Department of Energy

Portsmouth/Paducah Project Office
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RECEIVED
By Terri Drake at 1:46 pm, Nov 21, 2022

November 18, 2022

Ms. Lauren Linehan
Division of Waste Management
Kentucky Department for Environmental Protection
625 Hospital Drive
Madisonville, Kentucky 42431

PPPO-02-10022827-23B

Ms. April Webb
Hazardous Waste Branch Manager
Division of Waste Management
Kentucky Department for Environmental Protection
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

Dear Ms. Linehan and Ms. Webb:

C-404 HAZARDOUS WASTE LANDFILL NOVEMBER 2022 SEMIANNUAL GROUNDWATER REPORT (APRIL 2022–SEPTEMBER 2022), PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY, FRNP-RPT-0244/V2, HAZARDOUS WASTE MANAGEMENT FACILITY PERMIT NO. KY8-890-008-982, AGENCY INTEREST ID NO. 3059

Enclosed is the subject report for the second reporting period, fiscal year 2022. This report is required in accordance with Part II, Specific Condition II.K.6.d, of Hazardous Waste Management Facility Permit No. KY8-890-008-982 (Permit).

Results of the statistical analyses indicate that compliance well concentrations of permit-required parameters are not statistically different from those in background wells, except for arsenic in monitoring well MW84A. The plume discussed in the 2007 *C-404 Landfill Source Demonstration Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS-ENM-0031/R2 (ASD), demonstrated that the C-404 Landfill was not the source of the historical, statistically significant background exceedance of trichloroethene (TCE) in MW84. Current concentration trends and spatial distribution data for arsenic were demonstrated to be consistent with TCE distribution and trends presented in the 2007 ASD. This demonstration precludes the need for a compliance monitoring program or corrective action plan under Section II.K.8 of the Permit for the arsenic in MW84A.

If you have any questions or require additional information, please contact David Dollins at (270) 441-6819.

Sincerely,

April Ladd Digitally signed by April Ladd
Date: 2022.11.18 10:09:16 -06'00'

April Ladd
Acting Paducah Site Lead
Portsmouth/Paducah Project Office

Enclosures:
1. Certification Page
2. *C-404 Hazardous Waste Landfill November 2022 Semiannual Groundwater Report (April 2022–September 2022), Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0244/V2

cc w/enclosures:
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CERTIFICATION

Document Identification: ***C-404 Hazardous Waste Landfill November 2022 Semiannual Groundwater Report (April 2022–September 2022), Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0244/V2, Permit No. KY8-890-008-982, Agency Interest ID No. 3059, dated November 2022**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Four Rivers Nuclear Partnership, LLC

Myrna E. Redfield

Digitally signed by Myrna E. Redfield
Date: 2022.11.17 12:33:32 -06'00'

Myrna E. Redfield, Program Manager
Four Rivers Nuclear Partnership, LLC

Date Signed

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

U.S. Department of Energy

April Ladd

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Date: 2022.11.17 15:40:03 -06'00'

April Ladd, Acting Paducah Site Lead
Portsmouth/Paducah Project Office
U.S. Department of Energy

Date Signed

FRNP-RPT-0244/V2

C-404 Hazardous Waste Landfill November 2022 Semiannual Groundwater Report (April–September 2022), Paducah Gaseous Diffusion Plant, Paducah, Kentucky

FOUR RIVERS NUCLEAR PARTNERSHIP, LLC

This document is approved for public release per review by:

Jackie Thompson
FRNP Classification Support

11-15-22
Date

FRNP-RPT-0244/V2

C-404 Hazardous Waste Landfill November 2022 Semiannual Groundwater Report (April–September 2022), Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—November 2022

U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
FOUR RIVERS NUCLEAR PARTNERSHIP, LLC,
managing the
Deactivation and Remediation Project at the
Paducah Gaseous Diffusion Plant
under Contract DE-EM0004895

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TABLES

FIGURES

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ACRONYMS

AKGWA	Assembled Kentucky Groundwater
MW	monitoring well
RCRA	Resource Conservation and Recovery Act
RGA	Regional Gravel Aquifer
UCRS	Upper Continental Recharge System
URGA	Upper Regional Gravel Aquifer

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EXECUTIVE SUMMARY

This report, *C-404 Hazardous Waste Landfill November 2022 Semiannual Groundwater Report (April–September 2022), Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0244/V2, is being submitted by the U.S. Department of Energy in accordance with requirements in Kentucky Division of Waste Management Hazardous Waste Management Facility Permit, KY8-890-008-982 (Permit). The period covered by this report is April through September 2022; and the report includes analytical data from the July 2021, November 2021, January 2022, May 2022, and July–August 2022 quarterly compliance monitoring for radionuclides (including a resampling event for technetium-99; see Section 3 for additional details), as well as the July–September 2022 semiannual sampling [including resampling events for trichloroethene (TCE)] for all parameters of monitoring wells (MWs) located in the vicinity of the closed C-404 Hazardous Waste Landfill (C-404 Landfill).

The groundwater monitoring analytical data were subjected to statistical analyses. The analyses were conducted in accordance with the Hazardous Waste Management Facility Permit. Arsenic concentrations in compliance well MW84A were statistically different from concentrations in the background wells. The statistical tests on all other parameters showed no statistical difference between concentrations in the compliance and background wells.

Arsenic concentrations in compliance well MW84A are increasing similar to past TCE trends in the same well. Moreover, arsenic trends are increasing for both background and other compliance well locations, indicating that the contaminant plume discussed in the 2007 *C-404 Landfill Source Demonstration, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS-ENM-0031/R2 (PRS 2007a) (2007 ASD) for TCE appears to have continued to migrate northeastward. Additionally, none of the C-404 Landfill leachate samples collected over the past 10 years have had detectable concentrations of arsenic; therefore, consistent with the findings in the 2007 ASD for TCE, the C-404 Landfill cannot be the source of the arsenic found in the wells. This demonstration for arsenic in MW84A fulfills Section II.K.8 of the Hazardous Waste Management Facility Permit, which allows for demonstrating that the exceedance is consistent with the findings in the 2007 ASD and also allows for the demonstration to be submitted within the semiannual report.

The leachate in the C-404 Landfill leachate collection system is monitored at least monthly and, at a minimum, is removed and sampled when the level exceeds 3 ft in depth. During this reporting period of April through September 2022, the maximum depth of the leachate did not exceed 3 ft. Consequently, no leachate was removed or sampled during the current reporting period.

The annual leachate sump integrity test, as required by Section 1.2 of Appendix I2 of the Permit, was conducted between August 16, 2022, and September 26, 2022. Data was collected at a known depth at 1-hour increments to determine the change in leachate levels over time. Results of the integrity test were within normal limits.

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1. INTRODUCTION

This report contains the statistical evaluation of data from groundwater sampling and analysis for the closed C-404 Hazardous Waste Landfill (C-404 Landfill) at the U.S. Department of Energy Paducah Site (Paducah Site), Paducah, Kentucky. This semiannual report is required by the Kentucky Division of Waste Management Hazardous Waste Management Facility Permit, KY8-890-008-982 (Permit) (KDWM 2020), Specific Condition II.K.6.d—Recordkeeping, Reporting, and Response. The period covered by this report is April through September 2022.

Groundwater analytical results are provided in Appendix A. The statistical analyses and qualification statement are provided in Appendix B. The annual groundwater flow rate and direction determination is provided in Appendix C.

1.1 BACKGROUND

The closed C-404 Landfill is located in the west-central portion of the Paducah Site secured area. The 1.2-acre facility operated as a surface impoundment from approximately 1952 until early 1957. During this time, influents to the impoundment originated from the C-400 Cleaning Building. In 1957, the impoundment was converted to a solid waste disposal facility for uranium-contaminated solid waste. When the impoundment was converted into a disposal facility, a sump was installed at the former weir to collect the leachate from the facility. Leachate is pumped from the sump, as needed, into a mobile tank. The leachate then is transferred to a permitted hazardous waste storage facility on-site prior to characterization and transferred off-site for treatment.

In 1986, the disposal of waste at the C-404 Landfill was halted, and a portion of the disposed-of waste was found to be Resource Conservation and Recovery Act (RCRA)-hazardous. The landfill was covered with a RCRA multilayered cap and certified closed in 1987. It currently is regulated under RCRA as a land disposal unit and compliance is monitored under the current Hazardous Waste Management Facility Permit (KDWM 2020).

Previous groundwater monitoring documented that concentrations in compliance wells were statistically different from background wells for trichloroethene (TCE). The *C-404 Landfill Source Demonstration, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, (PRS 2007a) (2007 ASD) demonstrated that the source of the TCE in compliance wells is not from the C-404 Landfill, but rather, the source is located upgradient/crossgradient of the C-404 Landfill.

Regional Gravel Aquifer (RGA) compliance monitoring well (MW) 90 was abandoned and replaced by MW90A in 2001. RGA compliance well MW420 was installed in 2007 to better assess groundwater quality at the C-404 Landfill (PRS 2007b).

Previous groundwater monitoring of RGA compliance well MW87 documented that concentrations in the compliance well were statistically different from background wells for lead and uranium (FRNP 2018). The *C-404 Hazardous Waste Landfill Alternate Source Demonstration—Source of Lead and Uranium in MW87 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, (FRNP 2019) concluded that the statistical differences were a result of infiltration of Upper Continental Recharge System (UCRS) groundwater into the RGA well due to compromised integrity of the well. The integrity of the well had deteriorated to a point that it no longer was suitable for its intended purpose. RGA compliance wells MW84, MW87, and background well MW93 were abandoned and replaced with MW84A, MW87A, and MW93A in 2019. RGA wells MW84 and MW93 were abandoned and replaced because they were the same age (installed in 1988) as MW87. MW84A and MW87A were placed 10 ft north of MW84 and MW87, respectively, and

screened at the same depth intervals. MW93A was placed 6 ft west of MW93 and screened at the same depth interval.

In the first semiannual reporting period for 2021 (October 2020–March 2021), statistical analysis of Tc-99 detections in downgradient compliance well MW84A indicated a statistically significant exceedance over background concentrations. Notification of the statistically significant difference for Tc-99 in MW84A was submitted, pursuant to Part II, Specific Condition II.K.6.a, to the Kentucky Department of Waste Management.

An alternate source demonstration investigation for Tc-99 in MW84A was performed in June 2021. The *C-404 Hazardous Waste Landfill Alternate Source Demonstration—Source of Technetium-99 in MW84A at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0206, consisted of redevelopment and over pumping of MW84A, and review of the lines of evidence relating redevelopment of MW84A and the associated Tc-99 levels (FRNP 2021). The lines of evidence concluded that the observed trend of increasing Tc-99 in MW84A is not a result of contamination introduced into the well boring during drilling and well installation, but it is indicative of dissolved Tc-99 contamination in the RGA. Quarterly compliance monitoring for Tc-99 and other radionuclides is currently being conducted at the C-404 Landfill. This current semiannual report contains results from additional quarterly compliance sampling for radiological constituents conducted in November 2021 and May 2022, in addition to the routine semiannual groundwater sampling.

In accordance with Permit Specific Condition II.K.6.j, development and submittal of an engineering feasibility plan for a corrective action program is not required when a statistically significant exceedance has been confirmed for radionuclides (i.e., Tc-99).

1.2 MONITORING PERIOD ACTIVITIES

1.2.1 Groundwater Monitoring

There are nine MWs sampled under the Permit for the C-404 Landfill: four UCRS wells and five Upper Regional Gravel Aquifer (URGA) wells. A map of the MW locations is provided in Figure 1.

Table 1 presents the well number for URGA wells located upgradient and downgradient of the C-404 Landfill. Table 1 also presents the well numbers for the UCRS wells located in proximity to the URGA wells. This table refers to the UCRS wells as being adjacent to an upgradient or downgradient URGA well location and are identified relative to URGA groundwater flow direction. The conceptual model for the C-404 Landfill indicates that groundwater in the UCRS wells flows primarily vertically downward until it reaches the URGA; therefore, UCRS wells are not considered "upgradient" or "downgradient" of other UCRS wells in the area.

Table 1. Monitoring Well Locations

UCRS	
Located south of C-404 Landfill, adjacent to upgradient URGA background well MW93A	MW94
Located north of C-404 Landfill, adjacent to downgradient URGA compliance wells	MW85, MW88, MW91A*
URGA	
Upgradient background wells	MW93A*, MW420
Downgradient compliance wells	MW84A*, MW87A*, MW90A*

*MW90 was abandoned in 2001 and replaced with MW90A. MW91 was abandoned in 2017 and replaced with MW91A. MW84, MW87, and MW93 were abandoned in 2019 and replaced with MW84A, MW87A, and MW93A.

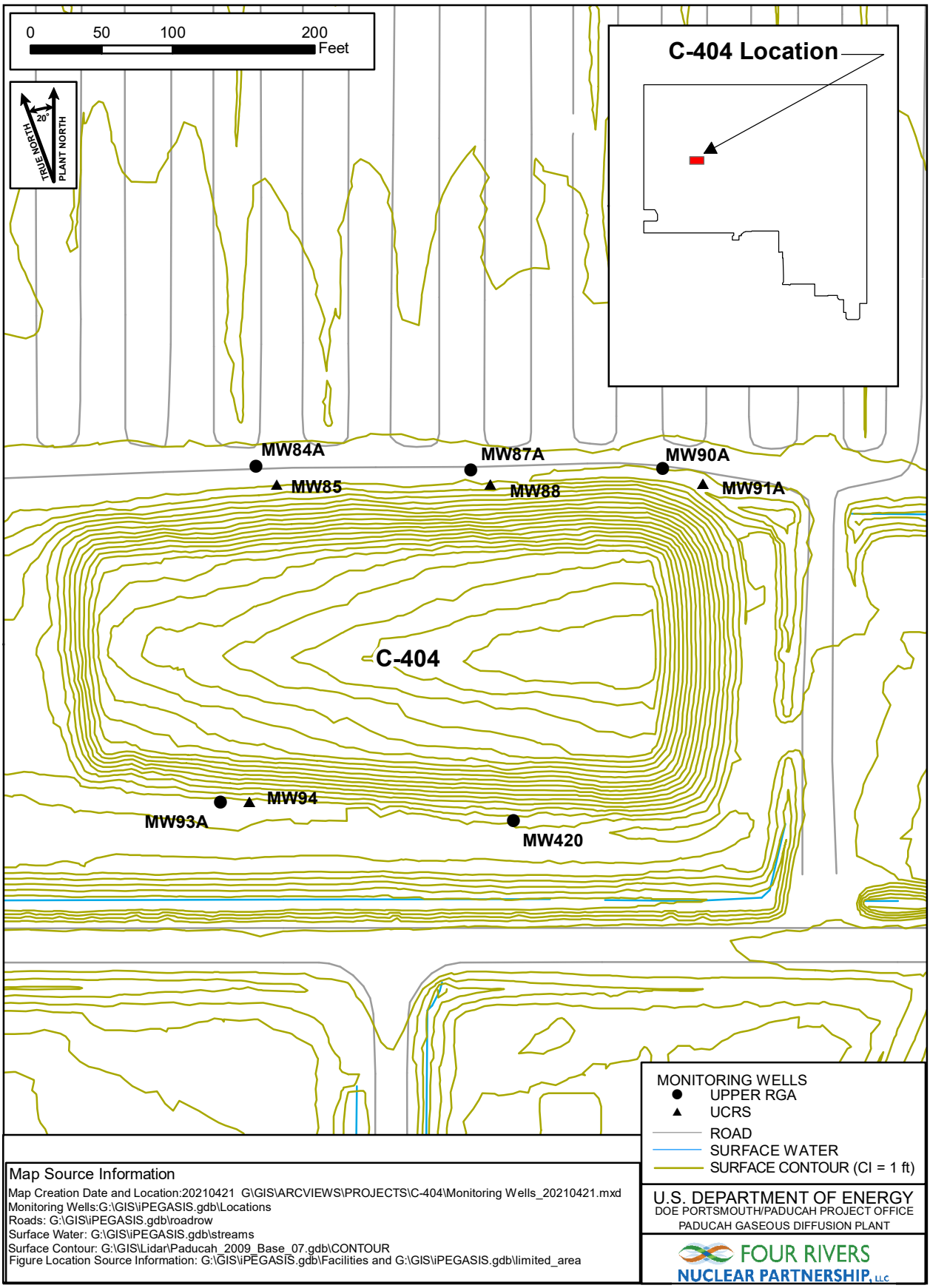

Figure 1. Monitoring Wells

Table 2 presents the Assembled Kentucky Groundwater (AKGWA) numbers for each MW.

Table 2. Assembled Kentucky Groundwater Numbers

Paducah Site Well Number	AKGWA Number
MW84A	8007-4849
MW85	8000-5234
MW87A	8007-4850
MW88	8000-5237
MW90A	8004-0357
MW91A	8007-2917
MW93A	8007-4851
MW94	8000-5103
MW420	8005-3263

All nine MWs were sampled in May and July 2022 during this reporting period. Samples collected in May 2022 were analyzed for radionuclides and the samples collected in July 2022 were analyzed for parameters required by Part VIII.E of the Permit. Four MWs were resampled for TCE and Tc-99 in August 2022, and three MWs were resampled for TCE in September 2022 (see Section 3 for additional details). Groundwater sampling was conducted using procedure CP4-ES-2101, *Groundwater Sampling*. Appropriate sample containers and preservatives were used. The laboratory that performed the analyses used U.S. Environmental Protection Agency-approved methods, as applicable. Appendix A of this report contains the analytical results. Appendix B of this report contains the statistical analyses.

1.2.2 Landfill Leachate

In accordance with Appendix I2, C-404 Landfill Closure Plan, Section 1.2 of the Permit, the quantity of liquid in the leachate collection system is monitored (at least monthly) and, at a minimum, will be "removed when the quantity exceeds 3 ft in depth." Once the leachate depth reaches 3 ft, the leachate is pumped into a mobile tank. The leachate then is transferred to a permitted hazardous waste storage facility on-site prior to characterization and transferred off-site for treatment. During this reporting period of April through September 2022, the maximum depth of the leachate did not exceed 3 ft. Consequently, no leachate was removed or sampled during the current reporting period.

The annual leachate sump integrity test, as required by Section 1.2 of Appendix I2 of the Permit, was conducted between August 16, 2022, and September 26, 2022. Data was collected at a known depth at 1-hour increments to determine the change in leachate levels over time. Results of the integrity test were within normal limits.

2. STATISTICAL SYNOPSIS

The statistical analyses conducted on the data collected from the C-404 Landfill were performed in accordance with procedures in the Permit, Part VIII.E, reissued in February 2020. Appendix B of this report contains the statistical analyses performed for this reporting period. Statistical analyses utilized data from the URGA background wells, MW93A and MW420, and URGA compliance wells, MW84A, MW87A, and MW90A. Quarterly compliance monitoring groundwater sampling for radiological constituents was initiated during third quarter 2021 (July 2021) and the second quarterly monitoring event occurred during fourth quarter 2021 (November 2021). The additional quarter of groundwater data for radiological constituents alters the available data sets for the statistical analyses. For this reporting period, the data set includes nonradionuclide data from July 2020, January 2021, July 2021, January 2022 and July–August 2022 (including resampling events for TCE; see Section 3 for additional details). The reporting period data set for radionuclides includes July 2021, November 2021, January 2022, May 2022, and July–August 2022 (including resampling events for Tc-99).

Appendix B provides a summary of the statistical analyses performed. The statistical tests on all wells and parameters showed no statistical difference between concentrations in the compliance and background wells with the exception of arsenic in MW84A.

STATISTICALLY SIGNIFICANT EXCEEDANCE OF ARSENIC BACKGROUND IN MW84A

An alternate source demonstration previously was conducted for TCE in MW84. The 2007 ASD demonstrated that the C-404 Landfill was not the source of the historical, statistically significant background exceedance of TCE in MW84. The 2007 ASD found that the statistically significant increase of TCE in compliance well MW84 appeared to be due to an upgradient source of TCE migrating through the C-404 Landfill area.

The exceedance in arsenic concentration in MW84A over background concentrations is consistent with the findings in the 2007 ASD (PRS 2007a). The trend of arsenic concentrations in MW84 and MW84A is similar to the historical TCE trends observed at MW84 and MW84A (Figure 2). Rising arsenic levels occur in adjacent compliance well MW87A as well as background wells MW93A and MW420, as demonstrated in Figures 3 and 4.

