



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

September 19, 2019

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

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 Availability of Assessment of Corrective Measure Report

As required by 40 CFR 257.106(h)(7), on May 15, 2019, the Ohio Valley Electric Corporation (OVEC) provided notification to the Director of the Ohio Environmental Protection Agency that an Assessment of Corrective Measures had been initiated for a confirmed Statistically Significant Increase (SSI) of Appendix IV constituent Arsenic at Kyger Creek Station's boiler slag pond.

Further, as required by 40 CFR 257.96(d), a report detailing the effectiveness of potential corrective measures was prepared by AGES, Inc. using 40 CFR 257.27 as a basis for the selection of potential remedies. Per 40 CFR 257.106(h)(8), this letter provides notification that the report has been placed in the facility's operating record, as well as on the company's publically accessible internet site, and can be viewed at <http://www.ovec.com/CCRCompliance.php>. Prior to the selection of a remedy, OVEC will host a public meeting as detailed in 40 CFR 257.26(d) to discuss the results of the corrective measures assessment with interested and affected parties.

If you have any questions, or require any additional information, I can be reached at (740) 897-7768.

Sincerely,

A handwritten signature in black ink that reads "Tim Fulk".

Tim Fulk
Engineer II

TLF:klr



AGES

Applied Geology And Environmental Science, Inc.

2402 Hookstown Grade Road, Suite 200

Clinton, PA 15026

www.appliedgeology.net

P 412. 264. 6453

F 412. 264. 6567

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
CHESHIRE, OHIO**

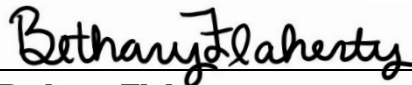
SEPTEMBER 2019

Prepared for:

OHIO VALLEY ELECTRIC CORPORATION (OVEC)

Prepared By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.



Bethany Flaherty
Senior Scientist I



Robert W. King, P.G.
President/Chief Hydrogeologist

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

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION	1
2.0 SITE BACKGROUND.....	2
3.0 GEOLOGY AND HYDROGEOLOGY	2
3.1 Regional Setting.....	2
3.2 Unit-Specific Setting.....	3
4.0 SUMMARY OF GROUNDWATER MONITORING PROGRAM: BOILER SLAG POND	3
4.1 Groundwater Monitoring Network	4
4.2 Groundwater Sampling	4
4.3 Analytical Results	4
4.4 Groundwater Protection Standards-BSP.....	5
5.0 CCR SITE CHARACTERIZATION ACTIVITIES	6
5.1 Grain Size Analysis and Monitoring Well Design	6
5.2 Monitoring Well Installation, Development, Sampling and Testing	7
5.2.1 Monitoring Well Installation.....	7
5.2.2 Monitoring Well Development.....	8
5.2.3 Groundwater Sampling	8
5.2.4 Aquifer Testing	8
5.3 Results of Site Characterization.....	9
5.3.1 Site Geology Updates	9
5.3.2 Groundwater Flow	9
5.3.3 Slug Testing	9
5.3.4 Groundwater Flow Velocity	9
5.3.5 Groundwater Sampling Results	10
6.0 ASSESSMENT OF CORRECTIVE MEASURES.....	10
6.1 Objectives of Remedial Technology Evaluation	10
6.2 Potential Source Control Measures.....	11
6.3 Potential Remedial Technologies	11
6.3.1 In-Situ Groundwater Remedial Technologies	12
6.3.2 Ex-Situ Groundwater Remedial Technologies	14
6.3.3 Treatment of Extracted Groundwater	14
6.4 Evaluation to Meet Requirements in 40 CFR § 257.96(c).....	16
6.4.1 Performance	17

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

**T A B L E O F C O N T E N T S
(continued)**

<u>Section</u>	<u>Page</u>
6.4.2 Reliability.....	19
6.4.3 Ease of Implementation	20
6.4.4 Potential Safety Impacts	21
6.4.5 Potential Cross-Media Impacts	21
6.4.6 Potential Impacts from Control of Exposure to Residual Constituents	22
6.4.7 Time Required to Begin Remedy	23
6.4.8 Time Required to Complete Remedy	23
6.4.9 State, Local, or Other Environmental Permit Requirements That May Impact Implementation	24
6.5 Conclusions.....	25
7.0 SELECTION OF REMEDY PROCESS.....	26
7.1 Data Gaps.....	26
7.2 Selection of Remedy	27
7.3 Public Meeting Requirement in 40 CFR § 257.96(e)	27
7.4 Final Remedy Selection	27
8.0 REFERENCES	28

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

**TABLE OF CONTENTS
(continued)**

LIST OF TABLES

- 4-1 Groundwater Monitoring Network – Boiler Slag Pond
- 4-2 Summary of Potential and Confirmed Appendix III SSIs – Boiler Slag Pond
- 4-3 Groundwater Protection Standards – Boiler Slag Pond
- 5-1 Grain Size Analysis Results
- 5-2 New Monitoring Well Construction Details
- 5-3 Summary of Well Development Data
- 5-4 Summary of Groundwater Elevation Data
- 5-5 Summary of Slug Test Results
- 5-6 Summary of Groundwater Velocity Calculations
- 5-7 Summary of Groundwater Analytical Results
- 6-1 Source Control Technologies Screening Matrix
- 6-2 In-Situ and Ex-Situ Groundwater Remedial Technologies Screening Matrix

LIST OF FIGURES

- 2-1 Site Location Map
- 3-1 Generalized Geologic Cross Section - Boiler Slag Pond
- 4-1 Existing Monitoring Well Location Map
- 5-1 Existing and New Monitoring Well Locations – Boiler Slag Pond
- 5-2 Groundwater Elevations and Flow Map – June 2019 – Boiler Slag Pond
- 5-3 Arsenic in Groundwater Results March 2019 and April 2019 – Boiler Slag Pond

LIST OF APPENDICES

- A Groundwater Flow Maps for 2018
- B Analytical Results for 2018 Groundwater Monitoring
- C Grain Size Analysis Lab Reports
- D Well Boring and Construction Logs
- E Slug Test Results

LIST OF ACRONYMS

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
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 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 (°C) 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 Groundwater Sampling Results

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 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 In-Situ Groundwater Remedial Technologies

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 ($\text{FeAsO}_4 \cdot 2 \text{H}_2\text{O}$); 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

Applied Geology and Environmental Science, Inc. (AGES) 2019. Coal Combustion Residuals Regulation 2018 Groundwater Monitoring and Corrective Action Report. Ohio Valley Electric Corporation, Kyger Creek Station, Cheshire, Gallia County, Ohio. Revision 1.0. February 2019.

Applied Geology and Environmental Science, Inc. (AGES), 2018. Coal Combustion Residuals Regulation Alternate Source Demonstration Report, February/March 2018 Detection Monitoring Event, Ohio Valley Electric Corporation, Kyger Creek Station, Cheshire, Gallia County, Ohio. September 2018.

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.

Fetter, Charles W. 1980. Applied Hydrogeology. Merrill. 1980.

Ford, R., Wilkin, R. and Puls, R. (Editors), 2007. Monitored Natural Attenuation of Inorganic Contaminants in Groundwater, National Risk Management Research Laboratory, EPA 600/R-07/140, Volume 2.

Reinsel, M. 2015. Arsenic Removal Technologies: A Review, www.wateronline.com.

Smedley, P. and Kinniburgh, D. 2002. A Review of the Source Behavior and Distribution of Arsenic in Natural Waters, Journal of Applied Geochemistry, Volume 17, Issue 5.

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.

United States Environmental Protection Agency (U.S.EPA), 2002. Office of Solid Waste and Emergency Response. Arsenic Treatment Technologies for Soil, Waste, and Water. EPA 542-R-02-004. June 2002.

United States Environmental Protection Agency (U.S. EPA) 1991. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. March 1991.

Wang S. and Mulligan, C. 2006. Natural Attenuation Processes for Remediation of Arsenic Contaminated Soils and Groundwater, Journal of Hazardous Materials, Volume 138, Issue 3.

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:

h₁ = Head elevation in well #1

h₂ = 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

Parameter	Well ID	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

	<i>Source Control Technologies</i>		
	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**

	<i>In-Situ Groundwater Remedial Technologies</i>				<i>Ex-Situ Groundwater Remedial Technologies</i>		
	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.

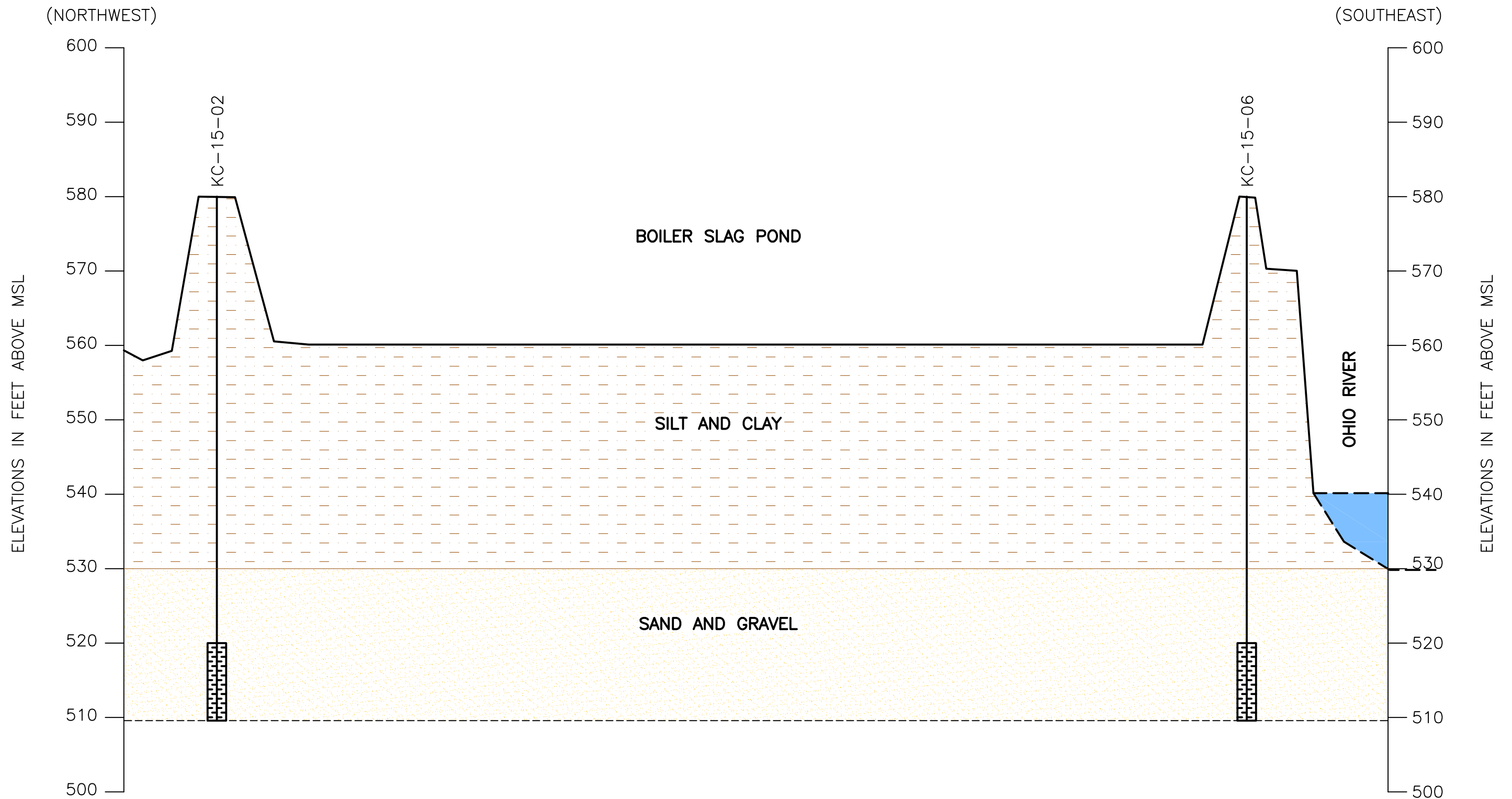
FIGURES



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

AGES
Applied Geology And Environmental Science, Inc.
2402 Hookstown Grade Road, Suite 200
Clinton, PA 15026
412.264.6453

OHIO VALLEY ELECTRIC COMPANY	
KYGER CREEK STATION CHESHIRE, GALLIA COUNTY, OHIO SITE LOCATION MAP	
DRAWING NAME	FIGURE 2-1
REV.	0

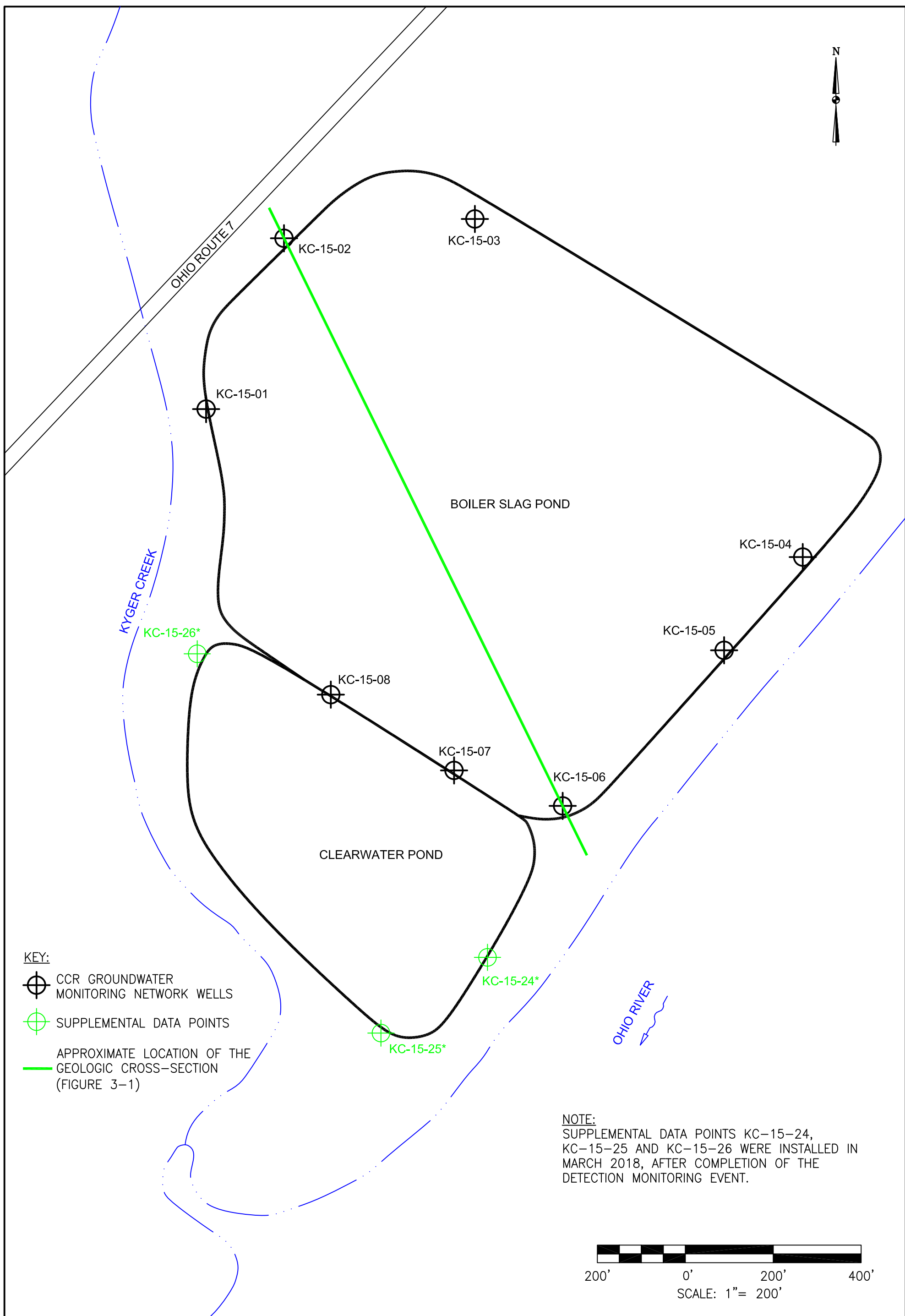


NOTE:
 THE APPROXIMATE LOCATION OF THE CROSS-SECTION
 IS ILLUSTRATED ON FIGURE 4-1.

