RECEIVED
By Terri.Drake at 1:33 pm, Nov 27, 2023

Department of Energy

Portsmouth/Paducah Project Office
1017 Majestic Drive, Suite 200
Lexington, Kentucky 40513
(859) 219-4000

November 27, 2023

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

PPPO-02-10026135-24B

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 2023 SEMIANNUAL GROUNDWATER REPORT (APRIL–SEPTEMBER 2023), PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY, FRNP-RPT-0297/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 2023. 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 trichloroethene (TCE) was observed in compliance well MW84A at a statistically significant concentration above concentrations observed in the background wells. The trends discussed in the 2007 *C-404 Landfill Source Demonstration Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS-ENM-0031/R2, alternate source demonstration (ASD) showed that the C-404 Landfill was not the source of the historical, statistically significant background exceedance of TCE in MW84 (replaced by MW84A). Current concentration trends and spatial distribution data for TCE 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 a corrective action plan under Section II.K.8 of the Permit for TCE in MW84A.

If you have any questions or require additional information, please contact Ryan Callihan at (740) 970-0255.

Sincerely,

APRIL LADD Digitally signed by APRIL LADD Date: 2023.11.27 08:05:34 -06'00'

April Ladd
Paducah Site Lead
Portsmouth/Paducah Project Office

Enclosures:
1. Certification Page
2. *C-404 Hazardous Waste Landfill November 2023 Semiannual Groundwater Report (April–September 2023), Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0297/V2

cc: w/ enclosures:
abigail.parish@pppo.gov, PPPO
april.ladd@pppo.gov, PPPO
april.webb@ky.gov, KDEP
brian.begley@ky.gov, KDEP
bruce.ford@pad.pppo.gov, FRNP
bryan.smith@pad.pppo.gov, FRNP
christopher.travis@ky.gov, KDEP
dennis.greene@pad.pppo.gov, FRNP
frnpcorrespondence@pad.pppo.gov
jaime.morrow@pad.pppo.gov, FRNP
ken.davis@pad.pppo.gov, FRNP
lauren.linehan@ky.gov, KDEP
leo.williamson@ky.gov, KDEP
myrna.redfield@pad.pppo.gov, FRNP
pad.rmc@pad.pppo.gov
ryan.callihan@pppo.gov, PPPO
stephaniec.brock@ky.gov, KYRHB
victor.weeks@epa.gov EPA

CERTIFICATION

Document Identification: ***C-404 Hazardous Waste Landfill November 2023 Semiannual Groundwater Report (April 2023–September 2023), Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, FRNP-RPT-0297/V2, Permit No. KY8-890-008-982, Agency Interest ID No. 3059**

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 REDFIELD (Affiliate)
Digitally signed by MYRNA REDFIELD (Affiliate)
Date: 2023.11.27 10:07:24 -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
Digitally signed by APRIL LADD
Date: 2023.11.27 10:52:46 -06'00'

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

Date Signed

FRNP-RPT-0297/V2

C-404 Hazardous Waste Landfill November 2023 Semiannual Groundwater Report (April–September 2023), Paducah Gaseous Diffusion Plant, Paducah, Kentucky

FOUR RIVERS NUCLEAR PARTNERSHIP, LLC

CLEARED FOR PUBLIC RELEASE

C-404 Hazardous Waste Landfill November 2023 Semiannual Groundwater Report (April–September 2023), Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—November 2023

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

CLEARED FOR PUBLIC RELEASE

THIS PAGE INTENTIONALLY LEFT BLANK

CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

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

THIS PAGE INTENTIONALLY LEFT BLANK

EXECUTIVE SUMMARY

This report, *C-404 Hazardous Waste Landfill November 2023 Semiannual Groundwater Report (April–September 2023), Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* FRNP-RPT-0297/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 2023 through September 2023; and the report includes analytical data from the July 2023 semiannual sampling 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 statistical analyses were conducted in accordance with the Hazardous Waste Management Facility Permit. Trichloroethene (TCE) was observed in compliance well MW84A at a statistically significant concentration above concentrations observed in the background wells. The statistical tests on all other parameters, except technetium-99 (Tc-99), showed no statistically significant differences above concentrations observed in background wells. Tc-99 concentrations in compliance well MW84A showed statistically significant concentrations compared to concentrations observed in the background wells; however, the concentrations did not show an increasing trend, so there is no confirmed Tc-99 exceedance attributable to C-404.

TCE concentrations in compliance well MW84A are increasing, which is similar to past TCE trends in the same well. Moreover, TCE 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, for TCE appears to have continued to migrate northeastward (PRS 2007a). This demonstration for TCE 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 of the 2007 alternate source demonstration 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 2023 through September 2023, the depth of the leachate on May 8, 2023, was 35 inches. Subsequently, leachate was removed from the sump and sampled. The depth of the leachate has not exceeded 3 ft during any of the monthly monitoring events within the reporting period.

THIS PAGE INTENTIONALLY LEFT BLANK

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 (KDWM) Hazardous Waste Management Facility Permit, KY8-890-008-982 (Permit), Specific Condition II.K.6.d—Recordkeeping, Reporting, and Response (KDWM 2020). The period covered by this report is April 2023 through September 2023.

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. The C-404 leachate analytical results are provided in Appendix D.

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; once characterized, the leachate is 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 of trichloroethene (TCE) found in compliance wells were statistically different from those found in background wells. The *C-404 Landfill Source Demonstration, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PRS-ENM-0031/R2, demonstrated that the source of TCE in compliance wells is not from the C-404 Landfill, but rather, the source is located upgradient/crossgradient of the C-404 Landfill (PRS 2007a).

Regional Gravel Aquifer (RGA) compliance monitoring well (MW) MW90 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*, 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 (FRNP 2019). 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 technetium-99 (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 was conducted at the C-404 Landfill through November 2022. This current semiannual report contains results from additional quarterly compliance sampling for radiological constituents conducted in May 2022 and November 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.

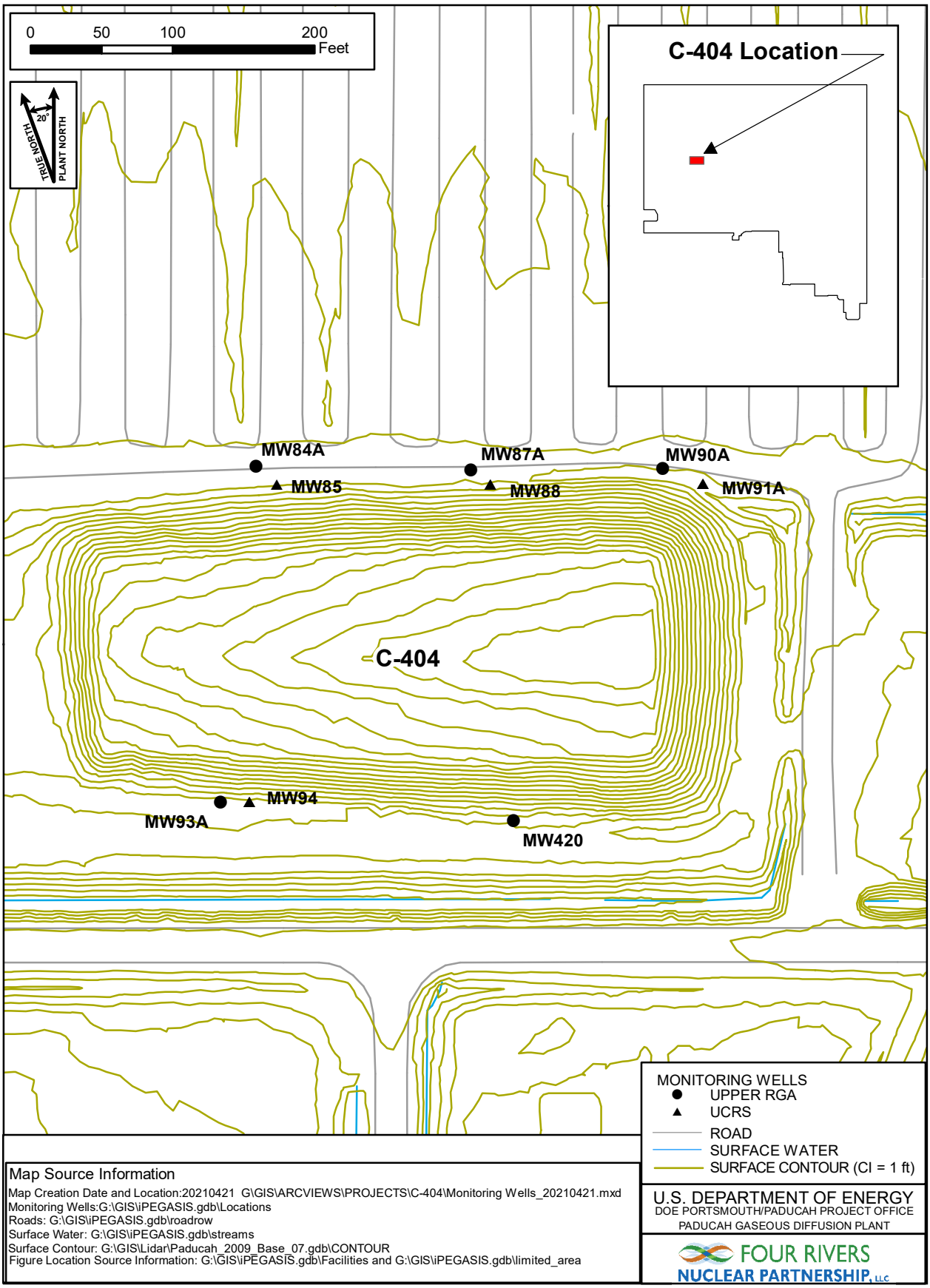


Figure 1. Monitoring Wells

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 July 2023 during this reporting period. Samples collected in July 2023 were analyzed for the parameters that are required by Part VIII.E of the Permit. Groundwater sampling was conducted using procedure CP4-ES-2101, *Groundwater Sampling*. The 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; once characterized, the leachate is transferred off-site for treatment. During this reporting period (April 2023 through September 2023), the depth of the leachate on May 8, 2023, was 35 inches. Subsequently, 1,400 gal of leachate were removed and sampled. The depth of the leachate has not exceeded 3 ft during any of the monthly monitoring events within the reporting period. Results of the leachate analysis of the samples collected in May 2023 have been included in Appendix D of this report.

