OHIO VALLEY ELECTRIC CORPORATION
3932 U. S. Route 23
P. O. Box 468
Piketon, Ohio 45661
740-289-7200

WRITER'S DIRECT DIAL NO:
740-897-7768

October 14, 2020

<u>Delivered Electronically</u>

Ms. Laurie Stevenson, Director
Ohio Environmental Protection Agency
50 West Town Street, Suite 700
P.O. Box 1049
Columbus, OH 43216-1049

Dear Ms. Stevenson:

Re: Ohio Valley Electric Corporation
Notification of Revision to Groundwater Monitoring Reports

As required by 40 CFR 257.106(h)(4), the Ohio Valley Electric Corporation (OVEC) is providing notification to the Director of the Ohio Environmental Protection Agency that revisions have been made to the 2017, 2018 and 2019 Annual Groundwater Monitoring and Corrective Actions reports for OVEC's Kyger Creek Station. These revisions were completed in accordance with 40 CFR 257.90(e) of the Federal CCR Rule, and were necessary to resolve an error discovered in the previously determined groundwater flow direction at the station's South Fly Ash Pond facility.

The updated reports have been placed in the facility's operating record in accordance with 40 CFR 257.105(h)(1), as well as on the company's publicly accessible internet site in accordance with 40 CFR 257.107(h)(1). The facility's publicly accessible internet site can be viewed at https://www.ovec.com/CCRCompliance.php.

If you have any questions, or require any additional information, please call me at (740) 897-7768.

Sincerely,

Tim Fulk
Engineer II

TLF:klr

Stantec Consulting Services Inc.
11687 Lebanon Road, Cincinnati OH 45241-2012

October 13, 2020

File: 175534017, 200.201

Ohio Valley Electric Corporation
Indiana-Kentucky Electric Corporation
Attention: Mr. Gabriel Coriell
3932 U.S. Route 23
P.O. Box 468
Piketon, Ohio 45661

Reference: 2019 Annual Groundwater Monitoring and Corrective Action Report (Rev. 1.0)
EPA Final Coal Combustion Residuals (CCR) Rule
Kyger Creek Generating Station
Cheshire, Ohio

Dear Mr. Coriell,

The EPA Final CCR Rule requires owners or operators of existing CCR landfills and surface impoundments to prepare an annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by 40 CFR 257.90(e). For the Ohio Valley Electric Corporation (OVEC), this applies to the Kyger Creek Station's South Fly Ash Pond, Boiler Slag Pond, and CCR Landfill.

The annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

1. A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;
2. Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;
3. In addition to all the monitoring data obtained under §§257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;
4. A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in

**Reference: 2019 Annual Groundwater Monitoring and Corrective Action Report (Rev. 1.0)
EPA Final Coal Combustion Residuals (CCR) Rule
Kyger Creek Generating Station
Cheshire, Ohio**

addition to identifying the constituent(s) detected at a statistically significant increase over background level); and

5. Other information required to be included in the annual report as specified in §§257.90 through 257.98.

OVEC has retained Applied Geology and Environmental Science, Inc. of Clinton, Pennsylvania (AGES) to perform the Kyger Creek Station's groundwater monitoring and corrective action support under the EPA Final CCR Rule. The 2019 CCR Regulation Groundwater Monitoring and Corrective Action Report (GWCAR) was prepared by AGES to present the annual groundwater monitoring at the South Fly Ash Pond, Boiler Slag Pond, and CCR Landfill of the Kyger Creek Station (AGES, 2020a). AGES (2020b, Rev. 1.0) corrected groundwater elevation data for wells at the South Fly Ash Pond. Stantec Consulting Services Inc. (Stantec) has reviewed AGES (2020a and 2020b, Rev. 1), and they meet the requirements specified in 40 CFR 257.90(e).

Please contact us with any questions or concerns. We appreciate the opportunity to continue to work with the Kyger Creek Generating Station and OVEC.

Regards,

Stantec Consulting Services Inc.

Jacqueline S. Harmon, P.E.
Senior Associate
Phone: (513) 842-8200 ext 8220
Fax: (513) 842-8250
Jacqueline.Harmon@stantec.com

Attachment: AGES (2020b). Coal Combustion Residuals Regulation, 2019 Groundwater Monitoring and Corrective Action Report. Ohio Valley Electric Corporation. Kyger Creek Station. Cheshire, Ohio. October. Revision 1.0.

c. Stan Harris, John Griggs

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AGES
Applied Geology And Environmental Science, Inc.
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Clinton, PA 15026
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COAL COMBUSTION RESIDUALS REGULATION
2019 GROUNDWATER MONITORING AND
CORRECTIVE ACTION REPORT

OHIO VALLEY ELECTRIC CORPORATION
KYGER CREEK STATION
CHESHIRE, OHIO

JANUARY 2020
OCTOBER 2020 REVISION 1.0

Prepared for:

OHIO VALLEY ELECTRIC CORPORATION (OVEC)

By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

COAL COMBUSTION RESIDUALS REGULATION
2019 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
OHIO VALLEY ELECTRIC CORPORATION
KYGER CREEK STATION
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Prepared for:

OHIO VALLEY ELECTRIC CORPORATION (OVEC)

Prepared By:

Applied Geology and Environmental Science, Inc.

Bethany Flaherty
Senior Scientist

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President/Chief Hydrogeologist

COAL COMBUSTION RESIDUALS REGULATION
2019 GROUNDWATER MONITORING AND
CORRECTIVE ACTION REPORT
OHIO VALLEY ELECTRIC CORPORATION
KYGER CREEK STATION
CHESHIRE, OHIO

T A B L E O F C O N T E N T S

COAL COMBUSTION RESIDUALS REGULATION
2019 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
OHIO VALLEY ELECTRIC CORPORATION
KYGER CREEK STATION
CHESHIRE, OHIO

T A B L E O F C O N T E N T S

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APPENDICES

LIST OF ACRONYMS

AGES	Applied Geology and Environmental Science, Inc.
ASD	Alternate Source Demonstration
BSP	Boiler Slag Pond
CCR	Coal Combustion Residuals
GMPP	Groundwater Monitoring Program Plan
GWPS	Groundwater Protection Standard
Landfill	Class III Residual Waste Landfill
MCL	Maximum Contaminant Level
OEPA	Ohio Environmental Protection Agency
OVEC	Ohio Valley Electric Corporation
RCRA	Resource Conservation and Recovery Act
StAP	Statistical Analysis Plan
SFAP	South Fly Ash Pond
Stantec	Stantec Consulting Services, Inc.
SSI	Statistically Significant Increase
TDS	Total Dissolved Solids
ug/L	Micrograms per liter
U.S. EPA	United States Environmental Protection Agency

COAL COMBUSTION RESIDUALS REGULATION 2019 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT OHIO VALLEY ELECTRIC CORPORATION KYGER CREEK STATION CHESHIRE, OHIO

1.0 INTRODUCTION

On December 19, 2014, the United States Environmental Protection Agency (U.S. EPA) issued their final Coal Combustion Residuals (CCR) regulation which regulates CCR as a non-hazardous waste under Subtitle D of Resource Conservation and Recovery Act (RCRA) and became effective six (6) months from the date of its publication (April 17, 2015) in the Federal Register, referred to as the "CCR Rule." The rule applies to new and existing landfills, and surface impoundments used to dispose of or otherwise manage CCR generated by electric utilities and independent power producers. Because the rule was promulgated under Subtitle D of RCRA, it does not require regulated facilities to obtain permits, does not require state adoption, and cannot be enforced by U.S. EPA.

The original version (January 2019) of this Groundwater Monitoring and Corrective Action Report were prepared in accordance with §257.90 (e) of the CCR Rule and documented the status of the groundwater monitoring and corrective action program for each CCR unit, summarized key actions completed during 2018, described any known problems encountered, discussed actions to resolve the problems, and projected key activities for the upcoming year.

This update (Revision 1.0-October 2020) of the 2019 Groundwater Monitoring and Corrective Action Report has been prepared to present corrected groundwater elevation data and an updated statistical analysis for wells at the South Fly Ash Pond (SFAP), a CCR unit at the Kyger Creek Station. In April 2019, a review of historic water level data for SFAP revealed that an error had been made in groundwater elevation calculations for that unit in 2016 that was carried through the 2017 and 2018 calculations. After the error was discovered, groundwater elevations at the SFAP were recalculated, which led to a significant change in the interpretation of groundwater flow directions at the unit and modifications of the upgradient and downgradient designations of several SFAP wells. As a result of these corrections, statistical calculations for groundwater at the unit were re-done and are presented in this revised report.

2.0 BACKGROUND

The Kyger Creek Station, located in Cheshire, Ohio, is a 1.1 gigawatt coal-fired generating station operated by Ohio Valley Electric Corporation (OVEC). The Kyger Creek Station has five (5), 217-megawatt generating units and has been in operation since 1955. Beginning in 1955, CCRs were sluiced to surface impoundments located in the plant site. During the course of plant operations, CCRs have been managed in various units at the station.

There are three (3) CCR units at the Kyger Creek Station (Figure 1):

- Class III Residual Waste Landfill (Landfill);
- Boiler Slag Pond (BSP); and,
- SFAP.

A discussion of the status of the groundwater monitoring program for each CCR unit is presented in the following sections of this report.

3.0 CLASS III RESIDUAL WASTE LANDFILL

The Landfill is a residual solid waste landfill located approximately one-half mile south of the intersection of Little Kyger Creek Road and Shaver Road in Addison Township, Gallia County, Ohio (Figure 1). The Landfill is bordered on the east by Shaver Road, and on the west, north and south by vacant, forested land owned by OVEC. The proposed permitted footprint of the Landfill occupies approximately 98 acres and is capable of managing approximately 20.4 million cubic yards (approximately 4,000 tons per day) of Class III residual waste generated by the coal-powered Kyger Creek Station located approximately two (2) miles southeast of the Landfill.

3.1 Groundwater Monitoring Network

As detailed in the Monitoring Well Installation Report (Applied Geology and Environmental Science, Inc. [AGES] 2016a), the CCR groundwater monitoring network for the Landfill consists of the following 13 wells:

- BUSW-1 (downgradient);
- BUSW-2 (upgradient);
- BUSW-3 (variable: usually side or downgradient);
- BUSW-4 (downgradient);
- BUSW-5 (upgradient);
- IMW-1BU (upgradient);
- BUSW-8 (upgradient);
- BUSW-10 (downgradient);
- MW-3D (upgradient);
- IMW-2BU (upgradient);
- MW-4D (upgradient);
- CCR-1BU (downgradient); and
- CCR-2BU (downgradient).

The locations of all of the wells in the groundwater monitoring network are shown on Figure 2. As listed above and shown on Table 3-1, the CCR groundwater monitoring network for the Landfill includes seven (7) upgradient monitoring wells and six (6) downgradient monitoring wells, which satisfies the requirements of the CCR Rule. Groundwater levels measured in 2019 are included in Table A-1 of Appendix A. Groundwater flow maps for the two (2) monitoring events completed in 2019 are included in Appendix B.

3.2 Groundwater Sampling

In accordance with §257.94 of the CCR Rule, OVEC completed two (2) rounds of groundwater monitoring in accordance with the requirements of the Detection Monitoring Program at the Landfill. The third round of Detection Monitoring samples was collected in March 2019 and the fourth round of Detection Monitoring groundwater samples was collected in September 2019. In accordance with §257.90(e)(3), Table 3-2 presents a sampling summary, including the number of groundwater samples collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the Detection or the Assessment Monitoring program. Table 3-3 summarizes the measurements of field parameters collected at the completion of purging, immediately prior to collection of each sample. All samples were collected in accordance with the Groundwater Monitoring Program Plan (GMPP) (AGES 2016b) and shipped to an analytical laboratory to be analyzed for all of the parameters listed in Appendix III of the CCR Rule (Appendix C).

3.3 Analytical Results

Upon receipt of the analytical results, the groundwater monitoring data were statistically evaluated in accordance with §257.93(f) of the CCR Rule and the Kyger Creek Station CCR Statistical Analysis Plan (StAP) (Stantec Consulting Services, Inc. [Stantec] 2018). The statistical evaluation of the data indicated no potential Statistically Significant Increases (SSIs) during either the March 2019 or the September 2019 Detection Monitoring events. Therefore, the Landfill will remain in Detection Monitoring. Appendix D summarizes the analytical results for groundwater samples collected in 2019.

4.0 BOILER SLAG POND

The BSP is located at the south end of the Kyger Creek Station and is approximately 32 acres in size (Figure 3). The BSP was built in 1955 to serve as a process and disposal area for the coal combustion waste products generated at the station. Overflow from the BSP is carried into a reinforced concrete intake structure at the south end of the Boiler Slag Complex. Water entering the intake structure is discharged into the Clearwater Pond. The Clearwater Pond was built in 1980, is approximately nine (9) acres in size and is located to the southwest end of the BSP. The Clearwater Pond is not a CCR unit and monitoring is not required. The CCR activities for the BSP during March and September 2019 are summarized in Sections 4.1 and 4.3 below.

4.1 Summary of CCR Activities for March 2019

4.1.1 Groundwater Monitoring Network

As detailed in the Monitoring Well Installation Report (AGES 2016a), the CCR groundwater monitoring network for the BSP consists of the following eight (8) wells:

- KC-15-01 (Upgradient);
- KC-15-02 (Upgradient);
- KC-15-03 (Upgradient);
- KC-15-04 (Downgradient);
- KC-15-05 (Downgradient);
- KC-15-06 (Downgradient);
- KC-15-07 (Downgradient); and
- KC-15-08 (Downgradient).

The locations of all the wells in the groundwater monitoring network are shown on Figure 3. As listed above and shown on Table 4-1, the CCR groundwater monitoring network for the BSP includes three (3) upgradient wells and five (5) downgradient wells, which satisfies the requirements of the CCR Rule.

Groundwater levels measured in 2019 are included in Table A-2 of Appendix A. The groundwater flow map for the March 2019 Assessment Monitoring event is included in Appendix B. Groundwater in the BSP flows from the northwest to the south and southeast toward the Ohio River. Because the BSP is located adjacent to the Ohio River, during periods when the water level in the Ohio River rises significantly and flooding occurs, groundwater flow in the uppermost aquifer may temporarily reverse and groundwater will flow toward the north and west beneath the BSP.

4.1.2 Groundwater Sampling

In accordance with §257.94 of the CCR Rule, OVEC completed the second round of Assessment Monitoring in March 2019 at the BSP.

All samples were collected in accordance with the GMPP (AGES 2016b) and analyzed for all Appendix III and Appendix IV constituents, which are listed in Appendix C. In accordance with §257.90(e)(3), Table 4-2 presents a sampling summary, including the number of groundwater samples collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the Detection or the Assessment Monitoring program. Table 4-3 summarizes the measurements of field parameters collected at the completion of purging, immediately prior to collection of each sample. All samples were shipped to an analytical laboratory to be analyzed.

4.1.3 Analytical Results-Appendix III

Upon receipt, the groundwater monitoring data were statistically evaluated in accordance with §257.93(f) of the CCR Rule and the Kyger Creek Station CCR StAP (Stantec 2018). Appendix D summarizes the analytical results for groundwater samples collected in 2019. The initial statistical evaluation identified potential SSIs of one (1) or more Appendix III constituents in monitoring wells KC-15-04, KC-15-05 and KC-15-08 at the BSP. In accordance with the StAP, OVEC resampled the wells for those constituents with potential SSIs. Based on the results of the resampling events, the following Appendix III SSIs were confirmed at the BSP (Table 4-4):

- KC-15-04: Boron, Total Dissolved Solids (TDS) and Sulfate;
- KC-15-05: Boron, TDS and Sulfate; and
- KC-15-08: Calcium, TDS and Sulfate.

4.1.4 Analytical Results-Appendix IV

Based on previous detections of Appendix IV constituents in groundwater at the BSP, OVEC established a Groundwater Protection Standard (GWPS) for each detected Appendix IV constituent in accordance with the §257.95(h)(1) through §257.95(h)(3) as follows:

(1) For constituents for which the U.S. EPA has established a Maximum Contaminant Level (MCL), the GWPS shall be the MCL for that constituent.

(2) On July 30, 2018, the U.S. EPA published alternate limits to be used for several constituents that did not have previously established MCLs to be used as the GWPS for those constituents.

(3) For constituents for which the background level is higher than the MCL or the alternate limit, the background concentration shall be the GWPS for that constituent.

Table 4-5 presents the list of GWPSs for the Assessment Monitoring program at the BSP that were developed in accordance with the above requirements. Based on a comparison of the Appendix IV sampling results to the GWPSs, it was confirmed that Arsenic in wells KC-15-07 and KC-15-08 exceeded the GWPS of 10 micrograms per liter (ug/L) during the March 2019 Assessment Monitoring event (Table 4-6).

4.2 Assessment of Corrective Measures

Based on the Arsenic exceedances, OVEC conducted additional groundwater sampling to characterize the nature and extent of the release and an Assessment of Corrective Measures (ACM) in accordance with §257.95(g). As part of this assessment, in April 2019, three (3) monitoring wells (KC-19-27, KC-19-28 and KC-19-29) were installed in the uppermost aquifer at the property boundary downgradient from the BSP (Figure 2). All of these wells were developed, hydraulically tested and sampled for Arsenic. Details regarding the installation of these wells and potential corrective measures are included in the ACM Report for the BSP (AGES 2019), which is included in Appendix E. In accordance with §257.96(e), in November 2019, a public meeting was held to discuss the results of the corrective measures.

4.3 Summary of CCR Activities for September 2019

4.3.1 Groundwater Monitoring Network

The three (3) monitoring wells that were installed as part of the additional assessment activities for the BSP (AGES 2019) were added to the CCR groundwater monitoring network for the BSP as follows:

- KC-19-27 (Downgradient);
- KC-19-28 (Downgradient); and
- KC-19-29 (Downgradient).

The locations of the wells in the groundwater monitoring network are shown on Figure 3. As listed above and shown on Table 4-1, these additional monitoring wells satisfy the requirements of the CCR Rule. Groundwater levels measured in 2019 are included in Table A-2 of Appendix A. The groundwater flow map for the Assessment Monitoring event completed in September 2019 is included in Appendix B.

4.3.2 Groundwater Sampling

In accordance with §257.94 of the CCR Rule, OVEC completed the third round of Assessment Monitoring in September 2019.

All samples were collected in accordance with the GMPP (AGES 2016b) and analyzed for Arsenic, the Appendix IV parameter with the confirmed exceedance during the September 2019 Assessment Monitoring event. In accordance with §257.90(e)(3), Table 4-2 presents a sampling summary, including the number of groundwater samples collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the Detection or the Assessment Monitoring program. Table 4-3 summarizes the measurements of field parameters collected at the completion of purging, immediately prior to collection of each sample. All samples were shipped to an analytical laboratory to be analyzed.

4.3.3 Analytical Results-Appendix III

Upon receipt, the groundwater monitoring data were statistically evaluated in accordance with §257.93(f) of the CCR Rule and the Kyger Creek Station CCR StAP (Stantec 2018). Appendix D summarizes the analytical results for groundwater samples collected in 2019. The initial statistical evaluation identified potential SSIs of one (1) or more Appendix III constituents in monitoring wells KC-15-04, KC-15-05 and KC-15-08 at the BSP. In accordance with the StAP, OVEC resampled the wells for those constituents with potential SSIs. Well KC-15-04 was inadvertently not resampled in November 2019; the potential SSIs were confirmed based on historic data. Based on the results of the resampling of wells KC-15-05 and KC-15-08 and historic data of well KC-15-04, the following Appendix III SSIs were confirmed at the BSP (Table 4-4):

- KC-15-04: TDS and Sulfate;
- KC-15-05: Boron, Calcium, TDS and Sulfate; and
- KC-15-08: Calcium, TDS and Sulfate.

4.3.4 Analytical Results-Appendix IV

Table 4-5 presents the list of GWPSs for the Assessment Monitoring program at the BSP that were developed in accordance with the requirements listed in Section 4.1.4. All Appendix IV results were compared to the GWPSs. Arsenic in well KC-15-07 was confirmed to exceed the applicable GWPS of 10 ug/L during the September 2019 Assessment Monitoring event (Table 4-6).

5.0 SOUTH FLY ASH POND

The SFAP is located at the northwest end of the station (Figure 4). The SFAP was built in 1955 to serve as a process and disposal area for the coal combustion waste products generated at the station. This collection pond is approximately 67 acres in size and banked on all sides.

5.1 Groundwater Monitoring Network

As detailed in the Monitoring Well Installation Report (AGES 2016a), the CCR groundwater monitoring network for the SFAP consists of the following 14 wells. The wells, along with revised location designations based on updated groundwater flow directions, are:

- KC-15-09 (Upgradient);
- KC-15-10 (Upgradient);
- KC-15-11 (Upgradient);
- KC-15-12 (Upgradient);
- KC-15-13 (Upgradient);
- KC-15-14 (Upgradient);
- KC-15-15 (Variable);

- KC-15-16 (Variable);
- KC-15-17 (Variable);
- KC-15-18 (Downgradient);
- KC-15-19 (Downgradient);
- KC-15-20 (Downgradient);
- KC-15-21 (Downgradient); and
- KC-15-22 (Downgradient).

The locations of the monitoring wells are shown on Figure 4. As listed above and shown on Table 5-1, the CCR groundwater monitoring network for the SFAP includes six (6) upgradient and five (5) downgradient wells, which satisfies the requirements of the CCR Rule.

As noted in the 2017 Annual Groundwater Monitoring and Corrective Action Report for the site, due to fluctuations in the stage of the nearby Ohio River, well KC-15-17 was located upgradient of the northeast portion of the SFAP during five (5) of the nine (9) monitoring events conducted from October 2015 through September 2017 (prior to the Detection Monitoring period at the unit). KC-15-17 was downgradient of the area during three (3) events and sidegradient during one (1) event. Well KC-15-15 was located upgradient of the northeast portion of the SFAP during three (3) of the nine (9) events, downgradient of the area during five (5) events, and sidegradient during one (1) event. Because of this high degree of variability in flow direction, wells KC-15-15 and KC-15-17 (and well KC-15-16 which is located between the wells) could not be designated as either upgradient or downgradient. These wells are therefore not included in the statistical evaluations for the SFAP.

Groundwater levels measured during 2019 are included in Table A-3 of Appendix A. Groundwater flow maps for the two (2) monitoring events completed in 2019 are included in Appendix B. Based on the groundwater level measurements, groundwater in the central portion of the SFAP flows generally from the north to the south/southeast toward the Ohio River. However, due to the close proximity of the SFAP to the Ohio River, changes in the stage of the river have a significant impact on the direction of groundwater flow at the unit. However, during periods when the stage of the Ohio River rises, groundwater flow in the uppermost aquifer reverses direction and flows toward the north/northwest (March 2019 and September 2019: Figures B-5 and B-6 in Appendix B). When the Ohio River stage lowers, groundwater levels also begin to lower and return to a more typical flow pattern. With these fluctuations in groundwater levels, the assignment of the upgradient and downgradient well designations above may fluctuate as well.

5.2 Groundwater Sampling

In accordance with §257.95 of the CCR Rule, OVEC completed the second and third rounds of Assessment Monitoring in March 2019 and September 2019.

All samples were collected in accordance with the GMPP (AGES 2016b) and analyzed for all Appendix III and Appendix IV constituents, which are listed in Appendix C. In accordance with §257.90(e)(3), Table 5-2 presents a sampling summary, including the number of groundwater samples collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the Detection or the Assessment Monitoring program. Table 5-3 summarizes the measurements of field parameters collected at the completion of purging, immediately prior to collection of each sample. All samples were shipped to an analytical laboratory to be analyzed.

5.3 Analytical Results

5.3.1 Analytical Results-Appendix III

Upon receipt, the groundwater monitoring data were statistically evaluated in accordance with §257.93(f) of the CCR Rule and the Kyger Creek Station CCR StAP (Stantec 2018). Appendix D summarizes the analytical results for groundwater samples collected in 2019. The statistical evaluation identified potential SSIs of one (1) or more Appendix III constituents in monitoring wells KC-15-18, KC-15-19, KC-15-20 and KC-15-21 at the SFAP. In accordance with the StAP, OVEC resampled the wells for those constituents with potential SSIs; however, due to the groundwater elevation calculation error described in the 2017 Groundwater Monitoring and Corrective Action Report (Revision 1.0-October 2020), resampling for some SSI parameters was not conducted (Table 5-4). In the absence of resampling data, these SSIs were assumed to be confirmed. Based on the results, the following Appendix III SSIs were confirmed at the SFAP (Table 5-4):

March 2019 Appendix III SSIs

- KC-15-18: Calcium and Chloride;
- KC-15-19: Calcium, TDS and Sulfate;
- KC-15-20: Calcium, TDS and Sulfate; and
- KC-15-21: Calcium.

September 2019 Appendix III SSIs

- KC-15-18: Calcium and Chloride;
- KC-15-19: Calcium, TDS and Sulfate;
- KC-15-20: Calcium and TDS; and
- KC-15-21: Calcium.

5.3.2 Analytical Results-Appendix IV

Table 5-5 presents the list of GWPSs for the Assessment Monitoring program at the SFAP that were developed in accordance with the requirements listed in Section 4.1.4. All Appendix IV results were compared to the GWPSs and none of the results exceeded the applicable GWPS (Table 5-5 and Appendix D).

6.0 PROBLEMS ENCOUNTERED

As noted above, in April 2019, a review of historic water level data for SFAP revealed that an error had been made in groundwater elevation calculations for that unit in 2016 that was carried through the 2017 and 2018 calculations. After the error was discovered, groundwater elevations at the SFAP were recalculated, which led to a significant change in the interpretation of groundwater flow directions at the unit and modifications of the upgradient and downgradient designations of several SFAP wells. As a result of these corrections, statistical calculations for groundwater at the unit were re-done and were presented in this revised report. No further action is required to address this issue.

No other problems were noted on the CCR program at the Kyger Creek Station in 2019.

7.0 PROJECTED ACTIVITIES FOR 2020

The Landfill will remain in Detection Monitoring and continue to be sampled on a semi-annual basis.

The BSP will remain in Assessment Monitoring and continue to be sampled on a semi-annual basis. As described in Section 4.2, an ACM has been completed for this unit and the process of the selection of remedy for the BSP will continue in 2020.

The SFAP will remain in Assessment Monitoring and continue to be sampled on a semi-annual basis.

8.0 REFERENCES

Applied Geology and Environmental Science, Inc. (AGES) 2019. Coal Combustion Residuals Regulation Assessment of Corrective Measures Report Boiler Slag Pond, Ohio Valley Electric Corporation, Kyger Creek Station, Cheshire, Gallia County, Ohio. September 2019.

Applied Geology and Environmental Science, Inc. (AGES) 2016a. Coal Combustion Residuals Regulation Monitoring Well Installation Report, Ohio Valley Electric Corporation, Kyger Creek Station, Cheshire, Gallia County, Ohio. August 2016.

Applied Geology and Environmental Science, Inc. (AGES) 2016b. Coal Combustion Residuals Regulation Groundwater Monitoring Program Plan, Ohio Valley Electric Corporation, Kyger Creek Station, Cheshire, Gallia County, Ohio. May 2016.

Stantec Consulting Services, Inc. (Stantec) 2018. Coal Combustion Residuals Regulation Statistical Analysis Plan, Ohio Valley Electric Corporation, Kyger Creek Station, Cheshire, Gallia County, Ohio. April 2018.

TABLES

TABLE 3-1
GROUNDWATER MONITORING NETWORK
CLASS III RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGAM
KYGER CREEK STATION
CHESHIRE, OHIO

Monitoring Well ID	Designation	Date of Installation	Coordinates		Ground Elevation (ft)²	Top of Casing Elevation (ft)²	Top of Screen Elevation (ft)	Base of Screen Elevation (ft)	Total Depth From Top of Casing (ft)
			Northing	Easting					
CCR Unit Boundary Wells									
BUSW-1	Downgradient	6/20/2006	335756.52	2063859.43	781.46	784.21	521.21	508.10	276.11
BUSW-2	Upgradient	--	336285.22	2062985.02	792.19	794.98	526.69	506.69	288.56
BUSW-3	Variable	9/13/2007	336746.19	2062430.81	787.57	790.01	529.57	504.57	283.56
BUSW-4	Downgradient	5/17/2006	337738.57	2062566.35	780.99	783.46	535.76	525.76	257.70
BUSW-5	Upgradient	8/2/2007	338123.59	2063553.15	781.06	783.27	542.06	502.06	281.12
IMW-1BU	Upgradient	9/6/2007	337177.94	2064160.50	699.89	702.29	519.39	499.39	202.97
CCR-1BU	Downgradient	10/13/2015	337641.36	2063220.23	783.41	785.80	524.41	504.41	281.39
CCR-2BU	Downgradient	10/21/2015	336302.19	2064286.87	742.28	744.69	514.78	494.78	249.91
Supplemental CCR Wells									
BUSW-8	Upgradient	4/17/2006	337692.04	2065706.88	630.59	633.48	498.12	498.12	145.36
BUSW-10	Downgradient	6/29/2007	336364.75	2065495.79	617.26	619.76	513.85	498.85	120.91
IMW-2BU	Upgradient	9/10/2007	337417.23	2065170.91	609.77	612.44	508.96	493.96	118.48
MW-3D	Upgradient	5/1/2006	338184.68	2065077.38	741.11	743.53	515.58	505.58	237.95
MW-4D	Upgradient	5/10/2006	336365.51	2066044.36	576.87	579.51	504.94	494.94	84.57

Notes:

1. The well locations are referenced to the Ohio State Plane South, North American Datum (NAD83), east zone coordinate system.

2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988.

TABLE 3-2
SAMPLES COLLECTED DURING 2019
CLASS III RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGAM
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Designation	Mar-19	Sep-19
BUSW-1	Downgradient	DM	DM
BUSW-2	Upgradient	DM	DM
BUSW-3	Variable	DM	DM
BUSW-4	Downgradient	DM	DM
BUSW-5	Upgradient	DM	DM
BUSW-8	Upgradient	DM	DM
BUSW-10	Downgradient	DM	DM
IMW-1BU	Upgradient	DM	DM
IMW-2BU	Upgradient	DM	DM
CCR-1BU	Downgradient	DM	DM
CCR-2BU	Downgradient	DM	DM
MW-3D	Upgradient	DM	DM
MW-4D	Upgradient	DM	DM

Notes:
1. DM: Detection Monitoring.

TABLE 3-3
SUMMARY OF MEASURED FIELD PARAMETERS DURING 2019
CLASS III RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGAM
KYGER CREEK STATION
CHESHIRE, OHIO

Sample ID	Date	Temperature (°C)	Conductivity (µohms/cm)	pH (S.U.)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)
BUSW-1	Mar-19	15.91	16100	7.91	-151	0	3.86
BUSW-2	Mar-19	13.85	23900	6.92	-165	0	3.56
BUSW-3	Mar-19	11.53	269	6.07	-29	0	3.88
BUSW-4	Mar-19	13.76	32800	6.38	28	0	24.13
BUSW-5	Mar-19	17.51	90900	6.47	-123	0	2.21
BUSW-8	Mar-19	12.31	82500	6.56	-108	0	3.76
BUSW-10	Mar-19	9.68	23400	7.07	-121	0	2.36
IMW-1BU	Mar-19	10.22	53800	7.03	45	8.03	3.32
IMW-2BU	Mar-19	13.3	84100	6.76	-116	0	2.87
MW-3D	Mar-19	16.08	68300	6.32	-85	0	1.98
MW-4D	Mar-19	13.68	11	7.55	-102	0	2.87
CCR-1BU	Mar-19	12.57	70600	6.77	-115	0	3.02
CCR-2BU	Mar-19	8.71	14600	7.77	-156	0	3.93
BUSW-1	Sep-19	22.31	7090	7.23	-211	5.7	4.01
BUSW-2	Sep-19	24.46	9120	7.58	-180	6.07	3.85
BUSW-3	Sep-19	21.89	43200	6.76	-106	2.02	4.68
BUSW-4	Sep-19	13.03	7564	7.03	-126	6.86	12.3
BUSW-5	Sep-19	19.58	37000	7.12	-162	3.21	2.08
BUSW-8	Sep-19	19.32	33300	7.07	-103	1.37	3.65
BUSW-10	Sep-19	16.11	9340	7.64	-162	2.25	1.76
IMW-1BU	Sep-19	17.27	20700	7.26	-175	2.26	3.91
IMW-2BU	Sep-19	16.93	33700	7.05	-66	2.76	3.03
MW-3D	Sep-19	21.76	46500	6.83	-63	5.55	3.01
MW-4D	Sep-19	17.56	2390	8.57	-208	1.78	1.92
CCR-1BU	Sep-19	17.41	30300	7.27	-140	5.34	2.75
CCR-2BU	Sep-19	19.64	7080	6.52	-108	4.06	4.06

Notes:
1. °C: Degrees Celsius.
2. µohms/cm: Micro-ohms per centimeter.
3. S.U.: Standard Units.
4. mV: Millivolts.
5. mg/L: Milligrams per liter.
6. NTUs: Nephelometric Turbidity Units.

TABLE 4-1
GROUNDWATER MONITORING NETWORK
BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Monitoring Well ID	Designation	Date of Installation	Coordinates		Ground Elevation (ft)²	Top of Casing Elevation (ft)²	Top of Screen Elevation (ft)	Base of Screen Elevation (ft)	Total Depth From Top of Casing (ft)
			Northing	Easting					
KC-15-01	Upgradient	8/5/2015	332114.55	2072393.84	579.77	579.20	519.77	509.77	69.43
KC-15-02	Upgradient	8/7/2012	332500.654	2072569.222	580.79	580.25	520.79	510.79	69.46
KC-15-03	Upgradient	8/12/2015	332546.402	2073001.342	582.03	581.55	520.03	510.03	71.52
KC-15-04	Downgradient	8/12/2015	331782.439	2073755.607	579.89	579.37	519.89	509.89	69.48
KC-15-05	Downgradient	8/19/2015	331569.994	2073574.832	580.52	580.07	520.52	510.52	69.55
KC-15-06	Downgradient	8/18/2015	331218.52	2073210.42	579.98	579.48	519.98	509.98	69.50
KC-15-07	Downgradient	8/11/2015	331291.75	2072957.79	578.54	578.04	508.54	498.54	79.50
KC-15-08	Downgradient	8/10/2015	331460.59	2072675.87	579.41	578.75	509.41	499.41	79.34
KC-19-27	Downgradient	4/5/2019	331507.38	2073611.94	558.22	561.13	530.22	520.22	38.00
KC-19-28	Downgradient	4/4/2019	331064.43	2073270.03	558.41	561.10	526.41	516.41	42.00
KC-19-29	Downgradient	4/3/2019	330558.94	2072840.95	561.13	564.17	530.13	520.13	41.00

Notes:

1. The well locations are referenced to the Ohio State Plane South, North American Datum (NAD83), east zone coordinate system.

2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988.

TABLE 4-2
SAMPLES COLLECTED DURING 2019
BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Designation	Mar-19	Jun-19	Sep-19	Nov-19
KC-15-01	Upgradient	AM	NS	AM	NS
KC-15-02	Upgradient	AM	NS	AM	NS
KC-15-03	Upgradient	AM	NS	AM	NS
KC-15-04	Downgradient	AM	AM	AM	NS
KC-15-05	Downgradient	AM	AM	AM	AM
KC-15-06	Downgradient	AM	NS	AM	NS
KC-15-07	Downgradient	AM	AM	AM	AM
KC-15-08	Downgradient	AM	AM	AM	AM
KC-19-27	Downgradient	NI	NI	AM	NS
KC-19-28	Downgradient	NI	NI	AM	NS
KC-19-29	Downgradient	NI	NI	AM	NS

Notes:
1. AM: Assessment Monitoring.
2. NS: Not Sampled.
3. NI: Not Installed or Sampled—refer to Sections 4.2 and 4.3.

TABLE 4-3
SUMMARY OF MEASURED FIELD PARAMETERS DURING 2019
BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Sample ID	Date	Temperature (°C)	Conductivity (μohms/cm)	pH (S.U.)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)
KC-15-01	Mar-19	13.46	751	6.06	13	0	4.57
KC-15-02	Mar-19	11.77	797	6.64	-57	1.32	4.92
KC-15-03	Mar-19	14.23	790	6.31	2	2.85	4.32
KC-15-04	Mar-19	10.99	2150	5.56	-20	0	2.98
KC-15-05	Mar-19	13.4	1110	6.11	43	1.65	4.24
KC-15-06	Mar-19	12.08	1900	6.77	-8	0	3.03
KC-15-07	Mar-19	12.68	836	6.6	-146	1.23	4.93
KC-15-08	Mar-19	13.59	1430	6.8	-104	1.12	5.15
KC-15-04	Jun-19	22.01	862	6.26	2	0.96	4.93
KC-15-05	Jun-19	17.87	1110	6.51	37	0.78	3.12
KC-15-07	Jun-19	17.74	913	6.93	-126	0.09	4.92
KC-15-08	Jun-19	18.1	1430	7.05	-87	0.08	4.45
KC-15-01	Sep-19	17.49	780	5.59	78	0	3.03
KC-15-02	Sep-19	18.09	850	6.5	-35	0	4.07
KC-15-03	Sep-19	19.44	795	6.21	44	0	4.3
KC-15-04	Sep-19	20.36	873	5.96	1	0	8.28
KC-15-05	Sep-19	18.46	1040	6.33	13	3.65	3.88
KC-15-06	Sep-19	21.54	707	7.16	25.1	0.2	4.14
KC-15-07	Sep-19	17.46	851	6.48	-124	0	2.11
KC-15-08	Sep-19	18.48	1410	6.55	-75	0	3.61
KC-19-27	Sep-19	15.84	1390	6.27	-88	3.29	3.78
KC-19-28	Sep-19	33.11	450	5.93	137	0	5.65
KC-19-29	Sep-19	22.35	721	5.77	95	0	3.51
KC-15-05	Nov-19	16.2	930	6.67	-10	2.7	4.06
KC-15-07	Nov-19	14.58	728	6.96	-163	4.81	4.65
KC-15-08	Nov-19	14.48	1380	7.22	-124	3.02	3.73

Notes:
1. °C: Degrees Celsius.
2. μohms/cm: Micro-ohms per centimeter.
3. S.U.: Standard Units.
4. mV: Millivolts.
5. mg/L: Milligrams per liter.
6. NTUs: Nephelometric Turbidity Units.

TABLE 4-4
SUMMARY OF POTENTIAL AND CONFIRMED APPENDIX III SSIs
BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGAM
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Potential SSI Parameter (Units)	2nd Assessment Monitoring Sampling Event March 2019		2nd Assessment Monitoring Resampling Event June 2019		3rd Assessment Monitoring Sampling Event September 2019		3rd Assessment Monitoring Resampling Event November 2019	
		Result	UTL	Result	Confirmed SSI (Yes/No)	Result	UTL	Result	Confirmed SSI (Yes/No)
KC-15-04	Boron (mg/L)	0.79	0.5566	0.85	Yes	NA	NA	NA	NA
	TDS (mg/L)	620	567.7	610	Yes	610	567	NS	Yes
	Sulfate (mg/L)	330	301.3	380	Yes	340	303	NS	Yes
KC-15-05	Boron (mg/L)	0.86	0.5566	1.0	Yes	1.1	0.8135	1.1	Yes
	Calcium (mg/L)	NA	NA	NA	NA	140	127.4	130	Yes
	TDS (mg/L)	760	567.7	720	Yes	760	567	750	Yes
	Sulfate (mg/L)	390	301.3	460	Yes	410	303	390	Yes
KC-15-08	Calcium (mg/L)	210	126	210	Yes	210	127.4	220	Yes
	TDS (mg/L)	1000	567.7	1100	Yes	1000	567	1100	Yes
	Sulfate (mg/L)	550	301.3	610	Yes	530	303	560	Yes

Notes:
1. SSI: Statistically Significant Increase.
2. UTL: Upper Tolerance Limit (Pooled Interwell UTL).
3. mg/L: Milligrams per liter.
4. NA: Not Applicable—no SSI.
5. NS: Not Sampled—Well KC-15-04 was inadvertently not re-sampled in November 2019. SSI was therefore assumed to be confirmed. Refer to Section 4.3.3.

TABLE 4-5
GROUNDWATER PROTECTION STANDARDS
BOILER SLAG POND
CCR ASSESSMENT MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Appendix IV Constituents			
Constituent (Units)	**Background**	**MCL/SMCL**	**GWPS**
Antimony, Sb (µg/L)	0.3273	6	6
Arsenic, As (µg/L)	7.604	10	10
Barium, Ba (µg/L)	133.7	2000	2000
Beryllium, Be (µg/L)	0.094	4	4
Cadmium, Cd (µg/L)	0.1482	5	5
Chromium, Cr (µg/L)	1.959	100	100
Cobalt, Co (µg/L)	9.745	6*	9.745
Fluoride, F (mg/L)	1.29	4	4
Lithium, Li (µg/L)	0.0125	40*	40
Lead, Pb (µg/L)	0.5159	15*	15
Mercury, Hg (µg/L)	0.25	2	2
Molybdenum, Mo (µg/L)	6.122	100*	100
Radium 226 & 228 (combined) (pCi/L)	1.695	5	5
Selenium, Se (µg/L)	0.4	50	50
Thallium, Tl (µg/L)	0.03	2	2

Notes:
1. MCL: Maximum Contaminant Level.
2. SMCL: Secondary Maximum Contaminant Level.
3. *: Established by U.S. EPA as part of 2018 decision.
4. GWPS: Groundwater Protection Standard.
5. µg/L: Micrograms per liter.
6. mg/L: Milligrams per liter.
7. pCi/L: Picocuries per liter.

TABLE 4-6
SUMMARY OF GWPS EXCEEDANCES
BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Potential Exceedance Parameter (Units)	2nd Assessment Monitoring Sampling Event March 2019		2nd Assessment Monitoring Resampling Event June 2019		3rd Assessment Monitoring Sampling Event September 2019		3rd Assessment Monitoring Resampling Event November 2019	
		Potential Exceedance Result	GWPS	Potential Exceedance Result	Confirmed Exceedance (Yes/No)	Potential Exceedance Result	GWPS	Potential Exceedance Result	Confirmed Exceedance (Yes/No)
KC-15-04	Cobalt (µg/L)	11	9.745	9.1	No	NA	NA	NA	NA
KC-15-07	Arsenic (µg/L)	160	10	120	**Yes**	120	10	160	**Yes**
KC-15-08	Arsenic (µg/L)	11	10	10	**Yes**	NA	NA	NA	NA

Notes:
1. GWPS: Groundwater Protection Standard.
2. µg/L: Micrograms per liter.
3. NA: Not Applicable—no potential exceedance.
4. NI: Not Installed.

