REMEDY SELECTION REPORT CARDINAL SITE – FLY ASH RESERVIOR II BRILLIANT, OHIO

Prepared for

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Definition
µg/L	Micrograms per Liter
cm/s	Centimeters per Second
ACM	Assessment of Corrective Measures
AEP	American Electric Power
AMSL	Above Mean Sea Level
BAC	Bottom Ash Complex
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
ESP	Electrostatic Precipitator
FAD 1	Fly Ash Dam 1
FAD 2	Fly Ash Dam 2
FAR I	Fly Ash Reservoir I
FAR II	Fly Ash Reservoir II
FGD	Flue Gas Desulfurization
GWPS	Groundwater Protection Standards
LLDPE	Low-Density Polyethylene
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
MW	Megawatts
NPDES	National Pollutant Discharge Elimination System
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
PTI	Permit to Install
QA/QC	Quality Assurance and Quality Control
RCRA	Resource Conservation and Recovery Act
RSR	Remedial Selection Report
RSW	Residual Solid Waste Landfill
SAP	Statistical Analysis Plan
SCR	Selective Catalytic Reduction (SCR) System
SSL	Statistically Significant Levels
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION

On behalf of our client, Cardinal Operating Company (Cardinal), Geosyntec Consultants, Inc. (Geosyntec) has produced this Remedy Selection Report (RSR) for the Fly Ash Reservoir II (FAR II), a regulated impoundment at the Cardinal Generating Plant (the Site or Facility). The Site is located one mile south of Brilliant, Ohio in Jefferson County, along the Ohio River (Figure 1). Under the United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) Rule (40 Code of Federal Regulations (CFR) 257 Subpart D), groundwater monitoring is required to assess impacts of CCR activities to groundwater compared to background conditions.

In 2019, an Assessment of Corrective Measures Report (ACM) and a Closure Plan for FAR II were prepared for the Site to address statistically significant levels (SSLs) of lithium and molybdenum above their respective groundwater protection standards (GWPS) that were observed at the Site in 2018 (Geosyntec, 2019a). This RSR has been prepared as required by and in accordance with 40 CFR 257.97 and was developed to select remedial measures for addressing elevated lithium and molybdenum concentrations in site groundwater.

1.1 Purpose and Scope

The purpose of this RSR is to present the selected remedial strategies and technologies for the reduction of lithium and molybdenum present in Site groundwater to acceptable regulatory cleanup levels in accordance with 40 CFR 257.97. The target cleanup levels are the GWPS defined under 40 CFR 257.95(h). The current site-specific GWPS for lithium and molybdenum are 149 micrograms per liter (µg/L) and 100 µg/L, respectively. While the ACM identified a GWPS of 140 µg/L for lithium, this value was updated to 149 µg/L following completion of the first semiannual assessment monitoring event of 2020 (Geosyntec, 2020a).

This RSR report relies on the 2019 Assessment of Corrective Measures, the 2019 Groundwater Characterization Report prepared by Geosyntec Consultants and the 2019 Final Closure Plan prepared by TRC Engineers, Inc. (TRC) to focus the selection of remedial technologies that will achieve the most efficient and reliable method of reducing concentrations of lithium and molybdenum to below the GWPS.

1.2 Remedial System Requirements

Per 40 CFR 257.97, the selected remedial system is required to, at minimum:

- Be protective of human health and the environment;
- Attain the groundwater protection standards pursuant to 40 CFR 257.95(h);
- Control the source of the releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to 40 CFR 257;
- Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
- Comply with standards for management of wastes as specified in 40 CFR 257.98(d).

The effectiveness of the selected remedy in meeting these requirements is discussed in **Section 4**.

SECTION 2

SITE BACKGROUND

2.1 Site Operational History

The Site is located approximately one mile south of Brilliant, Ohio in Jefferson County along the Ohio River (**Figure 1**). The generating station consists of three units with a nominal capacity of 1,830 megawatts (MW). Units 1 and 2 began operation in 1967 and Unit 3 began operation in 1977. All three units are coal powered, with an average annual coal use of 5.2 million tons for the entire plant. 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.

The regulated CCR storage unit addressed in the RSR and currently used by the Facility is the FAR II reservoir. The locations of the FAR II unit is shown in **Figure 1**. Fly ash is currently sluiced to FAR II, which is impounded by Fly Ash Dam 2 (FAD 2). FAR II/FAD 2 has a permitted discharge (Outfall 019) through the national pollutant discharge elimination system (NPDES).

Construction of FAR II began in 1985 under PTI 06-1250 (Cardinal, 2019b). The FAR II foundation consists of a bedrock base (claystone and shale), and geology adjacent to the eastern and western abutments consists of bedrock units, the Monongahela Group and a portion of the Conemaugh Group including the Morgantown Sandstone.

Prior to the construction of FAD 2, a colluvium landslide upstream of the western abutment of FAR II occurred, exposing the face of the Morgantown Sandstone. The abutment was installed such that the clay core contacted the competent bedrock at 90-degree angles on the upstream side of the abutment to prevent seepage beneath the dam and reduce cracking of the core (American Electric Power [AEP], 2016). The dam was constructed with an open cut to rock and a grout curtain was installed (AEP, 2016). The dam had a final crest height of 925 feet above mean sea level (AMSL; AEP, 1997).

The FAD 2 structure has been raised twice since the initial construction. The dam was raised to an elevation of 970 AMSL in 1997 and the final crest height of 983 ft AMSL in 2013 (AEP, 1997; AEP, 2016).

Groundwater monitoring for FAR II is conducted in accordance with 40 CFR 257. Monitoring wells within the CCR rule monitoring network and select other locations of interest are shown in **Figure 2**.

2.2 Geologic Site Conditions

The Site is underlain by horizontal sequences of lower Permian and upper Pennsylvanian age sedimentary bedrock. The geologic units of interest in the vicinity of FAR II/FAD 2 are the Pennsylvanian aged Monongahela Group and the Conemaugh Group. The Monongahela group is approximately 203 ft thick in the vicinity of the Site and consists of sandstone and shale, siltstone, limestone, sandstone, and coal (AEP, 2006).