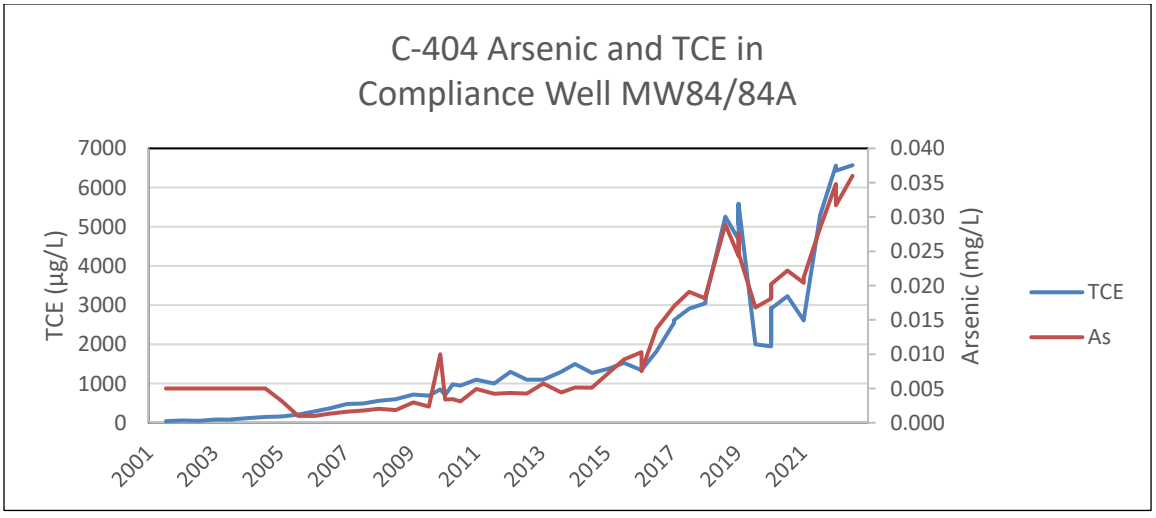

Figure 2. Arsenic and TCE Trends in C-404 Landfill Compliance Well MW84/84A

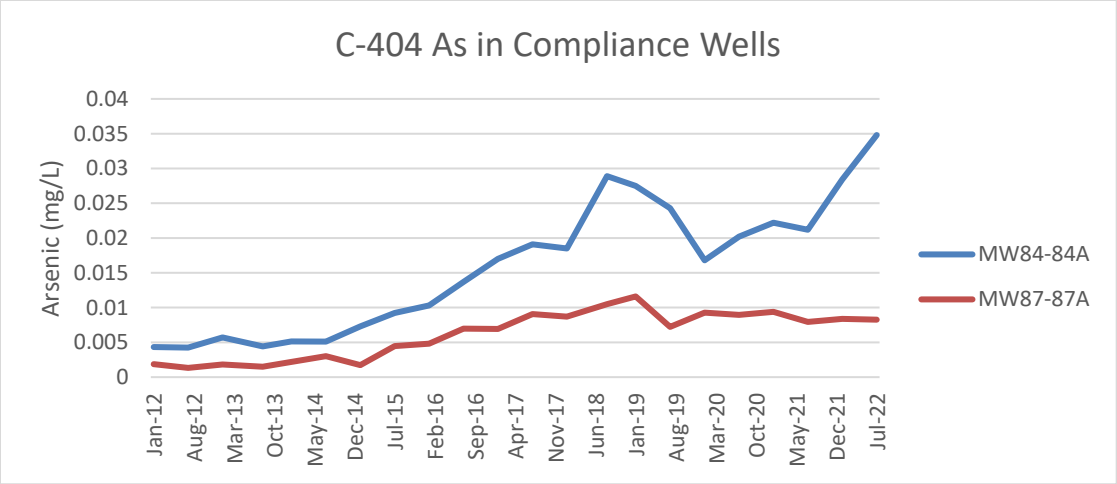

Figure 3. Arsenic Trends in C-404 Landfill Compliance Wells

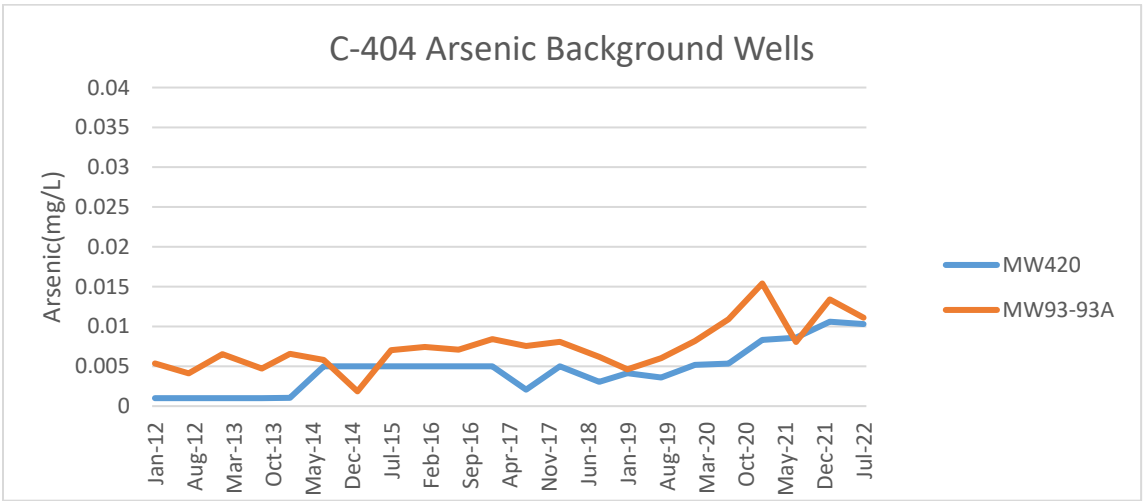

Figure 4. Arsenic Trends in C-404 Landfill Background Wells

Groundwater flow directions in July 2022 were to the northeast (see Figure 5), consistent with flow patterns found in 2007 during the alternate source demonstration. Recent increasing arsenic concentration trends in both compliance and background wells at the C-404 Landfill further indicate that the source of the arsenic is upgradient to the C-404 Landfill.

None of the C-404 Landfill leachate samples collected over the past 10 years have had detectable concentrations of arsenic; therefore, the C-404 Landfill cannot be the source of the arsenic found in the MWs.

This demonstration fulfills Section II.K.8 of the Hazardous Waste Management Facility Permit, which allows for demonstrating that the exceedance is consistent with the findings in the 2007 ASD and allows for the demonstration to be submitted within the semiannual report.

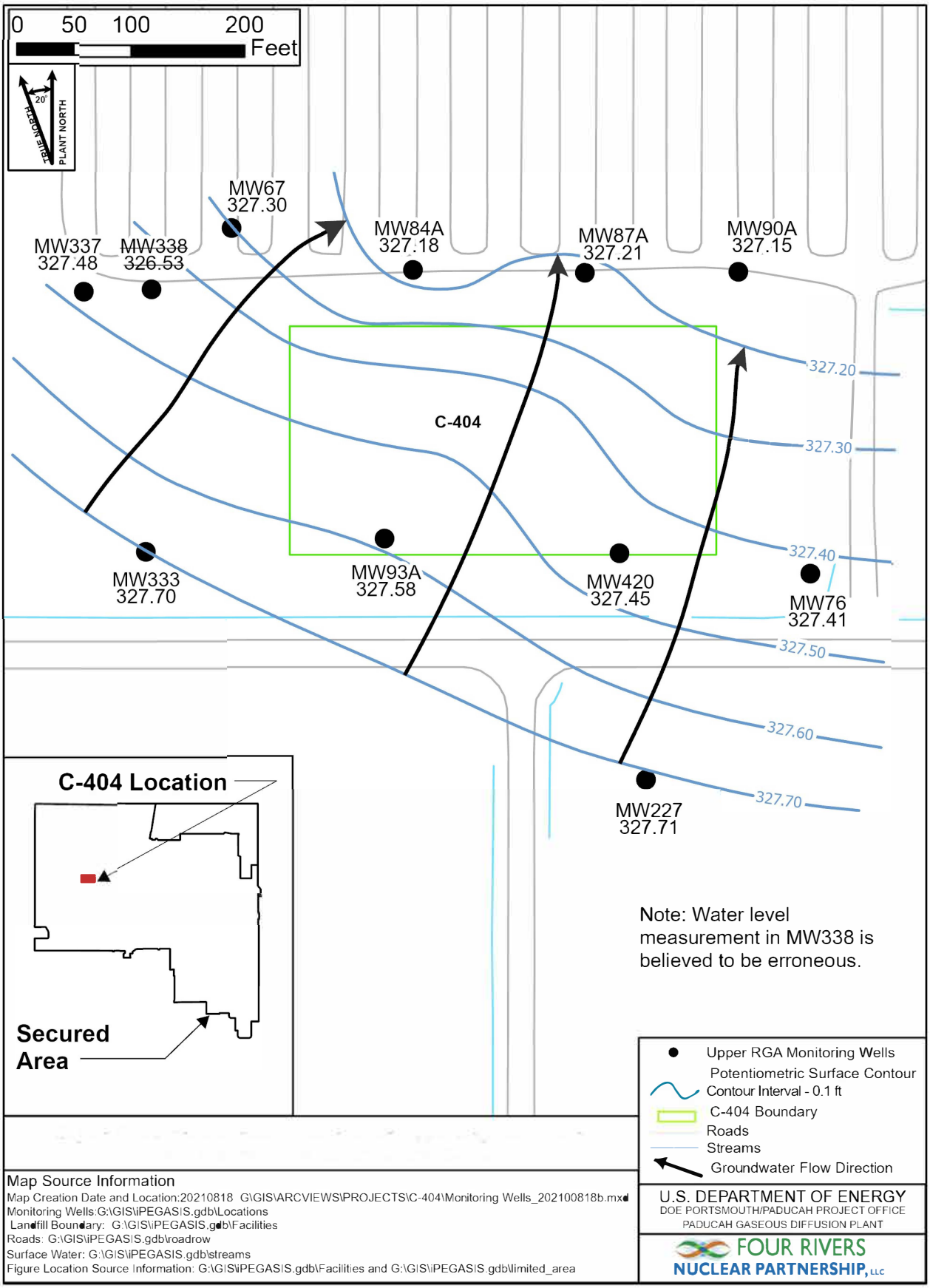

Figure 5. Potentiometric Surface of the Upper Regional Gravel Aquifer at the C-404 Landfill, July 26, 2022

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3. DATA VALIDATION AND QUALITY ASSURANCE/QUALITY CONTROL SUMMARY

The data and the data validation qualifiers for the May and July-September 2022 data sets are provided in Appendix A. All data for these data sets were considered useable as reported. Data validation was performed on the analytical data by an independent, third-party validator.

Field quality control samples are collected during each semiannual sampling event. Equipment rinseate blanks, field blanks, field duplicates, and trip blanks are obtained to ensure quality control and are reported in the analytical results in Appendix A. Laboratory quality control samples, such as matrix spikes, matrix spike duplicates, and method blanks, are performed by the laboratory and reported in the laboratory report. Both field and laboratory quality control sample results are reviewed as part of the data validation process.

In review of the July 2022 data, the laboratory suspected carryover of TCE in groundwater samples from MW420, MW87A, MW90A, and MW93A. Resampling of these wells for TCE was performed on August 15, 2022. TCE samples were collected to address analytical uncertainty. The same four wells were also resampled for Tc-99 in August 2022. Tc-99 samples were collected (opportunistically) to more fully evaluate Tc-99 trends across the C-404 Landfill.

Subsequent to the resampling, the original data package was reviewed and it was determined that the original sample from MW420 did not have an issue with carryover of TCE. The suspected carryover was associated with MW85. In addition to resampling MW85 on September 1, 2022, MW88 and MW94 were also resampled for TCE.

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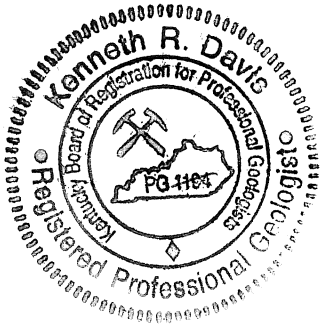
4. PROFESSIONAL GEOLOGIST AUTHORIZATION

DOCUMENT IDENTIFICATION: *C-404 Hazardous Waste Landfill*
November 2022 Semiannual Groundwater Report
(April–September 2022),
Paducah Gaseous Diffusion Plant, Paducah, Kentucky
(FRNP-RPT-0244/V2)

Stamped and signed pursuant to my authority as a duly registered geologist under the provisions of *KRS* Chapter 322A.



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K. Davis
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Kenneth R. Davis
Kenneth R. Davis

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November 14, 2022
Date

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5. REFERENCES

FRNP (Four Rivers Nuclear Partnership, LLC) 2018. *C-404 Hazardous Waste Landfill November 2018 Semiannual Groundwater Report (April 2018—September 2018), Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0026/V2, U.S. Department of Energy, Paducah, KY, November.

FRNP 2019. *C-404 Hazardous Waste Landfill Alternate Source Demonstration—Source of Lead and Uranium in MW87 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0078, Four Rivers Nuclear Partnership, LLC, Kevil, KY.

FRNP 2021. *C-404 Hazardous Waste Landfill Alternate Source Demonstration—Source of Technetium-99 in MW84A at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0206, Four Rivers Nuclear Partnership, LLC, Kevil, KY, August.

KDWM (Kentucky Division of Waste Management) 2020. Hazardous Waste Management Facility Permit for the U.S. Department of Energy, Paducah Gaseous Diffusion Plant, KY8-890-008-982, effective February 21.

PRS (Paducah Remediation Services, LLC) 2007a. *C-404 Landfill Source Demonstration, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS-ENM-0031/R2, Paducah Remediation Services, LLC, Kevil, KY.

PRS 2007b. *Well Plan for Addition of Wells for C-404 Monitoring Well Network, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS/PROJ/0028, Paducah Remediation Services, LLC, Kevil, KY, July.

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APPENDIX A

C-404 HAZARDOUS WASTE LANDFILL GROUNDWATER ANALYTICAL RESULTS

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Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW84A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4849

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.036	mg/L	0.005	7/11/2022			SW846-6020B	=
Arsenic, Dissolved		0.0361	mg/L	0.005	7/11/2022			SW846-6020B	=
Barometric Pressure Reading		29.93	Inches/Hg		7/11/2022				X
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Conductivity		472	umho/cm		7/11/2022				X
Depth to Water		47.49	ft		7/11/2022				X
Dissolved Oxygen		3.98	mg/L		7/11/2022				X
Lead	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
pH		5.81	Std Unit		7/11/2022				X
Redox		337	mV		7/11/2022				X
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Sulfate		6.99	mg/L	0.4	7/11/2022			SW846-9056A	=
Technetium-99		47.2	pCi/L	20.9	7/11/2022	13.5	14.4	HASL 300, Tc-02-RC M	=
Temperature		64.2	deg F		7/11/2022				X
Trichloroethene		6570	ug/L	200	7/11/2022			SW846-8260D	=
Turbidity		0	NTU		7/11/2022				X
Uranium	J	0.000068	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	-0.713	pCi/L	2.37	7/11/2022	0.763	0.764	HASL 300, U-02-RC M	=
Uranium-235	U	0.216	pCi/L	1.36	7/11/2022	0.811	0.812	HASL 300, U-02-RC M	=
Uranium-238	U	0.239	pCi/L	1.52	7/11/2022	0.818	0.819	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW85 REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5234

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.00505	mg/L	0.005	7/11/2022			SW846-6020B	=
Arsenic, Dissolved	J	0.00356	mg/L	0.005	7/11/2022			SW846-6020B	=
Barometric Pressure Reading		29.93	Inches/Hg		7/11/2022				X
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	J	0.00342	mg/L	0.01	7/11/2022			SW846-6020B	=
Chromium, Dissolved	J	0.00338	mg/L	0.01	7/11/2022			SW846-6020B	=
Conductivity		391	umho/cm		7/11/2022				X
Depth to Water		8.75	ft		7/11/2022				X
Dissolved Oxygen		3.27	mg/L		7/11/2022				X
Lead	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
pH		6.18	Std Unit		7/11/2022				X
Redox		348	mV		7/11/2022				X
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Sulfate		10.7	mg/L	0.4	7/11/2022			SW846-9056A	=
Technetium-99		47.5	pCi/L	21.6	7/11/2022	13.9	14.9	HASL 300, Tc-02-RC M	=
Temperature		65.5	deg F		7/11/2022				X
Trichloroethene	X	95.1	ug/L	1	7/11/2022			SW846-8260D	J
Turbidity		1.36	NTU		7/11/2022				X
Uranium		0.00106	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	0.00942	pCi/L	2.75	7/11/2022	1.26	1.26	HASL 300, U-02-RC M	=
Uranium-235	U	0.192	pCi/L	2.05	7/11/2022	1.07	1.07	HASL 300, U-02-RC M	=
Uranium-238	U	0.479	pCi/L	2.6	7/11/2022	1.39	1.4	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW85 REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5234

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.08	Inches/Hg		9/1/2022				X
Conductivity		428	umho/cm		9/1/2022				X
Depth to Water		9.68	ft		9/1/2022				X
Dissolved Oxygen		2.24	mg/L		9/1/2022				X
pH		6.18	Std Unit		9/1/2022				X
Redox		468	mV		9/1/2022				X
Temperature		63.3	deg F		9/1/2022				X
Trichloroethene	U	1	ug/L	1	9/1/2022			SW846-8260D	=
Turbidity		12.01	NTU		9/1/2022				X

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW85 FR Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5234

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.00506	mg/L	0.005	7/11/2022			SW846-6020B	=
Arsenic, Dissolved	J	0.00304	mg/L	0.005	7/11/2022			SW846-6020B	=
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	J	0.00319	mg/L	0.01	7/11/2022			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Lead	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Sulfate		10.7	mg/L	0.4	7/11/2022			SW846-9056A	=
Technetium-99		49	pCi/L	21.4	7/11/2022	13.8	14.8	HASL 300, Tc-02-RC M	=
Trichloroethene	X	51.2	ug/L	1	7/11/2022			SW846-8260D	J
Uranium		0.00106	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	-0.0255	pCi/L	2.33	7/11/2022	1.07	1.07	HASL 300, U-02-RC M	=
Uranium-235	U	0.0112	pCi/L	1.84	7/11/2022	0.829	0.83	HASL 300, U-02-RC M	=
Uranium-238	U	0.751	pCi/L	1.75	7/11/2022	1.13	1.13	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW85 FR Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5234

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Trichloroethene	U	1	ug/L	1	9/1/2022			SW846-8260D	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW87A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4850

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.00827	mg/L	0.005	7/11/2022			SW846-6020B	=
Arsenic, Dissolved		0.00563	mg/L	0.005	7/11/2022			SW846-6020B	=
Barometric Pressure Reading		29.94	Inches/Hg		7/11/2022				X
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Conductivity		345	umho/cm		7/11/2022				X
Depth to Water		47.51	ft		7/11/2022				X
Dissolved Oxygen		3.7	mg/L		7/11/2022				X
Lead	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
pH		5.74	Std Unit		7/11/2022				X
Redox		397	mV		7/11/2022				X
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Sulfate		6.84	mg/L	0.4	7/11/2022			SW846-9056A	=
Technetium-99	U	4.85	pCi/L	20.5	7/11/2022	12	12	HASL 300, Tc-02-RC M	=
Temperature		65.6	deg F		7/11/2022				X
Trichloroethene		2330	ug/L	50	7/11/2022			SW846-8260D	=
Turbidity		0	NTU		7/11/2022				X
Uranium	U	0.0002	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	0.135	pCi/L	1.64	7/11/2022	0.806	0.807	HASL 300, U-02-RC M	=
Uranium-235	U	-0.116	pCi/L	1.34	7/11/2022	0.514	0.515	HASL 300, U-02-RC M	=
Uranium-238	U	0.392	pCi/L	0.588	7/11/2022	0.672	0.674	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW87A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4850

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		29.96	Inches/Hg		8/15/2022				X
Conductivity		339	umho/cm		8/15/2022				X
Depth to Water		48.05	ft		8/15/2022				X
Dissolved Oxygen		4.99	mg/L		8/15/2022				X
pH		5.53	Std Unit		8/15/2022				X
Redox		425	mV		8/15/2022				X
Technetium-99	U	8.78	pCi/L	13.4	8/15/2022	8.04	8.1	HASL 300, Tc-02-RC M	=
Temperature		64.4	deg F		8/15/2022				X
Trichloroethene		1400	ug/L	50	8/15/2022			SW846-8260D	=
Turbidity		2.01	NTU		8/15/2022				X

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW88 REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5237