TABLE 5-1
GROUNDWATER MONITORING NETWORK
SOUTH FLY ASH POND
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK PLANT
CHESHIRE, OHIO

Monitoring Well ID	Designation	Date of Installation	Coordinates		Ground Elevation (ft)²	Top of Casing Elevation (ft)²	Top of Screen Elevation (ft)	Base of Screen Elevation (ft)	Total Depth From Top of Casing (ft)
			Northing	Easting					
KC-15-09	Upgradient	9/15/2015	334631.959	2072494.446	587.85	587.47	516.85	506.85	80.62
KC-15-10	Upgradient	9/16/2015	335018.949	2072695.744	587.75	587.45	523.75	513.75	73.70
KC-15-11	Upgradient	8/20/2015	335426.144	2072970.304	588.07	587.71	524.07	514.07	73.64
KC-15-12	Upgradient	9/17/2015	335867.034	2073268.666	588.40	587.94	524.40	514.40	73.54
KC-15-13	Upgradient	9/1/2015	336047.047	2073665.155	588.23	587.86	521.23	511.23	76.73
KC-15-14	Upgradient	8/20/2015	335808.537	2074057.138	588.85	587.80	524.85	513.85	72.95
KC-15-15	Variable	9/2/2015	335558.54	2074472.666	587.95	587.63	523.95	513.95	73.68
KC-15-16	Variable	9/3/2015	335223.916	2074799.53	588.82	588.38	524.82	514.82	73.50
KC-15-17	Variable	9/3/2015	334881.253	2074480.308	588.68	588.13	524.68	514.68	73.45
KC-15-18	Downgradient	8/25/2015	334507.455	2074126.888	588.27	587.72	524.27	514.27	73.45
KC-15-19	Downgradient	9/9/2015	334132.454	2073771.27	588.47	588.18	524.47	514.47	73.71
KC-15-20	Downgradient	8/27/2015	333841.393	2073452.842	589.45	588.72	525.45	515.45	73.26
KC-15-21	Downgradient	8/27/2015	334089.953	2073009.526	588.28	587.84	518.28	508.28	79.56
KC-15-22	Downgradient	9/10/2015	334307.567	2072647.434	587.51	587.27	518.51	508.51	78.76

Notes:

1. The well locations are referenced to the Ohio State Plane South, North American Datum (NAD83), east zone coordinate system.

2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988.

TABLE 5-2
SAMPLES COLLECTED DURING 2019
SOUTH FLY ASH POND
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Designation	Mar-19	Jun-19	Sep-19	Nov-19
KC-15-09	Upgradient	AM	NS	AM	NS
KC-15-10	Upgradient	AM	NS	AM	NS
KC-15-11	Upgradient	AM	NS	AM	NS
KC-15-12	Upgradient	AM	NS	AM	NS
KC-15-13	Upgradient	AM	NS	AM	NS
KC-15-14	Upgradient	AM	NS	AM	NS
KC-15-15	Variable	AM	NS	AM	NS
KC-15-16	Variable	AM	NS	AM	NS
KC-15-17	Variable	AM	NS	AM	NS
KC-15-18	Downgradient	AM	AM	AM	AM
KC-15-19	Downgradient	AM	AM	AM	AM
KC-15-20	Downgradient	AM	AM	AM	AM
KC-15-21	Downgradient	AM	AM	AM	NS
KC-15-22	Downgradient	AM	NS	AM	NS

Notes:
1. AM: Assessment Monitoring.
2. NS: Not Sampled.

TABLE 5-3
SUMMARY OF MEASURED FIELD PARAMETERS DURING 2019
SOUTH FLY ASH POND
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OH

Sample ID	Date	Temperature (°C)	Conductivity (µohms/cm)	pH (S.U.)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)
KC-15-09	Mar-19	10.62	496	6.75	211	0	4.98
KC-15-10	Mar-19	12.41	492	6.44	149	0	4.11
KC-15-11	Mar-19	11.77	539	6.5	224	0.65	3.78
KC-15-12	Mar-19	11.82	620	6.93	289	2.38	4.97
KC-15-13	Mar-19	11.85	954	6.02	1.49	0.94	4.75
KC-15-14	Mar-19	14.68	919	6.21	188	0.73	4.88
KC-15-15	Mar-19	14.1	730	6.06	279	0.23	4.95
KC-15-16	Mar-19	14.58	1160	6.18	244	0.51	4.75
KC-15-17	Mar-19	15.73	2350	6.4	192	0.06	4.65
KC-15-18	Mar-19	16.28	958	6.57	211	5.94	4.81
KC-15-19	Mar-19	15.26	1280	6.51	286	3.74	4.25
KC-15-20	Mar-19	16.2	1380	6.48	240	1.17	4.95
KC-15-21	Mar-19	17.51	888	6.3	-42	0	22.4
KC-15-22	Mar-19	14.53	755	6.56	-105	0	4.56
KC-15-19	Jun-19	18.1	1.46	6.09	85	1.36	1.7
KC-15-20	Jun-19	19.3	1.37	6.48	35	6.58	3.8
KC-15-09	Sep-19	17.05	501	6.81	16	0.24	3.77
KC-15-10	Sep-19	19.5	426	6.34	24	0.16	4.11
KC-15-11	Sep-19	22.74	418	6.39	181	1.27	4.61
KC-15-12	Sep-19	19.23	554	6.81	34	0.33	2.83
KC-15-13	Sep-19	17.62	1010	6.92	25	0.59	3.55
KC-15-14	Sep-19	20.52	622	6.49	81	2.11	4.1
KC-15-15	Sep-19	20.38	701	6.74	165	0.17	3.54
KC-15-16	Sep-19	18.55	954	7.07	124	0.19	4.11
KC-15-17	Sep-19	20.39	2102	6.87	77	0.73	3.55
KC-15-18	Sep-19	19.75	886	6.91	142	0.27	4.1
KC-15-19	Sep-19	18.78	1294	6.67	130	0.28	3.53
KC-15-20	Sep-19	18.97	1271	6.82	34	0.21	4.07
KC-15-21	Sep-19	20.35	591	6.81	64	0.34	3.83
KC-15-22	Sep-19	19.37	642	6.87	-19	0.39	3.71
KC-15-18	Nov-19	14.38	1080	5.59	301	0.63	2.02
KC-15-19	Nov-19	16.31	1520	5.91	214	0.48	3.25
KC-15-20	Nov-19	16.81	1290	5.99	223	3.1	4.27

Notes:
1. °C: Degrees Celsius.
2. µohms/cm: Micro-ohms per centimeter.
3. S.U.: Standard Units.
4. mV: Millivolts.
5. mg/L: Milligrams per liter.
6. NTUs: Nephelometric Turbidity Units.

TABLE 5-4
SUMMARY OF POTENTIAL AND CONFIRMED APPENDIX III SSIs
SOUTH FLY ASH POND
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Potential SSI Parameter (Units)	2nd Assessment Monitoring Sampling Event March 2019		2nd Assessment Monitoring Resampling Event June 2019		3rd Assessment Monitoring Sampling Event September 2019		3rd Assessment Monitoring Resampling Event November 2019	
		Result	UTL	Result	Confirmed SSI (Yes/No)	Result	UTL	Result	Confirmed SSI (Yes/No)
KC-15-18	Calcium (mg/L)	120	119	130	**Yes**	130	118	140	**Yes**
	Chloride (mg/L)	63	61	NS	**Yes**	78	61	78	**Yes**
	TDS (mg/L)	NA	NA	NA	NA	910	830	820	No
KC-15-19	Calcium (mg/L)	190	119	190	**Yes**	200	118	190	**Yes**
	TDS (mg/L)	1100	830	1200	**Yes**	1200	830	1200	**Yes**
	Sulfate (mg/L)	660	508	790	**Yes**	710	508	670	**Yes**
KC-15-20	Calcium (mg/L)	210	119	200	**Yes**	210	118	200	**Yes**
	TDS (mg/L)	1100	830	1000	**Yes**	1100	830	1100	**Yes**
	Sulfate (mg/L)	630	508	670	**Yes**	610	508	<5	No
KC-15-21	Calcium (mg/L)	130	119	140	**Yes**	120	118	NS	**Yes**

Notes:
1. SSI: Statistically Significant Increase.
2. UTL: Upper Tolerance Limit (Pooled Interwell UTL).
3. mg/L: Milligrams per liter.
4. NA: Not Applicable—no SSI.
5. NS: Well inadvertently not re-sampled. SSI was therefore assumed to be confirmed. Refer to Section 5.0.

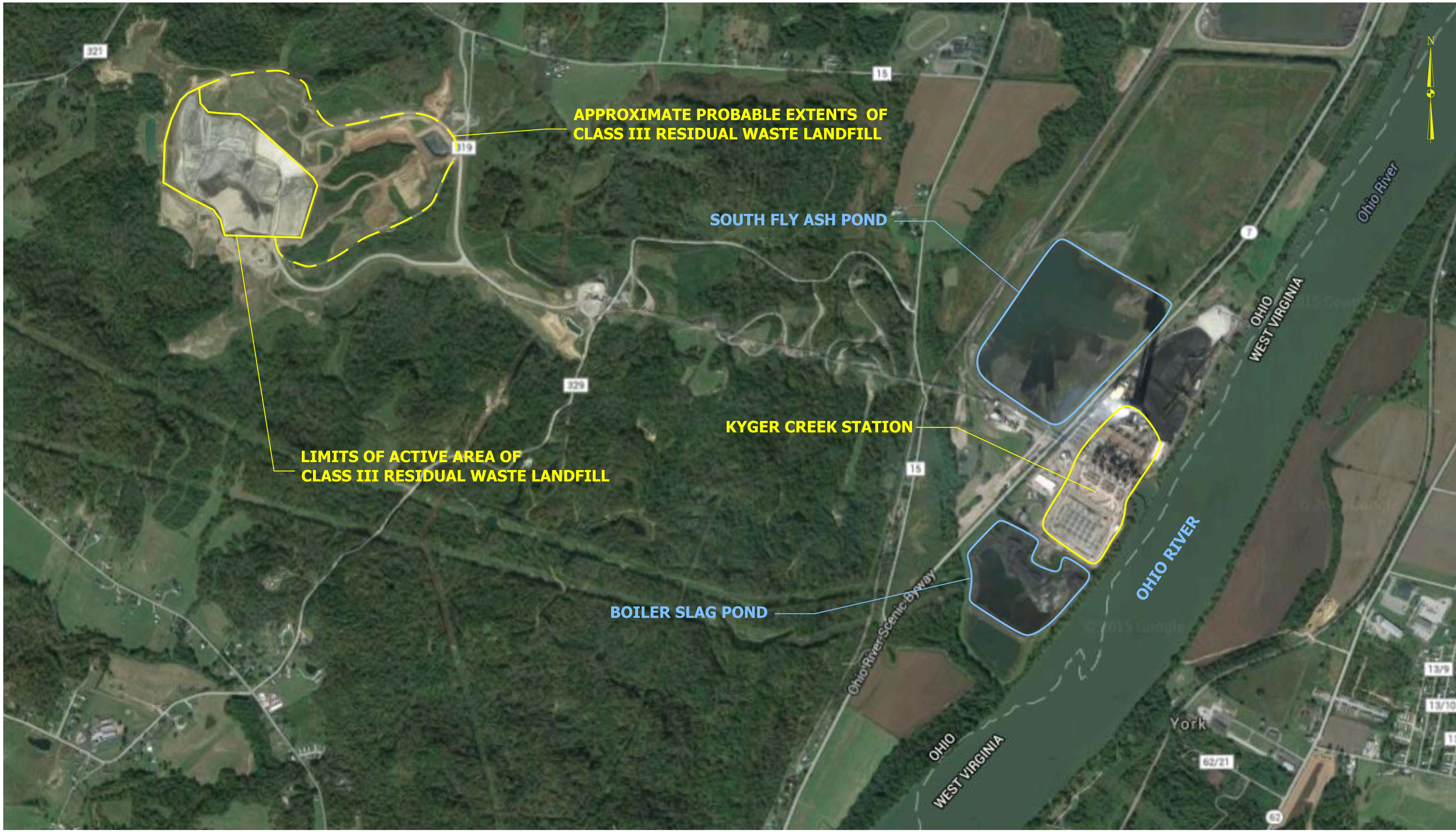
TABLE 5-5
GROUNDWATER PROTECTION STANDARDS
SOUTH FLY ASH POND
CCR ASSESSMENT MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Appendix IV Constituents			
Constituent (Units)	**Background**	**MCL/SMCL**	**GWPS**
Antimony, Sb (µg/L)	1	6	6
Arsenic, As (µg/L)	4.9	10	10
Barium, Ba (µg/L)	135	2000	2000
Beryllium, Be (µg/L)	0.05	4	4
Cadmium, Cd (µg/L)	1.2	5	5
Chromium, Cr (µg/L)	1.7	100	100
Cobalt, Co (µg/L)	12.7	6*	12.7
Fluoride, F (mg/L)	0.32	4	4
Lithium, Li (µg/L)	0.03	40*	40
Lead, Pb (µg/L)	0.7	15*	15
Mercury, Hg (µg/L)	0.25	2	2
Molybdenum, Mo (µg/L)	5.8	100*	100
Radium 226 & 228 (combined) (pCi/L)	2.5	5	5
Selenium, Se (µg/L)	2.5	50	50
Thallium, Tl (µg/L)	0.5	2	2

Notes:

1. MCL: Maximum Contaminant Level.
2. SMCL: Secondary Maximum Contaminant Level.
3. *: Established by U.S. EPA as part of 2018 decision.
4. GWPS: Groundwater Protection Standard.
5. µg/L: Micrograms per liter.
6. mg/L: Milligrams per liter.
7. pCi/L: Picocuries per liter.

FIGURES



DRAWN BY: JM	AGES Applied Geology And Environmental Science, Inc.	OHIO VALLEY ELECTRIC COMPANY	
DATE:		KYGER CREEK STATION CHESHIRE, GALLIA COUNTY, OHIO SITE LOCATION MAP	
CHECKED BY:			
JOB NO.: 2019018–KYG	2402 Hookstown Grade Road, Suite 200 Clinton, PA 15026 412.264.6453		
DWG FILE: KYGER_CCR_2019 Annual GW Rpt_Aerial Site b01.dwg			
DRAWING SCALE: NOT TO SCALE		DRAWING NAME: FIGURE 1	REV. 0

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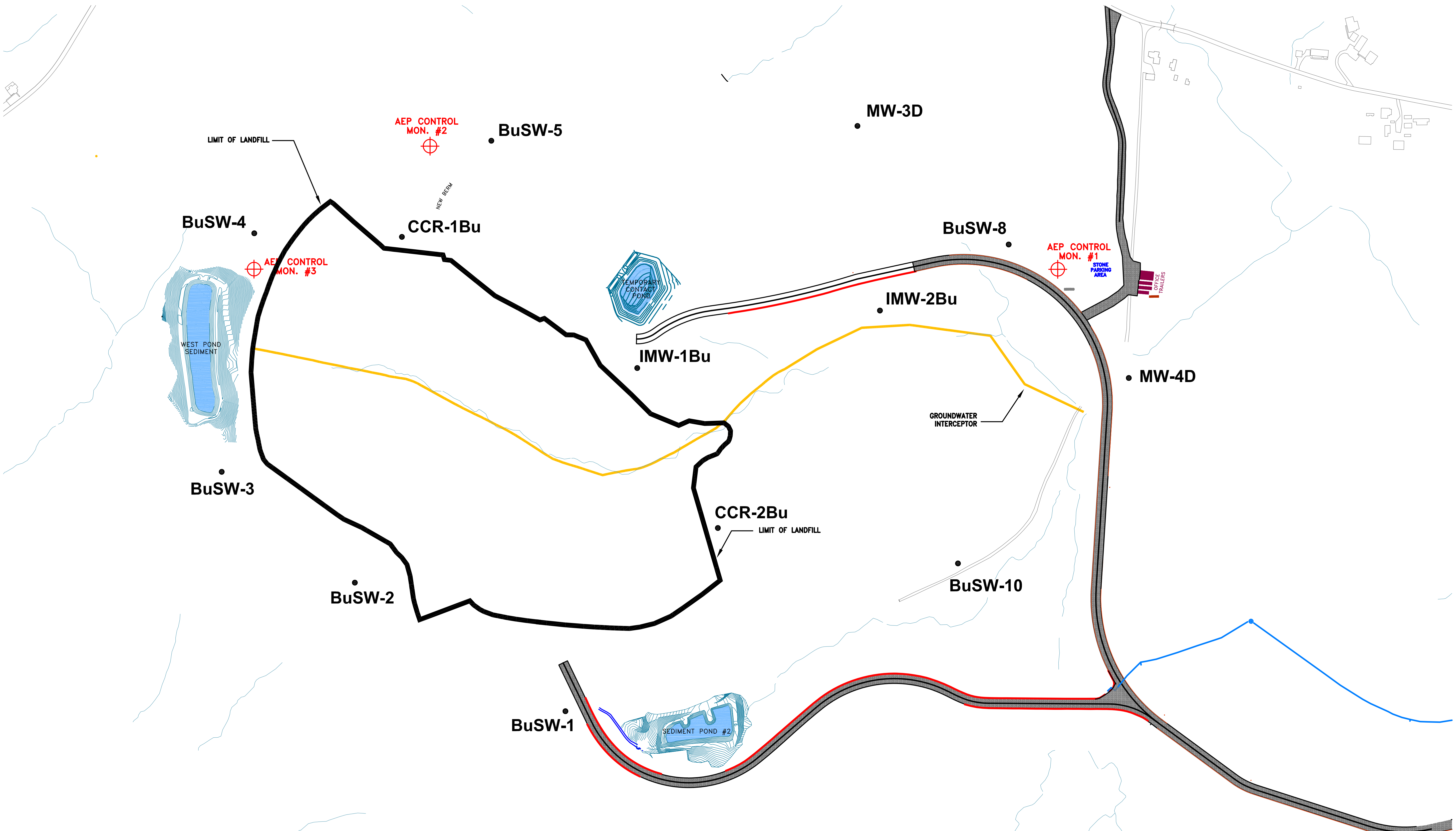

LEGEND:

● BuSW–1 BUFFALO SANDSTONE WELL

400' 0' 400' 800'

SCALE: 1"= 400'

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019018–KYGER
DWG FILE	KYGER_CCR_2019 Annual GW Rpt_Well Locs b02.dwg
DRAWING SCALE	AS SHOWN

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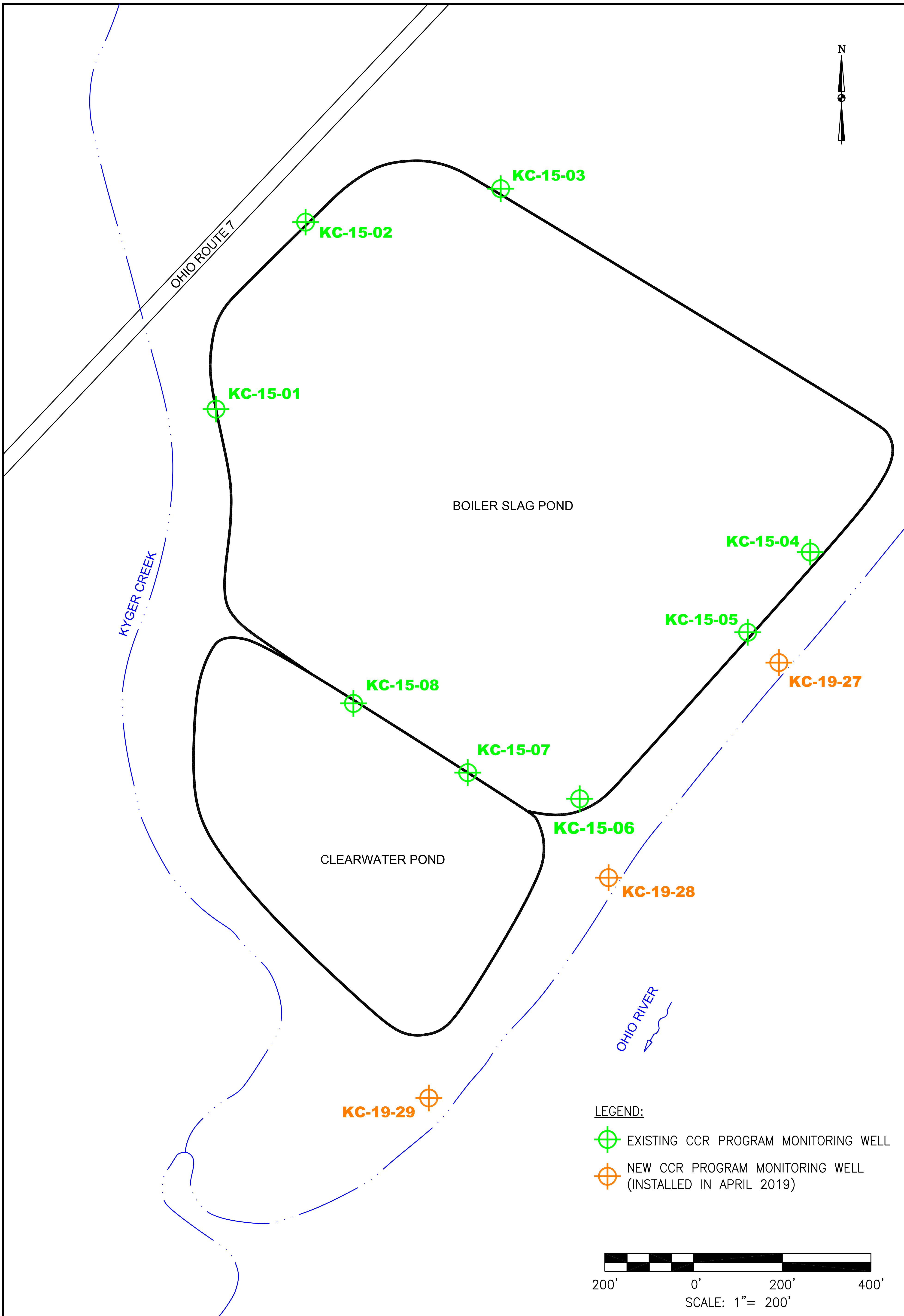
OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
CLASS III RESIDUAL WASTE LANDFILL
GROUNDWATER MONITORING WELL LOCATIONS

DRAWING NAME: FIGURE 2

REV. 0

Plot: 01/08/2020 09:28 _PROGRAMS–KYGER OVEC\Kyger Creek–CCR Program\CAD\2019 GW Monitoring–Corrective Action Rpt\KYGER_CCR_2019 Annual GW Rpt_Well Locs b02.dwg



DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019018–KYGER
DWG FILE	KYGER_CCR_2019 Annual GW Rpt_Ponds+MWs b03–b04.dwg
DRAWING SCALE	1"=200'

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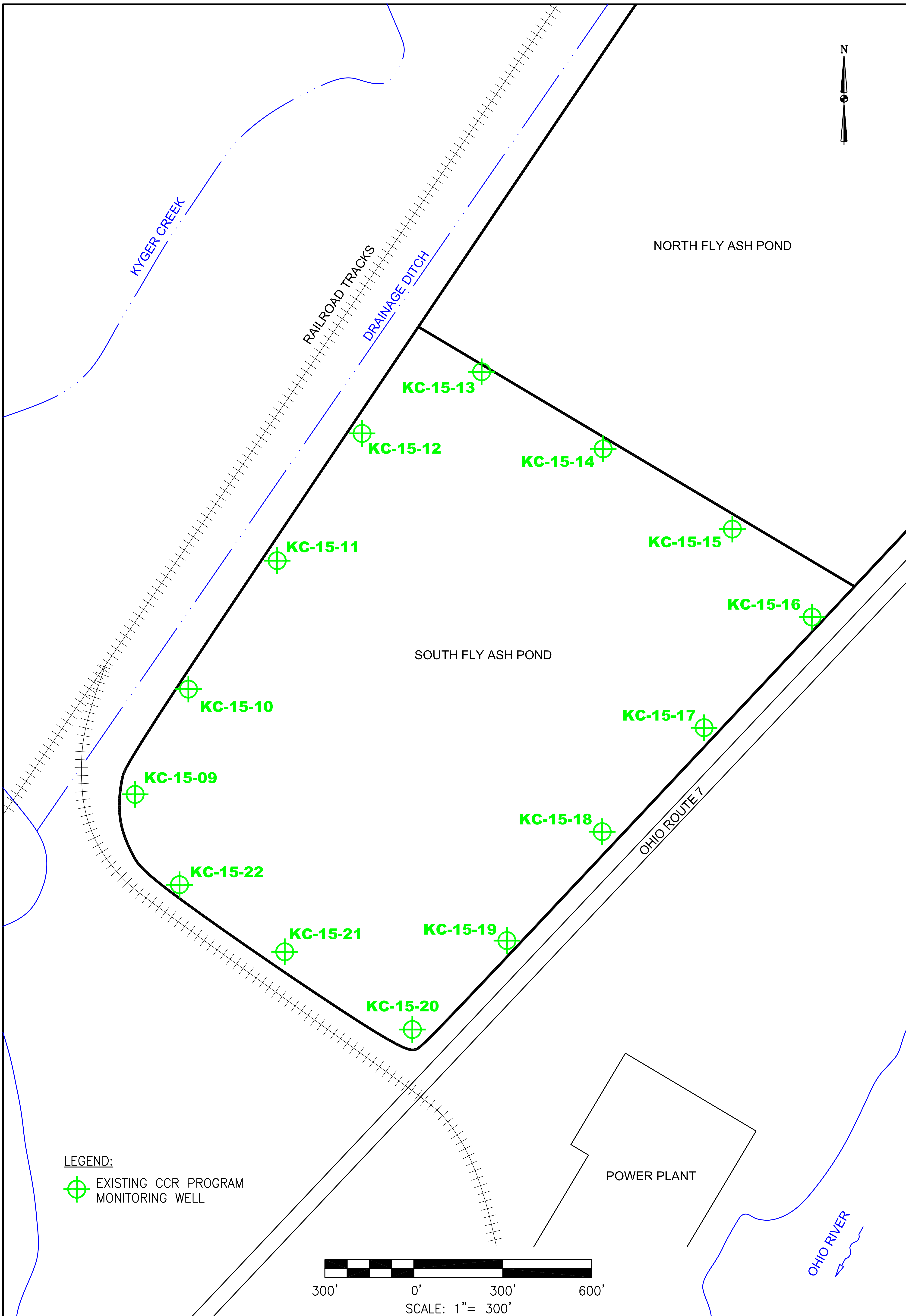
OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
BOILER SLAG POND
GROUNDWATER MONITORING WELL LOCATIONS

DRAWING NAME: FIGURE 3
REV.: 0

Plot: 01/17/2020 11:23 _PROGRAMS-KYGER OVEC\Kyger Creek-CCR Program\CAD\2019 GW Monitoring-Corrective Action Rpt\KYGER_CCR 2019 Annual GW Rpt_Ponds+MWs b03.dwg



DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019018–KYGER
DWG FILE	KYGER_CCR_2019 Annual GW Rpt_Ponds+MWs b03–b04.dwg
DRAWING SCALE	1"=300'

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OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
SOUTH FLY ASH POND
GROUNDWATER MONITORING WELL LOCATIONS

DRAWING NAME: FIGURE 4
REV. 0

Plot: 01/08/2020 10:01 _PROGRAMS–KYGER OVEC\Kyger Creek–CCR Program\CAD\2019 GW Monitoring–Corrective Action Rpt\KYGER_CCR_2019 Annual GW Rpt_Ponds+MWs b04.dwg

APPENDIX A

GROUNDWATER ELEVATIONS

TABLE A-1
SUMMARY OF GROUNDWATER ELEVATION DATA DURING 2019
CLASS III RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Mar-19	Jun-19	Sep-19	Nov-19
	Groundwater Elevation (ft)	Groundwater Elevation (ft)	Groundwater Elevation (ft)	Groundwater Elevation (ft)
BUSW-1	568.95	NM	568.64	NM
BUSW-2	571.52	NM	572.22	NM
BUSW-3	552.89	NM	552.59	NM
BUSW-4	530.18	NM	529.87	NM
BUSW-5	576.20	NM	575.69	NM
BUSW-8	565.57	NM	565.27	NM
BUSW-10	566.25	NM	565.93	NM
IMW-1BU	573.46	NM	573.16	NM
IMW-2BU	565.07	NM	564.81	NM
CCR-1BU	564.62	NM	564.33	NM
CCR-2BU	566.46	NM	566.14	NM
MW-3D	572.17	NM	571.89	NM
MW-4D	566.89	NM	566.57	NM

Notes:

1. NM: Not Measured

TABLE A-2
SUMMARY OF GROUNDWATER ELEVATION DATA DURING 2019
BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Mar-19	Jun-19	Sep-19	Nov-19
	Groundwater Elevation (ft)	Groundwater Elevation (ft)	Groundwater Elevation (ft)	Groundwater Elevation (ft)
KC-15-01	542.05	539.71	539.52	539.41
KC-15-02	542.45	540.05	539.92	539.80
KC-15-03	542.24	539.85	539.69	539.59
KC-15-04	540.57	538.31	538.05	538.46
KC-15-05	540.45	538.23	537.92	538.33
KC-15-06	540.38	538.14	537.88	538.28
KC-15-07	540.64	538.38	538.10	538.39
KC-15-08	541.24	539.01	538.71	538.99
KC-19-27	NI	538.19	538.64	532.30
KC-19-28	NI	537.91	538.42	538.08
KC-19-29	NI	537.98	538.39	538.07

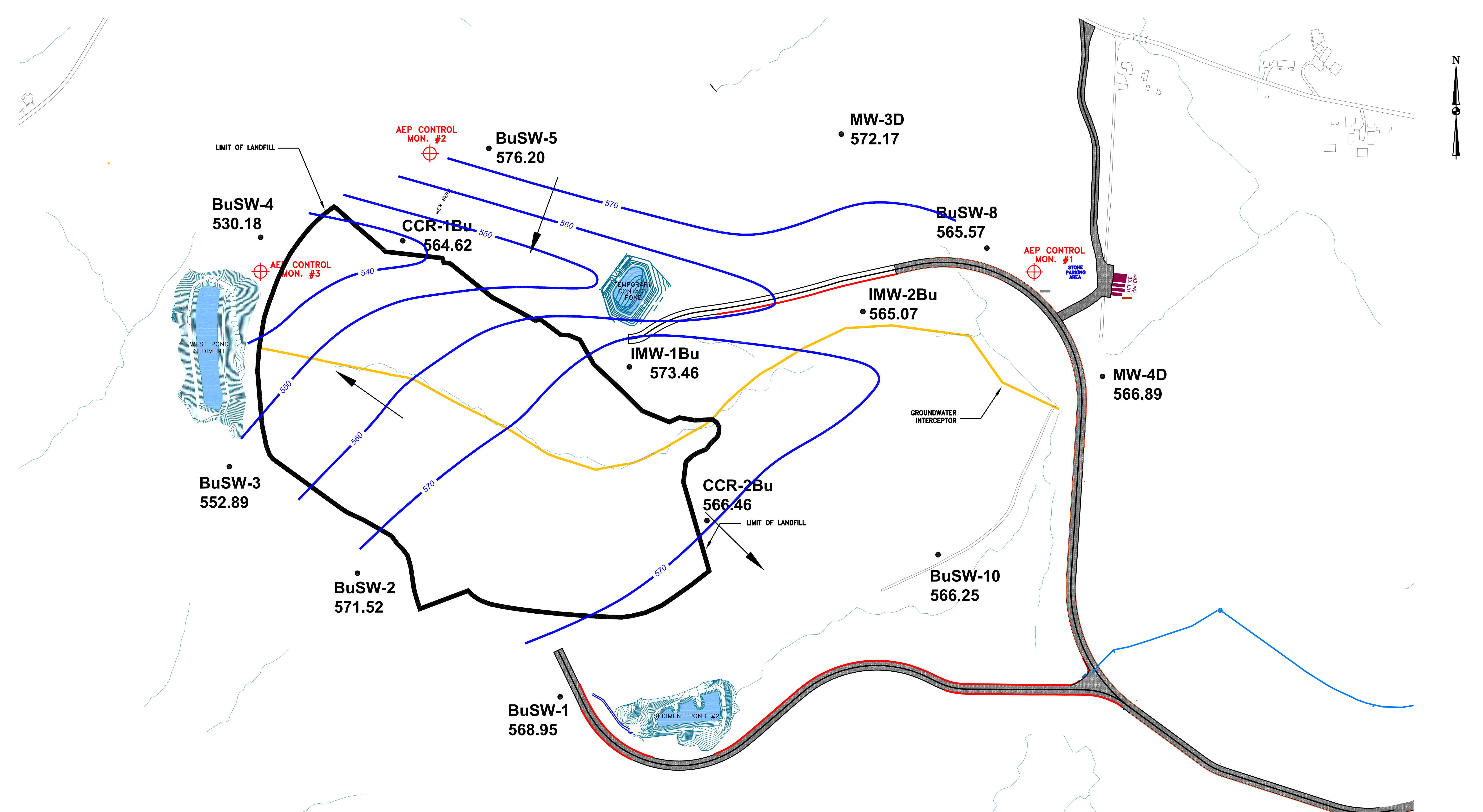
Notes:
1. NI: Not Installed

TABLE A-3
SUMMARY OF GROUNDWATER ELEVATION DATA DURING 2019
SOUTH FLY ASH POND
CCR GROUNDWATER MONITORING PROGRAM
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Mar-19 Groundwater Elevation (ft)	Jun-19 Groundwater Elevation (ft)	Sep-19 Groundwater Elevation (ft)	Nov-19 Groundwater Elevation (ft)
KC-15-09	544.37	541.87	540.96	541.24
KC-15-10	544.73	542.20	541.31	541.43
KC-15-11	545.11	542.55	541.71	541.80
KC-15-12	545.34	542.74	541.92	542.05
KC-15-13	545.36	542.74	541.95	542.05
KC-15-14	544.99	542.38	541.57	541.66
KC-15-15	544.47	541.87	541.06	541.26
KC-15-16	544.05	541.47	540.63	540.44
KC-15-17	548.53	541.60	545.10	545.29
KC-15-18	543.90	541.23	540.48	540.64
KC-15-19	543.58	541.08	540.17	540.38
KC-15-20	546.67	540.86	543.23	543.37
KC-15-21	543.74	541.19	540.31	542.56
KC-15-22	543.86	541.53	540.44	541.46

APPENDIX B

GROUNDWATER FLOW MAPS



LEGEND:

● BuSW-1 BUFFALO SANDSTONE WELL

400' 0' 400' 800'

SCALE: 1"= 400'

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019018-KYGER
DWG FILE	KYGER_CCR_2019 Annual GW Rpt_GW Flow_MAR2019.dwg
DRAWING SCALE	AS SHOWN

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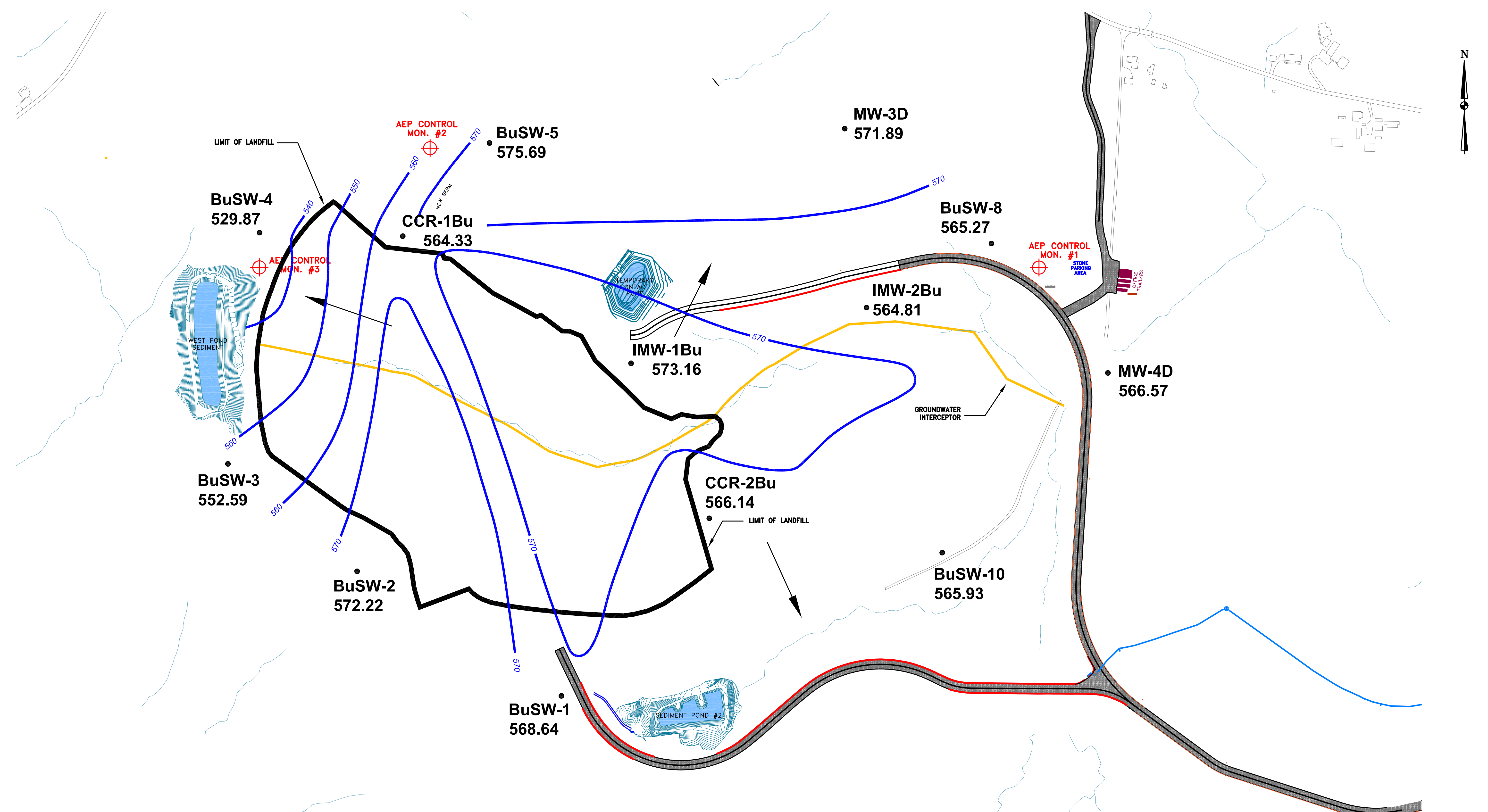
KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
CLASS III RESIDUAL WASTE LANDFILL
GROUNDWATER ELEVATIONS AND FLOW MAP
MARCH 2019

DRAWING NAME: FIGURE B-1

REV. 0

Plot: 01/27/2020 11:50 _PROGRAMS-KYGER OVEC\Kyger Creek-CCR Program\CAD\2019 GW Monitoring-Corrective Action Rpt\Appx B\KYGER_CCR_2019 Annual GW Rpt_GW Flow_MAR2019.dwg



LEGEND:

● BuSW-1 BUFFALO SANDSTONE WELL

400' 0' 400' 800'

SCALE: 1"= 400'

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019018-KYGER
DWG FILE	KYGER_CCR_2019 Annual GW Rpt_GW Flow_SEPT2019.dwg
DRAWING SCALE	AS SHOWN

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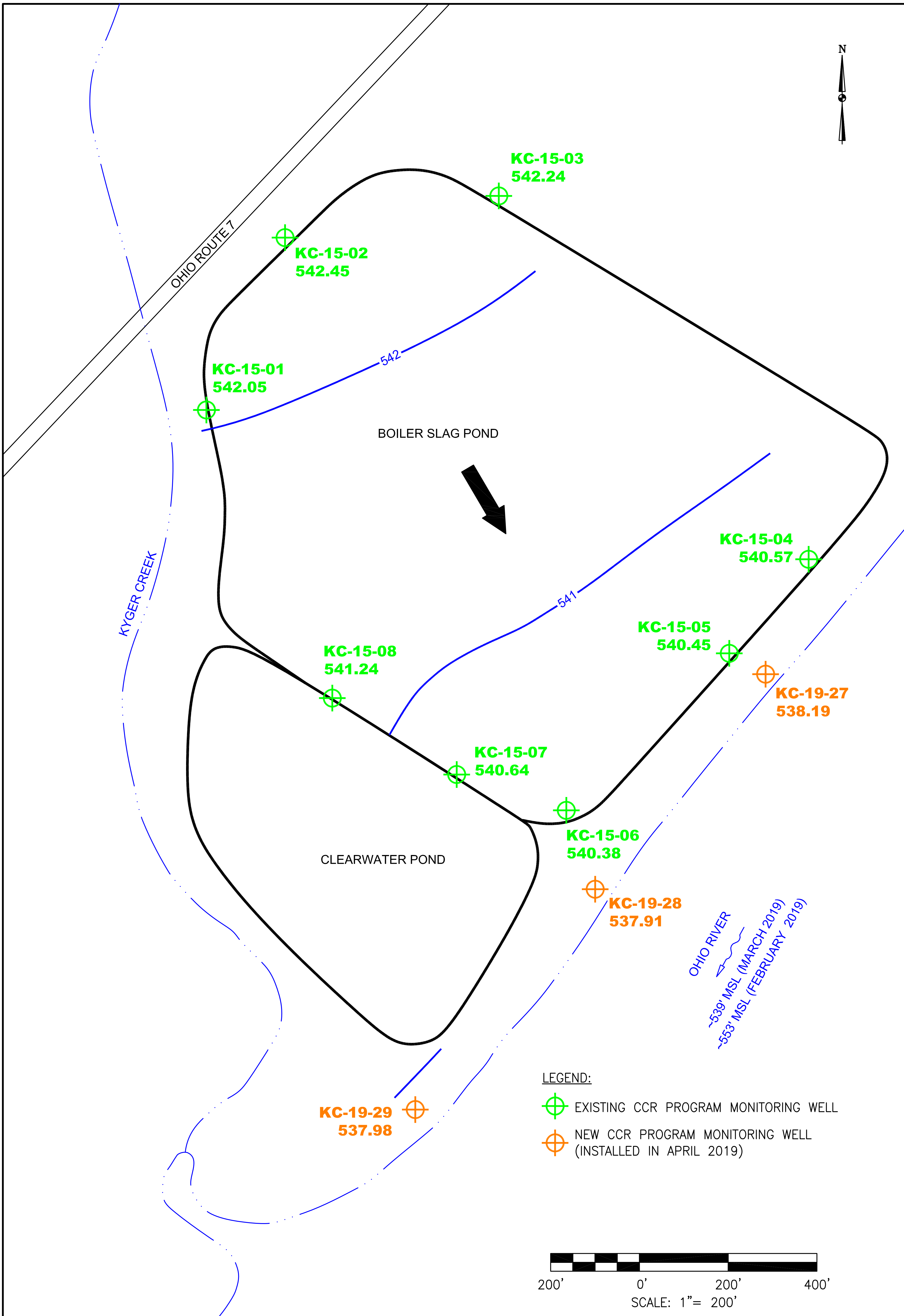
KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
CLASS III RESIDUAL WASTE LANDFILL
GROUNDWATER ELEVATIONS AND FLOW MAP
SEPTEMBER 2019

DRAWING NAME	REV.
FIGURE B-2	0

Plot: 01/27/2020 11:54 _PROGRAMS-KYGER OVEC\Kyger Creek-CCR Program\CAD\2019 GW Monitoring-Corrective Action Rpt\Appx B\KYGER_CCR_2019 Annual GW Rpt_GW Flow_SEPT2019.dwg



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DATE	
CHECKED BY	
JOB NO.	2019018-KYGER
DWG FILE	KYGER_CCR_2019 Annual GW Rpt_BSP_GW Flow_MAR2019.dwg
DRAWING SCALE	1"=200'