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

AGES
 Applied Geology And Environmental Science, Inc.
 2402 Hookstown Grade Road, Suite 200
 Clinton, PA 15026
 412.264.6453

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



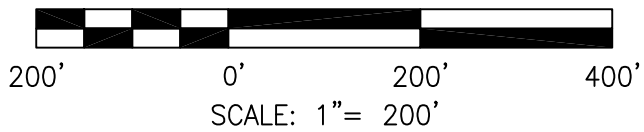
KEY:

CCR GROUNDWATER MONITORING NETWORK WELLS

SUPPLEMENTAL DATA POINTS

APPROXIMATE LOCATION OF THE GEOLOGIC CROSS-SECTION (FIGURE 3-1)

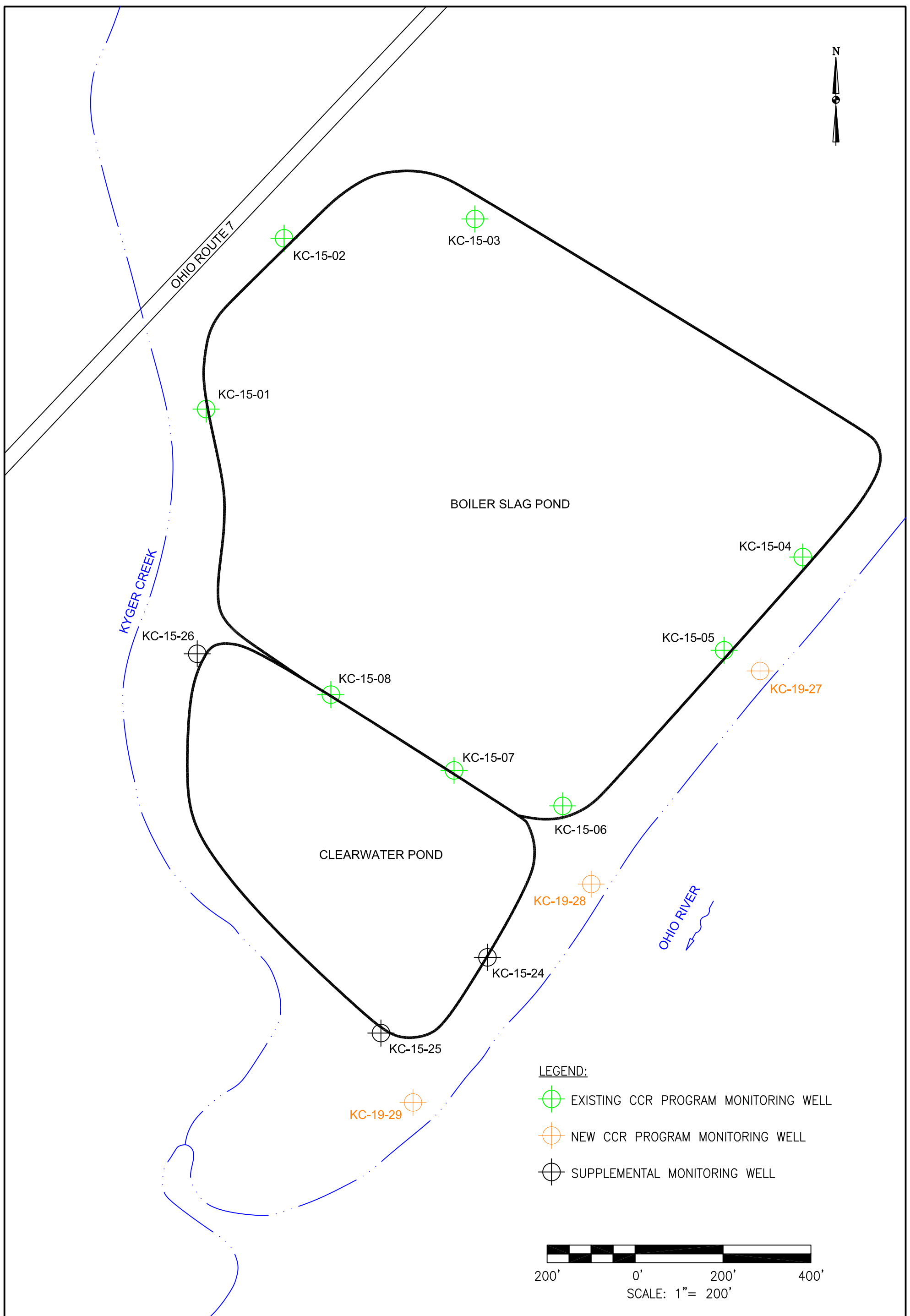
NOTE:
SUPPLEMENTAL DATA POINTS KC-15-24, KC-15-25 AND KC-15-26 WERE INSTALLED IN MARCH 2018, AFTER COMPLETION OF THE DETECTION MONITORING EVENT.






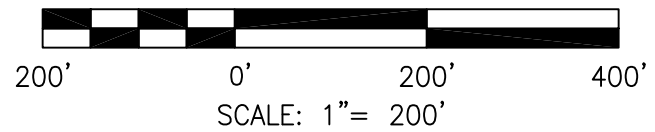
DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019109-1-KYGER
DWG FILE	2019 ACM_KYGER_Fig 4-1_BSP_MW LOCs.dwg
DRAWING SCALE	1"=200'

AGES
Applied Geology And Environmental Science, Inc.
2402 Hookstown Grade Road, Suite 200
Clinton, PA 15026
412.264.6453


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



- LEGEND:**
-  EXISTING CCR PROGRAM MONITORING WELL
 -  NEW CCR PROGRAM MONITORING WELL
 -  SUPPLEMENTAL MONITORING WELL

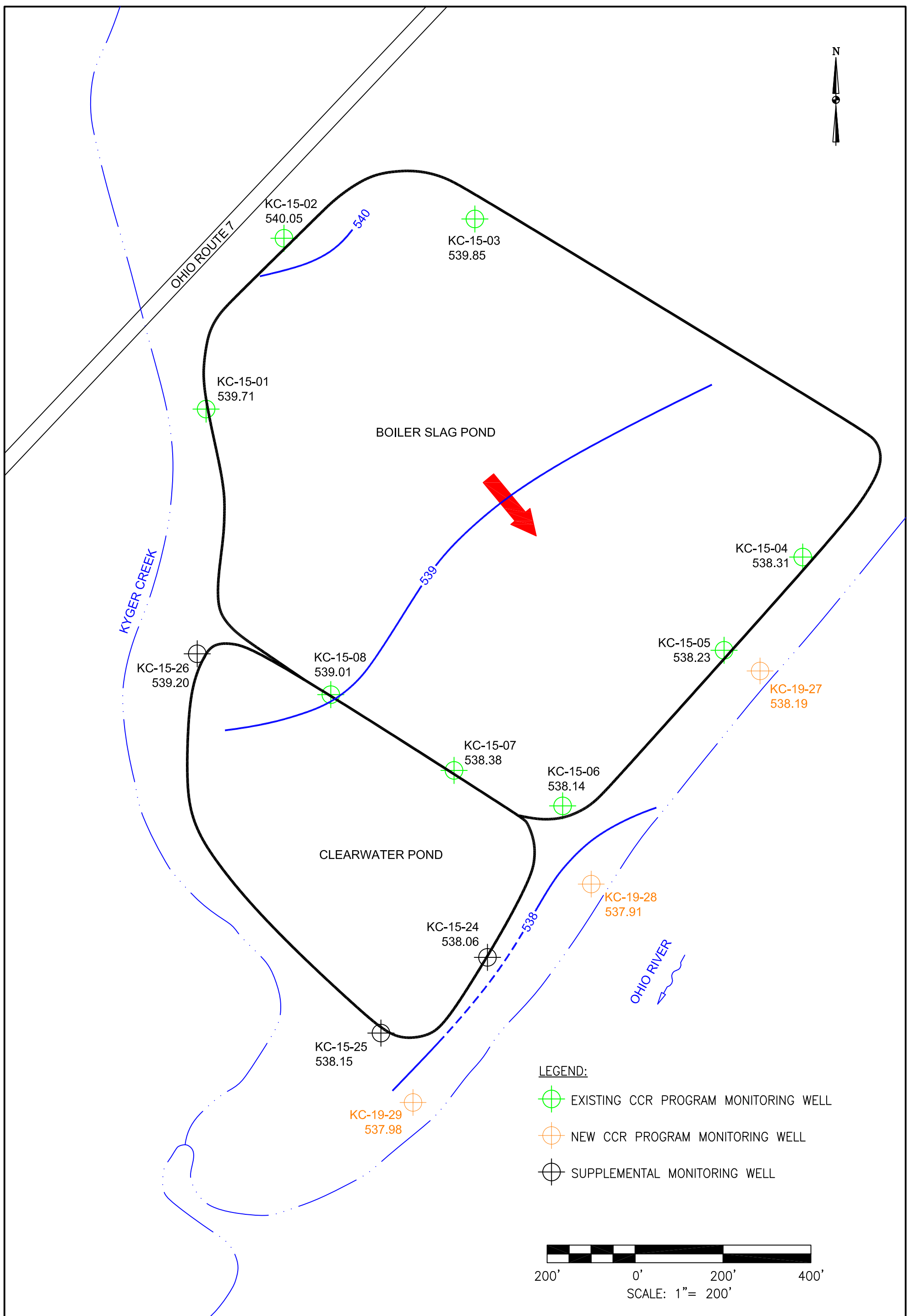


DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019109-1-KYGER
DWG FILE	2019 ACM_KYGER_Fig 5-1_BSP_MWs&SBs.dwg
DRAWING SCALE	1"=200'

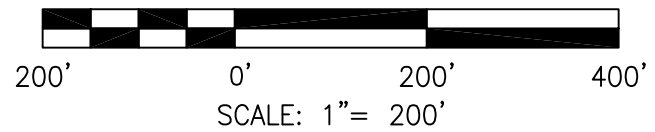


AGES
Applied Geology And Environmental Science, Inc.
2402 Hookstown Grade Road, Suite 200
Clinton, PA 15026
412.264.6453

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



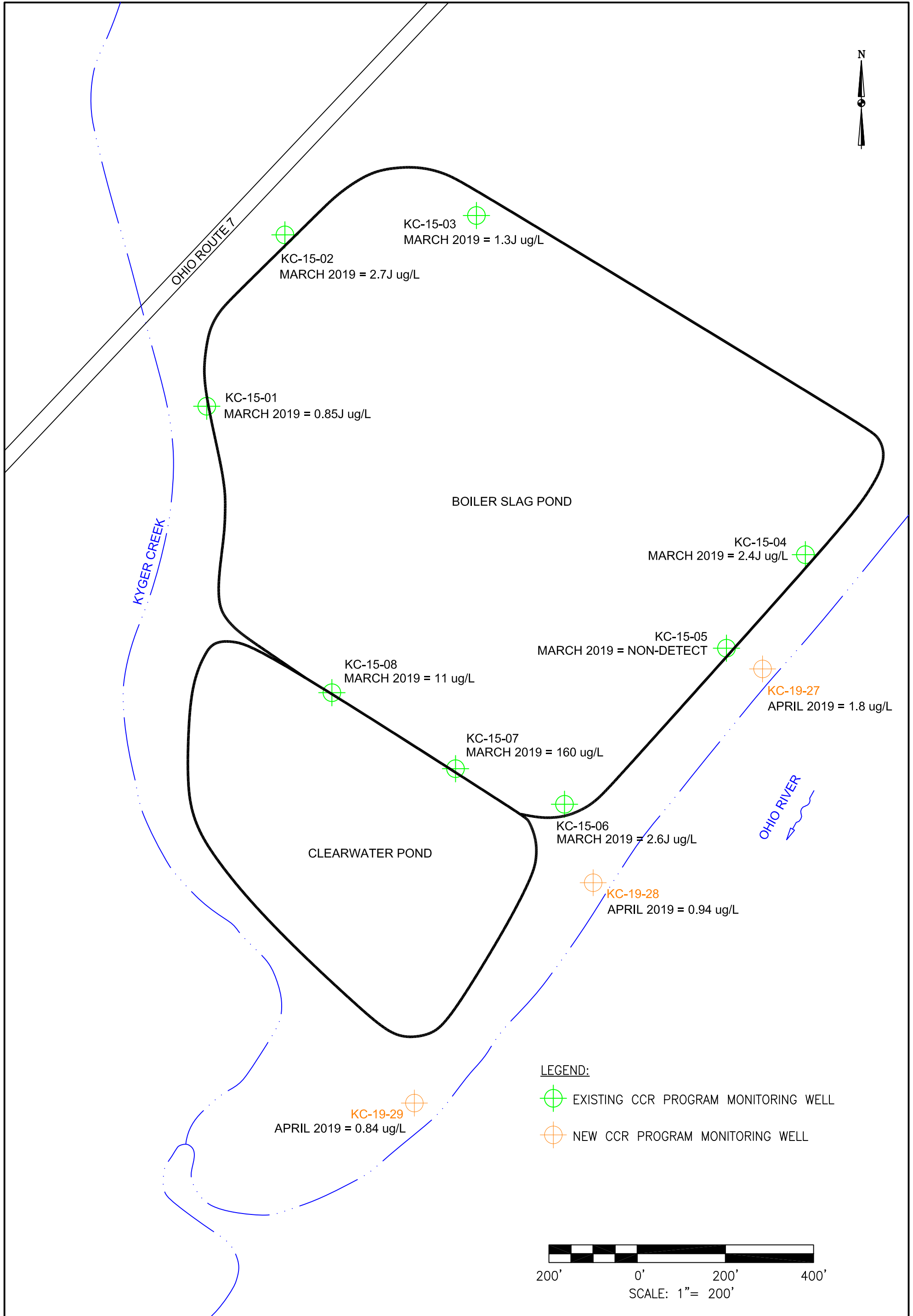
- LEGEND:**
- EXISTING CCR PROGRAM MONITORING WELL
 - NEW CCR PROGRAM MONITORING WELL
 - SUPPLEMENTAL MONITORING WELL



