257 - Constituents for Detection Monitoring* | | | | |
| Boron | EPA 6020B | 180 days | Plastic 250 mL | $HNO_3$ to pH<2 [1] Cool, <6 °C [2] |
| Calcium | EPA 6020B | 180 days | Plastic 250 mL | $HNO_3$ to pH<2 Cool, <6 °C [2] |
| Chloride, Total | SM 4500 Cl- E [3] or EPA 9056A | 28 days | Plastic 1 L | Cool, <6 °C |
| Fluoride | SM 4500 F C [3] or EPA 9056A | 28 days | Plastic 1 L | Cool, <6 °C |
| Sulfate, Total | SM 4500 SO4 E [3] or EPA 9056A | 28 days | Plastic 1 L | Cool, <6 °C |
| Total Dissolved Solids | SM 2540C | 7 days | Plastic 1 L | Cool, <6 °C |
| pH | Field pH Meter | Immediately | Plastic or Glass | Not Applicable |
| *Appendix IV to 40 CFR Part 257 – Constituents for Assessment Monitoring* | | | | |
| Metals (Sb, As, Ba, Be, Cd, Cr, Co, Pb, Li, Mo, Se, Tl) [4] | EPA 6020B | 180 days | Plastic 250 mL | $HNO_3$ to pH<2 Cool, <6 °C |
| Mercury | EPA 7470A | 28 days | Plastic 250 mL | $HNO_3$ to pH<2 Cool, <6 °C |
| Fluoride | SM 4500 F C or EPA 9056A | 28 days | Plastic 1 L | Cool, <6 °C |
| Radium 226 and 228 combined | 9315-Ra226 & 9320-Ra228 | 180 days | Plastic 1 L | $HNO_3$ to pH<2 |

[1] HNO3 to pH <2 = Nitric acid added to lower sample pH to less than two units.
[2] Cool, <6 °C = Cool sample to six degrees Celsius or less.
[3] SM 4500 = Series 4500 of Standard Methods for the Examination of Waters and Wastewaters are USEPA-approved analytical test methods under 40 CFR Appendix A to Subpart C of Part 141.
[4] Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, lithium, molybdenum, selenium, and thallium.

## 2.5 Quality Assurance and Quality Control

In addition to the collection of groundwater samples, field and laboratory quality control samples will be prepared and analyzed for quality assurance and quality control purposes.

### 2.5.1 Field Quality Control

The following field quality control samples will be collected for each groundwater-sampling event:

- Field duplicate
- Field blank
- Matrix Spike and Matrix Spike Duplicate (MS/MSD).

Equipment blanks will not be collected given that all sampling equipment in contact with the sample will be dedicated and disposable.

The field duplicate groundwater sample will be collected from one of the downgradient wells at a rate of one field duplicate per sampling event. Sampling error due to sampling technique and matrix heterogeneity will be estimated by calculating the relative percent difference (RPD) between the field sample and corresponding field duplicate. The RPD is a measure of precision, and field duplicates measure both the field and laboratory precision. The target RPD value for field duplicate samples will be 20% or less (*i.e.*, $\leq$ 20%) for constituents detected at concentrations above the laboratory reporting limit (*i.e.*, the practical quantitation limit). Any RPD value above 20% will be noted and its potential causes investigated so that these may be corrected or mitigated in future sampling events. Analytical results need to be at least five times the reporting limit to allow for the evaluation of matrix or sampling issues.

One field blank will be collected per sampling day. The field blank will be prepared in the field by pouring laboratory-supplied deionized water into the sample containers provided by the laboratory. The field blank will be kept open during sampling and will be closed at the end of the sampling day. The associated laboratory method blank will be evaluated if any constituent is detected in the field blank (see the Analytical Quality Control section below). A constituent detected in the field blank but not in the corresponding laboratory method blank may indicate sample contamination. Potential contamination sources may derive from the sample container, laboratory-added sample preservative, or other laboratory or field sources. Detections above the reporting limit will be investigated if present in the field blank but not in the associated laboratory method blank.

Triple sample-volume from one of the monitoring wells will be collected in the field. This will result in the collection of three sets of sample containers. The additional sample volume will be submitted to the analytical laboratory for the preparation of laboratory QC samples, including the MS and MSD (see below).

All field QC samples will be handled and shipped in the same manner as the collected groundwater samples and will be analyzed for the required Appendix III and Appendix IV CCR constituents.

### 2.5.2 Analytical Quality Control

The analytical laboratory will prepare and analyze laboratory QC samples per its Quality Assurance Manual. Laboratory QC samples will consist of laboratory blanks, laboratory control samples, matrix spike/matrix spike duplicates (MS/MSD), and sample duplicates, among others.

The laboratory will prepare a method blank to evaluate if contamination has been introduced during sample preparation or analysis. The method blank will be prepared and analyzed along with the corresponding samples at a frequency of one blank per analytical batch. The laboratory will take and document corrective action if the concentration of any target analyte is detected in the method blank above the laboratory reporting limit and if less than ten times of the amount of the analyte found in the associated sample. Corrective actions may include the re-preparation and re-analysis of all samples, where possible, along with a full set of the required QC samples. Data qualifiers will be applied to any result reported that is associated with a contaminated method blank.

The MS/MSD for each matrix type will contain all analytes specified by the analytical method and will be analyzed once per every 20 samples for each analytical method for which an MS and MSD sample is required. The MS and MSD will be evaluated against the corresponding method control limits. Any compound outside control limits will be qualified appropriately.

The laboratory will prepare a Laboratory Control Sample (LCS) to evaluate the performance of the entire analytical system, including preparation and analysis. The LCS will contain all analytes specified by the analytical method and will be analyzed along with the corresponding samples at a frequency of one LCS per batch. The LCS will be evaluated against the corresponding method control limit. Any compound outside control limits will be qualified appropriately. Any associated sample containing an "outside of control" analyte will be re-analyzed with a successful LCS or reported with the appropriate data qualifier.

# 3 STATISTICAL EVALUATION PROCEDURES

The procedures described in this section are tailored to the statistical evaluation of groundwater data obtained during the implementation of corrective action monitoring at AES-PR. However, given that well/constituent pairs that have not been detected at an SSL above GWPS will remain under assessment monitoring, and the AES-PR monitoring program is expected to revert to detection monitoring in the future, an updated Statistical Analysis Plan applicable to all groundwater monitoring phases has been included in **Appendix A** (the "2023 Statistical Analysis Plan"). The 2023 Statistical Analysis Plan replaces the original Statistical Analysis Plan prepared in 2017 that was included in the document entitled *Groundwater Monitoring System & Sampling and Analysis Program, AES Puerto Rico LP, Guayama, Puerto Rico* (DNA, August 2017). The 2023 Statistical Analysis Plan has been certified by a qualified professional engineer pursuant to 40 CFR §257.93(f)(6).

Statistical procedures will be performed in accordance with the USEPA guidance document entitled: *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (USEPA, 2009), commonly referred to as the Unified Guidance. Graphical and statistical analyses will be conducted using Sanitas™ Statistical Software or similar software (*e.g.*, ProUCL, R statistical software, or others).

## 3.1 Reviewing and Preparing Data

The following statistical procedures for data screening and preparation will be performed on all upgradient and downgradient groundwater datasets whether generated during detection, assessment, or corrective action monitoring.

### 3.1.1 Summary Statistics

Summary statistics (*e.g.*, mean, median, standard deviation) will be calculated for all available datasets. Graphical representations of descriptive statistics may be generated as appropriate.

### 3.1.2 Identification of Potential Outliers

Time series graphs and side-by-side box plots will be constructed for each well and constituent pair (well/constituent pair) to identify potential outliers visually. The Tukey's Outlier Screening test, Dixon statistical test, or similar procedure will be performed to confirm the presence or absence of outlier values. The Unified Guidance recommends that testing for outliers be performed, but outliers should not be generally removed unless error or basis for the observed discrepancy can be identified. Potential sources of errors may include sampling and analytical errors. Potential discrepancies may include inconsistent sample turbidity, and values significantly outside the historical ranges of existing data. Even if excluded from statistical analyses, outlier values should be flagged and maintained in the database to be reevaluated as new data become available.