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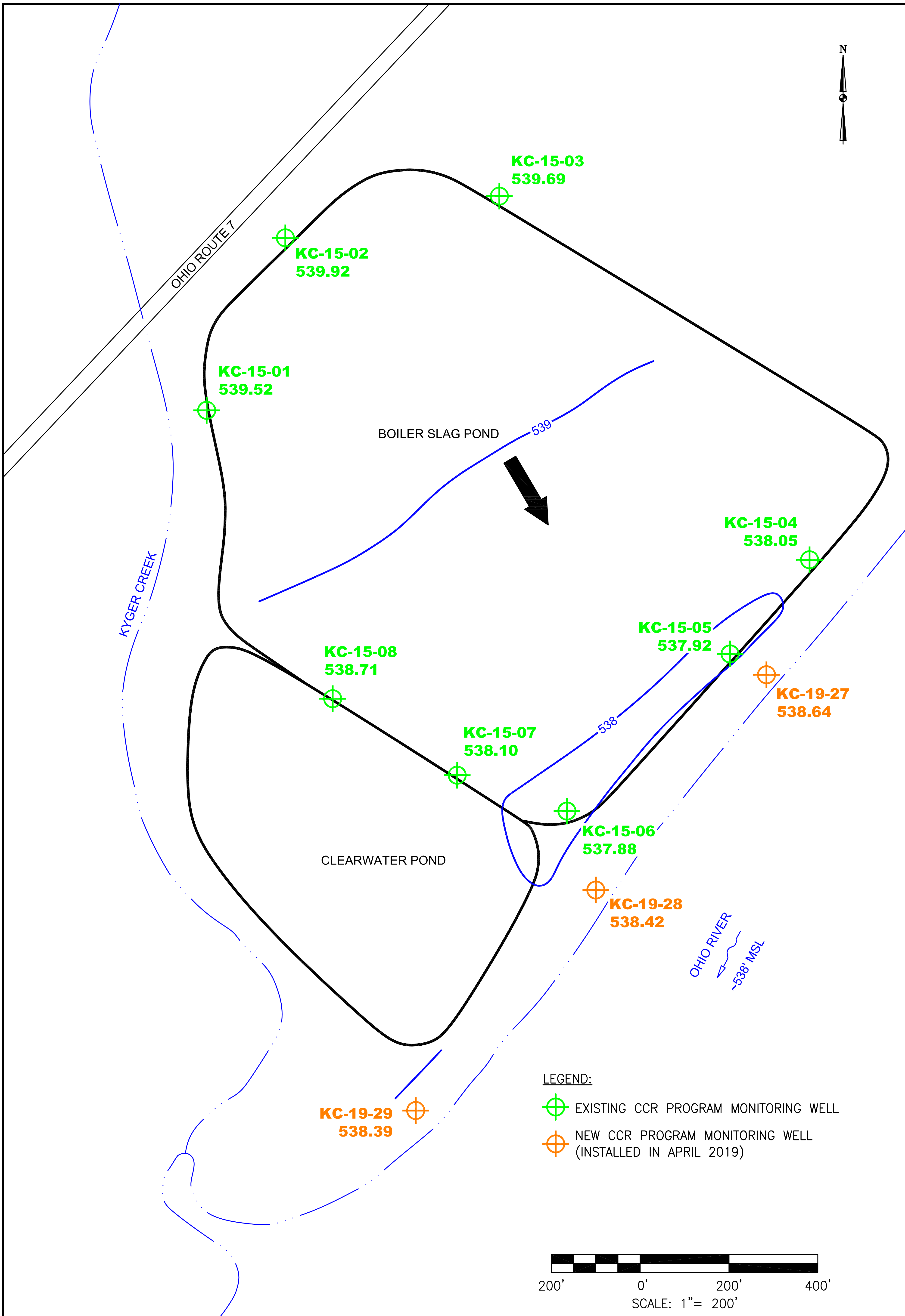
OHIO VALLEY ELECTRIC COMPANY
KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
BOILER SLAG POND
GROUNDWATER LEVELS AND FLOW DIRECTION
MARCH 2019

DRAWING NAME: FIGURE B-3
REV. 0

Plot: 01/17/2020 11:52 \Kyger Creek-CCR Program\CAD\2019 GW Monitoring-Corrective Action Rpt\Appx B\KYGER_CCR_2019 Annual GW Rpt_BSP_GW Flow_MAR2019.dwg



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DATE	
CHECKED BY	
JOB NO.	2019018–KYGER
DWG FILE	KYGER_CCR_2019 Annual GW Rpt_BSP_GW Flow_SEPT2019.dwg
DRAWING SCALE	1"=200'

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OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
BOILER SLAG POND
GROUNDWATER LEVELS AND FLOW DIRECTION
SEPTEMBER 2019

DRAWING NAME	REV.
FIGURE B–4	0

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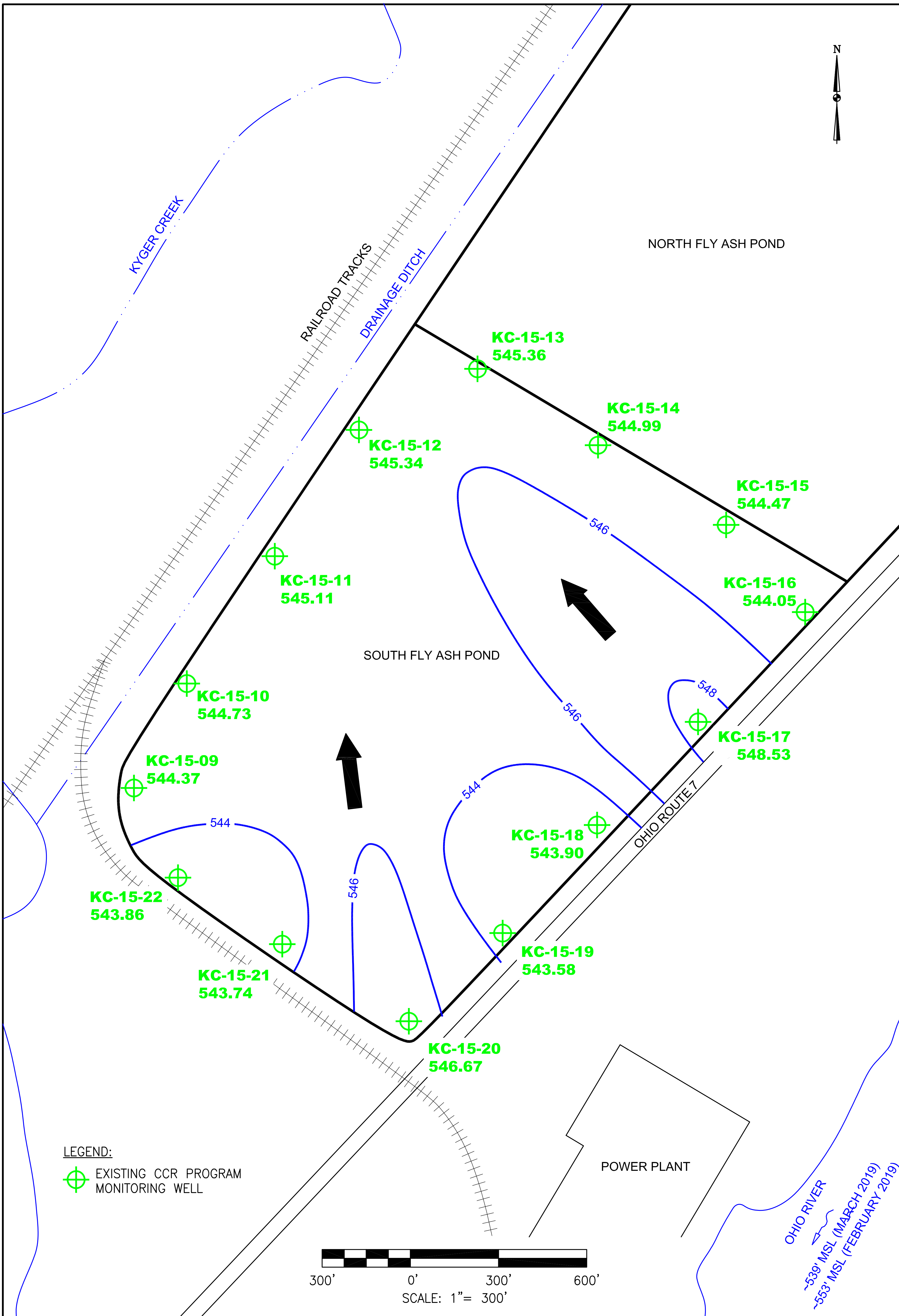

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DWG FILE	KYGER_CCR_2019 Annual GW Rpt_SFAP_GW Flow_MAR2019.dwg
DRAWING SCALE	1"=300'

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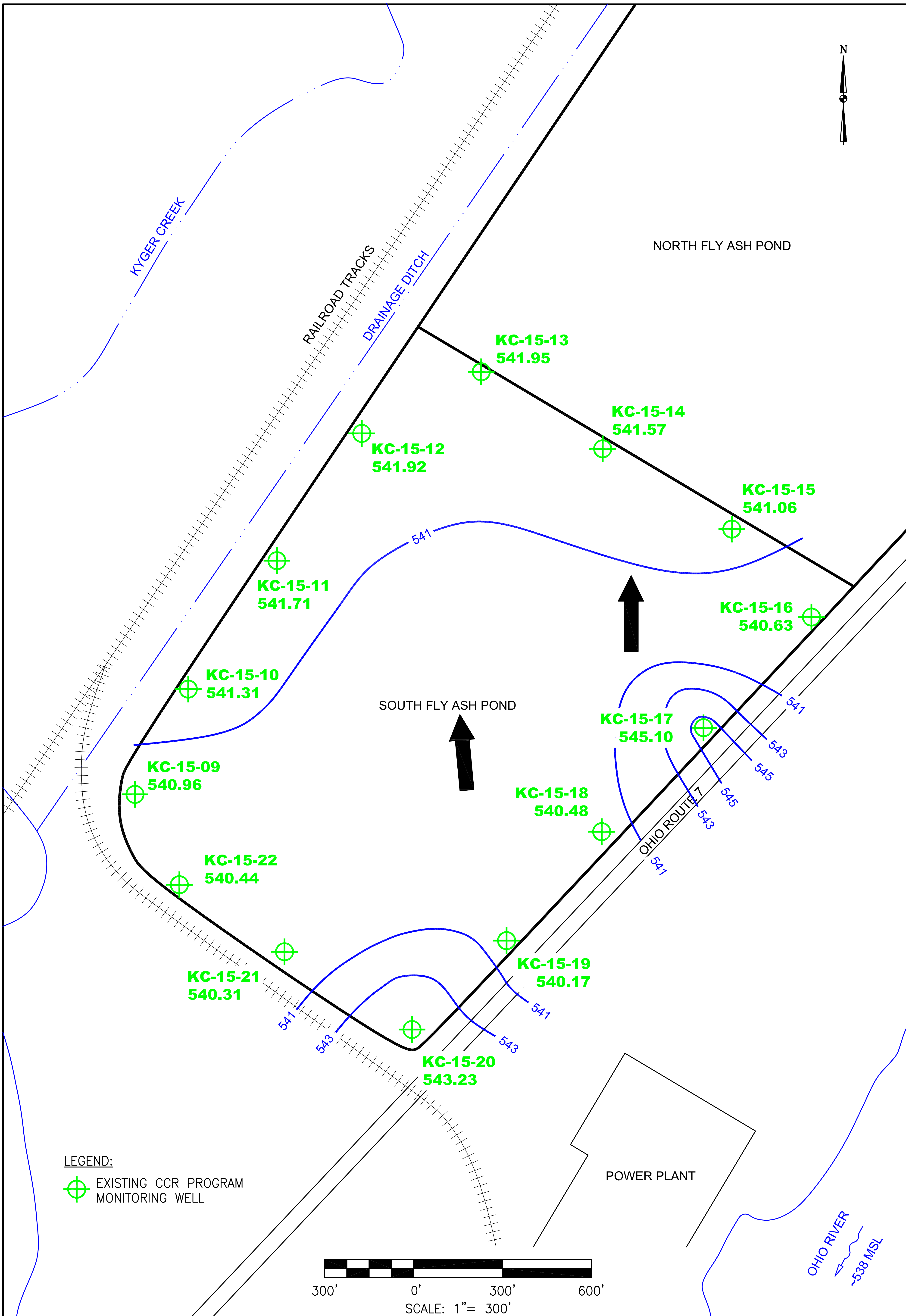
OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
SOUTH FLY ASH POND
GROUNDWATER LEVELS AND FLOW DIRECTION
MARCH 2019

DRAWING NAME: FIGURE B–5
REV. 0

Plot: 01/17/2020 15:55 \Kyger Creek–CCR Program\CAD\2019 GW Monitoring–Corrective Action Rpt\Appx B\KYGER_CCR_2019 Annual GW Rpt_SFAP_GW Flow_MAR2019.dwg



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DWG FILE	KYGER_CCR_2019 Annual GW Rpt_SFAP_GW Flow_SEPT2019.dwg
DRAWING SCALE	1"=300'

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OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
SOUTH FLY ASH POND
GROUNDWATER LEVELS AND FLOW DIRECTION
SEPTEMBER 2019

DRAWING NAME	REV.
FIGURE B–6	0

Plot: 01/22/2020 15:25 \Kyger Creek–CCR Program\CAD\2019 GW Monitoring–Corrective Action Rpt\Appx B\KYGER_CCR_2019 Annual GW Rpt_SFAP_GW Flow_SEPT2019.dwg

APPENDIX C

APPENDIX III AND APPENDIX IV CONSTITUENTS

APPENDIX III AND APPENDIX IV CONSTITUENTS

Appendix III Constituents (Detection Monitoring)
Constituent
Boron, B
Calcium, Ca
Chloride, Cl
Fluoride, F
pH (units=SU)
Sulfate, SO4
Total Dissolved Solids (TDS)
Appendix IV Constituents (Assessment Monitoring)
Constituent
Antimony, Sb
Arsenic, As
Barium, Ba
Beryllium, Be
Cadmium, Cd
Chromium, Cr
Cobalt, Co
Fluoride, F
Lithium, Li
Lead, Pb
Mercury, Hg
Molybdenum, Mo
Radium 226 & 228 (combined)(units=pCi/L)
Selenium, Se
Thallium, Tl

APPENDIX D

ANALYTICAL RESULTS

BuSW-1
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.35	0.34
Calcium, Ca	mg/L	14	16
Chloride, Cl	mg/L	2200	2100
Fluoride, F	mg/L	1.3	1.2
pH	s.u.	7.91	7.23
Sulfate, SO4	mg/L	84	75
Total Dissolved Solids (TDS)	mg/L	3300	2500

BuSW-2
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.42	0.43
Calcium, Ca	mg/L	39	37
Chloride, Cl	mg/L	3100	3000
Fluoride, F	mg/L	1.4	1.4
pH	s.u.	6.92	7.58
Sulfate, SO4	mg/L	7.5	4.2 J
Total Dissolved Solids (TDS)	mg/L	5200	3500

BuSW-3
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.47	0.45
Calcium, Ca	mg/L	1100	920
Chloride, Cl	mg/L	19000	19000
Fluoride, F	mg/L	2.5 U	2.5 U
pH	s.u.	6.07	6.76
Sulfate, SO4	mg/L	43 J	33 J
Total Dissolved Solids (TDS)	mg/L	30000	38000

BuSW-4
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.41	0.37
Calcium, Ca	mg/L	990	980
Chloride, Cl	mg/L	19000	21000
Fluoride, F	mg/L	2.5 U	2.5 U
pH	s.u.	6.38	7.03
Sulfate, SO4	mg/L	19 J	32 J
Total Dissolved Solids (TDS)	mg/L	25000	37000

BuSW-5
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.42	0.38
Calcium, Ca	mg/L	640	650
Chloride, Cl	mg/L	16000	16000
Fluoride, F	mg/L	2.5 U	2.5 U
pH	s.u.	6.47	7.12
Sulfate, SO4	mg/L	50 U	50 U
Total Dissolved Solids (TDS)	mg/L	22000	32000

BuSW-8
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.41	0.39
Calcium, Ca	mg/L	500	540
Chloride, Cl	mg/L	14000	14000
Fluoride, F	mg/L	2.5 U	2.5 U
pH	s.u.	6.56	7.07
Sulfate, SO4	mg/L	50 U	50 U
Total Dissolved Solids (TDS)	mg/L	18000	24000

BuSW-10
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.38	0.38
Calcium, Ca	mg/L	33	33
Chloride, Cl	mg/L	3100	3200
Fluoride, F	mg/L	1.3	1.3
pH	s.u.	7.07	7.64
Sulfate, SO4	mg/L	8.4	4.9 J
Total Dissolved Solids (TDS)	mg/L	4900	5400

CCR-1BU
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.3	0.3
Calcium, Ca	mg/L	500	540
Chloride, Cl	mg/L	12000	13000
Fluoride, F	mg/L	2.5 U	2.5 U
pH	s.u.	6.77	7.27
Sulfate, SO4	mg/L	50 U	50 U
Total Dissolved Solids (TDS)	mg/L	19000	24000

CCR-2BU
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.26	0.26
Calcium, Ca	mg/L	48	43
Chloride, Cl	mg/L	2000	2200
Fluoride, F	mg/L	1.1	1.4
pH	s.u.	7.77	6.52
Sulfate, SO4	mg/L	57	50
Total Dissolved Solids (TDS)	mg/L	3100	2900

IMW-1BU
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.41	0.4
Calcium, Ca	mg/L	220	230
Chloride, Cl	mg/L	7900	8200
Fluoride, F	mg/L	0.85	0.77
pH	s.u.	7.03	7.26
Sulfate, SO4	mg/L	12	9.3 J
Total Dissolved Solids (TDS)	mg/L	13000	13000

IMW-2BU
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.36	0.4
Calcium, Ca	mg/L	560	570
Chloride, Cl	mg/L	14000	14000
Fluoride, F	mg/L	2.5 U	2.5 U
pH	s.u.	6.76	7.05
Sulfate, SO4	mg/L	50 U	50 U
Total Dissolved Solids (TDS)	mg/L	20000	24000

MW-3D
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.42	0.39
Calcium, Ca	mg/L	1100	1000
Chloride, Cl	mg/L	21000	22000
Fluoride, F	mg/L	2.5 U	2.5 U
pH	s.u.	6.32	6.83
Sulfate, SO4	mg/L	50 U	50 U
Total Dissolved Solids (TDS)	mg/L	28000	44000

MW-4D
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.43	0.43
Calcium, Ca	mg/L	5.8	3.2 J
Chloride, Cl	mg/L	290	220
Fluoride, F	mg/L	1.6	1.5
pH	s.u.	7.55	8.57
Sulfate, SO4	mg/L	290	290
Total Dissolved Solids (TDS)	mg/L	1300	1100

KC-15-01
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.33	0.48
Calcium, Ca	mg/L	85	90
Chloride, Cl	mg/L	32	26
Fluoride, F	mg/L	0.049 J	0.068
pH	s.u.	6.06	5.59
Sulfate, SO4	mg/L	270	330
Total Dissolved Solids (TDS)	mg/L	510	520
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	0.85 J	0.87 J
Barium, Ba	ug/L	26	25
Beryllium, Be	ug/L	1 U	0.49 J
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	5.7	7.1
Fluoride, F	mg/L	0.049 J	0.068
Lithium, Li	mg/L	0.0036 J	0.0058 J
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	5 U
Radium 226 & 228 (combined)	pCi/L	0.255 U	5 U
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	0.65 J

KC-15-02
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.041 J	0.068 J
Calcium, Ca	mg/L	110	110
Chloride, Cl	mg/L	33	35
Fluoride, F	mg/L	0.12	0.21
pH	s.u.	6.64	6.5
Sulfate, SO4	mg/L	120	130
Total Dissolved Solids (TDS)	mg/L	480	530
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	2.7 J	2.7 J
Barium, Ba	ug/L	100	100
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	1.4	1
Fluoride, F	mg/L	0.12	0.21
Lithium, Li	mg/L	0.0034 J	0.006 J
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	1.7 J	1.2 J
Radium 226 & 228 (combined)	pCi/L	0.604	5 U
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	0.26 J	1 U

KC-15-03
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.18	0.18
Calcium, Ca	mg/L	120	120
Chloride, Cl	mg/L	29	29
Fluoride, F	mg/L	0.089	0.094
pH	s.u.	6.31	6.21
Sulfate, SO4	mg/L	190	200
Total Dissolved Solids (TDS)	mg/L	490	550
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	1.3 J	1.6 J
Barium, Ba	ug/L	69	67
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	4.6	4.3
Fluoride, F	mg/L	0.089	0.094
Lithium, Li	mg/L	0.0045 J	0.0096
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	5 U
Radium 226 & 228 (combined)	pCi/L	0.501	5 U
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	1 U

KC-15-04
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Jun-19	Sep-19
Appendix III Constituents				
Boron, B	mg/L	0.79	0.85	0.79
Calcium, Ca	mg/L	100	NA	100
Chloride, Cl	mg/L	30	NA	30
Fluoride, F	mg/L	0.071	NA	0.082
pH	s.u.	5.56	NA	5.96
Sulfate, SO4	mg/L	330	380	340
Total Dissolved Solids (TDS)	mg/L	620	610	610
Appendix IV Constituents				
Antimony, Sb	ug/L	2 U	NA	2 U
Arsenic, As	ug/L	2.4 J	NA	1.9 J
Barium, Ba	ug/L	76	NA	56
Beryllium, Be	ug/L	1 U	NA	1 U
Cadmium, Cd	ug/L	1 U	NA	1 U
Chromium, Cr	ug/L	2 U	NA	2 U
Cobalt, Co	ug/L	11	9.1	7.9
Fluoride, F	mg/L	0.071	NA	0.082
Lithium, Li	mg/L	0.011	NA	0.01
Lead, Pb	ug/L	1 U	NA	0.59 J
Mercury, Hg	ug/L	0.2 U	NA	0.2 U
Molybdenum, Mo	ug/L	5 U	NA	5 U
Radium 226 & 228 (combined)	pCi/L	0.486	NA	0.521
Selenium, Se	ug/L	5 U	NA	5 U
Thallium, Tl	ug/L	1 U	NA	1 U

Notes:
NA: Sampling not required for this parameter.

KC-15-05
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	**Units**	**Mar-19**	**Jun-19**	**Sep-19**	**Nov-19**
Appendix III Constituents					
Boron, B	mg/L	0.86	1	1.1	1.1
Calcium, Ca	mg/L	120	NA	140	130
Chloride, Cl	mg/L	32	NA	32	NA
Fluoride, F	mg/L	0.12	NA	0.14	NA
pH	s.u.	6.11	NA	6.33	NA
Sulfate, SO4	mg/L	390	460	410	390
Total Dissolved Solids (TDS)	mg/L	760	720	760	750
Appendix IV Constituents					
Antimony, Sb	ug/L	2 U	NA	2 U	NA
Arsenic, As	ug/L	5 U	NA	5 U	NA
Barium, Ba	ug/L	37	NA	39	NA
Beryllium, Be	ug/L	1 U	NA	1 U	NA
Cadmium, Cd	ug/L	1 U	NA	1 U	NA
Chromium, Cr	ug/L	2 U	NA	2 U	NA
Cobalt, Co	ug/L	5.5	NA	6.2	NA
Fluoride, F	mg/L	0.12	NA	0.14	NA
Lithium, Li	mg/L	0.0027 J	NA	0.0041 J	NA
Lead, Pb	ug/L	1 U	NA	0.46 J	NA
Mercury, Hg	ug/L	0.2 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	5 U	NA	5 U	NA
Radium 226 & 228 (combined)	pCi/L	0.587	NA	5 U	NA
Selenium, Se	ug/L	5 U	NA	5 U	NA
Thallium, Tl	ug/L	0.23 J	NA	1 U	NA

Notes:
NA: Sampling not required for this parameter.

KC-15-06
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.31	0.34
Calcium, Ca	mg/L	92	94
Chloride, Cl	mg/L	34	34
Fluoride, F	mg/L	0.095	0.091
pH	s.u.	6.77	7.16
Sulfate, SO4	mg/L	180	170
Total Dissolved Solids (TDS)	mg/L	490	490
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	2.6 J	3.2 J
Barium, Ba	ug/L	110	96
Beryllium, Be	ug/L	1 U	0.58 J
Cadmium, Cd	ug/L	0.29 J	1 U
Chromium, Cr	ug/L	2 U	1.3 J
Cobalt, Co	ug/L	4.3	4.6
Fluoride, F	mg/L	0.095	0.091
Lithium, Li	mg/L	0.003 J	0.006 J
Lead, Pb	ug/L	1 U	0.53 J
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	1.5 J
Radium 226 & 228 (combined)	pCi/L	0.417	5 U
Selenium, Se	ug/L	5 U	3.7 J
Thallium, Tl	ug/L	0.25 J	0.56 J

KC-15-07
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Jun-19	Sep-19
Appendix III Constituents				
Boron, B	mg/L	0.12	NA	0.13
Calcium, Ca	mg/L	88	NA	100
Chloride, Cl	mg/L	33	NA	34
Fluoride, F	mg/L	0.064	NA	0.075
pH	s.u.	6.6	NA	6.48
Sulfate, SO4	mg/L	87	NA	120
Total Dissolved Solids (TDS)	mg/L	410	NA	500
Appendix IV Constituents				
Antimony, Sb	ug/L	2 U	NA	2 U
Arsenic, As	ug/L	160	120	120
Barium, Ba	ug/L	560	NA	450
Beryllium, Be	ug/L	1 U	NA	1 U
Cadmium, Cd	ug/L	1 U	NA	1 U
Chromium, Cr	ug/L	2 U	NA	2 U
Cobalt, Co	ug/L	0.27 J	NA	0.69 J
Fluoride, F	mg/L	0.064	NA	0.075
Lithium, Li	mg/L	0.0024 J	NA	0.0054 J
Lead, Pb	ug/L	1 U	NA	1 U
Mercury, Hg	ug/L	0.2 U	NA	0.2 U
Molybdenum, Mo	ug/L	5 U	NA	5 U
Radium 226 & 228 (combined)	pCi/L	1.29	NA	1.39
Selenium, Se	ug/L	5 U	NA	1.4 J
Thallium, Tl	ug/L	1 U	NA	1 U

Notes:
NA: Sampling not required for this parameter.

KC-15-08
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Jun-19	Sep-19	Nov-19
Appendix III Constituents					
Boron, B	mg/L	0.51	NA	0.5	NA
Calcium, Ca	mg/L	210	210	210	220
Chloride, Cl	mg/L	45	NA	45	NA
Fluoride, F	mg/L	0.092	NA	0.12	NA
pH	s.u.	6.8	NA	6.55	NA
Sulfate, SO4	mg/L	550	610	530	560
Total Dissolved Solids (TDS)	mg/L	1000	1100	1000	1100
Appendix IV Constituents					
Antimony, Sb	ug/L	2 U	NA	2 U	NA
Arsenic, As	ug/L	11	10	9.4	NA
Barium, Ba	ug/L	54	NA	47	NA
Beryllium, Be	ug/L	1 U	NA	0.53 J	NA
Cadmium, Cd	ug/L	1 U	NA	1 U	NA
Chromium, Cr	ug/L	2 U	NA	2 U	NA
Cobalt, Co	ug/L	5	NA	5.4	NA
Fluoride, F	mg/L	0.092	NA	0.12	NA
Lithium, Li	mg/L	0.0046 J	NA	0.0095	NA
Lead, Pb	ug/L	1 U	NA	1 U	NA
Mercury, Hg	ug/L	0.2 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	5 U	NA	1.7 J	NA
Radium 226 & 228 (combined)	pCi/L	0.539	NA	0.657	NA
Selenium, Se	ug/L	5 U	NA	3.2 J	NA
Thallium, Tl	ug/L	1 U	NA	0.62 J	NA

Notes:
NA: Sampling not required for this parameter.

KC-19-27
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Sep-19
Appendix IV Constituents		
Arsenic, As	ug/L	7.2

KC-19-28
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Sep-19
Appendix IV Constituents		
Arsenic, As	ug/L	5 U

KC-19-29
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Sep-19
Appendix IV Constituents		
Arsenic, As	ug/L	5 U

KC-15-09
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.027 J	0.1 U
Calcium, Ca	mg/L	71	77
Chloride, Cl	mg/L	9.6	12
Fluoride, F	mg/L	0.15	0.18
pH	s.u.	6.75	6.81
Sulfate, SO4	mg/L	62	65
Total Dissolved Solids (TDS)	mg/L	290	400
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	5 U	5 U
Barium, Ba	ug/L	42	34
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	1.8	2.5
Fluoride, F	mg/L	0.15	0.18
Lithium, Li	mg/L	0.0034 J	0.0054 J
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	1.2 J	5 U
Radium 226 & 228 (combined)	pCi/L	0.0941 U	5 U
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	1 U

KC-15-10
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	**Units**	**Mar-19**	**Sep-19**
Appendix III Constituents			
Boron, B	mg/L	0.1 U	0.1 U
Calcium, Ca	mg/L	63	54
Chloride, Cl	mg/L	9.4	9.9
Fluoride, F	mg/L	0.18	0.26
pH	s.u.	6.44	6.34
Sulfate, SO4	mg/L	74	73
Total Dissolved Solids (TDS)	mg/L	300	290
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	2.1 J	2 J
Barium, Ba	ug/L	42	33
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	1.1	1
Fluoride, F	mg/L	0.18	0.26
Lithium, Li	mg/L	0.0051 J	0.0065 J
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	5 U
Radium 226 & 228 (combined)	pCi/L	0.0245 U	5 U
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	1 U

KC-15-11
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.031 J	0.033 J
Calcium, Ca	mg/L	75	56
Chloride, Cl	mg/L	11	10
Fluoride, F	mg/L	0.18	0.17
pH	s.u.	6.5	6.39
Sulfate, SO4	mg/L	89	82
Total Dissolved Solids (TDS)	mg/L	320	250
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	0.87 J	1.3 J
Barium, Ba	ug/L	43	33
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1.1	0.22 J
Chromium, Cr	ug/L	2 U	1.2 J
Cobalt, Co	ug/L	1.4	1.6
Fluoride, F	mg/L	0.18	0.17
Lithium, Li	mg/L	0.0045 J	0.0075 J
Lead, Pb	ug/L	1 U	0.78 J
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	5 U
Radium 226 & 228 (combined)	pCi/L	0.721	5 U
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	1 U

KC-15-12
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.31	0.099 J
Calcium, Ca	mg/L	94	83
Chloride, Cl	mg/L	21	13
Fluoride, F	mg/L	0.1	0.13
pH	s.u.	6.93	6.81
Sulfate, SO4	mg/L	97	69
Total Dissolved Solids (TDS)	mg/L	370	300
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	5 U	1.2 J
Barium, Ba	ug/L	74	72
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	1	0.75 J
Fluoride, F	mg/L	0.1	0.13
Lithium, Li	mg/L	0.0029 J	0.0051 J
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	5 U
Radium 226 & 228 (combined)	pCi/L	0.247 U	0.734
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	1 U

KC-15-13
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	4.3	6.1
Calcium, Ca	mg/L	86	110
Chloride, Cl	mg/L	61	38
Fluoride, F	mg/L	0.069	0.073
pH	s.u.	6.02	6.92
Sulfate, SO4	mg/L	320	410
Total Dissolved Solids (TDS)	mg/L	650	800
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	1.8 J	1.5 J
Barium, Ba	ug/L	57	62
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	9.1	9.5
Fluoride, F	mg/L	0.069	0.073
Lithium, Li	mg/L	0.0084	0.011
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	5 U
Radium 226 & 228 (combined)	pCi/L	0.323	5 U
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	1 U

KC-15-14
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	15	11
Calcium, Ca	mg/L	97	64
Chloride, Cl	mg/L	43	39
Fluoride, F	mg/L	0.1	0.12
pH	s.u.	6.21	6.49
Sulfate, SO4	mg/L	360	230
Total Dissolved Solids (TDS)	mg/L	690	500
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	1.7 J	2.4 J
Barium, Ba	ug/L	51	23
Beryllium, Be	ug/L	1 U	0.49 J
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	5.2	2.7
Fluoride, F	mg/L	0.1	0.12
Lithium, Li	mg/L	0.015	0.017
Lead, Pb	ug/L	1 U	0.5 J
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	1.2 J
Radium 226 & 228 (combined)	pCi/L	0.58	0.517
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	0.67 J

KC-15-15
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	13	14
Calcium, Ca	mg/L	70	75
Chloride, Cl	mg/L	59	52
Fluoride, F	mg/L	0.15	0.092
pH	s.u.	6.06	6.74
Sulfate, SO4	mg/L	250	280
Total Dissolved Solids (TDS)	mg/L	530	280
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	5 U	5 U
Barium, Ba	ug/L	25	27
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	0.91 J	0.58 J
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	9.7	13
Fluoride, F	mg/L	0.15	0.092
Lithium, Li	mg/L	0.018	0.021
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	5 U
Radium 226 & 228 (combined)	pCi/L	0.272 U	5 U
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	0.2 J

KC-15-16
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	9.9	9.8
Calcium, Ca	mg/L	150	130
Chloride, Cl	mg/L	77	81
Fluoride, F	mg/L	0.037 J	0.036 J
pH	s.u.	6.18	7.07
Sulfate, SO4	mg/L	470	390
Total Dissolved Solids (TDS)	mg/L	820	750
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	1.5 J	1.2 J
Barium, Ba	ug/L	48	30
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1 U	0.2 J
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	8.6	7.7
Fluoride, F	mg/L	0.037 J	0.036 J
Lithium, Li	mg/L	0.011	0.0098
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	5 U
Radium 226 & 228 (combined)	pCi/L	0.438	5 U
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	0.47 J	1 U

KC-15-17
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	20	20
Calcium, Ca	mg/L	230	240
Chloride, Cl	mg/L	110	110
Fluoride, F	mg/L	0.047 J	0.049 J
pH	s.u.	6.4	6.87
Sulfate, SO4	mg/L	1100	1100
Total Dissolved Solids (TDS)	mg/L	1600	1800
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	2.6 J	3.1 J
Barium, Ba	ug/L	33	28
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	0.29 J	0.39 J
Chromium, Cr	ug/L	2 U	1.8 J
Cobalt, Co	ug/L	26	27
Fluoride, F	mg/L	0.047 J	0.049 J
Lithium, Li	mg/L	0.028	0.029
Lead, Pb	ug/L	1 U	1
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	1.3 J	1.4 J
Radium 226 & 228 (combined)	pCi/L	0.167 U	5 U
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	0.24 J	1 U

KC-15-18
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Jun-19	Sep-19	Nov-19
Appendix III Constituents					
Boron, B	mg/L	15	NA	15	NA
Calcium, Ca	mg/L	120	130	130	140
Chloride, Cl	mg/L	63	NA	78	78
Fluoride, F	mg/L	0.089	NA	0.069	NA
pH	s.u.	6.57	NA	6.91	NA
Sulfate, SO4	mg/L	380	NA	410	NA
Total Dissolved Solids (TDS)	mg/L	680	NA	910	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	2 U	NA	2 U	NA
Arsenic, As	ug/L	3.7 J	NA	1.8 J	NA
Barium, Ba	ug/L	27	NA	22	NA
Beryllium, Be	ug/L	1 U	NA	1 U	NA
Cadmium, Cd	ug/L	1 U	NA	0.21 J	NA
Chromium, Cr	ug/L	2 U	NA	2 U	NA
Cobalt, Co	ug/L	8.4	NA	7.4	NA
Fluoride, F	mg/L	0.089	NA	0.069	NA
Lithium, Li	mg/L	0.031	NA	0.036	NA
Lead, Pb	ug/L	1 U	NA	1 U	NA
Mercury, Hg	ug/L	0.2 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	2.6 J	NA	5 U	NA
Radium 226 & 228 (combined)	pCi/L	0.27 U	NA	0.509	NA
Selenium, Se	ug/L	5 U	NA	5 U	NA
Thallium, Tl	ug/L	1 U	NA	1 U	NA

KC-15-19
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Jun-19	Sep-19	Nov-19
Appendix III Constituents					
Boron, B	mg/L	13	NA	17	NA
Calcium, Ca	mg/L	190	190	200	190
Chloride, Cl	mg/L	36	NA	43	NA
Fluoride, F	mg/L	0.1	NA	0.098	NA
pH	s.u.	6.51	NA	6.67	NA
Sulfate, SO4	mg/L	660	790	710	670
Total Dissolved Solids (TDS)	mg/L	1100	1200	1200	1200
Appendix IV Constituents					
Antimony, Sb	ug/L	2 U	NA	2 U	NA
Arsenic, As	ug/L	5 U	NA	5 U	NA
Barium, Ba	ug/L	15	NA	16	NA
Beryllium, Be	ug/L	1 U	NA	1 U	NA
Cadmium, Cd	ug/L	0.34 J	NA	0.25 J	NA
Chromium, Cr	ug/L	2 U	NA	2 U	NA
Cobalt, Co	ug/L	12	NA	11	NA
Fluoride, F	mg/L	0.1	NA	0.098	NA
Lithium, Li	mg/L	0.012	NA	0.015	NA
Lead, Pb	ug/L	1 U	NA	1 U	NA
Mercury, Hg	ug/L	0.2 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	5 U	NA	5 U	NA
Radium 226 & 228 (combined)	pCi/L	0.134 U	NA	5 U	NA
Selenium, Se	ug/L	5 U	NA	5 U	NA
Thallium, Tl	ug/L	1 U	NA	1 U	NA

KC-15-20
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Jun-19	Sep-19	Nov-19
Appendix III Constituents					
Boron, B	mg/L	10	NA	12	NA
Calcium, Ca	mg/L	210	200	210	200
Chloride, Cl	mg/L	35	NA	38	NA
Fluoride, F	mg/L	0.085	NA	0.098	NA
pH	s.u.	6.48	NA	6.82	NA
Sulfate, SO4	mg/L	630	670	610	5 U
Total Dissolved Solids (TDS)	mg/L	1100	1000	1100	1100
Appendix IV Constituents					
Antimony, Sb	ug/L	2 U	NA	2 U	NA
Arsenic, As	ug/L	1.9 J	NA	1.8 J	NA
Barium, Ba	ug/L	34	NA	27	NA
Beryllium, Be	ug/L	1 U	NA	0.36 J	NA
Cadmium, Cd	ug/L	1 U	NA	1 U	NA
Chromium, Cr	ug/L	2 U	NA	2 U	NA
Cobalt, Co	ug/L	4	NA	3.6	NA
Fluoride, F	mg/L	0.085	NA	0.098	NA
Lithium, Li	mg/L	0.024	NA	0.013	NA
Lead, Pb	ug/L	1 U	NA	1 U	NA
Mercury, Hg	ug/L	0.2 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	1.5 J	NA	1.9 J	NA
Radium 226 & 228 (combined)	pCi/L	0.384	NA	5 U	NA
Selenium, Se	ug/L	5 U	NA	5 U	NA
Thallium, Tl	ug/L	1 U	NA	0.56 J	NA

KC-15-21
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Jun-19	Sep-19	Nov-19
Appendix III Constituents					
Boron, B	mg/L	4.8	NA	6.1	NA
Calcium, Ca	mg/L	130	140	120	NA
Chloride, Cl	mg/L	27	NA	29	NA
Fluoride, F	mg/L	0.11	NA	0.11	NA
pH	s.u.	6.3	NA	6.81	NA
Sulfate, SO4	mg/L	290	NA	270	NA
Total Dissolved Solids (TDS)	mg/L	670	NA	630	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	2 U	NA	2 U	NA
Arsenic, As	ug/L	3.8 J	NA	2.5 J	NA
Barium, Ba	ug/L	45	NA	31	NA
Beryllium, Be	ug/L	1 U	NA	1 U	NA
Cadmium, Cd	ug/L	1 U	NA	1 U	NA
Chromium, Cr	ug/L	2 U	NA	2 U	NA
Cobalt, Co	ug/L	10	NA	12	NA
Fluoride, F	mg/L	0.11	NA	0.11	NA
Lithium, Li	mg/L	0.0055 J	NA	0.0074 J	NA
Lead, Pb	ug/L	1 U	NA	1 U	NA
Mercury, Hg	ug/L	0.2 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	1.4 J	NA	5 U	NA
Radium 226 & 228 (combined)	pCi/L	0.208 U	NA	5 U	NA
Selenium, Se	ug/L	5 U	NA	5 U	NA
Thallium, Tl	ug/L	1 U	NA	1 U	NA

KC-15-22
SUMMARY OF 2019 ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	Mar-19	Sep-19
Appendix III Constituents			
Boron, B	mg/L	0.48	0.2
Calcium, Ca	mg/L	110	110
Chloride, Cl	mg/L	17	14
Fluoride, F	mg/L	0.11	0.13
pH	s.u.	6.56	6.87
Sulfate, SO4	mg/L	120	82
Total Dissolved Solids (TDS)	mg/L	460	440
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	2.9 J	2.8 J
Barium, Ba	ug/L	90	71
Beryllium, Be	ug/L	1 U	0.34 J
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	2 U
Cobalt, Co	ug/L	1 U	1 U
Fluoride, F	mg/L	0.11	0.13
Lithium, Li	mg/L	0.0046 J	0.0061 J
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	5 U
Radium 226 & 228 (combined)	pCi/L	0.597	0.601
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	0.42 J

APPENDIX E

ASSESSMENT OF CORRECTIVE MEASURES SEPTEMBER 2019

AGES
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COAL COMBUSTION RESIDUALS REGULATION ASSESSMENT OF CORRECTIVE MEASURES REPORT

BOILER SLAG POND (BSP)
OHIO VALLEY ELECTRIC CORPORATION
KYGER CREEK STATION
CHESHIRE, OHIO

SEPTEMBER 2019

Prepared for:

OHIO VALLEY ELECTRIC CORPORATION (OVEC)

By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

COAL COMBUSTION RESIDUALS REGULATION
ASSESSMENT OF CORRECTIVE MEASURES REPORT
BOILER SLAG POND (BSP)
OHIO VALLEY ELECTRIC CORPORATION
KYGER CREEK STATION
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COAL COMBUSTION RESIDUALS REGULATION
ASSESSMENT OF CORRECTIVE MEASURES REPORT
BOILER SLAG POND (BSP)
OHIO VALLEY ELECTRIC CORPORATION
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CHESHIRE, OHIO

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AGES	Applied Geology and Environmental Science, Inc.
ACM	Assessment of Corrective Measures
ASD	Alternate Source Demonstration
ASTM	American Society for Testing and Materials
bgs	Below Ground Surface
BSP	Boiler Slag Pond
CCR	Coal Combustion Residuals
ft/day	Feet Per Day
ft/sec	Feet Per Second
°C	Degrees Celsius
GMPP	Groundwater Monitoring Program Plan
GWPS	Groundwater Protection Standard
HSA	Hollow Stem Auger
K	Hydraulic Conductivity
Landfill	Class III Residual Waste Landfill
MCL	Maximum Contaminant Level
mg/kg	Milligrams Per Kilogram
mm	Millimeter
MNA	Monitored Natural Attenuation
mV	Millivolt
MW	Megawatt
NPDES	National Pollution Discharge Elimination System
NTU	Nephelometric Unit
O&M	Operations and Maintenance
Ohio EPA	Ohio Environmental Protection Agency
ORP	Oxidation Reduction Potential
OVEC	Ohio Valley Electric Corporation
PRB	Permeable Reactive Barrier
PVC	Polyvinyl Chloride
RCRA	Resource Conservation and Recovery Act
SFAP	South Fly Ash Pond
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
Stantec	Stantec Consulting Services, Inc.
StAP	Statistical Analysis Plan
S.U.	Standard Unit
TDS	Total Dissolved Solids
ug/L	Micrograms Per Liter
U.S. EPA	United States Environmental Protection Agency

COAL COMBUSTION RESIDUALS REGULATION
ASSESSMENT OF CORRECTIVE MEASURES REPORT
BOILER SLAG POND (BSP)
OHIO VALLEY ELECTRIC CORPORATION
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CHESHIRE, OHIO

1.0 INTRODUCTION

On December 19, 2014, the United States Environmental Protection Agency (U.S. EPA) issued their final Coal Combustion Residuals (CCR) regulation which regulates CCR as a non-hazardous waste under Subtitle D of Resource Conservation and Recovery Act (RCRA) and became effective six (6) months from the date of its publication (April 17, 2015) in the Federal Register, referred to as the "CCR Rule." The rule applies to new and existing landfills, and surface impoundments used to dispose of or otherwise manage CCR generated by electric utilities and independent power producers. Because the rule was promulgated under Subtitle D of RCRA, it does not require regulated facilities to obtain permits, does not require state adoption, and cannot be enforced by U.S. EPA.

