Semi-Annual Remedy Selection Progress Report

Wilson Phase II Landfill
D.B Wilson Generating Station
Ohio County, Kentucky

Prepared for:

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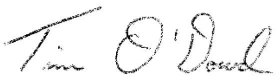			
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Revision History

Revision	Revision date	Details	Authorized	Name	Position
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Distribution List

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	1	Big Rivers Electric Corporation

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Executive Summary

Title 40 of the Code of Federal Regulations Part 257.97(a) requires that progress reports be prepared on a semi-annual basis describing progress made in selecting and designing a remedy to address groundwater impacts resulting from a release of coal combustion residuals (CCR) into the environment. Big Rivers Electric Corporation (BREC) is in the process of selecting a remedy for groundwater impacts at the D.B. Wilson Generating Station Phase II Landfill (the Unit), located in Ohio County, Kentucky.

BREC performed an Assessment of Corrective Measures (ACM), to identify applicable remedial technologies to address cobalt impacts in groundwater in 2019. A report summarizing the results of the ACM was posted to BREC's publicly-accessible CCR reporting website on June 14, 2019. Currently BREC considers four (4) potential corrective action alternatives as viable options to address groundwater impacts at the Unit. To evaluate each alternative, additional data collection will be required.

BREC is working to establish a comprehensive list of data collection needs to proceed forward with remedy evaluation and anticipates providing additional data in future semi-annual remedy selection progress reports.

1. Introduction

In accordance with provisions of the United States Environmental Protection Agency's (USEPA) coal combustion residual (CCR) rule, Title 40 of the Code of Federal Regulations (CFR) Part 257.97, Big Rivers Electric Corporation (BREC) is in the process of selecting a remedy for groundwater impacts at the D.B. Wilson Generating Station Phase II Landfill (the Unit), located in Ohio County, Kentucky **(Figure 1)**. A map depicting site features along with locations of all program monitoring wells is presented as **Figure 2**.

Assessment monitoring results for groundwater sampling activities performed at the Site in 2018 indicated the presence of cobalt at a Statistically Significant Level (SSL) above the Ground Water Protection Standard (GWPS) in one monitoring well (MW-10) at the Unit. In response to the SSL exceedance, BREC evaluated the nature and extent of groundwater impacts as required by Title 40 CFR Part 257.95(g) for characterization monitoring. In addition, BREC performed an Assessment of Corrective Measures (ACM), to identify applicable remedial technologies to address cobalt impacts in groundwater pursuant to Tile 40 CFR Part 257.96. A notice of ACM initiation dated January 14, 2019 was posted to BREC's publicly-accessible CCR reporting website. A report summarizing the results of the ACM (AECOM, June 2019) was posted to BREC's publicly-accessible CCR reporting website on June 14, 2019.

Assessment monitoring results for groundwater sampling activities perfomred at the Site in 2019 indicated that lithium in monitoring well MW-6 is present at an SSL above its GWPS in addition to cobalt in monitoring well MW-10. Additional Assessment monitoring performed in 2020 indicated that cobalt is present at SSL in monitoring wells MW-5 and MW-6. As a result, BREC is expanding the remedy selection evaluation for the Unit to include this additional Appendix IV parameter.

Title 40 CFR Part 257.97(a) requires that progress reports be prepared on a semi-annual basis describing progress made in selecting and designing a remedy. The following sections provide an overview of BREC's activities previously performed, currently underway, and planned in the future to select a remedy that meets the requirement of Title 40 CFR Part 257.97 (b) as follows:

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

(2) Attain the GWPS as specified pursuant to Section 257.95(h);

(3) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents 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 Section 257.98(d).

2. Site Background

2.1 Site Description

The Wilson Phase II Landfill is located in Ohio County approximately 5 miles northwest of the town of Centertown, Kentucky (**Figure 1**). The property is located northwest and adjacent to the D.B. Wilson Generating Station (Wilson Station). The current Wilson Phase II Landfill footprint is approximately 92 acres (**Figure 2**). Adjacent to the Phase II Landfill on the east is the Wilson Station Phase I Landfill, which is currently being regulated by Special Waste permit by the Kentucky Department for Environmental Protection, Division of Waste Management (KDMW) under Title 401 of the Kentucky Administrative Regulations (KAR) Section 45.

The Wilson Phase II Landfill is raised above adjacent ground to a maximum elevation of approximately 520 feet above mean sea level (amsl). The original ground surface within the landfill footprint was an irregular post-mining reclaimed surface.

2.2 Program Monitoring Well Systems

2.2.1 Operating Permit Monitoring Wells

Prior to implementation of the CCR Rule, a groundwater monitoring well network was already present at the Unit in compliance with the requirements of the facility's operating permit. The existing wells are located along the perimeter of the permitted footprint for the Wilson Phase II Landfill and meet the CCR Rule requirements that downgradient monitoring wells must be located at the waste boundary of the (active) CCR unit, or as close as practical.

Under the requirements stated in the operating permit, five (5) monitoring wells (MW-5, MW-6, MW-7, MW-8 and MW-10) were installed adjacent to the Wilson Phase II CCR Landfill to determine the general direction of groundwater movement and to monitoring groundwater at the site. MW-8 is located north of the landfill and is considered upgradient. MW-5, MW-6 (both west of the landfill), MW-7 (southwest of the landfill) and MW-10 (south of the landfill) are considered as downgradient. The locations of the groundwater monitoring wells are shown on **Figure 2**. Each well has a dedicated bladder pump and tubing system installed for sampling purposes.

As stated in the CCR monitoring well network certification, the stratigraphic interval considered as the most prominent water-transmitting zone within and adjacent to the Wilson Station is material identified as reclaimed surface mining spoil material comprised of disrupted consolidated sandstone and shale of the Carbondale Formation. The United States Geological Survey (USGS) Geologic Map of the Equality Quadrangle describes underlying bedrock as "Sandstone, siltstone, shale, coal and underclay: Sandstone, light- to medium-gray, fine-grained, massive, micaceous, locally grades into thin-bedded siltstone. Siltstone, light- to medium-gray and yellowish-brown." For purposes of compliance with the CCR Rule groundwater monitoring requirements, this disrupted sequence comprising the unconsolidated mine spoil is considered the uppermost aquifer underlying the Wilson Phase II Landfill.

Details about the monitoring network are presented in the *Monitoring Well Completion Report, D.B. Wilson Special Waste Landfill, Solid Waste Permit Number 092-00004, Ohio County, Kentucky* (Associated Engineers, Inc., April 13, 2009). Monitoring wells MW-1, MW-2, MW-3, and MW-4, and piezometers P-9 and P-11 are included in the CCR program as "water level only" monitoring points.

2.2.2 Characterization Monitoring Wells

To address the requirements of 40 CFR § 257.95(g)(1), five (5) Characterization monitoring wells (MW-102, MW-104, MW-105, MW-110, and MW-4D) were installed in October 2018 for the characterization of groundwater at locations indicated on **Figure 2**. A Monitoring Well Construction Progress Report

(AECOM, December 13, 2019) was prepared to summarize the well installation process and testing results.

The Characterization monitoring wells, located at projected downgradient positions east, southeast, south, and southwest of the Unit, were used to assist in the characterization of the existence, quality, quantity, areal extent, and depth of groundwater degradation, and the rate and direction of migration of CCR contaminants in the groundwater.

2.3 Groundwater Investigation Summary

Nine rounds of Baseline groundwater sampling for Appendix III constituents were conducted between April 2016 and October 2017. Statistical evaluation for Detection monitoring indicated that SSIs over background had occurred, and therefore, Assessment monitoring was triggered. Detection monitoring activities and data are presented in the annual reports that have been prepared to date, (AECOM 2018 and 2019).

As part of Assessment monitoring, background and downgradient wells for the Phase II Landfill were sampled for Appendix IV constituents in April, July, and October 2018. GWPSs were established for Assessment monitoring of the Appendix IV constituents, and statistical evaluation indicated exceedances of GWPSs at SSLs for cobalt. Assessment monitoring results for groundwater sampling activities performed at the Site in 2019 indicated that lithium in monitoring well MW-6 was present at an SSL above its GWPS. Additional Assessment monitoring performed in 2020 indicated that cobalt is present at SSL in monitoring wells MW-5 and MW-6. SSL exceedances of GWPS, including when they occurred, are detailed in **Table 1** below.

