November 20, 2019

Mr. Christian Johanningmeier
Power Production Superintendent
City of Columbia
1501 Business Loop 70 E
Columbia, Missouri 66205

Re: Establishment of Groundwater Protection Standards and Initial Assessment Monitoring Event

Dear Mr. Christian Johanningmeier:

This letter presents groundwater protection standards (GWPSs) that have been established for the inactive surface impoundment (More's Lake) in accordance with U.S. Environmental Protection Agency's *Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments (40 Code of Federal Regulations [CFR] Part 257, Subpart D)*. This letter also presents a comparison of GWPSs to the analytical data that was generated during the August 2019 initial assessment monitoring event conducted at the inactive surface impoundment in accordance with §257.95(d)(1).

Groundwater protection standards have been established in accordance with §257.95(h) for Appendix IV constituents that were detected in one or more monitoring well during an initial assessment groundwater monitoring event performed in August 2019 in accordance with §257.95(b). When establishing GWPSs, established background concentrations were compared to maximum concentration limits (MCLs) and the health-based levels presented for cobalt, lithium, and molybdenum in §257.95(h)(2). Background limits were calculated using prediction interval analysis consistent with § 257.93(f)(3). The prediction interval assessment was performed using historic data from upgradient monitoring wells MW-2 through MW-7 as the background dataset. As presented on Table 1, calculated background limits were compared to the levels identified in §257.95(h)(1) or §257.95(h)(2) and the higher of the two values was selected as the GWPS in accordance with §257.95(h)(3).

Table 2 presents the results of the August 2019 groundwater monitoring event and compares detected constituents to their respective GWPS. As presented on Table 2, no Appendix IV assessment monitoring constituents were detected at a concentration above the GWPS. Statistical analysis was performed in accordance §257.93(g) to determine if one or more constituents were detected at statistically significant levels (SSLs) above the GWPS in downgradient monitoring wells MW-1, MW-8, and PZ-2. None of the parameters listed in Appendix IV of §257.93 were detected at SSLs above their respective GWPS. Based on these results, the assessment monitoring program will continue with the next monitoring event scheduled in December 2019. Because no Appendix IV parameters were detected at SSLs above their respective GWPS, further characterization and notification requirements presented in §257.93(g)(1) and initiation of an assessment of corrective measures stated in §257.96 are not required.

If you have questions regarding the information presented herein, please contact the undersigned at bweis@burnsmcd.com.

Sincerely,

Mr. Brian Weis, PE
Project Manager

CJH/bw
Attachments:
Table 1 – Summary of Groundwater Protection Standards
Table 2 - Summary of August 2019 Anatlycial Results