The CCR Rule in 40 CFR § 257.96(a) requires that an owner or operator initiate an Assessment of Corrective Measures (ACM) to prevent further release, to remediate any releases, and to restore affected area(s) to original conditions in the event that any Appendix IV constituent has been detected at a Statistically Significant Level (SSL) greater than a Groundwater Protection Standard (GWPS). The ACM must be completed within 90 days after initiation. The CCR Rule allows up to an additional 60 days to complete the ACM if a demonstration shows that more time is needed because of site-specific conditions or circumstances. A certification from a qualified professional engineer attesting that the demonstration is accurate is required. As required by 40 CFR § 257.90(e), the certified demonstration that more time was needed will be included in the 2019 Groundwater Monitoring and Corrective Action Report.

This ACM Report has been prepared to comply with 40 CFR § 257.90(c) of the CCR Rule and documents the results that are the basis for the evaluation of potential corrective measure remedial technologies. This report includes a summary of groundwater monitoring conducted to date, along with the results of site characterization activities. Finally, potential remedial technologies are identified in this report and evaluated against requirements, as specified in the CCR Rule.

2.0 SITE BACKGROUND

The Kyger Creek Station, located in Cheshire, Ohio, is a 1.1 gigawatt coal-fired generating station operated by Ohio Valley Electric Corporation (OVEC). The Kyger Creek Station has five (5), 217-megawatt (MW) generating units and has been in operation since 1955. Beginning in 1955, CCRs were sluiced to surface impoundments located in the plant site. During the course of plant operations, CCRs have been managed in various units at the station.

There are three (3) CCR units at the Kyger Creek Station (Figure 2-1):

- Class III Residual Waste Landfill (Landfill);
- Boiler Slag Pond (BSP); and,
- South Fly Ash Pond (SFAP).

Under the CCR program, OVEC installed a groundwater monitoring system at each unit in accordance with the requirements of the CCR Rule. From October 2015 through September 2017, nine (9) rounds of background groundwater monitoring were conducted at all of the CCR units. The first round of Detection Monitoring was performed in March 2018. Based on groundwater monitoring conducted to date, no Statistically Significant Increases (SSIs) have been identified for Appendix III constituents at the Landfill. Therefore, this unit has remained in Detection Monitoring under the CCR program.

During the March 2019 Detection Monitoring event at the SFAP, Appendix III SSIs for Calcium, Sulfate and Total Dissolved Solids (TDS) were identified. OVEC is preparing an Alternate Source Demonstration (ASD) report to show that the SFAP is not the source of the Appendix III constituents. Based on the results of the ASD, the SFAP is anticipated to remain in Detection Monitoring.

During the March 2018 Detection Monitoring event, SSIs were identified for the BSP and it entered into Assessment Monitoring in September 2018. Further action was therefore required for this unit under the CCR program. Details regarding these efforts are presented in the following sections of this report.

3.0 GEOLOGY AND HYDROGEOLOGY

3.1 Regional Setting

Gallia County is located on the western edge of the Appalachian Basin within the Appalachian Plateau Physiographic Province, Allegheny Section, locally known as the Marietta Plateau. Sedimentary bedrock formations in this area are as much as 7,400 feet thick and range in geologic age from Pennsylvanian to Cambrian. The primary stratigraphic units underlying Gallia County include, from youngest to oldest: recent (Holocene) colluvium and alluvium deposits, Pleistocene lacustrine and glacial sand and gravel deposits, and Pennsylvanian age bedrock composed predominantly of shale and sandstone, with occasional thin limestone and coal seams.

The Appalachian Plateau in Gallia County is bordered on its northern margin by the Glaciated Appalachian Plateau 40 to 50 miles to the northwest. The geomorphology of the Appalachian Plateau in Gallia County consists of steeply sloping ridges and steep, narrow stream valleys. Upland areas are primarily underlain by sandstone bedrock while valleys are underlain by shale bedrock and colluvial and alluvial sediments. Ground elevation ranges from as much as 1,000 feet along ridge tops to 500 feet near the Ohio River Valley. Generally, surface water drainage is to the south and southeast into the Ohio River.

3.2 Unit-Specific Setting

Based on available existing data, deposits of silts and clays beneath the base of the BSP range from 15 to over 50 feet thick. The silts and clays transition to a layer of sand and gravel where groundwater is present. A generalized cross section of the geology beneath the BSP is presented in Figure 3-1. Based on previously reported physical properties and yield, the sand and gravel unit was determined to be the uppermost aquifer beneath the BSP and is located more than five (5) feet beneath the bottom of the BSP as required by the CCR Rule. Based on water level data from the existing wells, groundwater was determined to flow primarily toward the south and southwest.

Regional groundwater flows to the south and southeast towards the Ohio River. Appendix A includes groundwater flow maps from February and September 2018. Local groundwater flow beneath the BSP generally flows from the northwest to the south and southeast towards the Ohio River (Figure A-2 in Appendix A). During periods when the water level in the Ohio River rises significantly and flooding occurs, groundwater flow in the uppermost aquifer will temporarily reverse with groundwater flowing toward the north and east beneath the BSP. This flow reversal is evident in groundwater levels measured in February 2018 (Figure A-1 in Appendix A).

4.0 SUMMARY OF GROUNDWATER MONITORING PROGRAM: BOILER SLAG POND

In accordance with 40 CFR § 257.90(e) of the CCR Rule, a Groundwater Monitoring and Corrective Action Report was prepared for the Kyger Creek Station. The report documented the status of the groundwater monitoring and corrective action program for each CCR unit, summarized the key actions completed during 2018, described any problems encountered, discussed actions to resolve the problems, and projected key activities for the upcoming year (Applied Geology and Environmental Science, Inc. [AGES] 2019). Applicable details of the report are presented below in Sections 4.1, 4.2, and 4.3.

4.1 Groundwater Monitoring Network

As detailed in the Monitoring Well Installation Report (AGES 2016a), the CCR groundwater monitoring network for the BSP consists of the following eight (8) monitoring wells:

- KC-15-01 (Upgradient);
- KC-15-02 (Upgradient);
- KC-15-03 (Variable);
- KC-15-04 (Downgradient);
- KC-15-05 (Downgradient);
- KC-15-06 (Downgradient);
- KC-15-07 (Downgradient); and
- KC-15-08 (Downgradient).

The locations of all the wells in the groundwater monitoring network are shown on Figure 4-1. As listed above and shown on Table 4-1, the CCR groundwater monitoring network includes three (3) upgradient and five (5) downgradient monitoring wells, which satisfies the requirements of the CCR Rule. Groundwater flow maps for the two (2) monitoring events completed in 2018 are included in Appendix A.

In March 2018, three (3) monitoring wells (KC-15-24, KC-15-25 and KC-15-26) were installed around the Clearwater Pond to provide supplemental data, if needed, to evaluate conditions south of the BSP (Figure 4-1).

4.2 Groundwater Sampling

In accordance with 40 CFR § 257.94 of the CCR Rule, the first round of Detection Monitoring was conducted in February and March 2018 and resampling was conducted in May 2018. Based on the results of the statistical evaluation of the Detection Monitoring data, the BSP entered into Assessment Monitoring on September 11, 2018. The first round of Assessment Monitoring samples was collected in September 2018 and resampling was conducted in December 2018.

All groundwater samples were collected in accordance with the Groundwater Monitoring Program Plan (GMPP) (AGES 2016b). The Detection Monitoring samples were analyzed for all Appendix III constituents, and the Assessment Monitoring samples were analyzed for all Appendix III and Appendix IV constituents. All samples were shipped to an analytical laboratory to be analyzed for all of the parameters listed in Appendix III and/or Appendix IV of the CCR Rule.

4.3 Analytical Results

The analytical results for groundwater samples collected in 2018 are summarized in Appendix B. Upon receipt, the February/March 2018 groundwater monitoring data were statistically evaluated in accordance with 40 CFR § 257.93(f) of the CCR Rule and the Statistical Analysis Plan (StAP) (Stantec Consulting Services, Inc. [Stantec] 2018). This initial statistical evaluation of the Detection Monitoring data identified potential SSIs for Boron, Calcium, pH, TDS, and Sulfate in five (5) wells (KC-15-04 through KC-15-08).

As discussed in the 2018 Groundwater Monitoring and Corrective Action Report (AGES 2019), a faulty pH meter was suspected of causing the SSIs for pH. In accordance with the StAP, in May 2018 the wells were resampled for all Appendix III constituents with potential SSIs. Based on the results of the resampling, the following Appendix III SSIs were confirmed:

- KC-15-04: Boron, TDS and Sulfate;
- KC-15-05: Boron, TDS and Sulfate; and
- KC-15-08: Boron, Calcium, TDS and Sulfate.

A partial ASD was completed in September 2018 for the Appendix III constituents identified at the BSP (AGES 2018). The ASD demonstrated that the source of the Calcium, TDS, and Sulfate was likely the active gas production wells located adjacent to the west/northwest of the BSP. However, an alternate source for Boron could not be established by the ASD. Therefore, the BSP entered into Assessment Monitoring under the CCR Rule in September 2018.

The first round of Assessment Monitoring groundwater samples was collected in September 2018, in accordance with § 257.95 of the CCR Rule and the GMPP (AGES 2016b) and analyzed for all Appendix III and Appendix IV constituents. Upon receipt of the September 2018 analytical results, the groundwater monitoring data were statistically evaluated in accordance with 40 CFR § 257.93(f) of the CCR Rule and the StAP (Stantec 2018). The initial statistical evaluation identified potential Appendix III SSIs of Boron, Calcium, TDS and Sulfate in KC-15-04, KC-15-05 and KC-15-08. In accordance with the StAP, the wells were resampled for those constituents in December 2018. Based on the results of the resampling, Appendix III SSIs were confirmed at the BSP for TDS in KC-15-04 and Calcium, TDS and Sulfate in KC-15-05 (Table 4-2).

As Appendix IV constituents were detected in downgradient wells during Assessment Monitoring, OVEC began the process of establishing GWPSs for any detected Appendix IV constituents.

4.4 Groundwater Protection Standards-BSP

In accordance with 40 CFR § 257.95(h)(1) through 40 CFR § 257.95(h)(3), OVEC established a GWPS for each Appendix IV constituent that was detected in groundwater (Table 4-3). Results for all Appendix IV constituents were less than the applicable GWPSs, except for Arsenic in well KC-15-07 in September 2018 (152 micrograms per liter [ug/L]) and December 2018 (15.3 ug/L), which exceeded the GWPS of 10 ug/L. Arsenic in the other four (4) downgradient wells, KC-15-04 (1.66 ug/L), KC-15-05 (0.88 ug/L), KC-15-06 (1.58 ug/L), and KC-15-08 (3.86 ug/L), did not exceed the GWPS in September 2018.

Based on the results in well KC-15-07, OVEC proceeded to characterize the nature and extent of the release, completed required notifications, and initiated an ACM in accordance with 40 CFR § 257.95(g). Results of these activities are presented in the following sections of this report.

5.0 CCR SITE CHARACTERIZATION ACTIVITIES

As specified in the CCR Rule in 40 CFR § 257.95(g)(1), further characterization of the nature and extent of the release to groundwater at the BSP was required. The objectives of the characterization were to:

- Install additional monitoring wells necessary to define the contaminant plume(s);
- Collect data on the nature of material released including specific information on the constituents listed in Appendix IV and the levels at which they are present in the material released;
- Install at least one (1) additional monitoring well at the facility boundary in the direction of contaminant migration and sample this well in accordance with § 257.95(d)(1); and
- Sample all wells in accordance with § 257.95(d)(1) to characterize the nature and extent of the release.

This section details the work conducted between March and June 2019 to collect additional data to aid in characterization of the release and assessment of corrective measures. To evaluate the extent of the Arsenic impacts, three (3) additional wells (KC-19-27, KC-19-28 and KC-19-29) were installed in the uppermost aquifer at the property boundary downgradient from the BSP (Figure 5-1). The wells were developed, hydraulically tested and sampled for analysis of Appendix III and Appendix IV constituents.

Details regarding this work are presented in the following sections of this report.

5.1 Grain Size Analysis and Monitoring Well Design

The CCR Rule requires that unfiltered groundwater samples be submitted for laboratory analysis of Appendix III and IV constituents. According to the preamble to the CCR Rule, the unfiltered sample requirement assumes that groundwater samples with a turbidity of less than 5 nephelometric turbidity units (NTUs) can be obtained from a properly designed monitoring well. The proper design of the sand pack and well screen in each unconsolidated CCR well is therefore critical to obtaining representative samples.

The three (3) new monitoring wells were designed and installed using the same methods and materials used during the installation of the other wells in the CCR groundwater monitoring network and in accordance with the GMPP (AGES 2016b). During installation, representative samples of the aquifer material were collected from each well boring. These soil samples were submitted to a geotechnical laboratory for grain-size analysis per American Society for Testing and Materials (ASTM) Methods D421 and D422. The results of the grain size analyses were used to confirm that the design of the well screens and filter packs was appropriate for the CCR monitoring program. In accordance with U.S. EPA monitoring well design guidelines (U.S. EPA 1991), the grain size of the filter pack was chosen by multiplying the 70% retention (or 30% passing) size of the formation, as determined by the grain size analysis, by a factor of three (3) (for fine uniform formations) to six (6) (for coarse, non-uniform formations). Table 5-1 summarizes the results of the grain-size analysis and the 70% retention size for each of the samples collected from each boring. The laboratory reports are included in Appendix C.

Two (2)-inch diameter 0.01" slotted Schedule 40 polyvinyl chloride (PVC) pre-packed screens designed specifically for sampling metals in groundwater were selected for use in the wells at the BSP to reduce turbidity. The pre-packed well screens were constructed using an inner filter pack consisting of 0.40 millimeter (mm) clean quartz filter sand between two layers of food-grade plastic mesh to reduce sample turbidity by filtering out smaller particles than is possible with standard filter packed wells and prepack screens. No metal components were used in the construction of the pre-packed well screens, thus eliminating potential interference with metals analysis.

5.2 Monitoring Well Installation, Development, Sampling and Testing

5.2.1 Monitoring Well Installation

From April 3 through April 5, 2019, a total of three (3) monitoring wells were installed at the BSP using hollow stem auger (HSA) drilling methods (Figure 5-1). During drilling, the drill bit was simultaneously pushed down and rotated. Continuous split-spoon samples were logged by the AGES geologist. The augers were used to advance each boring to the desired depth and were kept in place to keep the borehole open during well installation. The augers were removed as well installation progressed.

Once each borehole was advanced to the desired depth, a 10-foot pre-packed well screen was set into the borehole. An outer filter pack consisting of 0.40 mm clean quartz sand was installed directly around the pre-packed well screen. The sand was placed as the augers were pulled back in one (1)- to two (2)- foot increments to reduce caving effects and ensure proper placement of the filter pack. The filter pack extended one (1)-foot above the top of the screen.

A two (2)-foot thick annular bentonite seal was installed above the filter pack in each well. Once in place, the bentonite seal was allowed to hydrate before the remainder of the annular space around each monitoring well was backfilled using a grout consisting of Portland cement and bentonite. Each monitoring well was completed with an above-ground protective steel casing and a locking well cap. Following installation, each monitoring well was surveyed for elevation and location by OVEC personnel.

Well construction details for the three (3) new wells installed at the BSP are presented in Table 5-2. All well boring and construction logs are included in Appendix D.

5.2.2 Monitoring Well Development

Well development was initiated at least 48 hours after installation of each of the monitoring wells. Development consisted of alternating surging and pumping with a submersible pump. During development of the monitoring wells, field parameters including temperature, specific conductance, pH and turbidity were recorded at regular intervals. Development continued until each parameter stabilized and turbidity was less than 5 NTUs. Well development data for each well is summarized on Table 5-3.

5.2.3 Groundwater Sampling

On April 16, 2019, the three (3) new monitoring wells were sampled in accordance with the GMPP (AGES 2016b) for all Appendix III and Appendix IV constituents. The monitoring wells were purged using a submersible pump to remove stagnant water in the casing and to ensure that a representative groundwater sample was collected.

Samples were collected in laboratory-provided, pre-preserved (if necessary) bottleware. All bottles were labeled with the unique sample number, time and date of sample collection, and the identity of the sampling fraction. Field parameters were measured and recorded on purging forms at the time of sample collection.

Following sample collection, the samples were packed in ice in insulated coolers to maintain a temperature of less than four (4) degrees centigrade (^oC) and shipped to the TestAmerica analytical laboratory located in Canton, Ohio.

5.2.4 Aquifer Testing

In April 2019, both falling and rising head slug tests were conducted on two (2) of the new wells (KC-19-27 and KC-19-28) to obtain data required to calculate the saturated hydraulic conductivity (K) for the uppermost aquifer beneath the BSP. The falling head tests were performed by lowering a prefabricated solid slug with a known volume, into the water column of the well and recording the drop in head over time. The rising head tests were performed by removing the slug and recording the rise in head over time. The change in head over time was recorded using a data logger and pressure transducer. Dedicated rope was used for each well and the slug was decontaminated between wells using the procedures specified in the GMPP (AGES 2016b).

The slug test data were evaluated using AQTESOLV, a commercially available software package. Data from each monitoring well were analyzed using both the Bouwer-Rice and Hvorslev slug test solutions (with automatic curve matching) which are straight-line analytical techniques commonly used to analyze rising and falling head slug test data. The AQTESOLV data for each well are presented in Appendix E.

5.3 Results of Site Characterization

5.3.1 Site Geology Updates

Based on the results of the site characterization, an update to the information about the geology at the unit was not necessary. The soil boring logs prepared during monitoring well installation confirmed that the BSP is underlain by deposits of silt and clay ranging from 15 to over 50 feet thick (Appendix D). The uppermost aquifer beneath the BSP is a layer of sand and gravel beneath the deposits of silt and clay (Figure 3-1).

5.3.2 Groundwater Flow

A complete round of groundwater level data was collected in June 2019 (Table 5-4). The groundwater flow map generated using these data indicates that groundwater beneath the BSP flows to the southeast toward the Ohio River (Figure 5-2). A review of historic groundwater elevation data indicated that groundwater flow beneath the BSP is affected by the flow and water level in the Ohio River and evidence of several flow reversals has been observed in the historic data (AGES 2018). Data regarding groundwater flow at the unit is consistent with historic results.

5.3.3 Slug Testing

Slug test results from testing completed in May 2016 and April 2019 are summarized on Table 5-5. The updated mean K for the uppermost aquifer beneath the BSP is 6.28×10^{-4} feet per second (ft/sec). Published literature indicates that this is a reasonable K value for unconsolidated deposits of fine to medium sand and gravel (Fetter 1980).

5.3.4 Groundwater Flow Velocity

Using water level data collected in June 2019 (Table 5-4) and slug test data collected in May 2016 and April 2019 (Table 5-5), AGES calculated the average groundwater velocity beneath the BSP as 0.201 feet per day (ft/day) (Table 5-6). The distance between wells KC-15-02 and KC-19-28 is approximately 1,600 feet. Given the calculated flow rate and the distance between the wells, the travel time for groundwater to flow from KC-15-02 (northwest) to KC-19-28 (southeast) is approximately 22 years. This travel time is likely greater than 22 years due to documented flow reversals (Appendix A), which would significantly increase the travel time between the two (2) wells.

5.3.5 <u>Groundwater Sampling Results</u>

March and April 2019 analytical results for the previously installed CCR wells and for the three (3) new wells are shown on Table 5-7. As shown on Figure 5-3, Arsenic concentrations in existing wells (KC-15-01 through KC-15-08) around the BSP ranged from Non Detect in KC-15-05 to 160 ug/L in KC-15-07. Arsenic concentrations in the three (3) new wells ranged from 0.84 ug/L ug/L in KC-19-29 to 1.8 ug/L in KC-19-27. Based on these results, Arsenic concentrations exceeding the GWPS of 10 ug/L are confined to the site and are not reaching the Ohio River. However, to address Arsenic concentrations in the uppermost aquifer, an ACM is required.

6.0 ASSESSMENT OF CORRECTIVE MEASURES

Groundwater monitoring of the uppermost aquifer at the BSP has identified Arsenic (an Appendix IV constituent) at concentrations that exceed the GWPS defined under 40 CFR § 257.95(h); therefore, an ACM is necessary. The ACM will require identification and evaluation of technologies and methods that may be used as elements of remedial actions to meet the requirements of the CCR Rule. These elements include potential source control methods and various groundwater remedial technologies that may be applicable to the BSP. Additional remedial technologies may also be evaluated at a later date, if determined to be applicable and appropriate.

Presented below is a discussion of the objectives of the ACM, the potential source control measures, a list of remedial technologies, a summary of the assessment process, and the detailed ACM evaluation.

6.1 Objectives of Remedial Technology Evaluation

Per 40 CFR § 257.96(a), the objectives of the corrective measures evaluated in this ACM Report are “to prevent further releases, to remediate any releases, and to restore affected area to original conditions.” As required in 40 CFR § 257.97(b), corrective measures, at minimum, must:

(1) Be protective of human health and the environment;

(2) Attain the groundwater protection standard as specified pursuant to § 257.95(h);

(3) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part into the environment;

(4) 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;

(5) Comply with standards for management of wastes as specified in § 257.98(d).

6.2 Potential Source Control Measures

The objective of source control measures is to prevent further releases from the source (i.e., the BSP). According to 40 CFR § 257:

"Remedies must control the source of the contamination to reduce or eliminate further releases by identifying and locating the cause of the release. Source control measures may include the following: Modifying the operational procedures (e.g., banning waste disposal); undertaking more extensive and effective maintenance activities (e.g., excavate waste to repair a liner failure); or, in extreme cases, excavation of deposited wastes for treatment and/ or offsite disposal. Construction and operation requirements also should be evaluated."

The detailed evaluation of source control measures at the BSP is provided in Table 6-1. Three (3) technologies are included in this evaluation:

- Dewatering of Pond Water;
- Engineered Cover System; and
- Excavation of Boiler Slag.

Per state and federal regulatory requirements and timelines, OVEC tentatively plans to close the BSP. The method and timing of closure of the unit will depend on receipt of approval from the Ohio EPA. Source control through closure will likely initially include the cessation of ongoing placement of material into the BSP, a combination of passive and active decanting of ponded water within the unit, and interstitial dewatering of boiler slag pore-water within the unit.

Groundwater quality near the BSP is anticipated to significantly improve over time as a result of the above-referenced closure activities. Ceasing placement of material in the BSP will reduce the amount of Arsenic being loaded to the unit and thereby reduce the source of Arsenic available to impact groundwater. Decanting of any ponded water will decrease the hydraulic head in the BSP and thereby reduce infiltration of water from the unit to the underlying groundwater. Finally, dewatering of the boiler slag will reduce the contact-time for Arsenic with the boiler slag pore-water, which should reduce the mobility of the Arsenic. Groundwater monitoring over time is necessary to fully evaluate the positive impact that closure of the BSP will have on groundwater quality.

6.3 Potential Remedial Technologies

The focus of corrective measures for the BSP is to address Arsenic in groundwater that exceeded the GWPS. To accomplish this, the following three (3) types of technologies will be presented in Sections 6.3.1 through 6.3.3:

- In-Situ Groundwater Remedial Technologies;
- Ex-Situ Groundwater Remedial Technologies; and
- Treatment of Extracted Groundwater.

As described in Section 6.2, groundwater quality near the BSP is anticipated to significantly improve over time as a result of planned closure activities. Therefore, a flexible and adaptive approach to groundwater remediation that begins with post-closure groundwater monitoring at the unit is planned. During the post-closure monitoring period, the positive impacts of closure and the effects of natural attenuation on groundwater quality will be fully evaluated. The need for more active remedial measures (as discussed below) will be determined after sufficient post-closure groundwater quality data has been collected and evaluated. The final selection of a remedy will be made based on the results of the post-closure groundwater monitoring program.

6.3.1 <u>In-Situ Groundwater Remedial Technologies</u>

In-situ groundwater remediation approach involves treating the groundwater where it is presently situated, rather than removing and transferring it elsewhere for treatment and disposal. Long-term groundwater monitoring would be required to evaluate the effectiveness of any of these technologies. In-situ groundwater remediation technologies are discussed below.

6.3.1.1 Monitored Natural Attenuation (MNA)

Monitored natural attenuation (MNA) is a strategy and set of procedures used to demonstrate that physical, chemical and/or biological processes in an aquifer will reduce concentrations of constituents to levels below applicable standards. These processes attenuate the concentrations of inorganics in groundwater by physical and chemical means (e.g., dispersion, dilution, sorption, and/or precipitation). Dilution from recharge to shallow groundwater, mineral precipitation, and constituent adsorption will occur over time, which will further reduce constituent concentrations through attenuation. Regular monitoring of select groundwater monitoring wells is conducted to ensure constituent concentrations in groundwater are attenuating over time.

6.3.1.2 Groundwater Migration Barriers

Low permeability barriers can be installed below the ground surface to prevent groundwater flow from reaching locations that pose a threat to receptors. Barriers can be installed with continuous trenching techniques using bentonite or other slurries as a barrier material to prevent migration of groundwater. Barriers of cement/concrete and sheet piling can also be used.

Barriers are most effective at preventing flow to relatively small areas or to protect specific receptors. Protecting larger areas is possible if the constituent of concern is not highly soluble and cannot follow a diverted groundwater flow pattern. The barrier will change the groundwater flow conditions, and at some point the increased head (pressure) will cause a change in flow patterns.

This will generally be around the flanks or beneath the barrier. To ensure that groundwater will not flow beneath the barrier, it must be sealed at an underlying impermeable layer such as a clay layer.

Groundwater migration barriers are often used in conjunction with groundwater extraction systems. The barriers are used to restrict flow to allow extraction systems upgradient of the barrier to collect groundwater. However, the challenges discussed above for creating a competent seal with any underlying unit may still apply.

6.3.1.3 Permeable Reactive Barriers (PRBs)

Permeable reactive barriers (PRBs) can be an effective in-situ groundwater treatment technology. General design involves excavation of a narrow trench perpendicular to groundwater flow similar to migration barriers and then backfilling the trench with a reactive material that either removes or transforms the constituents as the groundwater passes through the PRB. Unlike simple barriers, the PRB can be designed to include impermeable sections to funnel the flow through a more narrow and permeable reactive zone. The ability to maintain adequate and reactive reagent concentrations at depth over an extended period of time is a significant operational and performance assurance challenge. As with other in-situ approaches, reconstruction or regeneration may be needed on a periodic basis.

6.3.1.4 In-Situ Chemical Stabilization

The placement of chemical reactants to immobilize dissolved phase constituents through precipitation or sorption can be an effective approach to reducing downgradient migration. Reagents such as ferrous sulfate, calcium polysulfide, zero-valent iron, organo-phosphorous mixtures, and sodium dithionate have been evaluated as potentially effective for CCR-related constituents.

Two (2) issues that must be considered with this technology are permanence of the reaction product insolubility and the ability to inject the reactants sufficiently to ensure adequate contact with the constituents. Most stabilization reactions can be reversible depending on environmental conditions such as pH and oxidation state. Given the long periods of time for which the reaction products must remain insoluble, it may be difficult to predict future conditions sufficiently to ensure permanence of this technology. Recurring treatment, based on routine testing, may be an option. Contact between reagents and the constituents must also be evaluated. This technology may need to be considered more as a source reduction technology than a capture or barrier technology, as the reactants may not be viable over an extended period of time.

6.3.2 Ex-Situ Groundwater Remedial Technologies

Ex-situ remedial technologies require groundwater extraction to remove constituent mass from the groundwater and can provide hydraulic control to reduce or prevent groundwater constituent migration. Groundwater can be removed from the aquifer through the use of conventional vertical extraction wells, horizontal wells, collection trenches and associated pumping systems. The type of well or trench system selected is based upon site-specific conditions. Long-term groundwater monitoring would be required to evaluate the effectiveness of any of these technologies. Ex-situ groundwater remediation technologies are discussed below.

6.3.2.1 Conventional Vertical Well System

Conventional vertical wells can usually be used in most cases unless accessibility is an issue. Well spacing and depths depend upon the aquifer characteristics. If flow production from the aquifer is extremely limited, conventional wells may not be feasible due to the extremely close spacing that would be required. Vertical wells may be used at any depth and can be screened in unconsolidated soils or completed as open-hole borings in bedrock.

6.3.2.2 Horizontal Well Systems

The use of horizontal recovery wells has increased due to development of more efficient horizontal drilling techniques. These systems can cover a significant horizontal cross-section and may be much more efficient than conventional vertical wells. They are not well suited to aquifers with wide variation in water levels, as the horizontal well may end up being dry.

6.3.2.3 Trenching Systems

Horizontal collection trenches function similarly to horizontal wells but are installed with excavation techniques. They can be more effective at shallow depths and with higher flow regimes. However, they may not be practical for deeper installations.

6.3.3 Treatment of Extracted Groundwater

Several technologies exist for treatment of extracted groundwater to remove or immobilize constituents ex-situ. The following technologies would be considered if treatment of extracted groundwater became necessary prior to a permitted discharge:

- Precipitation;
- Adsorption;
- Exchange;
- Filtration; and
- Biological & Oxidation.

Brief overviews of these technologies are presented below.

6.3.3.1 Precipitation

Treating impacted groundwater through the precipitation of metals is a well proven and often-used technology. In this process, soluble (dissolved) constituents are converted to insoluble particles that will precipitate such as hydroxides, carbonates, or sulfides. Insoluble particles are then removed by physical methods like clarification and/or filtration. The process typically involves pH adjustment, addition of a precipitant, and flocculation. The details of the process are driven by the solubility of the constituents and the effluent limit requirements. For many constituents, low effluent concentrations can be achieved; however, this technology has not been extensively used for all constituents related to CCR sites.

6.3.3.2 Adsorption

Groundwater containing dissolved constituents can be treated with adsorption media to reduce their concentration in the bulk fluid phase. The column must be regenerated or disposed of and replaced with new media, on a routine basis. Common adsorbent media include activated alumina, copper-zinc granules, granular ferric hydroxide, ferric oxide-coated sand, greensand, zeolite, and other proprietary materials. This technology may also generate a significant regeneration waste stream.

6.3.3.3 Exchange

Ion exchange is a well proven technology for removing metals from groundwater. With some constituents, ion exchange can achieve very low effluent concentrations. Ion exchange is a physical process in which ions held electrostatically on the surface of a solid are exchanged for target ions of similar charge in a solution. The medium used for ion exchange is typically a resin made from synthetic organic materials, inorganic materials, or natural polymeric materials that contain ionic functional groups to which exchangeable ions are attached. The resin must be regenerated routinely, which involves treatment of the resin with a concentrated solution, often containing sodium or hydrogen ions (acid). There must be a feasible method to dispose of the regeneration effluent for this technology. Pretreatment may be required, based on site specific conditions.

6.3.3.4 Filtration

There are a number of permeable membrane technologies that can be used to treat impacted groundwater for metals and other constituents. The most common is reverse osmosis, although microfiltration, ultrafiltration, and nanofiltration are also used. All of these technologies use pressure to force impacted water through a permeable membrane which rejects the target constituents. The differences in the technologies are based on the size of the molecules rejected and the corresponding pressures needed to allow the permeate to pass through. These technologies can capture a number of target compounds simultaneously and can achieve low effluent concentrations, but they are also very sensitive to fouling and often require a pretreatment step. Like ion exchange, they also result in a relatively high volume reject effluent which may require additional treatment prior to disposal.

6.3.3.5 Biological & Oxidation

Several biological treatment methods and other oxidation methods have been used to treat metals and other CCR constituents. For Arsenic removal, biological systems can require a relatively long residence time (several hours) (Reinsel 2015). Other systems to remove Arsenic use biological formation of Bioscorodite (FeAsO4•2 H2O); in this process bacteria oxidize Iron and available Arsenic to Ferric Iron and Arsenate. In general, biological systems are used to alter the oxidation state of the constituents so that it is less soluble and may be removed through adsorption or other means.

6.4 Evaluation to Meet Requirements in 40 CFR § 257.96(c)

For this evaluation, each of the potential remedial technologies identified above will be screened against evaluation criteria requirements in 40 CFR § 257.96(c) listed below:

The assessment under paragraph (a) of this section must include an analysis of the effectiveness of potential corrective measures in meeting all of the requirements and objectives of the remedy as described under § 257.97 addressing at least the following:

(1) The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;

(2) The time required to begin and complete the remedy;

(3) The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).

The ACM evaluation is provided in Table 6-2 and summarized below.

6.4.1 Performance

This criterion includes the ability of the technology to effectively achieve the specified goal of corrective measures to prevent further releases, to remediate any releases, and to restore the affected area to original conditions.

6.4.1.1 In-Situ Groundwater Remedial Technologies

MNA is a proven technology that can be implemented to reduce constituent concentrations over time through natural processes of geochemical and physical attenuation. Typical attenuation mechanisms that could affect Arsenic would include sorption, microbial activity and dispersion. Sorption to solid phases is a primary mechanism for removing Arsenic from groundwater. Hydroxides of Iron, Aluminum and Manganese, Sulfide Minerals, and organic matter are known to significantly adsorb Arsenic in groundwater (Wang and Mulligan 2006). The rate and amount of sorption is influenced by groundwater pH, redox potential, other ions, and the associated species of Arsenic (Ford, Wilkin and Puls 2007). Microbial activity may also catalyze the transformation of Arsenic species, or impact redox reactions; this would also influence the mobility of the Arsenic.

In the environment, Arsenic is more mobile at pH values greater than 8.5 Standard Units (SU), when it will desorb from mineral oxides (Smedley and Kinniburgh 2002). Highly reducing conditions at near neutral pH would also lead to mobilization of Arsenic as it desorbs from oxides. In groundwater with high concentrations of Arsenic III and Iron II and low Sulfate concentrations, the reductive dissolution of Iron and Manganese Oxides can also release Arsenic to the environment.

At the BSP, Oxidation Reduction Potential (ORP) values varied significantly in 2018 with ranges of -101 millivolts (mV) to 154 mV at KC-15-07, and -10.1 mV to 48 mV at KC-15-06 (AGES 2019). The pH values at the BSP were more consistent ranging from 6.02 to 6.71 SU at both wells over the course of 2018. The range of ORP values are likely related to flood events when the groundwater flow direction reverses and water from the Ohio River recharges groundwater at the site. In the environment, Arsenic is not extremely mobile in this range of pH and ORP values.

Dispersion, the mixing and spreading of constituents due to microscopic variations in velocity within and between interstitial voids in the aquifer, and dilution would reduce Arsenic concentrations but would not destroy the Arsenic. Given groundwater flow conditions, with periodic flood events and flow reversals, dispersion and dilution of Arsenic would likely be a major factor in natural attenuation.

At the BSP, the existing well network would be used to monitor constituent trends over time. Given that Arsenic concentrations are less than the GWPS at the property boundary, a long-term timeframe would likely be acceptable.

Although migration barriers, PRBs, and in-situ chemical stabilization are proven technologies, conditions at the BSP would limit the performance of each of these approaches. A groundwater extraction system may be coupled with these technologies to increase their long-term effectiveness. To be effective, a migration barrier would need to be tied into a lower competent unit at the BSP. Given that the uppermost aquifer extends to a depth of at least 50 feet below ground surface (bgs) and the unit is located along the banks of the Ohio River, these conditions are not practical for a migration barrier or PRB. Periodic flooding of the area by the Ohio River would also adversely impact the performance of these technologies.

Given site conditions, in-situ chemical stabilization reagents could be injected into the uppermost aquifer and distributed to where impacts occur. It would be critical to fully evaluate future groundwater conditions (i.e., pH, ORP, etc.) to maintain this approach. As with the barrier technologies above, periodic flooding of the area by the Ohio River would also impact the performance of in-situ chemical stabilization through dilution of the reagents.

6.4.1.2 Ex-Situ Groundwater Remedial Technologies

Groundwater extraction is a proven technology that has been successfully implemented for decades at many sites. Conventional vertical wells are the most often used approach; although the use of horizontal wells has been increasing. At the BSP, a series of vertical recovery wells can likely be installed and operated to address impacted groundwater. Horizontal wells operate in a similar manner to vertical wells but are less effective in areas with significant water level fluctuations, like the BSP. The performance of both types of wells would be significantly impacted by the Iron content of groundwater, which can lead to clogging. Significant levels of operation and maintenance would likely be necessary. Periodic flooding of the area by the Ohio River would also impact the performance of these ex-situ technologies.

Trenching systems are often used when groundwater impacts are encountered in a shallow unit. The depth to groundwater at the BSP is approximately 40 feet bgs, which would likely preclude the use of a trench at the unit.

6.4.1.3 Treatment of Extracted Groundwater

Groundwater treatment is required as a supplemental technology to be used in conjunction with groundwater extraction. The need for treatment depends on permit requirements for discharge of the treated water via a National Pollution Discharge Elimination System (NPDES) permit. The concentrations of Arsenic would need to be reduced to less than the required permit limits. Treatment for other constituents may also be required based on permit requirements.

Treatment of extracted groundwater can be performed as several proven methods for Arsenic treatment exist. Precipitation is a frequently used and proven technology to treat Arsenic in water at various concentrations (U.S. EPA 2002). As the effectiveness of adsorption and ion exchange can be impacted by the presence of other constituents, these technologies are often used when Arsenic is the only constituent requiring treatment. Filtration is used less frequently because it tends to have higher costs and produce a larger volume of residuals than other technologies that are available for treatment of Arsenic. Several biological treatment methods and other oxidation methods have been used to treat Arsenic. However, most would not likely be practical at the scope of this project.

Filtration, adsorption, and ion exchange systems may require modification if permit-required discharge limits are at or less than the Maximum Contaminant Level (MCL) of 10 ug/L. System changes may include addition of an adsorption media bed, more frequent regeneration or replacement of ion exchange media, or use of a membrane with a smaller molecular weight cutoff. These technologies could also be supplemental or used in tandem to achieve the required discharge limits.

6.4.2 Reliability

This criterion includes the degree of certainty that the technology will consistently work toward and achieve the specified goal of corrective measures over time.

6.4.2.1 In-Situ Groundwater Remedial Technologies

As the process of MNA is based on natural processes, this approach would be considered to be reliable. However, as groundwater geochemistry can vary over time, routine monitoring is required to evaluate conditions and ensure the ongoing effectiveness of the MNA process. Geochemical changes in groundwater could significantly impact the effectiveness of MNA, which could lead to the need to implement other remedial measures at the BSP.

Migration barriers and PRBs are typically reliable technologies; the primary issue being the potential for altered groundwater flow directions and further migration of constituents. In addition, maintaining adequate and reactive reagent concentrations at depth over an extended period of time in a PRB can also be a significant Operational and Maintenance (O&M) issue.

For in-situ chemical stabilization, reagents must be injected uniformly and consistently to adequately distribute them into the aquifer. Lack of a uniform and consistent approach could lead to reliability issues. Finally, changes in the geochemistry of the aquifer can lead to the need for adjustments in reagent type, concentrations and injection approach.

6.4.2.2 Ex-Situ Groundwater Remedial Technologies

Groundwater extraction solutions are generally considered reliable at controlling and removing constituents from the subsurface. At the BSP, conventional vertical wells would be the more reliable approach, as the large water level fluctuations at the unit would significantly impact the reliability of horizontal wells. There can be significant O&M issues associated with both conventional vertical or horizontal wells but these issues are well understood and can be readily addressed. Once in the place, trenching systems would also be reliable at the BSP although long term O&M would be required.

6.4.2.3 Treatment of Extracted Groundwater

Treatment of Arsenic in extracted groundwater would be reliable as long as the treatment processes are properly implemented.

6.4.3 Ease of Implementation

This criterion includes the ease with which the technologies can be implemented at the BSP.

6.4.3.1 In-Situ Groundwater Remedial Technologies

MNA is among the easiest of corrective measures to implement at a site. A sufficient number of monitoring wells already exist at the BSP, which could be used to monitor the effectiveness of MNA.

Due to the significant amount of time, effort, and disturbance required for implementation at the BSP, migration barrier and PRB implementation would be difficult. Difficulties in construction would be related to the depth of installation and the lack of an impermeable layer at depth. In-situ chemical stabilization may require less time and effort than a migration barrier or PRB.

6.4.3.2 Ex-Situ Technologies for Groundwater Extraction

Implementation of both conventional vertical and horizontal wells at the BSP would require drilling and limited field construction; however, the conventional vertical wells would be the more easily implemented. The orientation of the horizontal wells could present potential installation issues. Trenching systems would require significant construction and would be difficult to implement at the BSP, given site conditions.

6.4.3.3 Treatment of Extracted Groundwater

Treatment of Arsenic in extracted groundwater is implementable, as long as proper processes are used.

6.4.4 Potential Safety Impacts

This criterion includes potential safety impacts that may result from implementation and use of the technology at the BSP.

6.4.4.1 In-Situ Groundwater Remedial Technologies

Potential safety impacts associated with MNA are very minimal; especially as no additional well installation is required. Minimal safety concerns are therefore associated with the ongoing groundwater monitoring program.

Migration barriers and PRBs require a significant construction effort and use of construction equipment, which would entail a relatively high risk of potential safety impacts. However, neither technology would have any potential significant safety impacts following construction. Potential safety concerns related to in-situ chemical stabilization are moderate. The potential for incidents during injection well construction or unintended worker contact with the chemicals used for treatment would be the primary safety concerns with this technology.

6.4.4.2 Ex-Situ Groundwater Remedial Technologies

Groundwater extraction through use of wells (conventional vertical or horizontal) would involve drilling, construction, and installation of extraction wells, pumps, and associated control wiring and piping. Potential safety concerns exist with the activities associated with installation of these wells, as well as the ongoing O&M of the system, including inspection, maintenance, or replacement of the various system components.

Trenching systems would require use of significant construction equipment and present worker safety concerns, especially with the depth of the trench. Ongoing operation of the system would present minimal safety concerns.

6.4.4.3 Treatment of Extracted Groundwater

Treatment of extracted Arsenic in groundwater would have minimal safety concerns.

6.4.5 Potential Cross-Media Impacts

This criterion includes the ability to control cross-media impacts during implementation and use of the technology at the BSP.

6.4.5.1 In-Situ Groundwater Remedial Technologies

MNA poses no significant cross-media impact potential. Migration barriers and PRBs pose minimal risk of cross-media impacts, as they primarily involve an intended modification in groundwater flow. For a barrier technology, there could be some risk with the migration of impacted groundwater to other areas of the site; this concern is minimal. In the case of PRBs, constituents are removed from the groundwater through use of reagents; this includes minimal potential for cross-media impacts.

6.4.5.2 Ex-Situ Groundwater Remedial Technologies

Well and trench systems pose a moderate risk of cross-media impacts.