Table 1 Wilson Station Phase II Landfill - Constituents of Concern

Monitoring Well (Date)	Parameter	
	Cobalt GWPS 0.005 (mg/L)	Lithium GWPS 0.04 (mg/L)
MW-10 (Apr 2018)	**0.0412**	<0.05
MW-10 (Jul 2018)	**0.0704**	0.0102
MW-10 (Oct 2018)	**0.114**	0.0147
MW-10 (Jun 2019)	**0.110**	0.009
MW-6 (Nov 2019)	0.008	**0.04**
MW-10 (Nov 2019)	**0.108**	<0.02
MW-5 (Apr 2020)	**0.009**	0.03
MW-6 (Apr 2020)	**0.009**	**0.04**
MW-10 (Apr 2020)	**0.082**	0.006
MW-5 (Oct 2020)	**0.010**	0.03
MW-6 (Oct 2020)	**0.009**	**0.04**
MW-10 (Oct 2020)	**0.078**	0.008

GWPSs are the greater of the site-specific background concentrations, the USEPA primary drinking water standard maximum contaminant limits (MCL), or GWPS provided in 40 CFR 257.95(3)(h)(2)
Bold text indicates an SSL exceedance of the GWPS.

Five characterization monitoring wells (MW-4D, MW-102, MW-104, MW-105, and MW-110) were installed in 2018 to estimate the downgradient extent of impacted groundwater. Sample collection for Appendix III and IV parameters took place in November 2018 and June 2019. With the exception of MW-4D, which is not part of the monitoring well network for the Phase II Landfill, the analytical results for cobalt and lithium were below the GWPS. The additional characterization data are summarized in **Table 2** below.

Table 2 – Wilson Station Phase II Landfill - Characterization Sample Results

Monitoring Well (Date)	Parameter	
	Cobalt [a] GWPS 0.005 (mg/L)	Lithium [b] GWPS 0.04 (mg/L)
MW-4D (Nov 2018)	**0.0122**	**0.181**
MW-102 (Nov 2018)	0.00263 J	<0.05
MW-104 (Nov 2018)	0.00388 J	0.0326 J
MW-105 (Nov 2018)	0.00488 J	0.0141 J
MW-110 (Nov 2018)	0.00240 J	0.0122 J
MW-4D (June 2019)	**0.010**	**0.14**
MW-102 (June 2019)	0.00286 J	<0.05
MW-104 (June 2019)	0.00164 J	0.0261 J
MW-105 (June 2019)	0.00435 J	0.0278 J
MW-110 (June 2019)	0.000827 J	<0.05

J=Estimated concentration above minimum detection limit but below reporting limit

Bold value exceeds GWPS

a The Upper Prediction Limit for cobalt was calculated as 0.0016 mg/L.

b The Upper Prediction Limit for lithium was calculated as 0.015 mg/L.

The results from both characterization sampling events helped to confirm the downgradient (southwestern) extent of COC impacts above GWPS at the Unit. However, further downgradient characterization is anticipated in 2020.

Semi-annual Assessment monitoring continued at the Unit in 2020 in accordance with 40 CFR Part 257.95.

2.4 Conceptual Site Model

Development and refinement of a Conceptual Site Model (CSM) is necessary to support remedy selection for the Unit. A CSM is based on a set of working hypotheses regarding how contaminants of concern (COCs) entered the environment at a site, how they were and continue to be transported to various media, what the potential routes of exposure are, and who may be exposed, including both human and ecological receptors. As such, the CSM is a “living” model. As new data become available or site conditions change, a CSM should be evaluated and updated as necessary.

The CSM for the Unit was first provided in the June 2019 ACM for the Unit (AECOM 2019). The CSM presents the physical setting of the Unit (adjacent to the Green River), the unconsolidated and bedrock geologic strata underling the Unit, the occurrence and movement of groundwater, the distribution of COCs in groundwater, and the potential receptors (or lack thereof) for impacted groundwater. These elements are described in detail below and have been updated with new information for this report as appropriate.

2.4.1 Physical Setting

The Unit is located on an upland plain to the east of the Green River at an elevation of approximately 420 feet (ft.) above mean sea level (amsl), with a maximum elevation of 520 ft. amsl. Near the Unit, maximum topographic relief is on the order of 70 feet. Precipitation falling on the Unit is directed to ponds on the south and west sides of the Unit and then to Elk Creek under Kentucky Pollution Discharge and

Elimination System permits. Elk Creek is a primary tributary to the Green River, and it flows westward to the Green River.

2.4.2 Geology

The Unit lies in the Western Kentucky Coalfields section of the Interior Low Plateaus physiographic province, which is characterized by rolling uplands underlain by coal-bearing bedrock of the Pennsylvanian Period. The geology underlying the site vicinity consists of unconsolidated materials, including loess, alluvial deposits, and mine spoil, underlain by Upper to Middle Pennsylvanian-age clastic and carbonate bedrock consisting primarily of sandstone and shale.

The geologic quadrangle for the area published by the United States Geological Survey (Geologic map of the Equality quadrangle, Ohio County, Kentucky, 1969) shows the surficial material to be unconsolidated Quaternary alluvium and Upper Pennsylvanian coal deposits, however, north of State Route 85 these materials were removed as part of historic strip-mining operations. Where present, native unconsolidated deposits consist of silty clay and clayey silt, which ranges in thickness from 6 feet (MW-104) to 36 feet (MW-102). The mine spoil deposits are primarily located north of State Route 85 in the reclaimed mine area. The spoil deposits consist of a relatively fine-grained matrix of disaggregated shales with gravel to boulder-sized pieces of sandstone.

The unconsolidated materials are shown to be underlain by bedrock of the Middle Pennsylvanian Carbondale Formation. The Carbondale Formation consists of cyclic sequences of sandstones, shales, siltstones and coals. The Carbondale sediments were deposited in a fluvial-deltaic system. As a result of this depositional environment, the sandstone units of the Carbondale tend to be lenticular bodies rather than continuous sheet-like strata. Gradational and abrupt horizontal changes in lithology are often encountered. The base of the spoil deposits slopes from north to south, following the base of the number 9 coal bed of the Carbondale Formation, which was removed by strip mining and subsequently reclaimed with spoil backfill.

2.4.3 Groundwater Hydrogeology

For purposes of compliance with the CCR Rule groundwater monitoring requirements, the unconsolidated mine spoil is considered to be the uppermost aquifer underlying the Phase II Landfill. As noted above, the spoil deposits are dominated by a fine-grained matrix derived from the processed shales, so it is a relatively poor water-bearing unit. The uppermost aquifer is unconfined and first encountered at an elevation of approximately 400 ft., amsl at the north end of the Phase II Landfill and 395 ft. amsl at the south end.

Groundwater elevation data collected in October 2020 are summarized on **Table 3** below. These data were utilized to construct a piezometric surface map illustrating groundwater flow conditions for the uppermost aquifer (see **Figure 3**). Overall flow direction beneath the Unit is to the south and southeast. The mine spoil is bounded on the south (i.e., downgradient) by a headwall of undisturbed Carbondale Formation.

Table 3. Wilson Landfill -October 2020 Groundwater Elevation Data

Monitoring Well	Top of Casing Elevation (ft) [a]	Depth to Groundwater (ft)	Groundwater Elevation (ft, amsl)
MW-1 [b]	443.89	19.47	424.42
MW-2 [b]	417.11	18.51	398.60
MW-3 [b]	411.12	24.59	386.53
MW-4 [b]	408.82	22.78	386.04
MW-4D [b]	410.02	23.98	386.04
MW-5	469.14	57.71	411.43
MW-6	433.06	42.59	390.47
MW-7	426.14	39.98	386.16
MW-8	471.60	45.53	426.07
MW-10	398.91	13.33	385.58
MW-102	399.71	11.58	388.13
MW-104	392.87	6.94	385.93
MW-105	396.74	6.27	390.47
MW-110	393.54	8.93	384.61
P-9	432.37	24.51	407.86
P-11	446.55	60.50	386.05

a Reference elevation of monitoring wells surveyed by Associated Engineers, Inc., Madisonville, Kentucky, June 2015. Survey coordinates were based on the Kentucky State Plane, Kentucky Southern Zone, NAD27 datum.
b MW-1 through MW-4D are utilized for collection of piezometric data only and are not part of the CCR monitoring well network for the Wilson Phase II Landfill.