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.00694	mg/L	0.005	7/11/2022			SW846-6020B	=
Arsenic, Dissolved	J	0.00367	mg/L	0.005	7/11/2022			SW846-6020B	=
Barometric Pressure Reading		29.95	Inches/Hg		7/11/2022				X
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	J	0.00317	mg/L	0.01	7/11/2022			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Conductivity		627	umho/cm		7/11/2022				X
Depth to Water		8.23	ft		7/11/2022				X
Dissolved Oxygen		1.22	mg/L		7/11/2022				X
Lead	J	0.000584	mg/L	0.002	7/11/2022			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	J	0.000156	mg/L	0.0002	7/11/2022			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
pH		5.73	Std Unit		7/11/2022				X
Redox		398	mV		7/11/2022				X
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Sulfate		116	mg/L	4	7/11/2022			SW846-9056A	=
Technetium-99	U	20	pCi/L	21.4	7/11/2022	13	13.2	HASL 300, Tc-02-RC M	=
Temperature		65.4	deg F		7/11/2022				X
Trichloroethene	X	59.4	ug/L	1	7/11/2022			SW846-8260D	=
Turbidity		13.55	NTU		7/11/2022				X
Uranium	J	0.000127	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	-0.697	pCi/L	2.61	7/11/2022	0.742	0.744	HASL 300, U-02-RC M	=
Uranium-235	U	0.496	pCi/L	2.37	7/11/2022	1.36	1.37	HASL 300, U-02-RC M	=
Uranium-238	U	-0.376	pCi/L	2.2	7/11/2022	0.712	0.714	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW88 REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5237

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.09	Inches/Hg		9/1/2022				X
Conductivity		638	umho/cm		9/1/2022				X
Depth to Water		9.02	ft		9/1/2022				X
Dissolved Oxygen		1.26	mg/L		9/1/2022				X
pH		5.8	Std Unit		9/1/2022				X
Redox		391	mV		9/1/2022				X
Temperature		65.7	deg F		9/1/2022				X
Trichloroethene		2.3	ug/L	1	9/1/2022			SW846-8260D	=
Turbidity		110	NTU		9/1/2022				X

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW90A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8004-0357

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Arsenic, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Barometric Pressure Reading		29.95	Inches/Hg		7/11/2022				X
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Cadmium, Dissolved	J	0.000353	mg/L	0.001	7/11/2022			SW846-6020B	J
Chromium	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Conductivity		224	umho/cm		7/11/2022				X
Depth to Water		46.72	ft		7/11/2022				X
Dissolved Oxygen		5.4	mg/L		7/11/2022				X
Lead	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
pH		5.79	Std Unit		7/11/2022				X
Redox		391	mV		7/11/2022				X
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Selenium, Dissolved		0.0121	mg/L	0.005	7/11/2022			SW846-6020B	=
Sulfate		4.2	mg/L	0.4	7/11/2022			SW846-9056A	=
Technetium-99	U	19.4	pCi/L	21	7/11/2022	12.8	12.9	HASL 300, Tc-02-RC M	=
Temperature		66	deg F		7/11/2022				X
Trichloroethene		231	ug/L	4	7/11/2022			SW846-8260D	=
Turbidity		2.57	NTU		7/11/2022				X
Uranium	U	0.0002	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	-0.316	pCi/L	1.83	7/11/2022	0.657	0.658	HASL 300, U-02-RC M	=
Uranium-235	U	-0.254	pCi/L	1.74	7/11/2022	0.587	0.589	HASL 300, U-02-RC M	=
Uranium-238	U	0.0171	pCi/L	1.73	7/11/2022	0.785	0.786	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW90A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8004-0357

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		29.96	Inches/Hg		8/15/2022				X
Conductivity		226	umho/cm		8/15/2022				X
Depth to Water		47.4	ft		8/15/2022				X
Dissolved Oxygen		5.35	mg/L		8/15/2022				X
pH		5.71	Std Unit		8/15/2022				X
Redox		410	mV		8/15/2022				X
Technetium-99		25.7	pCi/L	13.5	8/15/2022	8.98	9.42	HASL 300, Tc-02-RC M	=
Temperature		64.4	deg F		8/15/2022				X
Trichloroethene		222	ug/L	5	8/15/2022			SW846-8260D	=
Turbidity		1.04	NTU		8/15/2022				X

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW91A REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8007-2917

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic	J	0.00366	mg/L	0.005	7/11/2022			SW846-6020B	=
Arsenic, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Barometric Pressure Reading		29.93	Inches/Hg		7/11/2022				X
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Conductivity		812	umho/cm		7/11/2022				X
Depth to Water		12.47	ft		7/11/2022				X
Dissolved Oxygen		2.5	mg/L		7/11/2022				X
Lead	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
pH		6.01	Std Unit		7/11/2022				X
Redox		230	mV		7/11/2022				X
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Sulfate		69.8	mg/L	2	7/11/2022			SW846-9056A	=
Technetium-99		86.7	pCi/L	22.8	7/11/2022	15.6	18.3	HASL 300, Tc-02-RC M	=
Temperature		66.5	deg F		7/11/2022				X
Trichloroethene		24.4	ug/L	1	7/11/2022			SW846-8260D	=
Turbidity		3.21	NTU		7/11/2022				X
Uranium	U	0.0002	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	0.29	pCi/L	1.25	7/11/2022	0.691	0.693	HASL 300, U-02-RC M	=
Uranium-235	U	0	pCi/L	0.514	7/11/2022	0.346	0.346	HASL 300, U-02-RC M	=
Uranium-238	U	0.316	pCi/L	0.847	7/11/2022	0.559	0.56	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW93A REG Upgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4851

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.0111	mg/L	0.005	7/11/2022			SW846-6020B	=
Arsenic, Dissolved		0.00816	mg/L	0.005	7/11/2022			SW846-6020B	=
Barometric Pressure Reading		29.95	Inches/Hg		7/11/2022				X
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	J	0.00527	mg/L	0.01	7/11/2022			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Conductivity		380	umho/cm		7/11/2022				X
Depth to Water		50.45	ft		7/11/2022				X
Dissolved Oxygen		3.25	mg/L		7/11/2022				X
Lead	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
pH		5.8	Std Unit		7/11/2022				X
Redox		365	mV		7/11/2022				X
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Sulfate		7.51	mg/L	0.4	7/11/2022			SW846-9056A	=
Technetium-99	U	2.26	pCi/L	22.1	7/11/2022	12.9	12.9	HASL 300, Tc-02-RC M	=
Temperature		65.9	deg F		7/11/2022				X
Trichloroethene		2870	ug/L	50	7/11/2022			SW846-8260D	=
Turbidity		7.65	NTU		7/11/2022				X
Uranium	J	0.000076	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	-0.592	pCi/L	1.78	7/11/2022	0.646	0.646	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0417	pCi/L	0.833	7/11/2022	0.36	0.36	HASL 300, U-02-RC M	=
Uranium-238	U	-0.0675	pCi/L	0.779	7/11/2022	0.298	0.299	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW93A REG Upgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4851

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		29.95	Inches/Hg		8/15/2022				X
Conductivity		382	umho/cm		8/15/2022				X
Depth to Water		51.02	ft		8/15/2022				X
Dissolved Oxygen		3.3	mg/L		8/15/2022				X
pH		5.6	Std Unit		8/15/2022				X
Redox		407	mV		8/15/2022				X
Technetium-99	U	2.94	pCi/L	15.7	8/15/2022	9.03	9.03	HASL 300, Tc-02-RC M	=
Temperature		63.7	deg F		8/15/2022				X
Trichloroethene		1630	ug/L	50	8/15/2022			SW846-8260D	=
Turbidity		3.59	NTU		8/15/2022				X

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW94 REG Upgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5103

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Arsenic, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Barometric Pressure Reading		29.96	Inches/Hg		7/11/2022				X
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	J	0.00683	mg/L	0.01	7/11/2022			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Conductivity		800	umho/cm		7/11/2022				X
Depth to Water		13.22	ft		7/11/2022				X
Dissolved Oxygen		1.47	mg/L		7/11/2022				X
Lead	J	0.000893	mg/L	0.002	7/11/2022			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
pH		6.32	Std Unit		7/11/2022				X
Redox		374	mV		7/11/2022				X
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Sulfate		77.1	mg/L	2	7/11/2022			SW846-9056A	=
Technetium-99		759	pCi/L	22.1	7/11/2022	27.4	88.4	HASL 300, Tc-02-RC M	=
Temperature		66	deg F		7/11/2022				X
Trichloroethene	X	64.8	ug/L	1	7/11/2022			SW846-8260D	=
Turbidity		21.91	NTU		7/11/2022				X
Uranium		0.00153	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	0.356	pCi/L	3.19	7/11/2022	1.61	1.61	HASL 300, U-02-RC M	=
Uranium-235	U	0.434	pCi/L	2.07	7/11/2022	1.38	1.38	HASL 300, U-02-RC M	=
Uranium-238	U	1.01	pCi/L	2.16	7/11/2022	1.58	1.59	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW94 REG Upgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5103

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.09	Inches/Hg		9/1/2022				X
Conductivity		805	umho/cm		9/1/2022				X
Depth to Water		13.9	ft		9/1/2022				X
Dissolved Oxygen		1.4	mg/L		9/1/2022				X
pH		6.34	Std Unit		9/1/2022				X
Redox		378	mV		9/1/2022				X
Temperature		65.3	deg F		9/1/2022				X
Trichloroethene		1.12	ug/L	1	9/1/2022			SW846-8260D	=
Turbidity		114	NTU		9/1/2022				X

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW420 REG Upgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8005-3263

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic		0.0103	mg/L	0.005	7/11/2022			SW846-6020B	=
Arsenic, Dissolved		0.0059	mg/L	0.005	7/11/2022			SW846-6020B	=
Barometric Pressure Reading		29.96	Inches/Hg		7/11/2022				X
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Conductivity		380	umho/cm		7/11/2022				X
Depth to Water		50.15	ft		7/11/2022				X
Dissolved Oxygen		1.79	mg/L		7/11/2022				X
Lead	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
pH		5.74	Std Unit		7/11/2022				X
Redox		410	mV		7/11/2022				X
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Sulfate		6.22	mg/L	0.4	7/11/2022			SW846-9056A	=
Technetium-99	U	-4	pCi/L	22.7	7/11/2022	13.1	13.1	HASL 300, Tc-02-RC M	=
Temperature		67	deg F		7/11/2022				X
Trichloroethene		2590	ug/L	40	7/11/2022			SW846-8260D	=
Turbidity		3.48	NTU		7/11/2022				X
Uranium	U	0.0002	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	-0.957	pCi/L	2.39	7/11/2022	0.727	0.728	HASL 300, U-02-RC M	UJ
Uranium-235	U	-0.43	pCi/L	1.98	7/11/2022	0.606	0.607	HASL 300, U-02-RC M	=
Uranium-238	U	0.058	pCi/L	1.26	7/11/2022	0.606	0.607	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW420 REG Upgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8005-3263

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		29.94	Inches/Hg		8/15/2022				X
Conductivity		385	umho/cm		8/15/2022				X
Depth to Water		50.51	ft		8/15/2022				X
Dissolved Oxygen		2.44	mg/L		8/15/2022				X
pH		5.61	Std Unit		8/15/2022				X
Redox		464	mV		8/15/2022				X
Technetium-99	U	-6.58	pCi/L	14.5	8/15/2022	7.84	7.84	HASL 300, Tc-02-RC M	=
Temperature		66.1	deg F		8/15/2022				X
Trichloroethene		1620	ug/L	40	8/15/2022			SW846-8260D	=
Turbidity		3.79	NTU		8/15/2022				X

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Type of Sample: FB **Period:** Semiannual Report QC Samples

AKGWA Well Tag #: 0000-0000

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Lead	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Technetium-99	U	-5.64	pCi/L	22.1	7/11/2022	12.6	12.6	HASL 300, Tc-02-RC M	=
Trichloroethene	U	1	ug/L	1	7/11/2022			SW846-8260D	=
Uranium	U	0.0002	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	-0.824	pCi/L	1.82	7/11/2022	0.586	0.587	HASL 300, U-02-RC M	UJ
Uranium-235	U	-0.0411	pCi/L	0.821	7/11/2022	0.354	0.355	HASL 300, U-02-RC M	=
Uranium-238	U	-0.0277	pCi/L	0.971	7/11/2022	0.416	0.416	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Type of Sample: RI **Period:** Semiannual Report QC Samples

AKGWA Well Tag #: 0000-0000

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Arsenic	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Cadmium	U	0.001	mg/L	0.001	7/11/2022			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2022			SW846-6020B	=
Lead	U	0.002	mg/L	0.002	7/11/2022			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2022			SW846-7470A	=
Selenium	U	0.005	mg/L	0.005	7/11/2022			SW846-6020B	=
Technetium-99	U	4.78	pCi/L	21.8	7/11/2022	12.8	12.8	HASL 300, Tc-02-RC M	=
Trichloroethene	U	1	ug/L	1	7/11/2022			SW846-8260D	=
Uranium	U	0.0002	mg/L	0.0002	7/11/2022			SW846-6020B	=
Uranium-234	U	0.408	pCi/L	2.08	7/11/2022	1.12	1.13	HASL 300, U-02-RC M	=
Uranium-235	U	-0.132	pCi/L	1.52	7/11/2022	0.583	0.585	HASL 300, U-02-RC M	=
Uranium-238	U	-0.311	pCi/L	1.93	7/11/2022	0.707	0.708	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Type of Sample: TB **Period:** Semiannual Report QC Samples

AKGWA Well Tag #: 0000-0000

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Trichloroethene	U	1	ug/L	1	7/11/2022			SW846-8260D	=
	U	1	ug/L	1	8/15/2022			SW846-8260D	=
	U	1	ug/L	1	9/1/2022			SW846-8260D	=
	U	1	ug/L	1	9/1/2022			SW846-8260D	=

QUALIFIER Codes

U Analyte analyzed for, but not detected at or below the lowest concentration reported.
J Estimated quantitation.
X Other specific flags and footnotes may be required to properly define the results.

SAMPLING POINT Codes

UCRS Upper Continental Recharge System
URGA Upper Regional Gravel Aquifer

SAMPLE TYPE Codes

FB Field Blank
FR Field Duplicate as defined in sampling procedure.
REG Regular
RI QC Equipment Rinseate/Decon
TB Trip Blank

VALIDATION Codes

= Validated result, no qualifier is necessary.
J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
X Not validated.

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW84A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4849

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.19	Inches/Hg		5/11/2022				X
Conductivity		512	umho/cm		5/11/2022				X
Depth to Water		46.52	ft		5/11/2022				X
Dissolved Oxygen		3.28	mg/L		5/11/2022				X
pH		5.9	Std Unit		5/11/2022				X
Redox		387	mV		5/11/2022				X
Technetium-99		47.9	pCi/L	18.4	5/11/2022	11.9	13.1	HASL 300, Tc-02-RC M	=
Temperature		63.4	deg F		5/11/2022				X
Turbidity		0	NTU		5/11/2022				X
Uranium-234	U	-0.155	pCi/L	0.6	5/11/2022	0.198	0.198	HASL 300, U-02-RC M	=
Uranium-235	U	0.0585	pCi/L	0.369	5/11/2022	0.219	0.22	HASL 300, U-02-RC M	=
Uranium-238	U	0.142	pCi/L	0.38	5/11/2022	0.251	0.252	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW85 REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5234

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.19	Inches/Hg		5/11/2022				X
Conductivity		409	umho/cm		5/11/2022				X
Depth to Water		8.1	ft		5/11/2022				X
Dissolved Oxygen		2.85	mg/L		5/11/2022				X
pH		6.24	Std Unit		5/11/2022				X
Redox		367	mV		5/11/2022				X
Technetium-99		56	pCi/L	16.7	5/11/2022	11.5	13.1	HASL 300, Tc-02-RC M	=
Temperature		65.7	deg F		5/11/2022				X
Turbidity		2.19	NTU		5/11/2022				X
Uranium-234	U	-0.131	pCi/L	0.623	5/11/2022	0.215	0.215	HASL 300, U-02-RC M	=
Uranium-235	U	-0.041	pCi/L	0.473	5/11/2022	0.181	0.182	HASL 300, U-02-RC M	=
Uranium-238		1.32	pCi/L	0.558	5/11/2022	0.642	0.667	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW87A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4850

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.19	Inches/Hg		5/11/2022				X
Conductivity		355	umho/cm		5/11/2022				X
Depth to Water		46.53	ft		5/11/2022				X
Dissolved Oxygen		2.81	mg/L		5/11/2022				X
pH		5.8	Std Unit		5/11/2022				X
Redox		407	mV		5/11/2022				X
Technetium-99	U	4.57	pCi/L	12	5/11/2022	7.11	7.13	HASL 300, Tc-02-RC M	=
Temperature		65.3	deg F		5/11/2022				X
Turbidity		0	NTU		5/11/2022				X
Uranium-234	U	-0.00031	pCi/L	0.605	5/11/2022	0.281	0.281	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0354	pCi/L	0.409	5/11/2022	0.157	0.157	HASL 300, U-02-RC M	=
Uranium-238	U	0.0191	pCi/L	0.463	5/11/2022	0.218	0.218	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW88 REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5237

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.17	Inches/Hg		5/11/2022				X
Conductivity		618	umho/cm		5/11/2022				X
Depth to Water		8.76	ft		5/11/2022				X
Dissolved Oxygen		1.41	mg/L		5/11/2022				X
pH		5.78	Std Unit		5/11/2022				X
Redox		401	mV		5/11/2022				X
Technetium-99		23.6	pCi/L	22.6	5/11/2022	13.8	14	HASL 300, Tc-02-RC M	=
Temperature		64.8	deg F		5/11/2022				X
Turbidity		6.13	NTU		5/11/2022				X
Uranium-234	U	-0.28	pCi/L	0.666	5/11/2022	0.169	0.17	HASL 300, U-02-RC M	UJ
Uranium-235	U	0.0626	pCi/L	0.549	5/11/2022	0.28	0.281	HASL 300, U-02-RC M	=
Uranium-238	U	-0.137	pCi/L	0.531	5/11/2022	0.156	0.156	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW90A REG Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8004-0357

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.17	Inches/Hg		5/11/2022				X
Conductivity		271	umho/cm		5/11/2022				X
Depth to Water		45.74	ft		5/11/2022				X
Dissolved Oxygen		5.19	mg/L		5/11/2022				X
pH		5.81	Std Unit		5/11/2022				X
Redox		405	mV		5/11/2022				X
Technetium-99		28.5	pCi/L	22	5/11/2022	13.6	13.9	HASL 300, Tc-02-RC M	=
Temperature		66.4	deg F		5/11/2022				X
Turbidity		0.1	NTU		5/11/2022				X
Uranium-234	U	-0.0322	pCi/L	0.539	5/11/2022	0.228	0.228	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0187	pCi/L	0.373	5/11/2022	0.161	0.161	HASL 300, U-02-RC M	=
Uranium-238	U	-0.106	pCi/L	0.488	5/11/2022	0.149	0.149	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW90A FR Downgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8004-0357

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Technetium-99		34.4	pCi/L	20.7	5/11/2022	13	13.6	HASL 300, Tc-02-RC M	=
Uranium-234	U	-0.126	pCi/L	0.676	5/11/2022	0.256	0.256	HASL 300, U-02-RC M	=
Uranium-235	U	0	pCi/L	0.25	5/11/2022	0.168	0.168	HASL 300, U-02-RC M	=
Uranium-238	U	0.00539	pCi/L	0.544	5/11/2022	0.248	0.248	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW91A REG Downgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8007-2917

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.17	Inches/Hg		5/11/2022				X
Conductivity		772	umho/cm		5/11/2022				X
Depth to Water		12.53	ft		5/11/2022				X
Dissolved Oxygen		2.09	mg/L		5/11/2022				X
pH		6.18	Std Unit		5/11/2022				X
Redox		366	mV		5/11/2022				X
Technetium-99		82.2	pCi/L	19.4	5/11/2022	13.4	16.2	HASL 300, Tc-02-RC M	=
Temperature		65.8	deg F		5/11/2022				X
Turbidity		3.44	NTU		5/11/2022				X
Uranium-234	U	-0.0774	pCi/L	0.45	5/11/2022	0.16	0.16	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0632	pCi/L	0.434	5/11/2022	0.146	0.147	HASL 300, U-02-RC M	=
Uranium-238	U	0.0426	pCi/L	0.373	5/11/2022	0.191	0.191	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW93A REG Upgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8007-4851

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.19	Inches/Hg		5/11/2022				X
Conductivity		379	umho/cm		5/11/2022				X
Depth to Water		49.55	ft		5/11/2022				X
Dissolved Oxygen		2.94	mg/L		5/11/2022				X
pH		5.81	Std Unit		5/11/2022				X
Redox		371	mV		5/11/2022				X
Technetium-99	U	13	pCi/L	15.9	5/11/2022	9.62	9.73	HASL 300, Tc-02-RC M	=
Temperature		64.6	deg F		5/11/2022				X
Turbidity		4.8	NTU		5/11/2022				X
Uranium-234	U	-0.0627	pCi/L	0.552	5/11/2022	0.222	0.222	HASL 300, U-02-RC M	=
Uranium-235	U	0	pCi/L	0.224	5/11/2022	0.15	0.151	HASL 300, U-02-RC M	=
Uranium-238	U	0.198	pCi/L	0.368	5/11/2022	0.27	0.271	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW94 REG Upgradient UCRS **Period:** Semiannual Report