The annual leachate sump integrity test, as required by Section 1.2 of Appendix I2 of the Permit, was conducted between August 15, 2023, and September 19, 2023. 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 concluded in November 2022. The additional quarters 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 2021, January 2022, July–August 2022, January 2023, and July 2023. The reporting period data set for radionuclides includes May 2022, July–August 2022, November 2022, January 2023, and July 2023.

Appendix B provides a summary of the statistical analyses performed. The statistical test results on all wells and parameters showed no statistically significant exceedances above concentrations observed in the background wells with the exception of Tc-99 and TCE in MW84A. Tc-99 concentrations in compliance well MW84A showed statistically significant concentrations above concentrations observed in the background wells; however, the concentrations did not show an increasing trend, so there is no confirmed Tc-99 exceedance attributable to C-404.

3. DATA VALIDATION AND QUALITY ASSURANCE/QUALITY CONTROL SUMMARY

The data and the data validation qualifiers for the July 2023 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.

THIS PAGE INTENTIONALLY LEFT BLANK

4. PROFESSIONAL GEOLOGIST AUTHORIZATION

DOCUMENT IDENTIFICATION: *C-404 Hazardous Waste Landfill*
November 2023 Semiannual Groundwater Report
(April–September 2023),
Paducah Gaseous Diffusion Plant, Paducah, Kentucky
(FRNP-RPT-0297/V2)

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

PG113927
K.R.D.
11-14-2023

Kenneth R. Davis
Kenneth R. Davis

PG113927

November 14, 2023
Date

THIS PAGE INTENTIONALLY LEFT BLANK

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, Paducah, KY, February.

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, Paducah, 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, August.

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.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A