Slug tests were performed on April 23, 2019 at monitoring wells MW-4, MW-4D, and MW-10 to assess the hydraulic characteristics of the uppermost aquifer. The estimated hydraulic conductivity of the monitoring wells tested were 8.03 $\times10^{-2}$ centimeters per second (cm/sec) in MW-4, 9.30 $\times10^{-2}$ cm/sec in MW-4D, and 2.91 $\times10^{-2}$ cm/sec in MW-10. Hydraulic conductivity for the Carbondale Formation is estimated from literature, and for the purposes of this ACM, a range for sandstone of 1 $\times10^{-4}$ cm/sec to 1 $\times10^{-5}$ cm/sec is used. Groundwater flow downgradient of the mine spoil beneath the Phase II Landfill is therefore rate-limited by the lower permeability in the Carbondale Formation.

2.4.4 Constituents of Concern

Two Appendix IV COCs, cobalt and lithium, have been detected at concentrations exceeding GWPS at SSLs in monitoring wells (MW-5, MW-6 and MW-10) at the Unit. As a result, the corrective measure evaluation is confined to the area adjacent to the monitoring wells in which the exceedances have been identified.

2.4.5 Impacted Media

Groundwater is the single impacted media of concern identified as requiring corrective measures at the Unit.

2.4.6 Distribution of COCs

Groundwater sampling was performed at the Unit most recently in October 2020. The additional cobalt and lithium data collected during this event are summarized below in **Table 4**.

Table 4. Wilson Phase II Landfill - October 2020 Groundwater Analytical Results

Monitoring Well (Date)	Parameter	
	Cobalt GWPS 0.005 (mg/L)	Lithium GWPS 0.04 (mg/L)
MW-5	0.01	0.03
MW-6	0.009	0.04
MW-7	<0.004	0.03
MW-8	0.015	0.02
MW-10	0.078	0.008
MW-102	<0.004	<0.02
MW-104	<0.004	0.03
MW-105	<0.004	0.02
MW-110	<0.004	<0.02

Figure 4 illustrates the distribution of COCs and other groundwater quality constituents in groundwater at the Unit. This distribution of COCs in groundwater suggests that impacts to groundwater likely originate as seepage from beneath the Phase II Landfill, however there is currently no feasible means of directly tracing that potential under the footprint of the Unit.

2.4.7 Potential Receptors/Exposure Pathways

Contact with water (e.g., shallow groundwater or surface water) impacted by COCs at levels above GWPS is regarded as the exposure pathway for potential receptors. Based on a database maintained by the Kentucky Geological Survey (KGS), there are no known groundwater wells used for drinking water within a 1-mile radius of the Wilson Phase II Landfill, thus limiting the potential receptors to the surface water, i.e., the Green River and its tributary, Elk Creek. The pathways to these receptors include seepage of water from the Phase II Landfill through manmade and natural hydraulic barriers and groundwater discharge.

Other potential exposure pathways (e.g., soil or vapor) are not considered complete as the CCR material is isolated in the Unit. This isolation prevents direct access by individuals that might result in direct contact or ingestion. In addition, the inherent non-volatile nature of the unit-specific COCs eliminates the potential for a complete vapor pathway (i.e., vapor intrusion to indoor air).

2.5 Interim Corrective Measures

No formal interim corrective measures have been performed at the Wilson Landfill for groundwater, but corrective measures for known non-groundwater releases (landfill seepage) are underway. The compatibility of those corrective measures with potential groundwater remedies is being evaluated as part of the remedy selection process.

2.6 Assessment of Corrective Measures Summary

In June 2019, BREC performed an ACM for the Unit to identify remedial alternatives to address groundwater impacts. Title 40 CFR Section 257.96(c) requires that the ACM include an analysis of the effectiveness of potential corrective measures in meeting the objectives for remedies identified under Section 257.97(b), by 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; and
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).

As part of the groundwater ACM, several potential corrective measures technologies were evaluated to identify which ones could be carried forward as components of corrective measures alternatives. The results of the corrective measures technology evaluation are presented below in **Table 5**.

Table 5 – Potential Corrective Measures Options for Groundwater Impacts

Potentially Applicable Technology	Status	Description/Overview
No Action	Not retained as standalone technology, but carried forward for baseline comparisons	This technology has been included in the preliminary evaluation/screening but is not retained because it will not meet the established Corrective Action Objectives (CAOs).
Institutional Controls (ICs)	Retained as supplement to corrective measures alternatives	The use of ICs (i.e., Environmental Covenant, groundwater use restrictions, etc.) is retained as a useful technology. However, it is noted the ICs are not anticipated to be used as a stand-alone technology. Environmental Covenants, groundwater use restrictions, etc., are expected to be combined with other applicable technologies as part of corrective measures alternatives.
Groundwater Monitoring (Assessment and Detection mode)	Retained as supplement to corrective measures alternatives	The use of groundwater monitoring (Assessment and/or Detection modes as appropriate) when combined with other applicable technologies as part of any proposed corrective measures alternative is retained to address the CAO and to track the effectiveness of the overall remedy. However, it is not retained as a standalone technology.
Hydraulic Containment	Retained	The use of hydraulic containment is retained because it is an effective means of preventing offsite migration of soluble contaminants. Hydraulic containment requires management and potential ex-situ treatment of extracted groundwater, so it is not a stand-alone technology. The CSM will guide the design of any groundwater extraction system to optimize the total discharge of groundwater needed to provide hydraulic containment.
Physical Containment	Retained	The use of physical containment is retained because it can be an effective means of managing groundwater flow. Physical containment often requires pairing with hydraulic containment and/or in-situ treatment (funnel and gate style) to manage the flux of groundwater flow into the system. The CSM will guide the design of any physical barrier system, but technology limitations may increase implementation difficulty with scale.
Ex-situ Physical/Chemical/Biological Treatment	Retained	Ex-situ treatment technologies are retained as a way of removing contaminants from extracted groundwater from a hydraulic containment system. Ex-situ treatment may be paired with wastewater treatment, non-groundwater release treatment systems, or with permitted discharge to manage groundwater contamination. The CSM and data gaps investigations will guide the design of any ex-situ treatment

Potentially Applicable Technology	Status	Description/Overview
In-situ Physical/Chemical Treatment	Retained	In-situ treatment technologies are retained for circumstances in which groundwater flow volumes are particularly low, source controls are effective, COCs are amenable to treatment, and impacted groundwater is not expected to persist as a treatment demand. The CSM and data gaps investigations will guide the design of any in-situ treatment
Permeable Reactive Barriers (PRB)	Retained	The use of PRBs is retained for circumstances in which groundwater flow volumes are particularly low or in which they can be paired with physical containment to achieve passive management of impacted groundwater. The CSM, as well as bench and pilot-scale testing will guide the design of any PRB system.
Closure in Place (CiP) (of the regulated unit)	Retained	The use of CiP as a source control technology and is amenable with respect to CAO attainment.
Closure by Removal (CbR) (of the regulated unit)	Retained	The use of CbR as a source control technology is amenable with respect to CAO attainment.
Other Source Control Technologies	Retained	Control of source area non-groundwater (i.e., leachate seeps) related releases. Engineering measures, including seepage/leachate collection, lining of trenches and/or ponds, and other isolation methods are part of operational practices and/or closure technologies selected for the site.

Note: Technologies that were retained may be used as components of a corrective action alternative, but when evaluated in conjunction with other available technologies any single technology may not be utilized.