6.4.5.3 Treatment of Extracted Groundwater

Treatment of extracted groundwater for Arsenic would pose minimal risk of cross-media impacts.

6.4.6 Potential Impacts from Control of Exposure to Residual Constituents

This criterion includes the ability to control exposure of humans and the environment to residual constituents through implementation and use of the technology at the BSP.

6.4.6.1 In-Situ Groundwater Remedial Technologies

MNA poses no significant potential for human or environmental exposure to impacted groundwater. Overall, in-situ technologies involve placement or injection of a structure or reagent to treat impacted groundwater in-place. Consequently, there is no risk of exposure of humans and the environment to residual contamination.

6.4.6.2 Ex-Situ Groundwater Remedial Technologies

Groundwater extraction involves bringing impacted groundwater from the subsurface to the surface for potential treatment and discharge. This would slightly increase the potential for exposure of humans or the environment to impacted groundwater. The groundwater would be conveyed through an engineered system designed to prevent the release of water into the environment and to limit the potential for human or environmental exposure to the impacted groundwater. The potential for exposure to residual contamination associated with this technology is therefore unlikely.

6.4.6.3 Treatment of Extracted Groundwater

Treatment of extracted groundwater for Arsenic would pose minimal risk of exposure to residual contamination.

6.4.7 Time Required to Begin Remedy

This criterion includes the time necessary for planning, pilot testing, design, permitting, procurement, installation, and startup of this technology at the BSP. Timeframes presented below and in Table 6-2 are the times to begin the remedy after closure of the unit.

6.4.7.1 In-Situ Groundwater Remedial Technologies

A MNA program could be implemented at the BSP within three (3) months, as a sufficient monitoring well network already exists at the site and a monitoring program is already established. This potential remedy would require the least amount of time to implement of the technologies considered.

Migration barriers, in-situ chemical stabilization, and PRBs could take a significant amount of time to design and install. Either technology would also involve a significant amount of regulatory permitting. The design and implementation time could take 1 to 1.5 years.

6.4.7.2 Ex-Situ Groundwater Remedial Technologies

Design and installation of groundwater extraction systems could be completed in six (6) months to one (1) year. This could vary depending on potential groundwater modeling efforts and regulatory approval and permitting.

6.4.7.3 Treatment of Extracted Groundwater

Design and installation of the system, including bench-scale and pilot testing, could be completed in six (6) months to one (1) year. This would depend on the regulatory approval and permitting process.

6.4.8 Time Required to Complete Remedy

This criterion includes the estimated time necessary to achieve the stated goals of corrective measures to prevent further releases from the BSP, to remediate any releases, and to restore the affected area to original conditions.

6.4.8.1 In-Situ Groundwater Remedial Technologies

As MNA does not require additional physical or chemical remedial treatment, the timeframe is the longest period to reach remedial goals. A groundwater model would be useful to more accurately predict the anticipated time required to complete the remediation.

A significant amount of time is expected to be required to meet remedial goals with migration barriers and PRB. However, as groundwater modeling has not been performed for the site, an accurate estimate cannot be developed at this time. If in-situ chemical stabilization option can effectively treat Arsenic at the unit boundary, this approach has the potential to treat groundwater more quickly than a barrier or PRB.

6.4.8.2 Ex-Situ Groundwater Remedial Technologies

A significant amount of time is expected to be required to meet remedial goals with ex-situ technologies. However, as groundwater modeling has not been performed for the site, an accurate estimate cannot be developed at this time.

6.4.8.3 Treatment of Extracted Groundwater

The time required to meet remedial goals depends on the type of groundwater extraction system implemented. The time required for treatment of extracted groundwater is insignificant.

6.4.9 State, Local, or Other Environmental Permit Requirements That May Impact Implementation

This criterion includes anticipation of any state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the technology at the BSP.

6.4.9.1 In-Situ Groundwater Remedial Technologies

A MNA program would likely require coordination with the Ohio Environmental Protection Agency (Ohio EPA) but likely not formal approval. Therefore, it could be implemented in as little as (3) months, as a sufficient monitoring well network already exists at the site.

Migration barriers, in-situ chemical stabilization, and PRBs would require installation of barrier walls and associated components in the aquifer and/or chemical injections, which may require permitting through Ohio EPA. This would require an anticipated minimum of 1 to 1.5 years of review and approval.

6.4.9.2 Ex-Situ Groundwater Remedial Technologies

A groundwater extraction system would require the installation of new wells and a treatment system at the BSP, which may require permitting through Ohio EPA. This would require an anticipated minimum of 1 to 1.5 years of review and approval.

6.4.9.3 Treatment of Extracted Groundwater

The selection of a treatment system may require permitting through Ohio EPA, especially if a NPDES permit is required. This would require an anticipated minimum of 1 to 1.5 years of review and approval.

6.5 Conclusions

For this evaluation, several in-situ and ex-situ remedial technologies to address Arsenic in groundwater at the BSP were screened against evaluation criteria requirements in 40 CFR § 257.96(c). As presented in Table 6-2, during the screening, the technologies were ranked as High, Medium or Low using professional judgement and past experience. Based on these rankings, the two (2) technologies that appear to be most likely for selection as a remedy were:

- MNA; and
- Conventional Vertical Well System (Groundwater Extraction) (Ex-Situ).

Groundwater treatment would be required as a supplemental technology in conjunction with a Conventional Vertical Well System. The selection of a treatment technology would be based on conditions at the time of selection of a final remedy.

The technologies that appear to be less likely for selection as a remedy were:

- Groundwater Migration Barriers (In-Situ);
- PRB (In-Situ);
- In-Situ Chemical Stabilization (In-Situ);
- Horizontal Well Systems (Ex-Situ); and
- Trenching Systems (Ex-Situ).

As groundwater quality near the BSP is anticipated to significantly improve over time as a result of planned closure activities, a flexible and adaptive approach to groundwater remediation that begins with post-closure groundwater monitoring at the unit is planned. During the post-closure monitoring period, the positive impacts of closure and the effects of natural attenuation on groundwater quality will be fully evaluated. The need for more active remedial measures will be determined after sufficient post-closure groundwater quality data has been collected and evaluated.

The final selection of a remedy will be made based on the results of post-closure groundwater monitoring program.

Additional remedial technologies may also be evaluated at a later date if determined to be applicable and appropriate.

7.0 SELECTION OF REMEDY PROCESS

The remedy selection begins following completion of the ACM Report. Per 40 CFR § 257.97(a):

Based on the results of the corrective measures assessment conducted under § 257.96, the owner or operator must, as soon as feasible, select a remedy that, at a minimum, meets the standards listed in paragraph (b) of this section. This requirement applies to, not in place of, any applicable standards under the Occupational Safety and Health Act. The owner or operator must prepare a semiannual report describing the progress in selecting and designing the remedy. Upon selection of a remedy, the owner or operator must prepare a final report describing the selected remedy and how it meets the standards specified in paragraph (b) of this section. The owner or operator must obtain a certification from a qualified professional engineer that the remedy selected meets the requirements of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(12).

This ACM Report provides a high-level assessment of groundwater remedial technologies that could potentially address Arsenic concentrations in groundwater that exceed the GWPS at the BSP. With the submittal of this report, OVEC will begin the remedy selection process and ultimately select a remedy. The remedy selection process and selected remedy will satisfy standards listed in 40 CFR § 257.97(b) with consideration to evaluation factors listed in 40 CFR § 257.97(c). The progress toward selecting a remedy will be documented in semiannual reports.

7.1 Data Gaps

Based on a review of data to date, the following recommendations for additional data collection/evaluation have been identified:

- The development of a 3D groundwater model using Modflow or another commercially available product would be useful in supporting the evaluation of various potential remedial techniques at the BSP.

- As previously discussed, groundwater quality near the BSP is anticipated to significantly improve over time as a result of planned closure activities and natural attenuation. Ongoing sampling of monitoring wells prior to and after closure of the BSP should continue to evaluate whether Arsenic concentrations in groundwater are increasing, decreasing or are asymptotic. This data will be useful in developing time-series evaluations that will support potential groundwater modeling efforts and the final selection of a remedy for the BSP.

- Additional hydraulic testing near the BSP would provide more accurate data regarding the hydraulic conductivity and storage coefficient of the uppermost aquifer. This data will be useful in supporting the potential groundwater modeling effort.

- Given the dynamic nature of groundwater flow at the BSP, additional depth-to-groundwater data from wells in the area would be useful to support the potential groundwater modeling effort. This data can be most efficiently collected by installing downhole transducers in select wells near the BSP.

7.2 Selection of Remedy

As noted above, OVEC will begin the process of selecting a remedy following submittal of this ACM Report. Per 40 CFR § 257.97, the remedy will be selected and implemented as soon as feasible and progress toward selecting the remedy will be documented in semiannual reports. As part of the process, one or more preferred remedial approaches will be developed based upon technology effectiveness under site conditions, implementability and other considerations. As discussed above, a flexible and adaptive approach to groundwater remediation that begins with post-closure monitoring is planned.

7.3 Public Meeting Requirement in 40 CFR § 257.96(e)

Per 40 CFR § 257.96(e), OVEC will hold a public meeting to discuss ACM results, the remedy selection process, and selection of one or more preferred remedial approaches. The public meeting will be conducted at least 30 days prior to selection of a final remedy, in accordance with the above-referenced rule. Prior to the meeting, citizen and governmental stakeholders will be formally notified as to the schedule for the public meeting.

7.4 Final Remedy Selection

After selection of a remedy, a report documenting the remedy selection process will be prepared. The report will demonstrate how the remedy selection process was performed and how the selected remedial approach satisfies 40 CFR § 257.97 requirements.

8.0 REFERENCES

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TABLES

TABLE 4-1
GROUNDWATER MONITORING NETWORK
BOILER SLAG POND
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Designation	Date of Installation	Coordinates		Ground Elevation (ft)[2]	Top of Casing Elevation (ft)[2]	Top of Screen Elevation (ft)	Base of Screen Elevation (ft)	Total Depth From Top of Casing (ft)
			Northing	Easting					
KC-15-01	Upgradient	8/5/2015	332114.55	2072393.84	579.77	579.20	519.77	509.77	69.43
KC-15-02	Upgradient	8/7/2012	332500.654	2072569.222	580.79	580.25	520.79	510.79	69.46
KC-15-03	Variable	8/12/2015	332546.402	2073001.342	582.03	581.55	520.03	510.03	71.52
KC-15-04	Downgradient	8/12/2015	331782.439	2073755.607	579.89	579.37	519.89	509.89	69.48
KC-15-05	Downgradient	8/19/2015	331569.994	2073574.832	580.52	580.07	520.52	510.52	69.55
KC-15-06	Downgradient	8/18/2015	331218.52	2073210.42	579.98	579.48	519.98	509.98	69.50
KC-15-07	Downgradient	8/11/2015	331291.75	2072957.79	578.54	578.04	508.54	498.54	79.50
KC-15-08	Downgradient	8/10/2015	331460.59	2072675.87	579.41	578.75	509.41	499.41	79.34
KC-15-24 [3]	Downgradient	3/14/2018	330870.06	2073034.90	579.93	579.65	512.43	502.43	77.50
KC-15-25 [3]	Downgradient	3/14/2018	330693.87	2072791.81	579.80	579.70	511.70	501.70	78.00
KC-15-26 [3]	Downgradient	3/15/2018	331554.54	2072376.63	579.72	579.49	511.49	501.49	78.00

Notes:
1. The well locations are referenced to the Ohio State Plane South, North American Datum (NAD83), east zone coordinate system.
2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988
3. Supplemental groundwater monitoring well.

TABLE 4-2
SUMMARY OF POTENTIAL AND CONFIRMED APPENDIX III SSIs
BOILER SLAG POND
KYGER CREEK STATION
CHESHIRE, OHIO

Well Id	Parameter	1st Detection Monitoring Event February/March 2018	1st Detection Monitoring Resampling May 2018	1st Assessment Monitoring Event September 2018	1st Assessment Monitoring Resampling December 2018
		Potential SSI	Confirmed SSI (Yes/No)	Potential SSI	Confirmed SSI (Yes/No)
KC-15-04	Boron	**Yes**	**Yes**	**Yes**	**No**
	pH	**Yes**	No	No	--
	TDS	**Yes**	**Yes**	**Yes**	**Yes**
	Sulfate	**Yes**	**Yes**	**Yes**	**No**
KC-15-05	Boron	**Yes**	**Yes**	No	--
	Calcium	**Yes**	No	**Yes**	**Yes**
	pH	**Yes**	No	No	--
	TDS	**Yes**	**Yes**	**Yes**	**Yes**
	Sulfate	**Yes**	**Yes**	**Yes**	**Yes**
KC-15-06	pH	**Yes**	No	No	--
KC-15-07	Calcium	**Yes**	No	No	--
	pH	**Yes**	No	No	--
KC-15-08	Boron	**Yes**	**Yes**	No	--
	Calcium	**Yes**	**Yes**	**Yes**	**No**
	pH	**Yes**	No	No	--
	TDS	**Yes**	**Yes**	**Yes**	**No**
	Sulfate	**Yes**	**Yes**	**Yes**	**No**

Notes:
SSI: Statistically Significant Increase
-- : Not evaluated

TABLE 4-3
GROUNDWATER PROTECTION STANDARDS
BOILER SLAG POND
KYGER CREEK STATION
CHESHIRE, OHIO

Appendix IV Constituents			
Constituent	**Background**	**MCL/SMCL**	**GWPS**
Antimony, Sb	0.3273 (ug/L)	6 (ug/L)	6 (ug/L)
Arsenic, As	7.604 (ug/L)	10 (ug/L)	10 (ug/L)
Barium, Ba	133.7 (ug/L)	2000 (ug/L)	2000 (ug/L)
Beryllium, Be	0.094 (ug/L)	4 (ug/L)	4 (ug/L)
Cadmium, Cd	0.1482 (ug/L)	5 (ug/L)	5 (ug/L)
Chromium, Cr	1.959 (ug/L)	100 (ug/L)	100 (ug/L)
Cobalt, Co	9.745 (ug/L)	6 (ug/L)*	9.745 (ug/L)
Fluoride, F	1.29 (mg/L)	4 (mg/L)	4 (mg/L)
Lithium, Li	0.0125 (ug/L)	40 (ug/L)*	40 (ug/L)
Lead, Pb	0.5159 (ug/L)	15 (ug/L)*	15 (ug/L)
Mercury, Hg	0.25 (ug/L)	2 (ug/L)	2 (ug/L)
Molybdenum, Mo	6.122 (ug/L)	100 (ug/L)*	100 (ug/L)
Radium 226 & 228 (combined)	1.695(pCi/L)	5(pCi/L)	5(pCi/L)
Selenium, Se	0.4 (ug/L)	50 (ug/L)	50 (ug/L)
Thallium, Tl	0.03 (ug/L)	2 (ug/L)	2 (ug/L)

Notes:
GWPS: Groundwater Protection Standard
MCL: Maximum Contaminant Level
SMCL: Secondary Maximum Contaminant Level
ug/L: Micrograms per liter
pCi/L: Pico Curies per Liter
* Established by EPA as part of 2018 decision.

TABLE 5-1
GRAIN SIZE ANALYSIS RESULTS
BOILER SLAG POND
KYGER CREEK STATION
CHESHIRE, OHIO

Boring Number	Sample Depth (feet)	70% Retention (30% Passing) Size (mm)	Filter Pack Size (mm)	Screen Mesh (inches)	Unified Soil Classification Symbol & Description	
KC-19-27	28 - 38	0.079	0.40	0.01	SM	Silty Sand
KC-19-28	30 - 40	0.11	0.40	0.01	SM	Silty Sand
KC-19-29	32 - 42	0.091	0.40	0.01	SM	Silty Sand

Notes:
mm: Millimeters

TABLE 5-2
NEW MONITORING WELL CONSTRUCTION DETAILS
BOILER SLAG POND
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Designation	Date of Installation	Coordinates [1]		Ground Elevation[2] (feet)	Top of Casing Elevation[2] (feet)	Top of Screen bgs (feet)	Base of Screen bgs (feet)	Total Depth bgs (feet)
			Northing	Easting					
KC-19-27	Downgradient	4/5/2019	331507.38	2073611.953	558.22	561.13	28.00	38.00	38.00
KC-19-28	Downgradient	4/4/2019	331064.431	2073270.027	558.41	561.10	32.00	42.00	42.00
KC-19-29	Downgradient	4/3/2019	330558.936	2072840.947	561.13	564.17	31.00	41.00	41.00

Notes:
1. Well locations are referenced to the North American Datum (NAD83), east zone coordinate system.
2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988

bgs: Below Ground Surface

TABLE 5-3
SUMMARY OF WELL DEVELOPMENT DATA
BOILER SLAG POND
KYGER CREEK PLANT
CHESHIRE, OHIO

Well ID	Dates	Method	Volume (gallons)	Final Turbidity (NTU)
KC-19-27	4/8/2019	Pump	213	4.89
KC-19-28	4/9/2019	Pump	232	4.7
KC-19-29	4/10/2019	Pump	106	4.51

Notes:
NTU: Nephelometric Turbidity Unit

TABLE 5-4
SUMMARY OF GROUNDWATER ELEVATION DATA
JUNE 2019
BOILER SLAG POND
KYGER CREEK PLANT
CHESHIRE, OHIO

Well ID	Top of Casing Elevation (feet)	Depth to Groundwater (feet)	Groundwater Elevation (feet)
KC-15-01	579.20	39.49	539.71
KC-15-02	580.25	40.20	540.05
KC-15-03	581.55	41.70	539.85
KC-15-04	579.37	41.06	538.31
KC-15-05	580.07	41.84	538.23
KC-15-06	579.48	41.34	538.14
KC-15-07	578.04	39.66	538.38
KC-15-08	578.75	39.74	539.01
KC-15-24 [1]	579.65	41.59	538.06
KC-15-25 [1]	579.70	41.55	538.15
KC-15-26 [1]	579.49	40.29	539.20
KC-19-27	561.13	22.94	538.19
KC-19-28	561.10	23.19	537.91
KC-19-29	564.17	26.19	537.98

Notes:

[1] Supplemental groundwater monitoring well.

TABLE 5-5
SUMMARY OF SLUG TEST RESULTS
BOILER SLAG POND
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID	Test	Analytical Method	K (ft/sec)	Mean K
Slug Tests Conducted May 2016				
KC-15-02	Rising Head #1	Bouwer-Rice	4.79E-04	6.77E-04
		Hvorslev	5.28E-04	
	Falling Head #1	Bouwer-Rice	1.17E-03	
		Hvorslev	7.31E-04	
	Rising Head #2	Bouwer-Rice	6.56E-04	
		Hvorslev	7.05E-04	
	Falling Head #2	Bouwer-Rice	5.64E-04	
		Hvorslev	5.81E-04	
KC-15-05	Rising Head #1	Bouwer-Rice	1.91E-04	1.14E-04
		Hvorslev	2.13E-04	
	Falling Head #1	Bouwer-Rice	5.22E-05	
		Hvorslev	5.87E-05	
	Rising Head #2	Bouwer-Rice	1.55E-04	
		Hvorslev	1.61E-04	
	Falling Head #2	Bouwer-Rice	3.77E-05	
		Hvorslev	4.17E-05	
Slug Tests Conducted April 2019				
KC-19-27	Falling Head #1	Bouwer-Rice	8.31E-05	7.45E-05
		Hvorslev	9.95E-05	
	Rising Head #1	Bouwer-Rice	5.14E-05	
		Hvorslev	6.14E-05	
	Falling Head #2	Bouwer-Rice	7.76E-05	
		Hvorslev	9.29E-05	
	Rising Head #2	Bouwer-Rice	5.92E-05	
		Hvorslev	7.08E-05	
KC-19-28	Falling Head #1	Bouwer-Rice	3.22E-03	1.65E-03
		Hvorslev	4.12E-03	
	Rising Head #1	Bouwer-Rice	7.38E-04	
		Hvorslev	8.75E-04	
	Falling Head #2	Bouwer-Rice	1.17E-03	
		Hvorslev	1.39E-03	
	Rising Head #2	Bouwer-Rice	7.57E-04	
		Hvorslev	8.96E-04	
			Mean K (ft/sec)	**6.28E-04**

Notes:
ft/sec: Feet per second
K: Hydraulic Conductivity

TABLE 5-6
SUMMARY OF GROUNDWATER VELOCITY CALCULATIONS
JUNE 2019
BOILER SLAG POND
KYGER CREEK STATION
CHESHIRE, OHIO

Well Pair		h_1 (feet)	h_2 (feet)	d (feet)	K (feet/day)	n	i	V (feet/day)
KC-15-02 (h_1)	KC-15-06 (h_2)	540.05	538.14	1400	54.26	0.25	0.001364	0.296
KC-15-05 (h_1)	KC-19-27 (h_2)	538.23	538.19	90	54.26	0.25	0.00044	0.095
KC-15-06 (h_1)	KC-19-28 (h_2)	538.14	537.91	180	54.26	0.25	0.00128	0.278
KC-15-07 (h_1)	KC-19-29 (h_2)	538.38	537.98	740	54.26	0.25	0.00054	0.117
KC-15-25 (h_1)	KC-19-29 (h_2)	538.15	537.98	170	54.26	0.25	0.0010	0.217
							Average V =	**0.201**

Notes:

h_1 = Head elevation in well #1
h_2 = Head elevation in well #2
d = distance between wells
K = Hydraulic conductivity
n = effective porosity
i = Horizontal Hydraulic Gradient
V = Groundwater Velocity

Horizontal Hydraulic Gradient:

$$i = \frac{h_1 - h_2}{d}$$

Groundwater Velocity:

$$V = K\left(\frac{i}{n}\right)$$

TABLE 5-7
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS
MARCH AND APRIL 2019
BOILER SLAG POND
KYGER CREEK STATION
CHESHIRE, OHIO

Well ID / Parameter	Units	GWPS	KC-15-01 Mar-19	KC-15-02 Mar-19	KC-15-03 Mar-19	KC-15-04 Mar-19	KC-15-05 Mar-19	KC-15-06 Mar-19	KC-15-07 Mar-19	KC-15-08 Mar-19	KC-19-27 Apr-19	KC-19-28 Apr-19	KC-19-29 Apr-19
Appendix III Constituents													
Boron, B	mg/L	--	0.33	0.041 J	0.18	0.79	0.86	0.31	0.12	0.51	0.22	0.12	<0.1
Calcium, Ca	mg/L	--	85	110	120	100	120	92	88	210	200	64	110
Chloride, Cl	mg/L	--	32	33	29	30	32	34	33	45	26	19	5.8
Fluoride, F	mg/L	--	0.049 J	0.12	0.089	0.071	0.12	0.095	0.064	0.092	0.089	0.081	0.072
pH	s.u.	--	6.06	6.64	6.31	5.56	6.11	6.77	6.6	6.8	5.78	5.64	5.66
Sulfate, SO4	mg/L	--	270	120	190	330	390	180	87	550	750	88	110
Total Dissolved Solids (TDS)	mg/L	--	510	480	490	620	760	490	410	1000	1200	350	560
Appendix IV Constituents													
Antimony, Sb	ug/L	6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Arsenic, As	ug/L	10	0.85 J	2.7 J	1.3 J	2.4 J	<5.0	2.6 J	160	11	1.8	0.94	0.84
Barium, Ba	ug/L	2000	26	100	69	76	37	110	560	54	33	100	140
Beryllium, Be	ug/L	4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0	1.1
Cadmium, Cd	ug/L	5	<1.0	<1.0	<1.0	<1.0	<1.0	0.29 J	<1.0	<1.0	0.75	0.35	0.74
Chromium, Cr	ug/L	100	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Cobalt, Co	ug/L	9.745	5.7	1.4	4.6	11	5.5	4.3	0.27 J	5	68	10	28
Fluoride, F	mg/L	4	0.049 J	0.12	0.089	0.071	0.12	0.095	0.064	0.092	0.089	0.081	0.072
Lithium, Li	mg/L	0.04	0.0036 J	0.0034 J	0.0045 J	0.011	0.0027 J	0.003 J	0.0024 J	0.0046 J	0.003	0.0022	0.0039
Lead, Pb	ug/L	15	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.49
Mercury, Hg	ug/L	2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum, Mo	ug/L	100	<5.0	1.7 J	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Radium 226 & 228 (combined)	pCi/L	5	0.255 U	0.604	0.501	0.486	0.587	0.417	1.29	0.539	0.257	-0.142	0.582
Selenium, Se	ug/L	50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Thallium, Tl	ug/L	2	<1.0	0.26 J	<1.0	<1.0	0.23 J	0.25 J	<1.0	<1.0	0.28	<1.0	0.22

Notes:
GWPS: Groundwater Protection Standard
mg/L: Milligrams per liter
s.u.: Standard Units
ug/L: Micrograms per liter
pCi/L: Picocuries per liter

TABLE 6-1
SOURCE CONTROL TECHNOLOGIES SCREENING MATRIX - 40 CFR § 257.96(c) REQUIREMENTS
BOILER SLAG POND
KYGER CREEK STATION
CHESHIRE, OHIO

	Source Control Technologies		
	Dewatering of Pond Water	**Engineered Cover System**	**Excavation of Boiler Slag**
257.96(c)(1)			
Performance	Low	Medium	High
Reliability	Low	Medium	High
Ease of Implementation	Low Water Removal, Treatment & Discharge Required	Medium Field Construction Required	High Field Construction Required
Potential Safety Impacts	Low Field Construction Required	Medium Field Construction Required	High Field Construction Required
Potential Cross-Media Impacts	Medium	Low	Medium
Potential Impacts from Control of Exposure to Residual Constituents	Low	Low	Low
257.96(c)(2)			
Time To Begin Remedy	6 months to 1 year	1 to 1.5 years	1 to 1.5 years
Time To Complete Remedy	6 months to 1 year	1 to 2.5 years	2 to 3 years
257.96(c)(3)			
State, Local or other Environmental Permit Requirements that May Impact Implementation	Requires Approval from Ohio EPA	Requires Approval from Ohio EPA	Requires Approval from Ohio EPA
Additional Information	Required for In-Place Closure or Closure by Removal	Ash Remains in Place as Long-Term Source for Groundwater	Groundwater Issues Need to be Addressed

Notes:
Relative assessments (low, medium, high) are based on experience and professional judgement

TABLE 6-2
IN-SITU AND EX-SITU GROUNDWATER REMEDIAL TECHNOLOGIES SCREENING MATRIX - 40 CFR § 257.96(c) REQUIREMENTS
BOILER SLAG POND
KYGER CREEK STATION
CHESHIRE, OHIO

	In-Situ Groundwater Remedial Technologies				*Ex-Situ Groundwater Remedial Technologies*		
	Monitored Natural Attenuation	**Groundwater Migration Barriers**	**In-situ Chemical Stabilization**	**Permeable Reactive Barrier**	**Conventional Well System**	**Horizontal Well System**	**Trenching System**
257.96(c)(1)							
Performance	High	Low	Low	Low	High	Low Significant Water Level Fluctuations Reduce Effectiveness of Horizontal Wells	High
Reliability	High	Low	Medium	Medium	High Long Term O&M Required	Low Significant Issues with Water Level Fluctuations	High Long Term O&M Required
Ease of Implementation	High	Low	Low	Low	High Drilling and Limited Field Construction Required	Medium Drilling and Limited Field Construction Required	Low Trench Construction Required
Potential Safety Impacts	Low	Medium Field Construction Required	Medium Field Construction Required	Medium Field Construction Required	Medium Drilling Required	Medium Drilling Required	Medium Trench Construction Required
Potential Cross-Media Impacts	Low	Medium	Low	Low	Medium	Medium	Medium
Potential Impacts from Control of Exposure to Residual Constituents	Low	Low	Low	Low	Low	Low	Low
257.96(c)(2)							
Time To Begin Remedy*	3 months	1 to 1.5 years	1 to 1.5 years	1 to 1.5 years	6 months to 1 year	6 months to 1 year	6 months to 1 year
Time To Complete Remedy	Highly Variable Further Evaluation Required	Highly Variable Further Evaluation Required	Highly Variable Further Evaluation Required	Highly Variable Further Evaluation Required	Highly Variable Further Evaluation Required	Highly Variable Further Evaluation Required	Highly Variable Further Evaluation Required
257.96(c)(3)							
State, Local or other Environmental Permit Requirements that May Impact Implementation	Requires Coordination with Ohio EPA	Requires Approval from Ohio EPA	Requires Approval from Ohio EPA	Requires Approval from Ohio EPA	Requires Approval from Ohio EPA	Requires Approval from Ohio EPA	Requires Approval from Ohio EPA
Additional Information	Groundwater F&T Modeling Required to Evaluate the Timing for This Approach for Arsenic	Lack of Competent Lower Unit Likely Precludes This Approach	Pilot Testing Required for This Approach	Lack of Competent Lower Unit Likely Precludes This Approach	Groundwater Flow Modeling Required to Fully Evaluate This Approach	Groundwater Flow Modeling Required to Fully Evaluate This Approach	Groundwater Flow Modeling Required to Fully Evaluate This Approach

Notes:
Relative assessments (low, medium, high) are based on experience and professional judgement
*The time to begin the remedy is based on the time after closure of the unit.

FIGURES

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019109-1-KYG
DWG FILE	2019 ACM_KYGER_Fig 2-1_Aerial Site.dwg
DRAWING SCALE	NOT TO SCALE

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412.264.6453

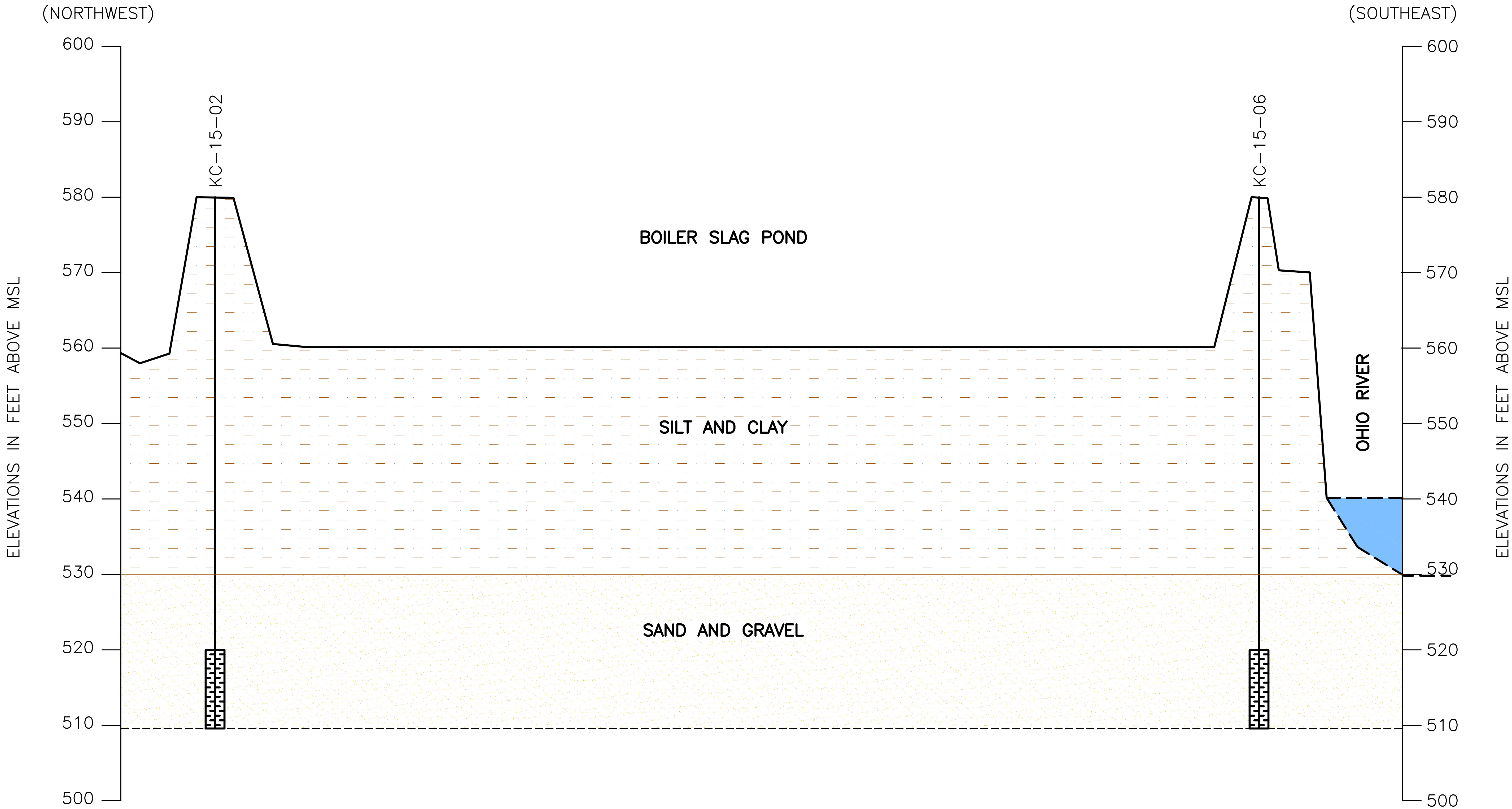
OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
SITE LOCATION MAP

DRAWING NAME: FIGURE 2-1

REV. 0

Plot: 08/13/2019 11:03 _PROGRAMS-KYGER OVEC\Kyger Creek-CCR Program\CAD\2019 Assessment of Corrective Measures\2019 ACM_KYGER_Fig 2-1_Aerial Site.dwg



NOTE:
THE APPROXIMATE LOCATION OF THE CROSS-SECTION IS ILLUSTRATED ON FIGURE 4-1.

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019109-1-KYGER
DWG FILE	2019 ACM_KYGER_Fig 3-1_BSP_Cross Sec.dwg
DRAWING SCALE	NOT TO SCALE

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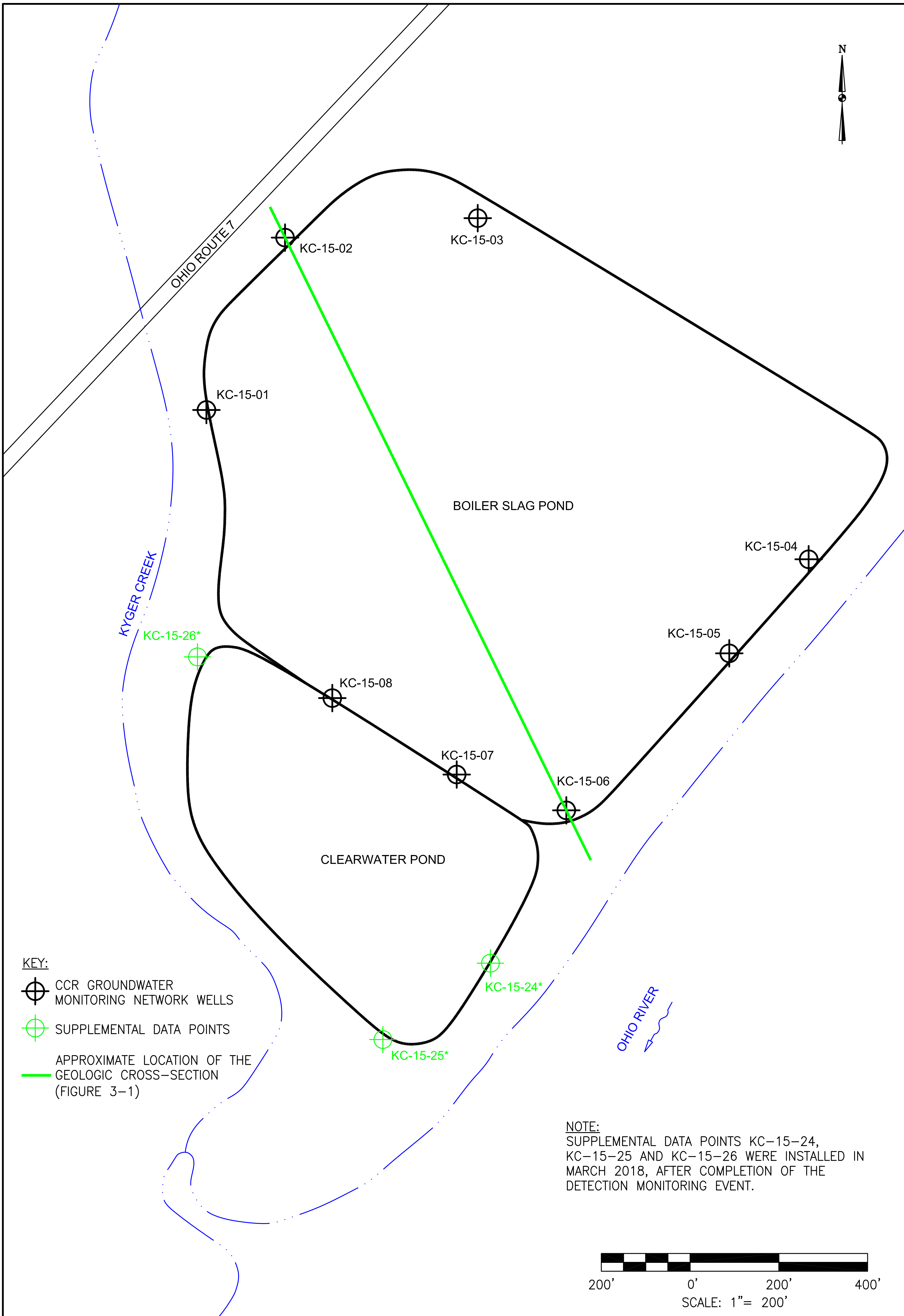
OHIO VALLEY ELECTRIC COMPANY
KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
BOILER SLAG POND
GENERALIZED GEOLOGIC CROSS-SECTION
(NORTHWEST - SOUTHEAST)

DRAWING NAME: FIGURE 3-1

REV. 0



NOTE:
SUPPLEMENTAL DATA POINTS KC–15–24, KC–15–25 AND KC–15–26 WERE INSTALLED IN MARCH 2018, AFTER COMPLETION OF THE DETECTION MONITORING EVENT.