The Conemaugh group is approximately 500 feet thick in the vicinity of the Site and 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, the Cow Run Sandstone, and the Buffalo Sandstone. The Morgantown Sandstone is a fractured and jointed conglomeratic sandstone that is approximately 75 to 100 feet thick in the vicinity of the western abutment of FAD 2 (Sanborn Head & Associates, Inc. [Sanborn Head], 2018). In the vicinity of FAD 2, the base of the Morgantown Sandstone slopes south from M-21 to the Jules Verne Seep, and east from M-1003 to the Jules Verne Seep (Sanborn Head, 2018). The Elk Lick Limestone, the Skelly Limestone and Shale and the Ames Limestone vary in a combined thickness of approximately 80 feet. At the bottom of the Conemaugh Group, the Cow Run Sandstone is approximately 20 to 30 feet thick (AEP, 2006).

Prior to the development of the FAR II, overburden in the FAR II valley consisted of 10 to 30 feet of residual soils, mine spoil, landside debris and alluvial deposits (AEP, 1984; AEP, 2006). Along the valley walls, the overburden consisted of clayey colluvium (Amaya et al., 2009). Prior to the construction of FAD 2, a landslide upstream of the western abutment of FAD 2 occurred, exposing the face of the Morgantown Sandstone at approximately 880 feet AMSL. FAR II incises the Monongahela Group and partially incises the Conemaugh Group, including the Morgantown Sandstone. Cross sections for the geology at FAD 2 are shown in **Figure 3** and **Figure 4**.

2.3 Hydrogeologic Site Conditions

Groundwater in the vicinity of FAR II is present in three aquifers: the surficial aquifer, the Morgantown Sandstone, and the Cow Run Sandstone. The surficial aquifer is comprised of the Conemaugh group, primarily the Connellsville Sandstone, the Summerfield Limestone, the Bellaire Sandstone, former room and pillar mines, and mine spoils. The groundwater flow in the surficial aquifer tends to follow local topography. Underlying the surficial aquifer is a shale aquitard.

The Morgantown Sandstone aquifer is found below the shale aquitard and consists of a fractured and jointed conglomeratic sandstone with fractures. Regionally, groundwater in the Morgantown Aquifer flows south-southeast towards the Ohio River southeast of the Site. In the vicinity of FAD 2, groundwater in the Morgantown Aquifer travels through FAR II and around FAD 2 with discharges on the eastern and western abutments. Along the western abutment, the Morgantown Sandstone outcrops, and groundwater is discharged through the Jules Verne Seep (**Figure 4**).

Underlying the Morgantown Sandstone is approximately 50 to 100 feet of low permeability shale and limestone beds followed by the Cow Run Sandstone Aquifer. The Cow Run Sandstone Aquifer generally flows south-southeast towards the Ohio River in the vicinity of the Site. Additional details of the hydrogeologic conditions at the Site are discussed in the 2019 ACM report.

2.4 Groundwater Quality

A groundwater sampling program is in place at the Site to monitor background groundwater conditions and groundwater conditions downgradient of the FAR II unit in accordance with 40 CFR 257. In 2018, SSLs of lithium and molybdenum above their respective GWPS were observed at the Site (Geosyntec, 2019a).

Efforts completed in 2019 to delineate groundwater impacts found that although the FAR II unit discharges into the Morgantown Aquifer, the impacts from the FAR II are limited to monitoring wells FA-8, M-11, M-2000, and the Jules Verne Seep (Geosyntec, 2019c). Additionally, concentrations of lithium and molybdenum in the Cow Run Aquifer were generally much lower than concentrations in the impacted Morgantown Aquifer monitoring wells indicating that there is little to no vertical migration from the Morgantown Aquifer to the Cow Run Aquifer.

Groundwater flow and geochemical analysis of water from the Jule Verne Seep indicates that the seep water originates from the FAR II unit (Sanborn Head, 2018; Geosyntec, 2019c). The entry point for the water from FAR II is likely the location of the colluvium landside that occurred in the native overburden at 880 ft AMSL feet during the installation of FAD 2.

The hydraulic gradient in the Morgantown Aquifer along the north-south transect of the dam is from north to south (M-11 to M-2000) as shown in **Figure 3.** Along the east-west transect, the hydraulic gradient is from west to east and ultimately discharges through the Jules Verne Seep (M-1003 to Jules Verne Seep; **Figure 4**). Therefore, impacts from FAR II likely enter the Morgantown Aquifer in the vicinity of M-11 and discharge through the outcrop of the Morgantown Sandstone at the Jules Verne Seep. Groundwater discharging from the Jules Verne Seep is collected at the base of FAD 2 and discharged to the Ohio River through NPDES Permitted Outfall No. 19.

SECTION 3

SELECTED REMEDY

3.1 Overview

The selected remedy for the Site to mitigate and remediate SSLs of lithium and molybdenum in the affected portion of the Morgantown Aquifer includes the closure of the FAR II unit via dewatering and capping and long-term monitoring in accordance with the closure plan.

The FAR II unit will be closed by closure in place in accordance with 40 CFR 257.102(d) commencing in 2021. Closure in place will be achieved by:

- Removal of free water from the CCR material (unwatering),
- dewatering the CCR material,
- regrading the CCR material, leaving the existing CCR material within the unit in place, and
- installing a geomembrane cover system in accordance with 40 CFR 257.102(d) with drainage channels to divert water away from the capped CCR unit.

The existing dam and spillway are proposed to remain.

A written final closure plan was developed by TRC (TRC, 2019) in accordance with 40 CFR 257.102(b) and approved by Ohio Environmental Protection Agency (OEPA) on February 2, 2020. The closure process is expected to take approximately five years, after which groundwater impacts will be addressed through long-term groundwater monitoring. The individual steps that will be taken to achieve the remedial system requirements presented in **Section 1.2** are discussed in detail in the following subsections.

3.2 Remedy Selection Process

Four remedial alternatives were assessed in the 2019 ACM report, including monitored natural attenuation (MNA); closure of the FAR II unit with long-term monitoring; installation of bedrock grouting or a cutoff wall; and, hydraulic gradient control

(Geosyntec, 2019c). The corrective measure alternatives were evaluated based on the criteria provided in 40 CFR 257.96(c).