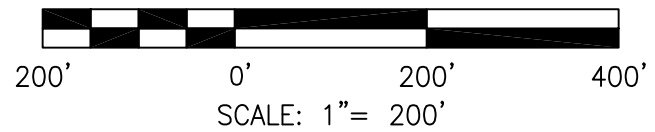
DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019109-1-KYGER
DWG FILE	2019 ACM_KYGER_Fig 5-2_BSP_GW Contours_JUN19.dwg
DRAWING SCALE	1"=200'

AGES
Applied Geology And Environmental Science, Inc.
2402 Hookstown Grade Road, Suite 200
Clinton, PA 15026
412.264.6453

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



LEGEND:
 EXISTING CCR PROGRAM MONITORING WELL
 NEW CCR PROGRAM MONITORING WELL



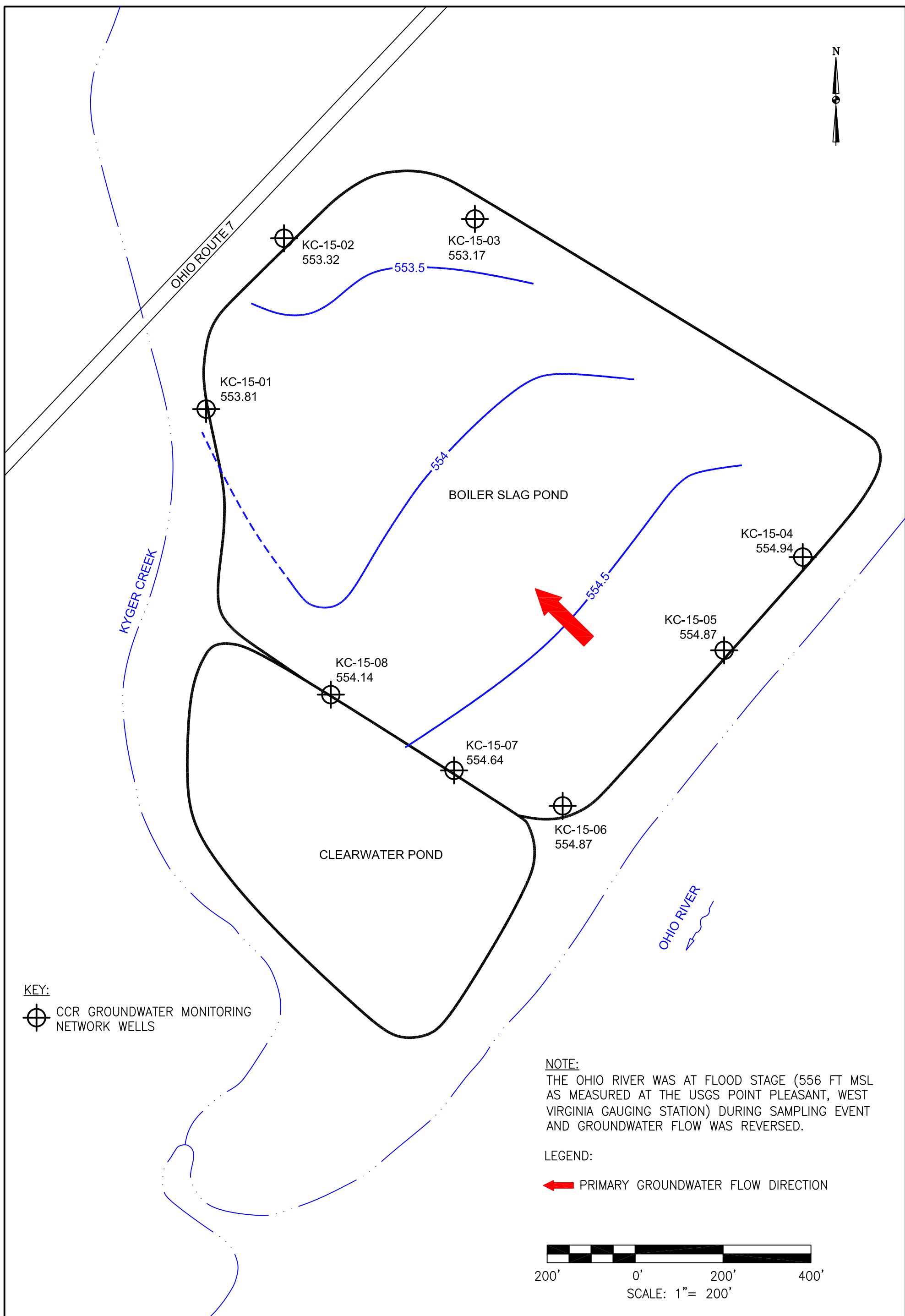
DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019109-1-KYGER
DWG FILE	2019 ACM_KYGER_Fig 5-3_BSP_Arsenic.dwg
DRAWING SCALE	1"=200'

AGES
 Applied Geology And Environmental Science, Inc.
 2402 Hookstown Grade Road, Suite 200
 Clinton, PA 15026
 412.264.6453

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

APPENDIX A

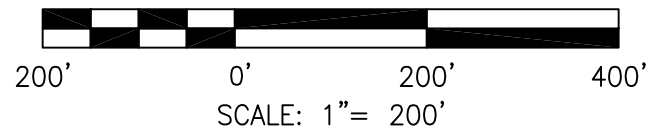
GROUNDWATER FLOW MAPS FOR 2018




KEY:
 CCR GROUNDWATER MONITORING NETWORK WELLS

NOTE:
 THE OHIO RIVER WAS AT FLOOD STAGE (556 FT MSL AS MEASURED AT THE USGS POINT PLEASANT, WEST VIRGINIA GAUGING STATION) DURING SAMPLING EVENT AND GROUNDWATER FLOW WAS REVERSED.

LEGEND:
 PRIMARY GROUNDWATER FLOW DIRECTION

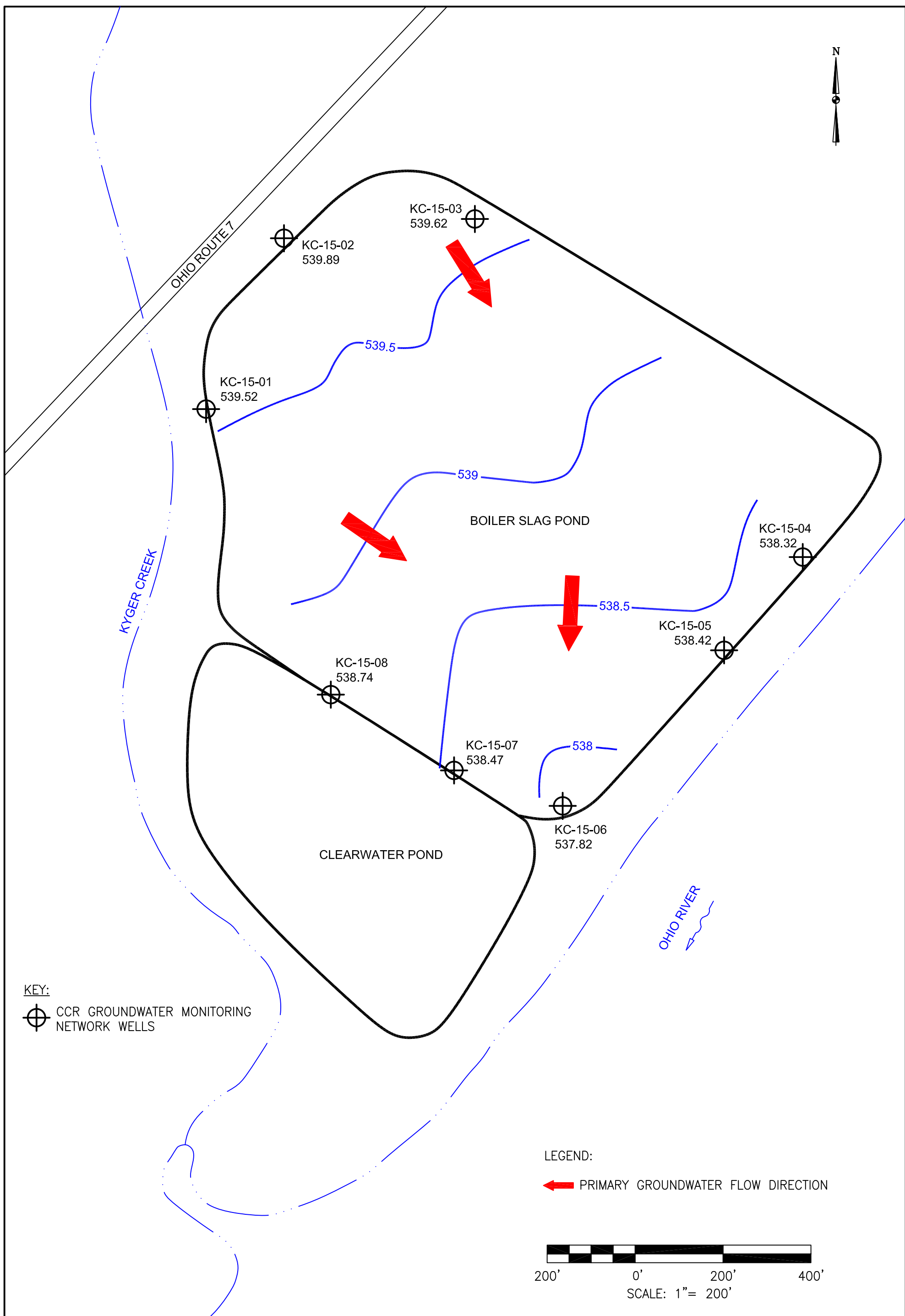


DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2019109-1-KYGER
DWG FILE	2019 ACM_KYGER_Fig A-1_BSP_Contours_FEB-18.dwg
DRAWING SCALE	1"=200'



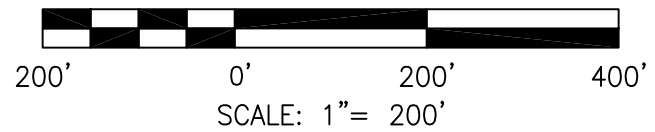
AGES
 Applied Geology And Environmental Science, Inc.
 2402 Hookstown Grade Road, Suite 200
 Clinton, PA 15026
 412.264.6453

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




KEY:
 CCR GROUNDWATER MONITORING NETWORK WELLS

LEGEND:
 PRIMARY GROUNDWATER FLOW DIRECTION



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'



AGES
 Applied Geology And Environmental Science, Inc.
 2402 Hookstown Grade Road, Suite 200
 Clinton, PA 15026
 412.264.6453

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

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

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

 Project Number 175534017
 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		% Passing
Sieve Size	(mm)	
	N/A	
	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 (%)

Range	ASTM (%)	AASHTO (%)
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/ft³): N/A
 Maximum Dry Density (kg/m³): 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/ft³): 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)

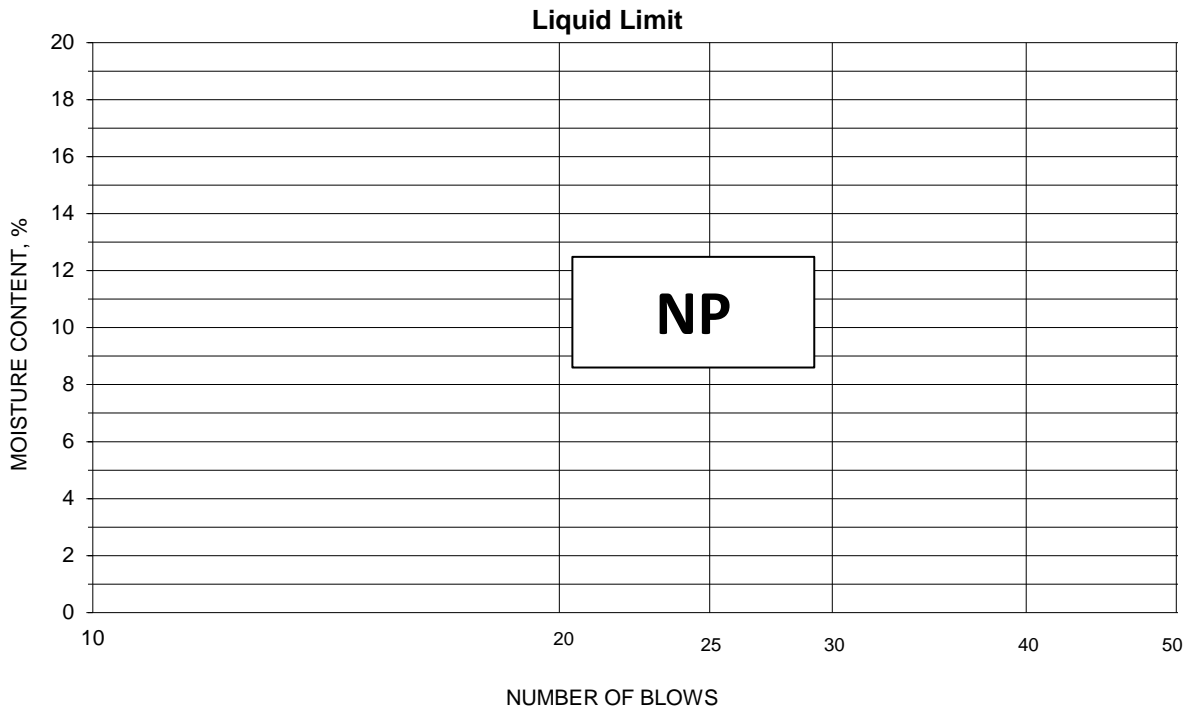
 Comments: _____

 Reviewed By JS

Project Kyger Creek CCR Rule - Groundwater
 Source KC-19-27-28-38
 Tested By MP Test Method ASTM D 4318 Method A
 Test Date 04-11-2019 Prepared Dry

Project No. 175534017
 Lab ID 7
 % + No. 40 1
 Date Received 04-09-2019

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



Summary of Soil Tests

Project Name Kyger Creek CCR Rule - Groundwater
 Source KC-19-28-30-40

Project Number 175534017
 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		% Passing
Sieve Size	(mm)	
	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/ft³): N/A
 Maximum Dry Density (kg/m³): 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/ft³): 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