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019109–1–KYGER
DWG FILE	2019 ACM_KYGER_Fig 4–1_BSP_MW LOCs.dwg
DRAWING SCALE	1"=200'

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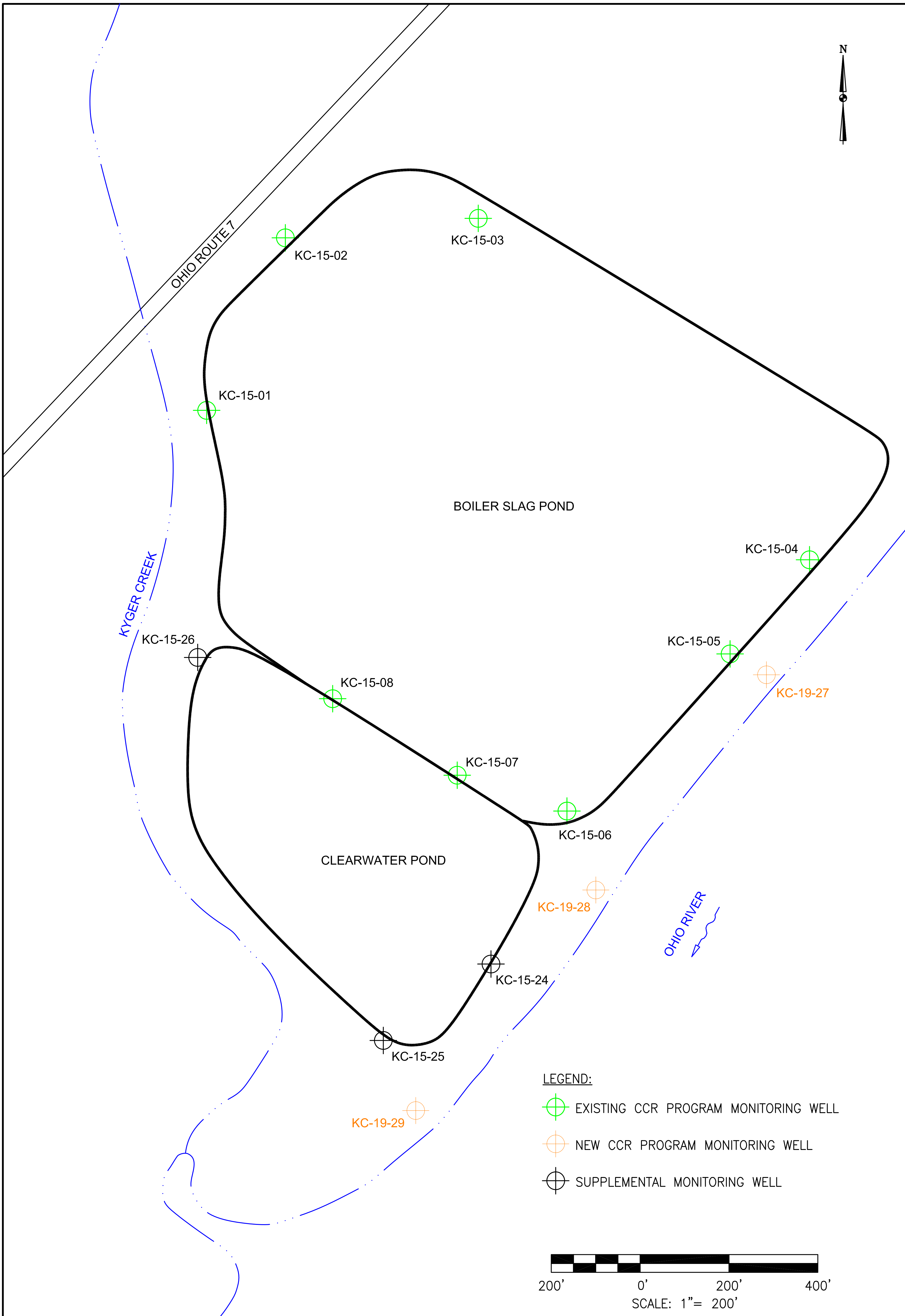
OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
BOILER SLAG POND
EXISTING MONITORING WELL LOCATION MAP

DRAWING NAME: FIGURE 4–1
REV. 0

Plot: 09/10/2019 10:50 _PROGRAM–KYGER OVEC\Kyger Creek–CCR Program\CAD\2019 Assessment of Corrective Measures\2019 ACM_KYGER_Fig 4–1_BSP_MW LOCs.dwg



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CHECKED BY	
JOB NO.	2019109-1-KYGER
DWG FILE	2019 ACM_KYGER_Fig 5-1_BSP_MWs&SBs.dwg
DRAWING SCALE	1"=200'

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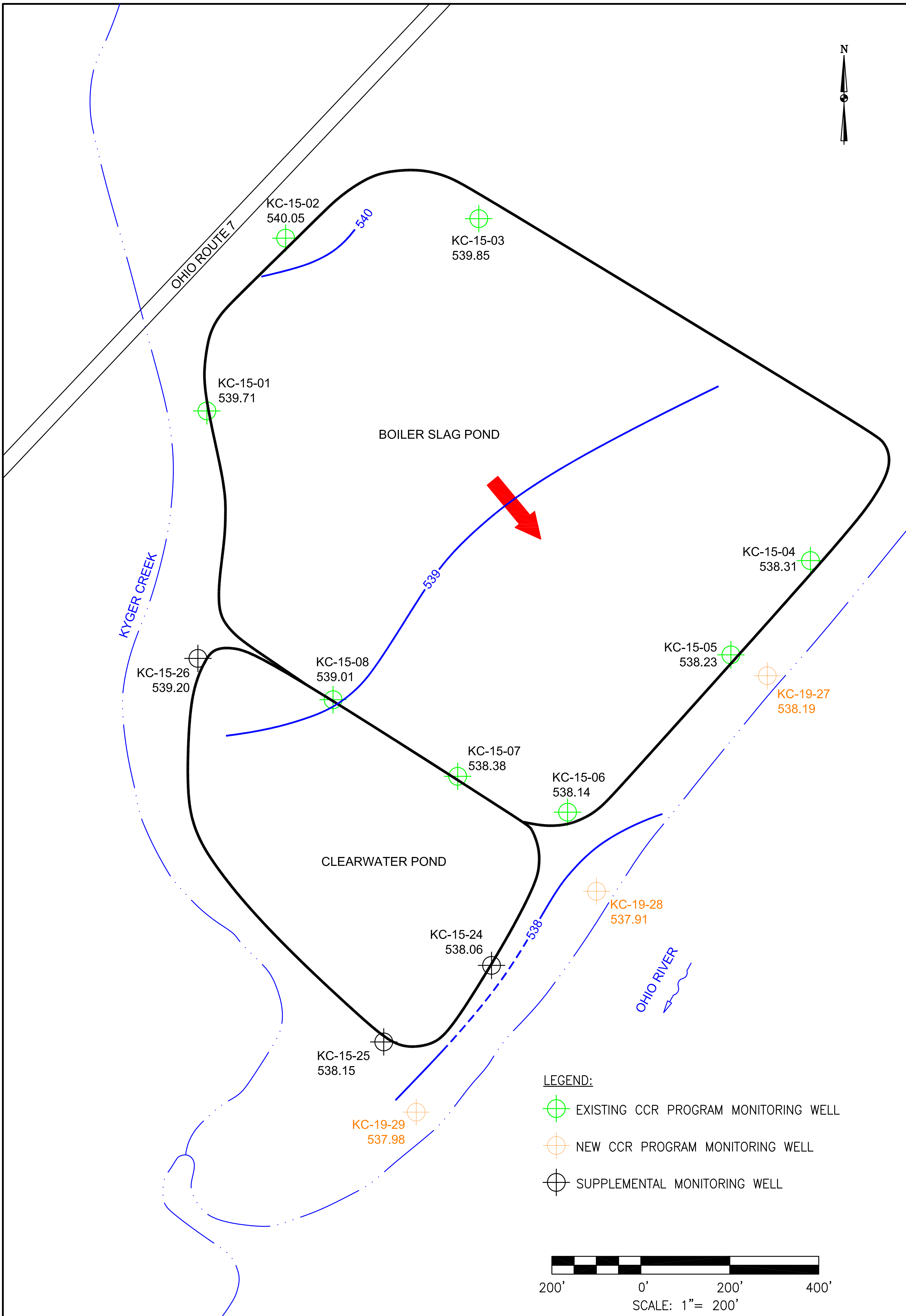
OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
BOILER SLAG POND
EXISTING AND NEW MONITORING WELL LOCATIONS

DRAWING NAME: FIGURE 5-1
REV. 0

Plot: 09/10/2019 10:54 _PROGRAM-KYGER OVEC\Kyger Creek-CCR Program\CAD\2019 Assessment of Corrective Measures\2019 ACM_KYGER_Fig 5-1_BSP_MWs&SBs.dwg



DRAWN BY JM

DATE

CHECKED BY

JOB NO. 2019109-1-KYGER

DWG FILE 2019 ACM_KYGER_Fig 5-2_BSP_GW Contours_JUN19.dwg

DRAWING SCALE 1"=200'

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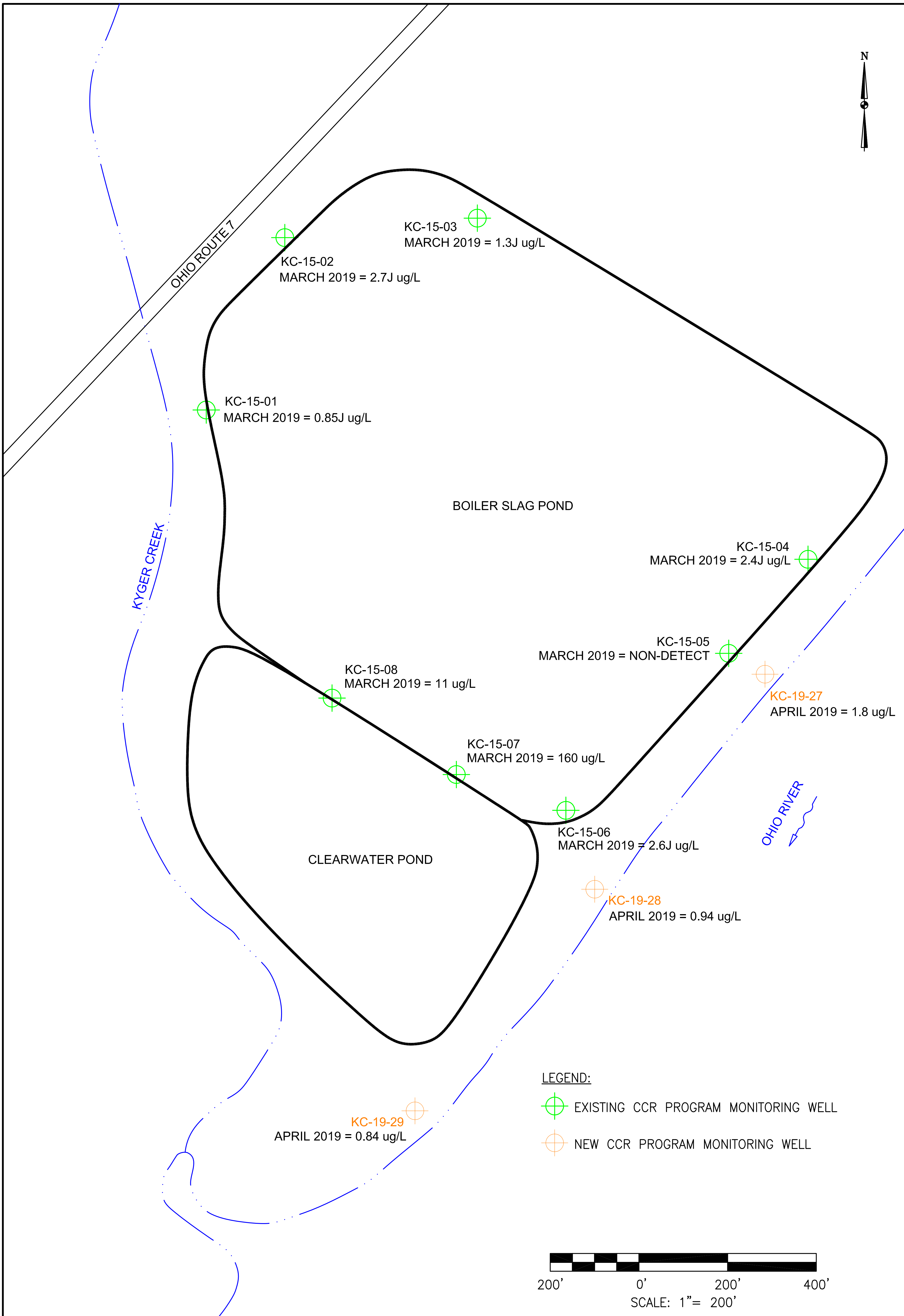
OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
BOILER SLAG POND
GROUNDWATER ELEVATIONS AND FLOW MAP
JUNE 2019

DRAWING NAME FIGURE 5-2

REV. 0

Plot: 08/14/2019 11:45 \Kyger Creek-CCR Program\CAD\2019 Assessment of Corrective Measures\2019 ACM_KYGER_Fig 5-2_BSP_GW Contours_JUN19.dwg



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DATE	
CHECKED BY	
JOB NO.	2019109-1-KYGER
DWG FILE	2019 ACM_KYGER_Fig 5-3_BSP_Arsenic.dwg
DRAWING SCALE	1"=200'

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OHIO VALLEY ELECTRIC COMPANY

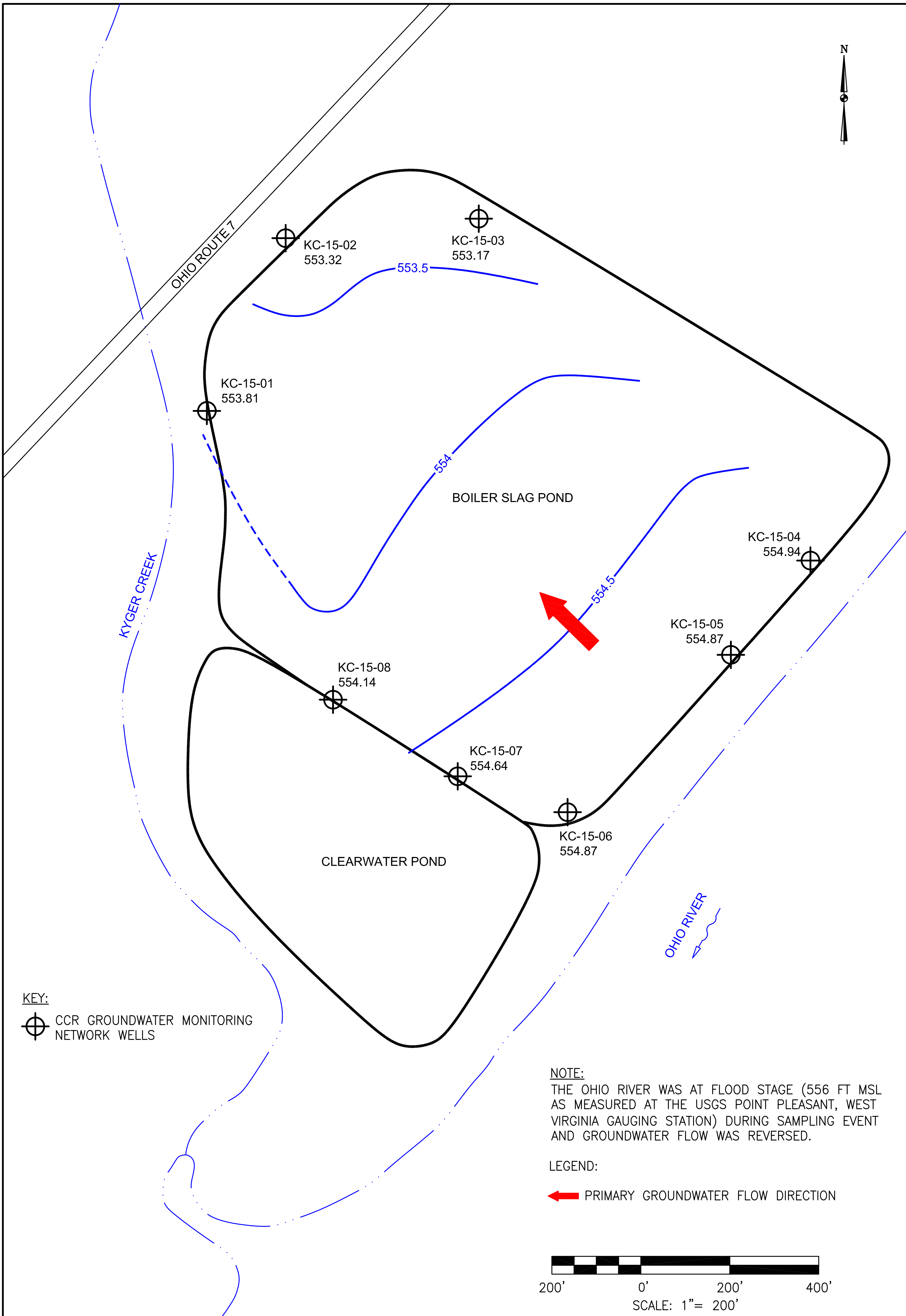
KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
BOILER SLAG POND
ARSENIC IN GROUNDWATER RESULTS
MARCH 2019 AND APRIL 2019

DRAWING NAME: FIGURE 5-3
REV. 0

Plot: 09/10/2019 11:02 _PROGRAMS-KYGER OVEC\Kyger Creek-CCR Program\CAD\2019 Assessment of Corrective Measures\2019 ACM_KYGER_Fig 5-3_BSP_Arsenic.dwg

APPENDIX A

GROUNDWATER FLOW MAPS FOR 2018



DRAWN BY	JM
DATE	
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JOB NO.	2019109-1-KYGER
DWG FILE	2019 ACM_KYGER_Fig A-1_BSP_Contours_FEB-18.dwg
DRAWING SCALE	1"=200'

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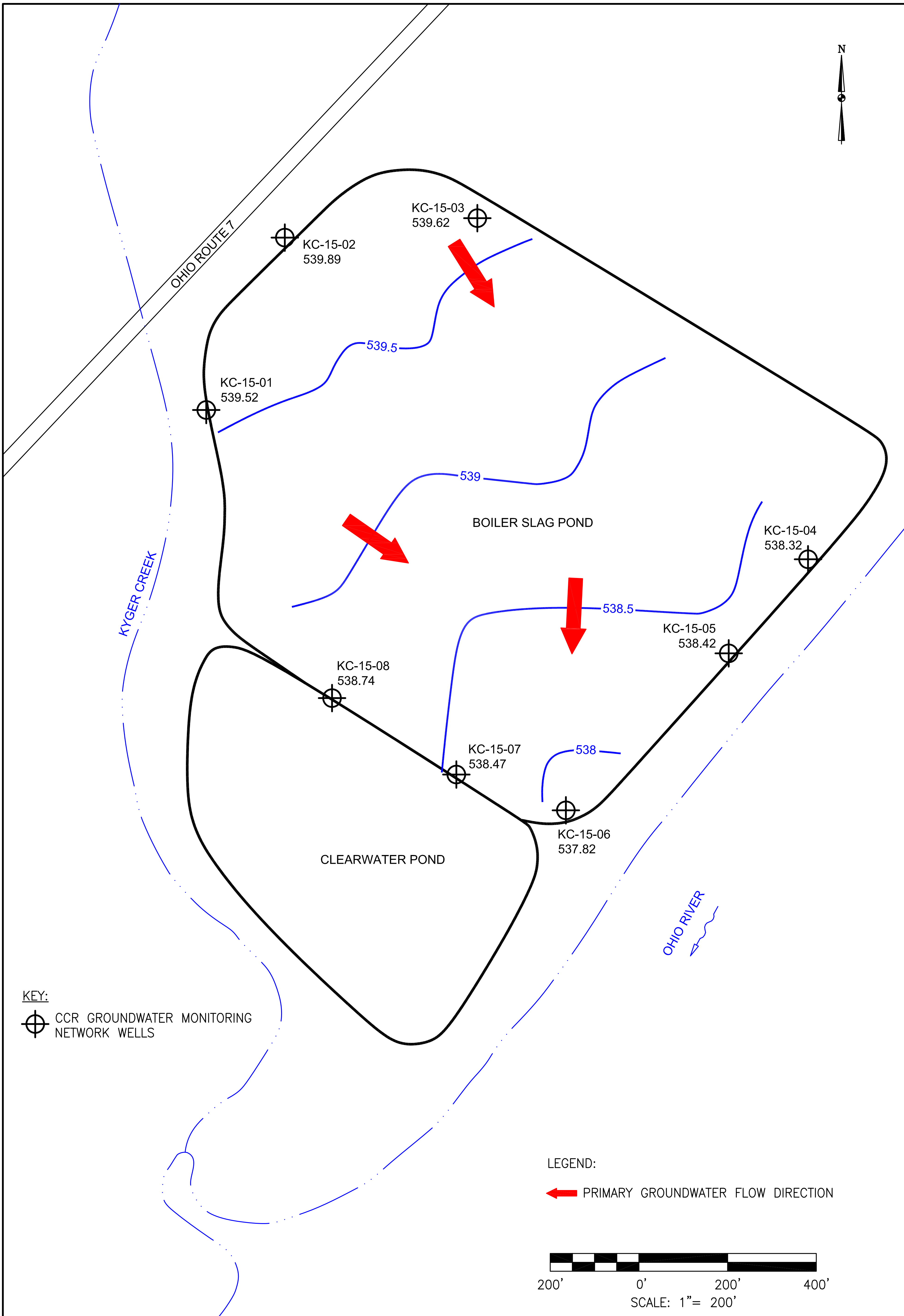
OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
BOILER SLAG POND
GROUNDWATER CONTOUR MAP – FEBRUARY 2018

DRAWING NAME: FIGURE A-1
REV.: 0

Plot: 08/13/2019 12:12 _PROGRAM-KYGER OVEC\Kyger Creek-CCR Program\CAD\2019 Assessment of Corrective Measures\Appx A\2019 ACM_KYGER_Fig A-1_BSP_Contours_FEB-18.dwg



DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019109-1-KYGER
DWG FILE	2019 ACM_KYGER_Fig A-2_BSP_Contours_SEPT-18.dwg
DRAWING SCALE	1"=200'

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OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK STATION
CHESHIRE, GALLIA COUNTY, OHIO
BOILER SLAG POND
GROUNDWATER CONTOUR MAP – SEPTEMBER 2018

DRAWING NAME: FIGURE A-2
REV. 0

Plot: 08/13/2019 12:18 _PROGRAM-KYGER OVEC\Kyger Creek-CCR Program\CAD\2019 Assessment of Corrective Measures\Appx A\2019 ACM_KYGER_Fig A-2_BSP_Contours_SEPT-18.dwg

APPENDIX B

ANALYTICAL RESULTS FOR 2018 GROUNDWATER MONITORING

KC-15-01
SUMMARY OF ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	GWPS	Detection Monitoring	Assessment Monitoring
			Mar-18	Sep-18
Appendix III Constituents				
Boron, B	mg/L	--	0.35	0.416
Calcium, Ca	mg/L	--	85	77.6
Chloride, Cl	mg/L	--	30.2	24.9
Fluoride, F	mg/L	--	0.04 J	0.04 J
pH	s.u.	--	9.09	5.64
Sulfate, SO4	mg/L	--	239	257
Total Dissolved Solids (TDS)	mg/L	--	460	453
Appendix IV Constituents				
Antimony, Sb	ug/L	6	NA	0.07
Arsenic, As	ug/L	10	NA	0.33
Barium, Ba	ug/L	2000	NA	23.4
Beryllium, Be	ug/L	4	NA	0.067
Cadmium, Cd	ug/L	5	NA	0.02
Chromium, Cr	ug/L	100	NA	0.171
Cobalt, Co	ug/L	9.745	NA	4.3
Fluoride, F	mg/L	4	0.04 J	0.04 J
Lithium, Li	mg/L	0.04	NA	0.018
Lead, Pb	ug/L	15	NA	0.06
Mercury, Hg	ug/L	2	NA	0.005
Molybdenum, Mo	ug/L	100	NA	0.29
Radium 226 & 228 (combined)	pCi/L	5	NA	2.0065
Selenium, Se	ug/L	50	NA	0.1
Thallium, Tl	ug/L	2	NA	0.03 J

Notes:
Yellow highlight indicates compound exceeds
NA = Sample not analyzed for the parameter
-- = not applicable

KC-15-02
SUMMARY OF ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	GWPS	Detection Monitoring	Assessment Monitoring
			Mar-18	Sep-18
Appendix III Constituents				
Boron, B	mg/L	--	0.03	0.128
Calcium, Ca	mg/L	--	112	101
Chloride, Cl	mg/L	--	34.1	36.4
Fluoride, F	mg/L	--	0.1 J	0.1 J
pH	s.u.	--	12.44	6.42
Sulfate, SO4	mg/L	--	109	105
Total Dissolved Solids (TDS)	mg/L	--	478	452
Appendix IV Constituents				
Antimony, Sb	ug/L	6	NA	0.03 J
Arsenic, As	ug/L	10	NA	2.39
Barium, Ba	ug/L	2000	NA	85.7
Beryllium, Be	ug/L	4	NA	0.009 J
Cadmium, Cd	ug/L	5	NA	0.14
Chromium, Cr	ug/L	100	NA	0.391
Cobalt, Co	ug/L	9.745	NA	2.26
Fluoride, F	mg/L	4	0.1 J	0.1 J
Lithium, Li	mg/L	0.04	NA	0.0007 J
Lead, Pb	ug/L	15	NA	0.189
Mercury, Hg	ug/L	2	NA	0.003 J
Molybdenum, Mo	ug/L	100	NA	1.25
Radium 226 & 228 (combined)	pCi/L	5	NA	0.976
Selenium, Se	ug/L	50	NA	0.08 J
Thallium, Tl	ug/L	2	NA	0.02 J

Notes:
Yellow highlight indicates compound exceeds
NA = Sample not analyzed for the parameter
-- = not applicable

KC-15-03
SUMMARY OF ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	GWPS	Detection Monitoring	Assessment Monitoring
			Mar-18	Sep-18
Appendix III Constituents				
Boron, B	mg/L	--	0.096	0.131
Calcium, Ca	mg/L	--	109	105
Chloride, Cl	mg/L	--	28.1	29.1
Fluoride, F	mg/L	--	0.08	0.1 J
pH	s.u.	--	11	6.31
Sulfate, SO4	mg/L	--	192	181
Total Dissolved Solids (TDS)	mg/L	--	490	472
Appendix IV Constituents				
Antimony, Sb	ug/L	6	NA	0.02 J
Arsenic, As	ug/L	10	NA	1.44
Barium, Ba	ug/L	2000	NA	66.5
Beryllium, Be	ug/L	4	NA	0.02 U
Cadmium, Cd	ug/L	5	NA	0.06
Chromium, Cr	ug/L	100	NA	0.103
Cobalt, Co	ug/L	9.745	NA	7.58
Fluoride, F	mg/L	4	0.08	0.1 J
Lithium, Li	mg/L	0.04	NA	0.032
Lead, Pb	ug/L	15	NA	0.02 J
Mercury, Hg	ug/L	2	NA	0.003 J
Molybdenum, Mo	ug/L	100	NA	0.89
Radium 226 & 228 (combined)	pCi/L	5	NA	0.285
Selenium, Se	ug/L	50	NA	0.1 U
Thallium, Tl	ug/L	2	NA	0.05 U

Notes:
Yellow highlight indicates compound exceeds
NA = Sample not analyzed for the parameter
-- = not applicable

KC-15-04
SUMMARY OF ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	GWPS	Detection Monitoring		Assessment Monitoring	
			Mar-18	May-18	Sep-18	Dec-18
Appendix III Constituents						
Boron, B	mg/L	--	0.717	1.01	0.924	0.781
Calcium, Ca	mg/L	--	105	NA	109	NA
Chloride, Cl	mg/L	--	24.6	NA	28.3	NA
Fluoride, F	mg/L	--	0.06	NA	0.09	NA
pH	s.u.	--	10.2	6.49	6.34	6.25
Sulfate, SO4	mg/L	--	344	369	358	300
Total Dissolved Solids (TDS)	mg/L	--	600	660	600	585
Appendix IV Constituents						
Antimony, Sb	ug/L	6	NA	NA	0.17	NA
Arsenic, As	ug/L	10	NA	NA	1.66	NA
Barium, Ba	ug/L	2000	NA	NA	58.3	NA
Beryllium, Be	ug/L	4	NA	NA	0.01 J	NA
Cadmium, Cd	ug/L	5	NA	NA	0.03	NA
Chromium, Cr	ug/L	100	NA	NA	0.161	NA
Cobalt, Co	ug/L	9.745	NA	NA	8.83	NA
Fluoride, F	mg/L	4	0.06	NA	0.09	NA
Lithium, Li	mg/L	0.04	NA	NA	0.014	0.03 U
Lead, Pb	ug/L	15	NA	NA	0.081	NA
Mercury, Hg	ug/L	2	NA	NA	0.003 J	NA
Molybdenum, Mo	ug/L	100	NA	NA	0.52	NA
Radium 226 & 228 (combined)	pCi/L	5	NA	NA	0.403	NA
Selenium, Se	ug/L	50	NA	NA	0.1	NA
Thallium, Tl	ug/L	2	NA	NA	0.02 J	NA

Notes:
Yellow highlight indicates compound exceeds
NA = Sample not analyzed for the parameter
-- = not applicable

KC-15-05
SUMMARY OF ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	GWPS	Detection Monitoring		Assessment Monitoring	
			Mar-18	May-18	Sep-18	Dec-18
Appendix III Constituents						
Boron, B	mg/L	--	0.889	0.815	0.762	NA
Calcium, Ca	mg/L	--	136	109	129	129
Chloride, Cl	mg/L	--	27.9	NA	28.9	NA
Fluoride, F	mg/L	--	0.09	NA	0.13	NA
pH	s.u.	--	9.01	6.57	6.35	6.6
Sulfate, SO4	mg/L	--	363	318	346	333
Total Dissolved Solids (TDS)	mg/L	--	691	652	664	689
Appendix IV Constituents						
Antimony, Sb	ug/L	6	NA	NA	0.02 J	NA
Arsenic, As	ug/L	10	NA	NA	0.88	NA
Barium, Ba	ug/L	2000	NA	NA	35.4	NA
Beryllium, Be	ug/L	4	NA	NA	0.005 J	NA
Cadmium, Cd	ug/L	5	NA	NA	0.07	NA
Chromium, Cr	ug/L	100	NA	NA	0.21	NA
Cobalt, Co	ug/L	9.745	NA	NA	5.27	NA
Fluoride, F	mg/L	4	0.09	NA	0.13	NA
Lithium, Li	mg/L	0.04	NA	NA	0.027	0.03 U
Lead, Pb	ug/L	15	NA	NA	0.07	NA
Mercury, Hg	ug/L	2	NA	NA	0.004 J	NA
Molybdenum, Mo	ug/L	100	NA	NA	0.57	NA
Radium 226 & 228 (combined)	pCi/L	5	NA	NA	3.086	NA
Selenium, Se	ug/L	50	NA	NA	0.1	NA
Thallium, Tl	ug/L	2	NA	NA	0.04 J	0.5 U

Notes:
Yellow highlight indicates compound exceeds
NA = Sample not analyzed for the parameter
-- = not applicable

KC-15-06
SUMMARY OF ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	GWPS	Detection Monitoring	Assessment Monitoring
			Mar-18	Sep-18
Appendix III Constituents				
Boron, B	mg/L	--	0.275	0.306
Calcium, Ca	mg/L	--	108	94.8
Chloride, Cl	mg/L	--	38	36.1
Fluoride, F	mg/L	--	0.09 J	0.1 J
pH	s.u.	--	9.33	6.52
Sulfate, SO4	mg/L	--	177	144
Total Dissolved Solids (TDS)	mg/L	--	502	465
Appendix IV Constituents				
Antimony, Sb	ug/L	6	NA	0.01 J
Arsenic, As	ug/L	10	NA	1.58
Barium, Ba	ug/L	2000	NA	110
Beryllium, Be	ug/L	4	NA	0.02 U
Cadmium, Cd	ug/L	5	NA	0.13
Chromium, Cr	ug/L	100	NA	0.238
Cobalt, Co	ug/L	9.745	NA	2.76
Fluoride, F	mg/L	4	0.09 J	0.1 J
Lithium, Li	mg/L	0.04	NA	0.001
Lead, Pb	ug/L	15	NA	0.044
Mercury, Hg	ug/L	2	NA	0.002 J
Molybdenum, Mo	ug/L	100	NA	0.37
Radium 226 & 228 (combined)	pCi/L	5	NA	0.916
Selenium, Se	ug/L	50	NA	0.06 J
Thallium, Tl	ug/L	2	NA	0.02 J

Notes:
Yellow highlight indicates compound exceeds
NA = Sample not analyzed for the parameter
-- = not applicable

KC-15-07
SUMMARY OF ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	GWPS	Detection Monitoring		Assessment Monitoring	
			Mar-18	May-18	Sep-18	Dec-18
Appendix III Constituents						
Boron, B	mg/L	--	0.256	NA	0.078	NA
Calcium, Ca	mg/L	--	123	78.8	69.3	NA
Chloride, Cl	mg/L	--	39.8	NA	30.9	NA
Fluoride, F	mg/L	--	0.08 J	NA	0.07 J	NA
pH	s.u.	--	8.45	6.02	6.27	6.71
Sulfate, SO4	mg/L	--	191	NA	46.1	NA
Total Dissolved Solids (TDS)	mg/L	--	544	NA	367	NA
Appendix IV Constituents						
Antimony, Sb	ug/L	6	NA	NA	0.01 J	NA
Arsenic, As	ug/L	10	NA	NA	152	15.3
Barium, Ba	ug/L	2000	NA	NA	510	40
Beryllium, Be	ug/L	4	NA	NA	0.006 J	NA
Cadmium, Cd	ug/L	5	NA	NA	0.01 J	NA
Chromium, Cr	ug/L	100	NA	NA	0.189	NA
Cobalt, Co	ug/L	9.745	NA	NA	0.132	NA
Fluoride, F	mg/L	4	0.08 J	NA	0.07 J	NA
Lithium, Li	mg/L	0.04	NA	NA	0.004	NA
Lead, Pb	ug/L	15	NA	NA	0.01 J	NA
Mercury, Hg	ug/L	2	NA	NA	0.004 J	NA
Molybdenum, Mo	ug/L	100	NA	NA	0.75	NA
Radium 226 & 228 (combined)	pCi/L	5	NA	NA	1.62	NA
Selenium, Se	ug/L	50	NA	NA	0.09 J	NA
Thallium, Tl	ug/L	2	NA	NA	0.01 J	NA

Notes:
Yellow highlight indicates compound exceeds
NA = Sample not analyzed for the parameter
-- = not applicable

KC-15-08
SUMMARY OF ANALYTICAL RESULTS
Ohio Valley Electric Corporation
Kyger Creek Station
Gallia County, Ohio

Parameter	Units	GWPS	Detection Monitoring		Assessment Monitoring	
			Mar-18	May-18	Sep-18	Dec-18
Appendix III Constituents						
Boron, B	mg/L	--	0.58	0.495	0.332	NA
Calcium, Ca	mg/L	--	245	187	153	105
Chloride, Cl	mg/L	--	42.9	NA	39.7	NA
Fluoride, F	mg/L	--	0.08	NA	0.12	NA
pH	s.u.	--	8.45	6.25	6.85	6.61
Sulfate, SO4	mg/L	--	599	510	375	150
Total Dissolved Solids (TDS)	mg/L	--	1130	1070	842	510
Appendix IV Constituents						
Antimony, Sb	ug/L	6	NA	NA	0.02 J	NA
Arsenic, As	ug/L	10	NA	NA	3.86	NA
Barium, Ba	ug/L	2000	NA	NA	50.2	NA
Beryllium, Be	ug/L	4	NA	NA	0.02 U	NA
Cadmium, Cd	ug/L	5	NA	NA	0.02	NA
Chromium, Cr	ug/L	100	NA	NA	0.479	NA
Cobalt, Co	ug/L	9.745	NA	NA	5.99	NA
Fluoride, F	mg/L	4	0.08	NA	0.12	NA
Lithium, Li	mg/L	0.04	NA	NA	0.024	0.03 U
Lead, Pb	ug/L	15	NA	NA	0.02 J	NA
Mercury, Hg	ug/L	2	NA	NA	0.003 J	NA
Molybdenum, Mo	ug/L	100	NA	NA	0.56	NA
Radium 226 & 228 (combined)	pCi/L	5	NA	NA	0.582	NA
Selenium, Se	ug/L	50	NA	NA	0.04 J	NA
Thallium, Tl	ug/L	2	NA	NA	0.01 J	NA

Notes:
Yellow highlight indicates compound exceeds
NA = Sample not analyzed for the parameter
-- = not applicable

APPENDIX C

GRAIN SIZE ANALYSIS LAB REPORTS

Stantec

Summary of Soil Tests

Project Name: Kyger Creek CCR Rule - Groundwater
Project Number: 175534017
Source: KC-19-27-28-38
Lab ID: 7

Sample Type: BULK
Date Received: 4-9-19
Date Reported: 4-15-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 27.6

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.1
No. 200	0.075	28.3
	0.02	15.9
	0.005	9.8
	0.002	7.2
estimated	0.001	5.9

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.8
Medium Sand	0.8	---
Fine Sand	70.8	70.8
Silt	18.5	21.1
Clay	9.8	7.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

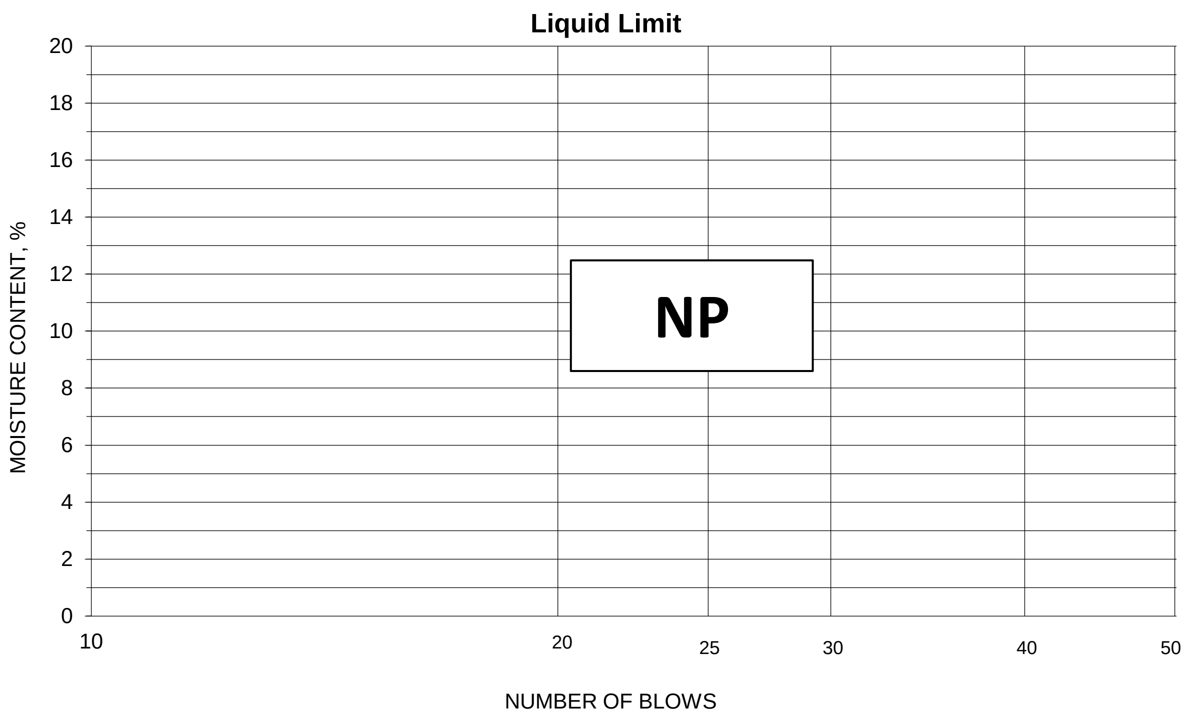
Reviewed By JS

Stantec

ATTERBERG LIMITS

Project	Kyger Creek CCR Rule - Groundwater	Project No.	175534017
Source	KC-19-27-28-38	Lab ID	7
		% + No. 40	1
Tested By	MP	Test Method	ASTM D 4318 Method A
Date Received	04-09-2019		
Test Date	04-11-2019	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: ______

Reviewed By JS

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Approved By: RJ

Stantec Consulting Services Inc.

Particle-Size Analysis of Soils

ASTM D 422

Project Name: Kyger Creek CCR Rule - Groundwater
Source: KC-19-27-28-38

Project Number: 175534017
Lab ID: 7

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GW
Test Date: 04-10-2019
Date Received: 04-09-2019

Maximum Particle size: No. 4 Sieve

Sieve Size	% Passing
No. 4	100.0
No. 10	99.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

Specific Gravity: 2.7

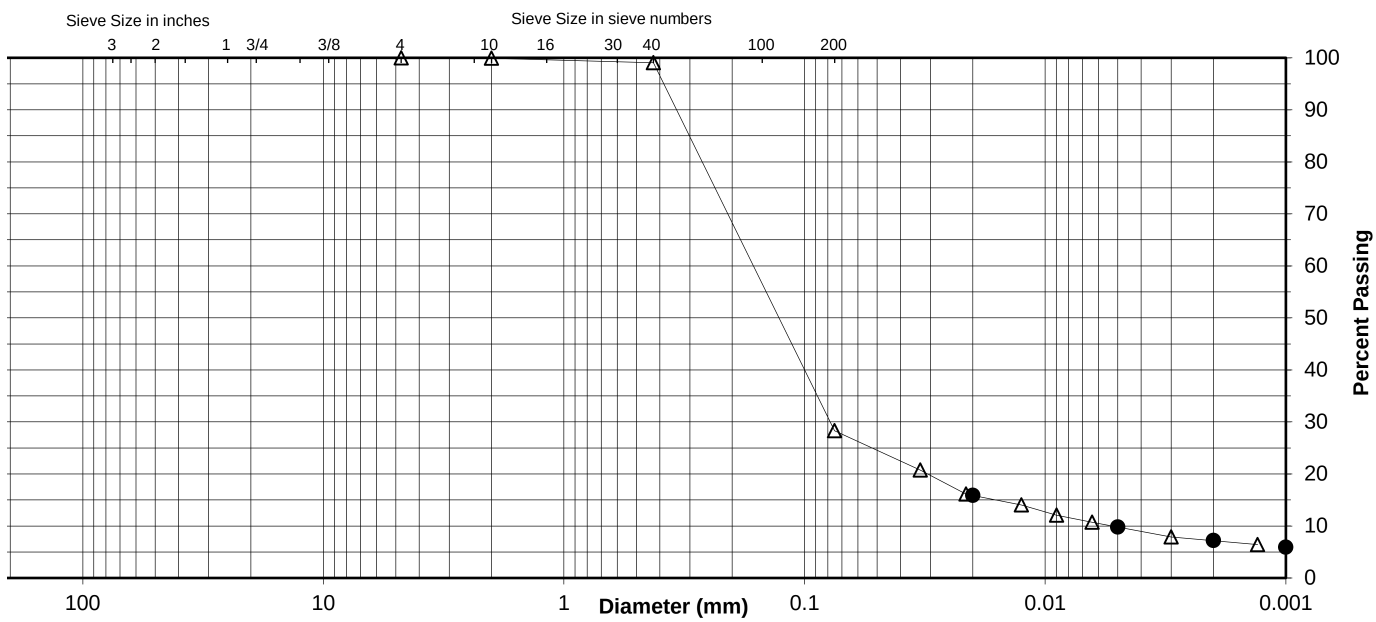
Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	99.1
No. 200	28.3
0.02 mm	15.9
0.005 mm	9.8
0.002 mm	7.2
0.001 mm	5.9

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	0.8	70.8	18.5	9.8

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.1	0.8	70.8	21.1	7.2



Comments ______________________

Reviewed By JS

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Version: 20170217
Approved By: RJ

Stantec

Summary of Soil Tests

Project Name: Kyger Creek CCR Rule - Groundwater
Project Number: 175534017
Source: KC-19-28-30-40
Lab ID: 8

Sample Type: BULK
Date Received: 4-9-19
Date Reported: 4-15-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 20.5

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size: Sieve Size	Particle Size: (mm)	% Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	99.8
No. 10	2	99.5
No. 40	0.425	95.9
No. 200	0.075	13.4
	0.02	7.4
	0.005	4.5
	0.002	3.2
estimated	0.001	2.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.2	0.5
Coarse Sand	0.3	3.6
Medium Sand	3.6	---
Fine Sand	82.5	82.5
Silt	8.9	10.2
Clay	4.5	3.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Reviewed By JS

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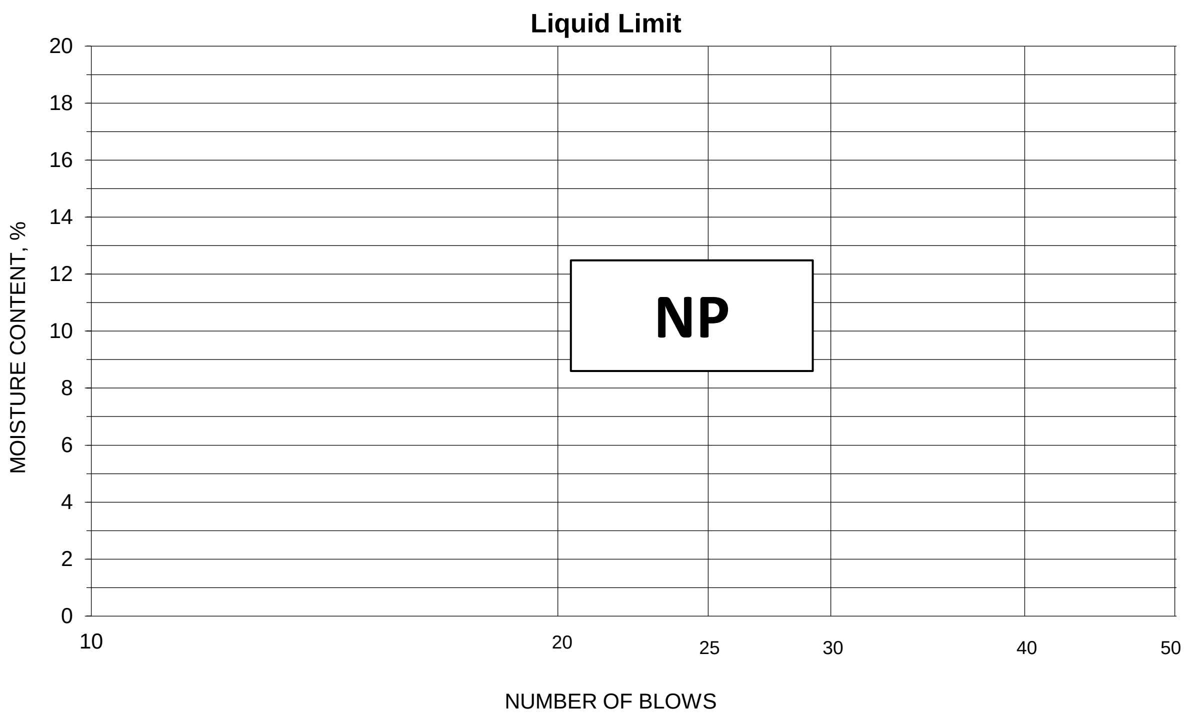
Approved By: RJ

ATTERBERG LIMITS

Stantec

Project	Kyger Creek CCR Rule - Groundwater	Project No.	175534017
Source	KC-19-28-30-40	Lab ID	8
		% + No. 40	4
Tested By	MP	Test Method	ASTM D 4318 Method A
Date Received	04-09-2019		
Test Date	04-11-2019	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: ______________________

Reviewed By JS

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Approved By: RJ

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Kyger Creek CCR Rule - Groundwater	Project Number	175534017
Source	KC-19-28-30-40	Lab ID	8

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GW
Test Date: 04-10-2019
Date Received: 04-09-2019

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	99.8
No. 10	99.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

Specific Gravity: 2.7

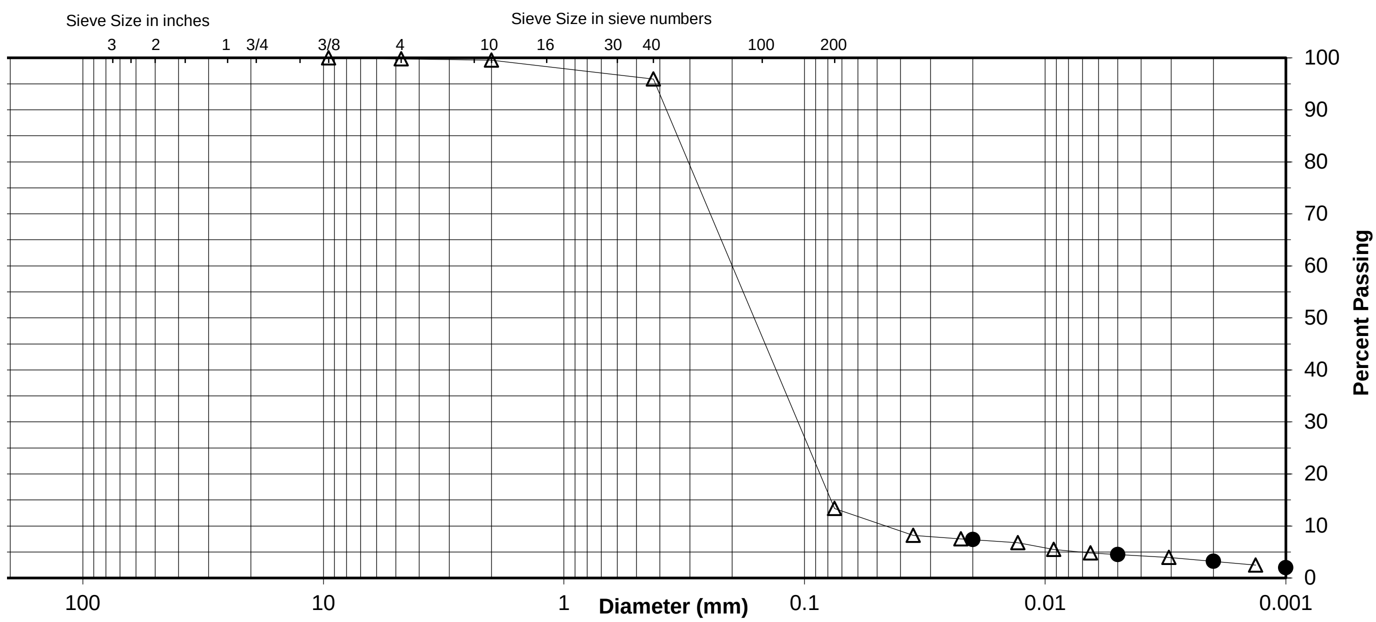
Dispersed using Apparatus A - Mechanical, for 1 minute

Sieve Size	% Passing
No. 40	95.9
No. 200	13.4
0.02 mm	7.4
0.005 mm	4.5
0.002 mm	3.2
0.001 mm	2.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.2	0.3	3.6	82.5	8.9	4.5

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.5	3.6	82.5	10.2	3.2



Comments ____________________

Reviewed By JS

Stantec

Summary of Soil Tests

Project Name: Kyger Creek CCR Rule - Groundwater
Project Number: 175534017
Source: KC-19-29-32-42
Lab ID: 9

Sample Type: BULK
Date Received: 4-9-19
Date Reported: 4-15-19

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 21.3

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.2
No. 200	0.075	20.8
	0.02	10.7
	0.005	6.6
	0.002	5.2
estimated	0.001	4.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.7
Medium Sand	0.7	---
Fine Sand	78.4	78.4
Silt	14.2	15.6
Clay	6.6	5.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: NP
Plastic Limit: NP
Plasticity Index: NP
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Reviewed By JS

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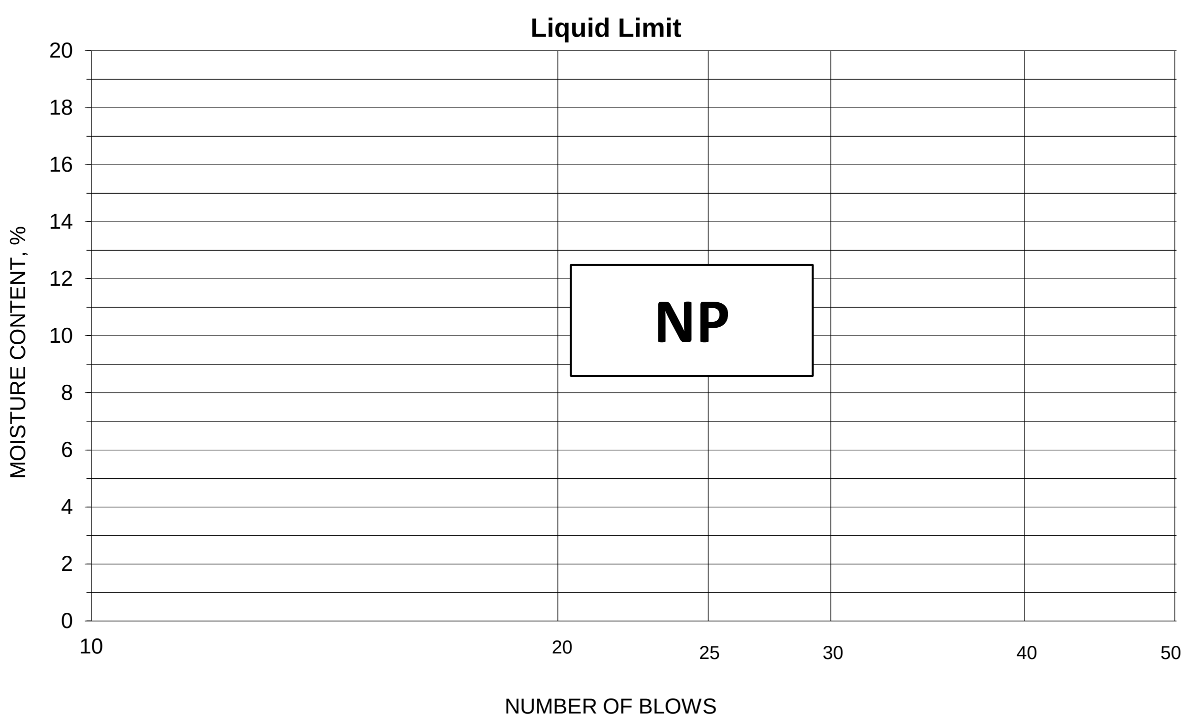
Version: 20170217
Approved By: RJ

Stantec

ATTERBERG LIMITS

Project	Kyger Creek CCR Rule - Groundwater			Project No.	175534017
Source	KC-19-29-32-42			Lab ID	9
				% + No. 40	1
Tested By	MP	Test Method	ASTM D 4318 Method A	Date Received	04-09-2019
Test Date	04-11-2019	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks:

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Version: 20170217
Approved By: RJ

Stantec Consulting Services Inc.