Preliminary assembly of corrective measures alternatives was performed based on site-specific and regional geology and groundwater conditions. For the Unit, six corrective measures alternatives were developed from this list of applicable corrective measures technologies during the ACM screening process:

- Alternative #1 – No Action and Groundwater Monitoring
- Alternative #2a – Closure in Place (CiP), Institutional Controls (ICs), Other Source Control, and Groundwater Monitoring
- Alternative #2b – Closure by Removal (CbR), ICs, and Groundwater Monitoring
- Alternative #3 – CiP, ICs, Hydraulic Containment, Other Source Control (consisting of seepage collection and treatment), Ex-Situ Treatment, and Groundwater Monitoring
- Alternative #4 – CiP, ICs, Other Source Control, Physical Containment, PRB, and Groundwater Monitoring
- Alternative #5 – CiP, ICs, Other Source Control, In-Situ Treatment, and Groundwater Monitoring

The assembly of corrective measures alternatives presented in the ACM was considered preliminary and subject to revision following additional evaluation during the remedy selection process and/or following comment from the regulatory community and public. Further evaluation of the alternatives is discussed in the following sections.

3. Remedy Selection Progress

The groundwater ACM performed for the Unit in June 2019 identified a total of six (6) corrective measures alternatives to be carried forward into the remedy selection process. In December 2019, BREC provided a *Semi-annual Remedy Selection Progress Report* (AECOM, December 2019) as required under 40 CFR 257.97(a). As part of this submittal, two (2) corrective measures alternatives were eliminated from further consideration, including:

- Alternative #1 (No Action and Groundwater Monitoring) – This alternative does not control or remove COCs from the environment and therefore does not achieve the RAOs.
- Alternative #2b – (CbR, ICs, and Groundwater Monitoring) – Implementing a CbR approach is considered cost prohibitive. In addition, any CbR approach would require relocating waste to an existing disposal unit or construction of a new waste disposal unit, which does not align with the one of the fundamental goals of RCRA (conserving energy and natural resources).

Four (4) potential corrective measures alternatives have been identified by BREC as viable options to address lithium impacts in groundwater and non-groundwater releases at the Unit, including:

- Alternative #2a: CiP, ICs, Other Source Control, and Groundwater Monitoring
- Alternative #3: CiP, ICs, Hydraulic Containment, Other Source Control, Ex-Situ Treatment, and Groundwater Monitoring
- Alternative #4: CiP, ICs, Physical Containment, PRB, and Groundwater Monitoring
- Alternative #5: CiP, ICs, Other Source Control, In-Situ Treatment, and Groundwater Monitoring

Each of the remining 4 corrective measures alternatives is discussed in more detail below.

3.1 Potential Corrective Action Alternatives

3.1.1 Alternative #2a – CiP, ICs, and Groundwater Monitoring

Alternative #2a employs a combination of four of the retained corrective measures technologies:

- CiP source control, which consists of planned Phase II Landfill closure activities;
- Implementation of ICs designed to restrict the property to industrial use and to prohibit groundwater use for potable purposes;
- Other source control consisting of collection and management of seeps emanating from the east side of the Phase II Landfill; and
- Groundwater Monitoring (Assessment) to track the effectiveness of the corrective measures and to identify conditions that allow the return to Detection monitoring and ultimately to cessation of corrective measures.

CiP was selected as the source control technology because the site's operational planning includes closure-related activities that will eventually result in placement of an engineered cap. CiP via CCR stabilization and capping would serve to control the source of COCs and thereby reduce contaminant loading to the surrounding environment.

Implementation of ICs is employed to help maintain the CiP and associated corrective measures by limiting the accessibility of the unit to unauthorized users and restricting future use of the property to those activities that may result in exposure potentials.

Seepage from CCR is present along the east side of the Phase II Landfill and the Wilson Station is in the process of designing a collection system that will convey seepage liquids to existing onsite treatment.

Groundwater monitoring of the unit is required by 40 CFR 257.90 through .98. The unit triggered Assessment-mode monitoring by the detection of indicator parameters (Appendix III of 40 CFR 257) in downgradient monitoring wells at concentrations representing a SSI over background. Continued groundwater monitoring is required under 40 CFR 257.95 until the CAOs are met. The CAOs are anticipated to be met as the effect of source control technologies are realized and as natural attenuation

Alternative #2a is recommended for further evaluation.

3.1.2 Alternative #3 – CiP, ICs, Hydraulic Containment, Other Source Control, Ex-Situ Treatment, and Groundwater Monitoring

Alternative #3 builds on Alternative #2a to also include the addition of Hydraulic Containment and Ex-Situ Treatment of groundwater:

- CiP source control, which consists of future planned Phase II Landfill closure activities following its operational life cycle;
- Other Source Control by means of collection and management of seepage liquids from the Landfill and conveyance to existing onsite treatment;
- Implementation of ICs designed to restrict the property to industrial use and to prohibit groundwater use for potable purposes;
- Hydraulic Containment using one or more vertical wells designed to prevent the movement of impacted groundwater past the limits of the Unit to the downgradient groundwater environment and potential points of exposure;
- Ex-Situ Treatment of groundwater extracted for hydraulic containment, which involves above-ground physical/chemical treatment methods and/or permitted discharge until the CAOs are achieved; and
- Groundwater Monitoring (Assessment mode) to track the effectiveness of the corrective measures and to identify conditions that allow the return to Detection-mode monitoring and ultimately to cessation of corrective measures.

Vertical groundwater recovery wells for Hydraulic Containment would be installed near the downgradient limit of the unit in the vicinity of MW-6 and MW-10. Due to the varying hydraulic conductivity values within the uppermost aquifer, Pre-Design Studies are anticipated to be needed to identify the appropriate number, design, and spacing of the extraction well system.

Alternative #3 incorporates treatment of extracted groundwater before it can be discharged to an outfall. Treatment will consist of piping the extracted groundwater to an existing surface water impoundment at the Wilson Station, which will accommodate conveyed discharge from the other source control collection remedy, and which will allow for compliance with discharge permits through an established NPDES outfall.

The COC concentrations downgradient of the hydraulic containment would also be expected to decrease over time through natural attenuation mechanisms including advection, dilution, and dispersion. As such, groundwater monitoring would be modified to include system performance monitoring, which may require installation of wells at new locations to evaluate the efficacy of hydraulic containment and to identify when CAOs have been achieved.

Alternative #3 is recommended for further evaluation.

3.1.3 Alternative #4 – CiP, ICs, Physical Containment, Permeable Reactive Barrier, and Groundwater Monitoring

Alternative #4 consists of BREC's planned unit closure activities, other source control, physical containment of impacted groundwater via installation of a funnel-gate system, and in-situ treatment of contained groundwater via PRB installed at the containment gate. Impacted groundwater would be contained by slurry wall constructed in a funnel-and-gate arrangement that directs the flow of groundwater to the PRB. The slurry wall would be installed by trenching equipment, and the length of the barrier would be 2,700 feet, with the target depth would be approximately 60 ft. A PRB would be installed at the "gate," and treatability studies would be required to design the reactive media, which would include granular zero-valent iron (ZVI), for treatment of cobalt.

Alternative #4 is recommended for further evaluation.

3.1.4 Alternative #5 – CiP, ICs, Other Source Control, In-Situ Treatment, and Groundwater Monitoring

Alternative #5 consists of BREC's planned unit closure activities, other source control, and in-situ treatment of groundwater via a PRB installed into the mine spoil in a linear arrangement downgradient of the Phase II Landfill. Impacted groundwater would be treated in-situ as it migrates through the PRB made of granular ZVI material. Treatability studies would be required to design the reactive media. The PRB would be installed with conventional drilling and injection methods along the south and southeast boundaries of the Phase II Landfill in the vicinity of MW-6, MW-10 and MW-4/MW-4D.

Alternative #5 is recommended for further evaluation.

3.2 Remedy Evaluation

Currently BREC considers four (4) potential corrective action alternatives as viable options to address groundwater impacts at the Unit, including:

- Alternative #2a;
- Alternative #3;
- Alternative #4; and
- Alternative #5.

To evaluate each alternative, additional data collection will likely be required. BREC is currently evaluating data collection needs in the following areas to assist with remedy selection:

1) Nature and Extent – groundwater trends, influence of non-groundwater remedies, etc.
2) Physical Characteristics – available data on the physical characteristics of the landfill and retention pond
3) Performance Modeling – data needed to develop digital models demonstrating the effectiveness of potential alternatives
4) Engineering – feasibility, cost estimates, etc.