AKGWA Well Tag #: 8000-5103

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.19	Inches/Hg		5/11/2022				X
Conductivity		787	umho/cm		5/11/2022				X
Depth to Water		12.56	ft		5/11/2022				X
Dissolved Oxygen		1.66	mg/L		5/11/2022				X
pH		6.34	Std Unit		5/11/2022				X
Redox		357	mV		5/11/2022				X
Technetium-99		460	pCi/L	22.5	5/11/2022	22.5	55.7	HASL 300, Tc-02-RC M	=
Temperature		64.6	deg F		5/11/2022				X
Turbidity		13.2	NTU		5/11/2022				X
Uranium-234		0.883	pCi/L	0.576	5/11/2022	0.518	0.532	HASL 300, U-02-RC M	=
Uranium-235	U	0	pCi/L	0.215	5/11/2022	0.145	0.145	HASL 300, U-02-RC M	=
Uranium-238		0.453	pCi/L	0.407	5/11/2022	0.366	0.371	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Sampling Point: MW420 REG Upgradient URGA **Period:** Semiannual Report

AKGWA Well Tag #: 8005-3263

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Barometric Pressure Reading		30.18	Inches/Hg		5/11/2022				X
Conductivity		427	umho/cm		5/11/2022				X
Depth to Water		49.28	ft		5/11/2022				X
Dissolved Oxygen		1.93	mg/L		5/11/2022				X
pH		5.81	Std Unit		5/11/2022				X
Redox		332	mV		5/11/2022				X
Technetium-99	U	2.96	pCi/L	15.9	5/11/2022	9.28	9.29	HASL 300, Tc-02-RC M	=
Temperature		65	deg F		5/11/2022				X
Turbidity		0	NTU		5/11/2022				X
Uranium-234	U	-0.202	pCi/L	0.723	5/11/2022	0.236	0.236	HASL 300, U-02-RC M	=
Uranium-235	U	0.0682	pCi/L	0.43	5/11/2022	0.256	0.256	HASL 300, U-02-RC M	=
Uranium-238	U	-0.122	pCi/L	0.563	5/11/2022	0.172	0.172	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Type of Sample: FB **Period:** Semiannual Report QC Samples

AKGWA Well Tag #: 0000-0000

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Technetium-99	U	0.318	pCi/L	19.2	5/11/2022	11.2	11.2	HASL 300, Tc-02-RC M	=
Uranium-234	U	-0.104	pCi/L	0.588	5/11/2022	0.224	0.224	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0177	pCi/L	0.353	5/11/2022	0.152	0.153	HASL 300, U-02-RC M	=
Uranium-238	U	0.198	pCi/L	0.461	5/11/2022	0.296	0.298	HASL 300, U-02-RC M	=

Paducah OREIS
GROUNDWATER MONITORING REPORT

Facility: C-404 Landfill **County:** McCracken **Permit #:** KY8-890-008-982

Type of Sample: RI **Period:** Semiannual Report QC Samples

AKGWA Well Tag #: 0000-0000

Parameter	Qualifier	Result	Units	Reporting Limit	Date Collected	Counting Error (+/-)	TPU	Method	Validation
Technetium-99	U	-1.47	pCi/L	14.5	5/11/2022	8.28	8.28	HASL 300, Tc-02-RC M	=
Uranium-234	U	0.00982	pCi/L	0.645	5/11/2022	0.299	0.299	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0425	pCi/L	0.491	5/11/2022	0.188	0.188	HASL 300, U-02-RC M	=
Uranium-238	U	-0.086	pCi/L	0.503	5/11/2022	0.163	0.163	HASL 300, U-02-RC M	=

QUALIFIER Codes

U Analyte analyzed for, but not detected at or below the lowest concentration reported.

SAMPLING POINT Codes

UCRS Upper Continental Recharge System
URGA Upper Regional Gravel Aquifer

SAMPLE TYPE Codes

FB Field Blank
FR Field Duplicate as defined in sampling procedure.
REG Regular
RI QC Equipment Rinseate/Decon

VALIDATION Codes

= Validated result, no qualifier is necessary.
J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
X Not validated.

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APPENDIX B

C-404 HAZARDOUS WASTE LANDFILL STATISTICAL ANALYSES

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GROUNDWATER STATISTICAL SUMMARY

INTRODUCTION

The statistical analyses conducted on the data collected from the C-404 Hazardous Waste Landfill (C-404 Landfill) were performed in accordance with procedures provided in Appendix E of the Hazardous Waste Management Facility Permit, reissued by the Kentucky Division of Waste Management in February 2020. The percent of censored (nondetected) data points for individual parameters was calculated for the combined analytical data from the most recent five sampling events. The percent of censored data was used to select the types of statistical analyses to determine whether compliance well concentrations differed from background well concentrations. Data points were used in the statistical analysis for analyte results close to the sample quantitation limit that were judged to be below that limit by the data validator.

Quarterly compliance monitoring groundwater sampling for radiological constituents was initiated in third quarter 2021 (July 2021) and has continued through August 2022 (including a resampling event for technetium-99; see Section 3 for additional details). The additional quarters of groundwater data for radiological constituents alters the available data sets for the statistical analyses. For the second reporting period 2022 semiannual report, the reporting period data set includes nonradiological data from July 2020, January 2021, July 2021, January 2022, and July–August 2022 (including a resampling event for trichloroethene conducted in August 2022). The reporting period data set for radiological constituents includes July 2021, November 2021, January 2022, May 2022, and July–August 2022.

STATISTICAL ANALYSIS PROCESS

Utilizing the current data set and four previous data sets, the type of statistical test conducted for each chemical data set is a function of the number of samples and proportion of censored data (nondetects) to uncensored data (detects) in each group. The percent of censored (nondetected) data points for individual parameters was calculated for the combined analytical data. The statistical procedures applied to the data are summarized below.

- Determine the percentage of the censored data using the reporting period data set.
- Group by percentage of censored data where the following apply:
  - — If censored data are greater than or equal to 90%, determine the limit of detection (LOD) and half of the LOD (½ LOD). This is Statistical Test 1.
  - — If censored data are between 50% and 90%, perform a Test of Proportions. If the analysis indicates a significant proportional difference in compliance wells, further analyze through nonparametric Analysis of Variance (ANOVA) Test. This is Statistical Test 2.

— If censored data are between 15% and 50%, perform nonparametric ANOVA Test. If results exceed the critical value, compute the critical difference used to identify individual well concentrations, which are significantly elevated compared with background. This is Statistical Test 3.

— If censored data are less than 15%, actual data values are analyzed using parametric ANOVA procedures. If the wells exhibit equal variances, then the data are used as presented. If the wells do not exhibit equal variances, then the log of the data is taken and then used in the calculations. Where statistical testing indicates elevated compliance well concentrations, Bonferroni's Test of Contrasts is performed. This is Statistical Test 4. Statistical Test 4 is found in Section 5.2.1 of EPA guidance document, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* (April 1989).

If the statistical method above indicates no statistical difference between concentrations in downgradient wells and concentrations in background wells, then there are no indications of statistically significant impacts on the groundwater from the C-404 Landfill. If the tiered statistical method above identifies a statistically significant difference between concentrations in downgradient wells and concentrations in background wells, then the data will be evaluated further to determine if the concentrations in downgradient wells are within the statistically developed upper tolerance limit (UTL) for background concentrations or are consistent with the findings of the 2007 Alternate Source Demonstration (ASD), as follows:

(1) Compare the most recent downgradient sample results to a 95% UTL using the five most recent sets of data for each upgradient well as described below. If downgradient concentrations are lower than the UTL for the paired upgradient concentrations, then there is no confirmed exceedance.

(2) Evaluate results using paired ANOVA of wells in the same direction relative to the landfill (e.g., compare upgradient westernmost well results to downgradient westernmost well results). If ANOVA does not identify a statistically significant difference between upgradient and downgradient wells, then the results are consistent with the historical ASD.

(3) If results show downgradient wells have statistically significant higher concentrations than upgradient wells, even when evaluated with respect to the ASD, additional intra-well evaluation of trend will be performed using the Mann-Kendall test for trend. If concentrations do not show an increasing trend, then there is no confirmed exceedance attributable to C-404.

(4) Review other Regional Gravel Aquifer (RGA) well results in vicinity to determine if they are consistent with ASD.

If the statistical analysis identifies downgradient well concentrations that are increasing, are higher than UTL, are higher than the upgradient well concentrations even when the ASD results are taken into account, this evaluation will identify a confirmed, statistically significant exceedance (in a compliance well) over background.

DATA ANALYSIS

Data from the upgradient background wells in the Upper Regional Gravel Aquifer (URGA) are included for comparison with three downgradient URGA wells. Figure 1 of this C-404 Landfill Groundwater Report provides a map of the well locations associated with the C-404 Landfill. Upper Continental Recharge System (UCRS) wells in Figure 1 are provided for reference only. Data from wells that are in the UCRS are not included in the statistical analyses.

Table B.1 presents the C-404 Landfill upgradient or background wells and downgradient or compliance wells from the URGA. Data from the URGA compliance wells were compared with data from the URGA background wells.

Table B.1. Monitoring Well Locations

URGA	
Upgradient background wells	MW93A*, MW420
Downgradient compliance wells	MW84A*, MW87A*, MW90A*

*MW90 was abandoned in 2001 and replaced with MW90A. MW84, MW87, and MW93 were abandoned in 2019 and replaced with MW84A, MW87A, and MW93A, respectively.

For this reporting period, the data set includes nonradionuclide data from July 2020, January 2021, July 2021, January 2022, and July–August 2022 (including a resampling event for trichloroethene) and consists of five sets of data. The reporting period data set for radiological data is from July 2021 through August 2022 (including a resampling event for technetium-99 conducted in August) and also consists of five sets of data.

Table B.2 lists the number of analyses (observations), nondetects (censored observations), detects (uncensored observations), and missing observations by parameter. When field duplicate data are available from a well, the higher of the two readings was retained for further evaluation.

Table B.2. Summary of Missing, Censored, and Uncensored Data Collected

Parameters	Observations	Missing Observations	Censored Observations (Nondetects)	Uncensored Observations (Detects)
URGA				
Arsenic	25	0	3	22
Cadmium	25	0	24	1
Chromium	25	0	22	3
Lead	25	0	24	1
Mercury	25	0	25	0
Selenium	25	0	25	0
Technetium-99	25	0	16	9
Trichloroethene	25	0	0	25
Uranium (Metals)	25	0	17	8
Uranium-234	25	0	25	0
Uranium-235	25	0	25	0
Uranium-238	25	0	25	0

Censoring Percentage and Statistical Analysis

The type of statistical test set applied to the data is a function of the number of nondetects (censored) versus detects (uncensored) in each of the parameter groups and among the wells. Table B.3 presents the percentage of censored data and type of statistical test chosen for each of the parameters required by Part VIII.E of the Permit.

Table B.3. Percent Censored Report and Statistical Test Set Selected

Parameter	Total Samples (Nonmissing)	Uncensored (Detects)	Censored (Nondetects)	Percent Censored	Statistical Test Set*
URGA					
Arsenic	25	22	3	12	4
Cadmium	25	1	24	96	1
Chromium	25	3	22	88	2
Lead	25	1	24	96	1
Mercury	25	0	25	100	1
Selenium	25	0	25	100	1
Technetium-99	25	9	16	64	2
Trichloroethene	25	25	0	0	4
Uranium (Metals)	25	8	17	68	2
Uranium-234	25	0	25	100	1
Uranium-235	25	0	25	100	1
Uranium-238	25	0	25	100	1

*A list of the constituents with greater than or equal to 90% censored data is included in Table B.4, which summarizes the results of Statistical Test 1.

SUMMARY OF CONCLUSIONS

The results for Statistical Test 1, LOD, are summarized in Table B.4. Table B.5 provides the summary of conclusions for the C-404 Landfill statistical analyses for the second reporting period 2022, including the statistical tests performed, the attachment number, well type, parameter, and results of each statistical test. Results of Statistical Test 2, Statistical Test 3, and Statistical Test 4 are presented in Attachments B1 through B5. The statistician qualification statement is presented in Attachment B6.

Table B.4. Statistical Test 1: Limit of Detection

Parameter	LOD Values	½ LOD Values
URGA		
Cadmium (mg/L)	0.001	0.0005
Lead (mg/L)	0.002	0.001
Mercury (mg/L)	0.0002	0.0001
Selenium (mg/L)	0.005	0.0025
Uranium-234 (pCi/L)	2.39	1.195
Uranium-235 (pCi/L)	1.98	0.99
Uranium-238 (pCi/L)	1.73	0.865

Table B.5. Summary of Conclusions from the C-404 Hazardous Waste Landfill Statistical Analyses for the Second Reporting Period 2022

Attachment	RGA Well Type	Parameter	Applied Statistical Test	Results
B1	URGA	Arsenic	Statistical Test 4, Parametric ANOVA, Statistical Test 3, Nonparametric ANOVA with 95% UTL, paired ANOVA (MW84A vs. MW93A), and Mann-Kendall	Because equality of variance could not be confirmed, Statistical Test 4 was abandoned and Statistical Test 3, Nonparametric ANOVA, was performed. Nonparametric ANOVA indicated a statistically significant difference between concentrations in downgradient well MW84A and concentrations in background wells; a comparison to the 95% UTL, paired ANOVA, and Mann-Kendall trend analysis were performed, as required by the Hazardous Waste Management Facility Permit. The 95% UTL indicated a statistically significant difference between concentrations in compliance well MW84A and concentrations in background wells. Results of the paired ANOVA identified a significant difference between upgradient (MW93A) and downgradient (MW84A) wells. The Mann-Kendall trend analysis identified a statistically significant increasing trend in MW84A.
B2	URGA	Chromium	Statistical Test 2, Test of Proportions, Nonparametric ANOVA.	Because Test of Proportions indicated statistically significant evidence that the proportion of detects in one group of data exceeds the proportion of detects in the other group, Nonparametric ANOVA was performed. Nonparametric ANOVA indicated no statistically significant difference between concentrations in downgradient wells and concentrations in background wells.
B3	URGA	Technetium-99	Statistical Test 2, Test of Proportions, Nonparametric ANOVA, 95% UTL, Parametric paired ANOVA	Because Test of Proportions indicated statistically significant evidence that the proportion of detects in one group of data exceeds the proportion of detects in the other group, Nonparametric ANOVA was performed. Nonparametric ANOVA indicated a statistically significant difference between concentrations in downgradient wells and concentrations in background wells for compliance well MW84A. A comparison to the 95% UTL identified a statistically significant difference between compliance well MW84A and background wells. The paired parametric ANOVA identified a statistically significant difference between concentrations in the background well and compliance well MW84A. The Mann-Kendall trend analysis was performed and identified a statistically significant decreasing technetium-99 trend in MW84A.

Table B.5. Summary of Conclusions from the C-404 Hazardous Waste Landfill Statistical Analyses for the Second Reporting Period 2022 (Continued)

Attachment	RGA Well Type	Parameter	Applied Statistical Test	Results
B4	URGA	Trichloroethene	Statistical Test 4, Parametric ANOVA, with 95% UTL, paired ANOVA (MW84A vs. MW93A), and Mann-Kendall trend analysis.	Because Parametric ANOVA indicated a statistically significant difference between concentrations in background wells and compliance well MW84A, a comparison to the 95% UTL was performed. The 95% UTL indicated a statistically significant difference between concentrations in compliance well MW84A and concentrations in background wells; therefore, a paired ANOVA (MW84A vs. MW93A) was performed that indicated a statistically significant difference between the wells. The Mann-Kendall trend analysis did not identify a statistically significant trend in MW84A.
B5	URGA	Uranium	Statistical Test 2, Test of Proportions	No statistically significant difference between concentrations in downgradient wells and concentrations in background wells.

In summary, Statistical Test 2, Test of Proportions, for chromium in the URGA identified a statistically significant difference between background and downgradient wells; however, detectable concentrations of chromium were not observed in any of the downgradient wells. As a result, an evaluation by nonparametric ANOVA was performed and did not indicate a statistically significant exceedance in downgradient wells as compared to background wells.

Statistical Test 2, Test of Proportions, for technetium-99 in the URGA identified a statistically significant difference between background and downgradient wells. As a result, an evaluation by nonparametric ANOVA was performed and identified a statistically significant exceedance in downgradient well MW84A when compared to background wells. The MW84A technetium-99 concentration exceeded the 95% UTL. Because a paired parametric ANOVA between upgradient well MW93A and downgradient well MW84A indicated a statistically significant exceedance, Mann-Kendall trend analysis was performed. The Mann-Kendall analysis showed a decreasing trend.

Statistical Test 2, Test of Proportions, for uranium in the URGA indicated no statistically significant difference between concentrations in downgradient wells and concentrations in background wells.

Statistical Test 4, parametric ANOVA, for arsenic in the URGA could not be performed because equality of variance could not be confirmed. Statistical Test 4 was abandoned and Statistical Test 3, Nonparametric ANOVA, was performed. Statistical Test 3, Nonparametric ANOVA, identified a statistically significant difference between concentrations in downgradient well MW84A and concentrations in background wells; therefore, the data were evaluated further by comparing results to the UTL. The 95% UTL indicated a statistically significant difference between concentrations in downgradient well MW84A and concentrations in background wells. Based on these results, the data were evaluated using paired (parametric) ANOVA of wells in the same direction relative to the landfill [e.g., performed a comparison of downgradient well (MW84A) results to upgradient westernmost well (MW93A) results]. Results of the paired (parametric) ANOVA identified a statistically significant difference between upgradient and

downgradient wells. A Mann-Kendall test was performed to evaluate the data further, and a statistically significant trend was identified for arsenic in MW84A.

Statistical Test 4, parametric ANOVA, for trichloroethene in the URGA indicated statistically significant difference between concentrations in downgradient well MW84A and concentrations in background wells; therefore, the data were evaluated further by comparing results to the UTL. The 95% UTL indicated a statistically significant difference between concentrations in downgradient well MW84A and concentrations in background wells; therefore, paired (parametric) ANOVA was performed on upgradient well MW93A and downgradient well MW84A. Paired (parametric) ANOVA identified a statistically significant difference between the upgradient and downgradient wells. A Mann-Kendall test was performed to evaluate the data further, and did not identify a statistically significant trend for trichloroethene in MW84A.

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ATTACHMENT B1

ARSENIC
STATISTICAL TEST 4

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Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Arsenic (As, mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	**0.0109**	**0.00534**	**0.0222**	**0.00895**	0.0025
Jan-21	**0.0154**	**0.00832**	**0.0212**	**0.00939**	**0.00211**
Jul-21	**0.00806**	**0.00859**	**0.0284**	**0.00793**	0.0025
Jan-22	**0.0134**	**0.0106**	**0.0348**	**0.00838**	**0.00213**
Jul-22	**0.0111**	**0.0103**	**0.036**	**0.00827**	0.0025
n_i	10		5	5	5
Sum	0.1020		0.1426	0.0429	0.0117
(x_i)avg	0.010		0.029	0.009	0.002

mg/L = milligrams per liter
Bolded values indicate a detected result.

Overall mean x.. =	0.01	
N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	0.30	x.. = the sum of the total number of samples

Determine Normality of Dataset

Coefficient of Variability Test

Table of Residuals

Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	0.001	-0.005	-0.006	0.000	0.000
Jan-21	0.005	-0.002	-0.007	0.001	0.000
Jul-21	-0.002	-0.002	0.000	-0.001	0.000
Jan-22	0.003	0.000	0.006	0.000	0.000
Jul-22	0.001	0.000	0.007	0.000	0.000

X: Mean Value =	1.73E-20	
S: Standard Deviation =	0.0	
K* Factor =	2.292	(for n = 25)
CV = S/X =	1.91E+17	> 1, data are not normally distributed

Data are not normally distributed (i.e.,>1)
*K factor [from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

If the coefficient of variation is < 1, the data are normally distributed.
If the coefficient of variation is > or = 1, data are not normally distributed.