### 3.1.3 Temporal Trends

The least-squares linear regression, or the Sen's Slope/Man-Kendall procedure, will be performed to test if a significant temporal trend exists. The least-squares linear regression method will be used when the dataset follows a normal or transformed normal distribution and when the dataset contains less than 15% non-detects. In addition, the regression residuals must be normally distributed and show equal variance across time. Otherwise, non-parametric methods (*e.g.*, Sen's Slope/Mann-Kendall) will be used to test for significant linear trends.

### 3.1.4 Testing for Normality

The Shapiro-Wilk method or similar procedure will be performed to test for normality. Whenever possible, non-normally distributed data will be transformed to normally distributed data using the Ladder of Powers procedure. In this method, the data is submitted to the following transformation sequence: $x$, $x^{1/2}$, $x^2$, $x^{1/3}$, $x^3$, $\ln(x)$, $x^4$, $x^5$, $x^6$, until a suitable transformation is applied to normalize the data.

### 3.1.5 Handling of Datasets with Non-Detect Results

Where available, estimated results less than the RL (*i.e.*, "J" flagged data) will be used in the statistical evaluation. Groundwater analytical data with non-detect results will be handled as follows:

- Datasets containing less than 15% non-detects will be replaced with one-half the reporting limit (RL). The reporting limit to be used for non-detects will be the practical quantitation limit (PQL) as reported by the analytical laboratory (typically identified as "RL" in laboratory analytical reports).
- Datasets containing between 15-50% non-detects will be submitted to the Kaplan-Meier adjustments, or regression of order statistics (ROS) adjustments, or similar tests. These

methods adjust the mean and standard deviation of the dataset to account for concentrations below the reporting limit.

- Nonparametric statistics will be used on datasets containing greater than 50% non-detects. Non-detects will be set at the RL (*i.e.*, PQL) for statistical testing.
- Note that statistical analyses are not required on well/constituent pairs containing 100% non-detects (refer to the Unified Guidance 2009, Chapter 6).

## 3.2 Corrective Action Monitoring

In corrective action monitoring, groundwater data is typically compared against a fixed numerical standard, which is established as a GWPS. The groundwater data will be statistically evaluated using confidence intervals around the mean or median for parametric or nonparametric distributions, respectively. Confidence interval analysis is the method recommended in the Unified Guidance when comparing compliance well data against a fixed numerical value (*i.e*., GWPS), to identify the presence or absence of an SSL.

The datasets from upgradient and downgradient wells will be statistically evaluated and handled following the procedures described in **Section 3.1** before computing GWPS and confidence intervals.

### 3.2.1 Groundwater Protection Standards

During corrective action monitoring, downgradient well concentrations of detected Appendix IV constituents are statistically compared to the corresponding GWPS. The GWPS for all detected Appendix IV constituents will be calculated in accordance with 40 CFR §257.95(h).

Pursuant to 40 CFR §257.95(h) and the USEPA amendments to 40 CFR §257.95 of July 30, 2018,[2] which promulgated CCR-Rule specified numeric criteria for cobalt (0.006 mg/L), lead (0.015 mg/L), lithium (0.040 mg/L), and molybdenum (0.100 mg/L), the GWPS will be:

- The maximum contaminant level (MCL) established under §141.62 and §141.66 of 40 CFR Part 257;
- The CCR-Rule specified numeric criteria for constituents for which an MCL has not been established (*i.e.*, cobalt, lead, lithium, and molybdenum); or
- The corresponding background concentration when the background level is higher than the MCL or CCR-Rule specified numeric criteria (see below).

[2] *See* Federal Register/Vol. 83, No. 146/Monday, July 30, 2018/Rules, and Regulations.

The Upper Tolerance Limit (UTL) will be used to calculate the site background levels for each Appendix IV constituent using the pooled upgradient-well data. The parametric UTL, with 95% confidence and 95% coverage, will be calculated for normal or transformed-normal distributions. Nonparametric upper tolerance limits will be calculated when the distribution of the background data is not normal or transformed-normal, or when the dataset contains more than 50 percent of non-detects. In such cases, the nonparametric UTL will be set at the highest value in the background dataset. When the background dataset contains 100% non-detects, the UTL will be the laboratory reporting limit (*i.e.*, PQL). Background values for Appendix IV constituents will be updated as described in **Appendix A, Section 2.2.1**, except that the upper tolerance limit will be used to calculate background levels.

### 3.2.2 Evaluation of Statistically Significant Levels

Under corrective action monitoring, one or more Appendix IV constituents have been demonstrated to exceed their respective GWPS (i.e., an SSL has been identified). Therefore, the selected remedy is deemed successful when the upper confidence limit (UCL) of the average concentration of the constituent of concern is less than the GWPS. However, well/constituent pairs not detected at an SSL will remain under assessment monitoring statistical evaluation until the CCR Unit returns to detection monitoring (see **Appendix A**).

For normal or transformed-normal distributions, a 95% UCL will be constructed from recent data.[3] Once the number of available observations (*i.e.*, results) exceeds 19 data points, the 99% UCL may be computed instead. Nonparametric UCL will be calculated for datasets with greater than 50% non-detects, and for datasets that do not follow a normal or transformed-normal distribution. The confidence interval for nonparametric UCL will be set based on the available number of observations.

For downgradient well data exhibiting a statistically significant temporal trend, the confidence interval will be plotted as 95% confidence bands around the predicted trend line. The least-squares linear regression, Sen's Slope/Mann-Kendall, or similar procedures will be performed to test if a statistically significant linear trend exist. **Section 3.1.3** contains a description of the procedures and requirements to test for statistically significant temporal trends. If a statistically significant trend is detected, the UCL (upper bound of the confidence band) will be compared against the GWPS.

[3] Statistical evaluation should be performed on datasets that are representative of existing groundwater quality conditions at the time of evaluation. For example, if a shift (jump) in the mean concentration of a constituent of concern is observed, and the new mean concentration is deemed statistically to be more representative of actual site conditions, then the newer dataset should be used in statistical analysis. Although four data points is the minimum number of observations required to construct a confidence interval, the Unified Guidance recommends at least eight observations. Statistically significant linear trends will be evaluated per **Section 3.2.2**.

# 4 DOCUMENTING THE EFFECTIVENESS OF THE CORRECTIVE ACTION REMEDY

Following completion of liner installation, the groundwater plume extent and concentration of each constituent detected at an SSL is expected to become stable and decrease with time due to the implementation of source control and natural attenuation processes in the subsurface.[4]

The effectiveness of the corrective action groundwater remedy will be assessed by monitoring the groundwater quality and gauging static water levels to:

- demonstrate compliance with GWPS at the downgradient boundary of the Agremax™ staging area;
- determine plume stability by monitoring water quality in wells located at the downgradient property limit of the Facility; and
- monitor groundwater flow dynamics following corrective action groundwater remedy implementation.

The corrective action remedy will be considered complete when the UCLs constructed for Appendix IV constituents in wells identified with SSLs have not exceeded the GWPS for three consecutive years [40 CFR §257.98(c)] at all points within the impact plume that lie beyond the monitoring well system as established under 40 CFR §257.91. At that point, the CCR unit may return to assessment monitoring. Following return to assessment monitoring, if, at any point during the post-closure care period specified under 40 CFR §257.104(c), the concentrations of all constituents listed in Appendices III and IV to 40 CFR Part 257 are shown to be at or below the background values for two consecutive sampling events, the CCR Unit may return to detection monitoring [40 CFR §257.95(e)].

[4] The Sen's Slope/Mann-Kendall statistical tests will be performed on downgradient well/constituent pairs to confirm whether a plume is stable or decreasing. A groundwater plume is stable when the slope of the concentration versus time does not result in a statistically significant difference from zero (*i.e.*, no discernable change in concertation with time). A statistically significant decreasing trend (*i.e.*, negative slope) indicates a shrinking plume.