TABLE 1
Groundwater Protection Standard Review
More's Lake - Columbia, Missouri

Detection Constituents (Appendix III)	Units	§257.95(h)(2) Interwell PL Background Level* calculated on data ranges 12/2017-03/2019	§257.95(h)(1) MCL or SMCL	§257.95(h)(2) Health-Based Level	Groundwater Protection Standard (GWPS)	GWPS Source
Boron	mg/L	0.415	NA	**4**	4	RSL (tap water; see note 3)
Calcium	mg/L	196	NA	--	196	Background
pH at 25 degrees C (field)	s.u.	6.853 - 7.734	**6.5-8.5**	--	6.5-8.5	Secondary MCL (see note 1)
pH at 25 degrees C (lab)	s.u.	6.853 - 7.734	**6.5-8.5**	--	6.5-8.5	Secondary MCL (see note 1)
TDS	mg/L	**869.6**	500	--	869.6	Background
Chloride	mg/L	73.2	**250**	--	250	Secondary MCL (see note 1)
Fluoride	mg/L	0.6833	**4**	--	4	MCL (Secondary MCL of 2)
Sulfate	mg/L	**283**	250	--	283	Background
Assessment Constituents (Appendix IV)						
Antimony	mg/L	0.005	**0.006**	--	0.006	MCL
Arsenic	mg/L	0.007	**0.01**	--	0.01	MCL
Barium	mg/L	0.657	**2**	--	2	MCL
Beryllium	mg/L	0.00062	**0.004**	--	0.004	MCL
Cadmium	mg/L	0.003007	**0.005**	--	0.005	MCL
Chromium	mg/L	0.0046	**0.1**	--	0.1	MCL
Cobalt	mg/L	0.0043	na	**0.006**	0.006	Health-based level (see note 2)
Fluoride	mg/L	0.6833	**4**	--	4	MCL (Secondary MCL of 2)
Lead	mg/L	0.0056	**0.015**	--	0.015	TT MCL
Lithium	mg/L	**0.07261**	na	0.040	0.07261	Background
Mercury	mg/L	0.002	**0.002**	--	0.002	MCL
Molybdenum	mg/L	0.01515	na	**0.100**	0.100	Health-based level (see note 2)
Selenium	mg/L	0.015	**0.05**	--	0.05	MCL
Thallium	mg/L	0.0005	**0.002**	--	0.002	MCL
Total Radium (226+228)**	pCi/L	2.651**	**5**	--	5	MCL
MDNR Water Quality						
Aluminum	mg/L	**1.878**	0.05 to 0.2	--	1.878	Secondary MCL (see note 1)
Chemical Oxygen Demand	mg/L	**60.8**	NA	--	60.8	Background
Copper	mg/L	0.01	**1.3**	--	1.3	TT MCL (Secondary MCL 1)
Chromium III (trivalent)	mg/L	0.007	NA	**22**	22	RSL (tap water; see note 3)
Chromium VI (hexavalent)	mg/L	**0.008**	3.50E-05	--	0.008	Background
Iron	mg/L	**1.506**	0.3	--	1.506	Background
Magnesium	mg/L	**43**	NA	--	43	Background
Manganese	mg/L	**0.9526**	0.05	--	0.9526	Background
Nickel	mg/L	**0.0317**	NA	--	0.0317	Background
Silver	mg/L	0.007	**0.1**	--	0.1	Secondary MCL (see note 1)
Sodium	mg/L	**80.37**	NA	--	80.37	Background
Total Hardness	mg/L	**659**	NA	--	659	Background
Total Organic Carbon	mg/L	**2.479**	NA	--	2.479	Background
Total Organic Halides	mg/L	**0.3946**	NA	--	0.3946	Background
Zinc	mg/L	0.603	**5**	--	5	Secondary MCL (see note 1)

*Background concentrations were determined utilizing interwell prediction limits. Upgradient wells MW-2, MW-3, MW-4, MW-5, MW-6, and MW-7 were used to determine these background concentrations. Wells MW-1, MW-8, and PZ-2 served as the downgradient/compliance data. Data included in these statistics included data ranging from December 2017 through March 2019.

**Combined radium is reported with an uncertainty. However, this uncertainty cannot be incorporated into statistical calculations as it varies per result and is not a standard value. Therefore, to maintain consistency in reporting these results, the reported laboratory concentration was used for the statistical analyses. Certainty values can be found in the analytical data reports.

Notes:

1. Unless otherwise noted, all GWPS concentrations are based on USEPA's Maximum Contaminant Level (MCL). In some instances, a Secondary MCL may be noted. National Primary Drinking Water Regulation Table (May 2009) can be found: https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulation-table. Secondary Drinking Water Standards can be found: https://www.epa.gov/dwstandardsregulations/secondary-drinking-water-standards-guidance-nuisance-chemicals.

2. Health-based level - CCR based GWPS for those analytes without an established MCL. See 40 CFR §257.95(h)(2) (July 2018).

3. USEPA Regional Screening Level (RSL) - health-based screening level used as GWPS for those analytes without an MCL (USEPA, April 2019). RSLs can be found: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Abbreviations:

GWPS - Groundwater Protection Standard
Interwell PL - interwell prediction limits (Sanitas®)
mg/L - milligrams per Liter
pCi/L - picocuries per Liter
SMCL = Secondary Maximum Contaminant Level
TT - Treatment technique MCL (see link above for MCLs)

Table 2
Summary Groundwater Analytical Results: August 2019
Inactive Ash Pond (More's Lake)
Columbia Municipal Power Plant - Columbia, MO