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Determine Equality of Variance of Dataset

p = number of well groups
n_i = number of data points per well
N = total sample size
S^2 = the square of the standard deviation
$\ln(S_i^2)$ = natural logarithm of each variance
f = total sample size minus the number of wells (groups)
$f_i = n_i - 1$
x.. = the sum of the total number of samples
$(x_{avg})_{..} =$ the mean of the total number of samples

$x_{..} =$ 0.30
$(x_{avg})_{..} =$ 0.01
p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	n_i	$f_iS_i^2$	$f_i\ln(S_i^2)$
0.003	0.00	-11.721	10	0.0	-105.5
0.007	0.00	-9.960	5	0.000	-39.8
0.001	0.00	-14.901	5	0.000	-59.6
0.000	0.00	-16.953	5	0.000	-67.8

$\sum(S_i^2) =$ 0.00 $\sum f_i\ln(S_i^2) =$ -272.7

Equality of Variance: Bartlett's Test

f = 21
$Sp^2 =$ 0.000
$\ln Sp^2 =$ -11.286
$c^2 =$ 35.746 (If $c^2 \le c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.815 at a 5% significance level with 3 degrees of freedom

NOTE: The variances are NOT equal. **(i.e., $c^2 > c^2_{crit}$)**

Variances are not equal, transform the original data to lognormal (i.e., since $c^2 > c^2_{crit}$).

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Lognormal Data for As

ln[As (mg/L)]					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	-4.52	-5.23	-3.81	-4.72	-5.99
Jan-21	-4.17	-4.79	-3.85	-4.67	-6.16
Jul-21	-4.82	-4.76	-3.56	-4.84	-5.99
Jan-22	-4.31	-4.55	-3.36	-4.78	-6.15
Jul-22	-4.50	-4.58	-3.32	-4.80	-5.99
Mean x_i	-4.47	-4.78	-3.58	-4.76	-6.06
Background Mean	-4.62		NA	NA	NA
Grand Mean	-4.73				
x_i^2	20.42	27.38	14.50	22.24	35.90
	17.42	22.94	14.85	21.79	37.96
These values needed for ANOVA	23.24	22.63	12.68	23.40	35.90
	18.60	20.67	11.28	22.87	37.84
	20.26	20.94	11.05	22.99	35.90
Sum x_i^2	576				

mg/L = milligrams per liter

Determine Normality of Dataset

Coefficient of Variability Test

Table of ln[As (mg/L)] Data

Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	-4.52	-5.23	-3.81	-4.72	-5.99
Jan-21	-4.17	-4.79	-3.85	-4.67	-6.16
Jul-21	-4.82	-4.76	-3.56	-4.84	-5.99
Jan-22	-4.31	-4.55	-3.36	-4.78	-6.15
Jul-22	-4.50	-4.58	-3.32	-4.80	-5.99

X: Mean Value = -4.73E+00
S: Standard Deviation = 0.83
K* Factor = 2.292 (for n = 25)
CV = S/X = -1.76E-01 <1, data are normally distributed

Data are normally distributed (i.e.,<1)

*K factor [from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Determine Equality of Variance of Dataset for Lognormal Data

p = number of wells (background wells considered as one group)
n_i = number of data points per well
N = total sample size
S^2 = the square of the standard deviation
$\ln(S_i^2)$ = natural logarithm of each variance
f = total sample size minus the number of wells (groups)
$f_i = n_i - 1$
x.. = the sum of the total lognormal dataset
$(x_{avg})_{..}$ = the mean of the lognormal dataset

$x_{..} = -118.22$
$(x_{avg})_{..} = -4.73$
$n_i = 5$
p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	n_i	$f_iS_i^2$	$f_i\ln(S_i^2)$
0.296	0.088	-2.435	10	0.789	-21.9
0.246	0.060	-2.806	5	0.242	-11.2
0.067	0.005	-5.402	5	0.018	-21.6
0.090	0.008	-4.808	5	0.033	-19.2

$\sum(S_i^2) =$ 0.16 $\sum f_i\ln(S_i^2) =$ -74.0

Equality of Variance: Bartlett's Test

f = 21
$Sp^2 =$ 0.051
$\ln Sp^2 =$ -2.967
$c^2 =$ 11.677 (If $c^2 \le c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.815 at a 5% significance level with 3 degrees of freedom

NOTE: The variances are NOT equal. (i.e., $c^2 \le c^2_{crit}$)

Because variances are not equal, Statistical Test 3, Nonparametric ANOVA is performed.**

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

**Section 5.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Arsenic (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	**0.0109**	**0.00534**	**0.0222**	**0.00895**	0.0025
Jan-21	**0.0154**	**0.00832**	**0.0212**	**0.00939**	**0.00211**
Jul-21	**0.00806**	**0.00859**	**0.0284**	**0.00793**	0.0025
Jan-22	**0.0134**	**0.0106**	**0.0348**	**0.00838**	**0.00213**
Jul-22	**0.0111**	**0.0103**	**0.036**	**0.00827**	0.0025
Sum	0.1020		0.14260	0.04292	0.0117
n_i	10		5	5	5
$(x_i)_{avg}$	0.01020		0.02852	0.00858	0.0023

mg/L = milligrams per liter
BG = background
DL = detection limit
All data sets represent 1/2 DL values for nondetects.
Bolded values indicate a detected result.

Overall mean x.. = 0.01197

N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	0.30	x.. = the sum of the total number of samples

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Nonparametric ANOVA

Ranking of Observations

Sequence	Arsenic (mg/L)	Adjusted Rank	Tie Number
1	0	2	Tie
2	0	2	
3	0	2	
4	**0.00211**	4	
5	**0.00213**	5	
6	**0.00534**	6	
7	**0.00793**	7	
8	**0.00806**	8	
9	**0.00827**	9	
10	**0.00832**	10	
11	**0.00838**	11	
12	**0.00859**	12	
13	**0.00895**	13	
14	**0.00939**	14	
15	**0.0103**	15	
16	**0.0106**	16	
17	**0.0109**	17	
18	**0.0111**	18	
19	**0.0134**	19	
20	**0.0154**	20	
21	**0.0212**	21	
22	**0.0222**	22	
23	**0.0284**	23	
24	**0.0348**	24	
25	**0.036**	25	

mg/L = milligrams per liter
BG = background
DL = detection limit
Bolded values indicate a detected result.
NOTE: For this method, observations below the detection limit that are considered nondetects (i.e., U qualified data) are reported as a concentration of 0.

n_{tie}

3 Tie 1 = 24

$\sum T_i$ = 24

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Sums of Ranks and Averages

Arsenic (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	**0.0109**	**0.00534**	**0.0222**	**0.00895**	0
Jan-21	**0.0154**	**0.00832**	**0.0212**	**0.00939**	**0.00211**
Jul-21	**0.00806**	**0.00859**	**0.0284**	**0.00793**	0
Jan-22	**0.0134**	**0.0106**	**0.0348**	**0.00838**	**0.00213**
Jul-22	**0.0111**	**0.0103**	**0.036**	**0.00827**	0

Observation Ranks for Arsenic					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	17	6	22	13	2
Jan-21	20	10	21	14	4
Jul-21	8	12	23	7	2
Jan-22	19	16	24	11	5
Jul-22	18	15	25	9	2
R_i	141		115	54	15
$(R_i)_{avg}$	14.1		23.0	10.8	3.0
R_i^2/n_i	1988.1		2645.0	583.2	45.0

$\Sigma R_i^2/n_i$ = 5261.3

K = 4

N = 25

mg/L = milligrams per liter

BG = background

DL = detection limit

Bolded values indicate a detected result.

NOTE: For this method, observations below the detection limit that are considered nondetects (i.e., U qualified data) are reported as a concentration of 0.

K = the number of n_i groups

N = the total number of samples

Calculation of Kruskal-Wallis Statistic

H =	19.132	Kruskal-Wallis Statistic	$H = [12/N(N+1)*\Sigma R_i^2/n_i] - 3(N+1)$
H' =	19.161	Corrected Kruskal-Wallis	$H' = H/[1-(\sum T_i/N^3-N)]$
χ^2_{crit}* =	7.815	3	degrees of freedom at the 5% significance level

NOTE: $H' > \chi^2_{crit}$

If $H' \leq \chi^2_{crit}$, the data from each well come from the same continuous distribution and hence have the same median concentrations of a specific constituent.

If $H' > \chi^2_{crit}$, reject the null hypothesis and calculate the critical difference for well comparisons to the background.

K-1 =	3	α/(K-1) =	0.01667	Z(α/(K-1))** =	2.1280
α =	0.05	1-(α/K-1) =	0.983		

NOTE: *Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

**Table 4, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Calculate Critical Values

Average Background Ranking = 14.1

	Well No.	C_i	$(R_i)_{avg} - (R_b)_{avg}$	Conclusion
BG Well	MW93A			
BG Well	MW420			
	MW84A	8.578	8.9	**evidence of contamination**
	MW87A	8.578	-3.3	not contaminated
	MW90A	8.578	-11.1	not contaminated

mg/L = milligrams per liter
BG = background
DL = detection limit

CONCLUSION: If $(R_i)_{avg} - (R_b)_{avg} > C_i$, then there is evidence that the compliance well is contaminated.

If $(R_i)_{avg} - (R_b)_{avg} < C_i$ for wells, there is no evidence of a statistically significant difference between concentrations in downgradient compliance test wells and background wells.

Since $(R_i)_{avg} - (R_b)_{avg} > C_i$ for MW84A, there is a statistically significant difference between downgradient compliance test wells and background wells in MW84A from the C-404 Landfill.

Because nonparametric ANOVA indicated a statistically significant difference between compliance test wells and background wells at the C-404 Landfill in compliance well MW84A, the 95% UTL was performed.

Since $(R_i)_{avg} - (R_b)_{avg} < C_i$ for MW87A and MW90A, there is no statistically significant difference between background wells and these downgradient compliance test wells; however, the negative value indicates that background wells have elevated concentrations.

Section 5.2.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

95% Upper Tolerance Limit (UTL)

Compare the most recent downgradient sample results to a calculated 95% UTL using the five most recent sets of data for each upgradient well, as described below. If downgradient concentration is less than the UTL for the paired upgradient concentrations, then there is no confirmed exceedance.

July 2022 Data, Second Reporting Period
Arsenic Observations (mg/L)

Well No.						
MW93A	**0.01090**	**0.01540**	**0.00806**	**0.01340**	**0.01110**	**Upgradient Well[!]**
MW420	**0.00534**	**0.00832**	**0.00859**	**0.01060**	**0.01030**	**Upgradient Well[!]**
						Current Data
MW84A						**0.036**
	X: Mean Value =		0.0102			
	S: Standard Deviation =		0.0028			
	K* factor =		2.911	(for n = 10)		
	CV = S/X		0.2793	<1, assume normal distribution		
	Upper Tolerance Interval: TL = X +(KxS) =		**0.0185**	(mg/L)		

! = Data from previous 5 sampling events.
CV = coefficient of variation
* = Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Result: **MW84A exceeded the UTL, which is statistically significant evidence that this compliance well has elevated concentration with respect to background data.**

Because the 95% UTL indicated a statistically significant difference between compliance test wells and background wells at the C-404 Landfill in compliance well MW84A, the paired ANOVA was performed.

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Paired (Parametric) ANOVA - MW93A and MW84A

Evaluate results using paired ANOVA of wells in the same direction relative to the landfill [e.g., compare upgradient westernmost well results to downgradient westernmost well results]. If ANOVA does not identify a statistically significant difference between upgradient and downgradient wells, then the results are consistent with the historical ASD.

Arsenic (mg/L)				
Date	Background	Compliance		
	MW93A	MW84A	n_i^2	
Jul-20	**0.0109**	**0.0222**	0.00012	0.00049
Jan-21	**0.0154**	**0.0212**	0.00024	0.00045
Jul-21	**0.00806**	**0.0284**	0.00006	0.00081
Jan-22	**0.0134**	**0.0348**	0.00018	0.00121
Jul-22	**0.0111**	**0.036**	0.00012	0.00130
Sum (x_i)	0.0589	0.1426	0.20146	Total Sum (x..)
n_i	5	5		
$(x_i)_{avg}$	0.0118	0.0285		
$(x_i)^2$	0.0035	0.0203		

mg/L = milligrams per liter
Bolded values indicate a detected result.

Overall mean x.. =	0.0201	
N =	10	N = the total number of samples
p =	2	p = the number of n_i groups
$x_{..}$ =	0.2015	x.. = the sum of the total number of samples

Determine Normality of Dataset

Coefficient of Variability Test

Table of Residuals ($x_i - x_{iavg}$)

Date	Background	Compliance
	MW93A	MW84A
Jul-20	-0.0009	-0.0063
Jan-21	0.0036	-0.0073
Jul-21	-0.0037	-0.0001
Jan-22	0.0016	0.0063
Jul-22	-0.0007	0.0075

X: Mean Value =	-8.67E-19	
S: Standard Deviation =	0.005	
K* Factor =	2.911	(for n = 10)
CV = S/X =	–5.70E+15	<1, data are normally distributed

Data are normally distributed (i.e.,<1)

*Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

If the coefficient of variation is < 1, the data are normally distributed.
If the coefficient of variation is > or = 1, data are not normally distributed.

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Determine Equality of Variance of Dataset

p = number of wells	$x_{..} =$ 0.2015
n_i = number of data points per well	$(x_{avg})_{..} =$ 0.0201
N = total sample size	$n_i =$ 5
S^2 = the square of the standard deviation	p = 2
$\ln(S_i^2)$ = natural logarithm of each variance	N = 10
f = total sample size minus the number of wells (groups)	f_i = 4
$f_i = n_i - 1$	

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$†	n_i	$f_i S_i^2$	$f_i \ln(S_i^2)$†
0.0028	0.0000	-11.774	5	0	-47.1
0.0069	0.0000	-9.960	5	0	-39.8

$\sum(S_i^2) =$ 0 $\sum f_i \ln(S_i^2) =$ -87

Equality of Variance: Bartlett's Test

f =	8	
Sp^2 =	0.0000	
ln Sp^2 =	-10.503	
χ^2 =	2.918	(If calculated $\chi^2 \leq$ tabulated χ^2_{crit}, then variances are equal at the given significance level).
χ^2_{crit} * =	3.841	at a 5% significance level with 1 degrees of freedom (p-1)

NOTE: The variances are equal. (i.e., calculated $\chi^2 \leq \chi^2_{crit}$)

Since calculated $\chi^2 \leq \chi^2_{crit}$, then the analysis can proceed as normal.

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Between Well Sum of Squares

Source of Variation	Sums of Squares		Degrees of Freedom	Mean Squares	Calculated F	F Statistic**
Between Wells	SS_{wells} =	0.0007	1	0.00070	25.53	5.32
Error	SS_{Error} =	0.0002	8	0.00003		
Total	SS_{Total} =	0.0009	9			

If calculated F > F statistic, then reject the hypothesis of equal well means. If calculated F is less than or equal to F statistic, it can be concluded that there is no significant difference between concentrations; therefore, there is no evidence of well contamination.

CONCLUSION: **Calculated F > F statistic; therefore, ANOVA has identified a significant difference between upgradient and downgradient wells.**

Because the paired ANOVA for the two wells indicated a statistically significant difference between compliance test wells and background wells at the C-404 Landfill in compliance well MW84A, a Mann-Kendall statistical analysis was performed.

**Table 2, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989). F statistic taken at the 5% significance level.

Mann-Kendall Trend Test Analysis
MW84A Arsenic July 2022

User Selected Options	
Date/Time of Computation	ProUCL 5.19/20/2022 1:54:52 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

MW84A_As_Jul22

Input Data

Date Collected	Result (µg/L)
Jan-19	**27.5**
Jul-19	**16.8**
Jan-20	**20.2**
Jul-20	**22.2**
Jan-21	**21.2**
Jul-21	**28.4**
Jan-22	**34.8**
Jul-22	**36.0**

Bolded values indicate a detected result.

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	8
Number Values Reported (n)	8
Minimum	16.8
Maximum	36
Mean	25.89
Geometric Mean	25.07
Median	24.85
Standard Deviation	6.981
Coefficient of Variation	0.27

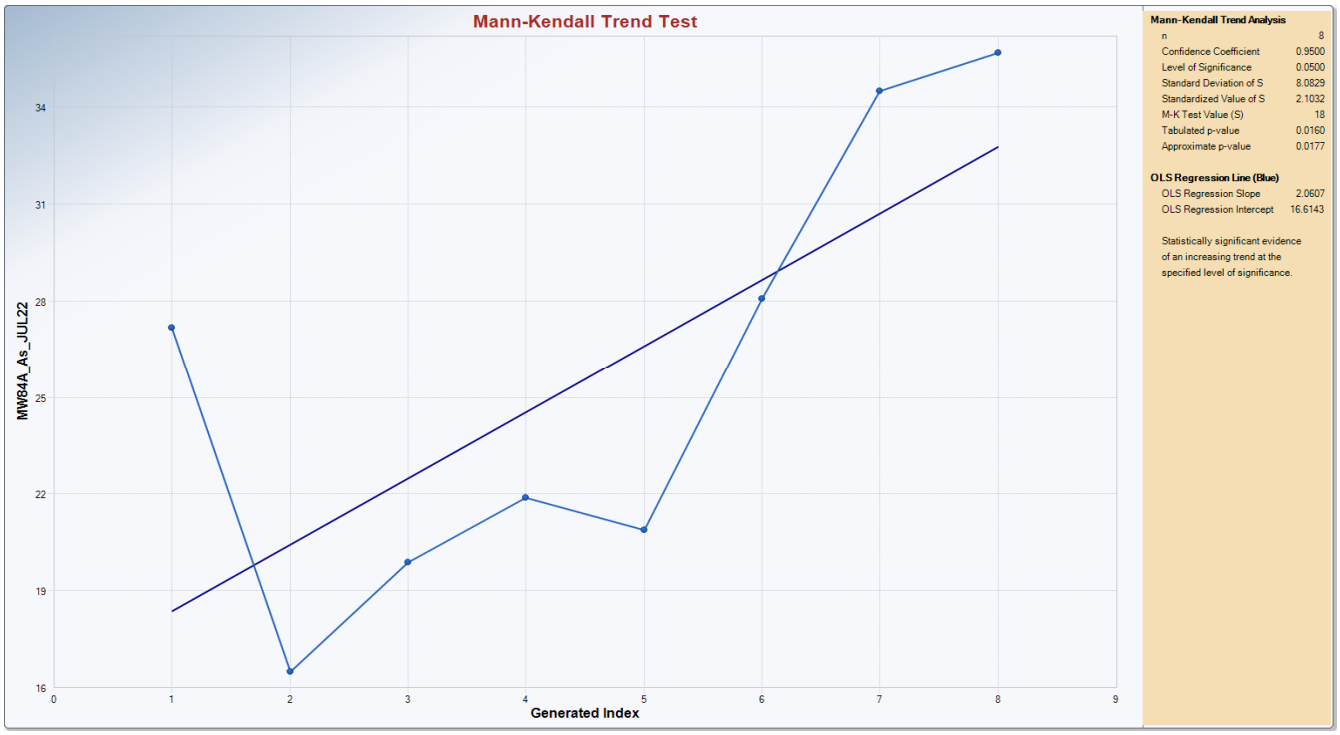
Mann-Kendall Test

M-K Test Value (S)	18
Tabulated p-value	0.016
Standard Deviation of S	8.083
Standardized Value of S	2.103
Approximate p-value	0.0177

Statistically significant evidence of an increasing trend at the specified level of significance.

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Mann-Kendall Trend Test Analysis
MW84A Arsenic July 2022



ATTACHMENT B2

CHROMIUM
STATISTICAL TEST 2

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Attachment B2: Chromium URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Chromium (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	0.005	0.005	0.005	0.005	0.005
Jan-21	**0.00338**	0.005	0.005	0.005	0.005
Jul-21	0.005	0.005	0.005	0.005	0.005
Jan-22	**0.00777**	0.005	0.005	0.005	0.005
Jul-22	**0.00527**	0.005	0.005	0.005	0.005

mg/L = milligrams per liter
BG = background
DL = detection limit
All data sets represent 1/2 DL values for nondetects.
Bolded values indicate a detected result.

[!] **Test of Proportions**

Calculate the number of detections in background wells vs. compliance wells.

X =	3	X = number of samples above DL in background wells
Y =	0	Y = number of samples above DL in compliance wells
n_b =	10	n_b = count of background well results/samples analyzed
n_c =	15	n_c = count of compliance well results/samples analyzed
n =	25	n = total number of samples

P =	0.120	P = (x+y)/n
nP =	3	$n = n_b+n_c$
n(1-P) =	22	

NOTE: If nP and n(1-P) are both >= 5, then the normal approximation may be used; however, because nP < 5 and/or n(1-P) < 5, the test was continued to determine if the conclusion, along with a simple evaluation of the data would be similar.