# 5 REFERENCES


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## FIGURES


**Figure 1**

**Site Location Map**

**AES Puerto Rico, LP**
**Guayama, Puerto Rico**

**Legend**

AES Puerto Rico
Approximate Property Boundary

N

0 250 500 750 1000 1250 ft

DNA-ENVIRONMENT, LLC


**Figure 2**

**CCR Groundwater Monitoring System**

**AES Puerto Rico, LP**
**Guayama, Puerto Rico**

DNA-ENVIRONMENT, LLC


**Figure 3**

**Corrective Action**

**Groundwater Monitoring Network**

**AES Puerto Rico, LP in Guayama, PR**

N

0 100 200 300 ft

DNA-ENVIRONMENT, LLC

# APPENDICES

## APPENDIX A

*STATISTICAL ANALYSIS PLAN, AES PUERTO RICO LP, GUAYAMA, PUERTO RICO*

*(UPDATED OCTOBER 2023)*

STATISTICAL ANALYSIS PLAN
AES PUERTO RICO LP, GUAYAMA, PUERTO RICO

PREPARED IN COMPLIANCE WITH USEPA's COAL COMBUSTION RESIDUALS RULE, 40 CFR 257.93

OCTOBER 2023

Prepared for:

AES Puerto Rico, LP
PO Box 1890
Guayama, Puerto Rico 00785

Prepared by:

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DNA-ENVIRONMENT, LLC

STATISTICAL ANALYSIS PLAN
AES PUERTO RICO LP, GUAYAMA, PUERTO RICO

PREPARED IN COMPLIANCE WITH USEPA's COAL COMBUSTION RESIDUALS RULE, 40 CFR 257.93

OCTOBER 2023

Prepared by: ______________________________

Alberto Meléndez

*Principal Environmental Consultant*

## CERTIFICATION

I, Edwin A. Ayala Ramírez, am a qualified professional engineer as defined in 40 CFR §257.53. I have reviewed this Statistical Analysis Plan (AES Puerto Rico LP, Guayama, Puerto Rico) and certify that the selected statistical methods described herein are appropriate and meet the statistical requirements under 40 CFR §257.93.

I am a duly registered Professional Engineer under the laws of the Commonwealth of Puerto Rico.

10-10-2023

Edwin A. Ayala Ramírez, P.E.
P.E. License No. 16316

Date


Fecha de Expiración: 2023-11-11

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AES-PR | AES Puerto Rico, LP |
| CCR | Coal Combustion Residuals |
| CFR | Code of Federal Regulations |
| DNA | DNA-Environment, LLC |
| GWPS | Groundwater Protection Standard |
| LCL | Lower Confidence Limit |
| Ln | Natural Logarithm |
| LPL | Lower Prediction Limit |
| MCL | Maximum Contaminant Level |
| mg/L | Milligrams per Liter |
| PE | Professional Engineer |
| PQL | Practical Quantitation Limit |
| RL | Reporting Limit |
| ROS | Regression of Order Statistics |
| § | Section |
| SSI | Statistically Significant Increase |
| SSL | Statistically Significant Level |
| SWFPR | Sitewide False Positive Rate |
| UCL | Upper Confidence Limit |
| UPL | Upper Prediction Limit |
| USEPA | United States Environmental Protection Agency |
| UTL | Upper Tolerance Limit |

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# 1 INTRODUCTION

## 1.1 Purpose and Scope

DNA-Environment, LLC (DNA) has prepared this Statistical Analysis Plan (Plan) for the temporary staging area of manufactured aggregate (AGREMAX™) at AES Puerto Rico LP (AES-PR) in Guayama, Puerto Rico. The Plan describes the statistical criteria and procedures that will be employed to evaluate site groundwater data in accordance with the Coal Combustion Residuals (CCR) groundwater monitoring and corrective action requirements under 40 CFR §§257.90 through 257.98. Acceptable statistical methods and performance criteria are prescribed in 40 CFR §257.93.

This Plan updates the procedures presented in the PE-Certified Statistical Analysis Plan prepared in 2017 for the CCR groundwater monitoring program at AES-PR, which was included in the document entitled *Groundwater Monitoring System & Sampling and Analysis Program, AES Puerto Rico LP, Guayama, Puerto Rico* (DNA, August 2017). This updated Plan incorporates additional details to improve clarity regarding the selected statistical procedures and replaces the 2017 Statistical Analysis Plan.

The procedures for collecting, preserving, shipping, and laboratory analysis of the groundwater samples are described in a separate document entitled *Federal CCR Corrective Action Groundwater Monitoring Plan, AES Puerto Rico LP, Guayama, Puerto Rico* (DNA, October 2023).

## 1.2 Groundwater Monitoring Requirements under the Federal CCR Rule

In April 2015, the United States Environmental Protection Agency (USEPA) issued the final rule that establishes national minimum criteria for existing CCR landfills, surface impoundments, and lateral extensions of those units under 40 CFR 257, Subpart D, which is commonly known as the CCR Rule. Facilities regulated under the CCR Rule are required to install and sample a groundwater monitoring well network to be analyzed for a prescribed list of constituents to evaluate whether its CCR unit has impacted downgradient groundwater quality. The monitored constituents under the CCR Rule are listed in Appendix III (*Constituents for Detection Monitoring*) and Appendix IV (*Constituents for Assessment Monitoring*) to 40 CFR Part 257 and **Table 1** of this Plan. At a minimum, the groundwater monitoring network must include one upgradient and three downgradient monitoring wells in relation to the location of the CCR unit. The groundwater monitoring system requirements are described in 40 CFR §257.91.

The CCR Rule establishes a multi-phase approach for the monitoring of groundwater. Among others, this approach provides for groundwater sampling, analysis, and statistical evaluation of the data and whether further assessment monitoring and corrective action are warranted.
The groundwater monitoring phases listed under the CCR Rule are as follows:

1. Detection Monitoring, which consists of:
    a. Initial eight rounds of monitoring to establish background levels; and
    b. Semiannual Detection Monitoring events (following the initial eight events).
2. Assessment Monitoring, if required.
3. Corrective Action Monitoring (following implementation of corrective measures, if any).

**Table 1**. Monitored Constituents under the CCR Rule

| **Appendix III to 40 CFR Part 257 –** *Constituents for Detection Monitoring* | **Appendix IV to 40 CFR Part 257 –** *Constituents for Assessment Monitoring* |
|---|---|
| Boron | Antimony |
| Calcium | Arsenic |
| Chloride | Barium |
| Fluoride | Beryllium |
| pH | Cadmium |
| Sulfate | Chromium |
| Total Dissolved Solids | Cobalt |
| | Fluoride |
| | Lead |
| | Lithium |
| | Mercury |
| | Molybdenum |
| | Selenium |
| | Thallium |
| | Radium 226 and 228 combined |

The groundwater monitoring program begins by conducting eight independent sampling events where groundwater samples are collected from each upgradient and downgradient well in the groundwater monitoring network. Groundwater samples are analyzed for the constituents listed in Appendices III and IV, and site-specific background levels are calculated from the groundwater dataset obtained from the sampling of the upgradient/background wells. Following the establishment of background levels, detection monitoring for the constituents listed in Appendix III is performed at least semiannually.

The groundwater detection monitoring phase progresses to the next monitoring phase (*i.e.*, assessment monitoring) if statistical evaluation of the constituents listed in Appendix III identifies a statistically significant increase (SSI) above the established background levels for any of the constituents, and it cannot be demonstrated that the increase is attributable to naturally occurring variations in groundwater quality, other sources of contamination, or sampling or analytical error.

If assessment monitoring is warranted, groundwater protection standards (GWPS) must be calculated for each detected constituent listed in Appendix IV. Assessment monitoring consists of an annual sampling event for the analysis of all constituents listed in Appendix IV and semiannual sampling events for all Appendix III constituents and Appendix IV constituents detected in the annual sampling event. If any of the Appendix IV constituents are identified at a statistically significant level (SSL) above the associated GWPS, the nature and extent of groundwater impact must be determined, and corrective action remedy implemented if it cannot be ruled out that the CCR unit has impacted the downgradient groundwater quality.

Following the implementation of corrective measures, a corrective action groundwater monitoring program must be established to document the effectiveness of the corrective action remedy and demonstrate compliance with the GWPS. As in assessment monitoring, corrective action monitoring consists of annual and semiannual sampling events to be analyzed for the constituents listed in Appendix III and Appendix IV to 40 CFR Part 257.

The following section contains a detailed description of the statistical methods to be applied at each CCR groundwater monitoring phase, as applicable.

# 2 STATISTICAL EVALUATION PROCEDURES

Statistical procedures will be performed in accordance with the USEPA guidance document entitled *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (USEPA, 2009), commonly referred to as the Unified Guidance. Graphical and statistical analyses will be conducted using Sanitas™ Statistical Software or similar software (*e.g.*, ProUCL, R statistical software, or others).