Prior to the selection of the remedy, the results of the ACM were presented at a public meeting with interested and affected parties on September 4, 2019, which was at least 30 days prior to the selection of the remedy as required by 40 CFR 257.96.

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 **Section 3.3**.

3.3 Selected Remedial System

3.3.1 Removal of Free Water

The FAR II unit currently receives sluiced fly ash waste from the generating unit's ESP and stormwater runoff from the FAR I RSW Landfill. Operational changes from wet to dry ash handling will result in the termination of disposal of sluiced fly ash in the FAR II. Additionally, as part of the FAR II unit closure plan, stormwater will be diverted from FAR I and FAR II to sedimentation ponds via earthen berms and ultimately discharged through NPDES Permitted Outfall No. 19.

The changes in operation of the FAR II unit will allow the start of the free water removal process from the FAR II unit (unwatering). Free water will be removed by lowering the stop logs of the existing service spillway and with pumps when needed.

3.3.2 CCR Dewatering

The CCR material in the FAR II unit will be dewatered to provide a stable surface for the final cap. Dewatering is anticipated to reduce pore water elevations within FAR II to below the elevation of the colluvium landslide (880 ft AMSL) which is the main entry point for water to enter the Morgantown from FAR II and discharge at Jules Verne seep. The final dewatering process will be followed as described in the Closure Plan (TRC, 2019).

3.3.3 CCR Stabilization

Once the FAR II unit has been dewatered, the CCR material will be stabilized to prevent sloughing or movement of the final cover system. CCR stabilization will be completed as described in the Closure Plan (TRC, 2019).

3.3.4 CCR Regrading

The CCR in the FAR II unit will be regraded to achieve the planned final grade of the cover system. As presented in the 2019 Permit-to-Install Modification Application, the site will be regraded to provide a final slope for the cover system of 1% to 2% from east to west in the main length of FAR II with general side grading of 3% to 5% with a maximum slope of 3:1 (TRC, 2019). The surface of FAR II will also include grading for stormwater collection and redirection of runoff towards the NPDES Permitted Outfall No. 19.

3.3.5 Cover Installation

The cover system will be constructed to control, minimize, or eliminate, to the maximum extent feasible, infiltration of precipitation into the FAR II unit as prescribed by 40 CFR 257.102(d)(i). The system will cover approximately 160 acres of CCR. The system will be installed directly over the dewatered and regraded CCR material and will consist of:

- a 40-mil linear low-density polyethylene (LLDPE) geomembrane placed directly on the CCR material;
- a geocomposite drainage layer within the swale or a cushion geotextile;
- an infiltration layer that contains 18 inches of earthen material, and
- six inches of earthen material capable of supporting native vegetation (TRC, 2019).

The Closure Plan states: "The geomembrane or general fill material will be selected such that the permeability of the cover system is less than or equal to the permeability of the natural subsoils and is not greater than $1\text{x}10^{-5}$ centimeters per second (cm/s)" (TRC, 2019).

3.3.6 Final Site Restoration

The final cover system will be vegetated to prevent erosion. Maintenance of the cover system will include mowing. The final cover will be inspected and maintained, including the drainage channels, the cover, the final cover surface, and the surface drainage system.

3.3.7 Long Term Monitoring

The Facility will comply with the post-closure care and maintenance requirements for a period of 30 years, as required by 40 CFR 257.104. These post-closure requirements include maintaining the final cover system, maintaining the leachate collection system, maintaining the groundwater monitoring system, and monitoring groundwater in accordance with 40 CFR 257.90 through 257.98. A post-closure plan has been developed in accordance with 40 CFR 257.104(d) (TRC, 2019).

Groundwater will continue to be monitored at the site after closure. Groundwater upgradient, down gradient and cross gradient to FAR II will continue to be monitored during closure and post-closure in accordance with 40 CFR 257.90 through 257.98 and with the site-specific CCR Groundwater Monitoring Design Network and Statistical Analysis Plan (TRC, 2019; Geosyntec, 2020b).

SECTION 4

EFFECTIVENESS OF SELECTED REMEDY

In accordance with 40 CFR 257.97(b), this section provides an evaluation of the effectiveness of the selected remedy at protecting human health and the environment, the attaining groundwater protection standards, controlling the source, removing released material, and managing wastes during the implementation of the remedy. Additionally, this section addresses the consideration of the evaluation factors listed in 40 CFR 257.97(c).

4.1 Protection of Human Health and the Environment

Under 40 CFR 257.97(b)(1), the selected remedy must be protective of human health and the environment. The risk to human health and the environment from exposure to CCR-related constituents in groundwater at the Site was assessed (Geosyntec, 2019b). The risk assessment included an exposure assessment and a screening-level risk evaluation. The purpose of the exposure assessment was to identify potentially complete exposure pathways by which human or ecological receptors may contact lithium or molybdenum in groundwater, while the purpose of the screening level risk evaluation was to quantitatively evaluate receptor-exposure scenarios for pathways identified as complete or assumed-to-be complete.

Based on the results of the exposure assessment and screening-level risk evaluation, lithium and molybdenum in FAR II groundwater are unlikely to pose an unacceptable risk to human or ecological receptors in the vicinity of the site under current or near-term future conditions. Until the remedy can be implemented, additional actions are not necessary to protect human health and the environment. Anticipated future remedy implementation and resulting site conditions are expected to further reduce these risks.

4.2 Ability to Attain the Groundwater Protection Standards

Under 40 CFR 257.97(b)(2), the selected remedy must be able to attain the GWPSs developed for the Site pursuant to 40 CFR 257.95(h). GWPSs must be established for each detected Appendix IV constituent. The GWPS shall be the greater of the background concentration and the maximum contaminant level (MCL) established by the USEPA for that constituent. The selected remedy will achieve GWPS by reducing impacts from FAR II to groundwater in the vicinity of the unit. Evaluation of whether the remedy has achieved the GWPSs will follow the statistical approach outlined in Section 4.2.1.