BREC is working to establish a comprehensive list of data collection needs to proceed forward with remedy evaluation and anticipates providing additional data in future semi-annual remedy selection progress reports.

In 2019, BREC constructed a series of collection trenches around the perimeter of the Unit to address non-groundwater releases. The ongoing groundwater monitoring program will assist in evaluating the success of the non-groundwater release remedies and provide relevant and important information to be considered in the final groundwater remedy selection.

4. Conclusion

Additional updates regarding remedy selection, including any additional corrective measures being considered, will be presented twice a year in future remedy selection progress reports. Once sufficient data has been collected to select an effective comprehensive remedy for the Unit, a public meeting will be held 30 days prior to formal remedy selection, followed by a detailed Remedy Selection Report describing the remedy and proposed schedule for implementation.

The next remedy selection progress report for the Unit is expected in June 2021.

5. References

AECOM, 2018. Annual Groundwater Monitoring and Corrective Action Report, 2016-2017; D.B. Wilson CCR Landfill, Ohio County, Kentucky.

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USEPA, 40 CFR Part 257. [EPA–HQ–RCRA–2015–0331; FRL–9928–44–OSWER]. RIN–2050–AE81. Technical Amendments to the Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities—Correction of the Effective Date. Federal Register / Vol. 80, No. 127 / Thursday, July 2, 2015 / Rules and Regulations.

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Figures

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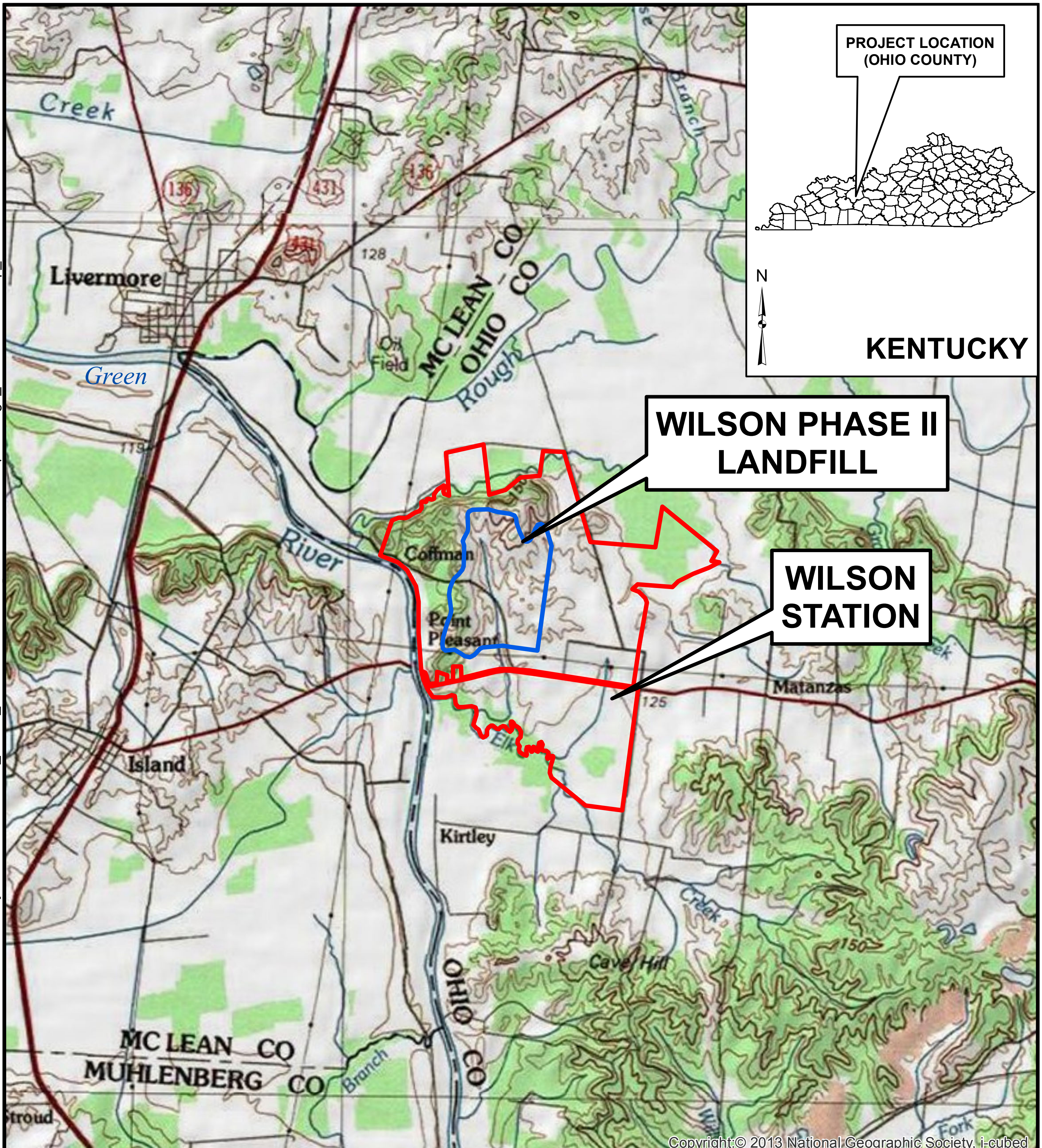

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

EQUALITY QUADRANGLE
(https://viewer.nationalmap.gov/basic/)

0 3,000 6,000 Feet

N

Big Rivers ELECTRIC CORPORATION

Wilson Station
Ohio County, Kentucky

FIGURE 1
SITE LOCATION MAP

DATE: 5/21/2019	SCALE: 1IN = 1,500 FEET
CREATED BY: ALW	
JOB NO. 60602363	

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Legend

- Property Boundary
- CCR Phase 2 Fill
- Bond Increment
- KAR Permit Area
- Downgradient CCR Monitoring Well Location
- Upgradient CCR Monitoring Well Location
- Characterization Monitoring Well Location
- Monitoring Well Location (Water Level Only)
- Piezometer Location (Water Level Only)