			Sample Location Sample Date Lab ID	MW-1 8/26/2019 60313018002	MW-2 8/26/2019 60313018003	DUP-1 8/26/2019 60313018004	MW-3 8/27/2019 60313169003	MW-4 8/27/2019 60313169002	MW-5 8/27/2019 60313169004	MW-6 8/27/2019 60313169005	MW-7 8/27/2019 60313169006	MW-8 8/27/2019 60313169001	PZ-2 8/26/2019 60313018001	BA Pond 8/27/2019 60313169007
		GWPS												
Analytical Method	**Analyte**		**Unit**		*Duplicate Pair*									
Field Water Quality Parameters														
In Situ (Field)	Temperature	NA	˚C	17.20	16.52	16.52	16.1	16.67	17.64	18.55	17.72	16.99	18.09	na
In Situ (Field)	Conductivity	NA	mS/cm	1.219	0.892	0.892	0.853	0.654	0.904	1.178	0.885	1.610	1.674	na
In Situ (Field)	pH	6.5-8.5	s.u.	6.93	6.99	6.99	7.11	7.15	7.22	6.77	7.08	6.74	6.64	na
In Situ (Field)	Oxidation-Reduction Potential (ORP)	NA	mV	-38.5	-44.5	-44.5	-77.8	-108.6	-85.0	-79.6	-77.4	-68.3	18.8	na
In Situ (Field)	Dissolved Oxygen (DO)	NA	mg/L	1.07	1.30	1.30	1.20	1.47	1.13	0.88	0.93	1.24	3.39	na
In Situ (Field)	Turbidity	NA	NTUs	1.44	1.50	1.50	1.30	1.76	1.48	14.20	14.80	11.80	1.20	na
Appendix III - Detection Monitoring														
6010	Boron	4	mg/l	2.17	0.082 J	0.0788 J	0.0506 J	0.0283 J	0.204	0.0613 J	0.16	0.354	0.434	1.19
6010	Calcium	196	mg/l	162	119	120	104	63.9	112	171	92.4	253	185	66.4
300	Chloride	250	mg/l	87.1	4.1	4.1	8.5	8.8	30.2	30.5	30	80.7	227	23.3
300	Fluoride	4	mg/l	0.43	0.52	0.51	0.55	0.27	0.45	0.29	0.42	0.17 J	0.53	1.1
SM4500-H+B	pH	6.5-8.5	s.u.	7.1 J	7.1 J	7.2 J	7.2 J	7.2 J	7.4 J	7.1 J	7.3 J	7.1 J	7.0 J	7.9 J
300	Sulfate	283	mg/l	277	58.9	59.5	37.3	27.4	106	97.2	96.8	474	243	161
2540 C	Total Dissolved Solids	869.6	mg/l	949	548	539	522	334	599	848	520	1170	1090	380
Appendix IV - Assessment Monitoring														
6010	Antimony	0.006	mg/l	0.000086 J	0.001 U	0.001 U	0.00011 J	0.00009 J	0.001 U	0.001 U	0.00032 J	0.000096 J	0.00019 J	0.00038 J
6010	Arsenic	0.01	mg/l	0.01 U	0.01 U	0.006 J	0.01 U	0.01 U	0.0052 J	0.01 U	0.0093 J	0.01 U	0.01 U	0.0098 J
6010	Barium	2	mg/l	0.052	0.132	0.135	0.176	0.106	0.22	0.063	0.111	0.0203	0.0669	0.0701
6010	Beryllium	0.004	mg/l	0.001 U	0.00029 J	0.001 U	0.001 U	0.001 U	0.00027 J	0.001 U	0.001 U	0.00032 J	0.001 U	0.00026 J
6010	Cadmium	0.005	mg/l	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
6010	Chromium	0.1	mg/l	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.0059	0.0013 J	0.005 U	0.0107
6010	Cobalt	0.006	mg/l	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.001 J	0.003 J	0.005 U	0.005 U	0.0033 J
300	Fluoride	4	mg/l	0.43	0.52	0.51	0.55	0.27	0.45	0.29	0.42	0.17 J	0.53	1.1
6010	Lead	0.015	mg/l	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0048 J	0.01 U	0.01 U	0.01 U	0.008 J
6010	Lithium	0.07261	mg/l	0.0408	0.0357	0.036	0.0298	0.0472	0.0376	0.0477	0.037	0.0245	0.0148	0.0086 J
7470	Mercury	0.002	mg/l	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