4.2.1 Corrective Action Effectiveness Evaluation

Following implementation of remedial activities, a corrective action groundwater monitoring program will be established in accordance with 40 CFR 257.98(a)(1). The effectiveness of the corrective action will be evaluated by comparing groundwater monitoring results to the site GWPSs developed in 2020. A Statistical Analysis Plan (SAP) has been prepared for the Site in accordance with the CCR Rule (Geosyntec, 2020b) and USEPA's *Statistical Analysis of Groundwater monitoring Data at Resource Conservation and Recovery Act (RCRA) Facilities, Unified Guidance* (USEPA, 2009). The SAP incorporates a logic process regarding the appropriate statistical analysis of groundwater data collected in compliance with the CCR Rules. Additionally, the SAP describes the statistical procedures to be used to establish background conditions and implement corrective action monitoring.

The conclusion that the remedy has successfully decreased concentrations below the GWPS is made when average concentrations of monitoring well-constituent pairs where an SSL has previously been identified are less than the GWPS (i.e., when the *upper* confidence limit [UCL] is *less* than the GWPS). Further, a remedy is considered complete when, among other things, confidence intervals constructed for Appendix IV constituents for monitoring wells identified with SSLs have not exceeded the GWPS for three consecutive years [40 CFR 257.98(c)(2)]. The statistical analysis plan includes a detailed path for calculating the UCL for the monitoring well-constituent pairs based on the nature of the data (i.e. seasonality, distribution of data, significant non-detects, etc.).

If a corrective action monitoring program is in place, it must meet the requirements of an assessment monitoring program [40 CFR 257.98(a)(1)(i)].

4.3 Source Control

In accordance with 40 CFR 257.97(b)(3), the remedy must control the source such that further releases are reduced to the "maximum extent feasible". The selected remedy should result in minimal further releases, as capping and dewatering the unit to below the elevation of the colluvium landslide is expected to eliminate the main pathway of water entry from FAR II to the environment.

4.4 Removal of Released Material

Under 40 CFR 257.97(b)(4), the selected remedy must remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible. As discussed in **Section 2.4**, seep water from the Jules Verne Seep is currently collected and discharged to a NPDES permitted outfall.

Assessment of the hydrogeology along the western abutment of FAD 2 indicates that collection of groundwater at the Jules Verne Seep is an effective way of capturing lithium and molybdenum impacted water released from FAR II. This practice will continue until the flow of seep water ceases after installation of the cap and dewatering of the CCR material or concentrations of lithium and molybdenum in seep water decrease below GWPS. Groundwater upgradient, within, and downgradient of the impacted portion of the aquifer will continue to be monitored to assess the post-closure groundwater concentrations as discussed in **Section 3.3.7**.

4.5 Compliance with Standards for Management of Wastes

The CCR material will be managed in compliance with applicable RCRA requirements as required under 40 CFR 257.98(d).

4.6 Evaluation Factors

In selecting the remedy, the evaluation factors listed in 40 CFR 257.97(c) were considered. A brief summary of each evaluation is provided below.

4.6.1 Long-Term and Short-Term Effectiveness and Protectiveness

In accordance with 40 CFR 257.97(c)(1), the long-term and short-term effectiveness and protectiveness of the potential remedy was evaluated, along with the degree of certainty that the remedy will prove successful based on consideration of multiple factors.

4.6.1.1 Short-Term Effectiveness and Protectiveness

As discussed in **Section 2.4**, water impacted with SSLs of lithium and molybdenum are released from the FAR II unit into the Morgantown Aquifer and ultimately discharge to the Jules Verne Seep. Impacts from the FAR II are limited to monitoring wells FA-8, M-11, M-2000, and the Jules Verne Seep (Geosyntec, 2019c). Impacted water discharged at the Jules Verne Seep is currently collected at the base of FAD 2 and discharged to the Ohio River through NPDES Permitted Outfall No. 19.

Assessment of the hydrogeology along the western abutment of FAD 2 indicates that collection of groundwater at the Jules Verne Seep is an effective way of capturing lithium and molybdenum impacted water released from FAR II. The risk assessment found that lithium and molybdenum in FAR II groundwater are unlikely to pose an unacceptable risk to human or ecological receptors in the vicinity of the site under current or near-term future conditions (Geosyntec, 2019b).

4.6.1.2 Long-Term Effectiveness

Dewatering and capping of FAR II will provide long-term source control of lithium and molybdenum at the Site. Ponded water in the FAR II unit will be removed to a sufficient elevation to provide structural stability and capped as part of the closure plan. Dewatering will be sufficient to reduce the hydraulic head in the CCR material in FAR II to below the elevation of the landslide in the native colluvium that is the assumed entry point for the water from FAR II into the Morgantown Aquifer as discussed in **Section 2.4**. Capping will reduce to the maximum extent possible infiltration of precipitation into the groundwater system, which will reduce the future potential for groundwater flow from FAR II to the Morgantown Aquifer.

Once the remedy is in place, a groundwater monitoring program will be implemented similar to the existing and on-going monitoring program under the Federal CCR Rule. As discussed in **Section 4.1.3**, an SAP has been developed for the Site which includes a logic process regarding the appropriate statistical analysis of groundwater for corrective action monitoring. The monitoring program will meet the requirements of 40 CFR 257.98(a)(1)(i) and progress towards remedy completion will be documented in an annual report that will include [40 CFR 257.95(d)(3)]:

- Analytical results for Appendix III and detected Appendix IV constituents,
- Background concentrations for all Appendix III and Appendix IV constituents, and
- GWPSs established for detected Appendix IV constituents.

4.6.2 Effectiveness of the Remedy

In accordance with 40 CFR 257.97(c)(3), the effectiveness of the remedy in reducing further releases should include consideration of the extent to which containment practices will reduce further releases and the extent to which treatment technologies may be used. The selected remedy uses industry-standard containment technologies which are anticipated to reduce the potential for further releases. The use of treatment technologies is not included in the design of the proposed remedy.

4.6.3 Ease of Implementation

While closure of the unit is a significant effort, the remedy can be implemented with respect to infrastructure. A written Closure Plan for FAR II has been developed in accordance with 40 CFR 257.102(b) and was approved by OEPA on February 2, 2020. The Closure Plan includes a plan for Quality Assurance and Quality Control (QA/QC) during construction which will facilitate long-term operational reliability of the implemented remedy. Closure and capping of FAR II is anticipated to take five years.