C-404 HAZARDOUS WASTE LANDFILL GROUNDWATER ANALYTICAL RESULTS

THIS PAGE INTENTIONALLY LEFT BLANK

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		0.0311	mg/L	0.03	7/11/2023			SW846-6010D	J
		0.0351	mg/L	0.005	7/11/2023			SW846-6020B	=
Arsenic, Dissolved	J	0.0191	mg/L	0.03	7/11/2023			SW846-6010D	=
		0.0284	mg/L	0.005	7/11/2023			SW846-6020B	=
Barometric Pressure Reading		30.01	Inches/Hg		7/11/2023				X
Cadmium	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Conductivity		467	umho/cm		7/11/2023				X
Depth to Water		50.43	ft		7/11/2023				X
Dissolved Oxygen		4.48	mg/L		7/11/2023				X
Eh (approx)		408	mV		7/11/2023				X
Lead	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
pH		5.8	Std Unit		7/11/2023				X
Selenium	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Sulfate		7.66	mg/L	0.4	7/11/2023			SW846-9056A	=
Technetium-99		64.2	pCi/L	19.1	7/11/2023	13	14.8	HASL 300, Tc-02-RC M	=
Temperature		75	deg F		7/11/2023				X
Trichloroethene		5870	ug/L	100	7/11/2023			SW846-8260D	=
Turbidity		2.6	NTU		7/11/2023				X
Uranium	U	0.0002	mg/L	0.0002	7/11/2023			SW846-6020B	=
Uranium-234	U	-0.279	pCi/L	1.18	7/11/2023	0.335	0.336	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0458	pCi/L	0.914	7/11/2023	0.395	0.395	HASL 300, U-02-RC M	=
Uranium-238	U	0.0802	pCi/L	0.854	7/11/2023	0.446	0.446	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	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	UJ
		0.00552	mg/L	0.005	7/11/2023			SW846-6020B	=
Arsenic, Dissolved	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	=
	J	0.00454	mg/L	0.005	7/11/2023			SW846-6020B	=
Barometric Pressure Reading		30.01	Inches/Hg		7/11/2023				X
Cadmium	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Chromium	J	0.00351	mg/L	0.01	7/11/2023			SW846-6020B	=
Chromium, Dissolved	J	0.00359	mg/L	0.01	7/11/2023			SW846-6020B	=
Conductivity		375	umho/cm		7/11/2023				X
Depth to Water		9.89	ft		7/11/2023				X
Dissolved Oxygen		3.77	mg/L		7/11/2023				X
Eh (approx)		406	mV		7/11/2023				X
Lead	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
pH		6.1	Std Unit		7/11/2023				X
Selenium	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Sulfate		12.3	mg/L	0.4	7/11/2023			SW846-9056A	=
Technetium-99		61	pCi/L	19.4	7/11/2023	13	14.7	HASL 300, Tc-02-RC M	=
Temperature		77.8	deg F		7/11/2023				X
Trichloroethene		1.94	ug/L	1	7/11/2023			SW846-8260D	=
Turbidity		4.24	NTU		7/11/2023				X
Uranium		0.000526	mg/L	0.0002	7/11/2023			SW846-6020B	=
Uranium-234	U	-0.113	pCi/L	1.46	7/11/2023	0.582	0.583	HASL 300, U-02-RC M	=
Uranium-235	U	0.128	pCi/L	1.36	7/11/2023	0.71	0.711	HASL 300, U-02-RC M	=
Uranium-238	U	0.7	pCi/L	1.1	7/11/2023	0.887	0.892	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
Arsenic	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	UJ
		0.00548	mg/L	0.005	7/11/2023			SW846-6020B	=
Arsenic, Dissolved	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	=
	J	0.00458	mg/L	0.005	7/11/2023			SW846-6020B	=
Cadmium	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Chromium	J	0.0034	mg/L	0.01	7/11/2023			SW846-6020B	=
Chromium, Dissolved	J	0.00328	mg/L	0.01	7/11/2023			SW846-6020B	=
Lead	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
Selenium	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Sulfate		12.4	mg/L	0.4	7/11/2023			SW846-9056A	=
Technetium-99		69.1	pCi/L	19.2	7/11/2023	13.1	15.2	HASL 300, Tc-02-RC M	=
Trichloroethene		1.66	ug/L	1	7/11/2023			SW846-8260D	=
Uranium		0.000511	mg/L	0.0002	7/11/2023			SW846-6020B	=
Uranium-234	U	-0.439	pCi/L	1.83	7/11/2023	0.615	0.616	HASL 300, U-02-RC M	=
Uranium-235	U	0.239	pCi/L	0.717	7/11/2023	0.672	0.673	HASL 300, U-02-RC M	=
Uranium-238	U	0.921	pCi/L	0.928	7/11/2023	0.938	0.947	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
Arsenic	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	UJ
		0.00863	mg/L	0.005	7/11/2023			SW846-6020B	=
Arsenic, Dissolved		0.00649	mg/L	0.005	7/11/2023			SW846-6020B	=
	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	=
Barometric Pressure Reading		29.99	Inches/Hg		7/11/2023				X
Cadmium	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Conductivity		344	umho/cm		7/11/2023				X
Depth to Water		50.51	ft		7/11/2023				X
Dissolved Oxygen		3.63	mg/L		7/11/2023				X
Eh (approx)		406	mV		7/11/2023				X
Lead	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
pH		5.74	Std Unit		7/11/2023				X
Selenium	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Sulfate		7.35	mg/L	0.4	7/11/2023			SW846-9056A	=
Technetium-99		33.3	pCi/L	19	7/11/2023	12	12.6	HASL 300, Tc-02-RC M	=
Temperature		69.7	deg F		7/11/2023				X
Trichloroethene		2160	ug/L	50	7/11/2023			SW846-8260D	=
Turbidity		3.59	NTU		7/11/2023				X
Uranium	U	0.0002	mg/L	0.0002	7/11/2023			SW846-6020B	=
Uranium-234	U	0.121	pCi/L	1.33	7/11/2023	0.664	0.665	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0564	pCi/L	1.13	7/11/2023	0.487	0.488	HASL 300, U-02-RC M	=
Uranium-238	U	0.0989	pCi/L	1.05	7/11/2023	0.549	0.55	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
Arsenic		0.00667	mg/L	0.005	7/12/2023			SW846-6020B	=
	U	0.03	mg/L	0.03	7/12/2023			SW846-6010D	=
Arsenic, Dissolved	U	0.03	mg/L	0.03	7/12/2023			SW846-6010D	=
		0.00567	mg/L	0.005	7/12/2023			SW846-6020B	=
Barometric Pressure Reading		29.95	Inches/Hg		7/12/2023				X
Cadmium	U	0.001	mg/L	0.001	7/12/2023			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/12/2023			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/12/2023			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/12/2023			SW846-6020B	=
Conductivity		625	umho/cm		7/12/2023				X
Depth to Water		9.34	ft		7/12/2023				X
Dissolved Oxygen		1.43	mg/L		7/12/2023				X
Eh (approx)		417	mV		7/12/2023				X
Lead	U	0.002	mg/L	0.002	7/12/2023			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/12/2023			SW846-6020B	=
Mercury	J	0.000088	mg/L	0.0002	7/12/2023			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/12/2023			SW846-7470A	=
pH		5.77	Std Unit		7/12/2023				X
Selenium	U	0.005	mg/L	0.005	7/12/2023			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/12/2023			SW846-6020B	=
Sulfate		106	mg/L	4	7/12/2023			SW846-9056A	=
Technetium-99	U	18.1	pCi/L	22.6	7/12/2023	13.6	13.8	HASL 300, Tc-02-RC M	=
Temperature		69	deg F		7/12/2023				X
Trichloroethene		1.75	ug/L	1	7/12/2023			SW846-8260D	=
Turbidity		7.2	NTU		7/12/2023				X
Uranium	J	0.000119	mg/L	0.0002	7/12/2023			SW846-6020B	=
Uranium-234	U	0.0189	pCi/L	1.4	7/12/2023	0.637	0.637	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0531	pCi/L	1.06	7/12/2023	0.458	0.459	HASL 300, U-02-RC M	=
Uranium-238	U	0.136	pCi/L	0.859	7/12/2023	0.511	0.511	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
Arsenic	J	0.0026	mg/L	0.005	7/12/2023			SW846-6020B	J
	U	0.03	mg/L	0.03	7/12/2023			SW846-6010D	=
Arsenic, Dissolved	J	0.00211	mg/L	0.005	7/12/2023			SW846-6020B	=
	J	0.00906	mg/L	0.03	7/12/2023			SW846-6010D	J
Barometric Pressure Reading		29.97	Inches/Hg		7/12/2023				X
Cadmium	U	0.001	mg/L	0.001	7/12/2023			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/12/2023			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/12/2023			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/12/2023			SW846-6020B	=
Conductivity		239	umho/cm		7/12/2023				X
Depth to Water		49.74	ft		7/12/2023				X
Dissolved Oxygen		5.2	mg/L		7/12/2023				X
Eh (approx)		413	mV		7/12/2023				X
Lead	U	0.002	mg/L	0.002	7/12/2023			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/12/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/12/2023			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/12/2023			SW846-7470A	=
pH		5.82	Std Unit		7/12/2023				X
Selenium	U	0.005	mg/L	0.005	7/12/2023			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/12/2023			SW846-6020B	=
Sulfate		4.22	mg/L	0.4	7/12/2023			SW846-9056A	=
Technetium-99		24.7	pCi/L	21.8	7/12/2023	13.3	13.6	HASL 300, Tc-02-RC M	=
Temperature		71.5	deg F		7/12/2023				X
Trichloroethene		267	ug/L	5	7/12/2023			SW846-8260D	=
Turbidity		0	NTU		7/12/2023				X
Uranium	U	0.0002	mg/L	0.0002	7/12/2023			SW846-6020B	=
Uranium-234	U	-0.106	pCi/L	1.61	7/12/2023	0.65	0.651	HASL 300, U-02-RC M	=
Uranium-235	U	0.275	pCi/L	0.824	7/12/2023	0.772	0.773	HASL 300, U-02-RC M	=
Uranium-238	U	0.116	pCi/L	1.23	7/12/2023	0.642	0.643	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
Arsenic	J	0.00434	mg/L	0.005	7/12/2023			SW846-6020B	=
	J	0.00812	mg/L	0.03	7/12/2023			SW846-6010D	J
Arsenic, Dissolved	U	0.03	mg/L	0.03	7/12/2023			SW846-6010D	=
	J	0.00315	mg/L	0.005	7/12/2023			SW846-6020B	=
Barometric Pressure Reading		29.97	Inches/Hg		7/12/2023				X
Cadmium	U	0.001	mg/L	0.001	7/12/2023			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/12/2023			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/12/2023			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/12/2023			SW846-6020B	=
Conductivity		796	umho/cm		7/12/2023				X
Depth to Water		13.31	ft		7/12/2023				X
Dissolved Oxygen		1.09	mg/L		7/12/2023				X
Eh (approx)		244	mV		7/12/2023				X
Lead	U	0.002	mg/L	0.002	7/12/2023			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/12/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/12/2023			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/12/2023			SW846-7470A	=
pH		6.1	Std Unit		7/12/2023				X
Selenium	U	0.005	mg/L	0.005	7/12/2023			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/12/2023			SW846-6020B	=
Sulfate		66.8	mg/L	2	7/12/2023			SW846-9056A	=
Technetium-99		126	pCi/L	22.2	7/12/2023	16.2	21.6	HASL 300, Tc-02-RC M	=
Temperature		78.1	deg F		7/12/2023				X
Trichloroethene		20.9	ug/L	1	7/12/2023			SW846-8260D	=
Turbidity		2.04	NTU		7/12/2023				X
Uranium	U	0.0002	mg/L	0.0002	7/12/2023			SW846-6020B	=
Uranium-234	U	-0.253	pCi/L	1.26	7/12/2023	0.376	0.377	HASL 300, U-02-RC M	=
Uranium-235	U	0.219	pCi/L	0.658	7/12/2023	0.616	0.617	HASL 300, U-02-RC M	=
Uranium-238	U	0.177	pCi/L	0.532	7/12/2023	0.499	0.499	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	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	UJ
		0.00863	mg/L	0.005	7/11/2023			SW846-6020B	=
Arsenic, Dissolved	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	=
		0.00631	mg/L	0.005	7/11/2023			SW846-6020B	=
Barometric Pressure Reading		30.02	Inches/Hg		7/11/2023				X
Cadmium	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Conductivity		370	umho/cm		7/11/2023				X
Depth to Water		53.53	ft		7/11/2023				X
Dissolved Oxygen		3	mg/L		7/11/2023				X
Eh (approx)		403	mV		7/11/2023				X
Lead	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
pH		5.81	Std Unit		7/11/2023				X
Selenium	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Sulfate		7.93	mg/L	0.4	7/11/2023			SW846-9056A	=
Technetium-99	U	15.5	pCi/L	18.7	7/11/2023	11.3	11.5	HASL 300, Tc-02-RC M	=
Temperature		74.5	deg F		7/11/2023				X
Trichloroethene		1880	ug/L	50	7/11/2023			SW846-8260D	=
Turbidity		3.35	NTU		7/11/2023				X
Uranium	U	0.0002	mg/L	0.0002	7/11/2023			SW846-6020B	=
Uranium-234	U	-0.301	pCi/L	1.37	7/11/2023	0.401	0.402	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0548	pCi/L	1.09	7/11/2023	0.472	0.473	HASL 300, U-02-RC M	=
Uranium-238	U	-0.0443	pCi/L	0.885	7/11/2023	0.382	0.383	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
Arsenic	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	UJ
	J	0.00223	mg/L	0.005	7/11/2023			SW846-6020B	=
Arsenic, Dissolved	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	=
	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Barometric Pressure Reading		30.02	Inches/Hg		7/11/2023				X
Cadmium	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Chromium	J	0.00506	mg/L	0.01	7/11/2023			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Conductivity		728	umho/cm		7/11/2023				X
Depth to Water		14.25	ft		7/11/2023				X
Dissolved Oxygen		1.62	mg/L		7/11/2023				X
Eh (approx)		385	mV		7/11/2023				X
Lead	J	0.000819	mg/L	0.002	7/11/2023			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
pH		6.25	Std Unit		7/11/2023				X
Selenium	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Sulfate		66.2	mg/L	2	7/11/2023			SW846-9056A	=
Technetium-99		1320	pCi/L	20	7/11/2023	33.6	150	HASL 300, Tc-02-RC M	=
Temperature		73.8	deg F		7/11/2023				X
Trichloroethene		7.02	ug/L	1	7/11/2023			SW846-8260D	=
Turbidity		23.06	NTU		7/11/2023				X
Uranium		0.00122	mg/L	0.0002	7/11/2023			SW846-6020B	=
Uranium-234	U	1.16	pCi/L	1.25	7/11/2023	1.05	1.07	HASL 300, U-02-RC M	=
Uranium-235	U	-0.0524	pCi/L	1.05	7/11/2023	0.452	0.453	HASL 300, U-02-RC M	=
Uranium-238	U	0.446	pCi/L	0.979	7/11/2023	0.708	0.711	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
Arsenic		0.0114	mg/L	0.005	7/11/2023			SW846-6020B	=
	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	UJ
Arsenic, Dissolved		0.00971	mg/L	0.005	7/11/2023			SW846-6020B	=
	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	=
Barometric Pressure Reading		30	Inches/Hg		7/11/2023				X
Cadmium	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Cadmium, Dissolved	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Chromium, Dissolved	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Conductivity		390	umho/cm		7/11/2023				X
Depth to Water		53.3	ft		7/11/2023				X
Dissolved Oxygen		2.1	mg/L		7/11/2023				X
Eh (approx)		417	mV		7/11/2023				X
Lead	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Lead, Dissolved	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
Mercury, Dissolved	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
pH		5.74	Std Unit		7/11/2023				X
Selenium	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Selenium, Dissolved	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Sulfate		6.56	mg/L	0.4	7/11/2023			SW846-9056A	=
Technetium-99	U	6.01	pCi/L	19.5	7/11/2023	11.5	11.5	HASL 300, Tc-02-RC M	=
Temperature		70.7	deg F		7/11/2023				X
Trichloroethene		2090	ug/L	40	7/11/2023			SW846-8260D	=
Turbidity		3.77	NTU		7/11/2023				X
Uranium	U	0.0002	mg/L	0.0002	7/11/2023			SW846-6020B	=
Uranium-234	U	-0.235	pCi/L	1.03	7/11/2023	0.296	0.297	HASL 300, U-02-RC M	=
Uranium-235	U	-0.124	pCi/L	1.05	7/11/2023	0.375	0.375	HASL 300, U-02-RC M	=
Uranium-238	U	0.039	pCi/L	0.851	7/11/2023	0.408	0.408	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
Arsenic	U	0.03	mg/L	0.03	7/11/2023			SW846-6010D	=
	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Cadmium	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Lead	U	0.002	mg/L	0.002	7/11/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
Selenium	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Technetium-99	U	11.7	pCi/L	18.9	7/11/2023	11.3	11.4	HASL 300, Tc-02-RC M	=
Trichloroethene	U	1	ug/L	1	7/11/2023			SW846-8260D	=
Uranium	U	0.0002	mg/L	0.0002	7/11/2023			SW846-6020B	=
Uranium-234	U	-0.0867	pCi/L	2.03	7/11/2023	0.849	0.85	HASL 300, U-02-RC M	=
Uranium-235	U	-0.172	pCi/L	1.98	7/11/2023	0.761	0.763	HASL 300, U-02-RC M	=
Uranium-238	U	-0.417	pCi/L	2.14	7/11/2023	0.673	0.675	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	0.03	mg/L	0.03	7/11/2023			SW846-6010D	UJ
	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Cadmium	U	0.001	mg/L	0.001	7/11/2023			SW846-6020B	=
Chromium	U	0.01	mg/L	0.01	7/11/2023			SW846-6020B	=
Lead	J	0.00081	mg/L	0.002	7/11/2023			SW846-6020B	=
Mercury	U	0.0002	mg/L	0.0002	7/11/2023			SW846-7470A	=
Selenium	U	0.005	mg/L	0.005	7/11/2023			SW846-6020B	=
Technetium-99	U	2.71	pCi/L	18.6	7/11/2023	10.9	10.9	HASL 300, Tc-02-RC M	=
Trichloroethene	U	1	ug/L	1	7/11/2023			SW846-8260D	=
Uranium	U	0.0002	mg/L	0.0002	7/11/2023			SW846-6020B	=
Uranium-234	U	0.508	pCi/L	1.78	7/11/2023	1.07	1.08	HASL 300, U-02-RC M	=
Uranium-235	U	0.172	pCi/L	1.84	7/11/2023	0.958	0.959	HASL 300, U-02-RC M	=
Uranium-238	U	0.139	pCi/L	1.49	7/11/2023	0.775	0.776	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	7/11/2023			SW846-8260D	=
	U	1	ug/L	1	7/12/2023			SW846-8260D	=