Project Kyger Creek CCR Rule - Groundwater
 Source KC-19-28-30-40

 Project No. 175534017

 Lab ID 8

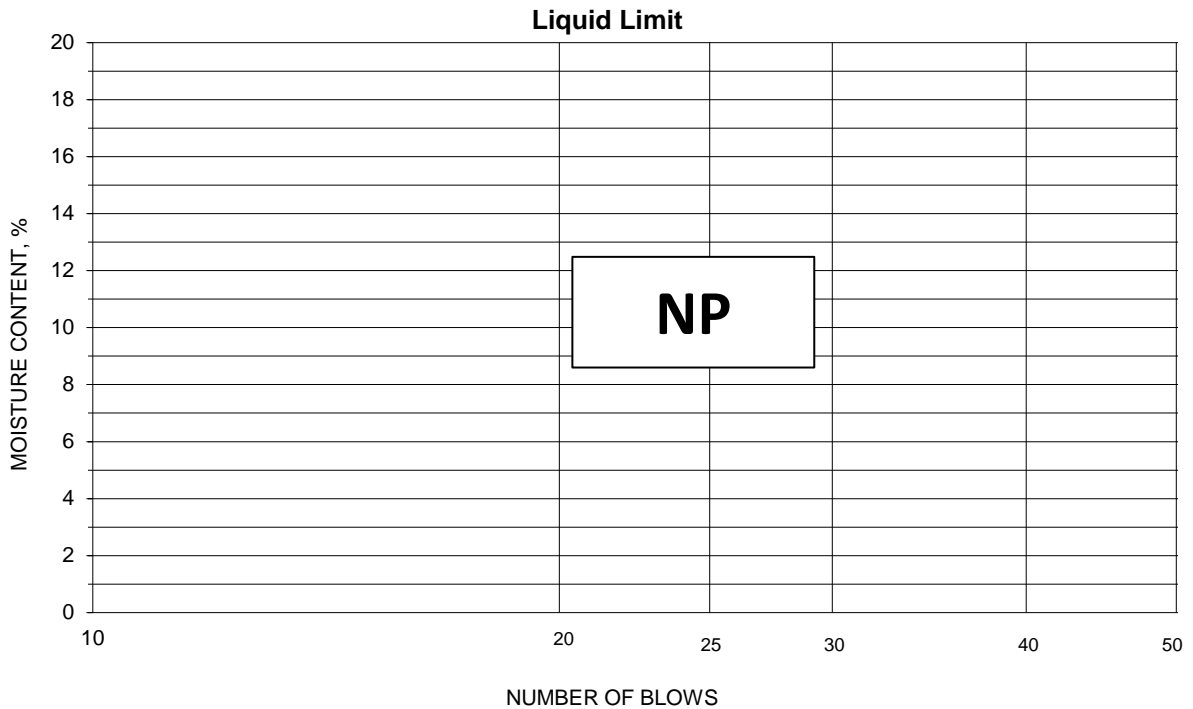
 % + No. 40 4

 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

Project Name Kyger Creek CCR Rule - Groundwater
 Source KC-19-29-32-42

 Project Number 175534017
 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		% Passing
Sieve Size	(mm)	
	N/A	
	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/ft³): N/A
 Maximum Dry Density (kg/m³): 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/ft³): 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)

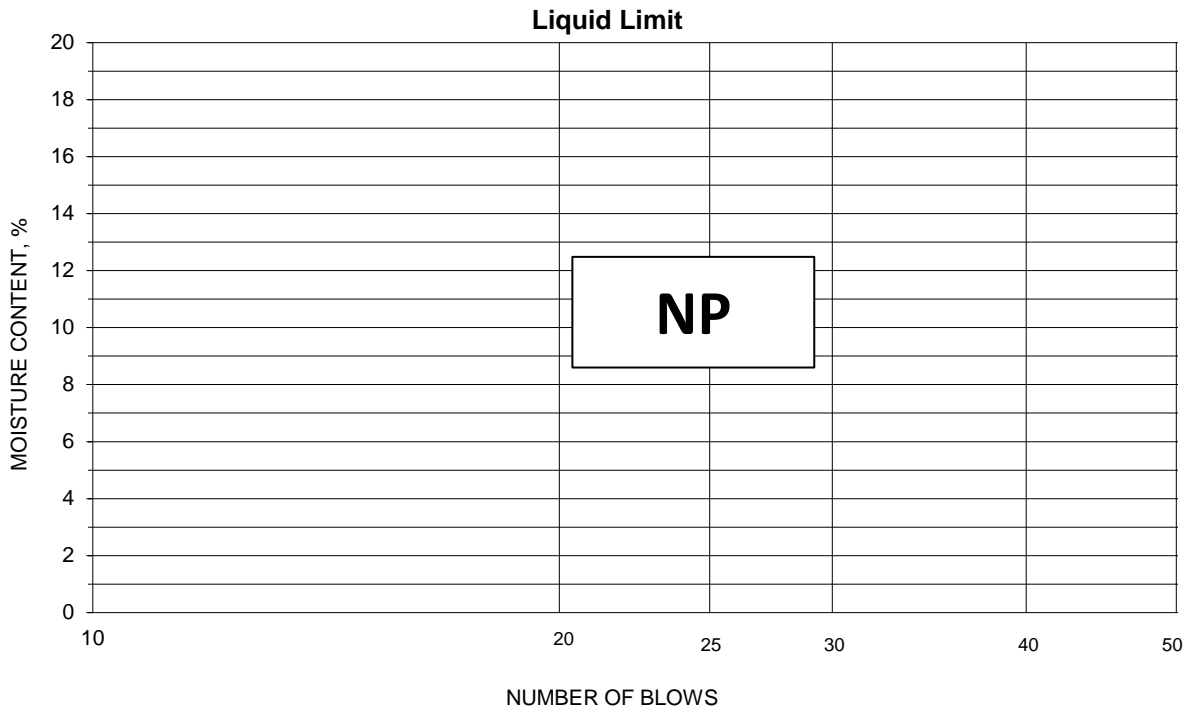
Comments: _____

 _____ Reviewed By JS

Project Kyger Creek CCR Rule - Groundwater
 Source KC-19-29-32-42
 Tested By MP Test Method ASTM D 4318 Method A
 Test Date 04-11-2019 Prepared Dry

Project No. 175534017
 Lab ID 9
 % + No. 40 1
 Date Received 04-09-2019

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

APPENDIX D

WELL BORING AND CONSTRUCTION LOGS

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

Project Number: <u>2019052</u>	Log Page <u>1</u> of <u>2</u>
Project Location: <u>Kyger Creek Plant Boiler Slag Pond</u>	Drilling Contractor: <u>HAD</u>
Drilling Date(s): <u>4/4/2019 to 4/5/2019</u>	AGES Geologist: <u>Mike Gelles</u>
Drilling Method: <u>Hollow Stem Auger</u>	Coring Device Size: <u>NA</u> Hammer Wt. <u>NA</u> and Drop <u>NA</u>
Sampling Method: <u>NA</u>	Borehole Diameter: <u>6"</u> Drilling Fluid Used: <u>Water</u>
Sampling Interval: <u>NA</u>	Borehole Depth: <u>38'</u> Surface Elevation: <u>558.22' msl</u>
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

Page 2 of 2

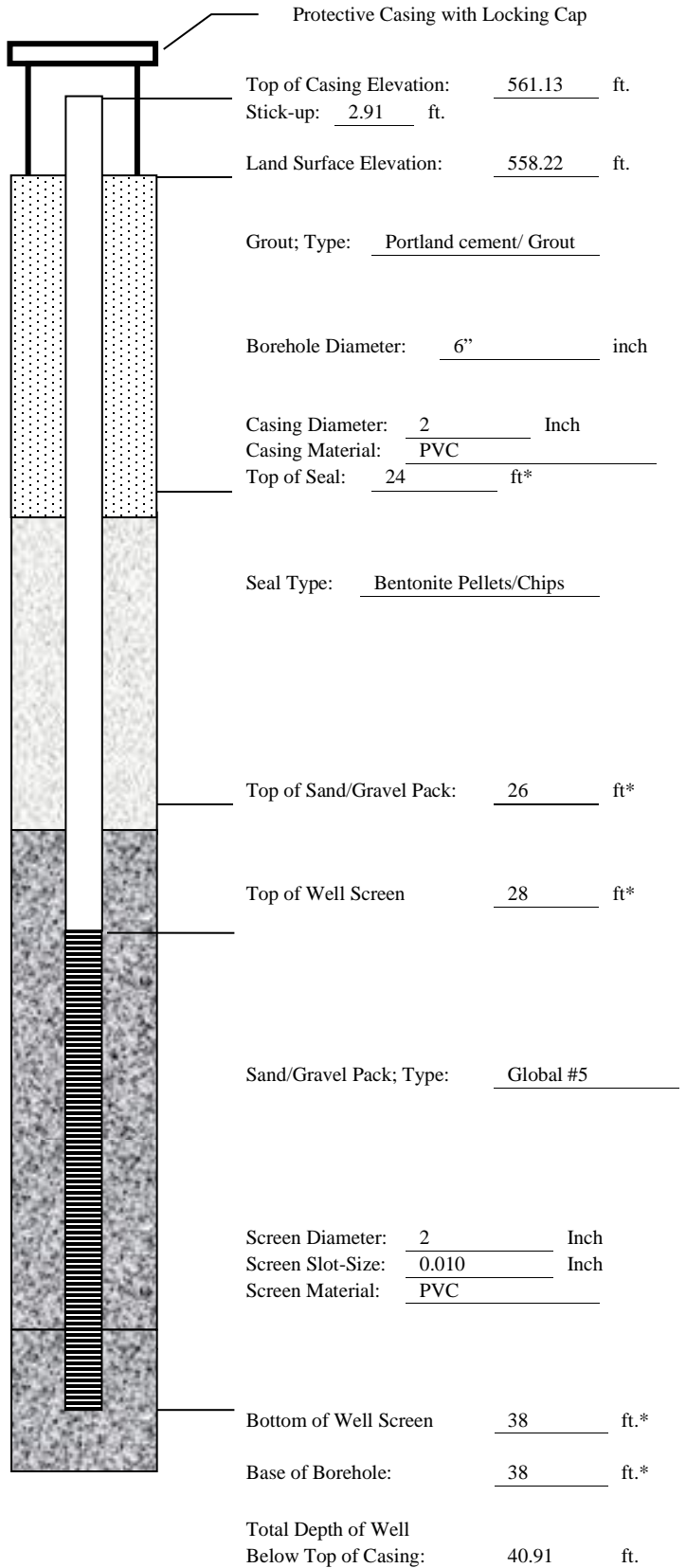
34-36	2	2-3-3-4	Brown sand, fine and medium, wet, loose, some gray sandy clay	N/A
36-38	2	1-1-4-5	Brown sand, fine and medium, wet, loose, some gray sand, fine and medium	N/A

WELL CONSTRUCTION LOG

WELL NO. KC-19-27

Project Number:	<u>2019052</u>
Project Location:	<u>Kyger Creek Plant – Boiler Slag Pond</u>
Installation Date(s):	<u>4/4/2019-4/5/2019</u>
Drilling Method:	<u>Hollow Stem Auger</u>
Drilling Contractor:	<u>HAD</u>
Development Date(s):	<u>4/8/2019</u>
Development Method:	<u>Pump & Surge until Field Parameters stabilized Turbidity = 4.89 NTUs</u>
Volume Purged:	<u>213 gallons</u>
Static Water-Level*:	<u>22.25'</u>
Top of Well Casing Elevation:	<u>561.13' msl</u>
Well Purpose:	<u>Groundwater Monitoring</u>
Northing (Y):	<u>331507.38</u>
Easting (X):	<u>2073611.935</u>
Comments/Notes:	<u>2 inch PVC riser and screen</u> <u>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.</u>
Inspector:	<u>Michael Gelles</u>

CONSTRUCTION MATERIALS USED:	
<u>3</u>	Bags of Sand
<u>1</u>	Bags/Buckets Bentonite Pellets
<u>8</u>	Bags Portland for Grout
<u> </u>	Bags Concrete/Sakrete



*Indicates Depth Below Land Surface

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

Project Number: <u>2019052</u>	Log Page <u>1</u> of <u>2</u>
Project Location: <u>Kyger Creek Boiler Slag Pond</u>	Drilling Contractor: <u>HAD</u>
Drilling Date(s): <u>4/4/2019</u>	AGES Geologist: <u>Mike Gelles</u>
Drilling Method: <u>Hollow Stem Auger</u>	Coring Device Size: <u>NA</u> Hammer Wt. <u>NA</u> and Drop <u>NA</u>
Sampling Method: <u>NA</u>	Borehole Diameter: <u>6"</u> Drilling Fluid Used: <u>Water</u>
Sampling Interval: <u>NA</u>	Borehole Depth: <u>42'</u> Surface Elevation: <u>558.41' msl</u>
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

CONTINUED SAMPLE/CORE LOG
BORING NO. KC-15-28

Project No: 2019052

Geologist: Mike Gelles

Page 2 of 2

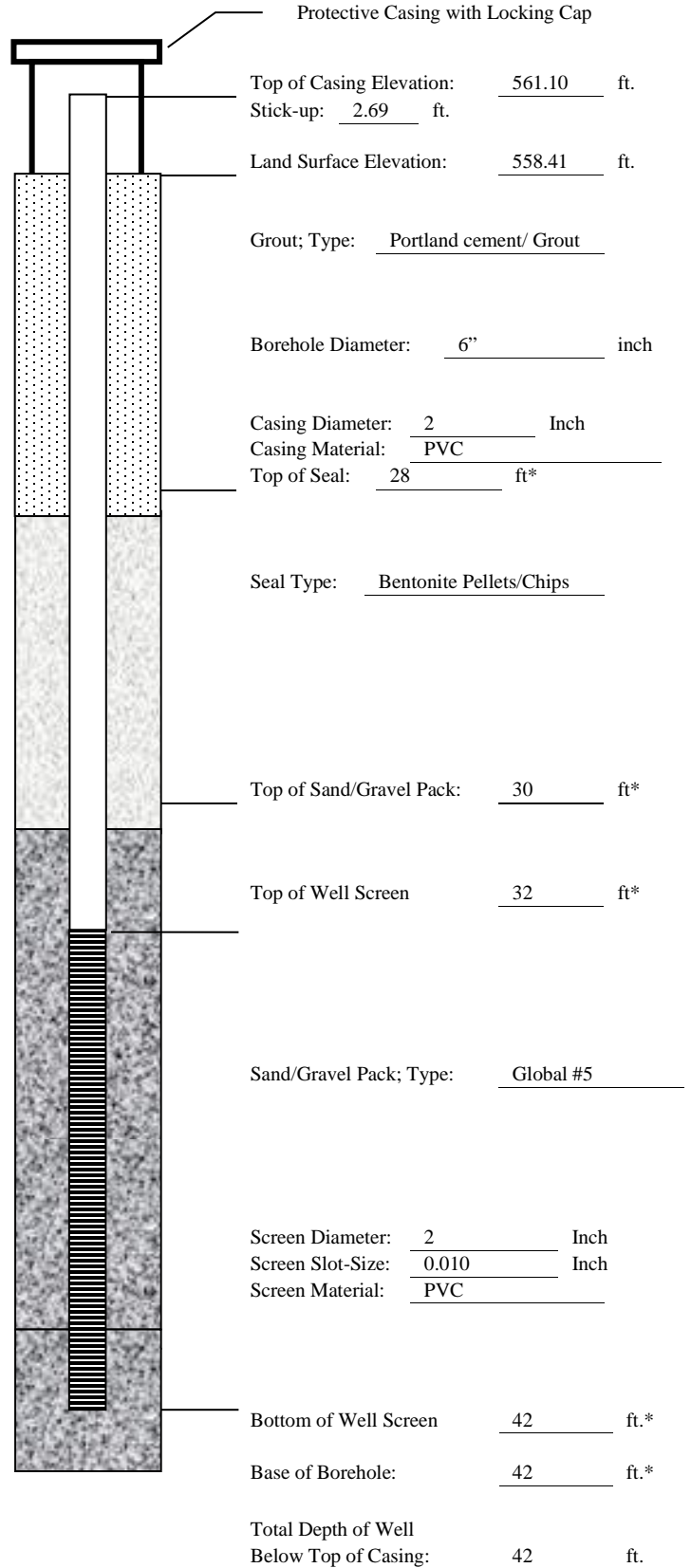
36-38	2	2-5-7-13	Brown sand, fine and medium, wet	N/A
38-40	2	2-3-5-9	Brown sand, fine and medium, wet	N/A