4.6.4 Community Concerns

Prior to the selection of the remedy, the results of the ACM were presented at a public meeting with interested and affected parties on September 4, 2019. Attendees of the meeting expressed no direct concerns with any of the proposed remedies.

4.7 Remedy Completion

The remedy will be considered complete when compliance with the GWPS have been achieved at all points within the plume of contamination that lie beyond the groundwater monitoring well system and confidence intervals constructed for Appendix IV constituents for wells identified with SSLs have not exceeded the GWPS for three consecutive years.

Upon completion of the remedy, the facility must prepare a notification that the remedy has been completed. The notification must be certified by a qualified professional engineer or approved by the State Director or USEPA and placed in the operating record [40 CFR 257.98(e)].

SECTION 5

REMEDY IMPLEMENTATION

The proposed remedy implementation schedule was developed in accordance with 40 CFR 257.97(d) and the anticipated schedule for the closure for the FAR II unit.

5.1 Schedule of Remedial Activities

The engineering and design for the closure of FAR II was approved by OEPA in 2020 (OEPA, 2020). The plant will stop receiving process water and divert storm water flows in 2021 and begin FAR II closure. CCR closure activities are expected to take five years to complete. Experience has shown that completion of remedial activities in five years at a pond of this size is within a reasonable period of time. Post-closure care, including groundwater monitoring, is expected to continue for 30 years after closure, in accordance with 40 CFR 257.104 (c).

5.2 Schedule Implementation Factors

The proposed remedy implementation schedule considers the factors established in CFR 257.97(d), as discussed in the **Section 5.2.1** through **Section 5.2.5**.

5.2.1 Extent and Nature of Contamination

The extent of lithium and molybdenum groundwater impacts has been defined to the area near the Jules Verne Seep. Impacted water discharged at the Jules Verne Seep is currently collected at the base of FAD 2 and discharged to the Ohio River through NPDES Permitted Outfall No. 19. Collection of seep water will continue until the flow of seep water ceases or concentrations of lithium and molybdenum in seep water decrease below GWPS.

The extent and nature of contamination does not strongly influence the remedy implementation schedule. The extent of contamination in groundwater is limited to on-site impacts and is unlikely to pose an unacceptable risk to human health or ecological receptors under current or near-term future conditions (Geosyntec, 2019b).

5.2.2 Reasonable Probability of Remedial Technologies in Achieving Compliance

The selected remedy is highly likely to achieve compliance with the GWPS established for the site. As the water level within FAR II is reduced below the elevation of the colluvium landslide, the main entry point for impacts to enter the groundwater will be eliminated. Following reduction in inputs of impacts to groundwater, concentrations are expected to decline below the GWPS and groundwater flow through the Jules Verne Seep is expected to significantly decline or cease over time.

Consequently, the reasonable probability of the selected remedy achieving compliance does not strongly influence the remedy selection implementation schedule.

5.2.3 Availability of Treatment or Disposal

Impacted groundwater is currently collected at the base of FAD 2 and discharged to the Ohio River through NPDES Permitted Outfall No. 19. Collection of seep water will continue until the flow of seep water ceases or concentrations of lithium and molybdenum in seep water decrease below GWPS.

Consequently, the availability of treatment for impacted does not strongly influence the remedy selection implementation schedule.

5.2.4 Potential Risks to Human Health and the Environment

The risk assessment conducted by Geosyntec (Geosyntec, 2019b) concluded that lithium and molybdenum in FAR II groundwater are unlikely to pose an unacceptable risk to human or ecological receptors in the vicinity of the site under current or near-term future conditions. Until the remedy can be implemented, additional actions are not necessary to protect human health and the environment.

Consequently, potential risks to human health and the environment do not strongly influence the remedy implementation schedule.

5.2.5 Resource Value of the Aquifer

Impacts of lithium and molybdenum at the Site have been delineated, with no off-site migration of impacts observed. Because there are no off-site impacts and there are no current or future uses of groundwater from the impacted aquifer on-site, the resource value of the aquifer is not affected in a way that would strongly influence the remedy implementation schedule. Additionally, the risk assessment found that lithium and molybdenum in FAR II groundwater are unlikely to pose an unacceptable risk to human or ecological receptors in the vicinity of the site under current or near-term future conditions (Geosyntec, 2019b). There are abundant alternate water supplies near the Site, with highly productive wells installed in the sand and gravel aquifer adjacent to the Ohio River, which is located less than one mile from the Site, provides abundant alternative water supplies. These resources provide additional support for the conclusion that the schedule for remedy implementation is not affected by the resource value of the aquifer.

SECTION 6

CERTIFICATION BY A PROFESSIONAL ENGINEER

By means of this certification, I certify that I have reviewed the Remedy Selection Report for the Fly Ash Reservoir II unit at the Cardinal Operating Company's Cardinal Plant and it meets the requirements of Section 40 CFR 257.97.

John Seymour, P.E.