QUALIFIER Codes

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

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.
UJ Analyte, compound or nuclide not detected above the reported detection limit, and the reported detection limit is approximated due to quality deficiency.
U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
X Not validated.

APPENDIX B

C-404 HAZARDOUS WASTE LANDFILL STATISTICAL ANALYSES

THIS PAGE INTENTIONALLY LEFT BLANK

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 was continued through November 2022. The additional quarters of groundwater data for radiological constituents alters the available data sets for the statistical analyses. For the second reporting period 2023 semiannual report, the reporting period data set includes nonradiological data from July 2021, January 2022, July–August 2022, January 2023, and July 2023. The reporting period data set for radiological constituents includes May 2022, July–August 2022, November 2022, January 2023, and July 2023.

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 the 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 2021, January 2022, July–August 2022, January 2023, and July 2023 and consists of five sets of data. The reporting period data set for radiological data is from May 2022 through July 2023 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	2	23
Cadmium	25	0	24	1
Chromium	25	0	23	2
Lead	25	0	24	1
Mercury	25	0	25	0
Selenium	25	0	25	0
Technetium-99	25	0	14	11
Trichloroethene	25	0	0	25
Uranium (Metals)	25	0	21	4
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 Hazardous Waste Management Facility 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	23	2	8	4
Cadmium	25	1	24	96	1
Chromium	25	2	23	92	1
Lead	25	1	24	96	1
Mercury	25	0	25	100	1
Selenium	25	0	25	100	1
Technetium-99	25	11	14	56	2
Trichloroethene	25	25	0	0	4
Uranium (Metals)	25	4	21	84	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 2023, 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
Chromium (mg/L)	0.01	0.005
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)	1.61	0.805
Uranium-235 (pCi/L)	1.13	0.565
Uranium-238 (pCi/L)	1.23	0.615

Table B.5. Summary of Conclusions from the C-404 Hazardous Waste Landfill Statistical Analyses for the First Reporting Period 2023

Attachment	RGA Well Type	Parameter	Applied Statistical Test	Results
B1	URGA	Arsenic	Statistical Test 4, parametric ANOVA (abandoned) and Statistical Test 3, nonparametric ANOVA.	Because equality of variance could not be confirmed, Statistical Test 4 was abandoned and Statistical Test 3, nonparametric ANOVA, was performed. Nonparametric ANOVA did not indicate a statistically significant difference between concentrations in downgradient wells and concentrations in background wells.
B2	URGA	Technetium-99	Statistical Test 2, Test of Proportions, nonparametric ANOVA, 95% UTL, paired (parametric) ANOVA, paired (nonparametric) ANOVA, and Mann-Kendall.	Because the test of proportions indicated statistically significant evidence that the proportion of detects in one group of data exceeded 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 the 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. A paired (parametric) ANOVA (MW84A vs. MW93A) was performed and determined the equality of variances was not equal, paired (nonparametric) ANOVA was performed. Paired (nonparametric) ANOVA identified a significant difference between upgradient (MW93A) and downgradient (MW84A) wells. The Mann-Kendall trend analysis did not identify a statistically significant trend for technetium-99 in MW84A.
B3	URGA	Trichloroethene (TCE)	Statistical Test 4, parametric ANOVA, with 95% UTL, paired (parametric) 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 (parametric) ANOVA (MW84A vs. MW93A) was performed that indicated a statistically significant difference between the wells. The Mann-Kendall trend analysis identified a statistically significant increasing trend for TCE in MW84A.

Table B.5. Summary of Conclusions from the C-404 Hazardous Waste Landfill Statistical Analyses for the First Reporting Period 2023 (Continued)

Attachment	RGA Well Type	Parameter	Applied Statistical Test	Results
B4	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 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 as compared to background wells. The MW84A technetium-99 concentration exceeded the 95% UTL. Because equality of variance could not be confirmed, paired (parametric) ANOVA was abandoned and a paired (nonparametric) was performed. Paired (nonparametric) ANOVA identified a significant difference between upgradient (MW93A) and downgradient (MW84A) wells. Mann-Kendall trend analysis was performed and did not indicate a statistically significant 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, because equality of variance by parametric ANOVA for arsenic could not be confirmed, the test was abandoned. Statistical Test 3, nonparametric ANOVA, did not identify a statistically significant difference between concentrations in downgradient wells and concentrations in background wells.

Statistical Test 4, parametric ANOVA, for TCE in the URGA indicated 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; 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 identified a statistically significant increasing trend for TCE in MW84A.

ATTACHMENT B1

ARSENIC
STATISTICAL TEST 4

THIS PAGE INTENTIONALLY LEFT BLANK

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

Arsenic (As, mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-21	**8.06E-03**	**8.59E-03**	**2.84E-02**	**7.93E-03**	2.50E-03
Jan-22	**1.34E-02**	**1.06E-02**	**3.48E-02**	**8.38E-03**	**2.13E-03**
Jul-22	**1.11E-02**	**1.03E-02**	**3.60E-02**	**8.27E-03**	2.50E-03
Jan-23	**1.11E-02**	**1.10E-02**	**3.43E-02**	**8.57E-03**	**2.78E-03**
Jul-23	**8.63E-03**	**1.14E-02**	**3.51E-02**	**8.63E-03**	**2.60E-03**
n_i	10		5	5	5
Sum	1.04E-01		1.69E-01	4.18E-02	1.25E-02
(x_i)avg	1.04E-02		3.37E-02	8.36E-03	2.50E-03

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

Overall mean x.. =	1.31E-02	
N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	3.27E-01	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-21	-2.36E-03	-1.83E-03	-5.32E-03	-4.26E-04	-2.00E-06
Jan-22	2.98E-03	1.82E-04	1.08E-03	2.40E-05	-3.72E-04
Jul-22	6.82E-04	-1.18E-04	2.28E-03	-8.60E-05	-2.00E-06
Jan-23	6.82E-04	5.82E-04	5.80E-04	2.14E-04	2.78E-04
Jul-23	-1.79E-03	9.82E-04	1.38E-03	2.74E-04	9.80E-05

X: Mean Value =	-6.94E-20	
S: Standard Deviation =	1.59E-03	
CV = S/X =	-2.29E+16	< 1, data are normally distributed

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

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 2023

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

$x_{..} =$ 3.27E-01
$(x_{avg})_{..} =$ 1.31E-02

p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	n_i	$f_iS_i^2$	$f_i\ln(S_i^2)$
1.61E-03	2.59E-06	-1.29E+01	10	2.33E-05	-1.16E+02
3.04E-03	9.23E-06	-1.16E+01	5	3.69E-05	-4.64E+01
2.79E-04	7.76E-08	-1.64E+01	5	3.10E-07	-6.55E+01
2.37E-04	5.63E-08	-1.67E+01	5	2.25E-07	-6.68E+01

$\sum(S_i^2) =$ 1.19E-05 $\sum f_i\ln(S_i^2) =$ -2.94E+02

Equality of Variance: Bartlett's Test

f = 21
$Sp^2 =$ 2.89E-06
$\ln Sp^2 =$ -1.28E+01
$c^2 =$ 2.66E+01 (If $c^2 \le c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.81E+00 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 2023

Lognormal Data for Arsenic

ln[As (mg/L)]					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-21	-4.82E+00	-4.76E+00	-3.56E+00	-4.84E+00	-5.99E+00
Jan-22	-4.31E+00	-4.55E+00	-3.36E+00	-4.78E+00	-6.15E+00
Jul-22	-4.50E+00	-4.58E+00	-3.32E+00	-4.80E+00	-5.99E+00
Jan-23	-4.50E+00	-4.51E+00	-3.37E+00	-4.76E+00	-5.89E+00
Jul-23	-4.75E+00	-4.47E+00	-3.35E+00	-4.75E+00	-5.95E+00
Mean x_i	-4.58E+00	-4.57E+00	-3.39E+00	-4.79E+00	-5.99E+00
Background Mean	-4.58E+00		NA	NA	NA
Grand Mean	-4.66E+00				
x_i^2	2.32E+01	2.26E+01	1.27E+01	2.34E+01	3.59E+01
	1.86E+01	2.07E+01	1.13E+01	2.29E+01	3.78E+01
These values needed for ANOVA	2.03E+01	2.09E+01	1.11E+01	2.30E+01	3.59E+01
	2.03E+01	2.03E+01	1.14E+01	2.27E+01	3.46E+01
	2.26E+01	2.00E+01	1.12E+01	2.26E+01	3.54E+01
Sum x_i^2	5.61E+02				