0 750 1,500
Feet

Wilson Station Landfill
Ohio County, Kentucky

FIGURE 2
WELL LOCATION MAP

DATE: 12/9/2019	SCALE: 1IN = 750 FEET
CREATED BY: ALW	
JOB NO. 60579935	

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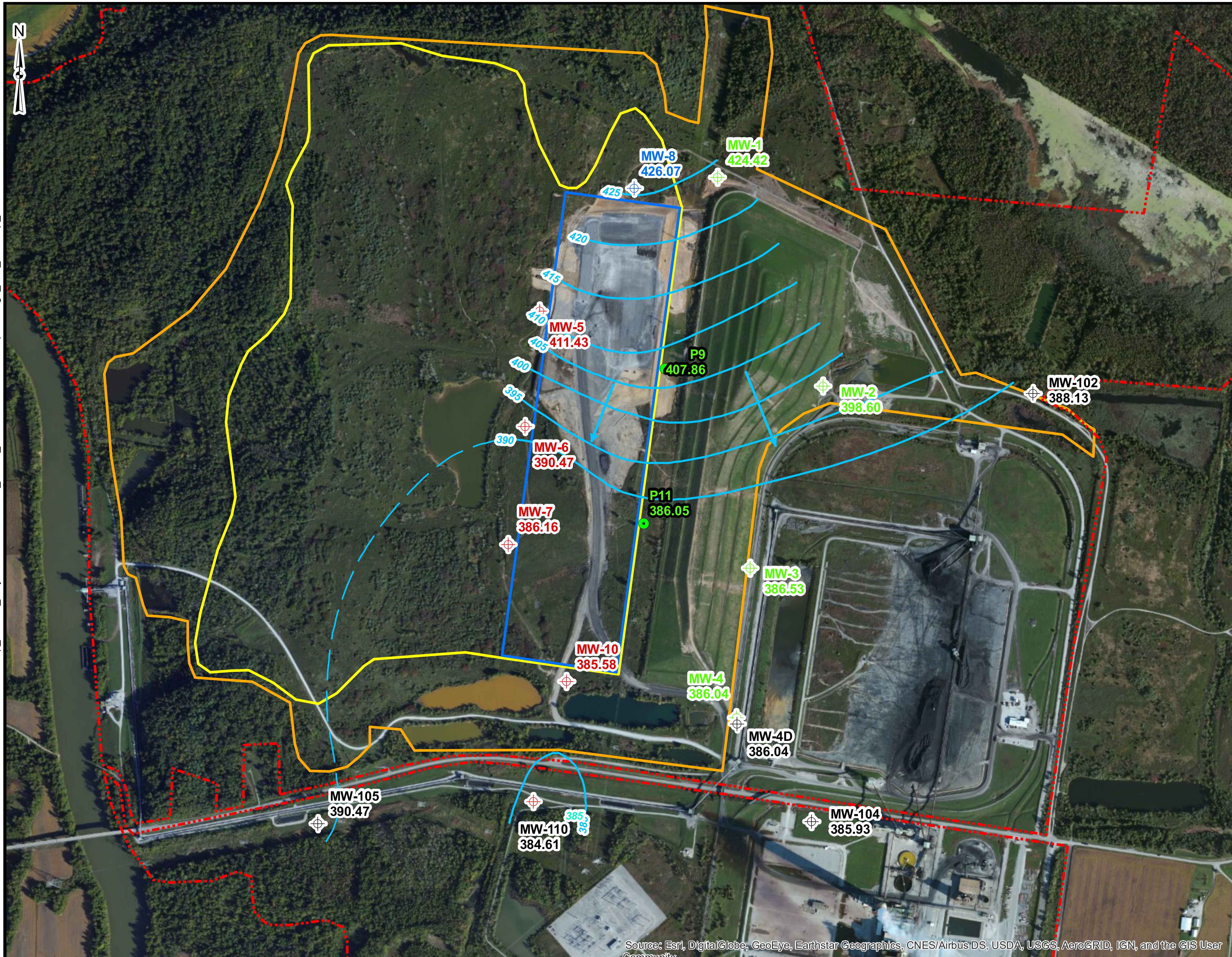


Legend

- Downgradient CCR Monitoring Well Location
- Upgradient CCR Monitoring Well Location
- Characterization Monitoring Well Location
- Piezometer Location (Water Level Only)
- Monitoring Well Location (Water Level Only)
- Property Boundary
- Bond Increment
- CCR Phase 2 Fill
- KAR Permit Area
- Water Table Contour (Inferred from Available Monitoring Data)
- Groundwater Flow Direction
- **409.69** Groundwater Elevation (Feet, NAD27) Measured October 28, 2020

Dennis P. Connair, Registered Professional Geologist, PG 0197

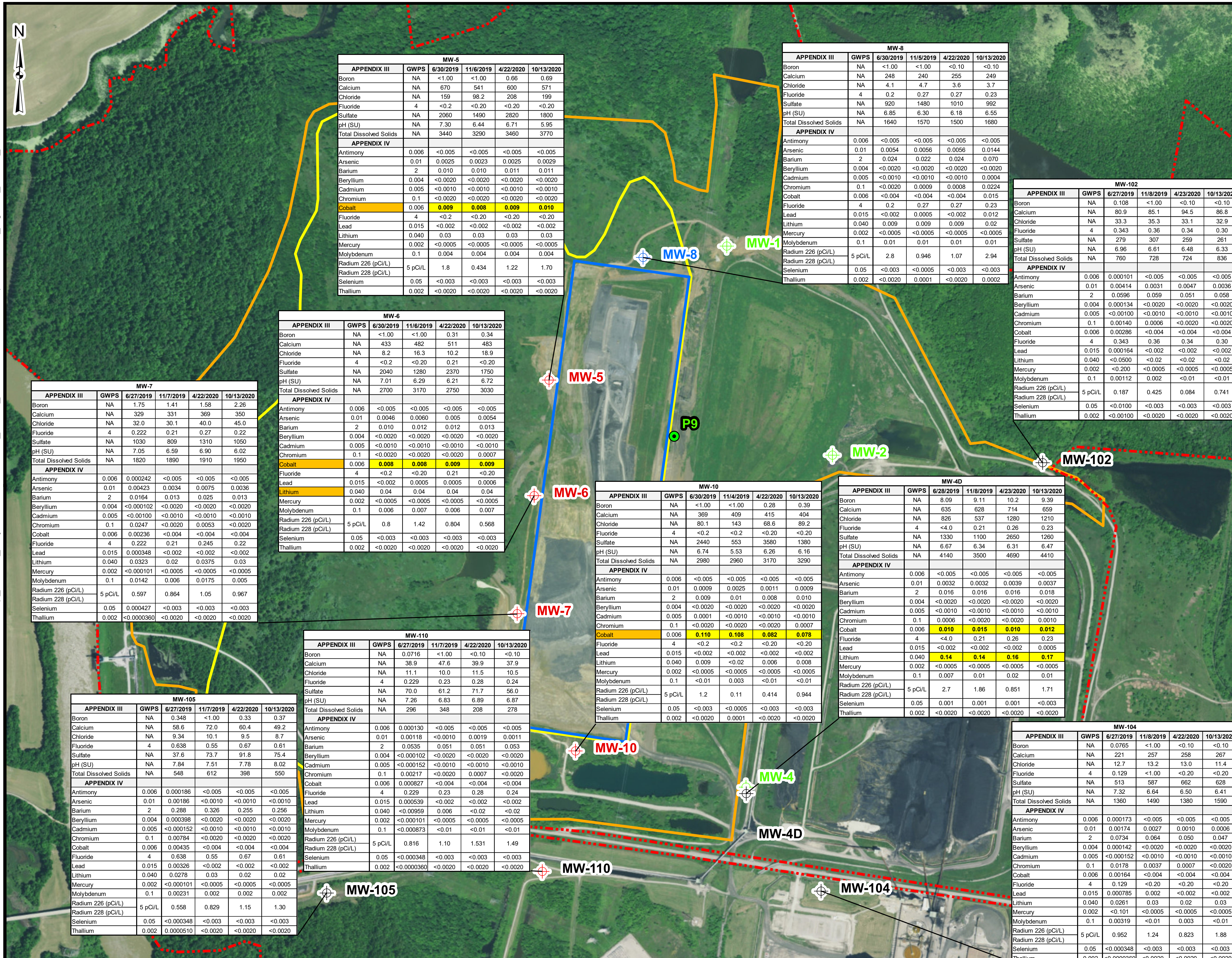
0 750 1,500
Feet

Big Rivers ELECTRIC CORPORATION

Wilson Landfill
Ohio County, Kentucky

FIGURE 3
GROUNDWATER SURFACE MAP
October 2020

DATE: 11/13/2020	SCALE: 1IN = 750 FEET
CREATED BY: AEH	
JOB NO. 60579935	



MW-5					
APPENDIX III	GWPS	6/30/2019	11/6/2019	4/22/2020	10/13/2020
Boron	NA	<1.00	<1.00	0.66	0.69
Calcium	NA	670	541	600	571
Chloride	NA	159	98.2	208	199
Fluoride	4	<0.2	<0.20	<0.20	<0.20
Sulfate	NA	2060	1490	2820	1800
pH (SU)	NA	7.30	6.44	6.71	5.95
Total Dissolved Solids	NA	3440	3290	3460	3770
APPENDIX IV					
Antimony	0.006	<0.005	<0.005	<0.005	<0.005
Arsenic	0.01	0.0025	0.0023	0.0025	0.0029
Barium	2	0.010	0.010	0.011	0.011
Beryllium	0.004	<0.0020	<0.0020	<0.0020	<0.0020
Cadmium	0.005	<0.0010	<0.0010	<0.0010	<0.0010
Chromium	0.1	<0.0020	<0.0020	<0.0020	<0.0020
Cobalt	0.006	**0.009**	**0.008**	**0.009**	**0.010**
Fluoride	4	<0.2	<0.20	<0.20	<0.20
Lead	0.015	<0.002	<0.002	<0.002	<0.002
Lithium	0.040	0.03	0.03	0.03	0.03
Mercury	0.002	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	0.1	0.004	0.004	0.004	0.004
Radium 226 (pCi/L) Radium 228 (pCi/L)	5 pCi/L	1.8	0.434	1.22	1.70
Selenium	0.05	<0.003	<0.003	<0.003	<0.003
Thallium	0.002	<0.0020	<0.0020	<0.0020	<0.0020