Printed Name of Registered Professional Engineer

STATE OF OHIO
JOHN
SEYMOUR
E-85326
REGISTERED
PROFESSIONAL ENGINEER

Signature

E-85326	OHIO	10/19/2020
Registration No.	Registration State	Date

SECTION 7

REFERENCES

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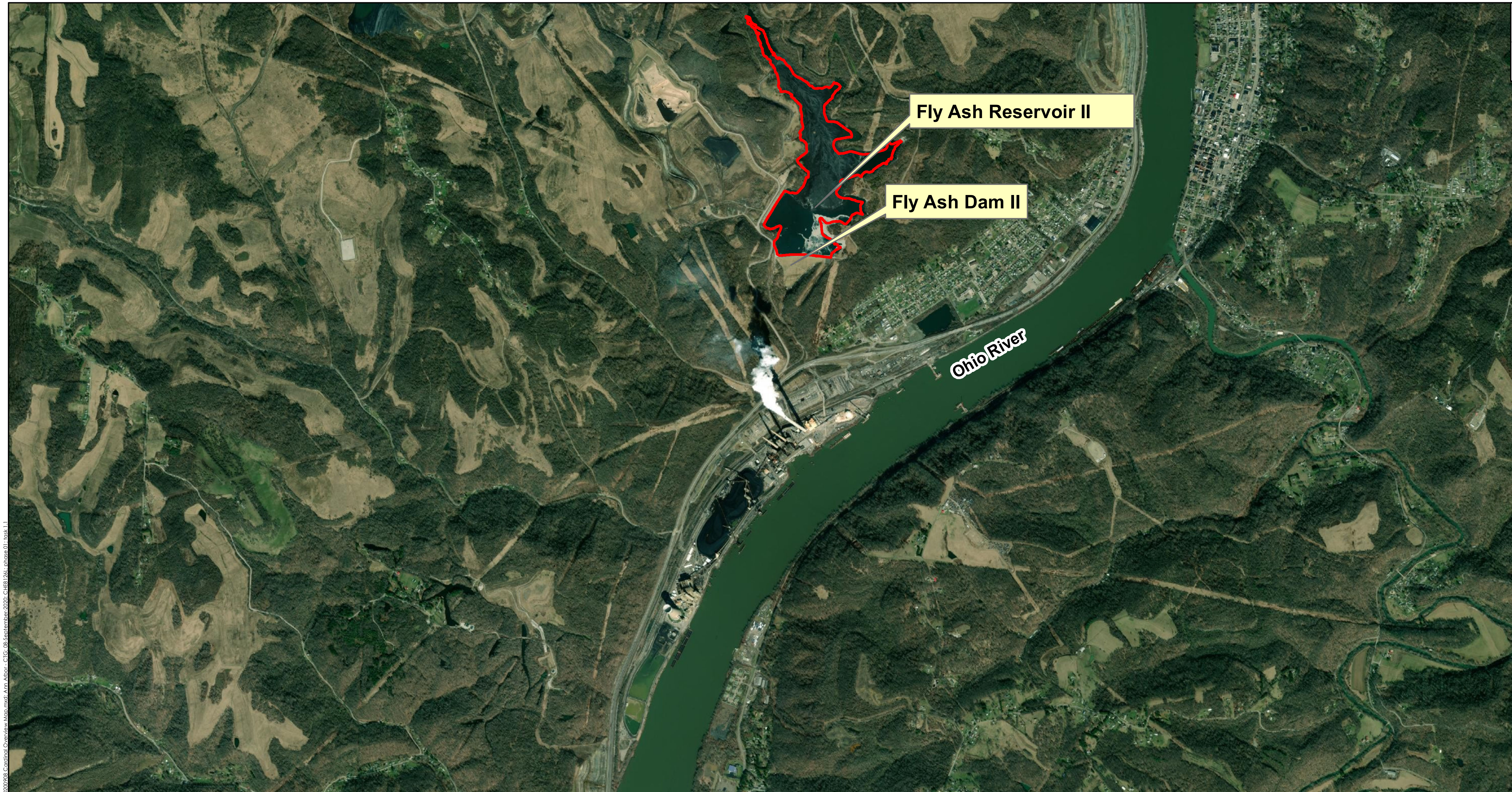
FIGURES



Legend

FAR II Reservoir

Notes
- Aerial imagery courtesy of ESRI.
- All boundaries are approximate.
- FAR = Fly Ash Reservoir

2,000 1,000 0 2,000 Feet

Fly Ash Reservoir II Location Map

Buckeye Power Cardinal Generating Plant
Brilliant, Ohio

Geosyntec consultants

Ann Arbor, Michigan | 09/08/2020

Figure 1

Legend

- Monitoring Wells
- Out of Network Locations

Notes
- Monitoring well coordinates provided by Buckeye Power.
-Site features based on information available in Groundwater Monitoring Network Evaluation - Cardinal Site - Fly Ash Reservoir II (Geosyntec, 2017) provided by Buckeye Power.

1,000 500 0 1,000 Feet

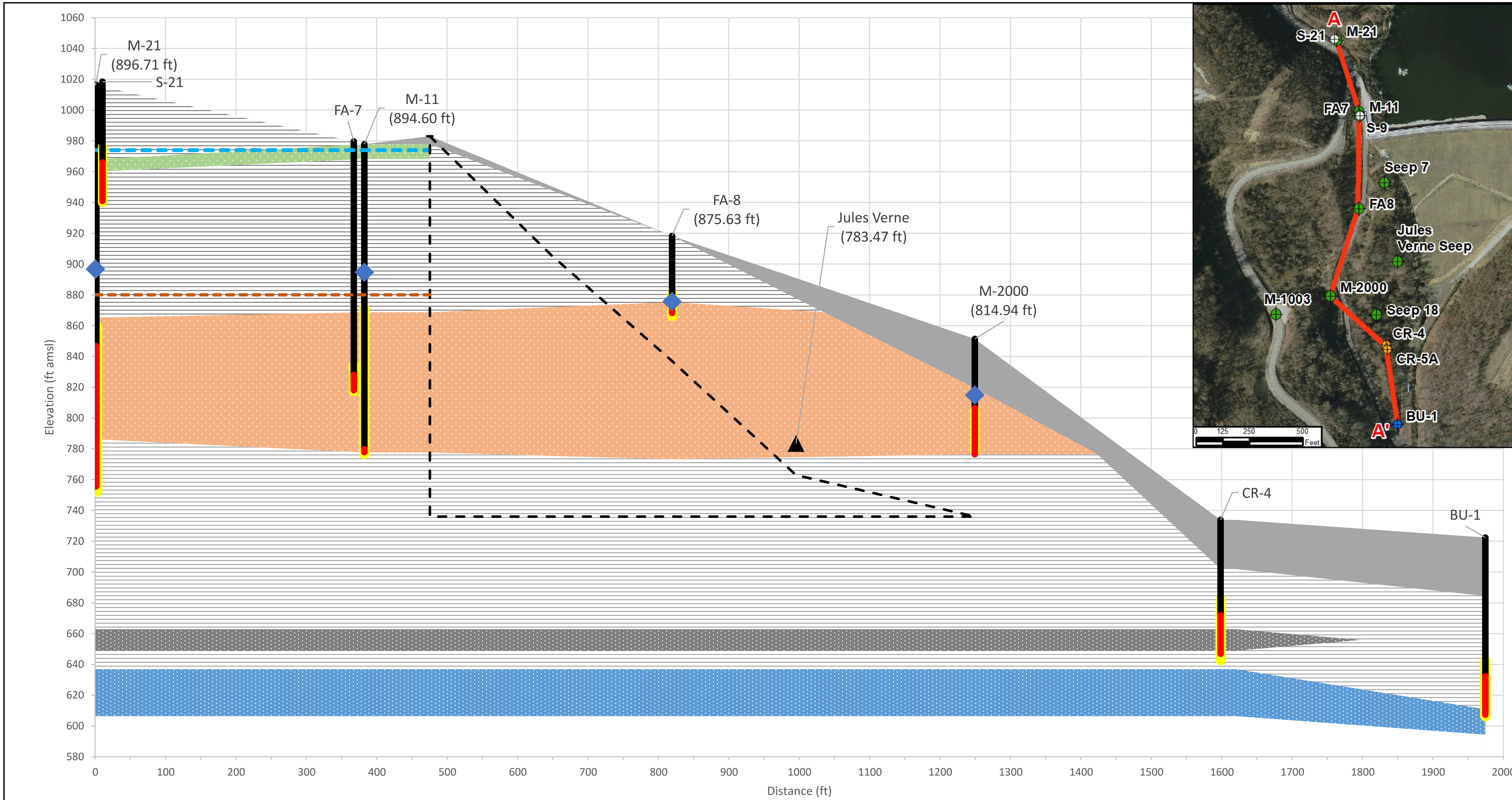
Monitoring Well Network
Fly Ash Reservoir II