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-21	-4.82E+00	-4.76E+00	-3.56E+00	-4.84E+00	-5.99E+00
Jan-22	-4.31E+00	-4.55E+00	-3.36E+00	-4.78E+00	-6.15E+00
Jul-22	-4.50E+00	-4.58E+00	-3.32E+00	-4.80E+00	-5.99E+00
Jan-23	-4.50E+00	-4.51E+00	-3.37E+00	-4.76E+00	-5.89E+00
Jul-23	-4.75E+00	-4.47E+00	-3.35E+00	-4.75E+00	-5.95E+00

X: Mean Value = -4.66E+00
S: Standard Deviation = 8.51E-01
CV = S/X = -1.82E-01 <1, data are normally distributed

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

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

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

$x_{..} =$ -1.17E+02
$(x_{avg})_{..} =$ -4.66E+00
$n_i =$ 5
p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	ni	$f_iS_i^2$	$f_i\ln(S_i^2)$
1.56E-01	2.45E-02	-3.71E+00	10	2.20E-01	-3.34E+01
9.56E-02	9.15E-03	-4.69E+00	5	3.66E-02	-1.88E+01
3.37E-02	1.13E-03	-6.78E+00	5	4.53E-03	-2.71E+01
9.80E-02	9.60E-03	-4.65E+00	5	3.84E-02	-1.86E+01

$\sum(S_i^2) =$ 4.44E-02 $\sum f_i\ln(S_i^2) =$ -9.79E+01

Equality of Variance: Bartlett's Test

f = 2.10E+01
$Sp^2 =$ 1.43E-02
$\ln Sp^2 =$ -4.25E+00
$c^2 =$ 8.65E+00 (If $c^2 \le c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.81E+00 at a 5% significance level with 3 degrees of freedom

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

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 2023

Nonparametric ANOVA

Arsenic (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-21	**8.06E-03**	**8.59E-03**	**2.84E-02**	**7.93E-03**	2.50E-03
Jan-22	**1.34E-02**	**1.06E-02**	**3.48E-02**	**8.38E-03**	**2.13E-03**
Jul-22	**1.11E-02**	**1.03E-02**	**3.60E-02**	**8.27E-03**	2.50E-03
Jan-23	**1.11E-02**	**1.10E-02**	**3.43E-02**	**8.57E-03**	**2.78E-03**
Jul-23	**8.63E-03**	**1.14E-02**	**3.51E-02**	**8.63E-03**	**2.60E-03**
Sum	1.04E-01		1.69E-01	4.18E-02	1.25E-02
n_i	10		5	5	5
$(x_i)_{avg}$	1.04E-02		3.37E-02	8.36E-03	2.50E-03

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.. = 1.31E-02

N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	3.27E-01	x.. = the sum of the total number of samples

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

Nonparametric ANOVA

Ranking of Observations

Sequence	Arsenic (mg/L)	Adjusted Rank	Tie Number
1	0	1.5	Tie 1
2	0	1.5	
3	**2.13E-03**	3	
4	**2.60E-03**	4	
5	**2.78E-03**	5	
6	**7.93E-03**	6	
7	**8.06E-03**	7	
8	**8.27E-03**	8	
9	**8.38E-03**	9	
10	**8.57E-03**	10	
11	**8.59E-03**	11	
12	**8.63E-03**	12.5	Tie 2
13	**8.63E-03**	12.5	
14	**1.03E-02**	14	
15	**1.06E-02**	15	
16	**1.10E-02**	16	
17	**1.11E-02**	17.5	Tie 3
18	**1.11E-02**	17.5	
19	**1.14E-02**	19	
20	**1.34E-02**	20	
21	**2.84E-02**	21	
22	**3.43E-02**	22	
23	**3.48E-02**	23	
24	**3.51E-02**	24	
25	**3.60E-02**	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}		
2	Tie 1 =	6
2	Tie 2 =	6
2	Tie 3 =	6
	$\sum T_i$ =	18

Attachment B1: Arsenic URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

Sums of Ranks and Averages

Arsenic (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-21	**8.06E-03**	**8.59E-03**	**2.84E-02**	**7.93E-03**	0
Jan-22	**1.34E-02**	**1.06E-02**	**3.48E-02**	**8.38E-03**	**2.13E-03**
Jul-22	**1.11E-02**	**1.03E-02**	**3.60E-02**	**8.27E-03**	0
Jan-23	**1.11E-02**	**1.10E-02**	**3.43E-02**	**8.57E-03**	**2.78E-03**
Jul-23	**8.63E-03**	**1.14E-02**	**3.51E-02**	**8.63E-03**	**2.60E-03**

Observation Ranks for Arsenic					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-21	7	11	21	6	1.5
Jan-22	20	15	23	9	3
Jul-22	17.5	14	25	8	1.5
Jan-23	17.5	16	22	10	5
Jul-23	12.5	19	24	12.5	4
R_i	149.5		115	45.5	15
$(R_i)_{avg}$	15.0		23.0	9.1	3.0
R_i^2/n_i	2235.0		2645.0	414.1	45.0

$\Sigma R_i^2/n_i$ = 5.34E+03

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 =	2.06E+01	Kruskal-Wallis Statistic	$H = [12/N(N+1)*\Sigma R_i^2/n_i] - 3(N+1)$
H' =	2.06E+01	Corrected Kruskal-Wallis	$H' = H/[1-(\sum T_i/N^3-N)]$
χ^2_{crit}* =	7.81E+00	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) =	1.67E-02	Z(α/(K-1))** =	2.13E+00
α =	0.05	1-(α/K-1) =	9.83E-01		

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 2023

Calculate Critical Values

Average Background Ranking = 15.0

	Well No.	C_i	$(R_i)_{avg} - (R_b)_{avg}$	Conclusion
BG Well	MW93A			
BG Well	MW420			
	MW84A	8.58E+00	8.05E+00	not contaminated
	MW87A	8.58E+00	-5.85E+00	not contaminated
	MW90A	8.58E+00	-1.20E+01	not contaminated

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 B2

TECHNETIUM-99
STATISTICAL TEST 4

THIS PAGE INTENTIONALLY LEFT BLANK

Attachment B2: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Technetium-99 (pCi/L)					
Date	**Background**	**Background**	**Compliance**	**Compliance**	**Compliance**
	MW93A	**MW420**	**MW84A**	**MW87A**	**MW90A**
May-22	7.95E+00	7.95E+00	**4.79E+01**	6.00E+00	**3.44E+01**
Jul-Aug-22	7.85E+00	7.25E+00	**4.72E+01**	6.70E+00	**2.57E+01**
Nov-22	8.65E+00	8.30E+00	**6.40E+01**	8.40E+00	**2.23E+01**
Jan-23	9.15E+00	8.85E+00	**2.02E+02**	**2.44E+01**	1.19E+01
Jul-23	9.35E+00	9.75E+00	**6.42E+01**	**3.33E+01**	**2.47E+01**

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 =	0	X = number of samples above DL in background wells
Y =	11	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 =	4.40E-01	P = (x+y)/n
nP =	11	n = n_b+n_c
n(1-P) =	14	

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

P_b =	0.00E+00	P_b = proportion of detects in background wells
P_c =	7.33E-01	P_c = proportion of detects in compliance wells
S_D =	2.03E-01	S_D = standard error of difference in proportions
Z =	-3.62E+00	Z = (P_b-P_c)/S_D
absolute value of Z =	3.62E+00	

If the absolute value of Z exceeds the 97.5th percentile value of 1.96E+00 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 1.96E+00, Nonparametric ANOVA was performed.

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

Attachment B2: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Nonparametric ANOVA

Technetium-99 (pCi/L)					
Date	**Background**	**Background**	**Compliance**	**Compliance**	**Compliance**
	MW93A	**MW420**	**MW84A**	**MW87A**	**MW90A**
May-22	7.95E+00	7.95E+00	**4.79E+01**	6.00E+00	**3.44E+01**
Jul-Aug-22	7.85E+00	7.25E+00	**4.72E+01**	6.70E+00	**2.57E+01**
Nov-22	8.65E+00	8.30E+00	**6.40E+01**	8.40E+00	**2.23E+01**
Jan-23	9.15E+00	8.85E+00	**2.02E+02**	**2.44E+01**	1.19E+01
Jul-23	9.35E+00	9.75E+00	**6.42E+01**	**3.33E+01**	**2.47E+01**
Sum	8.51E+01		4.25E+02	7.88E+01	1.19E+02
n_i	10		5	5	5
$(x_i)_{avg}$	8.51E+00		8.51E+01	1.58E+01	2.38E+01

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.. = 2.83E+01

N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	7.08E+02	x.. = the sum of the total number of samples

Attachment B2: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Nonparametric ANOVA

Ranking of Observations

Sequence	Technetium-99 (pCi/L)	Adjusted Rank	Tie Number
1	0	7.5	Tie 1
2	0	7.5	
3	0	7.5	
4	0	7.5	
5	0	7.5	
6	0	7.5	
7	0	7.5	
8	0	7.5	
9	0	7.5	
10	0	7.5	
11	0	7.5	
12	0	7.5	
13	0	7.5	
14	0	7.5	
15	**2.23E+01**	15	
16	**2.44E+01**	16	
17	**2.47E+01**	17	
18	**2.57E+01**	18	
19	**3.33E+01**	19	
20	**3.44E+01**	20	
21	**4.72E+01**	21	
22	**4.79E+01**	22	
23	**6.40E+01**	23	
24	**6.42E+01**	24	
25	**2.02E+02**	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}		
14	Tie 1 =	2.73E+03
	$\sum T_i$ =	2.73E+03