## 2.1 Reviewing and Preparing Data

The following statistical procedures for data screening and preparation will be performed on all upgradient and downgradient groundwater datasets, whether generated during detection, assessment, or corrective action monitoring.

### 2.1.1 Summary Statistics

Summary statistics (*e.g.*, mean, median, standard deviation) will be calculated for the available datasets. Graphical representations of descriptive statistics may be generated as appropriate.

### 2.1.2 Identification of Potential Outliers

Time series graphs and side-by-side box plots will be constructed for each well and constituent pair (well/constituent pair) to identify potential outliers visually. The Tukey's Outlier Screening test, Dixon statistical test, or similar procedure will be performed to confirm the presence or absence of outlier values. The Unified Guidance recommends that testing for outliers be performed, but outliers should not be generally removed unless an error or basis for the observed discrepancy can be identified. Potential sources of error may include sampling and analytical errors. Potential discrepancies may include inconsistent sample turbidity and values significantly outside the historical ranges of existing data. Even if excluded from statistical analyses, outlier values should be flagged and maintained in the database to be reevaluated as new data become available.

### 2.1.3 Temporal Trends

The least-squares linear regression, or the Sen's Slope/Man-Kendall procedure, will be performed to test if a significant temporal trend exists. The least-squares linear regression method will be used when the dataset follows a normal or transformed normal distribution and when the dataset contains less than 15% non-detects. In addition, the regression residuals must be normally distributed and show equal variance across time. Otherwise, nonparametric methods (*e.g.*, Sen's Slope/Mann-Kendall) will be used to test for significant linear trends.

### 2.1.4 Testing for Normality

The Shapiro-Wilk or similar test will be performed to test for normality. Whenever possible, non-normally distributed data will be transformed into normally distributed data using the Ladder of Powers procedure. In this method, the data is submitted to the following transformation sequence: $x$, $x^{1/2}$, $x^2$, $x^{1/3}$, $x^3$, $\ln(x)$, $x^4$, $x^5$, $x^6$, until a suitable transformation is applied to normalize the data.

### 2.1.5 Handling of Datasets with Non-Detect Results

Where available, estimated results less than the RL (i.e., "J" flagged data) will be used in the statistical evaluation. Groundwater analytical data with non-detect results will be handled as follows:

- Datasets containing less than 15% non-detects will be replaced with one-half of the reporting limit (RL). The reporting limit to be used for non-detects will be the practical quantitation limit (PQL) as reported by the analytical laboratory (typically identified as "RL" in laboratory analytical reports).
- Datasets containing between 15-50% non-detects will be submitted to the Kaplan-Meier adjustments, regression of order statistics (ROS) adjustments, or similar tests. These methods adjust the mean and standard deviation of the dataset to account for the non-detect values.
- Nonparametric statistics will be used on datasets containing more than 50% non-detects. Non-detects will be set at the RL (*i.e.*, PQL) for statistical testing.
- Note that statistical analyses are not required on well/constituent pairs containing 100% non-detects (refer to the Unified Guidance 2009, Chapter 6).

## 2.2 Detection Monitoring

During detection monitoring, analytical results will be statistically evaluated using the prediction interval method [40 CFR §257.93(f)93)]. Interwell prediction limits,[1] combined with a 1-of-2 resample plan, have been selected to meet the USEPA's requirement of maintaining a 10% annual sitewide false positive rate (SWFPR) and adequate statistical power.

[1] The method of interwell comparisons (i.e., comparisons of downgradient to upgradient well data) was selected over intrawell comparisons (i.e., comparisons of recent well data to historic background data from the same well) given that groundwater background data did not exist prior to CCR unit placement at AES-PR, and CCR impacts to downgradient wells could not be ruled out based on the downgradient wells concentrations of Appendix III constituents detected following the initial phase of detection monitoring (*See* footnote number 2, below).

### 2.2.1 Establishing and Updating Background

Upgradient well data will be used to establish background levels for each individual Appendix III constituent.[2] Initially, the dataset from the upgradient wells will be statistically evaluated and handled following the procedures described in **Section 2.1**, *Preparing and Reviewing Data*.

Groundwater constituent concentrations from the pooled upgradient well dataset will be used to compute the upper prediction limit (UPL) for each Appendix III constituent. Parametric prediction limits will be computed when the background data follow a normal or transformed-normal distribution. Nonparametric prediction limits will be calculated when the background data do not follow a normal or transformed-normal distribution or when more than 50% of the data consists of non-detects.

As new background data becomes available, it will be statistically evaluated to verify if the new dataset is representative of existing background values. The Unified Guidance recommends that background values be updated when four to eight new measurements are available to allow for statistical evaluation of the new dataset against the existing dataset. Besides statistically testing for significant trends and outliers, as described in **Section 2.1**, the Welch's *t*-test, or the nonparametric Mann-Whitey test (also known as the Wilcoxon rank-sum test) or similar procedure, should be used to test the new dataset against the existing dataset. If Welch's *t*-test or Mann-Whitney test finds no significant difference between the two groups, then the new data should be combined with the existing background data to calculate an updated UPL. Generally, the level of significance for the Welch's *t*-test is set at an alpha level equal to 0.01 ($\alpha$ = 0.01), whereas that for the Mann-Whitney test is set at $\alpha$ = 0.05 (if five or more new observations are available, alpha may be set at $\alpha$ = 0.01). In case of a significant Welch's *t*-test or Wilcoxon rank-sum test result, a closer investigation of the available data should be performed to determine whether existing or new background datasets are more representative of the current groundwater conditions.

### 2.2.2 Evaluating Statistically Significant Increases (SSIs)

Once background prediction limits are calculated, upgradient-to-downgradient interwell comparisons will be conducted by comparing the downgradient groundwater sampling results to the prediction limits computed as background concentrations. That is, the concentration of each constituent in individual downgradient wells will be compared to the corresponding background level to determine if a statistically significant increase (SSI) over background exists. An SSL is identified for a given well/constituent pair when the constituent concentration in the downgradient well is higher than the associated background UPL.[3] The detection monitoring program will be based on a 1-of-2 resample plan per the Unified Guidance (*i.e.*, a second independent sample may be collected and analyzed to confirm an initial SSI determination). The

[2] The initial phase of detection monitoring to establish background levels, which consisted of eight rounds of groundwater samples from the monitoring well network at AES-PR, was completed by October 17, 2017 [40 CFR §257.94(b)].

[3] Background pH levels have UPL and lower prediction limit (LPL) values. A statistically significant result is identified when the pH value in a downgradient well is higher than the background UPL or lower than the background LPL.

1-of-2 resample plan will help achieve the USEPA statistical requirements of an annual sitewide false positive rate (SWFPR) of 10% and adequate statistical power.

For any constituent, a confirmed determination of SSI over background may trigger assessment monitoring in the absence of evidence of natural variation, sampling or analytical error, or other sources of contamination.

## 2.3 Assessment Monitoring

In assessment monitoring, groundwater data is typically compared against a fixed numerical standard, which is established as a groundwater protection standard (GWPS). If assessment monitoring is warranted, the groundwater data will be statistically evaluated using confidence intervals around the mean for parametric or around the median for nonparametric testing. Confidence interval analysis is recommended in the Unified Guidance when comparing compliance well data against a fixed numerical value (*i.e.*, GWPS) to identify the presence or absence of an SSL.

The datasets from upgradient and downgradient wells will be statistically evaluated and handled following the procedures described in **Section 2.1** before computing GWPS and confidence intervals. Individual downgradient well data from each detected Appendix IV constituent will be used to construct confidence intervals and compared against the associated GWPS as described below.

### 2.3.1 Establishing Groundwater Protection Standards

During assessment monitoring, downgradient well concentrations of detected Appendix IV constituents are statistically compared to the corresponding GWPS. The GWPS for all detected Appendix IV constituents will be calculated in accordance with 40 CFR §257.95(h).

Pursuant to 40 CFR §257.95(h) and the USEPA amendments to 40 CFR §257.95 of July 30, 2018,[4] which promulgated CCR-Rule specified numeric criteria for cobalt (0.006 mg/L), lead (0.015 mg/L), lithium (0.040 mg/L), and molybdenum (0.100 mg/L), the GWPS will be:

- The maximum contaminant level (MCL) established under §§141.62 and 141.66 of 40 CFR Part 257;
- The CCR-Rule specified numeric criteria for constituents for which an MCL has not been established (i.e., cobalt, lead, lithium, and molybdenum); or
- The corresponding background concentration when the background level is higher than the MCL or CCR-Rule specified numeric criteria (see below).