Buckeye Power Cardinal Generating Plant
Brilliant, Ohio

Geosyntec consultants

Columbus, Ohio | 2020/09/09

Figure 2



Legend

- Overburden
- Shales, Limestones, Minor Sandstones
- Connellsville Sandstone
- Morgantown Sandstone
- Cow Run Sandstone
- Buffalo Sandstone
- Well Casing
- (875.63 ft) April 2020 Water Level
- Well Screen
- Well Sand Pack
- FAD II Outline
- FAR II Max Stage
- Approximate Landslide Elevation
- April 2020 Water Level in Morgantown Sandstone Well

Notes:

1. FAD – Fly Ash Dam
2. FAR – Fly Ash Reservoir
3. Elevations are approximate and were developed and interpolated from boring logs, existing cross sections, available LiDAR data, and well construction information.
4. The FAD II Outline and Jules Verne Seep locations represent an estimated projection against the cross-section plane from available LiDAR data.
5. LiDAR data for topography projections and inset aerial imagery from the Ohio Statewide Imagery Program (OSIP)
6. Inset map in Ohio State Plane North projection.

Cross Section A-A'
Fly Ash Reservoir II

Buckeye Power Cardinal Generating Plant
Brilliant, Ohio

Geosyntec consultants

Figure
3

CHA8468	August 2020

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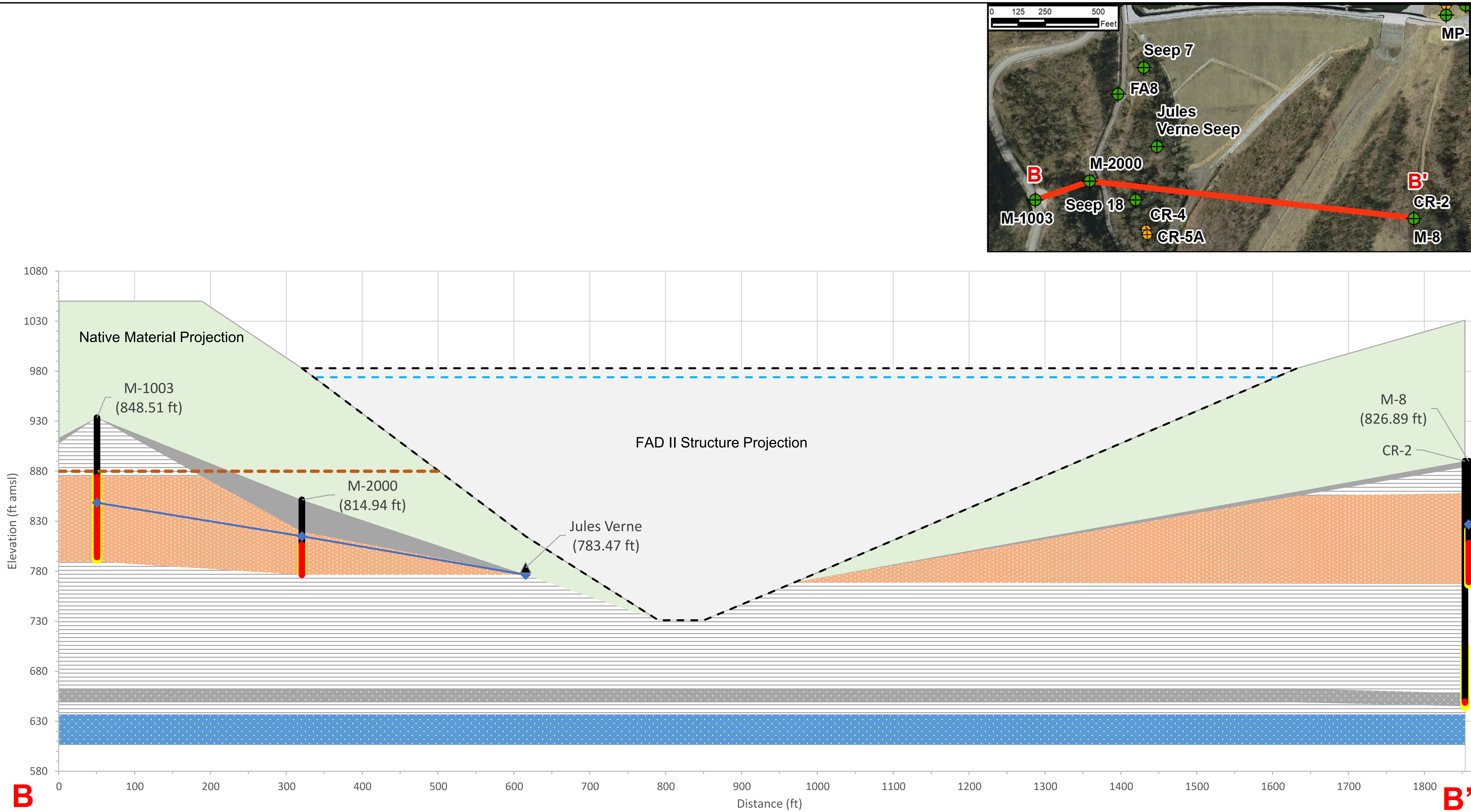