WELL CONSTRUCTION LOG

WELL NO. KC-19-28

Project Number:	<u>2019052</u>
Project Location:	<u>Kyger Creek Plant – Boiler Slag Pond</u>
Installation Date(s):	<u>4/4/2019</u>
Drilling Method:	<u>Hollow Stem Auger</u>
Drilling Contractor:	<u>HAD</u>
Development Date(s):	<u>4/9/2019</u>
Development Method:	<u>Pump & Surge until Field Parameters stabilized. Turbidity = 4.7 NTUs</u>
Volume Purged:	<u>232 gallons</u>
Static Water-Level*:	<u>22.95'</u>
Top of Well Casing Elevation:	<u>561.10' msl</u>
Well Purpose:	<u>Groundwater Monitoring</u>
Northing (Y):	<u>331064.431</u>
Easting (X):	<u>2073270.027</u>
Comments/Notes:	<u>2 inch PVC riser and screen</u> <u>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.</u>
Inspector:	<u>Michael Gelles</u>

CONSTRUCTION MATERIALS USED:	
<u>3</u>	Bags of Sand
<u>1</u>	Bags/Buckets Bentonite Pellets
<u>8</u>	Bags Portland for Grout
<u> </u>	Bags Concrete/Sakrete



*Indicates Depth Below Land Surface

WELL BORING NO. **KC-19-29**
SAMPLE/CORE LOG

Project Number: <u>2019052</u>	Log Page <u>1</u> of <u>2</u>
Project Location: <u>Kyger Creek Plant – Boiler Slag Pond</u>	Drilling Contractor: <u>HAD</u>
Drilling Date(s): <u>4/3/2019</u>	Geologist: <u>Michael Gelles</u>
Drilling Method: <u>Hollow Stem Auger</u> Coring Device Size: <u>NA</u> Hammer Wt. <u>160 lbs</u> and Drop <u>30"</u> Sampling Method: <u>Split Spoon</u> Borehole Diameter: <u>6"</u> Drilling Fluid Used: <u>Water</u> Sampling Interval: <u>2'</u> Borehole Depth: <u>42'</u> Surface Elevation: <u>561.13' msl</u>	
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

CONTINUED SAMPLE/CORE LOG
BORING NO. KC-19-29

Project No: 2019052

Geologist: Michael Gelles

Page 2 of 2

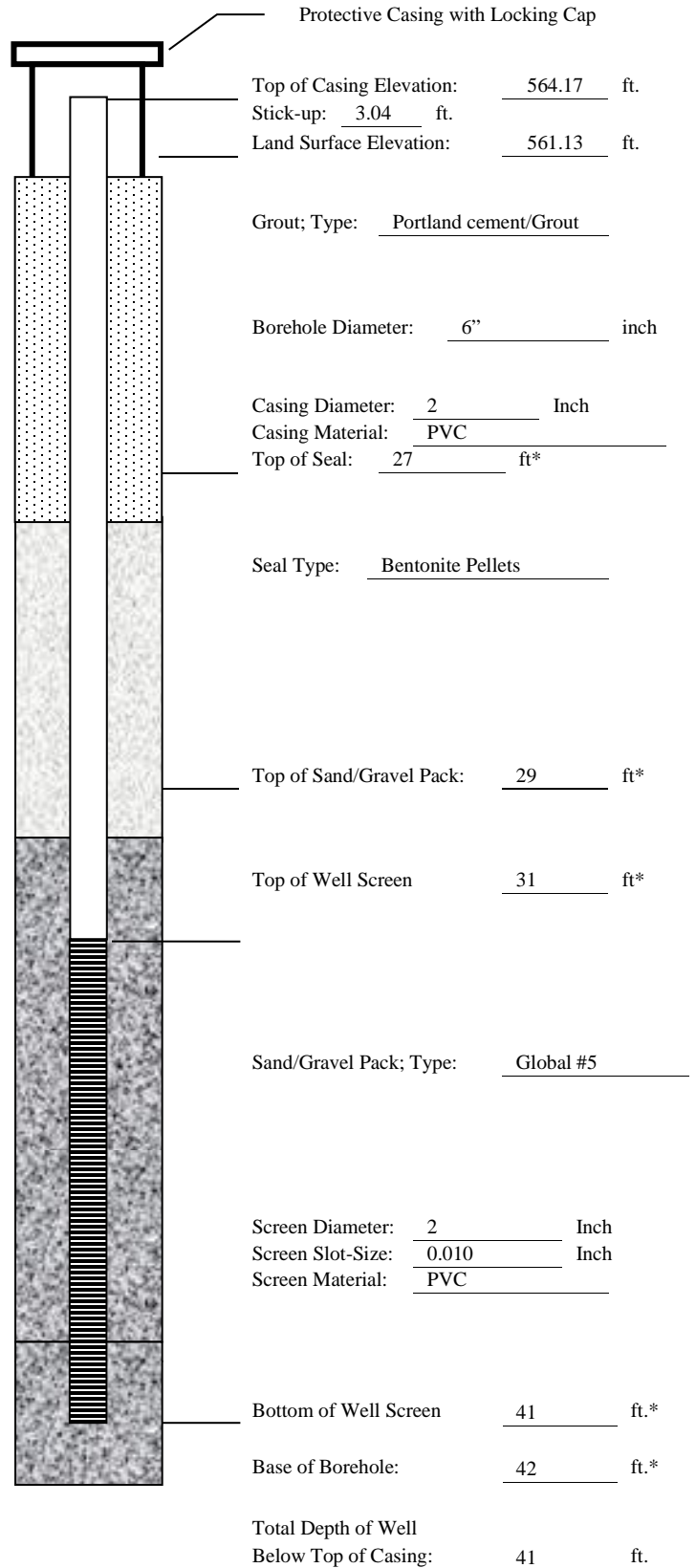
36-38	2	4-3-3-5	Orange brown sand fine to medium, loose, wet	NA
38-40	2	Wt/h(4)	Orange brown sand fine to medium, loose, wet	NA
40-42	2	2-5-4-8	Orange brown sand fine to medium, loose, wet	NA

WELL CONSTRUCTION LOG

WELL NO. KC-19-29

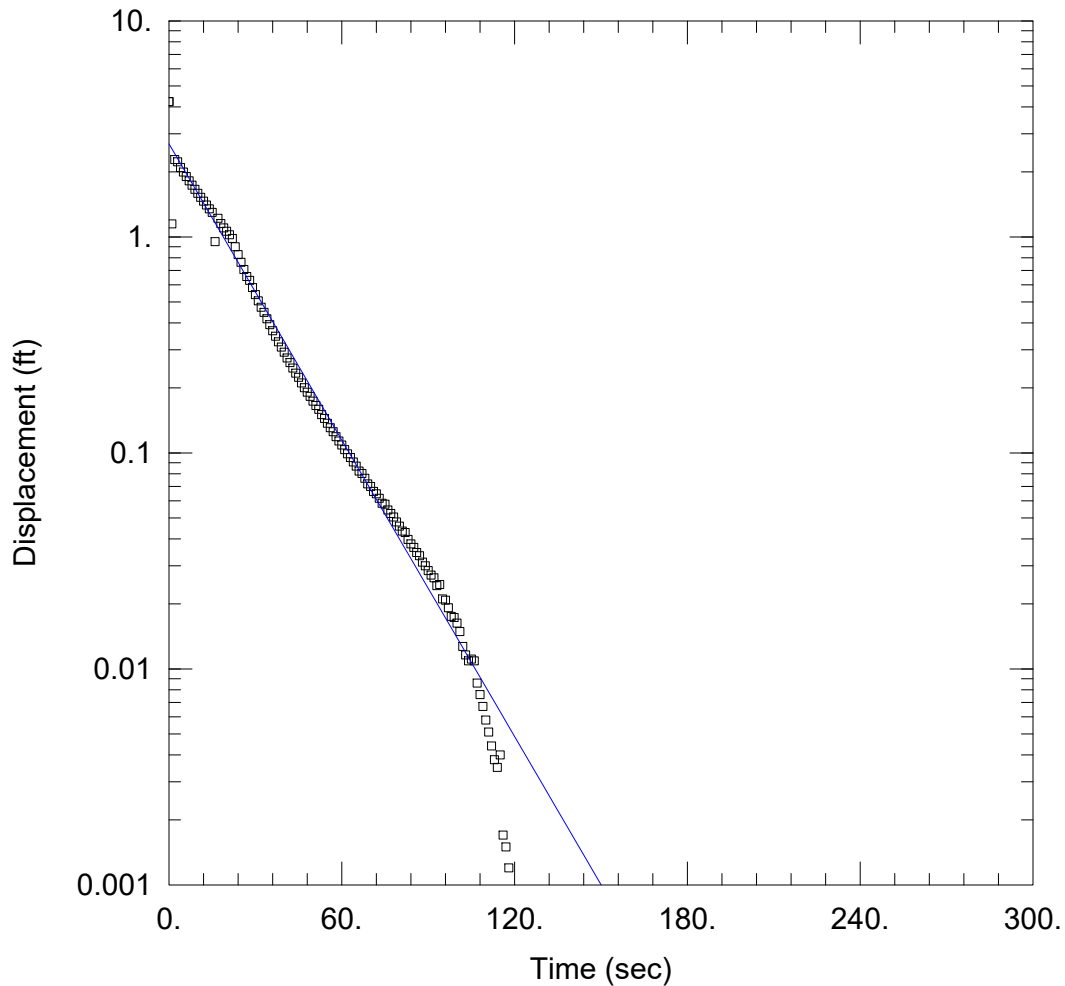
Project Number:	<u>2019052</u>
Project Location:	<u>Kyger Creek Plant – Boiler Slag Pond</u>
Installation Date(s):	<u>4/3/2019</u>
Drilling Method:	<u>Hollow Stem Auger</u>
Drilling Contractor:	<u>HAD</u>
Development Date(s):	<u>4/10/2019</u>
Development Method:	<u>Pump & Surge until Field Parameters Stabilized</u>
Turbidity = 4.51 NTUs	
Volume Purged:	<u>106 gallons</u>
Static Water-Level*:	<u>22.25'</u>
Top of Well Casing Elevation:	<u>564.17' msl</u>
Well Purpose:	<u>Groundwater Monitoring</u>
Northing (Y):	<u>330558.936</u>
Easting (X):	<u>2072840.947</u>
Comments/Notes:	<u>2 inch PVC riser and screen</u> <u>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.</u>
Inspector:	<u>Michael Gelles</u>

CONSTRUCTION MATERIALS USED:	
<u>3</u>	Bags of Sand
<u>1</u>	Bags/Buckets Bentonite Pellets
<u>8</u>	Bags Portland for Grout
<u> </u>	Bags Concrete/Sakrete



*Indicates Depth Below Land Surface

APPENDIX E
SLUG TEST RESULTS



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)

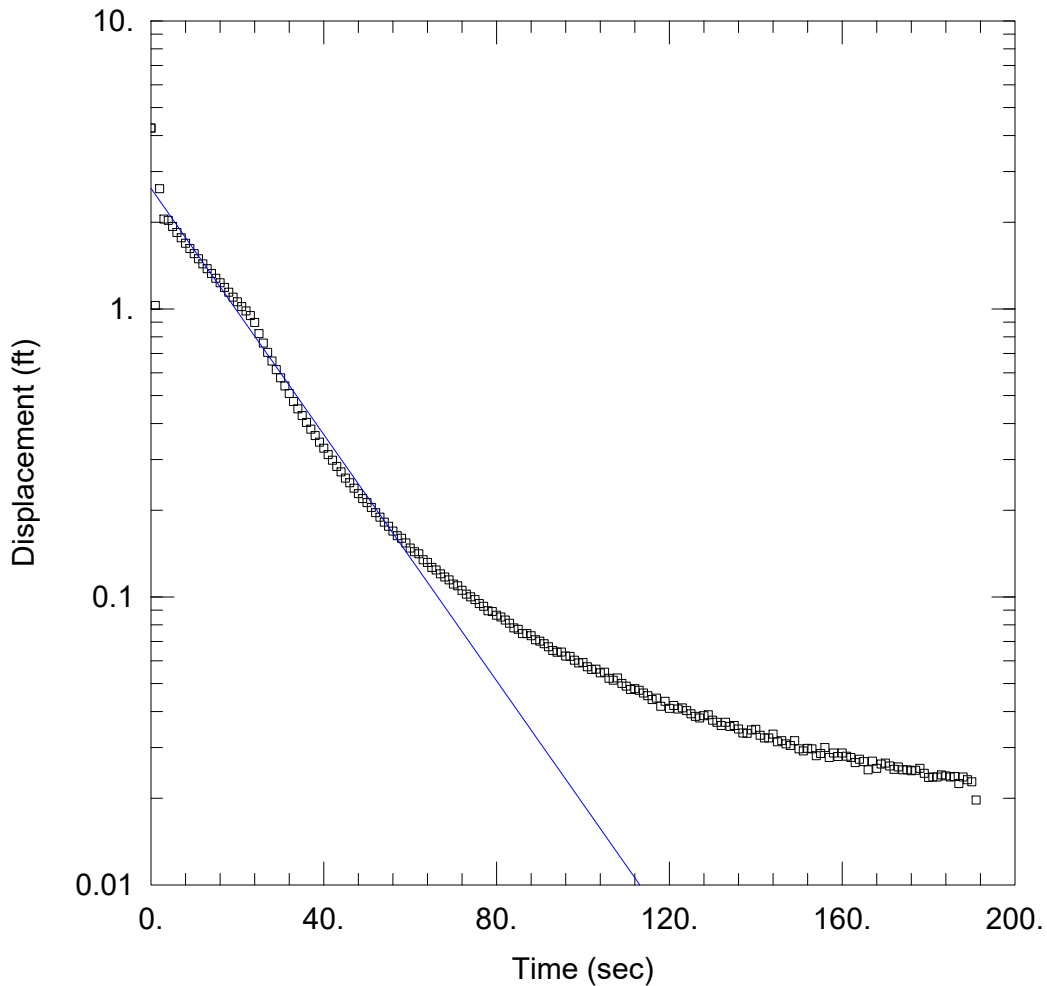
Initial Displacement: 4.231 ft
 Total Well Penetration Depth: 41.15 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 22.75 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 9.946E-5 ft/sec

Solution Method: Hvorslev
 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)