Attachment B2: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Nonparametric ANOVA

Sums of Ranks and Averages

Technetium-99 (pCi/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
May-22	0	0	**4.79E+01**	0	**3.44E+01**
Jul-Aug-22	0	0	**4.72E+01**	0	**2.57E+01**
Nov-22	0	0	**6.40E+01**	0	**2.23E+01**
Jan-23	0	0	**2.02E+02**	**2.44E+01**	0
Jul-23	0	0	**6.42E+01**	**3.33E+01**	**2.47E+01**

Observation Ranks for Technetium-99					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
May-22	7.5	7.5	22	7.5	20
Jul-Aug-22	7.5	7.5	21	7.5	18
Nov-22	7.5	7.5	23	7.5	15
Jan-23	7.5	7.5	25	16	7.5
Jul-23	7.5	7.5	24	19	17
R_i	75.00		115.00	57.50	77.50
$(R_i)_{avg}$	7.50		23.00	11.50	15.50
R_i^2/n_i	562.50		2645.00	661.25	1201.25

$\Sigma R_i^2/n_i$ = 5.07E+03

K = 4

N = 25

pCi/L = picocuries 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 = 1.56E+01 Kruskal-Wallis Statistic $H = [12/N(N+1)*\Sigma R_i^2/n_i] - 3(N+1)$

H' = 1.89E+01 Corrected Kruskal-Wallis $H' = H/[1-(\sum T_i/N^3-N)]$

χ^2_{crit}* = 7.81E+00 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 $\alpha/(K-1)$ = 1.67E-02 $Z(\alpha/(K-1))$** = 2.13E+00

α = 0.05 $1-(\alpha/K-1)$ = 9.83E-01

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: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Nonparametric ANOVA

Calculate Critical Values

Average Background Ranking = 7.5

	Well No.	C_i	$(R_i)_{avg} - (R_b)_{avg}$	Conclusion
BG Well	MW93A			
BG Well	MW420			
	MW84A	8.58E+00	1.55E+01	**evidence of contamination**
	MW87A	8.58E+00	4.00E+00	not contaminated
	MW90A	8.58E+00	8.00E+00	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 B2: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

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 2023 Data, Second Reporting Period
Technetium-99 Observations (pCi/L)

Well No.						
MW93A	**7.95E+00**	**7.85E+00**	**8.65E+00**	**9.15E+00**	**9.35E+00**	**Upgradient Well!**
MW420	**7.95E+00**	**7.25E+00**	**8.30E+00**	**8.85E+00**	**9.75E+00**	**Upgradient Well!**
						Current Data
MW84A						**6.42E+01**
	X: Mean Value =		8.51E+00			
	S: Standard Deviation =		7.80E-01			
	K* factor =		2.911	(for n = 10)		
	CV = S/X		9.18E-02	<1, assume normal distribution		
	Upper Tolerance Interval: TL = X +(KxS) =			**1.08E+01**	(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.**

Conclusion: **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.**

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	
May-22	7.95E+00	**4.79E+01**	6.32E+01	2.29E+03
Jul-Aug-22	7.85E+00	**4.72E+01**	6.16E+01	2.23E+03
Nov-22	8.65E+00	**6.40E+01**	7.48E+01	4.10E+03
Jan-23	9.15E+00	**2.02E+02**	8.37E+01	4.08E+04
Jul-23	9.35E+00	**6.42E+01**	8.74E+01	4.12E+03
Sum (x_i)	4.30E+01	4.25E+02	4.68E+02	Total Sum (x..)
n_i	5	5		
$(x_i)_{avg}$	8.59E+00	8.51E+01		
$(x_i)^2$	1.84E+03	1.81E+05		

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

Overall mean x.. =	4.68E+01	
N =	10	N = the total number of samples
p =	2	p = the number of n_i groups
$x_{..}$ =	4.68E+02	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
May-22	-6.40E-01	-3.72E+01
Jul-Aug-22	-7.40E-01	-3.79E+01
Nov-22	6.00E-02	-2.11E+01
Jan-23	5.60E-01	1.17E+02
Jul-23	7.60E-01	-2.09E+01

X: Mean Value =	0.00E+00	
S: Standard Deviation =	4.39E+01	
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 B2: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Determine Equality of Variance of Dataset

p = number of wells	$x_{..} =$ 4.68E+02
n_i = number of data points per well	$(x_{avg})_{..} =$ 4.68E+01
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	$f_iS_i^2$	$f_i\ln(S_i^2)$†
6.80E-01	4.63E-01	-7.70E-01	5	1.85E+00	-3.08E+00
6.59E+01	4.34E+03	8.38E+00	5	1.74E+04	3.35E+01

$\sum(S_i^2) =$ 4.34E+03 $\sum f_i\ln(S_i^2) =$ 3.04E+01

Equality of Variance: Bartlett's Test

f =	8	
Sp^2 =	2.17E+03	
ln Sp^2 =	7.68E+00	
χ^2 =	3.10E+01	(If calculated $\chi^2 \leq$ tabulated χ^2_{crit}, then variances are equal at the given significance level).
χ^2_{crit} * =	3.84E+00	at a 5% significance level witl 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 B2: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Paired (Parametric) ANOVA—Lognormal Data

ln[Technetium-99 (pCi/L)]				
Date	Background	Compliance		
	MW93A	MW84A	n_i^2	
May-22	2.07E+00	**3.87E+00**	4.30E+00	1.50E+01
Jul-Aug-22	2.06E+00	**3.85E+00**	4.25E+00	1.49E+01
Nov-22	2.16E+00	**4.16E+00**	4.66E+00	1.73E+01
Jan-23	2.21E+00	**5.31E+00**	4.90E+00	2.82E+01
Jul-23	2.24E+00	**4.16E+00**	5.00E+00	1.73E+01
Sum (x_i)	1.07E+01	2.14E+01	3.21E+01	Total Sum (x..)
n_i	5	5		
$(x_i)_{avg}$	2.15E+00	4.27E+00		
$(x_i)^2$	1.15E+02	4.56E+02		

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

Overall mean x.. =	3.21E+00	
N =	10	N = the total number of samples
p =	2	p = the number of n_i groups
$x_{..}$ =	3.21E+01	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
May-22	-7.49E-02	-4.01E-01
Jul-Aug-22	-8.76E-02	-4.16E-01
Nov-22	9.48E-03	-1.12E-01
Jan-23	6.57E-02	1.04E+00
Jul-23	8.73E-02	-1.09E-01

X: Mean Value =	-4.44E-17	
S: Standard Deviation =	4.03E-01	
K* Factor =	2.911	(for n = 10)
CV = S/X =	–9.07E+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 B2: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Determine Equality of Variance—Lognormal Data

p = number of wells	$x_{..} =$ 3.21E+01
n_i = number of data points per well	$(x_{avg})_{..} =$ 3.21E+00
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	$f_i S_i^2$	$f_i \ln(S_i^2)$
7.95E-02	6.33E-03	-5.06E+00	5	2.53E-02	-2.03E+01
5.99E-01	3.59E-01	-1.02E+00	5	1.44E+00	-4.10E+00

$\sum(S_i^2) =$ 3.65E-01 $\sum f_i \ln(S_i^2) =$ -2.44E+01

Equality of Variance: Bartlett's Test

f =	8	
Sp^2 =	1.83E-01	
ln Sp^2 =	-1.70E+00	
χ^2 =	1.07E+01	(If calculated $\chi^2 \leq$ tabulated χ^2_{crit}, then variances are equal at the given significance level).
χ^2_{crit} * =	3.84E+00	at a 5% significance level with 1 degrees of freedom (p-1)

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

Since the variances are not equal, paired (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 B2: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Paired Nonparametric ANOVA

Technetium-99 (pCi/L)		
Date	Background	Compliance
	MW93A	MW84A
May-22	7.95E+00	**4.79E+01**
Jul-Aug-22	7.85E+00	**4.72E+01**
Nov-22	8.65E+00	**6.40E+01**
Jan-23	9.15E+00	**2.02E+02**
Jul-23	9.35E+00	**6.42E+01**
Sum	4.30E+01	4.25E+02
n_i	5	5
$(x_i)_{avg}$	8.59E+00	8.51E+01

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

Overall mean x.. = 4.68E+01
N = 10
p = 2
x.. = 4.68E+02

Ranking of Observations

Sequence	Technetium-99	Adjusted	Tie Number
1	0	3	
2	0	3	
3	0	3	Tie 1
4	0	3	
5	0	3	
6	**4.72E+01**	6	
7	**4.79E+01**	7	
8	**6.40E+01**	8	
9	**6.42E+01**	9	
10	**2.02E+02**	10	

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

n_{tie} Adjustment for Ties: $(n_{tie}^3 - n_{tie})$
5 Tie 1 = 1.20E+02
$\sum T_i$ = 1.20E+02

Note: for this method, observations below the detection that are considered non-detects (i.e., U qualified data) are reported as a concentration 0.