Legend

- Overburden
- Shales, Limestones, Minor Sandstones
- Connellsville Sandstone
- Morgantown Sandstone
- Cow Run Sandstone
- Buffalo Sandstone
- Well Casing
- (848.51 ft) April 2020 Water Level
- Well Screen
- Well Sand Pack
- FAD II Outline
- FAR II Max Stage
- Approximate Landslide Elevation
- April 2020 Water Level in Morgantown Sandstone Well

Notes:

1. FAD – Fly Ash Dam
2. FAR – Fly Ash Reservoir
3. Elevations are approximate and were developed and interpolated from boring logs, existing cross sections, available LiDAR data, and well construction information.
4. The FAD II Outline and Jules Verne Seep locations represent an estimated projection against the cross-section plane from available LiDAR data.
5. LiDAR data for topography projections and inset aerial imagery from the Ohio Statewide Imagery Program (OSIP)
6. Inset map in Ohio State Plane North projection.

Cross Section B-B'
Fly Ash Reservoir II

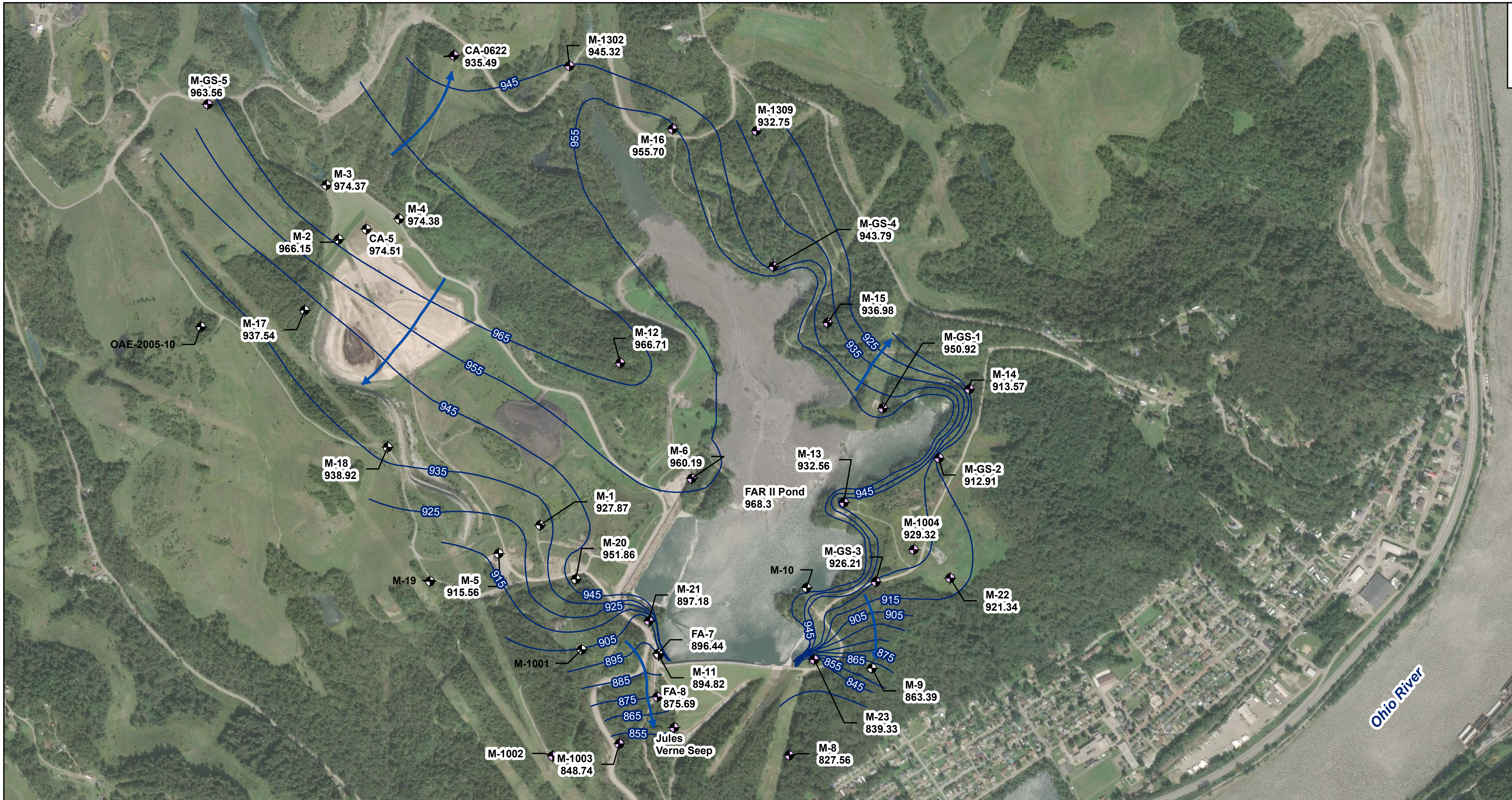
Buckeye Power Cardinal Generating Plant
Brilliant, Ohio

Geosyntec consultants

Figure

4

CHA8468 | August 2020



Legend

- FAR II Network Monitoring Well
- State/Other Program Monitoring Well
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on March 21, 2019) provided by Buckeye Power.
-Site features based on information available in Groundwater Monitoring Network Evaluation - Cardinal Site - Fly Ash Reservoir II (Geosyntec, 2017) provided by AEP.
- Groundwater discharge observed from Jules Verne Seep location.
- OAE-2005-10, M-10, M-19, and M-1001 were not gauged in March 2019.
- Groundwater elevation units are feet above mean sea level.

1,000 500 0 1,000
Feet

Potentiometric Surface Map - Morgantown Aquifer
Fly Ash Reservoir II
March 2019

Buckeye Power Cardinal Generating Plant
Brilliant, Ohio

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Figure **5**

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