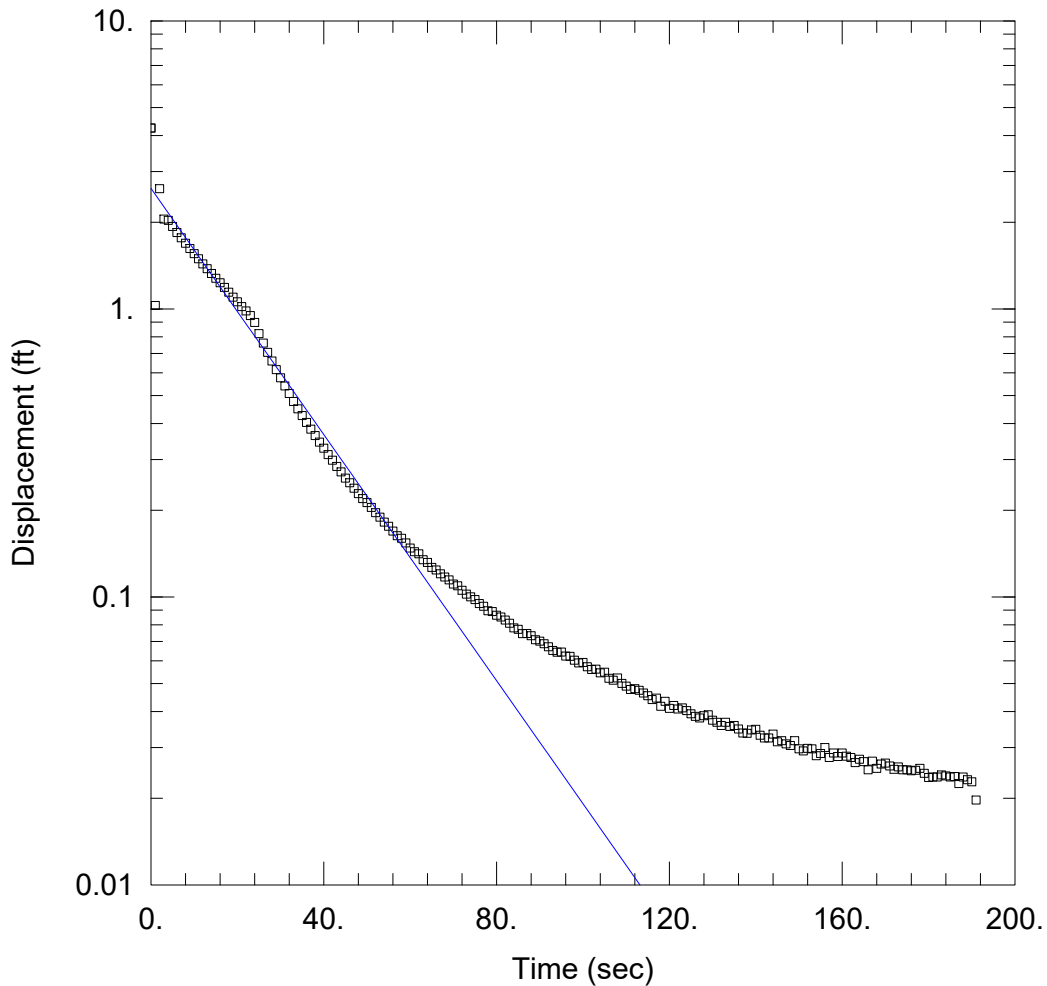
Initial Displacement: 4.248 ft
 Total Well Penetration Depth: 41.15 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 22.75 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 7.764E-5 ft/sec

Solution Method: Bower-Rice
 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)

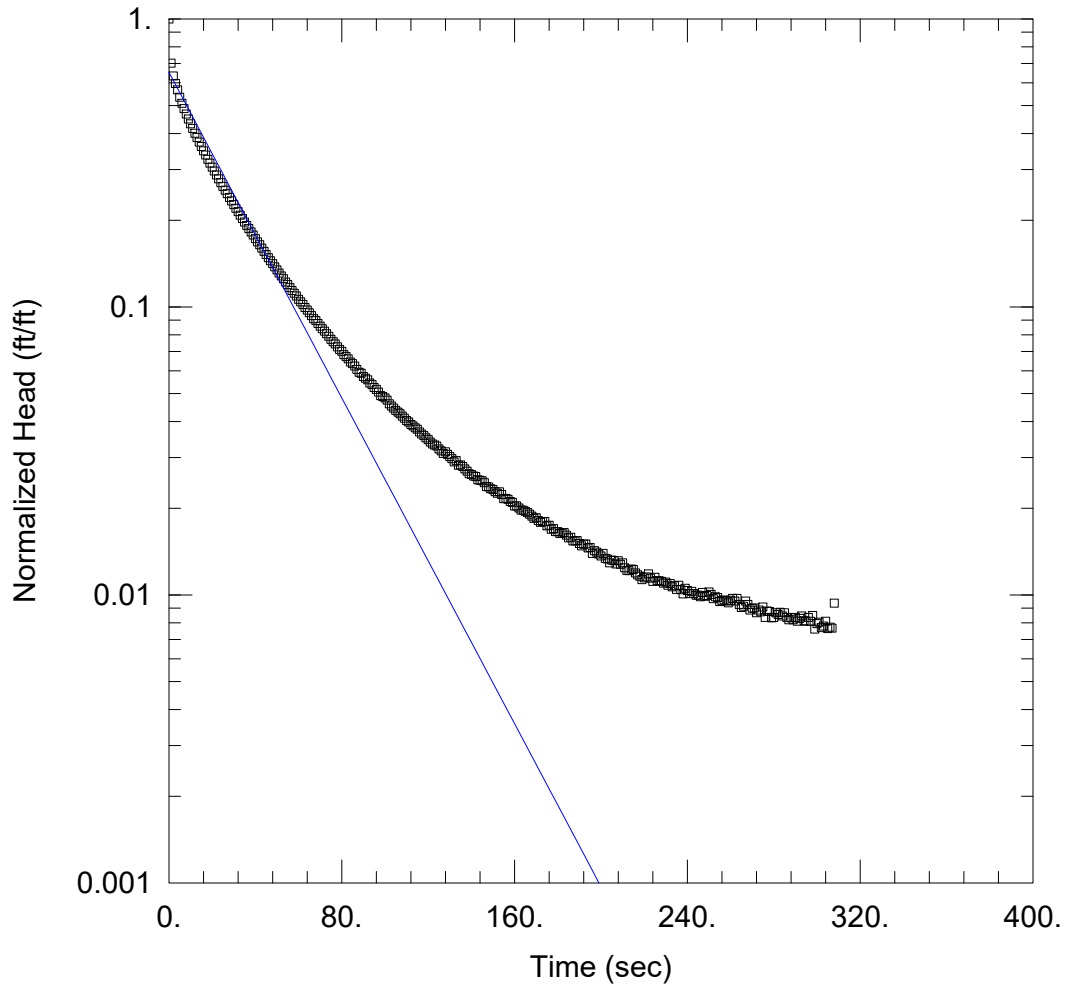
Initial Displacement: 4.248 ft
 Total Well Penetration Depth: 41.15 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 22.75 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 9.294E-5 ft/sec

Solution Method: Hvorslev
 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)

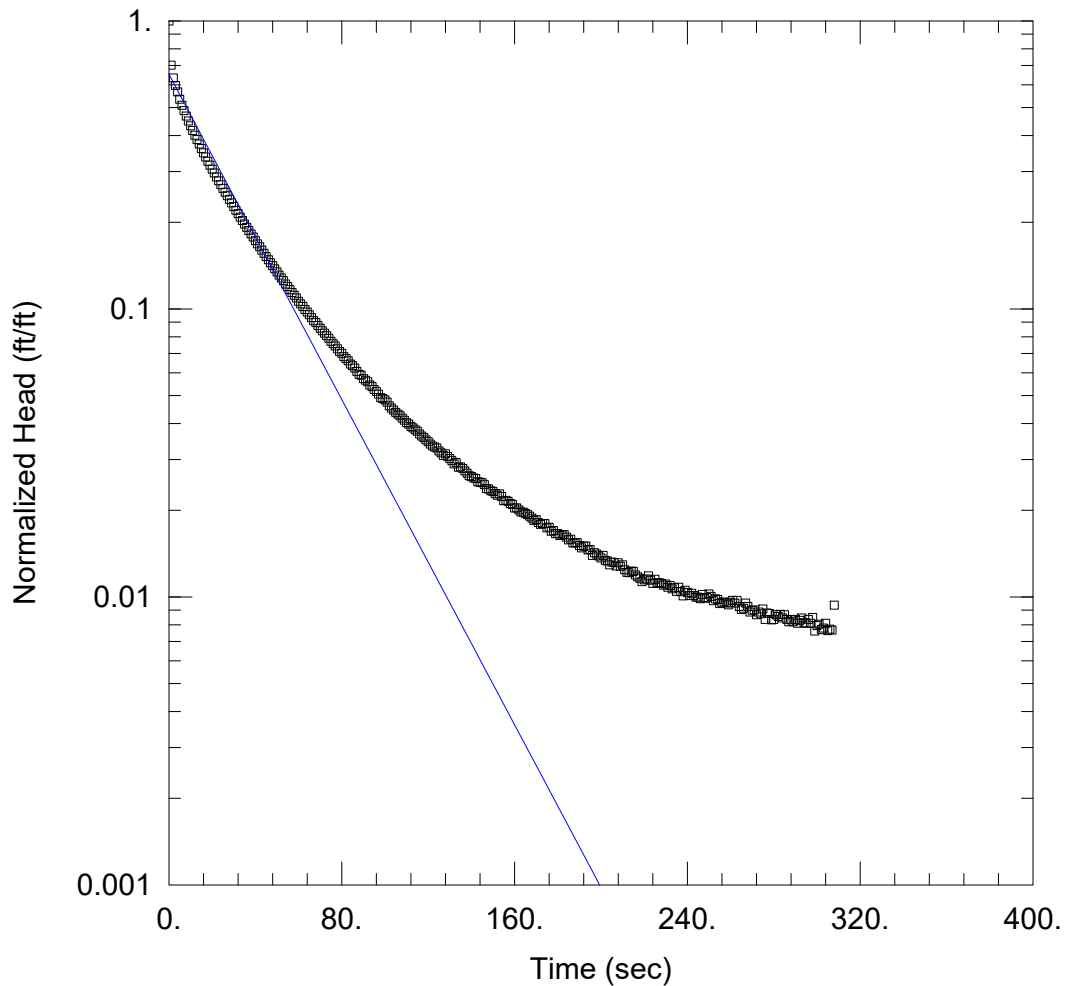
Initial Displacement: -3.195 ft
 Total Well Penetration Depth: 41.15 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 22.75 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 5.136E-5 ft/sec

Solution Method: Bouwer-Rice
 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)

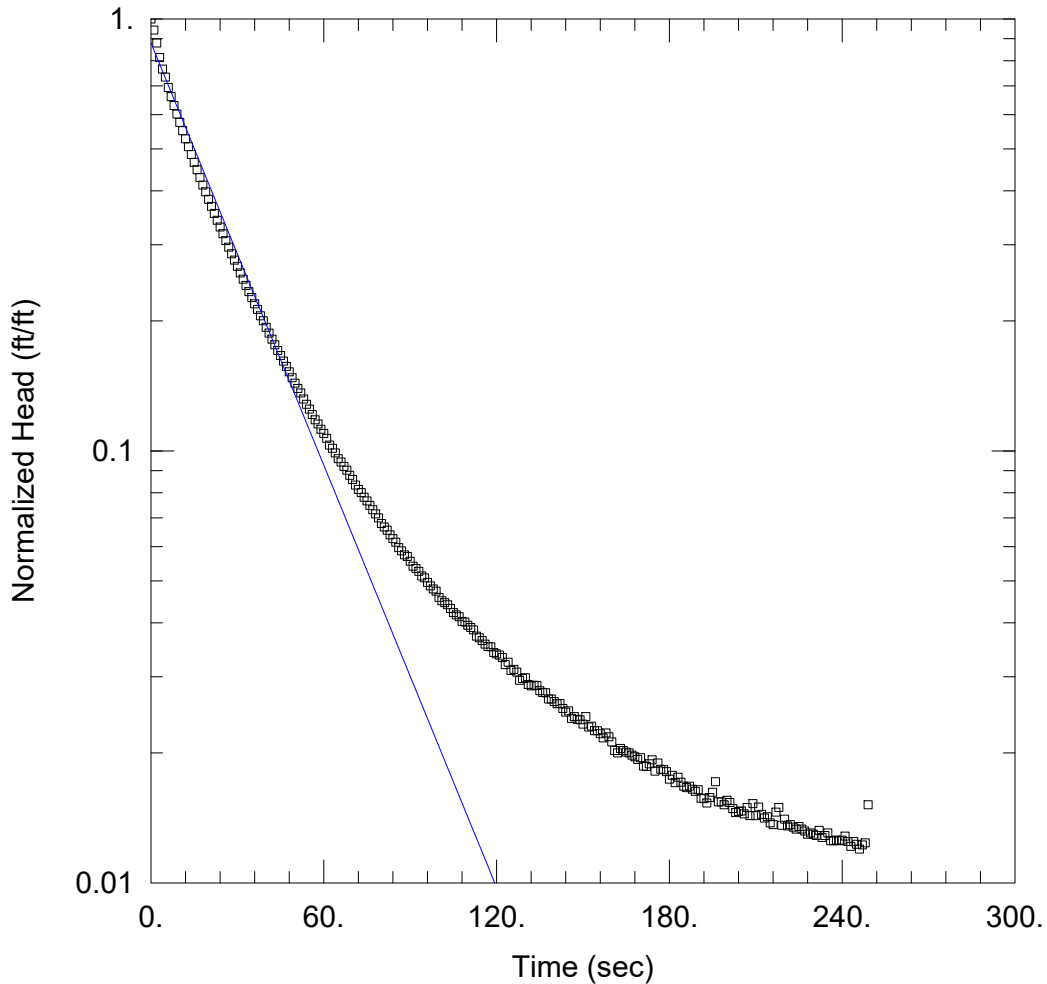
Initial Displacement: -3.195 ft
 Total Well Penetration Depth: 41.15 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 22.75 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 6.14E-5 ft/sec

Solution Method: Hvorslev
 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)

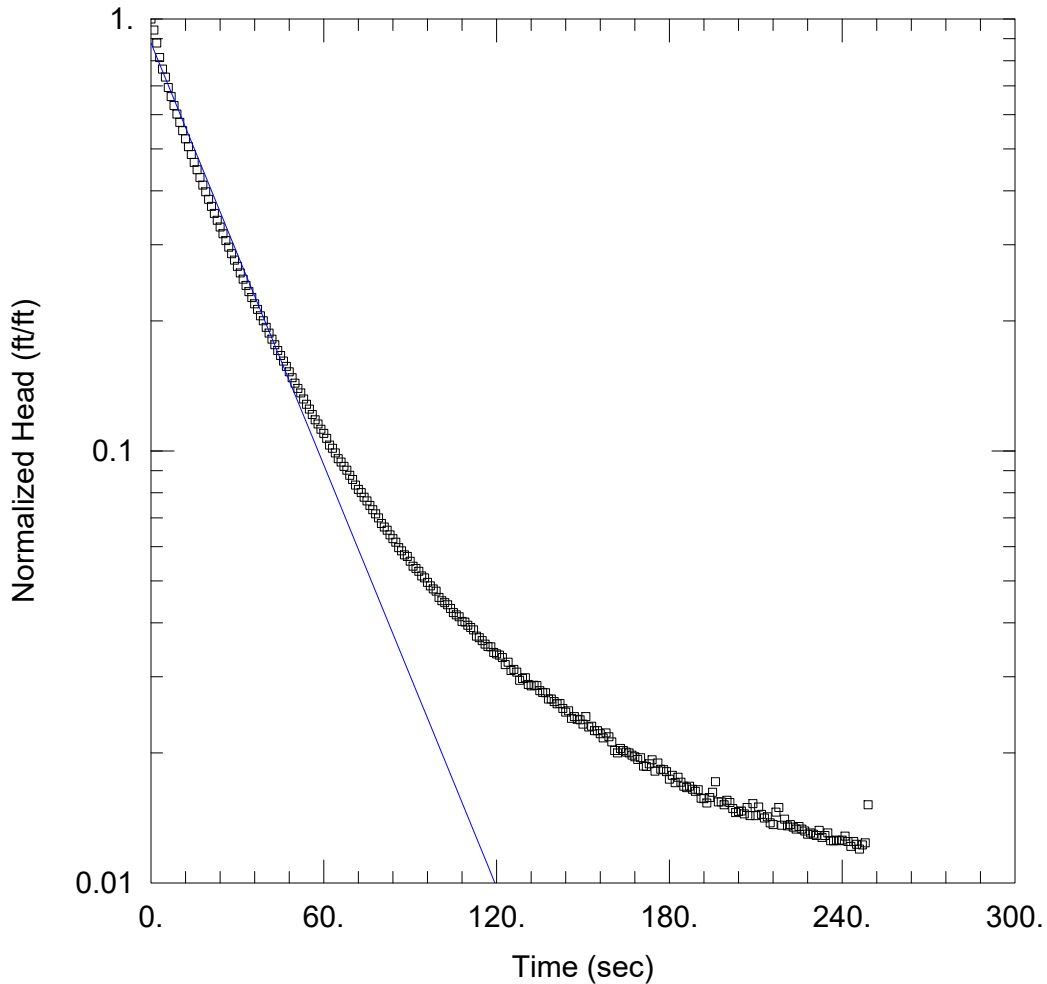
Initial Displacement: -2.221 ft
 Total Well Penetration Depth: 41.15 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 22.75 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 5.918E-5 ft/sec