P_b =	0.300	P_b = proportion of detects in background wells
P_c =	0.000	P_c = proportion of detects in compliance wells
S_D =	0.133	S_D = standard error of difference in proportions
Z =	2.261	$Z = (P_b-P_c)/S_D$
absolute value of Z =	2.261	

If the absolute value of Z exceeds the 97.5th percentile value of 1.96 from the standard normal distribution, this provides statistically significant evidence at the 5% significance level that the proportion of detects in one group of data exceeds the proportion of detects in the other group.

CONCLUSION: **Because the absolute value of Z greater than 1.96, there is statistical evidence that the proportion of samples with detected results differs between the background well and compliance well samples. Non-parametric ANOVA was performed.**

[!] Section 8.1.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* (EPA 1989).

Attachment B2: Chromium URGA, Statistical Test Statistical Test 2, Test of Proportions
Second Reporting Period 2022

Nonparametric ANOVA

Ranking of Observations

Sequence	Chromium (mg/L)	Adjusted Rank	Tie Number
1	0	11.5	
2	0	11.5	
3	0	11.5	
4	**0**	11.5	
5	**0**	11.5	
6	**0**	11.5	
7	**0**	11.5	
8	**0**	11.5	
9	**0**	11.5	
10	**0**	11.5	
11	**0**	11.5	Tie
12	**0**	11.5	
13	**0**	11.5	
14	**0**	11.5	
15	**0**	11.5	
16	**0**	11.5	
17	**0**	11.5	
18	**0**	11.5	
19	**0**	11.5	
20	**0**	11.5	
21	**0**	11.5	
22	**0**	11.5	
23	**0.00338**	23	
24	**0.00527**	24	
25	**0.00777**	25	

mg/L = milligrams per liter
BG = background
DL = detection limit
Bolded values indicate a detected result.
NOTE: For this method, observations below the detection limit that are considered nondetects (i.e., U qualified data) are reported as a concentration of 0.

n_{tie}

22 Tie 1 = 10626

$\sum T_i$ = 10626

Attachment B2: Chromium URGA, Statistical Test Statistical Test 2, Test of Proportions
Second Reporting Period 2022

Sums of Ranks and Averages

Chromium (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	0	0	0	0	0
Jan-21	**0.00338**	0	0	0	0
Jul-21	0	0	0	0	0
Jan-22	**0.00777**	0	0	0	0
Jul-22	**0.00527**	0	0	0	0

Observation Ranks for Chromium					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	11.5	11.5	11.5	11.5	11.5
Jan-21	23	11.5	11.5	11.5	11.5
Jul-21	11.5	11.5	11.5	11.5	11.5
Jan-22	25	11.5	11.5	11.5	11.5
Jul-22	24	11.5	11.5	11.5	11.5
R_i	152.5		57.5	57.5	57.5
$(R_i)_{avg}$	15.3		11.5	11.5	11.5
R_i^2/n_i	2325.6		661.3	661.3	661.3

$\Sigma R_i^2/n_i$ = 4309.4

K = 4

N = 25

mg/L = milligrams per liter

BG = background

DL = detection limit

K = the number of n_i groups

N = the total number of samples

Bolded values indicate a detected result.

NOTE: For this method, observations below the detection limit that are considered nondetects (i.e., U qualified data) are reported as a concentration of 0.

Calculation of Kruskal-Wallis Statistic

H = 1.558 Kruskal-Wallis Statistic $H = [12/N(N+1)*\Sigma R_i^2/n_i] - 3(N+1)$

H' = 4.885 Corrected Kruskal-Wallis $H' = H/[1-(\sum T_i/N^3-N)]$

χ^2_{crit}* = 7.815 3 degrees of freedom at the 5% significance level

NOTE: $H' < \chi^2_{crit}$

If $H' \leq \chi^2_{crit}$, the data from each well come from the same continuous distribution and hence have the same median concentrations of a specific constituent.

If $H' > \chi^2_{crit}$, reject the null hypothesis and calculate the critical difference for well comparisons to the background.

K-1 = 3 $\alpha/(K-1)$ = 0.01667 $Z(\alpha/(K-1))$** = 2.1280

α = 0.05 $1-(\alpha/K-1)$ = 0.983

NOTE: *Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

**Table 4, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B2: Chromium URGA, Statistical Test Statistical Test 2, Test of Proportions
Second Reporting Period 2022

Calculate Critical Values

Average Background Ranking = 15.3

	Well No.	C_i	$(R_i)_{avg} - (R_b)_{avg}$	Conclusion
BG Well	MW93A			
BG Well	MW420			
	MW84A	8.578	-3.8	not contaminated
	MW87A	8.578	-3.8	not contaminated
	MW90A	8.578	-3.8	not contaminated

mg/L = milligrams per liter
BG = background
DL = detection limit

CONCLUSION: If $(R_i)_{avg} - (R_b)_{avg} > C_i$, then there is evidence that the compliance well is contaminated.

If $(R_i)_{avg} - (R_b)_{avg} < C_i$ for wells, there is no evidence of a statistically significant difference between concentrations in downgradient compliance test wells and background wells.

Since $(R_i)_{avg} - (R_b)_{avg} < C_i$ for MW84A, MW87A, and MW90A, there is no statistically significant difference between background wells and these downgradient compliance test wells; however, the negative value indicates that background wells have elevated concentrations.

Section 5.2.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

ATTACHMENT B3

TECHNETIUM-99
STATISTICAL TEST 2

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Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Technetium-99 (pCi/L)					
Date	**Background**	**Background**	**Compliance**	**Compliance**	**Compliance**
	MW93A	**MW420**	**MW84A**	**MW87A**	**MW90A**
Jul-21	**20.5**	5.3	**229**	5.75	**24.3**
Nov-21	9.25	9.4	**258**	9.1	9.05
Jan-22	10.45	9.65	**225**	10	9.55
May-22	7.95	7.95	**47.9**	6	**34.4**
Jul-Aug-22	7.85	7.25	**47.2**	6.7	**25.7**

pCi/L = picocuries per liter
BG = background
DL = detection limit
Nondetect values are 1/2 DL.
Bolded values indicate a detected result.

[!] **Test of Proportions**

Calculate the number of detections in background wells vs. compliance wells.

X =	1	X = number of samples above DL in background wells
Y =	8	Y = number of samples above DL in compliance wells
n_b =	10	n_b = count of background well results/samples analyzed
n_c =	15	n_c = count of compliance well results/samples analyzed
n =	25	n = total number of samples

P =	0.360	P=(x+y)/n
nP =	9	$n=n_b+n_c$
n(1-P) =	16	

NOTE: If nP and n(1-P) are both >= 5, then the normal approximation may be used.

P_b =	0.100	P_b = proportion of detects in background wells
P_c =	0.533	P_c = proportion of detects in compliance wells
S_D =	0.196	S_D = standard error of difference in proportions
Z =	-2.211	$Z = (P_b-P_c)/S_D$
absolute value of Z =	2.211	

If the absolute value of Z exceeds the 97.5th percentile value of 1.96 from the standard normal distribution, this provides statistically significant evidence at the 5% significance level that the proportion of detects in one group of data exceeds the proportion of detects in the other group.

CONCLUSION: Because the absolute value of Z is greater than 1.96, Nonparameteric ANOVA was performed.

[!] Section 8.1.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* (EPA 1989).

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Technetium-99 (pCi/L)					
Date	**Background**	**Background**	**Compliance**	**Compliance**	**Compliance**
	MW93A	**MW420**	**MW84A**	**MW87A**	**MW90A**
Jul-21	**20.5**	5.3	**229**	5.75	**24.3**
Nov-21	9.25	9.4	**258**	9.1	9.05
Jan-22	10.45	9.65	**225**	10	9.55
May-22	7.95	7.95	**47.9**	6	**34.4**
Jul-Aug-22	7.85	7.25	**47.2**	6.7	**25.7**
Sum	95.5500		807.10000	37.55000	103.0000
n_i	10		5	5	5
$(x_i)_{avg}$	9.55500		161.42000	7.51000	20.6000

pCi/L = picocuries per liter
BG = background
DL = detection limit
All data sets represent 1/2 DL values for nondetects.
Bolded values indicate a detected result.

Overall mean x.. = 41.72800

N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	1043.20	x.. = the sum of the total number of samples

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Nonparametric ANOVA

Ranking of Observations

Sequence	Technetium-99 (pCi/L)	Adjusted Rank	Tie Number
1	**0**	8.5	Tie 1
2	**0**	8.5	
3	**0**	8.5	
4	**0**	8.5	
5	**0**	8.5	
6	**0**	8.5	
7	**0**	8.5	
8	**0**	8.5	
9	**0**	8.5	
10	**0**	8.5	
11	**0**	8.5	
12	**0**	8.5	
13	**0**	8.5	
14	**0**	8.5	
15	**0**	8.5	
16	**0**	8.5	
17	**20.5**	17	
18	**24.3**	18	
19	**25.7**	19	
20	**34.4**	20	
21	**47.2**	21	
22	**47.9**	22	
23	**225**	23	
24	**229**	24	
25	**258**	25	

pCi/L = picocuries per liter
BG = background
DL = detection limit
Bolded values indicate a detected result.
NOTE: For this method, observations below the detection limit that are considered nondetects (i.e., U qualified data) are reported as a concentration of 0.

n_{tie}		
16	Tie 1 =	4080
	$\sum T_i$ =	4080

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Sums of Ranks and Averages

Technetium-99 (pCi/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-21	**20.5**	0	**229**	0	**24.3**
Nov-21	0	0	**258**	0	0
Jan-22	0	0	**225**	0	0
May-22	0	0	**47.9**	0	**34.4**
Jul-Aug-22	0	0	**47.2**	0	**25.7**

Observation Ranks for Technetium-99					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-21	17	8.5	24	8.5	18
Nov-21	8.5	8.5	25	8.5	8.5
Jan-22	8.5	8.5	23	8.5	8.5
May-22	8.5	8.5	22	8.5	20
Jul-Aug-22	8.5	8.5	21	8.5	19
R_i	93.5		115	42.5	74
$(R_i)_{avg}$	9.4		23.0	8.5	14.8
R_i^2/n_i	874.2		2645.0	361.3	1095.2

$\Sigma R_i^2/n_i$ = 4975.7

pCi/L = picocuries per liter
BG = background
DL = detection limit
Bolded values indicate a detected result.

K = 4
N = 25

K = the number of n_i groups
N = the total number of samples

NOTE: For this method, observations below the detection limit that are considered nondetects (i.e., U qualified data) are reported as a concentration of 0.

Calculation of Kruskal-Wallis Statistic

H = 13.859 Kruskal-Wallis Statistic $H = [12/N(N+1)*\Sigma R_i^2/n_i] - 3(N+1)$

H' = 18.767 Corrected Kruskal-Wallis $H' = H/[1-(\sum T_i/N^3-N)]$

χ^2_{crit}* = 7.815 3 degrees of freedom at the 5% significance level

NOTE: $H' > \chi^2_{crit}$

If $H' \leq \chi^2_{crit}$, the data from each well come from the same continuous distribution and hence have the same median concentrations of a specific constituent.

If $H' > \chi^2_{crit}$, reject the null hypothesis and calculate the critical difference for well comparisons to the background.

K-1 = 3 $\alpha/(K-1)$ = 0.01667 $Z(\alpha/(K-1))$** = 2.1280

α = 0.05 $1-(\alpha/K-1)$ = 0.983

NOTE: *Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).
**Table 4, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Calculate Critical Values

Average Background Ranking = 9.4

	Well No.	C_i	$(R_i)_{avg} - (R_b)_{avg}$	Conclusion
BG Well	MW93A			
BG Well	MW420			
	MW84A	8.578	13.7	**evidence of contamination**
	MW87A	8.578	-0.9	not contaminated
	MW90A	8.578	5.5	not contaminated

pCi/L = picocuries per liter
BG = background
DL = detection limit

CONCLUSION: If $(R_i)_{avg} - (R_b)_{avg} > C_i$, then there is evidence that the compliance well is contaminated.

If $(R_i)_{avg} - (R_b)_{avg} < C_i$ for wells, there is no evidence of a statistically significant difference between concentrations in downgradient compliance test wells and background wells.

Since $(R_i)_{avg} - (R_b)_{avg} > C_i$ for MW84A, there is a statistically significant difference between downgradient compliance test wells and background wells in MW84A from the C-404 Landfill.

Because nonparametric ANOVA indicated a statistically significant difference between compliance test wells and background wells at the C-404 Landfill in compliance well MW84A, the 95% UTL was performed.

Since $(R_i)_{avg} - (R_b)_{avg} < C_i$ for MW87A and MW90A, there is no statistically significant difference between background wells and these downgradient compliance test wells.

Section 5.2.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

95% Upper Tolerance Limit (UTL)

Compare the most recent downgradient sample results to a calculated 95% UTL using the five most recent sets of data for each upgradient well, as described below. If downgradient concentration is less than the UTL for the paired upgradient concentrations, then there is no confirmed exceedance.

July-August 2022 Data, Second Reporting Period
Technetium-99 Observations (pCi/L)

Well No.						
MW93A	**20.5**	**9.25**	**10.45**	**7.95**	**7.85**	**Upgradient Well[!]**
MW420	**5.3**	**9.4**	**9.65**	**7.95**	**7.25**	**Upgradient Well[!]**
						Current Data
MW84A						**47.2**
	X: Mean Value =		10			
	S: Standard Deviation =		4			
	K* factor =		2.911	(for n = 10)		
	CV = S/X		0.4304	<1, assume normal distribution		
	Upper Tolerance Interval: TL = X +(KxS) =			**22**	(pCi/L)	

! = Data from previous 5 sampling events.
Nondetect values are 1/2 DL.
CV = coefficient of variation
* = Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Result: **MW84A exceeded the UTL, which is statistically significant evidence that this compliance well has elevated concentration with respect to background data.**

Because the 95% UTL indicated a statistically significant difference between compliance test wells and background wells at the C-404 Landfill in compliance wells MW84A, the paired (parametric) ANOVA was performed.

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Paired (Parametric) ANOVA - MW93A and MW84A

Evaluate results using paired ANOVA of wells in the same direction relative to the landfill [e.g., compare upgradient westernmost well results to downgradient westernmost well results]. If ANOVA does not identify a statistically significant difference between upgradient and downgradient wells, then the results are consistent with the historical ASD.

Technetium-99 (pCi/L)				
Date	Background	Compliance		
	MW93A	MW84A	n_i^2	
Jul-21	**20.5**	**229**	420	52441
Nov-21	9.25	**258**	86	66564
Jan-22	10.45	**225**	109	50625
May-22	7.95	**47.9**	63	2294
Jul-Aug-22	7.85	**47.2**	62	2228
Sum (x_i)	56	807	863	Total Sum (x..)
n_i	5	5		
$(x_i)_{avg}$	11	161		
$(x_i)^2$	3136	651410		

pCi/L = picocuries per liter
Nondetect values are 1/2 DL.
Bolded values indicate a detected result.

Overall mean x.. =	86	
N =	10	N = the total number of samples
p =	2	p = the number of n_i groups
$x_{..} =$	863	x.. = the sum of the total number of samples

Determine Normality of Dataset

Coefficient of Variability Test

Table of Residuals ($x_i - x_{iavg}$)

Date	Background	Compliance
	MW93A	MW84A
Jul-21	9	68
Nov-21	-2	97
Jan-22	-1	64
May-22	-3	-114
Jul-Aug-22	-3	-114

X: Mean Value =	0.00E+00	
S: Standard Deviation =	70	
K* Factor =	2.911	(for n = 10)
CV = S/X =	#ΔIç/0!	#DIV/0!

†The Coefficient of Variability Test was not performed due to mean = 0 (i.e., division by 0 not possible).

*Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

If the coefficient of variation is < 1, the data are normally distributed.
If the coefficient of variation is > or = 1, data are not normally distributed.

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Determine Equality of Variance of Dataset

p = number of wells	$x_{..} =$ 863
n_i = number of data points per well	$(x_{avg})_{..} =$ 86
N = total sample size	$n_i =$ 5
S^2 = the square of the standard deviation	p = 2
$\ln(S_i^2)$ = natural logarithm of each variance	N = 10
f = total sample size minus the number of wells (group	f_i = 4
$f_i = n_i - 1$	

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$†	n_i	$f_iS_i^2$	$f_i\ln(S_i^2)$†
5	28	3.338	5	113	13.4
105	10968	9.303	5	43870	37.2

$\sum(S_i^2) =$ 10,996 $\sum f_i\ln(S_i^2) =$ 51

Equality of Variance: Bartlett's Test

f =	8	
Sp^2 =	5498	
ln Sp^2 =	8.612	
χ^2 =	18.335	(If calculated $\chi^2 \leq$ tabulated χ^2_{crit}, then variances are equal at the given significance level).
χ^2_{crit} * =	3.841	at a 5% significance level v 1 degrees of freedom (p-1)

NOTE: The variances are NOT equal. (i.e., calculated $\chi^2 > \chi^2_{crit}$)

Variances are not equal, transform the original data to lognormal (i.e., since calculated $\chi^2 > \chi^2_{crit}$).

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Paired (Parametric) ANOVA—Lognormal Data

ln[Technetium-99 (pCi/L)]				
Date	Background	Compliance		
	MW93A	MW84A	n_i^2	
Jul-21	**3.02**	**5.43**	9.12	29.53
Nov-21	2.22	**5.55**	4.95	30.84
Jan-22	2.35	**5.42**	5.51	29.33
May-22	2.07	**3.87**	4.30	14.97
Jul-Aug-22	2.06	**3.85**	4.25	14.86
Sum (x_i)	11.73	24.13	35.85	Total Sum (x..)
n_i	5	5		
$(x_i)_{avg}$	2.35	4.83		
$(x_i)^2$	137.48	582.08		

pCi/L = picocuries per liter **Bolded values indicate a detected result.**

Overall mean x.. =	3.59	
N =	10	N = the total number of samples
p =	2	p = the number of n_i groups
$x_{..}$ =	35.85	x.. = the sum of the total number of samples

Determine Normality of Dataset

Coefficient of Variability Test—Lognormal Data

Table of Residuals (x_i-$x_i$avg) for Lognormal Data

Date	Background	Compliance
	MW93A	MW84A
Jul-21	0.68	0.61
Nov-21	-0.12	0.73
Jan-22	0.00	0.59
May-22	-0.27	-0.96
Jul-Aug-22	-0.28	-0.97

X: Mean Value =	-8.88E-17	
S: Standard Deviation =	0.64	
K* Factor =	2.911	(for n = 10)
CV = S/X =	–7.25E+15	<1, data are normally distributed

Data are normally distributed (i.e., < or =1)

*Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

If the coefficient of variation is < 1, the residuals are normally distributed.
If the coefficient of variation is > or = 1, the residuals are not normally distributed.

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Determine Equality of Variance—Lognormal Data

p = number of wells	$x_{..} =$ 35.85
n_i = number of data points per well	$(x_{avg})_{..} =$ 3.59
N = total sample size	$n_{i} =$ 5
S^2 = the square of the standard deviation	p = 2
$\ln(S_i^2)$ = natural logarithm of each variance	N = 10
f = total sample size minus the number of wells (group	f_i = 4
$f_i = n_i - 1$	

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	n_i	$f_iS_i^2$	$f_i\ln(S_i^2)$
0.40	0.16	-1.86	5	0.63	-7.4
0.88	0.78	-0.25	5	3.11	-1.0

$\sum(S_i^2)$ = 0.93 $\sum f_i\ln(S_i^2)$ = -8.43

Equality of Variance: Bartlett's Test

f =	8	
Sp^2 =	0.47	
ln Sp^2 =	-0.76	
χ^2 =	2.33	(If calculated $\chi^2 \leq$ tabulated χ^2_{crit}, then variances are equal at the given significance level).
χ^2_{crit} * =	3.841	at a 5% significance level v 1 degrees of freedom (p-1)

NOTE: The variances are equal. (i.e., calculated $\chi^2 \leq \chi^2_{crit}$)

Since calculated $\chi^2 \leq \chi^2_{crit}$, then the analysis can proceed as normal.

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

**Section 5.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Between Well Sum of Squares

Source of Variation	Sums of Squares		Degrees of Freedom	Mean Squares	Calculated F	F Statistic**
Between Wells	SS_{wells} =	15.38	1	15.38	32.97	5.32
Error	SS_{Error} =	3.73	8	0.47		
Total	SS_{Total} =	19.11	9			

If calculated F > F statistic, then reject the hypothesis of equal well means. If calculated F is less than or equal to F statistic, it can be concluded that there is no significant difference between concentrations; therefore, there is no evidence of well contamination.

CONCLUSION: **Calculated F > F statistic; therefore, ANOVA has identified a significant difference between background and downgradient wells.**

Because the paired ANOVA for the two wells indicated a statistically significant difference between compliance test wells and background wells at the C-404 Landfill in compliance well MW84A, a Mann-Kendall statistical analysis was performed.

