

2020 ANNUAL GROUNDWATER MONITORING REPORT (REV. 1)

FEDERAL CCR RULE

CARDINAL PLANT – FLY ASH RESERVOIR II BRILLIANT, OHIO

Submitted to



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LIST OF ACRONYMS AND ABBREVIATIONS

ACM	Assessment of Corrective Measures
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
cm/s	centimeters per second
ESP	Electrostatic Precipitator
FAD	Fly Ash Dam
FAR	Fly Ash Reservoir
FGD	Flue Gas Desulfurization
GWPS	Groundwater Protection Standards
MCL	Maximum Contaminant Level
MW	Megawatt
NPDES	National Pollutant Discharge Elimination System
RSL	Risk-Based Screening Level
RSW	Residual Solid Waste
SCR	Selective Catalytic Reduction
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
USEPA	United States Environmental Protection Agency

1. EXECUTIVE SUMMARY

Geosyntec Consultants (Geosyntec) has prepared this 2020 Annual Groundwater Monitoring Report (Report) for the Fly Ash Reservoir II (FAR II), an existing CCR unit at the Cardinal Generating Plant in Brilliant, Ohio (Site). This Report summarizes the groundwater monitoring activities conducted pursuant to the CCR Rule from January 1, 2020 through December 31, 2020 (the 2020 annual reporting period). This Report was prepared in accordance with 40 CFR 257.90(e).

At the start of the 2020 annual reporting period, FAR II was operating under the assessment monitoring program (40 CFR 257.95). FAR II remained in the assessment monitoring program throughout the 2020 annual reporting period. Statistical evaluations of two assessment monitoring events were completed during this annual reporting period – the second semiannual event of 2019 (October 2019) and the first semiannual event of 2020 (April 2020). The statistical analysis of the second semi-annual sampling event of 2020 (October 2020) will be completed in 2021 and presented in next year's Annual Groundwater Monitoring Report.

For the second semiannual assessment monitoring event of 2019, statistically significant levels (SSLs) above the groundwater protection standard were identified for lithium and molybdenum at downgradient monitoring wells FA-8 and M-11. The following statistically significant increases (SSIs) over background were identified:

- Boron SSIs were identified at FA-8, M-10, M-1004, M-11, M-21, M-22, M-23, and MGS-3.
- Calcium SSIs were identified at M-1004, M-13, MGS-1, and MGS-2.
- Chloride SSIs were identified at MGS-1.
- Fluoride SSIs were identified at M-13 and M-21.
- A pH SSI was identified at M-13, where the reported value was below the lower prediction limit.
- A sulfate SSI was identified at M-13.
- A total dissolved solids (TDS) SSI was identified at MGS-2.

For the first semiannual event of 2020, SSLs were identified for lithium and molybdenum at downgradient monitoring wells FA-8 and M-11. The following SSIs over background were identified:

- Boron SSIs were identified at FA-8, M-10, M-1004, M-11, M-21, M-22, M-23, and MGS-3.
- Calcium SSIs were identified at M-1003, M-1004, and M-21.
- Chloride SSIs were identified at M-8, M-16, M-23, M-1003, M-1004, MGS-3, and MGS-4.
- Fluoride SSIs were identified at M-8, M-10, M-11, M-13, and M-21.
- Sulfate SSIs were identified at M-8, M-13, M-16, and M-1003.

The assessment of corrective measures for the lithium and molybdenum SSLs was completed on July 9, 2019 and a revised version was posted to the public website on November 30, 2020. The public meeting for the assessment of corrective measures was held on September 4, 2019 in Steubenville, Ohio. A remedy was selected on October 27, 2020. Remedial activities were not initiated in the current annual reporting period and instead are planned to begin in 2021.

2. INTRODUCTION

The Federal Coal Combustion Residuals (CCR) Rule (40 Code of Federal Regulations [CFR] Part 257.90(e)) (USEPA, 2015) requires owners and or operators of existing CCR landfills and surface impoundments to prepare a Groundwater Monitoring and Corrective Action Report (Report) no later than January 31 annually. Geosyntec Consultants (Geosyntec) has prepared this Report for the Fly Ash Reservoir II (FAR II), an existing CCR unit at the Cardinal Generating Plant in Brilliant, Ohio (Site). This Report summarizes the groundwater monitoring activities conducted pursuant to the CCR Rule through December 31, 2020.

3. SITE SUMMARY

3.1 Site Description

The Site is located one mile south of Brilliant, Ohio in Jefferson County (**Figure 1**) and is operated by Cardinal Operating Company (Cardinal). Located along the Ohio River, the generating station consists of three coal-powered units with an 1,800-megawatt (MW) capacity and annual coal use of 5.2 million tons (Geosyntec, 2017). Units 1 and 2 began operation in 1967 and Unit 3 began operation in 1977. As of 2012, all three units were equipped with an electrostatic precipitator (ESP), a selective catalytic reduction (SCR) system, and a flue gas desulfurization (FGD) system.