Solution Method: Bouwer-Rice
 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)

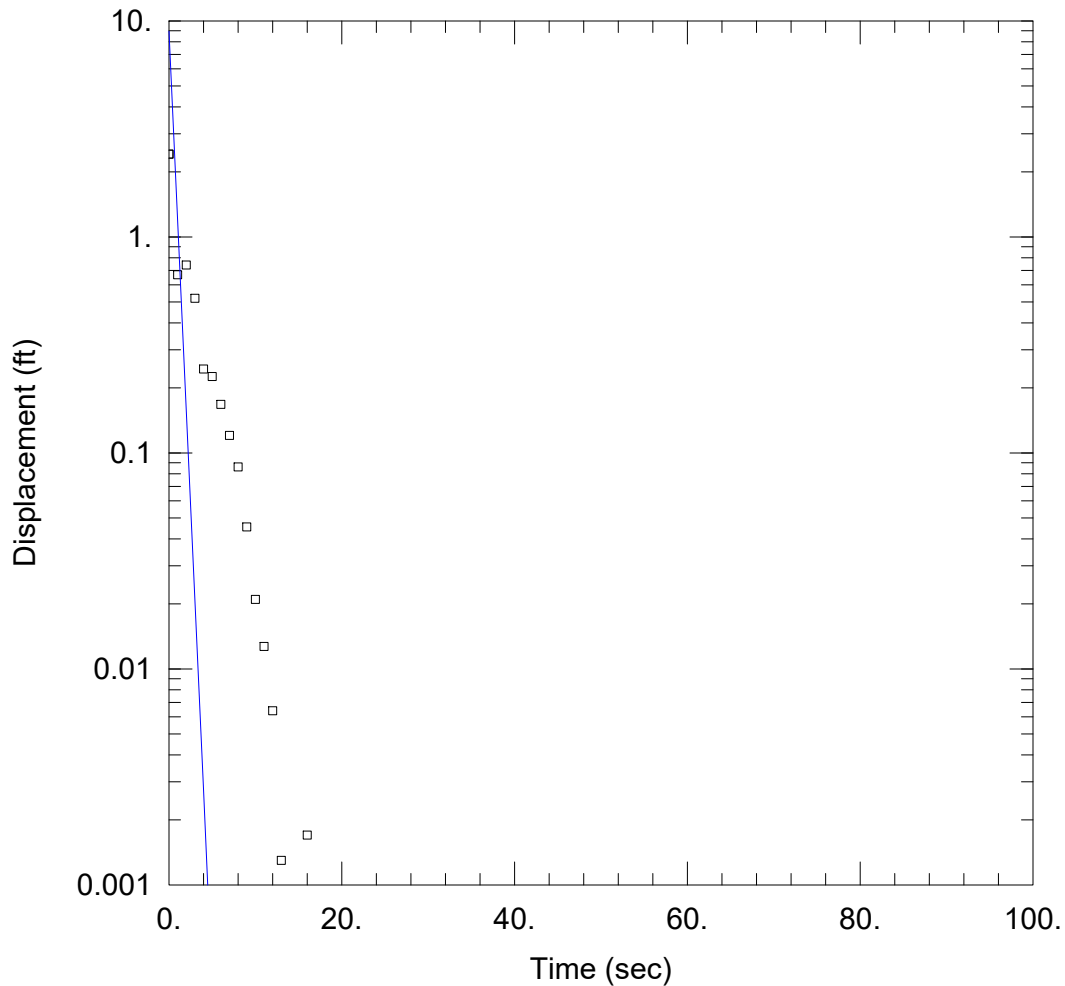
Initial Displacement: -2.221 ft
 Total Well Penetration Depth: 41.15 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 22.75 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 7.081E-5 ft/sec

Solution Method: Hvorslev
 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)

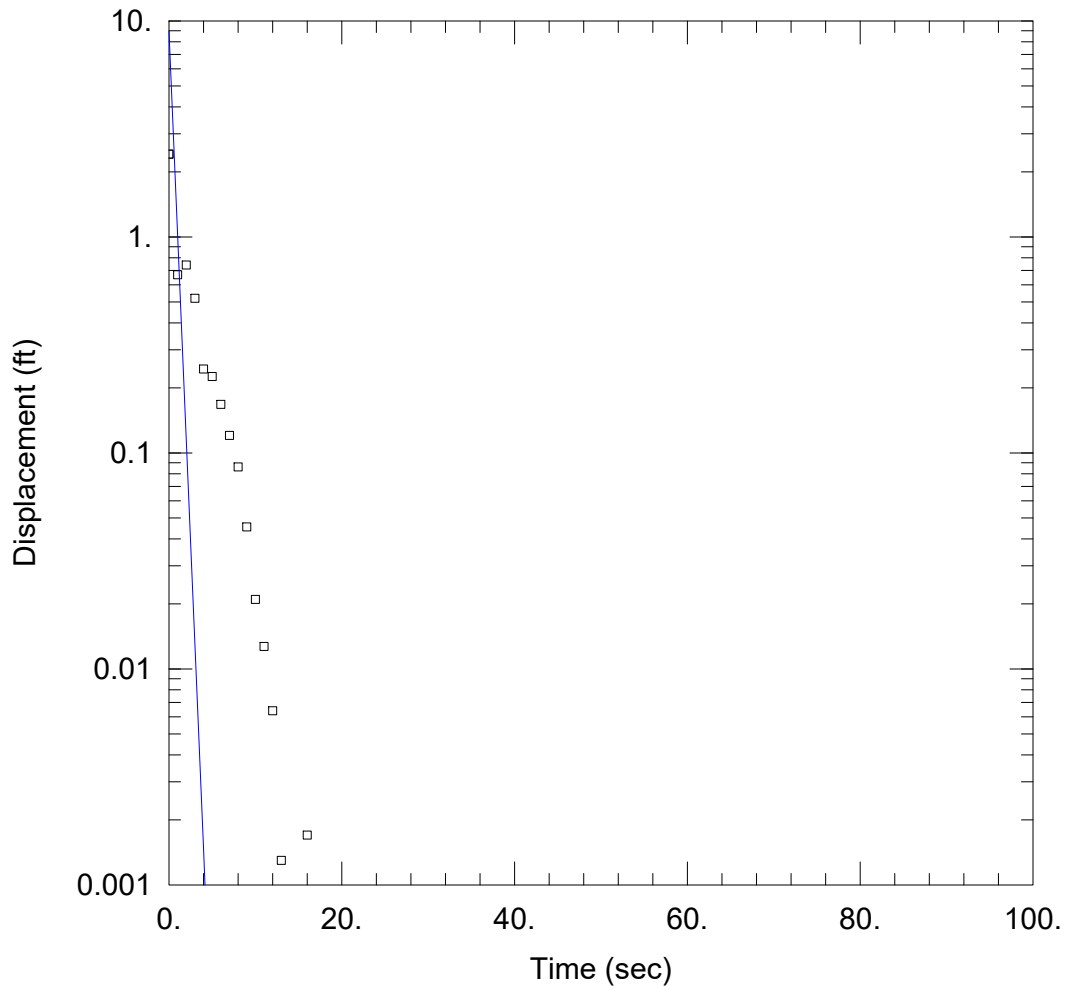
Initial Displacement: 2.416 ft
 Total Well Penetration Depth: 44.48 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 25.97 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 0.003224 ft/sec

Solution Method: Bouwer-Rice
 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)

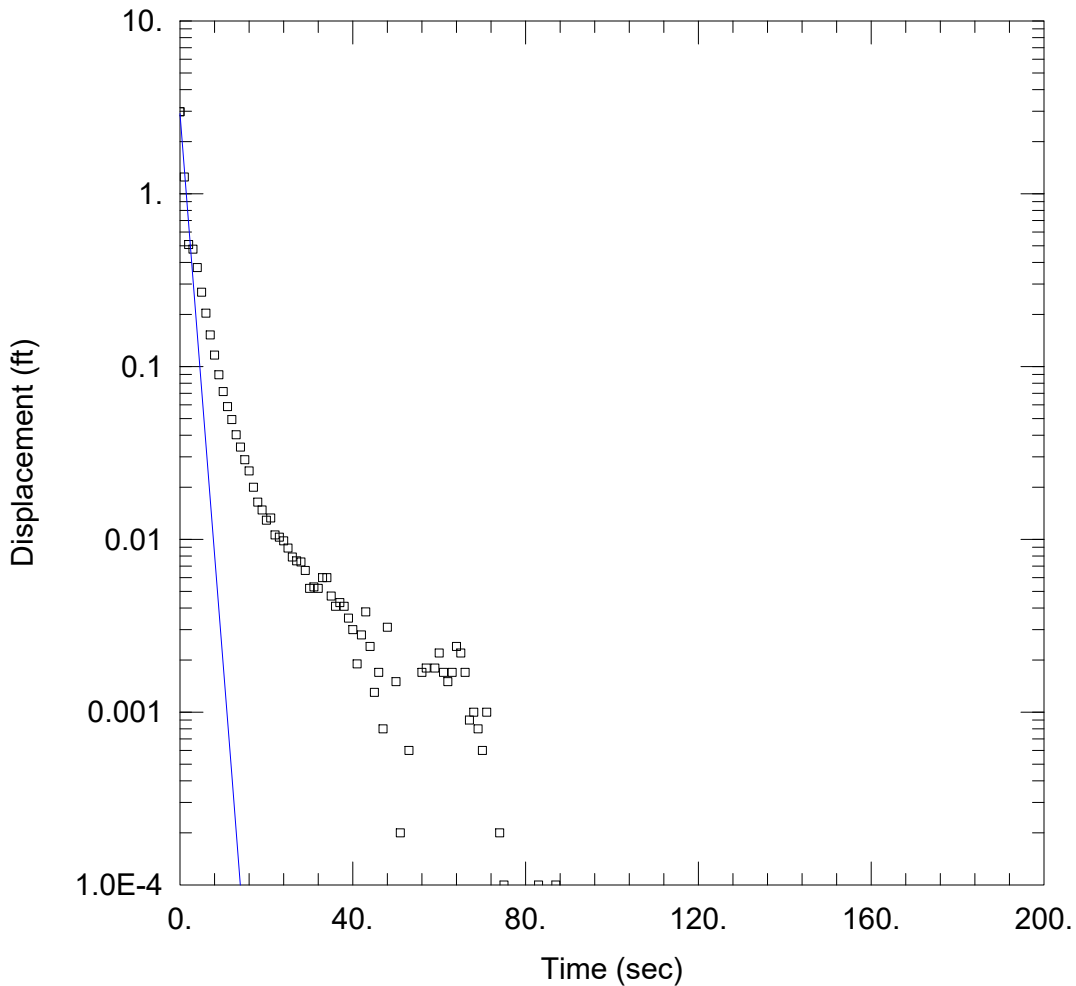
Initial Displacement: 2.416 ft
 Total Well Penetration Depth: 44.48 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 25.97 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 0.004117 ft/sec

Solution Method: Hvorslev
 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)

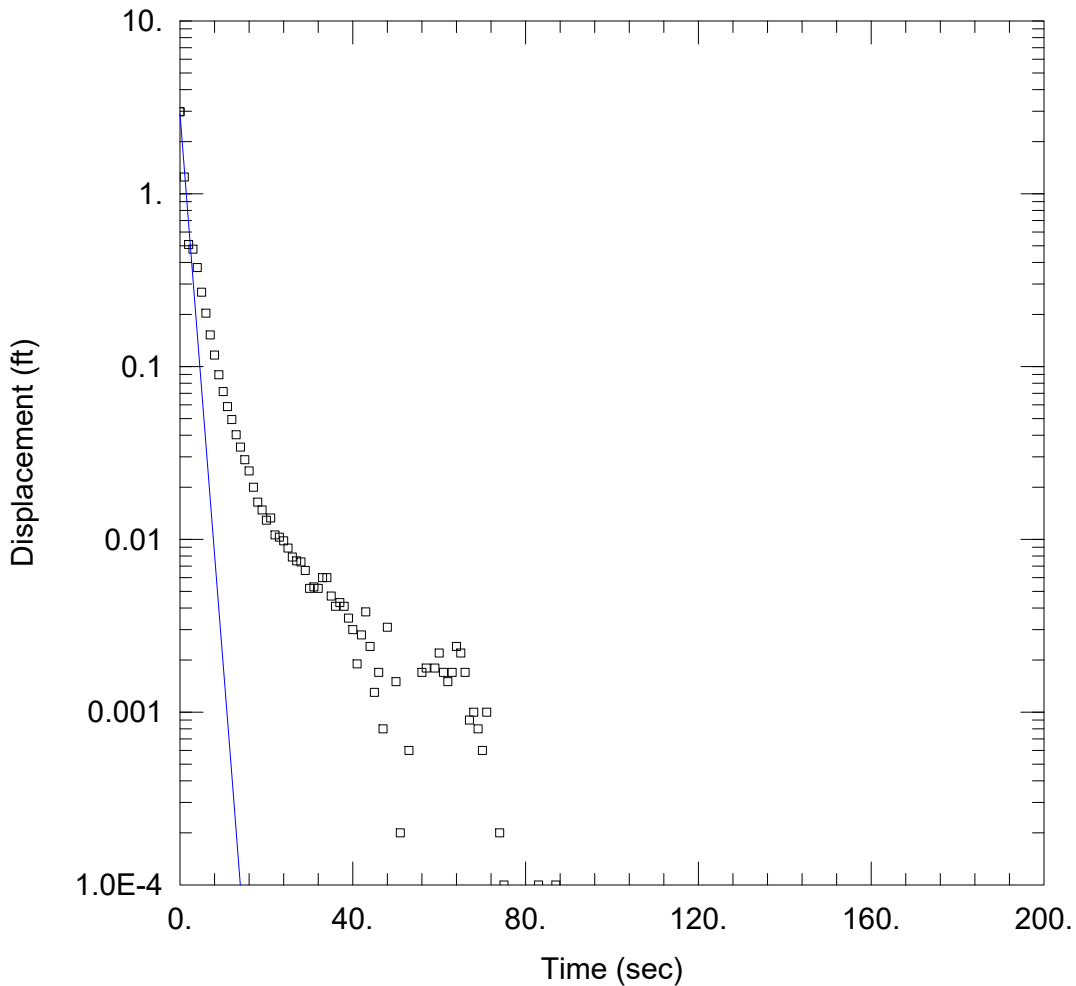
Initial Displacement: 2.979 ft
 Total Well Penetration Depth: 44.48 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 25.97 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 0.00117 ft/sec