6010	Molybdenum	0.1	mg/l	0.02 U	0.0063 J	0.0049 J	0.0061 J	0.02 U	0.0034 J	0.02 U	0.0051 J	0.02 U	0.02 U	0.0144 J
6010	Selenium	0.05	mg/l	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U
6010	Thallium	0.002	mg/l	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Calculated 903.1/904	Radium 226/228 Combined	5	pCi/L	1.14 ± 0.841 J	1.20 ± 0.993 J	0.858 ± 0.914 J	0.681 ± 0.946 J	0.403 ± 0.779 J	1.52 ± 1.04 J	1.20 ± 1.01 J	0.527 ± 0.843 J	1.44 ± 0.908 J	0.486 ± 0.955 J	0.983 ± 1.03 J
MDNR Water Quality Parameters														
6010	Aluminum	1.878	mg/l	0.05 U	0.0096 J	0.0104 J	0.0184 U	0.0401 U	0.0217 U	0.171	1.09	0.0853 U	0.0213 J	1.98
410.4	Chemical Oxygen Demand (COD)	60.8	mg/l	10 U	4.7 J	8.4 J	10 U	16.9	10 U	10.6	9.9 J	10 U	34 J-	42.4
Calculate 6010/7196	Chromium III	22	mg/l	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.011
7196 / 3500-Cr B	Chromium VI	0.008	mg/l	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U
6010	Copper	1.3	mg/l	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0068 J	0.01 U	0.01 U	0.0076 J
6010	Iron	1.506	mg/l	0.0331 J	0.0694	0.0758	0.0146 J	1.76	0.238	0.842	17.3	0.931	0.504	7.57
6010	Magnesium	43	mg/l	42.2	42.5	42.8	36.2	14.9	31.9	34.9	22.5	36.3	34.8	14.6
6010	Manganese	0.9526	mg/l	0.17	0.315	0.319	0.106	0.183	0.169	0.627	0.919	0.864	0.514	0.247
6010	Nickel	0.0317	mg/l	0.0056	0.0013 J	0.0017 J	0.005 U	0.0016 J	0.0019 J	0.0035 J	0.0083	0.0059	0.0043 J	0.0087
6010	Silver	0.1	mg/l	0.007 U	0.007 U	0.007 U	0.007 U	0.007 U	0.007 U	0.007 U	0.007 U	0.007 U	0.007 U	0.007 U
6010	Sodium	80.37	mg/l	68.2	29.2	29.3	35.8	29.5	56.4	48.9	35.6	71.8	137	27.9
2340B	Total Hardness	659	mg/l	578	472	476	408	221	411	571	323	781	606	226
5310C	Total Organic Carbon (TOC)	2.479	mg/l	0.8 UJ	0.99 UJ	1.2 U	0.95 J	7.2	1.2	2.8	1.4	0.63 J	4.9	3.6
9020B	Total Organic Halogens (TOX)	0.3946	mg/l	0.1 UJ	0.1 UJ	0.031 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.09 J	0.1 U
6010	Zinc	5	mg/l	0.05 U	0.0124 J	0.0127 J	0.05 U	0.0985	0.0140 J J	0.0092 J	0.662	0.05 U	0.05 U	0.0256 J

Notes:

˚C = degree Celsius
BA = Bottom Ash
J = Result as an estimated value
J+ = Result qualified as estimated; biased high
JU = Result qualified as nondetect during data validation
mg/l = milligram per liter

mS/cm = millisiemens/meter
mV = millivolt
NA = Not Available
NM = Not Measured
NTU = Nephelometric Turbidity Units
pCi/L = picocurie per liter

s.u. = Standard Units
U = Non Detect at the identified concentration
UJ = Result qualified as estimated at the reporting limit during data validation
V = The sample concentration is too high to evaluate accurate spike recoveries
Field parameters measured during purging/sampling on December 20-22, 2017.
* = pH measurement was collected on 5/4/2016

Bold - Parameter was detected.
Orange Shading indicates the detected parameter exceeds the GWPS.