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kyger Creek CCR Rule - Groundwater
Project Number: 175534017
Source: KC-19-29-32-42
Lab ID: 9

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: GW
Test Date: 04-10-2019
Date Received: 04-09-2019

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	100.0
No. 10	99.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

Specific Gravity: 2.7

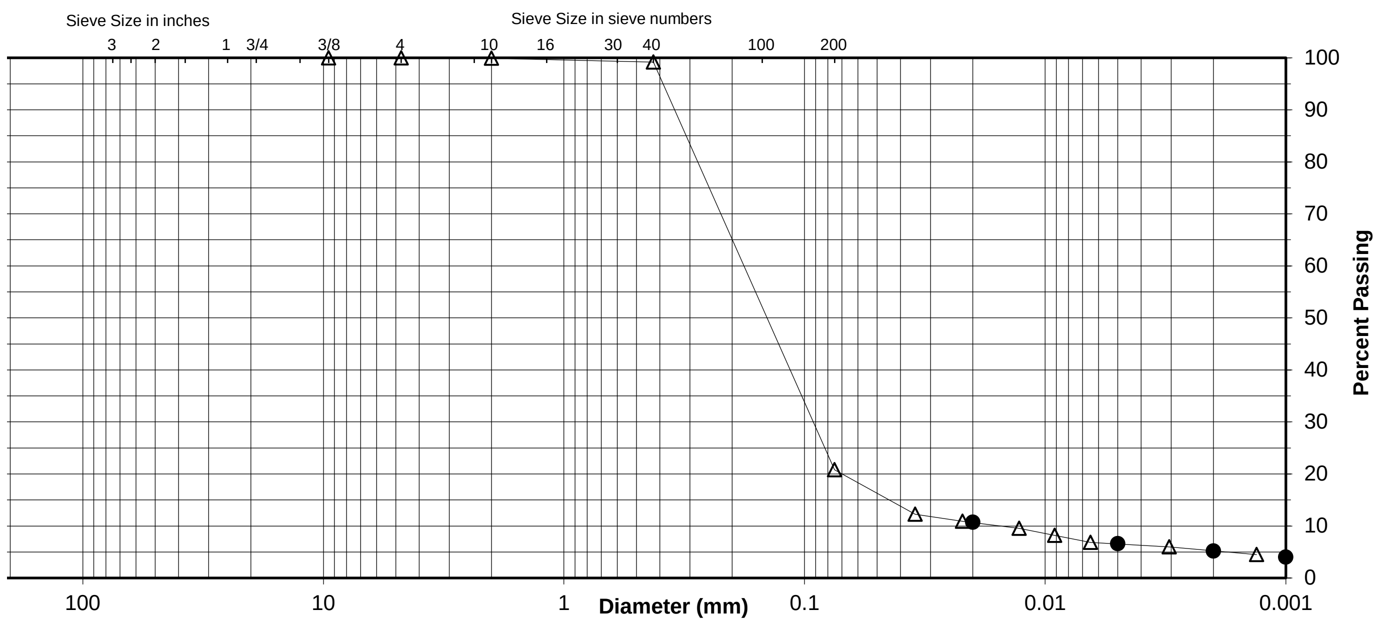
Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	99.2
No. 200	20.8
0.02 mm	10.7
0.005 mm	6.6
0.002 mm	5.2
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	0.7	78.4	14.2	6.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.1	0.7	78.4	15.6	5.2



Comments ______

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Version: 20170217
Approved By: RJ

APPENDIX D

WELL BORING AND CONSTRUCTION LOGS

BORING NO. _____KC-19-27__
SAMPLE/CORE LOG

Project Number:	2019052	Log Page	1 of 2
Project Location:	Kyger Creek Plant Boiler Slag Pond	Drilling Contractor:	HAD
Drilling Date(s):	4/4/2019 to 4/5/2019	AGES Geologist:	Mike Gelles

Drilling Method:	Hollow Stem Auger	Coring Device Size:	NA	Hammer Wt.	NA	and Drop	NA
Sampling Method:	NA	Borehole Diameter:	6”	Drilling Fluid Used:	Water		
Sampling Interval:	NA	Borehole Depth:	38’	Surface Elevation:	558.22’ msl		

NOTES/COMMENTS:

Depth Interval (feet)	Sample Recovery (feet)	Penetration (Hyd. Pres. or Blow Counts)	Sample/Core Description	PID (PPM)
0-2	1.6	4-5-6-6	Brown silty clay, moist	N/A
2-4	1	Wt/h(2)-3-4	Brown silty clay, moist	N/A
4-6	1.4	2-2-4-6	Brown silty clay, moist	N/A
6-8	1.6	2-3-5-6	Brown silty clay, moist	N/A
8-10	1.6	1-3-4-6	Brown silty clay, moist	N/A
10-12	1.6	2-4-5-7	Brown silty clay, moist	N/A
12-14	1.6	2-5-6-7	Brown silty clay, moist	N/A
14-16	1.6	1-3-5-5	Brown silty clay, plastic, moist	N/A
16-18	2	2-3-4-5	Brown silty clay, plastic, moist	N/A
18-20	2	4-6-4-6	Brown silty clay, plastic, moist	N/A
20-22	1.4	Wt/h(2)-2-3	Brown silty clay, plastic, moist	N/A
22-24	1.4	Wt/h-2-3-3	Brown silty clay, plastic, moist, trace sand	N/A
24-26	2	2-2-3-2	24.0-25.0’ Brown silty clay, plastic, moist; 25.0’-26.0’ Brown sand, fine and medium, wet	N/A
26-28	2	1-1-1-3	Brown sand, fine and medium, wet	N/A
28-30	2	1-1-2-3	Brown sand, fine and medium, wet, loose	N/A
30-32	2	1-2-3-4	Brown sand, fine and medium, wet, loose	N/A
32-34	2	2-2-4-6	Brown sand, fine and medium, wet, loose	N/A

CONTINUED SAMPLE/CORE LOG
BORING NO. KC-19-27

Project No: 2019052 Geologist: Mike Gelles

34-36	2	2-3-3-4	Brown sand, fine and medium, wet, loose, some gray sandy clay	N/A
36-38	2	1-1-4-5	Brown sand, fine and medium, wet, loose, some gray sand, fine and medium	N/A

WELL CONSTRUCTION LOG
WELL NO. KC-19-27

Project Number: 2019052

Project Location: Kyger Creek Plant – Boiler Slag Pond

Installation Date(s): 4/4/2019-4/5/2019

Drilling Method: Hollow Stem Auger
Drilling Contractor: HAD

Development Date(s): 4/8/2019

Development Method: Pump & Surge until Field Parameters stabilized
Turbidity = 4.89 NTUs

Volume Purged: 213 gallons

Static Water-Level*: 22.25'

Top of Well Casing Elevation: 561.13' msl

Well Purpose:
Groundwater Monitoring
Northing (Y): 331507.38
Easting (X): 2073611.935

Comments/Notes:
2 inch PVC riser and screen
10 ft of 0.010 pre-packed well screen with an inner filter pack of 0.40 mm clean quartz sand and an outer layer of food-grade nylon mesh.

Inspector: Michael Gelles

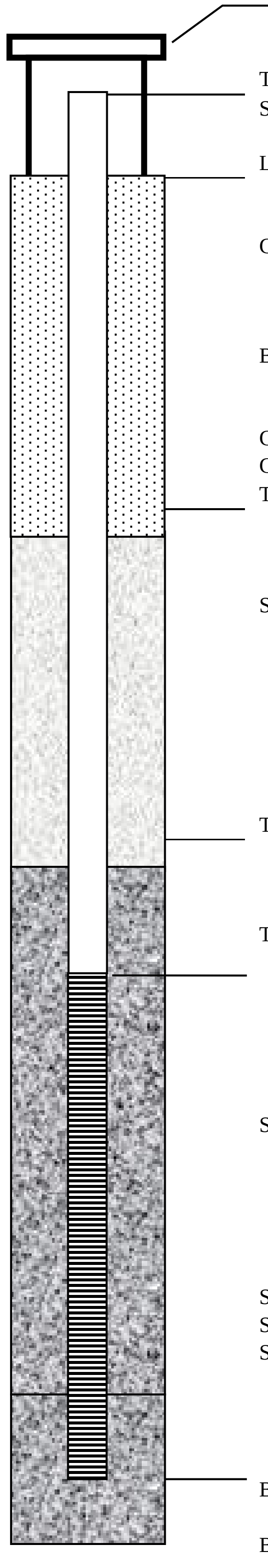
CONSTRUCTION MATERIALS USED:

3 Bags of Sand

1 Bags/Buckets Bentonite Pellets

8 Bags Portland for Grout

___ Bags Concrete/Sakrete



Protective Casing with Locking Cap

Top of Casing Elevation: 561.13 ft.
Stick-up: 2.91 ft.

Land Surface Elevation: 558.22 ft.

Grout; Type: Portland cement/ Grout

Borehole Diameter: 6" inch

Casing Diameter: 2 Inch
Casing Material: PVC
Top of Seal: 24 ft*

Seal Type: Bentonite Pellets/Chips

Top of Sand/Gravel Pack: 26 ft*

Top of Well Screen 28 ft*

Sand/Gravel Pack; Type: Global #5

Screen Diameter: 2 Inch
Screen Slot-Size: 0.010 Inch
Screen Material: PVC

Bottom of Well Screen 38 ft.*

Base of Borehole: 38 ft.*

Total Depth of Well Below Top of Casing: 40.91 ft.

*Indicates Depth Below Land Surface

BORING NO. KC-19-28
SAMPLE/CORE LOG

Project Number:	2019052	Log Page	1 of 2
Project Location:	Kyger Creek Boiler Slag Pond	Drilling Contractor:	HAD
Drilling Date(s):	4/4/2019	AGES Geologist:	Mike Gelles

Drilling Method:	Hollow Stem Auger	Coring Device Size:	NA	Hammer Wt.	NA	and Drop	NA
Sampling Method:	NA	Borehole Diameter:	6”	Drilling Fluid Used:	Water		
Sampling Interval:	NA	Borehole Depth:	42’	Surface Elevation:	558.41’ msl		

NOTES/COMMENTS:

Depth Interval (feet)	Sample Recovery (feet)	Penetration (Hyd. Pres. or Blow Counts)	Sample/Core Description	PID (PPM)
0-2	1.6	2-3-5-7	Brown silty clay, moist	N/A
2-4	1.6	3-4-6-4	Brown silty clay, moist	N/A
4-6	1	1-1-3-4	Brown silty clay, moist	N/A
6-8	1.4	1-2-3-5	Brown silty clay, moist	N/A
8-10	0.4	2-2-3-4	Brown silty clay, moist	N/A
10-12	1.6	2-3-4-5	Brown silty clay, moist	N/A
12-14	2	1-1-3-4	Brown silty clay, moist	N/A
14-16	2	2-3-3-5	Brown silty clay, moist	N/A
16-18	2	2-3-4-6	Brown silty clay, moist	N/A
18-20	2	2-3-4-4	Brown silty clay, moist	N/A
20-22	2	5-Wt/h(3)	Brown silty clay, moist	N/A
22-24	2	2-3-4-4	Brown silty clay, plastic, moist	N/A
24-26	2	2-2-3-4	Brown silty clay, plastic, moist	N/A
26-28	2	1-1-2-4	Brown silty clay, plastic, moist	N/A
28-30	2	1-2-2-3	Brown silty clay, plastic, moist	N/A
30-32	1.4	Wt/h(4)	Brown sand, fine and medium, trace gravel, trace clay, wet	N/A
32-34	2	1-2-2-2	Brown sand, fine and medium, some gravel, wet	N/A
34-36	2	1-1-3-3	Brown sand, fine and medium, wet	N/A

Project No: 2019052 Geologist: Mike Gelles Page 2 of 2

36-38	2	2-5-7-13	Brown sand, fine and medium, wet	N/A
38-40	2	2-3-5-9	Brown sand, fine and medium, wet	N/A

WELL CONSTRUCTION LOG
WELL NO. KC-19-28

Project Number: 2019052

Project Location: Kyger Creek Plant – Boiler Slag Pond

Installation Date(s): 4/4/2019

Drilling Method: Hollow Stem Auger
Drilling Contractor: HAD

Development Date(s): 4/9/2019

Development Method: Pump & Surge until Field Parameters stabilized.
Turbidity = 4.7 NTUs

Volume Purged: 232 gallons

Static Water-Level* 22.95'

Top of Well Casing Elevation: 561.10' msl

Well Purpose:
Groundwater Monitoring
Northing (Y): 331064.431
Easting (X): 2073270.027

Comments/Notes:
2 inch PVC riser and screen
10 ft of 0.010 pre-packed well screen with an inner filter pack of 0.40 mm clean quartz sand and an outer layer of food-grade nylon mesh.

Inspector: Michael Gelles

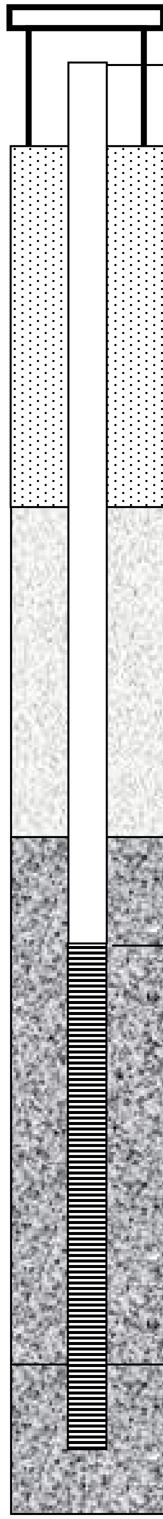
CONSTRUCTION MATERIALS USED:

3 Bags of Sand

1 Bags/Buckets Bentonite Pellets

8 Bags Portland for Grout

____ Bags Concrete/Sakrete



Protective Casing with Locking Cap

Top of Casing Elevation: 561.10 ft.
Stick-up: 2.69 ft.

Land Surface Elevation: 558.41 ft.

Grout; Type: Portland cement/ Grout

Borehole Diameter: 6" inch

Casing Diameter: 2 Inch
Casing Material: PVC
Top of Seal: 28 ft*

Seal Type: Bentonite Pellets/Chips

Top of Sand/Gravel Pack: 30 ft*

Top of Well Screen 32 ft*

Sand/Gravel Pack; Type: Global #5

Screen Diameter: 2 Inch
Screen Slot-Size: 0.010 Inch
Screen Material: PVC

Bottom of Well Screen 42 ft.*

Base of Borehole: 42 ft.*

Total Depth of Well Below Top of Casing: 42 ft.

*Indicates Depth Below Land Surface

Project Number:	2019052	Log Page	1 of 2
Project Location:	Kyger Creek Plant – Boiler Slag Pond	Drilling Contractor:	HAD
Drilling Date(s):	4/3/2019	Geologist:	Michael Gelles

Drilling Method:	Hollow Stem Auger	Coring Device Size:	NA	Hammer Wt.	160 lbs and Drop 30”
Sampling Method:	Split Spoon	Borehole Diameter:	6”	Drilling Fluid Used:	Water
Sampling Interval:	2’	Borehole Depth:	42’	Surface Elevation:	561.13’ msl

NOTES/COMMENTS:

Depth Interval (feet)	Sample Recovery (feet)	Penetration (Hyd. Pres. or Blow Counts)	Sample/Core Description	PID (PPM)
0-2	1.2	1-1-2-4	Orange brown silty clay, moist	NA
2-4	1.6	2-4-7-8	Orange brown silty clay, moist	NA
4-6	1.6	6-10-7-9	Orange brown silty clay, moist	NA
6-8	1.6	1-3-4-5	Orange brown silty clay, moist	NA
8-10	1.6	1-2-4-4	Orange brown silty clay, moist	NA
10-12	1.6	2-2-4-4	Orange brown silty clay, moist	NA
12-14	1.6	1-2-3-3	Orange brown silty clay, moist	NA
14-16	2	1-1-2-1	Orange brown silty clay, moist	NA
16-18	2	2-2-2-2	Orange brown silty clay, moist	NA
18-20	2	1-2-2-2	Orange brown silty clay, moist	NA
20-22	2	1-1-3-4	Orange brown silty clay, plastic, moist	NA
22-24	2	1-1-3-5	Orange brown silty clay, plastic, moist	NA
24-26	2	1-1-2-3	Orange brown silty clay, plastic, moist	NA
26-28	2	1-2-3-5	Orange brown silty clay, plastic, moist	NA
28-30	2	2-3-4-5	Orange brown silty clay, plastic, moist	NA
30-32	2	7-6-8-7	Orange brown sand fine to medium, loose, wet	NA
32-34	2	7-8-7-7	Orange brown sand fine to medium, trace clay, loose, wet	NA
34-36	2	Wt/h-1-3-3	Orange brown sand fine to medium, trace clay, loose, wet	NA

Project No: 2019052 Geologist: Michael Gelles

36-38	2	4-3-3-5	Orange brown sand fine to medium, loose, wet	NA
38-40	2	Wt/h(4)	Orange brown sand fine to medium, loose, wet	NA
40-42	2	2-5-4-8	Orange brown sand fine to medium, loose, wet	NA

WELL CONSTRUCTION LOG
WELL NO. KC-19-29

Project Number: 2019052

Project Location: Kyger Creek Plant – Boiler Slag Pond

Installation Date(s): 4/3/2019

Drilling Method: Hollow Stem Auger

Drilling Contractor: HAD

Development Date(s): 4/10/2019

Development Method: Pump & Surge until Field Parameters Stabilized
Turbidity = 4.51 NTUs

Volume Purged: 106 gallons

Static Water-Level*: 22.25'

Top of Well Casing Elevation: 564.17' msl

Well Purpose:
Groundwater Monitoring
Northing (Y): 330558.936
Easting (X): 2072840.947

Comments/Notes:
2 inch PVC riser and screen
10 ft of 0.010 pre-packed well screen with an inner filter pack of 0.40 mm clean quartz sand and an outer layer of food-grade nylon mesh.

Inspector: Michael Gelles

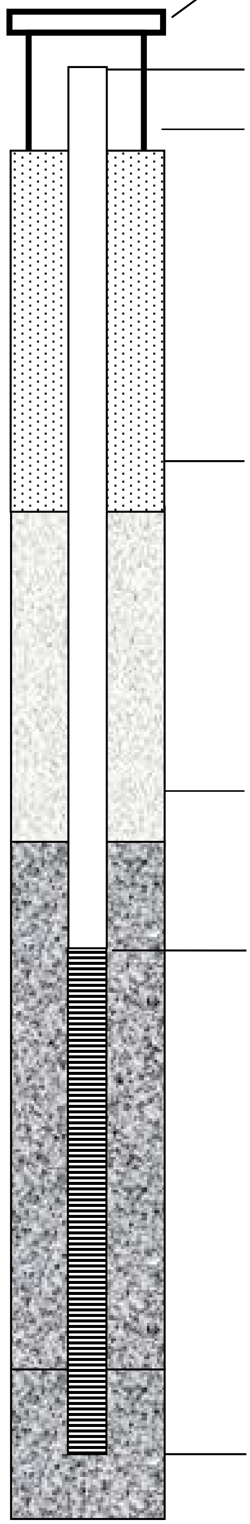
CONSTRUCTION MATERIALS USED:

3 Bags of Sand

1 Bags/Buckets Bentonite Pellets

8 Bags Portland for Grout

____ Bags Concrete/Sakrete



Protective Casing with Locking Cap

Top of Casing Elevation: 564.17 ft.

Stick-up: 3.04 ft.

Land Surface Elevation: 561.13 ft.

Grout; Type: Portland cement/Grout

Borehole Diameter: 6" inch

Casing Diameter: 2 Inch

Casing Material: PVC

Top of Seal: 27 ft*

Seal Type: Bentonite Pellets

Top of Sand/Gravel Pack: 29 ft*

Top of Well Screen 31 ft*

Sand/Gravel Pack; Type: Global #5

Screen Diameter: 2 Inch

Screen Slot-Size: 0.010 Inch

Screen Material: PVC

Bottom of Well Screen 41 ft.*

Base of Borehole: 42 ft.*

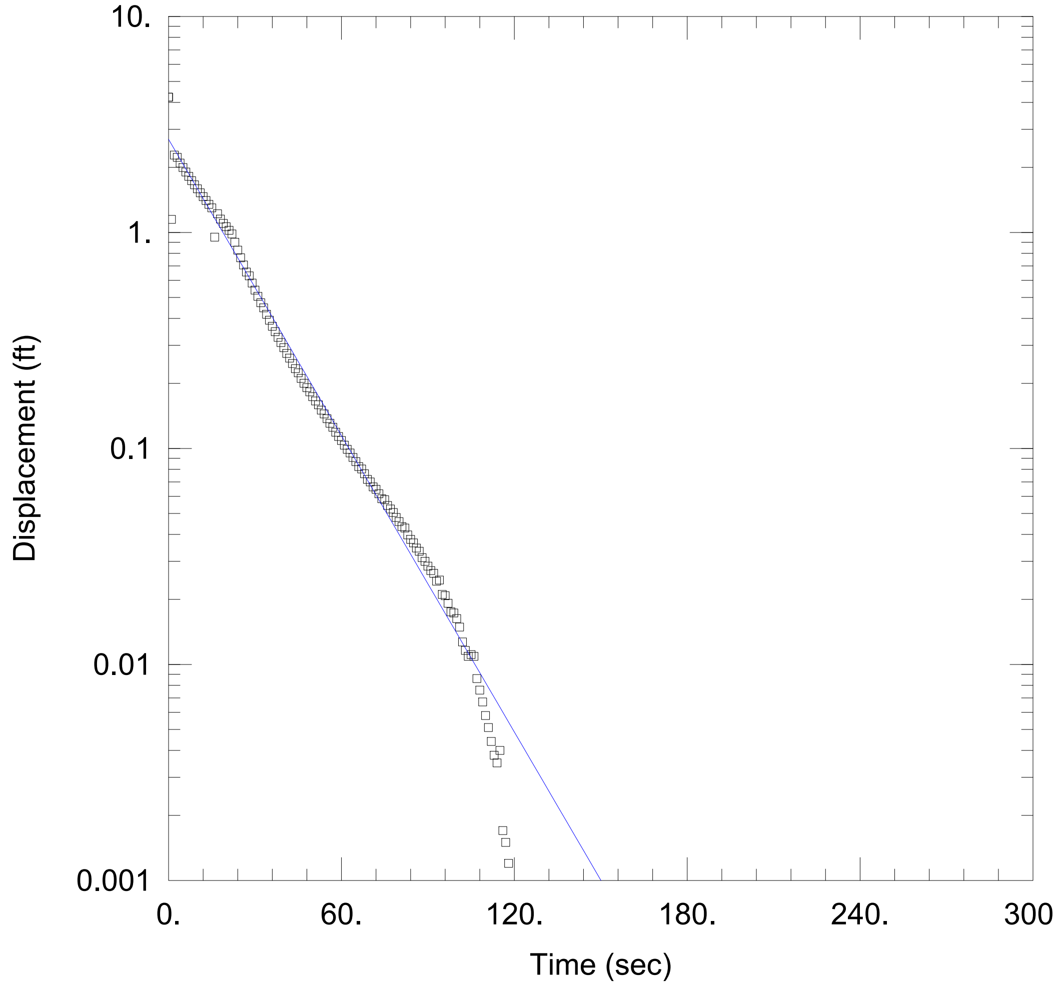
Total Depth of Well Below Top of Casing: 41 ft.

*Indicates Depth Below Land Surface

Z:\Shared\PROJECTS_PROGRAMS - KYGER OVEC\Kyger Creek - CCR Program\Reports\Assessment of Corrective Measures Report\Kyger Creek ACM Report_FINAL\Appendices_FINAL\Appendix D -Well Boring & Construction Logs\KC-19-29 Well Log.docx

APPENDIX E

SLUG TEST RESULTS



KC-19-27-IN1

Data Set: \...\KC-19-27-IN1.aqt
Date: 05/30/19 Time: 11:14:19

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-27
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 13. ft
Anisotropy Ratio (Kz/Kr): 1.

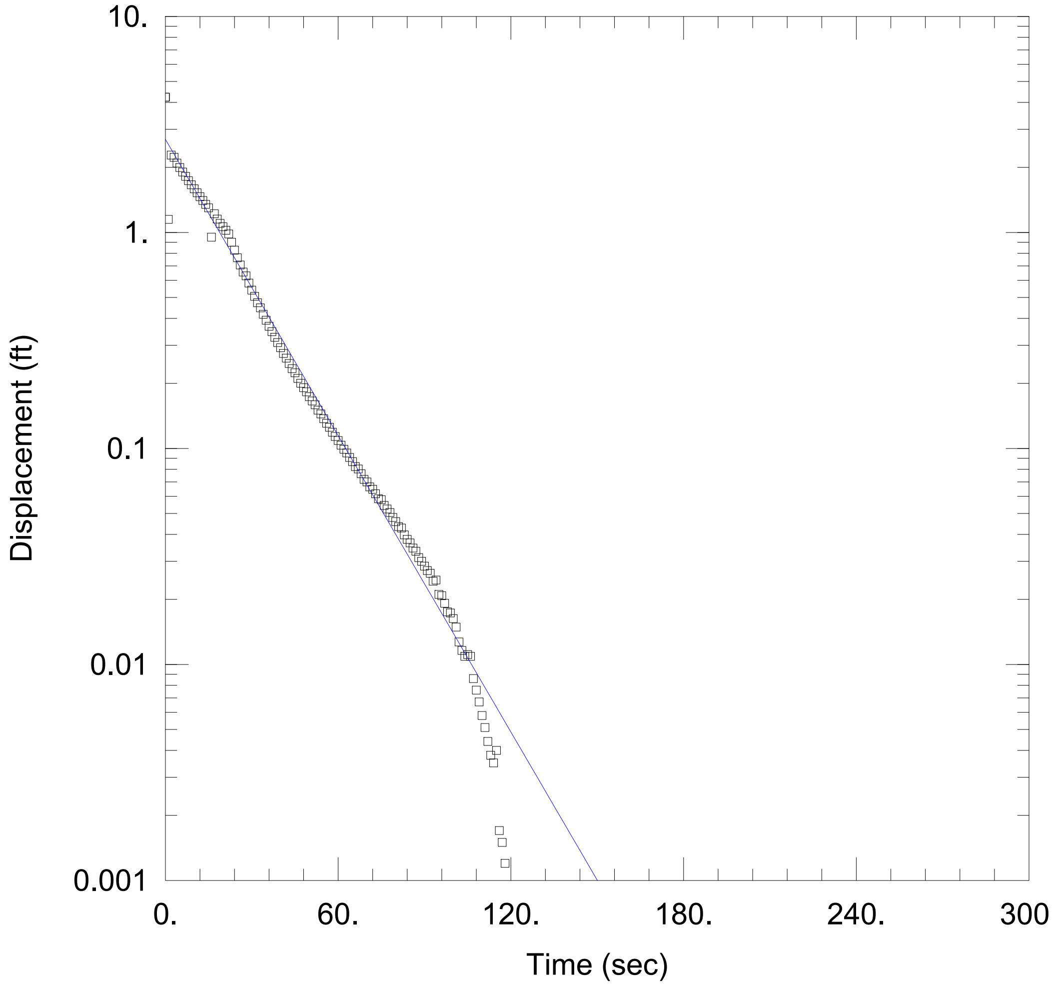
WELL DATA (KC-19-27)

Initial Displacement: 4.231 ft
Static Water Column Height: 22.75 ft
Total Well Penetration Depth: 41.15 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 8.307E-5 ft/sec
y0 = 2.698 ft



KC-19-27-IN1

Data Set: \...\KC-19-27-IN1.aqt
Date: 05/30/19 Time: 11:15:27

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-27
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 13. ft
Anisotropy Ratio (Kz/Kr): 1.

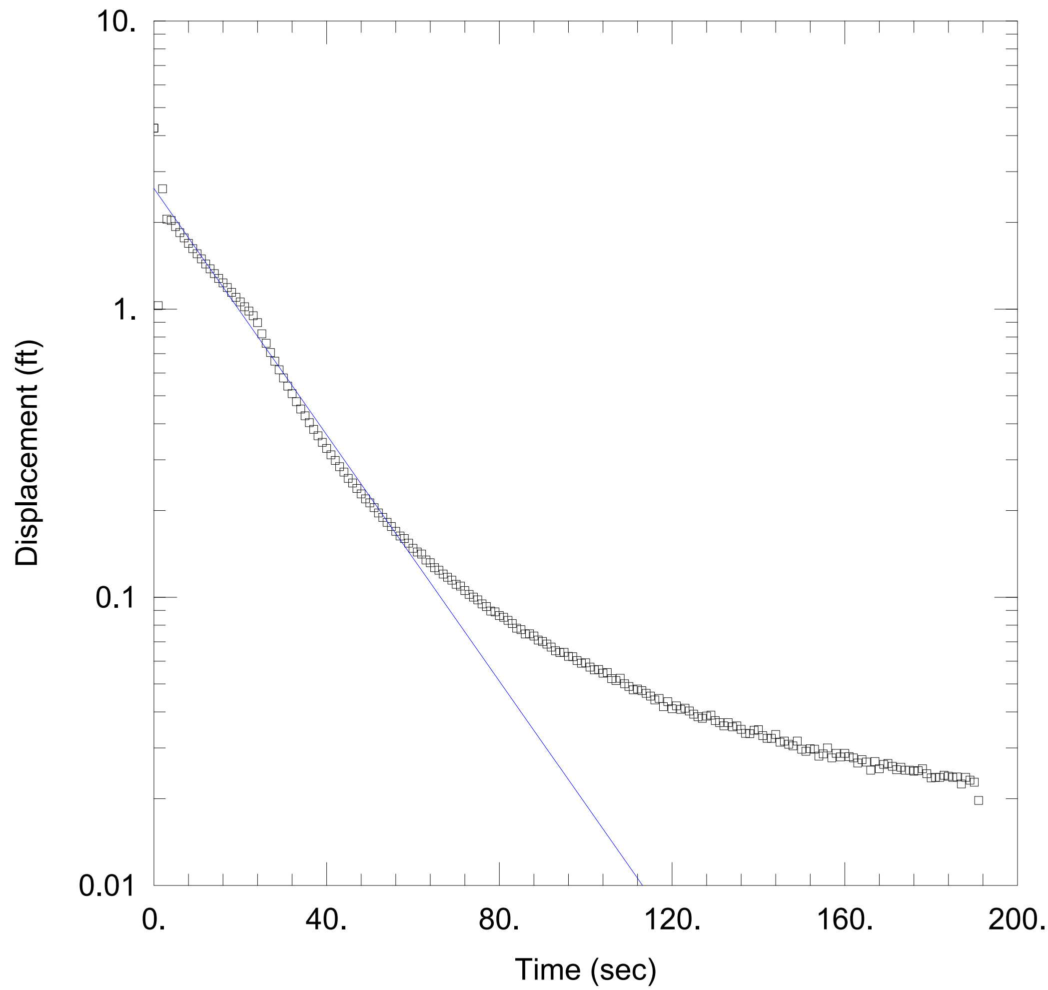
WELL DATA (KC-19-27)

Initial Displacement: 4.231 ft
Static Water Column Height: 22.75 ft
Total Well Penetration Depth: 41.15 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 9.946E-5 ft/sec
y0 = 2.698 ft



KC-19-27-IN2

Data Set: \...\KC-19-27-IN2.aqt
Date: 05/30/19 Time: 11:17:47

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-27
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 13. ft
Anisotropy Ratio (Kz/Kr): 1.

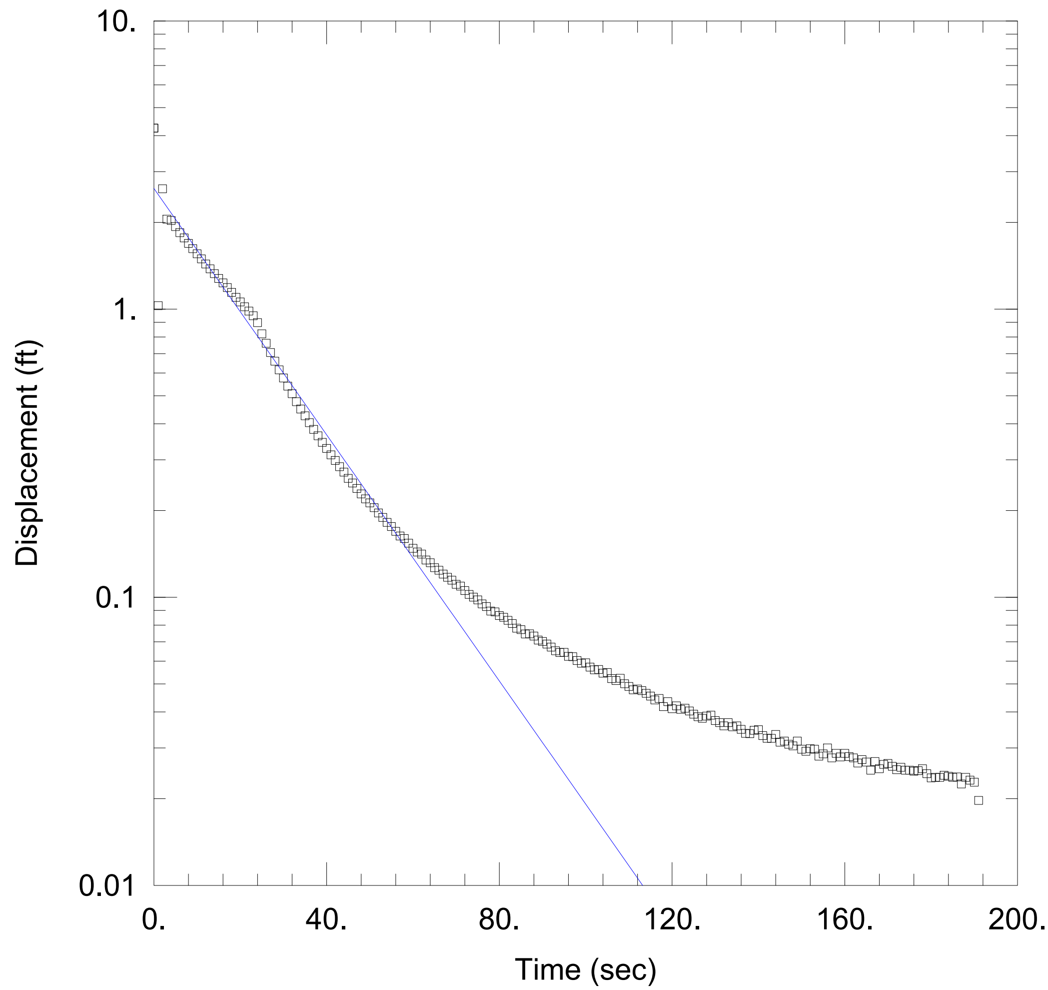
WELL DATA (KC-19-27)

Initial Displacement: 4.248 ft
Total Well Penetration Depth: 41.15 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.75 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 7.764E-5 ft/sec
y0 = 2.621 ft



KC-19-27-IN2

Data Set: \...\KC-19-27-IN2.aqt
Date: 05/30/19 Time: 11:18:30

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-27
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 13. ft
Anisotropy Ratio (Kz/Kr): 1.

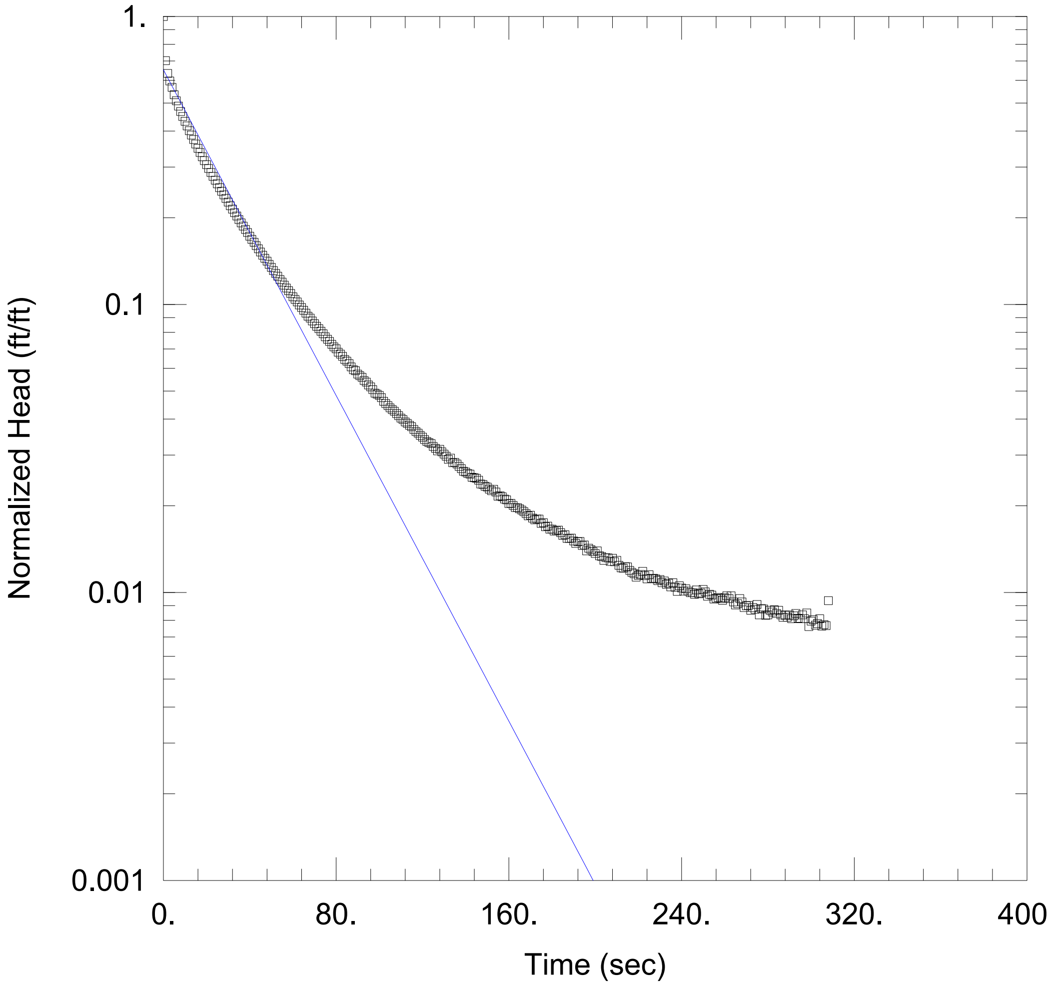
WELL DATA (KC-19-27)

Initial Displacement: 4.248 ft
Total Well Penetration Depth: 41.15 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.75 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 9.294E-5 ft/sec
y0 = 2.62 ft



KC-19-27-OUT1

Data Set: \...\KC-19-27-OUT1.aqt
Date: 05/30/19
Time: 11:20:38

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-27
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 13. ft
Anisotropy Ratio (Kz/Kr): 1.