**Table 2, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989). F statistic taken at the 5% significance level.

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Mann-Kendall Trend Analysis for Technetium-99 in MW84A

Input Data

Date Collected	Result (pCi/L)
Jan-20	**297**
Jul-20	**332**
Jan-21	**353**
Jul-21	**229**
Nov-21	**258**
Jan-22	**225**
May-22	**47.9**
Jul-22	**47.2**

Bolded values indicatet a detected result.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.19/26/2022 2:39:52 PM
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

MW84A_Tc-99_July2022

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	8
Number Values Reported (n)	8
Minimum	47.2
Maximum	353
Mean	223.6
Geometric Mean	178.8
Median	243.5
Standard Deviation	117.8
Coefficient of Variation	0.527

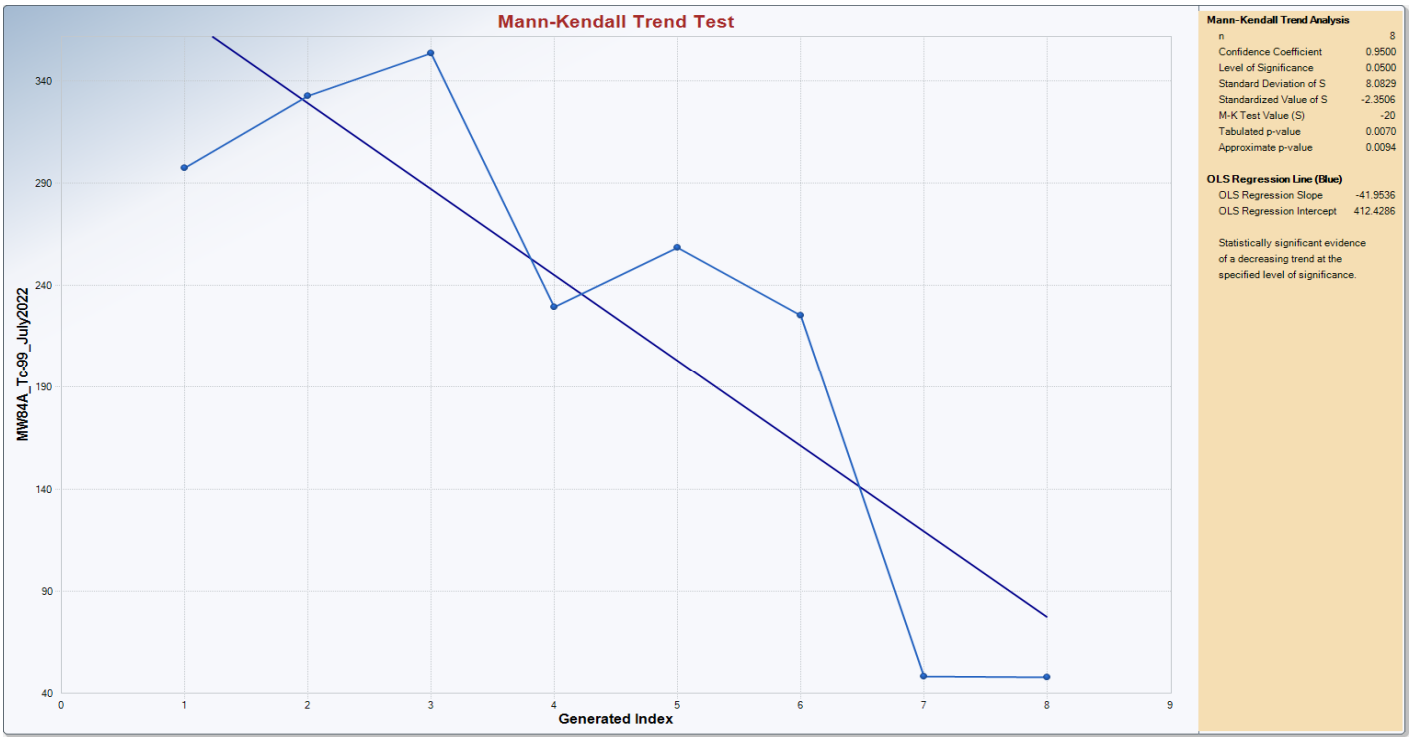
Mann-Kendall Test

M-K Test Value (S)	-20
Tabulated p-value	0.007
Standard Deviation of S	8.083
Standardized Value of S	-2.351
Approximate p-value	0.00937

Statistically significant evidence of a decreasing trend at the specified level of significance.

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Mann-Kendall Trend Analysis for Technetium-99 in MW84A



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ATTACHMENT B4

TRICHLOROETHENE
STATISTICAL TEST 4

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Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Trichloroethene (TCE, µg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	**2220**	**1340**	**3230**	**3090**	**52**
Jan-21	**3120**	**1690**	**2630**	**2570**	**99.6**
Jul-21	**3170**	**1790**	**5290**	**2410**	**148**
Jan-22	**2550**	**2100**	**6560**	**1890**	**146**
Jul-Aug-22	**1630**	**1620**	**6570**	**1400**	**222**
n_i	10		5	5	5
Sum	21230		24280	11360	667.60
(x_i)avg	2123.00		4856.00	2272.00	133.52

µg/L = micrograms per liter
Bolded values indicate a detected result.

Overall mean x.. =	2301.50	
N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	57537.60	x.. = the sum of the total number of samples

Determine Normality of Dataset

Coefficient of Variability Test

Table of Residuals

Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	97.00	-783.00	-1626.00	818.00	-81.52
Jan-21	997.00	-433.00	-2226.00	298.00	-33.92
Jul-21	1047.00	-333.00	434.00	138.00	14.48
Jan-22	427.00	-23.00	1704.00	-382.00	12.48
Jul-Aug-22	-493.00	-503.00	1714.00	-872.00	88.48

X: Mean Value =	0.00E+00	
S: Standard Deviation =	890.2	
K* Factor =	2.292	(for n = 25)
CV = S/X =	#DIV/0!	

The Coefficient of Variability Test was not performed due to mean = 0 (i.e., division by 0 not possible).
*K factor [from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

If the coefficient of variation is < 1, the data are normally distributed.
If the coefficient of variation is > or = 1, data are not normally distributed.

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Determine Equality of Variance of Dataset

p = number of well groups
n_i = number of data points per well
N = total sample size
S^2 = the square of the standard deviation
$\ln(S_i^2)$ = natural logarithm of each variance
f = total sample size minus the number of wells (groups)
$f_i = n_i - 1$
x.. = the sum of the total number of samples
$(x_{avg})_{..} =$ the mean of the total number of samples

$x_{..} =$ 57537.60
$(x_{avg})_{..} =$ 2301.50
p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	n_i	$f_i S_i^2$	$f_i \ln(S_i^2)$
640.313	410001.11	12.924	10	3690010.0	116.3
1845.855	3407180.00	15.041	5	13628720.000	60.2
648.706	420820.00	12.950	5	1683280.000	51.8
63.226	3997.55	8.293	5	15990.208	33.2

$\sum(S_i^2) =$ 4241998.66 $\sum f_i \ln(S_i^2) =$ 261.5

Equality of Variance: Bartlett's Test

f = 21
$Sp^2 =$ 905619.058
$\ln Sp^2 =$ 13.716
$c^2 =$ 26.589 (If $c^2 \leq c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.815 at a 5% significance level with 3 degrees of freedom

NOTE: The variances are NOT equal. (i.e., $c^2 > c^2_{crit}$)

Variances are not equal, transform the original data to lognormal (i.e., since $c^2 > c^2_{crit}$).

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Lognormal Data for TCE

ln[TCE (µg/L)]					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	7.71	7.20	8.08	8.04	3.95
Jan-21	8.05	7.43	7.87	7.85	4.60
Jul-21	8.06	7.49	8.57	7.79	5.00
Jan-22	7.84	7.65	8.79	7.54	4.98
Jul-Aug-22	7.40	7.39	8.79	7.24	5.40
Mean x_i	7.81	7.43	8.42	7.69	4.79
Background Mean	7.62		NA	NA	NA
Grand Mean	7.23				
x_i^2	59.37	51.85	65.29	64.58	15.61
	64.73	55.24	62.01	61.65	21.17
These values needed for ANOVA	64.99	56.10	73.51	60.64	24.97
	61.53	58.52	77.24	56.92	24.84
	54.71	54.61	77.27	52.48	29.19
Sum x_i^2	1349				

µg/L = micrograms per liter

Determine Normality of Dataset

Coefficient of Variability Test

Table of ln[TCE (µg/L)] Data

Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	7.71	7.20	8.08	8.04	3.95
Jan-21	8.05	7.43	7.87	7.85	4.60
Jul-21	8.06	7.49	8.57	7.79	5.00
Jan-22	7.84	7.65	8.79	7.54	4.98
Jul-Aug-22	7.40	7.39	8.79	7.24	5.40

X: Mean Value =	7.23E+00	
S: Standard Deviation =	1.33	
K* Factor =	2.292	(for n = 25)
CV = S/X =	1.84E-01	<1, data are normally distributed

Data are normally distributed (i.e.,<1)

*K factor [from Table 5, Appendix B of *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Determine Equality of Variance of Dataset for Lognormal Data

p = number of wells (background wells considered as one group)
n_i = number of data points per well
N = total sample size
S^2 = the square of the standard deviation
$\ln(S_i^2)$ = natural logarithm of each variance
f = total sample size minus the number of wells (groups)
$f_i = n_i - 1$
x.. = the sum of the total lognormal dataset
$(x_{avg})_{..} =$ the mean of the lognormal dataset

$x_{..} =$ 180.72
$(x_{avg})_{..} =$ 7.23
$n_i =$ 5
p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	ni	$f_iS_i^2$	$f_i\ln(S_i^2)$
0.292	0.085	-2.465	10	0.765	-22.2
0.421	0.177	-1.730	5	0.709	-6.9
0.306	0.094	-2.367	5	0.375	-9.5
0.547	0.299	-1.208	5	1.195	-4.8

$\sum(S_i^2) =$ 0.65 $\sum f_i\ln(S_i^2) =$ -43.4

Equality of Variance: Bartlett's Test

f = 21
$Sp^2 =$ 0.145
$\ln Sp^2 =$ -1.931
$c^2 =$ 2.848 (If $c^2 \le c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.815 at a 5% significance level with 3 degrees of freedom

NOTE: The variances are equal. (i.e., $c^2 \le c^2_{crit}$)

Because variances are equal, the Parametric ANOVA for the lognormal dataset will proceed.

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

**Section 5.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989)].

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Parametric ANOVA

Between Well Sum of Squares[1]

Source of Variation	Sums of Squares	df	Mean Squares	$F_{calculated}$
Between Wells (SS wells)	39.54	3	13.180	90.90
Error within wells (SS error)	3.04	21	0.145	
Total (SS total)	42.58	24		

If $F_{calculated} > F_{tabulated}$, then reject the hypothesis of equal well means. If $F_{calculated}$ is less than or equal to $F_{tabulated}$, it can be concluded that there is no significant difference between concentrations, therefore, there is no evidence of well contamination.

$F_{tabulated} = 3.07$**

CONCLUSION: $F_{calculated} > F_{tabulated}$; therefore, evidence of well contamination. Additional comparisons must be made.

NOTE: ** Table 2, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* , USEPA, 1989. $F_{tabulated}$ taken at the 5% significance level.

Comparison of Compliance Wells to Background Wells (Bonferroni Test)

n_b =	10	N-p =	21	α =	0.05
$(x_b)_{avg}$ =	7.62	m =	3	1-α/m =	0.9833

n_b = total sample size of all background wells

$(x_b)_{avg}$ = average concentration from all background wells

Well No.	Well Mean	Differences of Avg.	Standard Error	Bonferroni's t[2]	D_i	Conclusion
	$(x_b)_{avg}$	$(x_i)_{avg}-(x_b)_{avg}$	SE_i	$t_{(N-p),(\alpha/m)}$		
MW93A						
MW420						
MW84A	8.42	0.80	0.21	2.27	0.47	**evidence of contamination**
MW87A	7.69	0.07	0.21	2.27	0.47	not contaminated
MW90A	4.79	-2.83	0.21	2.27	0.47	not contaminated

CONCLUSION: **If the "Differences of Averages" is greater than D_i, then the well is contaminated. After performing Bonferroni's t calculation, the following can be concluded: MW84A shows statistically significantly levels of contamination as compared background wells. MW87A and MW90A do not show statistically significant levels of contamination.**

[1]Section 5.2.1, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* , (EPA, 1989).

[2]Appendix B, Table 3 (EPA, 1989).

A 95% UTL comparison is performed.

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

95% Upper Tolerance Limit (UTL)

Compare the most recent downgradient sample results to a calculated 95% UTL using the five most recent sets of data for each upgradient well, as described below. If downgradient concentration is less than the UTL for the paired upgradient concentrations, then there is no confirmed exceedance.

July-August 2022 Data, Second Reporting Period
TCE Observations (µg/L)

Well No.						
MW93A	**2220**	**3120**	**3170**	**2550**	**1630**	**Upgradient Well!**
MW420	**1340**	**1690**	**1790**	**2100**	**1620**	**Upgradient Well!**
						Current Data
MW84A						**6570**
	X: Mean Value =		2123			
	S: Standard Deviation =		640			
	K* factor =		2.911	(for n = 10)		
	CV = S/X		0.3016	<1, assume normal distribution		
	Upper Tolerance Interval: TL = X +(KxS) =		**3987**	(µg/L)		

! = Data from previous 5 sampling events.
CV = coefficient of variation
* = Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Result: **MW84A exceeded the 95% UTL, which is statistically significant evidence that this compliance well has elevated TCE concentrations with respect to background data.**

Paired (Parametric) ANOVA - MW93A and MW84A

Evaluate results using paired ANOVA of wells in the same direction relative to the landfill [e.g., compare upgradient westernmost well results to downgradient westernmost well results]. If ANOVA does not identify a statistically significant difference between upgradient and downgradient wells, then the results are consistent with the historical ASD.

TCE (µg/L)				
Date	Background	Compliance		
	MW93A	MW84A	n_i^2	
Jul-20	**2220**	**3230**	4928400	10432900
Jan-21	**3120**	**2630**	9734400	6916900
Jul-21	**3170**	**5290**	10048900	27984100
Jan-22	**2550**	**6560**	6502500	43033600
Jul-Aug-22	**1630**	**6570**	2656900	43164900
Sum (x_i)	12690	24280	36970	Total Sum (x..)
n_i	5	5		
$(x_i)_{avg}$	2538	4856		
$(x_i)^2$	161036100	589518400		

µg/L = micrograms per liter
Bolded values indicate a detected result.

Overall mean x.. =	3697	
N =	10	N = the total number of samples
p =	2	p = the number of n_i groups
$x_{..=}$	36970	x.. = the sum of the total number of samples

Determine Normality of Dataset

Coefficient of Variability Test

Table of Residuals ($x_i - x_{iavg}$)

Date	Background	Compliance
	MW93A	MW84A
Jul-20	-318	-1626
Jan-21	582	-2226
Jul-21	632	434
Jan-22	12	1704
Jul-Aug-22	-908	1714

X: Mean Value =	0.00E+00	
S: Standard Deviation =	1304	
K* Factor =	2.911	(for n = 10)
CV = S/X =	#ΔIç/0!	#DIV/0!

†The Coefficient of Variability Test was not performed due to mean = 0 (i.e., division by 0 not possible).

*Table 5, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

If the coefficient of variation is < 1, the data are normally distributed.
If the coefficient of variation is > or = 1, data are not normally distributed.

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Determine Equality of Variance of Dataset

p = number of wells	$x_{..} =$ 36970
n_i = number of data points per well	$(x_{avg})_{..} =$ 3697
N = total sample size	$n_{i} =$ 5
S^2 = the square of the standard deviation	p = 2
$\ln(S_i^2)$ = natural logarithm of each variance	N = 10
f = total sample size minus the number of wells (groups)	f_i = 4
$f_i = n_i - 1$	

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$†	n_i	$f_iS_i^2$	$f_i\ln(S_i^2)$†
645	415970	12.938	5	1663880	51.8
1846	3407180	15.041	5	13628720	60.2

$\sum(S_i^2)$ = 3,823,150 $\sum f_i\ln(S_i^2)$ = 112

Equality of Variance: Bartlett's Test

f =	8	
Sp^2 =	1911575	
ln Sp^2 =	14.463	
χ^2 =	3.788	(If calculated $\chi^2 \leq$ tabulated χ^2_{crit}, then variances are equal at the given significance level).
χ^2_{crit} * =	3.841	at a 5% significance level with 1 degrees of freedom (p-1)

NOTE: The variances are equal. (i.e., calculated $\chi^2 \leq \chi^2_{crit}$)

Since calculated $\chi^2 \leq \chi^2_{crit}$, then the analysis can proceed as normal.

*Table 1, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989).

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Between Well Sum of Squares

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	Calculated F	F Statistic**
Between Wells	SS_{wells} = 13432810.00	1	13432810.0	7.03	5.32
Error	SS_{Error} = 15292600.00	8	1911575.0		
Total	SS_{Total} = 28725410.00	9			

If calculated F > F statistic, then reject the hypothesis of equal well means. If calculated F is less than or equal to F statistic, it can be concluded that there is no significant difference between concentrations; therefore, there is no evidence of well contamination.

CONCLUSION: **Calculated F > F statistic; therefore, ANOVA has identified a significant difference between upgradient and downgradient wells.**

Mann-Kendall trend analysis was performed.

**Table 2, Appendix B, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Guidance* (EPA 1989). F statistic taken at the 5% significance level.

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Mann-Kendall Trend Test Analysis
MW84A Trichloroethene July 2022

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.19/26/2022 2:04:29 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

Input Data	
Date Collected	Result (µg/L)
Jan-19	**5580**
Jul-19	**2000**
Jan-20	**2930**
Jul-20	**3230**
Jan-21	**2630**
Jul-21	**5290**
Jan-22	**6560**
Jul-22	**6570**

Bolded values indicate a detected result.

MW84-MW84A TCE July 2022

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	8
Number Values Reported (n)	8
Minimum	2000
Maximum	6570
Mean	4349
Geometric Mean	3983
Median	4260
Standard Deviation	1850
Coefficient of Variation	0.425

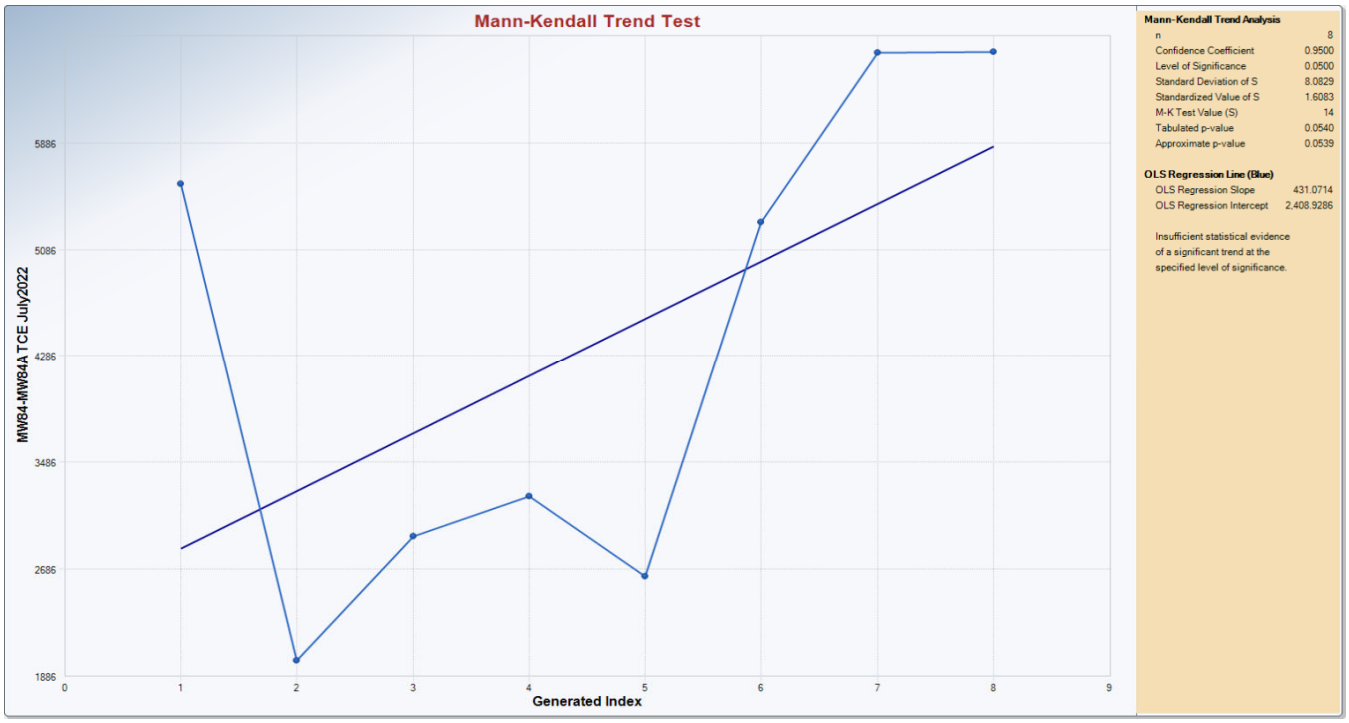
Mann-Kendall Test

M-K Test Value (S)	14
Tabulated p-value	0.054
Standard Deviation of S	8.083
Standardized Value of S	1.608
Approximate p-value	0.0539

Insufficient evidence to identify a significant trend at the specified level of significance.