FAR II is an existing wet fly ash disposal reservoir that is located approximately one mile north of the plant site and immediately east of the FAR I Residual Solid Waste (RSW) Landfill. The reservoir is contained within Blockhouse Hollow (also referred to as Blockhouse Run in references and drawings) by Fly Ash Dam (FAD) 2 and the decommissioned FAD I. FAR II receives sluiced fly ash from the generating units' ESPs and collected stormwater and leachate from the FAR I RSW Landfill. FAR II/FAD 2 has a permitted discharge through the National Pollutant Discharge Elimination System (NPDES) Outfall 019 (Geosyntec, 2017).

3.2 Regional Physiographic Setting

The Site is underlain by horizontal sequences of lower Permian and upper Pennsylvanian sedimentary rock. The Conemaugh Group, 500 feet (ft) thick in Jefferson County, consists of shale, sandstone, limestone, claystone, and coal. This group includes the Morgantown Sandstone underlain by the Elk Lick Limestone, the Skelly Limestone and Shale, the Ames Limestone, and the Cow Run Sandstone (Geosyntec, 2017). Above the current grade of the RSW Landfill lies the Monongahela Group consisting of shale, sandstone, limestone, coal, claystone, and siltstone. Overlying the Monongahela Group, at approximately 1,250 feet in elevation, is the Permian-age Dunkard Group.

The uppermost aquifer at the Site is comprised of unconsolidated mine waste and shallow sandstone and limestone deposits overlying a discontinuous shale aquitard above the Morgantown Sandstone. Groundwater in the uppermost aquifer generally flows south-southeast towards the Ohio River with hydraulic conductivity ranging from 1×10^{-1} to 1×10^{-9} centimeters per second

(cm/s). The hydraulic conductivity of the confining shale layer ranges from 1×10^{-7} to 1×10^{-9} cm/s (AEP, 2006).

4. GROUNDWATER MONITORING SYSTEM

The FAR II's groundwater monitoring network was designed to comply with 40 CFR 257.91. The groundwater monitoring network utilizes monitoring wells initially installed as part of a separate site-wide hydrogeologic investigation and is used to monitor groundwater quality in the uppermost aquifer at the Site. Monitoring well construction and soil boring logs were provided in the *Groundwater Monitoring Network Design Report* (Geosyntec, 2017a).

The FAR II groundwater monitoring network consists of twenty-three monitoring wells, as shown in **Figure 2**. Five upgradient monitoring wells (CA-0622A, M-12, M-1302, M-6, and M-GS-5) are used to measure background conditions and eighteen downgradient monitoring wells (FA-8, M-10, M-1003, M-1004, M-11, M-13, M-1309, M-14, M-15, M-16, M-21, M-22, M-23, M-8, M-GS-1, M-GS-2, M-GS-3, and M-GS-4) are used as compliance wells. Monitoring well M-2000 was installed in 2019 to facilitate characterization of the nature and extent of the release within the corrective measures program.

5. CCR RULE GROUNDWATER KEY ACTIVITIES COMPLETED

5.1 Statistical Analysis Plan Revision

A statistical analysis plan was previously prepared for the FAR II during the background monitoring period (Geosyntec, 2017b). Geosyntec's *Statistical Analysis Plan* (Geosyntec, 2020a) describes a logic process regarding the statistical analysis of groundwater data collected in compliance with the Federal CCR Rule. The revised statistical analysis plan primarily incorporates statistical procedures and reporting requirements for corrective action monitoring and incorporates a revision to the CCR rules that specifies screening levels for constituents that do not have a maximum contaminant level.

5.2 2020 Statistical Evaluation Activities

For each assessment monitoring event, a Groundwater Protection Standard (GWPS) was established for each Appendix IV parameter in accordance with the United States Environmental Protection Agency (USEPA's) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (Unified Guidance; USEPA, 2009) and the Site's *Statistical Analysis Plan* (Geosyntec, 2020a). The established GWPSs were determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based screening level (RSL) for each Appendix IV parameter. The current GWPSs are presented in **Table 1**.

A statistical evaluation of the October 2019 assessment monitoring data was completed in January 2020 and is described in the *Statistical Analysis Summary – Fly Ash Reservoir* (Geosyntec, 2020b). The statistical analysis report included an evaluation of statistically significant levels (SSLs) for

Appendix IV parameters and statistically significant increases (SSIs) for Appendix III parameters. The statistical analysis report identified SSLs of lithium and molybdenum above their respective GWPSs at monitoring wells FA-8 and M-11. SSIs of boron, calcium, chloride, fluoride, pH, and sulfate were identified.

A statistical evaluation of the April 2020 assessment monitoring data was completed in August 2020 and is described in the *Statistical Analysis Summary – Fly Ash Reservoir* (Geosyntec, 2020c). The statistical analysis report included an evaluation of SSLs for Appendix IV parameters and an evaluation of SSIs for Appendix III parameters. The statistical analysis report identified SSLs of lithium and molybdenum above their respective GWPS at monitoring wells FA-8 and M-11. Additional exceedances were identified for boron, calcium, chloride, fluoride, and sulfate.