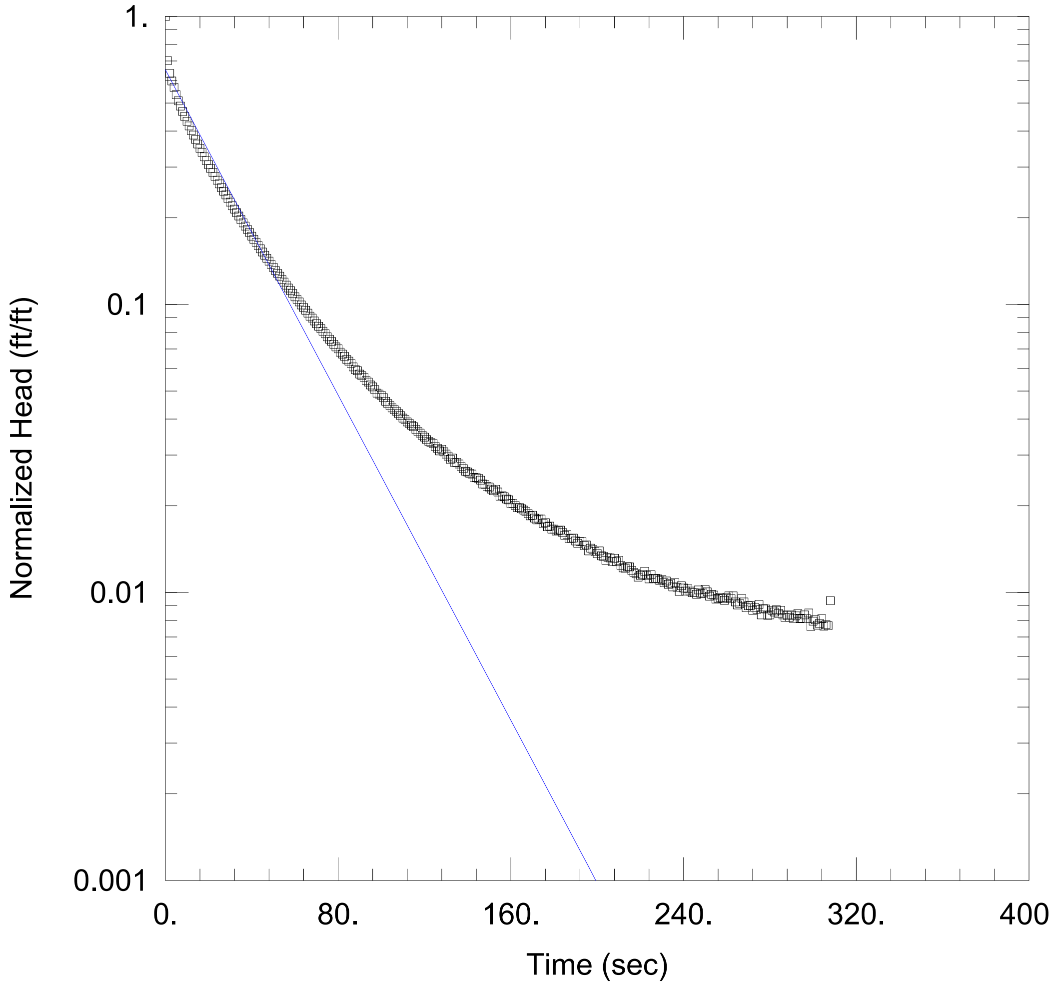
WELL DATA (KC-19-27)

Initial Displacement: -3.195 ft
Total Well Penetration Depth: 41.15 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.75 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 5.136E-5 ft/sec
y0 = -2.086 ft



KC-19-27-OUT1

Data Set: \...\KC-19-27-OUT1.aqt
Date: 05/30/19
Time: 11:21:18

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-27
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 13. ft
Anisotropy Ratio (Kz/Kr): 1.

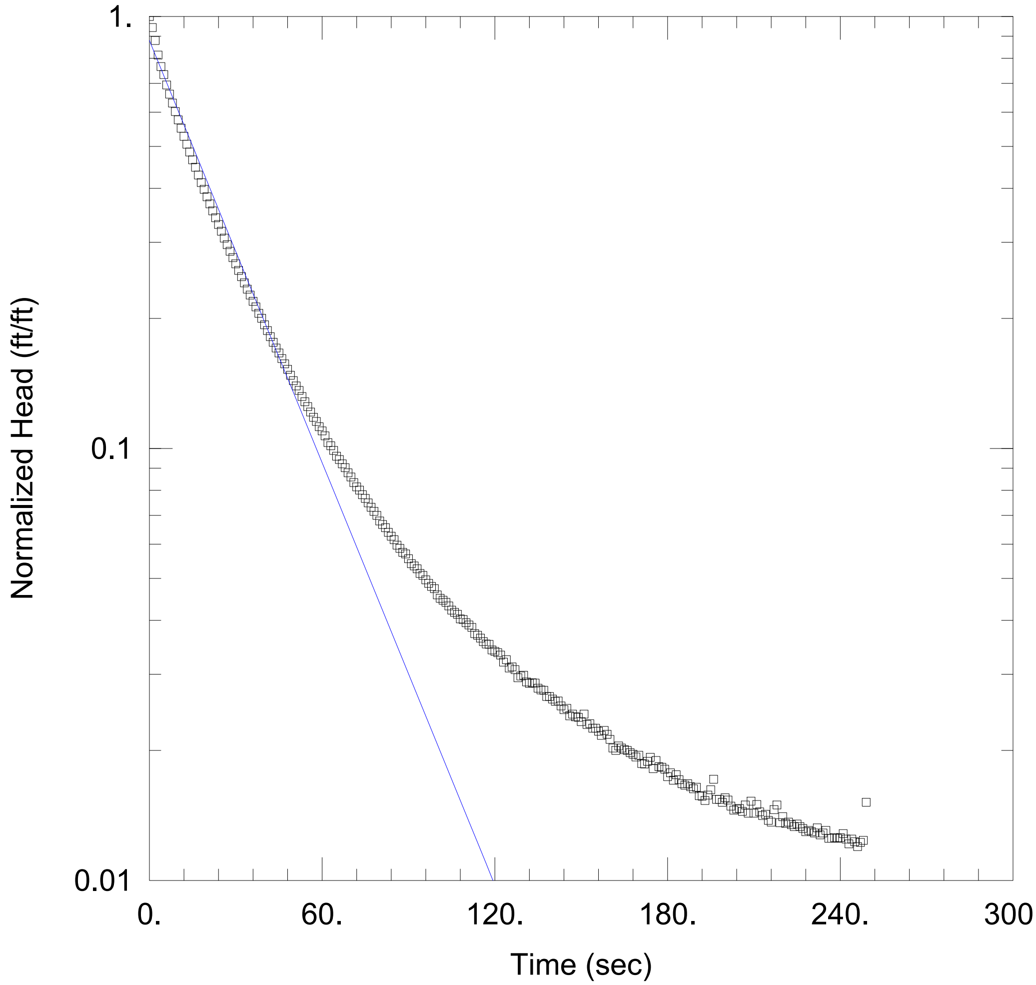
WELL DATA (KC-19-27)

Initial Displacement: -3.195 ft
Total Well Penetration Depth: 41.15 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.75 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 6.14E-5 ft/sec
y0 = -2.084 ft



KC-19-27-OUT2

Data Set: \...\KC-19-27-OUT2.aqt
Date: 05/30/19 Time: 11:23:38

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-27
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 13. ft
Anisotropy Ratio (Kz/Kr): 1.

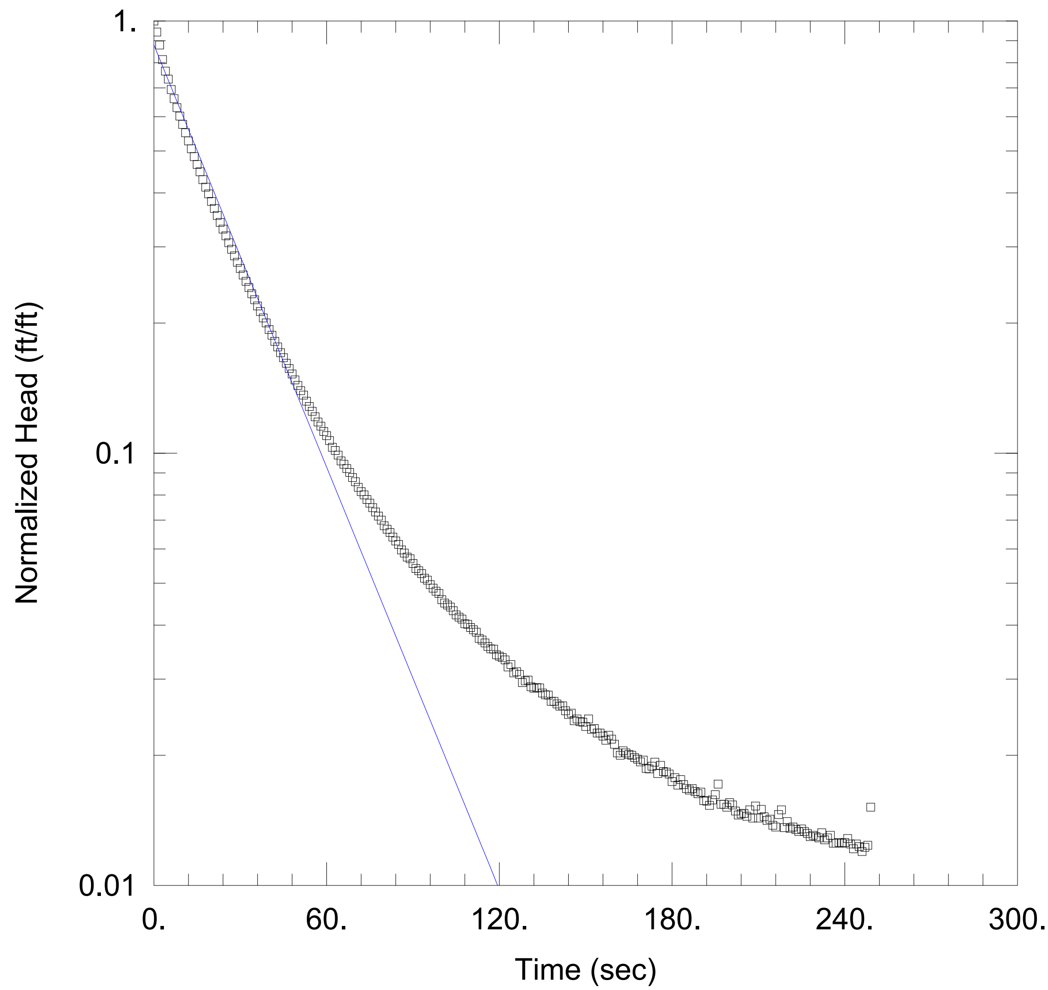
WELL DATA (KC-19-27)

Initial Displacement: -2.221 ft
Total Well Penetration Depth: 41.15 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.75 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 5.918E-5 ft/sec
y0 = -1.954 ft



KC-19-27-OUT2

Data Set: \...\KC-19-27-OUT2.aqt
Date: 05/30/19 Time: 11:24:29

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-27
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 13. ft
Anisotropy Ratio (Kz/Kr): 1.

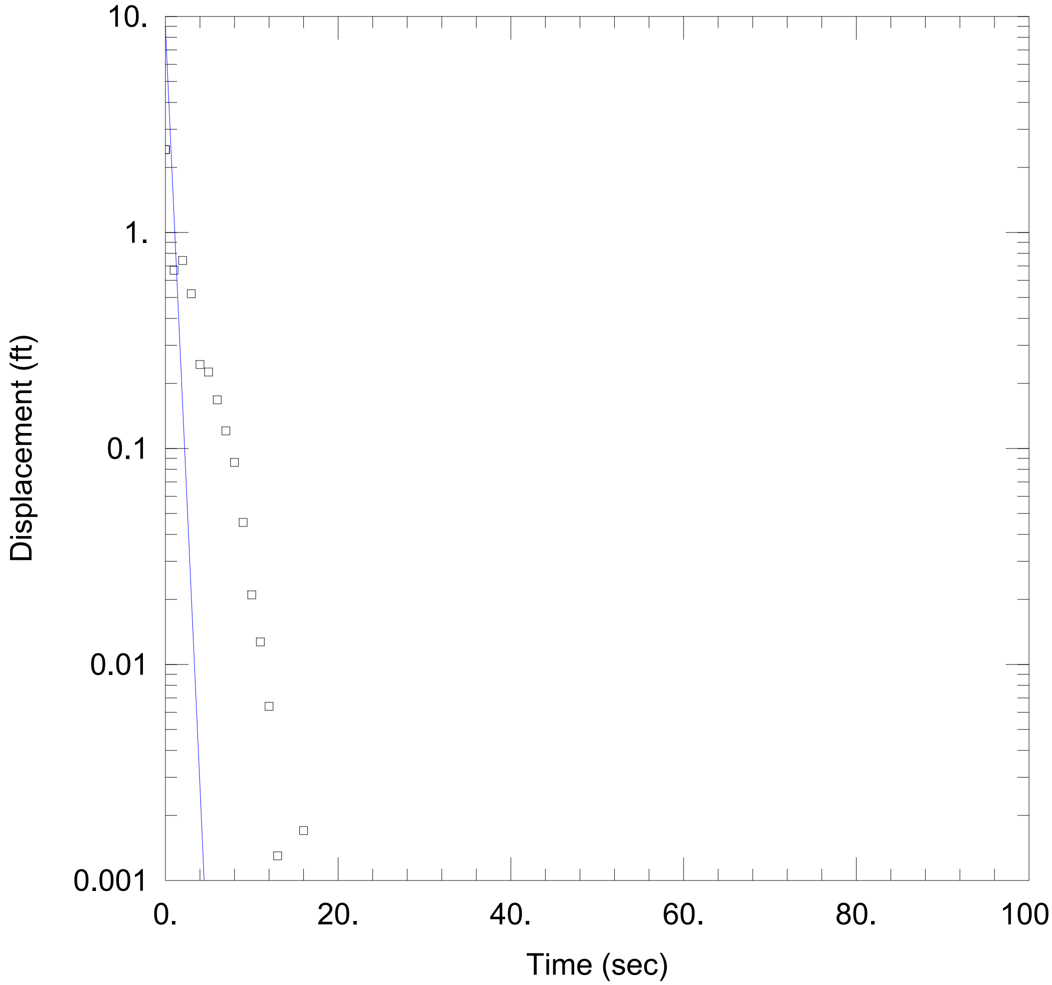
WELL DATA (KC-19-27)

Initial Displacement: -2.221 ft
Total Well Penetration Depth: 41.15 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.75 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 7.081E-5 ft/sec
y0 = -1.953 ft



KC-19-28-IN1

Data Set: \...\KC-19-28-IN1.aqt
Date: 05/30/19 Time: 11:26:52

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-28
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 12. ft Anisotropy Ratio (Kz/Kr): 1.

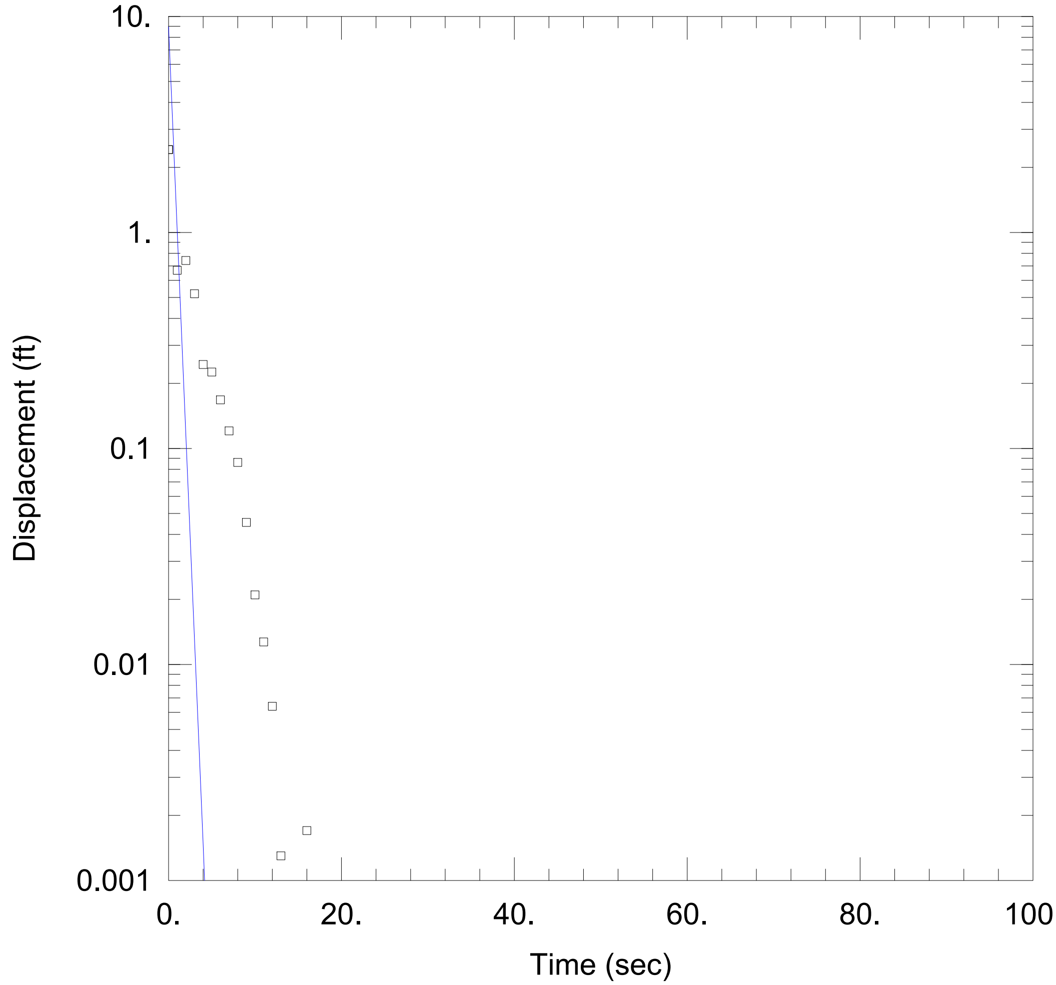
WELL DATA (KC-19-28)

Initial Displacement: 2.416 ft
Total Well Penetration Depth: 44.48 ft
Casing Radius: 0.083 ft
Static Water Column Height: 25.97 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.003224 ft/sec y0 = 8.965 ft



KC-19-28-IN1

Data Set: \...\KC-19-28-IN1.aqt
Date: 05/30/19 Time: 11:27:52

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-28
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 12. ft Anisotropy Ratio (Kz/Kr): 1.

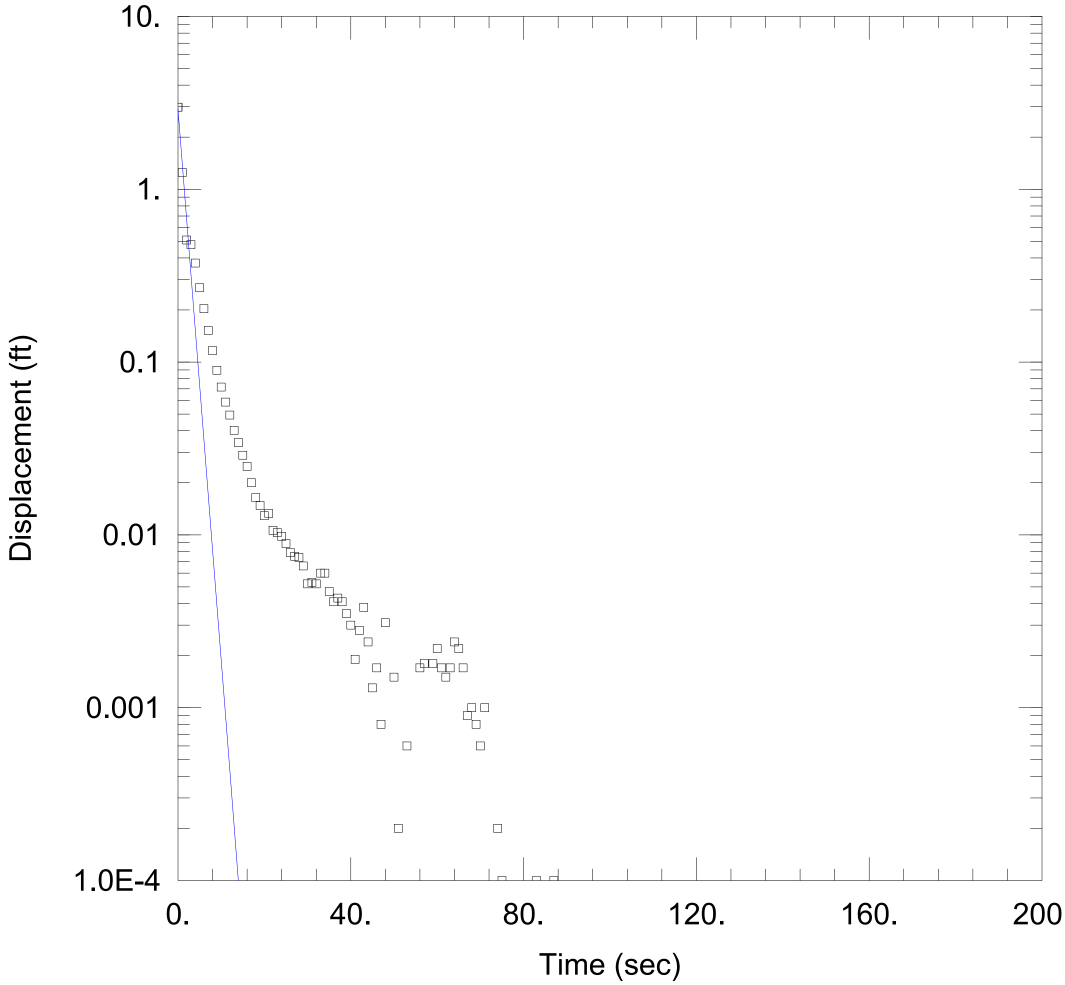
WELL DATA (KC-19-28)

Initial Displacement: 2.416 ft
Total Well Penetration Depth: 44.48 ft
Casing Radius: 0.083 ft
Static Water Column Height: 25.97 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 0.004117 ft/sec y0 = 8.965 ft



KC-19-28-IN2

Data Set: \...\KC-19-28-IN2.aqt
Date: 05/30/19 Time: 11:31:49

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-28
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 12. ft
Anisotropy Ratio (Kz/Kr): 1.

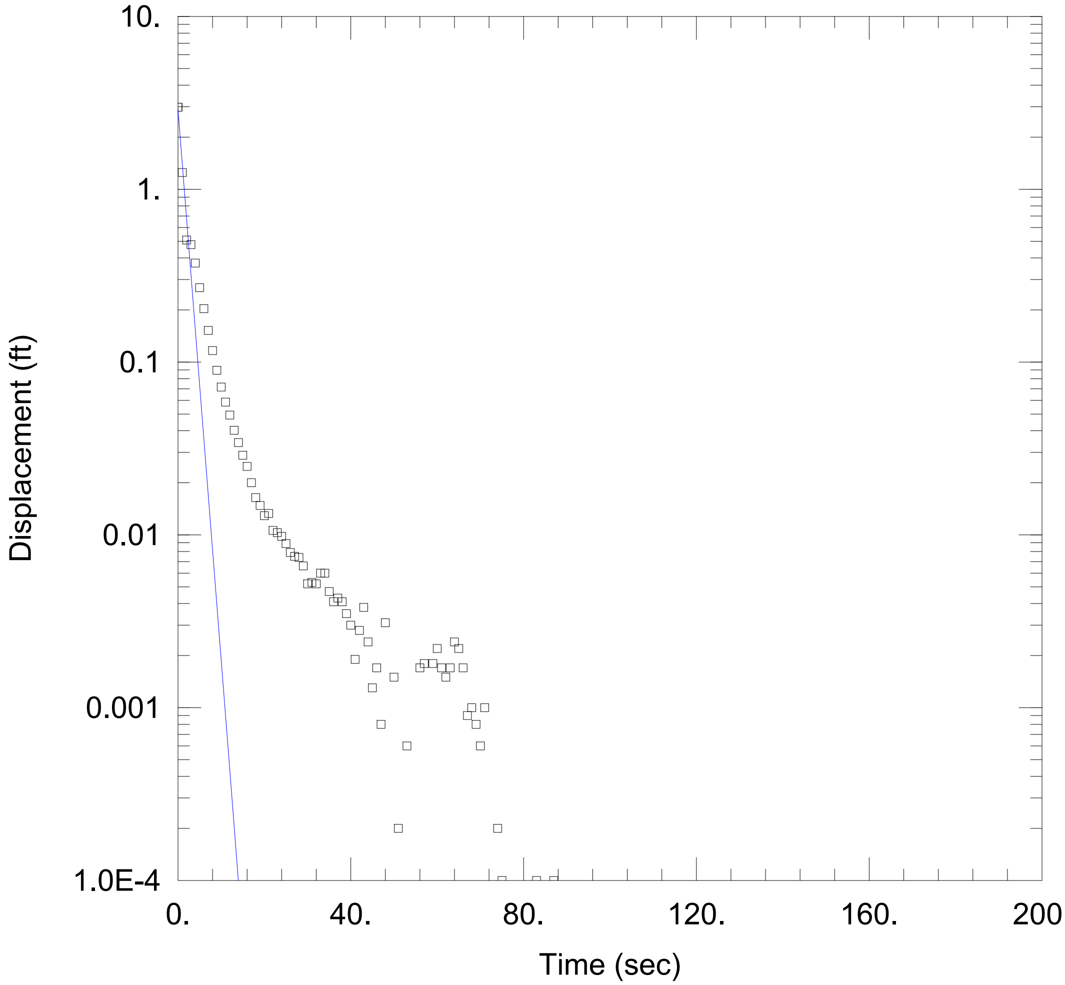
WELL DATA (KC-19-28)

Initial Displacement: 2.979 ft
Total Well Penetration Depth: 44.48 ft
Casing Radius: 0.083 ft
Static Water Column Height: 25.97 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.00117 ft/sec
y0 = 2.909 ft



KC-19-28-IN2

Data Set: \...\KC-19-28-IN2.aqt
Date: 05/30/19
Time: 11:32:56

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-28
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 12. ft
Anisotropy Ratio (Kz/Kr): 1.

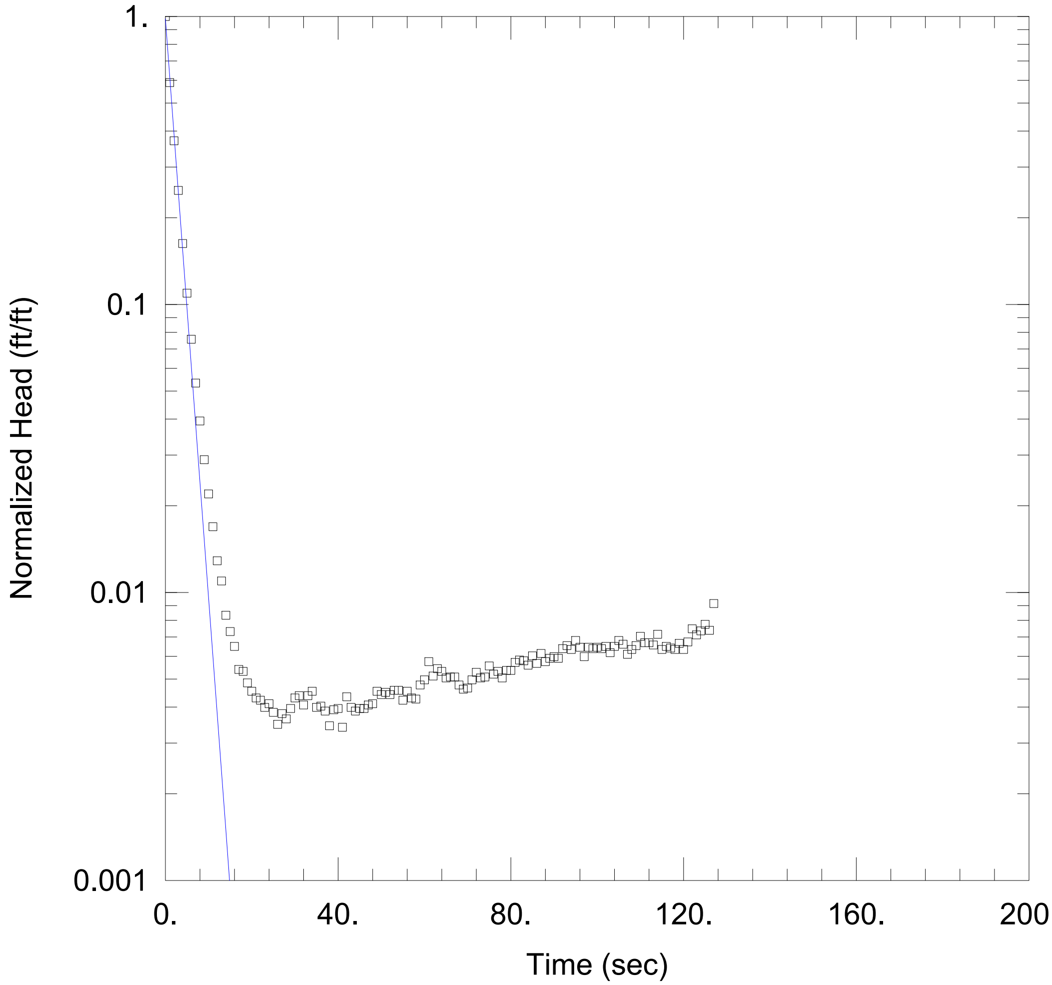
WELL DATA (KC-19-28)

Initial Displacement: 2.979 ft
Static Water Column Height: 25.97 ft
Total Well Penetration Depth: 44.48 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 0.001387 ft/sec
y0 = 2.909 ft



KC-19-28-OUT1

Data Set: \...\KC-19-28-OUT1.aqt
Date: 05/30/19 Time: 11:36:27

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-28
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 12. ft
Anisotropy Ratio (Kz/Kr): 1.

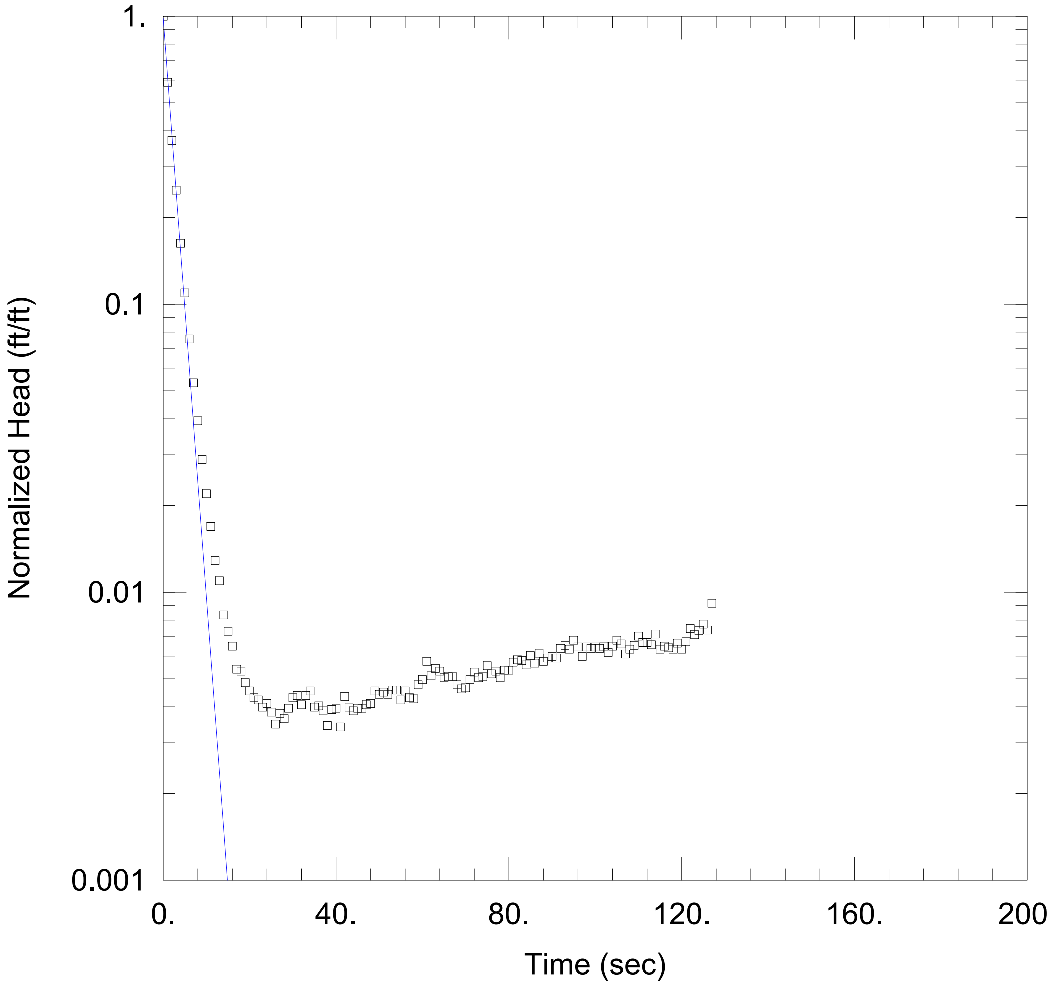
WELL DATA (KC-19-28)

Initial Displacement: -2.557 ft
Total Well Penetration Depth: 44.48 ft
Casing Radius: 0.083 ft
Static Water Column Height: 25.97 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0007384 ft/sec
y0 = -2.508 ft



KC-19-28-OUT1

Data Set: \...\KC-19-28-OUT1.aqt
Date: 05/30/19 Time: 11:37:17

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-28
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 12. ft
Anisotropy Ratio (Kz/Kr): 1.

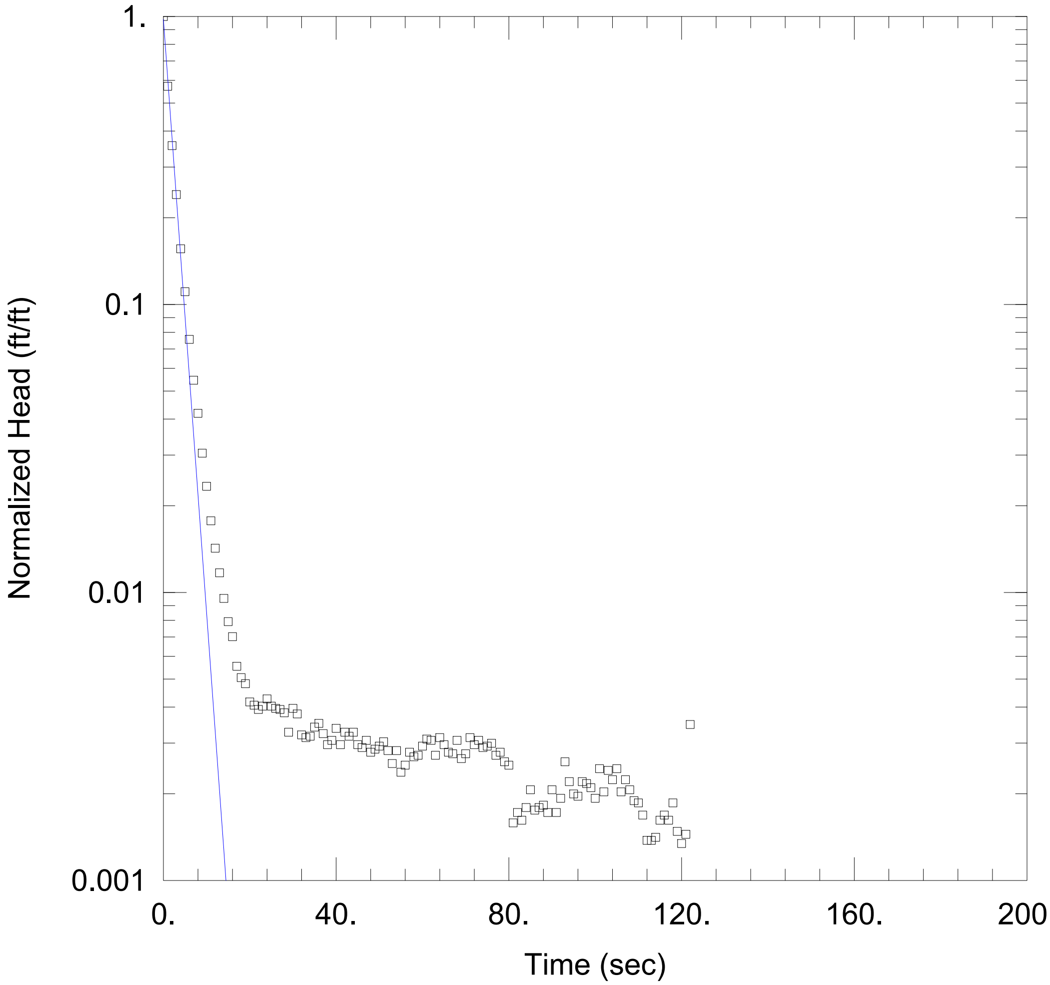
WELL DATA (KC-19-28)

Initial Displacement: -2.557 ft
Total Well Penetration Depth: 44.48 ft
Casing Radius: 0.083 ft
Static Water Column Height: 25.97 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 0.000875 ft/sec
y0 = -2.508 ft



KC-19-28-OUT2

Data Set: \...\KC-19-28-OUT2.aqt
Date: 05/30/19 Time: 11:43:10

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-28
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 12. ft
Anisotropy Ratio (Kz/Kr): 1.

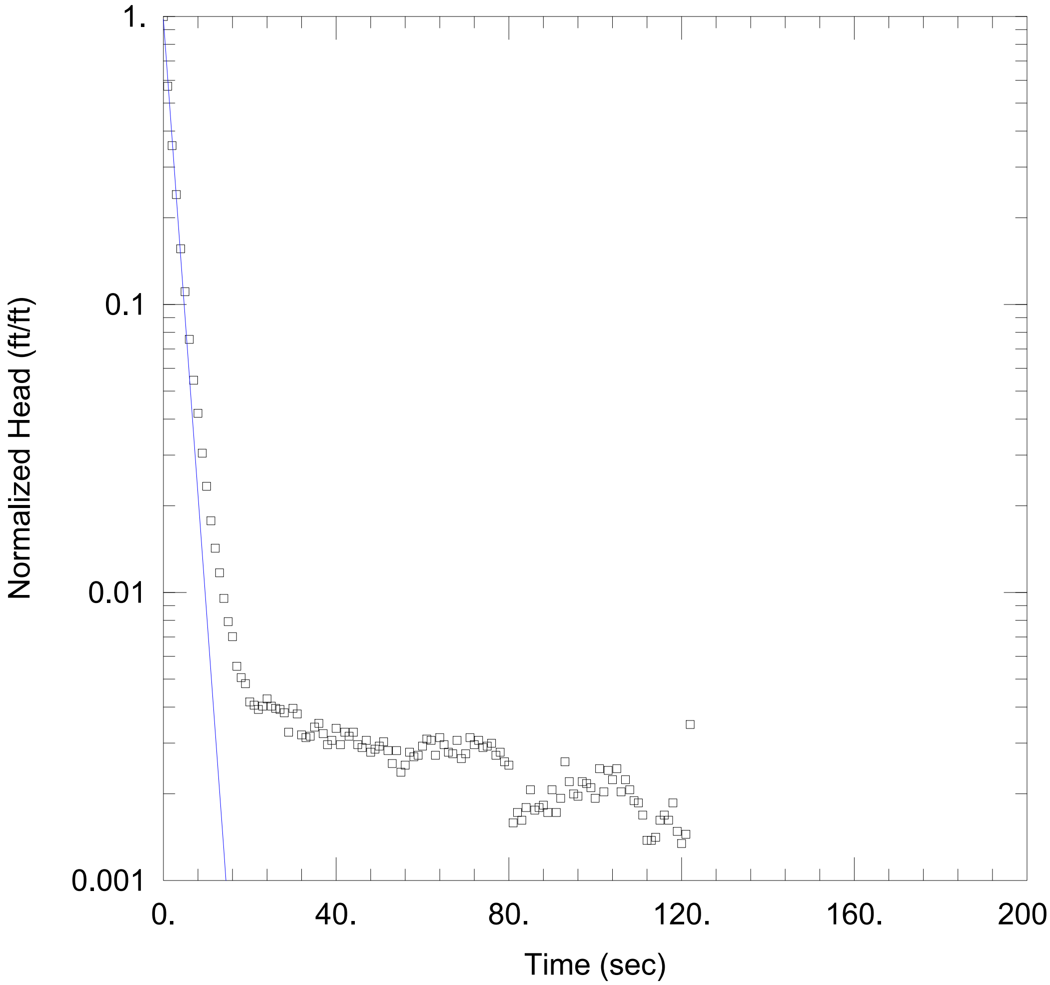
WELL DATA (KC-19-28)

Initial Displacement: -2.905 ft
Total Well Penetration Depth: 44.48 ft
Casing Radius: 0.083 ft
Static Water Column Height: 25.97 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0007565 ft/sec
y0 = -2.838 ft



KC-19-28-OUT2

Data Set: \...\KC-19-28-OUT2.aqt
Date: 05/30/19
Time: 11:44:14

PROJECT INFORMATION

Company: AGES, Inc.
Client: OVEC
Project: 2019052-05
Location: Kyger Creek
Test Well: KC-19-28
Test Date: 4/17/2019

AQUIFER DATA

Saturated Thickness: 12. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (KC-19-28)

Initial Displacement: -2.905 ft
Total Well Penetration Depth: 44.48 ft
Casing Radius: 0.083 ft
Static Water Column Height: 25.97 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 0.0008964 ft/sec
y0 = -2.837 ft