Solution Method: Bouwer-Rice
 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)

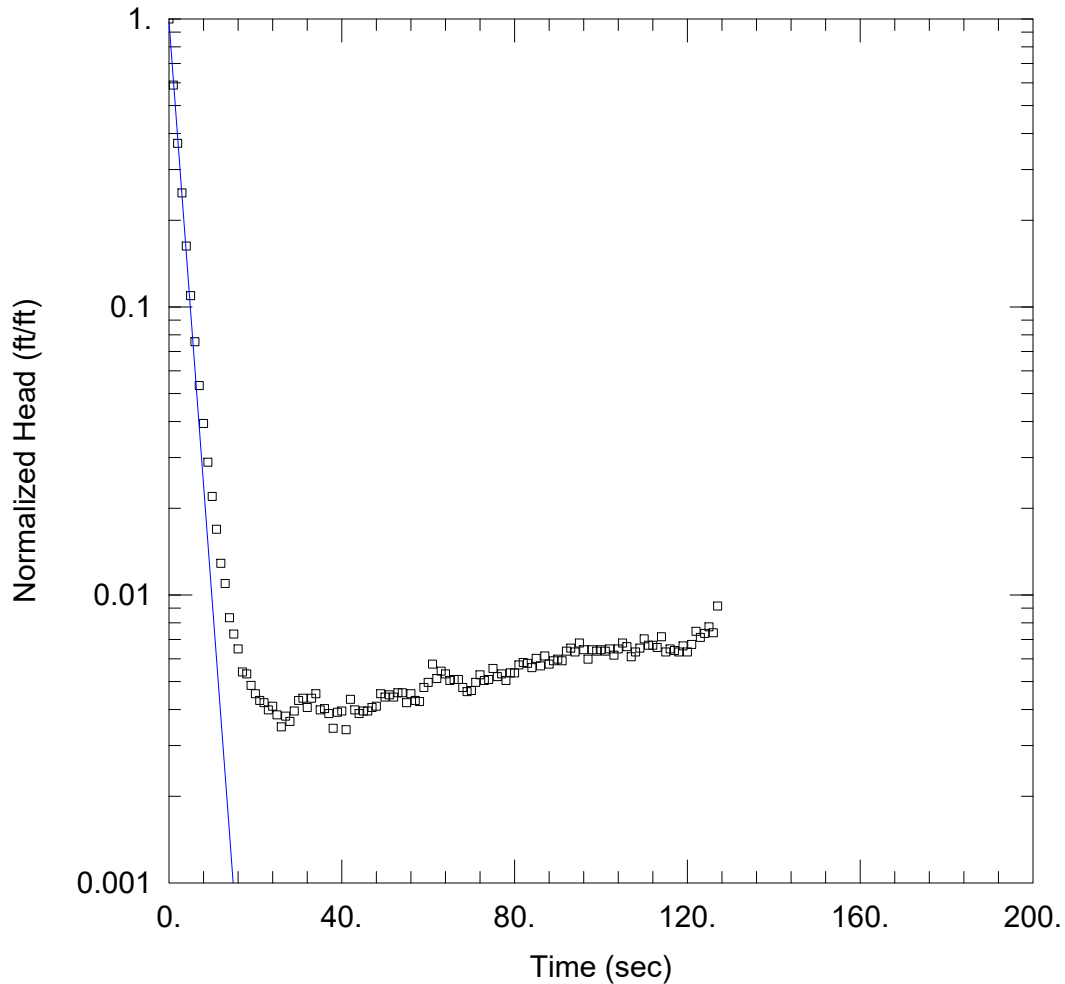
Initial Displacement: 2.979 ft
 Total Well Penetration Depth: 44.48 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 25.97 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 0.001387 ft/sec

Solution Method: Hvorslev
 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)

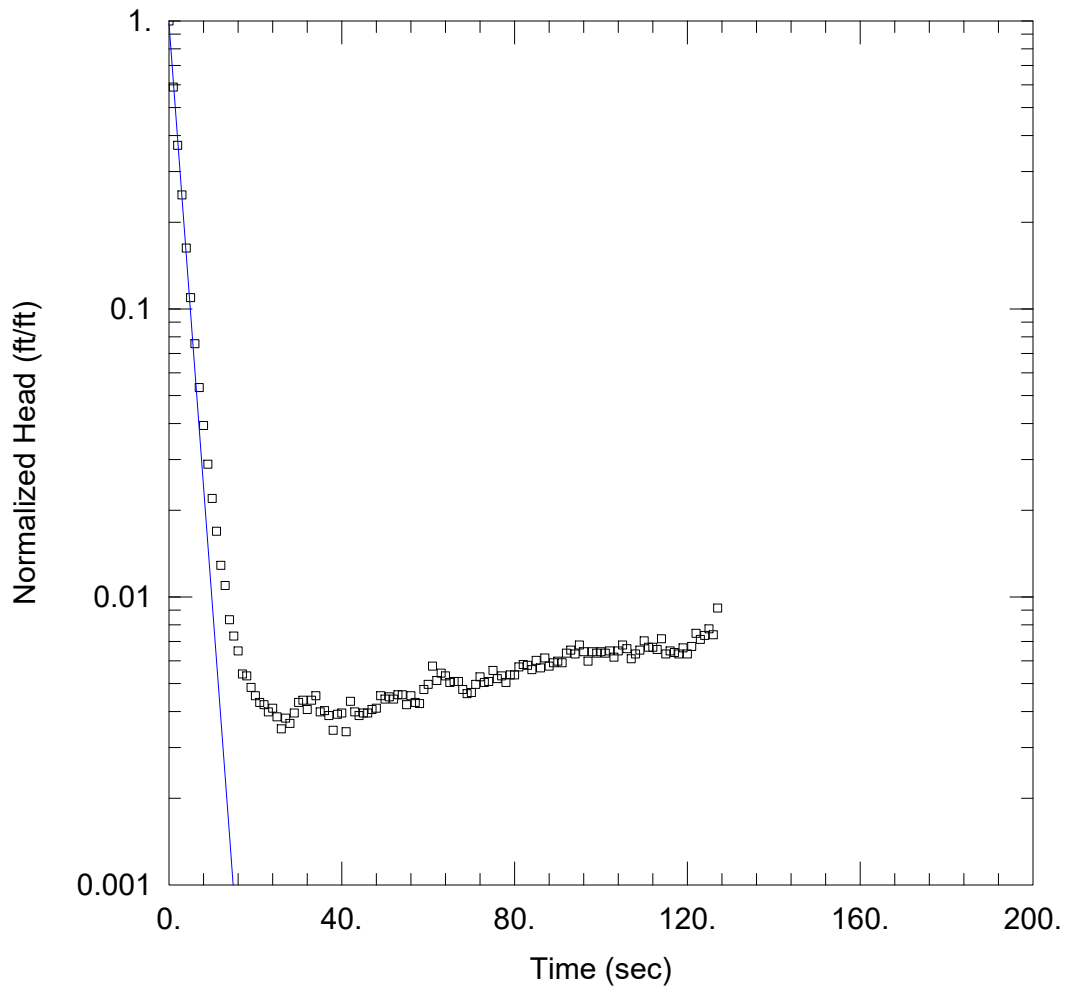
Initial Displacement: -2.557 ft
 Total Well Penetration Depth: 44.48 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 25.97 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 0.0007384 ft/sec

Solution Method: Bower-Rice
 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)

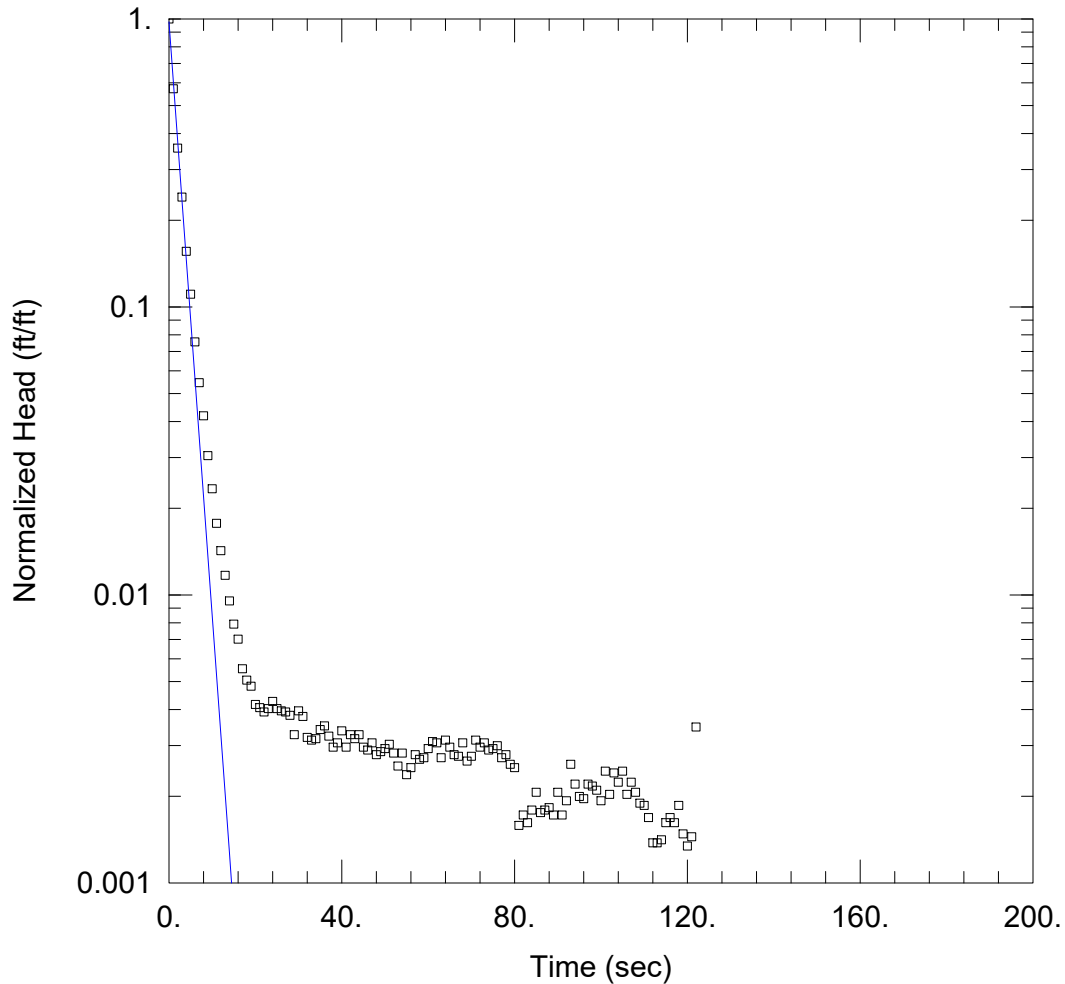
Initial Displacement: -2.557 ft
 Total Well Penetration Depth: 44.48 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 25.97 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 0.000875 ft/sec

Solution Method: Hvorslev
 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)

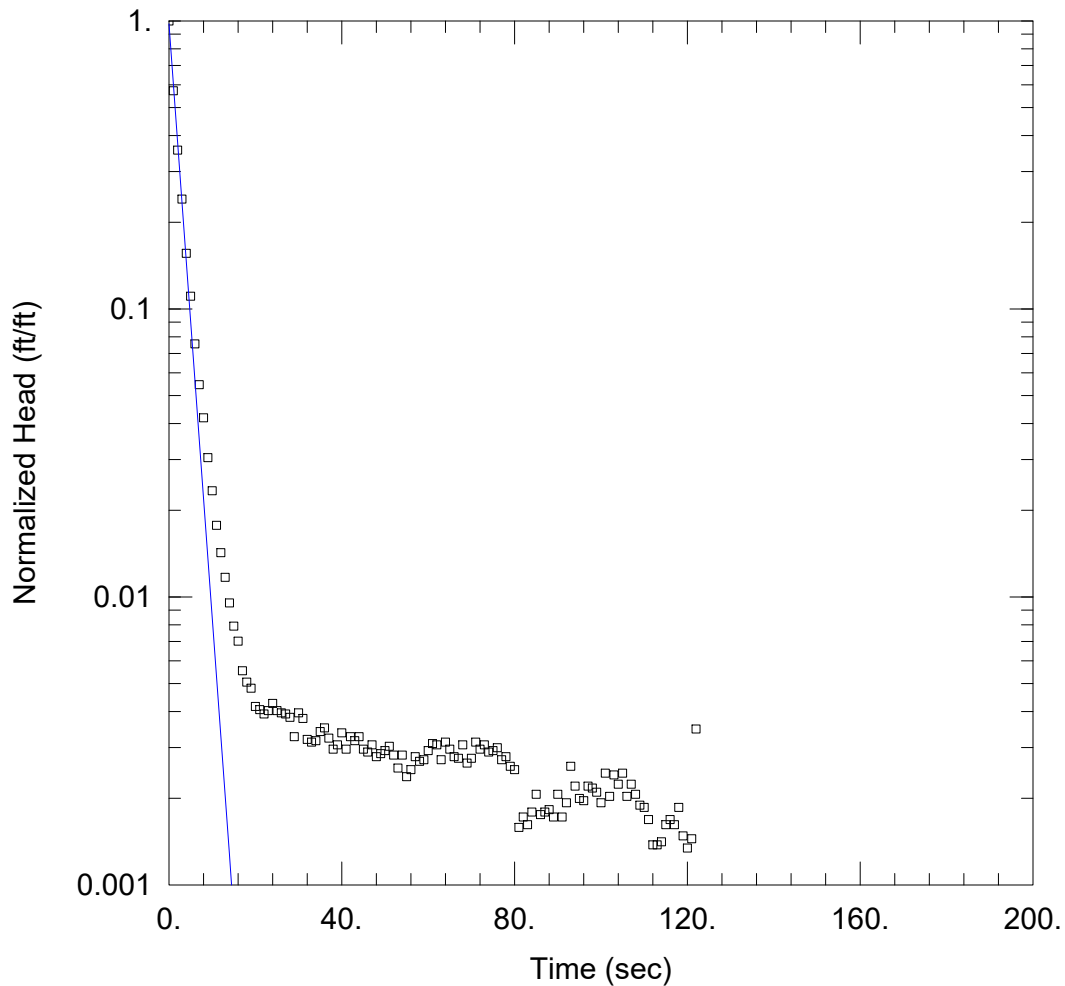
Initial Displacement: -2.905 ft
 Total Well Penetration Depth: 44.48 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 25.97 ft
 Screen Length: 10. ft
 Well Radius: 0.083 ft
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
 K = 0.0007565 ft/sec

Solution Method: Bower-Rice
 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
 K = 0.0008964 ft/sec

Solution Method: Hvorslev
 y0 = -2.837 ft