Attachment B4: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2022

Mann-Kendall Trend Test Analysis
MW84A Trichloroethene July 2022



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ATTACHMENT B5

URANIUM
STATISTICAL TEST 2

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Attachment B5: Uranium URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2022

Uranium (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-20	**0.000089**	0.0001	**0.000219**	0.0001	0.0001
Jan-21	**0.0001**	0.0001	**0.000156**	0.0001	0.0001
Jul-21	**0.000079**	0.0001	0.0001	0.0001	0.0001
Jan-22	**0.000126**	0.0001	0.0001	0.0001	0.0001
Jul-22	**0.000076**	0.0001	**0.000068**	0.0001	0.0001

mg/L = milligrams per liter
BG = background
DL = detection limit
Nondetect values are 1/2 DL.
Bolded values indicate a detected result.

[!]Test of Proportions

Calculate the number of detections in background wells vs. compliance wells.

X =	5	X = number of samples above DL in background wells
Y =	3	Y = number of samples above DL in compliance wells
n_b =	10	n_b = count of background well results/samples analyzed
n_c =	15	n_c = count of compliance well results/samples analyzed
n =	25	n = total number of samples

P =	0.320	P=(x+y)/n
nP =	8	$n=n_b+n_c$
n(1-P) =	17	

NOTE: If nP and n(1-P) are both >= 5, then the normal approximation may be used.

P_b =	0.500	P_b = proportion of detects in background wells
P_c =	0.200	P_c = proportion of detects in compliance wells
S_D =	0.190	S_D = standard error of difference in proportions
Z =	1.575	$Z = (P_b-P_c)/S_D$
absolute value of Z =	1.575	

If the absolute value of Z exceeds the 97.5th percentile value of 1.96 from the standard normal distribution, this provides statistically significant evidence at the 5% significance level that the proportion of detects in one group of data exceeds the proportion of detects in the other group.

CONCLUSION: **Because the absolute value of Z is less than 1.96, there is no statistical evidence that the proportion of samples with detected results differs between the background well and compliance well samples.**

[!]Section 8.1.2, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance* (EPA 1989).

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ATTACHMENT B6

STATISTICIAN STATEMENT

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FOUR RIVERS NUCLEAR PARTNERSHIP, LLC

Four Rivers Nuclear Partnership, LLC
5511 Hobbs Road
Kevil, KY 42053
www.fourriversnuclearpartnership.com

October 17, 2022

Mr. Dennis Greene
Four Rivers Nuclear Partnership, LLC
5511 Hobbs Road
Kevil, KY 42053

Dear Mr. Greene:

I am submitting this statement as a supplementary document to the completed statistical analysis I performed on the groundwater data for the C-404 Hazardous Waste Landfill at the Paducah Site.

As an Environmental Scientist, with a bachelor's degree in Earth Sciences/Geology, I have over 30 years of experience in reviewing and assessing laboratory analytical results associated with environmental sampling and investigation activities.

For this project, the statistical analyses on groundwater data from July 2020 through July-September 2022 were performed in accordance with the Hazardous Waste Management Facility Permit, Appendix E using Microsoft Excel 2016 and U.S. Environmental Protection Agency's (EPA's) ProUCL 5.1. The spreadsheets include the results for the following statistical tests:

- Test of Proportions
- Parametric Analysis of Variance (ANOVA)
- Nonparametric ANOVA
- 95% Upper Tolerance Limit
- Paired (parametric) ANOVA
- Mann-Kendall

The statistical analyses procedures were based on EPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance* (1989).

Sincerely,

Bryan Smith

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APPENDIX C

2022 ANNUAL REPORT OF THE C-404 LANDFILL HYDRAULIC FLOW RATE AND DIRECTION

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2022 ANNUAL REPORT OF THE C-404 LANDFILL HYDRAULIC FLOW RATE AND DIRECTION

The Hazardous Waste Management Facility Permit, KY8-890-008-982, (Permit) requires annual determination of average hydraulic flow rate and direction of flow in the uppermost aquifer at the C-404 Hazardous Waste Landfill (C-404 Landfill). The uppermost aquifer below C-404 Landfill is the Regional Gravel Aquifer (RGA). Water level measurements currently are taken from several wells at the perimeter of the C-404 Landfill on a semiannual basis. The water levels used for this analysis (taken on January 5, 2022, and July 26, 2022) were measured as closely as possible and within a 24-hour period to ensure the comparability of the data. Table C.1 documents the datums used for the water level measurements. These measurements were used to plot the potentiometric surface of the upper RGA for the January and July 2022 semiannual sampling events.

Table C.1. Measurement Control Datums Used for Upper Regional Gravel Aquifer C-404 Monitoring Wells During 2022

Well	Measurement Location	Datum Point Elevation (ft amsl)
MW84A	Top of Outside Casing	375.29
MW87A	Top of Outside Casing	375.30
MW90A	Top of Inside Casing	374.15
MW93A	Top of Outside Casing	378.67
MW420	Top of Inside Casing	377.55

Contours for each potentiometric surface were drawn after water level data were corrected for barometric pressure; groundwater hydraulic gradients then are calculated from the contours. The average of the gradients measured during this reporting period is the annual average groundwater hydraulic gradient for the upper RGA and is calculated at 1.36×10^{-3} ft/ft.

The hydraulic conductivity values reported in the *Resource Conservation and Recovery Act (RCRA) Part B Permit Modification for Inclusion of C-404 Low-Level Radioactive/Hazardous Waste Landfill* (June 1992) were determined by multi-well testing and range from 21 to 140 ft/day (7.41×10^{-3} to 4.94×10^{-2} cm/s).

Multiplication of the hydraulic gradient (i) and the hydraulic conductivity (K) yields the specific discharge (q) for a unit area of the RGA. Annual average linear-flow velocity (v) is calculated by multiplying the hydraulic conductivity by the gradient and dividing by the porosity (n). It is assumed that the porosity equals 25% in the RGA beneath the C-404 Landfill.

Table C.2 summarizes the annual average results of the calculations. Table C.3 presents the calculation information for the annual groundwater flow rate. The January and July 2022 potentiometric surface data of the upper RGA are presented in Tables C.4 and C.5, and potentiometric surface maps are presented in Figures C.1 and C.2.

The potentiometric contours depict the directions of hydraulic flow during each sampling event. Hydraulic flow direction beneath the C-404 Landfill generally trends northeastward, but commonly varies from northeast to north.

Table C.2. C-404 Landfill Annual Average Groundwater Flow Rate for 2022

Hydraulic Conductivity (K) Range	Annual Average Specific Discharge (q) ft/day (cm/s)	Annual Average Linear Flow Velocity (v) ft/day (cm/s)
Low K	0.0285 (1.01×10^{-5})	0.115 (4.03×10^{-5})
High K	0.191 (6.72×10^{-5})	0.762 (2.69×10^{-4})

Table C.3. Calculation Information for the C-404 Landfill Annual Groundwater Flow Rate 2022

Upper RGA K = 21 ft/d					
	i (ft/ft)	**q (ft/d)**	**q (cm/s)**	**v (ft/d)**	**v (cm/s)**
January 2022	-1.35×10^{-3}	0.0284	1.00×10^{-5}	0.114	4.01×10^{-5}
July 2022	-1.37×10^{-3}	0.0287	1.01×10^{-5}	0.115	4.05×10^{-5}
Annual Average	$\mathbf{-1.36 \times 10^{-3}}$	**0.0285**	$\mathbf{1.01 \times 10^{-5}}$	**0.115**	$\mathbf{4.03 \times 10^{-5}}$
Upper RGA K = 140 ft/d					
	i (ft/ft)	**q (ft/d)**	**q (cm/s)**	**v (ft/d)**	**v (cm/s)**
January 2022	-1.35×10^{-3}	0.190	6.69×10^{-5}	0.758	2.67×10^{-4}
July 2022	-1.37×10^{-3}	0.191	6.75×10^{-5}	0.765	2.70×10^{-4}
Annual Average	$\mathbf{-1.36 \times 10^{-3}}$	**0.191**	$\mathbf{6.72 \times 10^{-5}}$	**0.762**	$\mathbf{2.69 \times 10^{-4}}$

$q = K*i$

where:
q = specific discharge
K = hydraulic conductivity
i = hydraulic gradient (from potentiometric map)

ft/ft = foot per foot
ft/d = foot per day
cm/s = centimeter/second

$v = q/n$

where:
v = average linear velocity
q = specific discharge
n_e = porosity (assumed to be 25%)

Table C.4. January 2022 RGA Potentiometric Surface Data

C-404 Landfill (January 2022) Water Levels									
						Raw Data		*Corrected Data	
Date	Time	Well	Datum Elev (ft amsl)	BP (in Hg)	Delta BP (ft H_20)	DTW (ft)	Elev (ft amsl)	DTW (ft)	Elev (ft amsl)
1/5/2022	7:30	MW67	374.89	29.91	0.02	50.35	324.54	50.37	324.52
1/5/2022	8:09	MW76	376.56	29.93	0.00	51.95	324.61	51.95	324.61
1/5/2022	7:32	MW84A	375.29	29.91	0.02	50.90	324.39	50.92	324.37
1/5/2022	7:33	MW87A	375.30	29.91	0.02	50.95	324.35	50.97	324.33
1/5/2022	7:38	MW90A	374.15	29.91	0.02	49.79	324.36	49.81	324.34
1/5/2022	8:05	MW93A	378.67	29.93	0.00	53.42	325.25	53.42	325.25
1/5/2022	8:02	MW95A	376.96	29.93	0.00	52.21	324.75	52.21	324.75
1/5/2022	7:21	MW227	378.81	29.91	0.02	53.83	324.98	53.85	324.96
1/5/2022	8:06	MW333	377.20	29.93	0.00	52.42	324.78	52.42	324.78
1/5/2022	7:48	MW337	374.39	29.91	0.02	49.76	324.63	49.78	324.61
1/5/2022	7:50	MW338	374.85	29.91	0.02	50.10	324.75	50.12	324.73
1/5/2022	8:00	MW420	377.55	29.93	0.00	53.67	323.88	53.67	323.88

Reference Barometric Pressure **29.93**
Elev = elevation
amsl = above mean sea level
BP = barometric pressure
DTW = depth to water in feet below datum
*Assumes a barometric efficiency of 1.0

Table C.5. July 2022 RGA Potentiometric Surface Data

C-404 Landfill (July 2022) Water Levels									
						Raw Data		*Corrected Data	
Date	Time	Well	Datum Elev (ft amsl)	BP (in Hg)	Delta BP (ft H_20)	DTW (ft)	Elev (ft amsl)	DTW (ft)	Elev (ft amsl)
7/26/2022	13:12	MW67	374.89	30.04	-0.03	47.63	327.26	47.60	327.30
7/26/2022	8:50	MW76	376.56	30.01	0.00	49.15	327.41	49.15	327.41
7/26/2022	13:15	MW84A	375.29	30.04	-0.03	48.15	327.14	48.12	327.18
7/26/2022	13:21	MW87A	375.30	30.04	-0.03	48.12	327.18	48.09	327.21
7/26/2022	13:30	MW90A	374.15	30.04	-0.03	47.03	327.12	47.00	327.15
7/26/2022	8:53	MW93A	378.67	30.01	0.00	51.09	327.58	51.09	327.58
7/26/2022	8:38	MW227	378.81	30.01	0.00	51.10	327.71	51.10	327.71
7/26/2022	9:15	MW333	377.20	30.01	0.00	49.50	327.70	49.50	327.70
7/26/2022	12:40	MW337	374.39	30.05	-0.05	46.96	327.43	46.91	327.48
7/26/2022	12:41	MW338	374.85	30.05	-0.05	48.37	326.48	48.32	326.53
7/26/2022	8:51	MW420	377.55	30.01	0.00	50.10	327.45	50.10	327.45

Reference Barometric Pressure **30.01**
Elev = elevation
amsl = above mean sea level
BP = barometric pressure
DTW = depth to water in feet below datum
*Assumes a barometric efficiency of 1.0

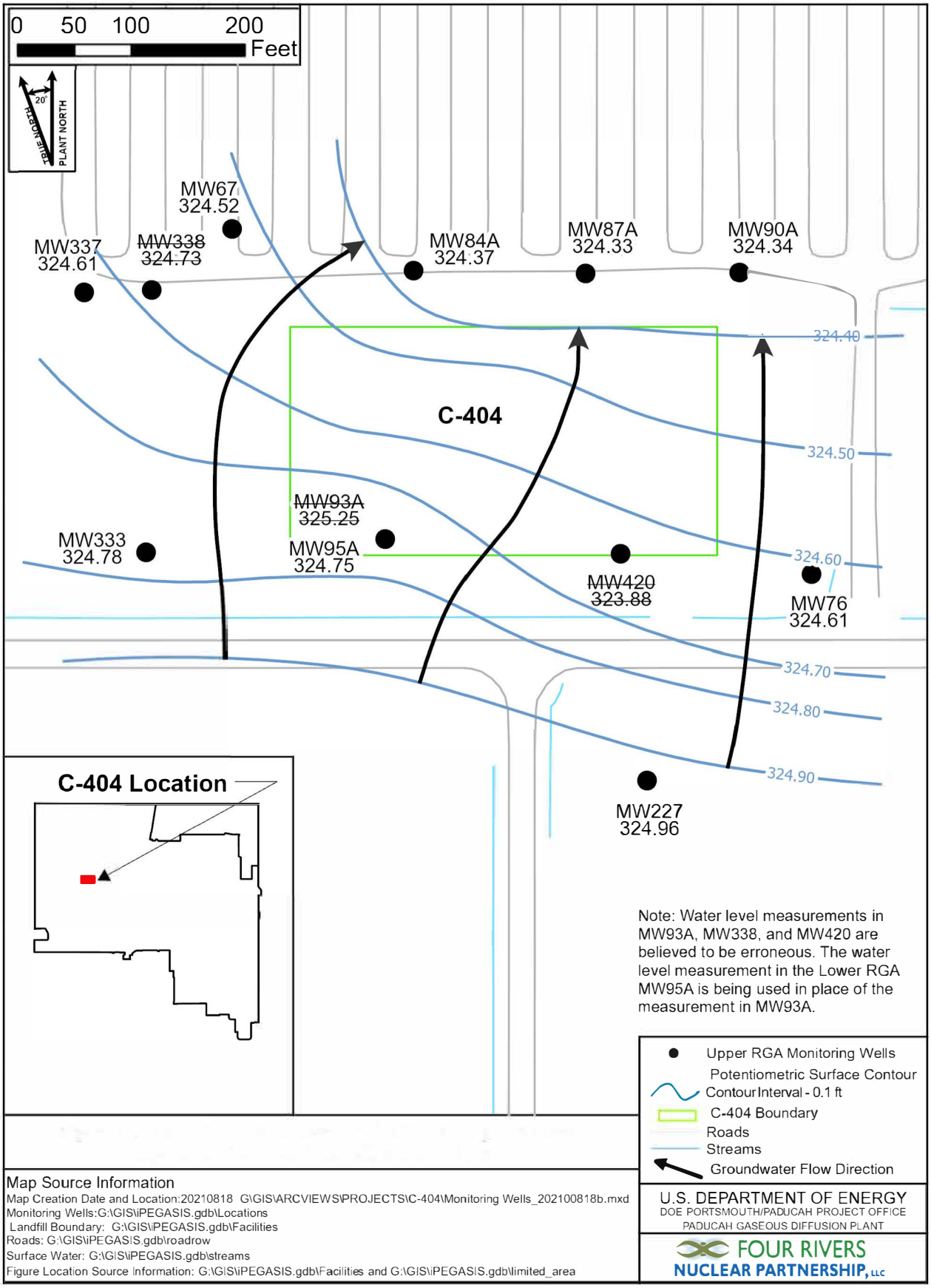

Figure C.1. Potentiometric Surface of the Upper Regional Gravel Aquifer at the C-404 Landfill, January 5, 2022

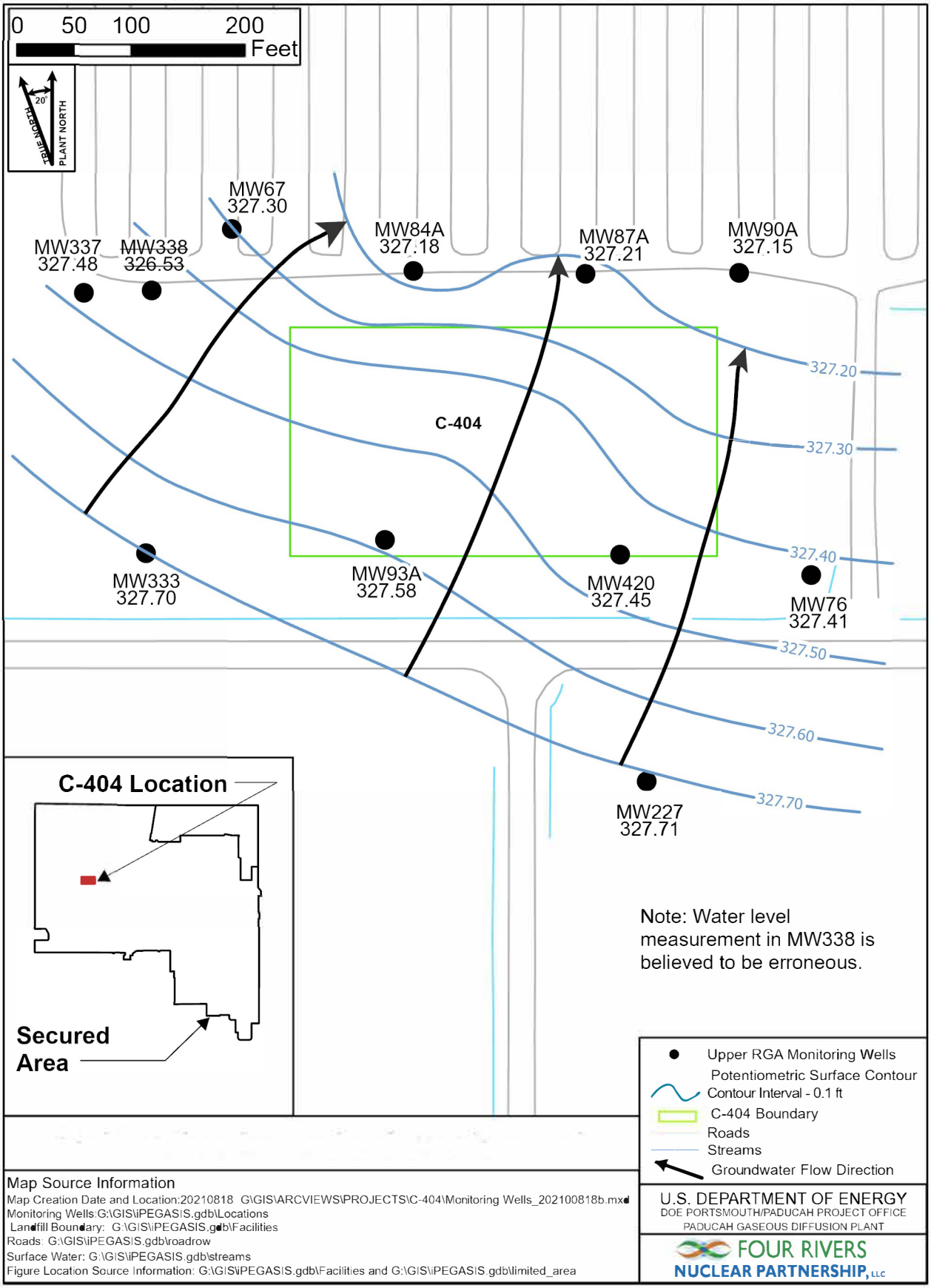

Figure C.2. Potentiometric Surface of the Upper Regional Gravel Aquifer at the C-404 Landfill, July 26, 2022

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