Sums of Ranks and Averages

Observation Ranks for Tc-99		
Date	Background	Compliance
	MW93A	MW84A
May-22	3	7
Jul-Aug-22	3	6
Nov-22	3	8
Jan-23	3	10
Jul-23	3	9
R_i	15	40
$(R_i)_{avg}$	3.0	8
R_i^2/n_i	45.0	320.0

$\Sigma R_i^2/n_i$ = 365
K = 2
N = 10

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

Attachment B2: Technetium-99 URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Calculation of Kruskal-Wallis Statistic

H =	6.82E+00	Kruskal-Wallis Statistic	$H = [12/N(N+1)*\Sigma R_i^2/n_i] - 3(N+1)$
H' =	7.76E+00	Corrected Kruskal-Wallis	$H' = H/[1-(\sum T_i/N^3-N)]$
χ^2_{crit} * =	3.84E+00	1	degrees of freedom at the 5% significance level

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

If $H' \leq \chi^2_{crit}$, the data from each well comes 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 =	1	α/(K-1) =	5.00E-02	Z(α/(K-1))** =	1.64E+00
α =	0.05	1-(α/K-1) =	9.50E-01		

*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).

Calculate Critical Values

Average Background Ranking = 3.000

	Well No.	C_i	$(R_i)_{avg} - (R_b)_{avg}$	Conclusion
BG Well	MW93A			
	MW84A	3.15E+00	5.00E+00	**evidence of contamination**

pCi/L = picocuries per liter
BG = background

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 (Ri)avg - (Rb)avg > Ci for MW84A, there is a statistically significant difference in this downgradient compliance test well.

Because the nonparametric 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.

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, First Reporting Period 2023

Mann-Kendall Trend Analysis for Technetium-99 in MW84A

Input Data

Date Collected	Result (pCi/L)
Jul-21	**2.29E+02**
Nov-21	**2.58E+02**
Jan-22	**2.25E+02**
May-22	**4.79E+01**
Jul-22	**4.72E+01**
Nov-22	**6.40E+01**
Jan-23	**2.02E+02**
Jul-23	**6.42E+01**

Bolded values indicate a detected result.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.110/9/2023 9:24:43 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

MW84A_Tc-99_July23

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	8
Number Values Reported (n)	8
Minimum	4.72E+01
Maximum	2.58E+02
Mean	1.42E+02
Geometric Mean	1.12E+02
Median	1.33E+02
Standard Deviation	9.37E+01
Coefficient of Variation	6.59E-01

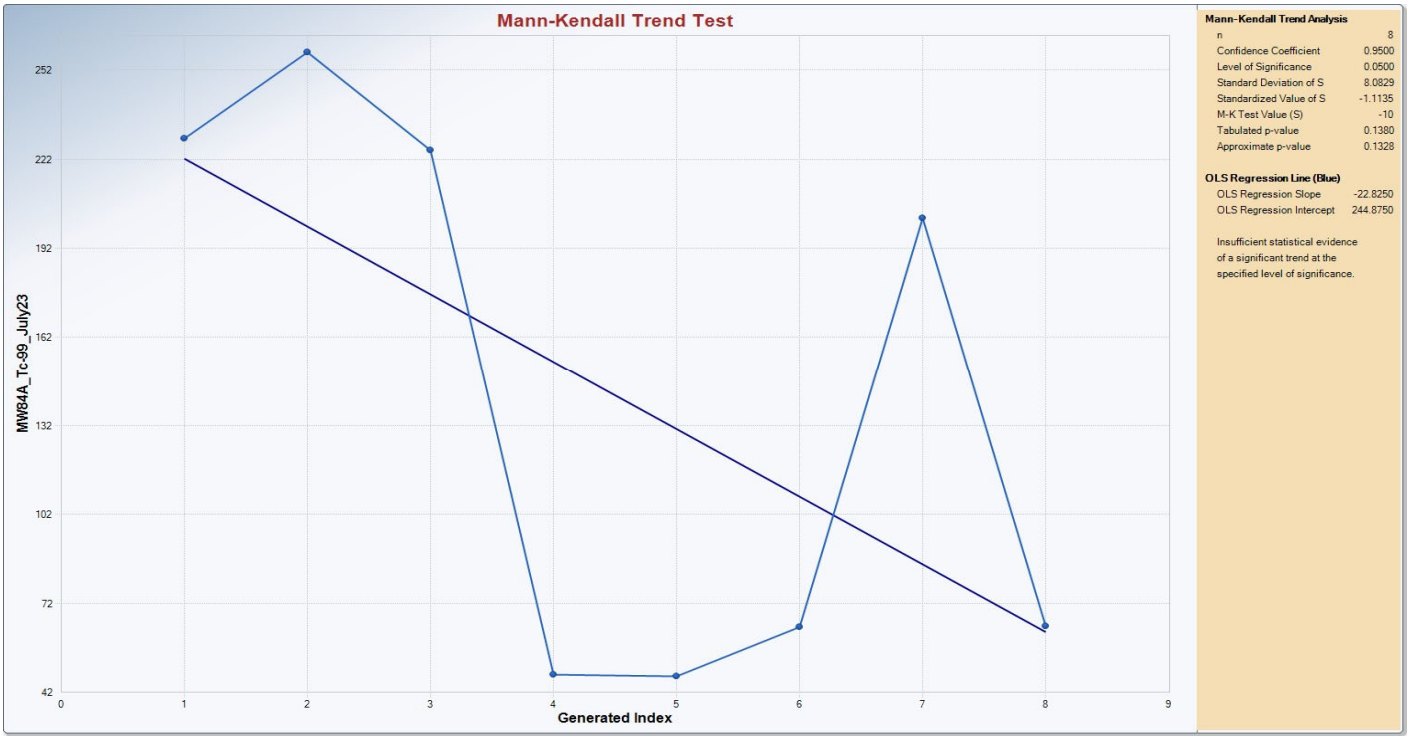
Mann-Kendall Test

M-K Test Value (S)	-10
Tabulated p-value	1.38E-01
Standard Deviation of S	8.08E+00
Standardized Value of S	-1.11E+00
Approximate p-value	1.33E-01

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

Attachment B3: Technetium-99 URGA, Statistical Test 2, Test of Proportions, First Reporting Period 2023

Mann-Kendall Trend Analysis for Technetium-99 in MW84A



ATTACHMENT B3

TRICHLOROETHENE
STATISTICAL TEST 4

THIS PAGE INTENTIONALLY LEFT BLANK

Attachment B3: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

Trichloroethene (TCE, µg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-21	**3.17E+03**	**1.79E+03**	**5.29E+03**	**2.41E+03**	**1.48E+02**
Jan-22	**2.55E+03**	**2.10E+03**	**6.56E+03**	**1.89E+03**	**1.46E+02**
Jul-Aug-22	**1.63E+03**	**1.62E+03**	**6.57E+03**	**1.40E+03**	**2.22E+02**
Jan-23	**1.96E+03**	**2.11E+03**	**7.00E+03**	**2.14E+03**	**2.96E+02**
Jul-23	**1.88E+03**	**2.09E+03**	**5.87E+03**	**2.16E+03**	**2.67E+02**
n_i	10		5	5	5
Sum	2.09E+04		3.13E+04	1.00E+04	1.08E+03
(x_i)avg	2.09E+03		6.26E+03	2.00E+03	2.16E+02

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

Overall mean x.. =	2.53E+03	
N =	25	N = the total number of samples
p =	4	p = the number of n_i groups
x.. =	6.33E+04	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-21	1.08E+03	-3.00E+02	-9.68E+02	4.10E+02	-6.78E+01
Jan-22	4.60E+02	1.00E+01	3.02E+02	-1.10E+02	-6.98E+01
Jul-Aug-22	-4.60E+02	-4.70E+02	3.12E+02	-6.00E+02	6.20E+00
Jan-23	-1.30E+02	2.00E+01	7.42E+02	1.40E+02	8.02E+01
Jul-23	-2.10E+02	0.00E+00	-3.88E+02	1.60E+02	5.12E+01

X: Mean Value =	4.55E-15	
S: Standard Deviation =	4.28E+02	
K* Factor =	2.292	(for n = 25)
CV = S/X =	9.41E+16	

Conclusion: Since the coefficient of variability is greater than 1, the data are not normally distributed.

*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 B3: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

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

$x_{..} =$ 6.33E+04
$(x_{avg})_{..} =$ 2.53E+03
p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	n_i	$f_i S_i^2$	$f_i \ln(S_i^2)$
4.67E+02	2.18E+05	1.23E+01	10	1.96E+06	1.11E+02
6.76E+02	4.57E+05	1.30E+01	5	1.83E+06	5.21E+01
3.83E+02	1.46E+05	1.19E+01	5	5.85E+05	4.76E+01
6.81E+01	4.64E+03	8.44E+00	5	1.86E+04	3.38E+01

$\sum(S_i^2) =$ 8.26E+05 $\sum f_i \ln(S_i^2) =$ 2.44E+02

Equality of Variance: Bartlett's Test

f = 21
$Sp^2 =$ 2.09E+05
$\ln Sp^2 =$ 1.23E+01
$c^2 =$ 1.32E+01 (If $c^2 \leq c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.81E+00 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 B3: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

Lognormal Data for TCE

ln[TCE (µg/L)]					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-21	8.06E+00	7.49E+00	8.57E+00	7.79E+00	5.00E+00
Jan-22	7.84E+00	7.65E+00	8.79E+00	7.54E+00	4.98E+00
Jul-Aug-22	7.40E+00	7.39E+00	8.79E+00	7.24E+00	5.40E+00
Jan-23	7.58E+00	7.65E+00	8.85E+00	7.67E+00	5.69E+00
Jul-23	7.54E+00	7.64E+00	8.68E+00	7.68E+00	5.59E+00
Mean x_i	7.68E+00	7.57E+00	8.74E+00	7.58E+00	5.33E+00
Background Mean	7.63E+00		NA	NA	NA
Grand Mean	7.38E+00				
x_i^2	6.50E+01	5.61E+01	7.35E+01	6.06E+01	2.50E+01
	6.15E+01	5.85E+01	7.72E+01	5.69E+01	2.48E+01
These values needed for ANOVA	5.47E+01	5.46E+01	7.73E+01	5.25E+01	2.92E+01
	5.75E+01	5.86E+01	7.84E+01	5.88E+01	3.24E+01
	5.68E+01	5.84E+01	7.53E+01	5.89E+01	3.12E+01
Sum x_i^2	1.39E+03				