MW-8					
APPENDIX III	GWPS	6/30/2019	11/5/2019	4/22/2020	10/13/2020
Boron	NA	<1.00	<1.00	<0.10	<0.10
Calcium	NA	248	240	255	249
Chloride	NA	4.1	4.7	3.6	3.7
Fluoride	4	0.2	0.27	0.27	0.23
Sulfate	NA	920	1480	1010	992
pH (SU)	NA	6.85	6.30	6.18	6.55
Total Dissolved Solids	NA	1640	1570	1500	1680
APPENDIX IV					
Antimony	0.006	<0.005	<0.005	<0.005	<0.005
Arsenic	0.01	0.0054	0.0056	0.0056	0.0144
Barium	2	0.024	0.022	0.024	0.070
Beryllium	0.004	<0.0020	<0.0020	<0.0020	<0.0020
Cadmium	0.005	<0.0010	<0.0010	<0.0010	0.0004
Chromium	0.1	<0.0020	0.0009	0.0008	0.0224
Cobalt	0.006	<0.004	<0.004	<0.004	0.015
Fluoride	4	0.2	0.27	0.27	0.23
Lead	0.015	<0.002	0.0005	<0.002	0.012
Lithium	0.040	0.009	0.009	0.009	0.02
Mercury	0.002	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	0.1	0.01	0.01	0.01	0.01
Radium 226 (pCi/L) Radium 228 (pCi/L)	5 pCi/L	2.8	0.946	1.07	2.94
Selenium	0.05	<0.003	<0.0005	<0.003	<0.003
Thallium	0.002	<0.0020	0.0001	<0.0020	0.0002

MW-102					
APPENDIX III	GWPS	6/27/2019	11/8/2019	4/23/2020	10/13/2020
Boron	NA	0.108	<1.00	<0.10	<0.10
Calcium	NA	80.9	85.1	94.5	86.8
Chloride	NA	33.3	35.3	33.1	32.9
Fluoride	4	0.343	0.36	0.34	0.30
Sulfate	NA	279	307	259	261
pH (SU)	NA	6.96	6.61	6.48	6.33
Total Dissolved Solids	NA	760	728	724	836
APPENDIX IV					
Antimony	0.006	0.000101	<0.005	<0.005	<0.005
Arsenic	0.01	0.00414	0.0031	0.0047	0.0036
Barium	2	0.0596	0.059	0.051	0.058
Beryllium	0.004	0.000134	<0.0020	<0.0020	<0.0020
Cadmium	0.005	<0.00100	<0.0010	<0.0010	<0.0010
Chromium	0.1	0.00140	0.0006	<0.0020	<0.0020
Cobalt	0.006	0.00286	<0.004	<0.004	<0.004
Fluoride	4	0.343	0.36	0.34	0.30
Lead	0.015	0.000164	<0.002	<0.002	<0.002
Lithium	0.040	<0.0500	<0.02	<0.02	<0.02
Mercury	0.002	<0.200	<0.0005	<0.0005	<0.0005
Molybdenum	0.1	0.00112	0.002	<0.01	<0.01
Radium 226 (pCi/L) Radium 228 (pCi/L)	5 pCi/L	0.187	0.425	0.084	0.741
Selenium	0.05	<0.0100	<0.003	<0.003	<0.003
Thallium	0.002	<0.00100	<0.0020	<0.0020	<0.0020

MW-6					
APPENDIX III	GWPS	6/30/2019	11/6/2019	4/22/2020	10/13/2020
Boron	NA	<1.00	<1.00	0.31	0.34
Calcium	NA	433	482	511	483
Chloride	NA	8.2	16.3	10.2	18.9
Fluoride	4	<0.2	<0.20	0.21	<0.20
Sulfate	NA	2040	1280	2370	1750
pH (SU)	NA	7.01	6.29	6.21	6.72
Total Dissolved Solids	NA	2700	3170	2750	3030
APPENDIX IV					
Antimony	0.006	<0.005	<0.005	<0.005	<0.005
Arsenic	0.01	0.0046	0.0060	0.005	0.0054
Barium	2	0.010	0.012	0.012	0.013
Beryllium	0.004	<0.0020	<0.0020	<0.0020	<0.0020
Cadmium	0.005	<0.0010	<0.0010	<0.0010	<0.0010
Chromium	0.1	<0.0020	<0.0020	<0.0020	0.0007
Cobalt	0.006	**0.008**	**0.008**	**0.009**	**0.009**
Fluoride	4	<0.2	<0.20	0.21	<0.20
Lead	0.015	<0.002	0.0005	0.0005	0.0006
Lithium	0.040	0.04	0.04	0.04	0.04
Mercury	0.002	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	0.1	0.006	0.007	0.006	0.007
Radium 226 (pCi/L) Radium 228 (pCi/L)	5 pCi/L	0.8	1.42	0.804	0.568
Selenium	0.05	<0.003	<0.003	<0.003	<0.003
Thallium	0.002	<0.0020	<0.0020	<0.0020	<0.0020

MW-7					
APPENDIX III	GWPS	6/27/2019	11/7/2019	4/22/2020	10/13/2020
Boron	NA	1.75	1.41	1.58	2.26
Calcium	NA	329	331	369	350
Chloride	NA	32.0	30.1	40.0	45.0
Fluoride	4	0.222	0.21	0.27	0.22
Sulfate	NA	1030	809	1310	1050
pH (SU)	NA	7.05	6.59	6.90	6.02
Total Dissolved Solids	NA	1820	1890	1910	1950
APPENDIX IV					
Antimony	0.006	0.000242	<0.005	<0.005	<0.005
Arsenic	0.01	0.00423	0.0034	0.0075	0.0036
Barium	2	0.0164	0.013	0.025	0.013
Beryllium	0.004	<0.000102	<0.0020	<0.0020	<0.0020
Cadmium	0.005	<0.00100	<0.0010	<0.0010	<0.0010
Chromium	0.1	0.0247	<0.0020	0.0053	<0.0020
Cobalt	0.006	0.00236	<0.004	<0.004	<0.004
Fluoride	4	0.222	0.21	0.245	0.22
Lead	0.015	0.000348	<0.002	<0.002	<0.002
Lithium	0.040	0.0323	0.02	0.0375	0.03
Mercury	0.002	<0.000101	<0.0005	<0.0005	<0.0005
Molybdenum	0.1	0.0142	0.006	0.0175	0.005
Radium 226 (pCi/L) Radium 228 (pCi/L)	5 pCi/L	0.597	0.864	1.05	0.967
Selenium	0.05	0.000427	<0.003	<0.003	<0.003
Thallium	0.002	<0.0000360	<0.0020	<0.0020	<0.0020

MW-10					
APPENDIX III	GWPS	6/30/2019	11/4/2019	4/22/2020	10/13/2020
Boron	NA	<1.00	<1.00	0.28	0.39
Calcium	NA	369	409	415	404
Chloride	NA	80.1	143	68.6	89.2
Fluoride	4	<0.2	<0.2	<0.20	<0.20
Sulfate	NA	2440	553	3580	1380
pH (SU)	NA	6.74	5.53	6.26	6.16
Total Dissolved Solids	NA	2980	2960	3170	3290
APPENDIX IV					
Antimony	0.006	<0.005	<0.005	<0.005	<0.005
Arsenic	0.01	0.0009	0.0025	0.0011	0.0009
Barium	2	0.009	0.01	0.008	0.010
Beryllium	0.004	<0.0020	<0.0020	<0.0020	<0.0020
Cadmium	0.005	0.0001	<0.0010	<0.0010	<0.0010
Chromium	0.1	<0.0020	<0.0020	<0.0020	0.0007
Cobalt	0.006	**0.110**	**0.108**	**0.082**	**0.078**
Fluoride	4	<0.2	<0.2	<0.20	<0.20
Lead	0.015	<0.002	<0.002	<0.002	<0.002
Lithium	0.040	0.009	<0.02	0.006	0.008
Mercury	0.002	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	0.1	<0.01	0.003	<0.01	<0.01
Radium 226 (pCi/L) Radium 228 (pCi/L)	5 pCi/L	1.2	0.11	0.414	0.944
Selenium	0.05	<0.003	<0.0005	<0.003	<0.003
Thallium	0.002	<0.0020	0.0001	<0.0020	<0.0020