The Upper Tolerance Limit (UTL) will be used to calculate the site background level for each Appendix IV constituent using the pooled upgradient-well data. The parametric UTL, with 95% confidence and 95% coverage, will be calculated for normal or transformed-normal distributions. Nonparametric upper tolerance limits will be calculated when the distribution of the background

[4] *See* Federal Register/Vol. 83, No. 146/Monday, July 30, 2018/Rules and Regulations.

data is not normal or transformed-normal or when the dataset contains more than 50 percent of non-detects. In such cases, the nonparametric UTL will be set at the highest value in the background dataset. When the background dataset contains 100% non-detects, the UTL will be the laboratory reporting limit (*i.e.*, PQL). Appendix IV background values will be updated as described in **Section 2.2.1**, except that the upper tolerance limit will be used to calculate background levels.

### 2.3.2 Evaluation of Statistically Significant Levels

Under assessment monitoring, the presumption is that the average concentrations of Appendix IV constituents are at or below their respective GWPS unless demonstrated otherwise. Therefore, a statistically significant level (SSL) is detected when the lower confidence limit (LCL) of the mean, or median, exceeds the associated GWPS.

For normal or transformed-normal distributions, a 95% LCL will be constructed from recent data.[5] Once the number of available observations (*i.e.*, results) exceeds 19 data points, the 99% LCL may be computed instead. Nonparametric LCL will be calculated for datasets with greater than 50% non-detects and for datasets that do not follow a normal or transformed-normal distribution. The confidence interval for nonparametric LCL will be set based on the available number of observations.

For downgradient well data exhibiting a statistically significant temporal trend, the confidence interval will be plotted as confidence bands around the predicted trend line. The least-squares linear regression, Sen's Slope/Mann-Kendall, or similar procedures will be performed to test if a significant linear trend exists. **Section 2.1.3** contains a description of the procedures and requirements to test for statistically significant temporal trends. If a statistically significant trend is detected, the LCL (lower bound of the confidence band) will be compared against the GWPS. An SSL is detected when the LCL of the confidence band exceeds the associated GWPS.

If an SSL is detected for one or more Appendix IV constituents, and if it cannot be demonstrated that the increase is attributable to naturally occurring variations in groundwater quality, other sources of contamination, or sampling or analytical error, the nature and extent of the groundwater impact for constituents with SSLs must be undertaken [40 CFR 257.95(g)(1)]. Within 90 days of detecting an SSL for any of the Appendix IV constituents, an assessment of corrective measures must be initiated [40 CFR 257.96(a)], a remedy must be selected [40 CFR 257.97], and corrective action groundwater monitoring program established [40 CFR 257.98(a)(1)] once the selected remedy has been implemented.

[5] Statistical evaluation should be performed on datasets that are representative of existing groundwater quality conditions at the time of evaluation. For example, if a shift (jump) in the mean concentration of a constituent of concern is observed, and the new mean concentration is deemed statistically to be more representative of actual site conditions, then the newer dataset should be used in statistical analysis. Although four data points are the minimum number of observations required to construct a confidence interval, the Unified Guidance recommends at least eight observations.

### 2.3.3 Comparing Data to Background

Besides performing a statistical evaluation to identify potential SSLs, the downgradient concentrations of the CCR constituents are frequently compared to the background levels. Confidence intervals for each constituent and downgradient well will be constructed from recent data and compared to the respective background upper tolerance limit (UTL) to determine if Appendix III and Appendix IV constituents are at or below background levels. When the upper confidence limit (UCL) is below the background UTL for two consecutive sampling events, it can be concluded that concentrations are at or below background, and the CCR unit may return to detection monitoring [40 CFR 257.95(e)].

## 2.4 Corrective Action Monitoring

In corrective action monitoring, groundwater data is typically compared against a fixed numerical standard, which is established as a GWPS. The groundwater data will be statistically evaluated using confidence intervals around the mean or median. Confidence interval analysis is the method recommended in the Unified Guidance when comparing compliance well data against a fixed numerical value (*i.e.*, GWPS) to identify the presence or absence of an SSL.

The datasets from upgradient and downgradient wells will be statistically evaluated and handled following the procedures described in **Section 2.1** before computing GWPS and confidence intervals.

### 2.4.1 Groundwater Protection Standards

During corrective action monitoring, downgradient well concentrations of detected Appendix IV constituents are statistically compared to the GWPS calculated during assessment monitoring pursuant to 40 CFR §257.95(h). As described in **Section 2.3.1**, the GWPS will be as follows: the MCL; the CCR-Rule specified numeric criteria for constituents for which an MCL has not been established (*i.e.*, cobalt, lead, lithium, and molybdenum); or the background concentration when the background level is higher than the MCL or CCR-Rule specified numeric criterion.

The Upper Tolerance Limit (UTL) will be used to calculate the site background levels for each Appendix IV constituent using the pooled upgradient-well data. The parametric UTL, with 95% confidence and 95% coverage, will be calculated for normal or transformed-normal distributions. Nonparametric upper tolerance limits will be calculated when the distribution of the background data is not normal or transformed-normal or when the dataset contains more than 50 percent of non-detects. In such cases, the nonparametric UTL will be set at the highest value in the background dataset. When the background dataset contains 100% non-detects, the UTL will be the laboratory reporting limit (*i.e.*, PQL). Background values for Appendix IV constituents will be updated as described in **Section 2.2.1**, except that the upper tolerance limit will be used to calculate background levels.

### 2.4.2 Evaluation of Statistically Significant Levels and Effectiveness of Remedy

Under corrective action monitoring, one or more Appendix IV constituents have been demonstrated to exceed their respective GWPS (i.e., an SSL has been identified). Therefore, the selected remedy is deemed successful when the upper confidence limit (UCL) of the average concentration of the constituent of concern is less than the GWPS.

For normal or transformed-normal distributions, a 95% UCL will be constructed from recent data. Once the number of available observations (*i.e.*, results) exceeds 19 data points, the 99% UCL may be computed instead. Nonparametric UCL will be calculated for datasets with greater than 50% non-detects and for datasets that do not follow a normal or transformed-normal distribution. The confidence interval for nonparametric UCL will be set based on the available number of observations.

For downgradient well data exhibiting a statistically significant temporal trend, the confidence interval will be plotted as 95% confidence bands around the predicted trend line. The least-squares linear regression, Sen's Slope/Mann-Kendall, or similar procedures will be performed to test if a statistically significant linear trend exists. **Section 2.1.3** describes the procedures and requirements to test for statistically significant temporal trends. If a statistically significant trend is detected, the UCL (upper bound of the confidence band) will be compared against the GWPS.

A remedy is considered complete when the upper confidence limits constructed for Appendix IV constituents in wells identified with SSLs have not exceeded the GWPS for three consecutive years [40 CFR 257.98(c)(2)] at all points within the impact plume that lie beyond the monitoring well system as established under 40 CFR 257.91 [40 CFR 257.98(c)(1)]. In that case, the CCR unit may return to assessment monitoring.

# 3 REFERENCES

DNA (DNA-Environment, LLC). August 2017. *Groundwater Monitoring System & Sampling and Analysis Program, AES Puerto Rico LP, Guayama, Puerto Rico.*

DNA (DNA-Environment, LLC). October 2023. *Federal CCR Corrective Action Groundwater Monitoring Plan, AES Puerto Rico LP, Guayama, Puerto Rico*.

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USEPA (United States Environmental Protection Agency). 2009. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Unified Guidanc*e. Washington, DC: EPA. EPA 530/R-09-007.