An alternate source was not identified for the SSLs following either assessment monitoring event and the CCR unit continued the selection and implementation of corrective measures, as discussed in **Section 5**.

5.3 2020 Sampling and Data Evaluation Activities

5.3.1 Assessment Monitoring Program

Assessment monitoring sampling events were conducted in April and October 2020 in accordance with 40 CFR 257.95(b) and 40 CFR 257.95(d)(1). Samples were analyzed for all Appendix III and Appendix IV parameters, with results provided in **Table 2**. A revision of the GWPS and statistical evaluation of the October 2020 assessment monitoring data is ongoing and will be completed outside of the timeframe of this report.

5.3.2 Groundwater Elevation and Flow Velocities

Prior to sampling, a synoptic round of groundwater level measurements was collected from the compliance and background monitoring wells. Potentiometric surface maps based on groundwater elevations measured during the April and October 2020 assessment monitoring events are presented on **Figure 3** and **Figure 4**, respectively. The potentiometric maps show that groundwater near FAR II flows southeast towards the Ohio River. The groundwater residence times within the wells at the FAR II ranged from 0.6 days at M-10 to 16.6 days at M-23. A summary of hydraulic gradients and groundwater residence times at the FAR II is provided in **Table 3**.

5.3.3 Data Usability

Upon receipt of laboratory analytical reports, the data were evaluated for usability. Analytical data were checked for the following:

- Samples were analyzed within the method specified hold times;
- Samples were received within holding temperature;
- Chain of custody forms were complete;

- Precision was within control limits using relative percent differences of blind duplicate samples;
- Matrix spike and matrix spike duplicate recoveries and laboratory control samples were within the control limits; and
- Potential for positive bias was evaluated using method blanks.

All data received during 2020 were considered complete and usable.

6. CORRECTIVE MEASURES PROGRAM

Following detection of lithium and molybdenum SSLs at FA-8 and M-11, a Notification of Exceedance of Groundwater Protection Standards was published to the public internet site on February 7, 2019 in accordance with 40 CFR 257.105(h) (Buckeye Power, 2019). Monitoring well installation and sampling efforts to characterize the nature and extent of the release were described in the *Groundwater Characterization Report, Cardinal Site – Fly Ash Reservoir II* (Geosyntec, 2019a). An Assessment of Corrective Measures (ACM) Report was completed in July 2019 in accordance with 40 CFR 257.96 and published to the public internet site (Geosyntec, 2019b). The ACM report listed four potential corrective measures that may be appropriate for addressing the elevated lithium and molybdenum concentrations in Site groundwater. A public meeting was held on September 4, 2019 in Steubenville, Ohio where the selection and implementation of potential corrective measures outlined in the ACM Report were reviewed and discussed.

A semi-annual progress report which was completed in March 2020 and published to the public internet site indicated that Cardinal was continuing evaluation of groundwater flow conditions at the facility to determine the most effective remedy (Cardinal, 2020a). Additionally, a semi-annual progress report which was completed in September 2020 and published to the public internet site indicated that Cardinal was in the final phases of selecting a remedy and in progress of preparing a Remedy Selection Report (Cardinal, 2020b). The conclusions of the ACM and public comments resulted in the selection of closure of the FAR II unit with long-term monitoring as the selected remedial approach as detailed in the *Remedy Selection Report, Cardinal Site – Fly Ash Reservoir II* (Geosyntec, 2020d).

7. PROBLEMS ENCOUNTERED AND RESOLUTIONS

No problems were encountered during 2020 related to assessment monitoring activities at the FAR II. No monitoring wells were gauged dry or abandoned within the well network during 2020.

8. STATUS OF MONITORING PROGRAM

The Site was in the assessment monitoring program from May 2018 through January 2019 and transitioned to the corrective measures program in February 2019. The Site remained in the corrective measures program through 2020. Assessment monitoring events were conducted in April and October 2020. FAR II will remain in the corrective measures program in 2021.

9. PLANNED KEY ACTIVITIES FOR 2021

The following activities are planned for 2021 at the FAR II:

- The 2020 Annual Groundwater Monitoring Report will be entered into the facility's operating record and posted to the public internet site;
- A statistical evaluation of the October 2020 assessment monitoring event will be completed, including a recalculation of the Site-specific GWPSs in accordance with the *Statistical Analysis Plan* (Geosyntec, 2020a). The FAR II's monitoring status will be confirmed following the evaluation;
- Two semi-annual groundwater assessment monitoring program events will be conducted;
- Implementation of the selected remedy will commence in 2021; and
- The 2021 Annual Groundwater Monitoring Report will be prepared for submittal in January 2022.

10. REFERENCES

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TABLES

FIGURES