MW-4D					
APPENDIX III	GWPS	6/28/2019	11/8/2019	4/23/2020	10/13/2020
Boron	NA	8.09	9.11	10.2	9.39
Calcium	NA	635	628	714	659
Chloride	NA	826	537	1280	1210
Fluoride	4	<4.0	0.21	0.26	0.23
Sulfate	NA	1330	1100	2650	1260
pH (SU)	NA	6.67	6.34	6.31	6.47
Total Dissolved Solids	NA	4140	3500	4690	4410
APPENDIX IV					
Antimony	0.006	<0.005	<0.005	<0.005	<0.005
Arsenic	0.01	0.0032	0.0032	0.0039	0.0037
Barium	2	0.016	0.016	0.016	0.018
Beryllium	0.004	<0.0020	<0.0020	<0.0020	<0.0020
Cadmium	0.005	<0.0010	<0.0010	<0.0010	<0.0010
Chromium	0.1	0.0006	<0.0020	<0.0020	0.0010
Cobalt	0.006	**0.010**	**0.015**	**0.010**	**0.012**
Fluoride	4	<4.0	0.21	0.26	0.23
Lead	0.015	<0.002	<0.002	<0.002	0.0005
Lithium	0.040	**0.14**	**0.14**	**0.16**	**0.17**
Mercury	0.002	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	0.1	0.007	0.01	0.02	0.01
Radium 226 (pCi/L) Radium 228 (pCi/L)	5 pCi/L	2.7	1.86	0.851	1.71
Selenium	0.05	0.001	0.001	0.001	<0.003
Thallium	0.002	<0.0020	<0.0020	<0.0020	<0.0020

MW-110					
APPENDIX III	GWPS	6/27/2019	11/7/2019	4/22/2020	10/13/2020
Boron	NA	0.0716	<1.00	<0.10	<0.10
Calcium	NA	38.9	47.6	39.9	37.9
Chloride	NA	11.1	10.0	11.5	10.5
Fluoride	4	0.229	0.23	0.28	0.24
Sulfate	NA	70.0	61.2	71.7	56.0
pH (SU)	NA	7.26	6.83	6.89	6.87
Total Dissolved Solids	NA	296	348	208	278
APPENDIX IV					
Antimony	0.006	0.000130	<0.005	<0.005	<0.005
Arsenic	0.01	0.00118	<0.0010	0.0019	0.0011
Barium	2	0.0535	0.051	0.051	0.053
Beryllium	0.004	<0.000102	<0.0020	<0.0020	<0.0020
Cadmium	0.005	<0.000152	<0.0010	<0.0010	<0.0010
Chromium	0.1	0.00217	<0.0020	0.0007	<0.0020
Cobalt	0.006	0.000827	<0.004	<0.004	<0.004
Fluoride	4	0.229	0.23	0.28	0.24
Lead	0.015	0.000539	<0.002	<0.002	<0.002
Lithium	0.040	<0.00959	0.006	<0.02	<0.02
Mercury	0.002	<0.000101	<0.0005	<0.0005	<0.0005
Molybdenum	0.1	<0.000873	<0.01	<0.01	<0.01
Radium 226 (pCi/L) Radium 228 (pCi/L)	5 pCi/L	0.816	1.10	1.531	1.49
Selenium	0.05	<0.000348	<0.003	<0.003	<0.003
Thallium	0.002	<0.0000360	<0.0020	<0.0020	<0.0020

MW-105					
APPENDIX III	GWPS	6/27/2019	11/7/2019	4/22/2020	10/13/2020
Boron	NA	0.348	<1.00	0.33	0.37
Calcium	NA	58.6	72.0	60.4	49.2
Chloride	NA	9.34	10.1	9.5	8.7
Fluoride	4	0.638	0.55	0.67	0.61
Sulfate	NA	37.6	73.7	91.8	75.4
pH (SU)	NA	7.84	7.51	7.78	8.02
Total Dissolved Solids	NA	548	612	398	550
APPENDIX IV					
Antimony	0.006	0.000186	<0.005	<0.005	<0.005
Arsenic	0.01	0.00186	<0.0010	<0.0010	<0.0010
Barium	2	0.288	0.326	0.255	0.256
Beryllium	0.004	0.000398	<0.0020	<0.0020	<0.0020
Cadmium	0.005	<0.000152	<0.0010	<0.0010	<0.0010
Chromium	0.1	0.00784	<0.0020	<0.0020	<0.0020
Cobalt	0.006	0.00435	<0.004	<0.004	<0.004
Fluoride	4	0.638	0.55	0.67	0.61
Lead	0.015	0.00326	<0.002	<0.002	<0.002
Lithium	0.040	0.0278	0.03	0.02	0.02
Mercury	0.002	<0.000101	<0.0005	<0.0005	<0.0005
Molybdenum	0.1	0.00231	0.002	0.002	0.002
Radium 226 (pCi/L) Radium 228 (pCi/L)	5 pCi/L	0.558	0.829	1.15	1.30
Selenium	0.05	<0.000348	<0.003	<0.003	<0.003
Thallium	0.002	0.0000510	<0.0020	<0.0020	<0.0020

MW-104					
APPENDIX III	GWPS	6/27/2019	11/8/2019	4/22/2020	10/13/2020
Boron	NA	0.0765	<1.00	<0.10	<0.10
Calcium	NA	221	257	258	267
Chloride	NA	12.7	13.2	13.0	11.4
Fluoride	4	0.129	<1.00	<0.20	<0.20
Sulfate	NA	513	587	662	628
pH (SU)	NA	7.32	6.64	6.50	6.41
Total Dissolved Solids	NA	1360	1490	1380	1590
APPENDIX IV					
Antimony	0.006	0.000173	<0.005	<0.005	<0.005
Arsenic	0.01	0.00174	0.0027	0.0010	0.0006
Barium	2	0.0734	0.064	0.050	0.047
Beryllium	0.004	0.000142	<0.0020	<0.0020	<0.0020
Cadmium	0.005	<0.000152	<0.0010	<0.0010	<0.0010
Chromium	0.1	0.0178	0.0037	0.0007	<0.0020
Cobalt	0.006	0.00164	<0.004	<0.004	<0.004
Fluoride	4	0.129	<0.20	<0.20	<0.20
Lead	0.015	0.000785	0.002	<0.002	<0.002
Lithium	0.040	0.0261	0.03	0.02	0.03
Mercury	0.002	<0.101	<0.0005	<0.0005	<0.0005
Molybdenum	0.1	0.00319	<0.01	0.003	<0.01
Radium 226 (pCi/L) Radium 228 (pCi/L)	5 pCi/L	0.952	1.24	0.823	1.88
Selenium	0.05	<0.000348	<0.003	<0.003	<0.003
Thallium	0.002	<0.0000360	<0.0020	<0.0020	<0.0020

Legend

- Property Boundary
- CCR Phase 2 Fill
- Bond Increment
- KAR Permit Area
- Downgradient CCR Monitoring Well Location
- Upgradient CCR Monitoring Well Location
- Characterization Monitoring Well Location
- Monitoring Well Location (Water Level Only)
- Piezometer Location (Water Level Only)

SSL: Statistically Significant Level
GWPS: Groundwater Protection Standard
NA: Not Applicable
pCi/L: picoCuries per Liter

All results listed in milligrams per liter (mg/L) unless otherwise noted.

Yellow highlighted values indicate GWPS exceedance.

Orange highlighted analyte indicate SSL above GWPS.

Wilson Station Landfill
Ohio County, Kentucky

FIGURE 4
GROUNDWATER CONDITIONS MAP
PHASE II LANDFILL 2019-2020 ANALYTICAL RESULTS

DATE: 12/2/2020	SCALE: 1IN = 750 FEET
CREATED BY: SEL	
JOB NO. 60619846	

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