# APPENDIX B

*TECHNICAL EVALUATION – CORRECTIVE ACTION GROUNDWATER MONITORING NETWORK*

*AES PUERTO RICO – STAGING AREA BY HALEY & ALDRICH*

Technical Justification - Corrective Action Groundwater Monitoring Network
AES Puerto Rico – Staging Area

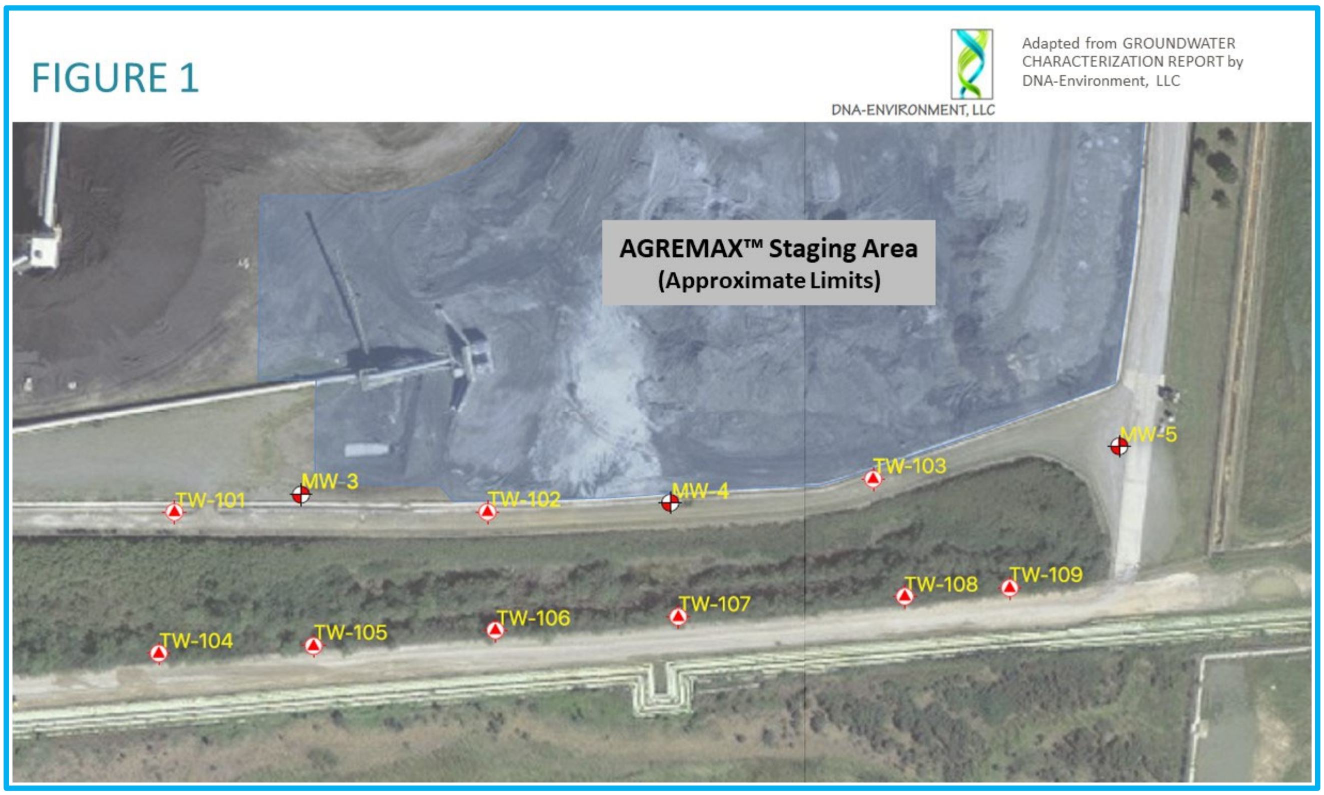
## Introduction

The Corrective Action (CA) remedy selected by AES Puerto Rico for the AGREMAX™ Staging Area is to *prevent AGREMAX™ contact with the ground by installation of a synthetic liner and employ Monitored Natural Attenuation (MNA).* This CA remedy is anticipated to be fully implemented in Q1 2023. 40 CFR 257.98 requires documenting the effectiveness of the CA remedy through a CA groundwater monitoring program.

## Basis of Design for the CA Groundwater Monitoring Program

Groundwater quality data, in addition to the hydrogeologic site conceptual model and supporting groundwater flow and CA remedy implementation modeling, forms the basis for the design of the recommended CA groundwater monitoring network. The design includes the geospatial array (**Figure 1**) and number of wells to be included in the CA monitoring program such that the CA monitoring network complies with 40 CFR 257.98.

FIGURE 1




## Performance Objectives of the CA Monitoring Program

The primary performance objectives of the CA Monitoring Program are to provide ongoing groundwater monitoring data, and to demonstrate the effectiveness of the CA remedy on groundwater quality at monitoring well locations within the CA monitoring network.

## Recommended CA Groundwater Monitoring Well Network

The following monitoring wells are recommended to assess the performance / effectiveness of the CA remedy on groundwater quality and groundwater / plume dynamics:

- **Achieving GWPS at the Staging Area Boundary** - MW-3, TW-102, MW-4, and TW-103 are located immediately downgradient of the Staging Area and show concentrations above applicable groundwater protection standards (GWPS). TW-101 and MW-5 are also located proximate to Staging Area boundary although no Appendix IV constituent were found at statistically significant levels above the applicable GWPSs. These locations are an essential part of the CA groundwater monitoring network and will be used to demonstrate that the GWPS will be met at the waste boundary.
- **Demonstrating Plume Stability and Concentrations** - TW-105, TW-106, TW-107, and TW-108, which are located hydraulically downgradient of MW-3, TW-102, MW-4, and TW-103, are needed to demonstrate plume stability and that GWPS are being met throughout the plume. Field parameters will be measured in all wells shown on Figure 1 and will include geochemical indicators (pH, dissolved oxygen and ORP).
- **Monitoring Groundwater Flow Dynamics due to CA Remedy Implementation** – The monitoring network shown in Figure 1 will be used to monitor groundwater levels and field parameters. The results will be used to assess if the CA remedy influences the generalized groundwater flow direction and/or the general plume migration dynamics.

Based on the above, the monitoring wells shown on **Figure 1** are recommended to form the CA groundwater monitoring network. The CA groundwater monitoring wells are sufficient to adequately monitor the CA remedy (i.e., achieving GWPS at the Staging Area boundary, demonstrating plume stability and concentrations throughout the plume, monitoring groundwater flow dynamics, and assessing CA remedy effects and plume migration dynamics). No additional monitoring wells are needed at this time to achieve the objectives of the CA groundwater monitoring program.

## Monitoring Schedule and Future Adequacy of the CA Groundwater Monitoring Program

Per requirements of 40 CFR 257.95(b) and 257.95(d)(1), semi-annual events of CA groundwater monitoring are needed once the installation of the remedy has been completed. The sampling based on 257.95 requirements will include sampling the CA monitoring network for all of the CCR Rule Appendix III and Appendix IV constituents on an annual basis. The semi-annual event will include sampling the CA monitoring network for Appendix III and previously detected Appendix IV constituents. Supplemental geochemical (organic and inorganic) indexing parameters will be included in the monitoring program, when needed, to assess the ongoing performance of the in-situ natural attenuation mechanisms.

The adequacy of the CA groundwater monitoring network will be assessed on an ongoing basis as additional data are collected to confirm compliance with the CCR Rule and the CA groundwater monitoring objectives. Adjustments to the network and CA monitoring program design (e.g., removal or addition of well locations, adjustments to the list of constituents to include in the groundwater quality analytics, etc.) will be addressed as required to maintain ongoing compliance with the CCR Rule requirements and to adequately assess the performance of the CA remedy.

# APPENDIX C

*LOW-FLOW PURGING AND SAMPLING PROCEDURE*

## A. Introduction

The purpose of Low-Flow Purging and Sampling (LFPS) is to collect groundwater samples from monitoring wells that are representative of ambient groundwater conditions in the aquifer. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well. LFPS has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity. Second, LFPS minimizes aeration of the groundwater during sample collection. Third, the amount of groundwater purged from a well is usually reduced as compared to conventional groundwater purging and sampling methods.

LFPS involves using a pump to purge water at a constant low rate to achieve field parameter stabilization, while minimizing stress on the aquifer. This method has been well documented as a preferred methodology for collecting representative samples from groundwater (*Low-Flow (Minimal Drawdown), Ground-Water Sampling Procedures*, Puls and Barcelona, USEPA, April 1996).

This procedure is accomplished by measuring field parameters at periodic intervals during purging with a flow cell container. The flow cell is an inline purge cell, which will allow the sample technician to constantly monitor field water quality parameters such as pH, dissolved oxygen, conductivity, redox potential (ORP), turbidity and temperature.

The following sections provide a general discussion on each aspect of the LFPS procedure with bulleted items being procedural steps.

### Equipment

The sampling team should have all equipment necessary for purging and sampling wells at low flow rates. Other equipment may include:

- Water level indicator;
- Flow cell to monitor field parameters;
- Calibrated purge water container;
- Dedicated pump system or disposable sample tubing (for non-dedicated pumps); and
- Field Meters to measure pH, dissolved oxygen, conductivity, redox potential (ORP), turbidity and temperature.

Prior to each sampling event the field probes will be calibrated in accordance with the owner's manual provided and the site-specific sampling plan.

### Decontamination

Sites that have observation wells without dedicated pumps will require the use of non-dedicated pumps. All non-dedicated equipment used during the purging and sampling process must be decontaminated prior to each use, including tubing, unless it is disposable):

- Downhole equipment, such as a water level indicator, is to be triple-rinsed between well locations.
- Discard disposable polyethylene tubing used with non-dedicated pumps after use at each well.

Sample bottles will be provided and properly prepared by the analytical laboratory scheduled to perform the analysis. No cleaning or preparation of sampling bottles by field personal will be performed.

**Purge Volumes and Monitoring Frequency**

Low-flow purging does not require the calculation of the water volume in the well, since purging is based solely on indicator parameter stabilization. Rather, the volume of the pump and discharge tubing are necessary for making calculations needed to determine field measurement frequency and/or the minimum purge ("passive") sampling system purge volume. Pump chamber or bladder volumes can be obtained from the manufacturer. Volumes of the sample tubing can be calculated or taken from the table below.

| Discharge Tubing Volumes | |
|---|---|
| **Tubing Diameter** | **Volume/foot** |
| 1/2" OD/3/8" ID | 20 ml |
| 3/8" OD/1/4" ID | 10 ml |
| 1/4" OD/1/8" ID | 5 ml |

Sampling equipment volumes are calculated or recorded for use in determining the frequency of field measurements. Depending on the equipment configuration, calculate and record the volume of the pump and sample tubing using the methodology described above (the volumes are typically converted to liters). The frequency of field readings is based on the time required to purge at least one volume of the pump and tubing system. For example, a pump and tubing volume of 500-ml purged at a rate of 250 ml/minute will be purged in two minutes; readings should be at least two minutes apart. In any case, it is important to ensure that the field parameters are measured on independent samples of water.

**Purge Rates**

The objective of the purging process is to remove sufficient water from within the well screen zone to result in a sample that is representative of actual aquifer conditions adjacent to the well. The sampling pump or pump intake should be located within the well screen. This pump location is already established for dedicated pumps. For non-dedicated pumps, the intake is placed within the screened interval, typically in the center of the screen. If the water column in the screen is shorter than the overall screen length, the pump should be placed lower in the screen but no lower than about 6-12 inches from the bottom of the screen to avoid picking up any settled solids in the well.

A low pumping rate (typically less than 1,000 ml/min) is used to minimize drawdown within the well and formation and mobilization of formation solids. Lower flow rates may be required during sampling. Flow rate is determined by measuring the time it takes to fill a calibrated container, or by measuring the volume of one pump discharge cycle and multiplying this volume by the number of cycles per minute (e.g., 125 ml/cycle x 4 CPM = 500 ml/min). Drawdown is monitored by measuring the water level below the top of the well casing with a water level indicator or similar device (e.g. transducer) while pumping. Drawdown will be stabilized during purging. Flow rates and drawdown are recorded on a field log, field data form or with a data logger.

- Measure water levels prior to initiating purging;
- Calculate well volumes, if required by permit;
- Calculate sampling system volume and determine indicator parameter measurement frequency;
- Lower water level meter probe to 1-2 feet below static water level;
- Connect the flow cell to the discharge tube from the pump;
- Begin purge at a rate of 100-200 ml/min (or at a rate determined from prior events);
- Check drawdown with a water level tape while pumping;
- If drawdown stabilizes quickly, increase the pumping rate in increments of 100 ml/min until drawdown increases, then reduce the rate slightly after a few minutes to achieve a stable pumping water level;
- If the water level continues to drop, reduce purge rate by 100 ml/min increments until the water level stabilizes;
- Once water level stabilization is achieved, proceed to indicator parameter stabilization.

**Parameter Stabilization**

Parameter stabilization ensures that the well is adequately purged and sampled groundwater is representative of formation water. In order to determine when a well has been adequately purged, samplers should:

- Monitor pH, specific conductance, and dissolved oxygen of the ground water removed during purging;
- Observe and record the water level drawdown; and
- Record the purge rate and note the volume of water removed if required by guidance or permit.

A well is adequately purged when the pH, specific conductance, and dissolved oxygen stabilize. Stabilization occurs as follows:

| | |
|---|---|
| pH: | +/- 0.2 pH units |
| Conductance: | +/- 5 % of reading value |
| Dissolved oxygen: | +/- 10.0% or 0.2 mg/L, whichever is greater. |

Temperature is not a reliable indicator of stabilization, being affected by ambient temperature at the well head, sunlight, and some sampling devices such as electric pumps. Temperature is typically measured to provide correction for temperature dependent parameters (e.g., DO % saturation, pH, and specific conductance).

While turbidity is not a direct measurement of water chemistry and is not used as an indicator parameter of stabilization, it is useful to support data from metals analyses. To avoid artifacts in sample analysis, turbidity should be as low as possible when samples are taken. Turbidity should be measured at least three times, once when purging is initiated, again after the water level in the well stabilizes, and again when the water chemistry indicator parameters being measured are stable. Turbidity should also be measured any time the pumping rate is increased or the water level in the well drops noticeably. If the initial turbidity reading is high (>50 NTU) and the second reading is not significantly lower, the pump rate should be reduced. The turbidity value measured prior to sampling will be recorded. If this value exceeds 50 NTU, procedures should be reviewed and the source of the elevated turbidity determined.

### Sampling

Wells should be sampled immediately upon completion of purging operations. Once the water level stabilizes, the purge rate should remain constant during low-flow sampling (generally less than 500 ml/min). For VOCs, lower sampling rates (100 - 200 milliliters/minute) may be required.

- Record field parameters prior to sampling;
- Record depth to water levels prior to sampling (note if the well has not stabilized).
- Record the flow rate determined using a calibrated measuring device;
- Disconnect the flow cell other equipment from the pump discharge tube;
- Collect samples from the pump discharge tube
- Collect large volume samples first (e.g.,1 liter bottles), then VOC samples, and any filtered samples last;

If, after three well volumes have been removed, the chemical parameters have not stabilized according to the above criteria, the sampling team may elect to collect a sample. The conditions of sampling should be noted in the field log or field information form.

## Low Yield Formations

In some situations, even with very slow purge rates, the well drawdown may not stabilize. In this case, sampling the water within the well screen zone provides the best opportunity to determine the formation water chemistry, as well evacuation can greatly affect sample chemistry through changes in dissolved gas levels, dissolved metals and VOCs.

*Attempts should be made to avoid purging wells to dryness. This can usually be accomplished by slowing the purge rate. If the well is evacuated during the purging procedures shown above, the sample may be collected as soon as a sufficient volume of water has recovered in the well. If the well goes dry repeatedly (i.e. over multiple monitoring events) prior to sampling, then a minimum purge or "passive" sampling approach should be used in lieu of well evacuation.*

## Minimum Purge ("Passive") Sampling

For wells that cannot achieve a stabilized water level and purge dry even at very low pumping rates, an alternative to the traditional evacuation approach is to use minimum purge (sometimes called "passive") sampling techniques to avoid the pitfalls of well evacuation and obtain a better estimation of the formation water quality. Sampling the water present in the screen zone provides the greatest chance of obtaining samples with minimal alteration of the chemistry. Although the low movement rate of the ground water in the screen provides only a limited exchange, avoiding the alteration caused by the factors mentioned above is really the best alternative.

The minimum purge approach requires the removal of the smallest possible purge volume prior to sampling, generally limited to the volume of the sampling system. The sampling system volume is minimized by using very small diameter tubing and the smallest possible pump chamber volume. Plastic tubing should have sufficient wall thickness to minimize the potential for oxygen transfer through the tubing when pumping at very low flow rates. After purging 1-3 volumes of the sampling system, samples are taken from the subsequent water pumped. Since minimum purge sampling requires the minimum possible disturbance to the water column and surrounding formation, dedicated sampling systems are required for this approach.

The pumping rates used for minimum purge sampling are much lower than for low-flow purging, generally 100 ml/minute or less. Drawdown is expected, since it cannot be avoided; however, it is still advisable to pump at the lowest possible rate to limit drawdown to the minimum possible. Monitoring indicator parameters for stability is not part of this approach, since the intention is not to purge until stabilization of these measurements. The pH, specific conductance and turbidity or any other required field parameters should be measured during collection of the sample from the recovered volume. *Regulatory approval should be obtained prior to collecting a sample using this method.*

## Field Records

Field information must be recorded during purging and sampling. At a minimum, the following information should be included in the field forms for each groundwater monitoring well.

- Purge Information (pumping rate, purge volume if required);
- Equipment Specifications (pump type, filter type and pore size if used);
- Well Data (depth to water, total depth, groundwater elevation);
- Field Measurements during purging and at the time of sample collection; and
- General weather conditions or other comments

This data is to be recorded on field forms and/or in a data logger.

## Other Technical Issues

The following are other technical issues addressed as follows by the facility:

- Dedicated pump intakes are generally set at the middle of the screen. Where water levels have dropped due to drought conditions, the sampling team may lower the pump in order to obtain sufficient sample.
- For wells installed in bedrock, packers are only required to seal off the zone of interest if the bedrock has been determined to be competent (e.g. is not highly fractured).
- The flow cell system does not require decontamination between wells, because the act of purging removes any liquids from other wells and because sampling takes place upstream of the flow cell and only after disconnecting the pump discharge tubing.

## APPENDIX D

*FIELD SHEETS FOR INSTRUMENT CALIBRATION AND RECORDING FIELD PARAMETERS*

Multiparameter Meter Calibration Sheet



Date of Calibration: ________________ Technician: ________________________________

Instrument Serial Number:____________ Software Revision:____________ Cable Model Number:______________

Temperature Reading________________ Temperature Accurate: Y N

DO Sensor in use: Polarographic Galvanic Sensor notated in Sensor menu? Y N

DO membrane changed? Y N Color of Membrane___________ Color notated in Sensor menu? Y N

Record the following calibration values:

| | Pre Cal | After Cal |
|---|---|---|
| Conductivity | ____________ | ___________ |
| ORP | ____________ | ___________ |
| DO | ____________ | ___________ |

True Barometric Pressure at time of calibration ________________

| | Pre Cal | | |
|---|---|---|---|
| pH 7 | ____________ | pH mV value__________ | Range 0 mV $\pm$ 50 mV |
| pH 4 | ____________ | pH mV value__________ | Range +165 to +180 from 7 buffer mV value |
| pH 10 | ____________ | pH mV value__________ | Range -165 to -180 from 7 buffer mV value |

NOTE: See pH Cal tips section for additional information. Span between pH 4 and 7 and 7 and 10 mV values should be ≈ 165 to 180 mV. 177 is the ideal distance or 59 mV per pH unit.

Ammonium

1st point (1 mg/L) ________ NH4 mV value______ Range: 0 mV +/- 20 mV (new sensor only)

2nd point (100 mg/L)_______ NH4 mV value______ Range: 90 to 130 mV > 1 mg/L mV value

Nitrate

1st point (1 mg/L) ________ NO3 mV value______ Range: 200 mV +/- 20 mV (new sensor only)

2nd point (100 mg/L)_______ NO3 mV value______ Range: 90 to 130 mV < 1 mg/L mV value

Chloride

1st point (10 mg/L) ________ Cl mV value ______ Range: 225 mV +/- 20 mV (new sensor only)

2nd point (1000mg/L)_______ Cl mV value ______ Range: 80 to 130 < 10 mg/L mV value

Record the following diagnostic numbers **after** calibration, by viewing the .glp file and reading the values for the day's calibration

| | | |
|---|---|---|
| Conductivity Cal Cell Constant | __________ | Range 5.0 +/- 1.0 acceptable |
| DO Sensor Value (uA) | __________ | (Membrane dependent, see DO Cal Tips) |
| pH Slope | __________ | (≈ 55 to 60 mV/pH, 59 ideal) |
| pH Slope % of ideal | __________ | |

# LOW FLOW SAMPLING DATA SHEET

DNA-ENVIRONMENT, LLC

SHEET ____ OF ____

**SITE:** AES Puerto Rico, LP in Guayama, Puerto Rico
**PROJECT NAME:** CCR Groundwater Monitoring
**DATE:** ____________
**FIELD PERSONNEL:** ____________
**WEATHER** ____________

**MONITORING WELL:** ____________ **WELL DEPTH:** ____________ **SCREENED/OPEN INTERVAL:** ____________
**LOCATION:** ____________ **WELL DIAMETER:** ____________ Inches

**PID/FID READINGS (ppm):**
**BACKGROUND:** NA
**BENEATH OUTER CAP:** NA
**BENEATH INNER CAP:** NA

**PUMP INTAKE DEPTH:** _______ ft below TOC
**DEPTH TO WATER BEFORE PUMP INSTALLATION:** _______ ft below TOC

| TIME | PURGING | SAMPLING | pH (pH units) | | CONDUCTIVITY (mS/cm) | | REDOX POTENTIAL (mv) | | DISSOLVED OXYGEN (mg/l) | | TURBIDITY (NTU) | | TEMPERATURE (degrees C) | | PUMPING RATE (ml/min) | DEPTH TO WATER (ft below TOC) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | READING | CHANGE* | READING | CHANGE* | READING | CHANGE* | READING | CHANGE* | READING | CHANGE* | READING | CHANGE* | | |
| | | | | NA | | NA | | NA | | NA | | NA | | NA | | |
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**COMMENTS:**

*INDICATOR PARAMETERS HAVE STABLIZED WHEN 3 CONSECUTIVE READINGS ARE WITHIN: ± 0.1 for pH; ± 3% for Specific Conductivity and Temperature; ± 10 mv for Redox Potential; and ± 10% for Dissolved Oxygen and Turbidity.

## APPENDIX E

*CHAIN OF CUSTODY RECORD*

**Eurofins Chicago**
2417 Bond Street
University Park, IL 60484
Phone (708) 534-5200 Fax (708) 534-5211

# Chain of Custody Record

eurofins | Environment Testing America

| **Client Information** | Sampler: | Lab PM: | Carrier Tracking No(s): | COC No: |
|---|---|---|---|---|
| Client Contact: | Phone: | E-Mail: | State of Origin: | Page: |
| Company: | PWSID: | **Analysis Requested** | | Job #: |
| Address: | **Due Date Requested:** | | | |
| City: | **TAT Requested (days):** | | | |
| State, Zip: | **Compliance Project:** ____Yes ____ No | | | |
| Phone: | PO #: | | | |
| Email: | WO #: | | | |
| Project Name: | Project #: | | | |
| Site: | SSOW#: | | | |

**Preservation Codes:**

A - HCL
B - NaOH
C - Zn Acetate
D - Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA
M - Hexane
N - None
O - AsNaO2
P - Na2O4S
Q - Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Z - other (specify)

**Other:**

| **Sample Identification** | **Sample Date** | **Sample Time** | **Sample Type** (C=comp, G=grab) | **Matrix** (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air) | Field Filtered Sample (Yes or No) | Perform MS/MSD (Yes or No) | | | | | | | | | | | | | | Total Number of containers | **Special Instructions/Note:** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preservation Code: | | | | | | | | | | | | | | | | | | |
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***Possible Hazard Identification***
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐ *Radiological*

***Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)***
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For ____________ Months*

Deliverable Requested: I, II, III, IV, Other (specify):

Special Instructions/QC Requirements:

| Empty Kit Relinquished by: | Date: | Time: | Method of Shipment: |
|---|---|---|---|

| Relinquished by: | Date/Time: | Company | Received by: | Date/Time: | Company |
|---|---|---|---|---|---|
| Relinquished by: | Date/Time: | Company | Received by: | Date/Time: | Company |
| Relinquished by: | Date/Time: | Company | Received by: | Date/Time: | Company |

| Custody Seals Intact: Δ Yes Δ No | Custody Seal No.: | Cooler Temperature(s) °C and Other Remarks: |
|---|---|---|