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-21	8.06E+00	7.49E+00	8.57E+00	7.79E+00	5.00E+00
Jan-22	7.84E+00	7.65E+00	8.79E+00	7.54E+00	4.98E+00
Jul-Aug-22	7.40E+00	7.39E+00	8.79E+00	7.24E+00	5.40E+00
Jan-23	7.58E+00	7.65E+00	8.85E+00	7.67E+00	5.69E+00
Jul-23	7.54E+00	7.64E+00	8.68E+00	7.68E+00	5.59E+00

X: Mean Value = 7.38E+00
S: Standard Deviation = 1.15E+00
K* Factor = 2.292 (for n = 25)
CV = S/X = 1.56E-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 B3: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

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

$x_{..} =$ 1.85E+02
$(x_{avg})_{..} =$ 7.38E+00
$n_i =$ 5
p = 4
N = 25

Calculations for Equality of Variance: Bartlett's Test

S_i	S_i^2	$\ln(S_i^2)$	ni	$f_iS_i^2$	$f_i\ln(S_i^2)$
2.04E-01	4.17E-02	-3.18E+00	10	3.75E-01	-2.86E+01
1.11E-01	1.23E-02	-4.39E+00	5	4.94E-02	-1.76E+01
2.09E-01	4.36E-02	-3.13E+00	5	1.74E-01	-1.25E+01
3.29E-01	1.08E-01	-2.23E+00	5	4.32E-01	-8.90E+00

$\sum(S_i^2) =$ 2.06E-01 $\sum f_i\ln(S_i^2) =$ -6.76E+01

Equality of Variance: Bartlett's Test

f = 21
$Sp^2 =$ 4.91E-02
$\ln Sp^2 =$ -3.01E+00
$c^2 =$ 4.32E+00 (If $c^2 \le c^2_{crit}$, then variances are equal at the given significance level).
c^2_{crit} * = 7.81E+00 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 B3: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

Parametric ANOVA

Between Well Sum of Squares[1]

Source of Variation	Sums of Squares	df	Mean Squares	$F_{calculated}$
Between Wells (SS wells)	3.10E+01	3	1.03E+01	2.10E+02
Error within wells (SS error)	1.03E+00	21	4.91E-02	
Total (SS total)	3.20E+01	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.

$F_{tabulated}$ = 3.07E+00**

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
$(x_b)_{avg}$ =	7.63E+00	m =	3	α/m =	1.67E-02

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	8.74E+00	1.11E+00	1.21E-01	2.27	0.28	**evidence of contamination**
MW87A	7.58E+00	-4.06E-02	1.21E-01	2.27	0.28	not contaminated
MW90A	5.33E+00	-2.29E+00	1.21E-01	2.27	0.28	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 B3: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

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 2023 Data, Second Reporting Period
TCE Observations (µg/L)

Well No.						
MW93A	**3.17E+03**	**2.55E+03**	**1.63E+03**	**1.96E+03**	**1.88E+03**	**Upgradient Well[!]**
MW420	**1.79E+03**	**2.10E+03**	**1.62E+03**	**2.11E+03**	**2.09E+03**	**Upgradient Well[!]**
						Current Data
MW84A						**5.87E+03**
	X: Mean Value =		2.09E+03			
	S: Standard Deviation =		4.67E+02			
	K* factor =		2.911	(for n = 10)		
	CV = S/X		2.23E-01	<1, assume normal distribution		
	Upper Tolerance Interval: TL = X +(KxS) =		**3.45E+03**	(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.**

Conclusion: **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.**

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-21	**3.17E+03**	**5.29E+03**	1.00E+07	2.80E+07
Jan-22	**2.55E+03**	**6.56E+03**	6.50E+06	4.30E+07
Jul-Aug-22	**1.63E+03**	**6.57E+03**	2.66E+06	4.32E+07
Jan-23	**1.96E+03**	**7.00E+03**	3.84E+06	4.90E+07
Jul-23	**1.88E+03**	**5.87E+03**	3.53E+06	3.45E+07
Sum (x_i)	1.12E+04	3.13E+04	4.25E+04	Total Sum (x..)
n_i	5	5		
$(x_i)_{avg}$	2.24E+03	6.26E+03		
$(x_i)^2$	1.25E+08	9.79E+08		

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

Overall mean x.. =	4.25E+03	
N =	10	N = the total number of samples
p =	2	p = the number of n_i groups
$x_{..=}$	4.25E+04	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	9.32E+02	-9.68E+02
Jan-22	3.12E+02	3.02E+02
Jul-Aug-22	-6.08E+02	3.12E+02
Jan-23	-2.78E+02	7.42E+02
Jul-23	-3.58E+02	-3.88E+02

X: Mean Value =	0.00E+00	
S: Standard Deviation =	6.12E+02	
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: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

Determine Equality of Variance of Dataset

p = number of wells	$x_{..} =$ 4.25E+04
n_i = number of data points per well	$(x_{avg})_{..} =$ 4.25E+03
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	$f_i S_i^2$	$f_i \ln(S_i^2)$†
6.21E+02	3.85E+05	1.29E+01	5	1.54E+06	5.14E+01
6.76E+02	4.57E+05	1.30E+01	5	1.83E+06	5.21E+01

$\sum(S_i^2) =$ 8.42E+05 $\sum f_i \ln(S_i^2) =$ 1.04E+02

Equality of Variance: Bartlett's Test

f =	8	
Sp^2 =	4.21E+05	
ln Sp^2 =	1.30E+01	
χ^2 =	2.89E-02	(If calculated $\chi^2 \leq$ tabulated χ^2_{crit}, then variances are equal at the given significance level).
χ^2_{crit} * =	3.84E+00	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 B3: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

Between Well Sum of Squares

Source of Variation	Sums of Squares		Degrees of Freedom	Mean Squares	Calculated F	F Statistic**
Between Wells	SS_{wells} =	4.04E+07	1	4.04E+07	9.60E+01	5.32E+00
Error	SS_{Error} =	3.37E+06	8	4.21E+05		
Total	SS_{Total} =	4.38E+07	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 B3: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

Mann-Kendall Trend Test Analysis
MW84A Trichloroethene July 2023

User Selected Options	
Date/Time of Computation	ProUCL 5.19/28/2023 10:42:14 AM
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

MW84A_TCE_Jul2023

Input Data

Date Collected	Result (µg/L)
Jan-20	**2.93E+03**
Jul-20	**3.23E+03**
Jan-21	**2.63E+03**
Jul-21	**5.29E+03**
Jan-22	**6.56E+03**
Jul-22	**6.57E+03**
Jan-23	**7.00E+03**
Jul-23	**5.87E+03**

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	2.63E+03
Maximum	7.00E+03
Mean	5.01E+03
Geometric Mean	4.69E+03
Median	5.58E+03
Standard Deviation	1.80E+03
Coefficient of Variation	3.60E-01

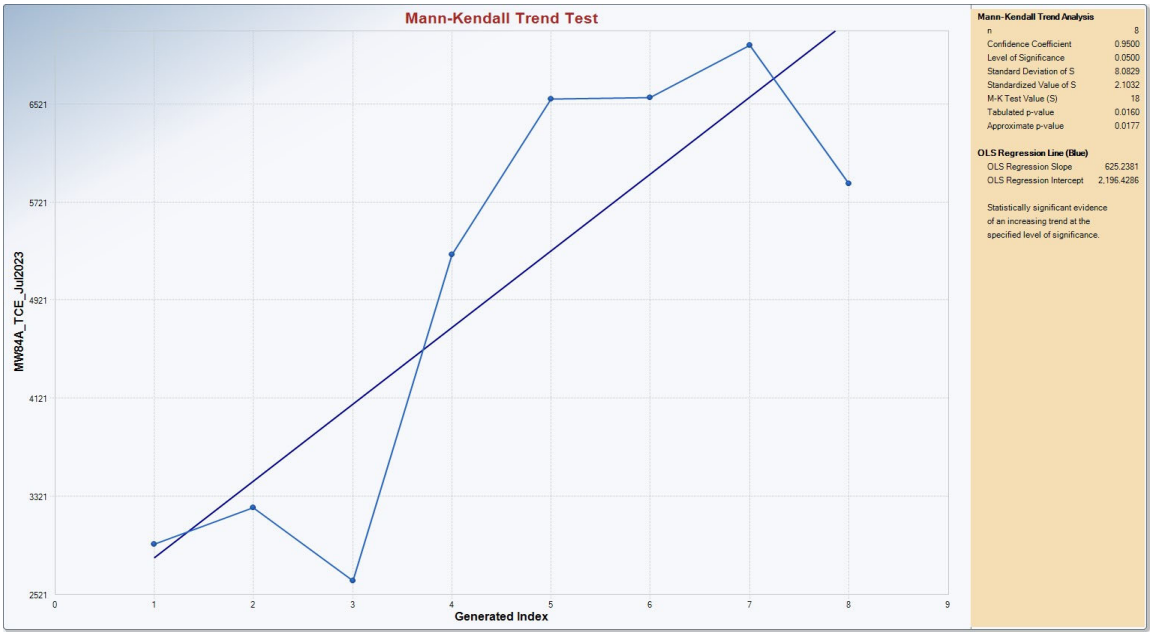
Mann-Kendall Test

M-K Test Value (S)	18
Tabulated p-value	1.60E-02
Standard Deviation of S	8.08E+00
Standardized Value of S	2.10E+00
Approximate p-value	1.77E-02

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

Attachment B3: Trichloroethene URGA, Statistical Test 4, Parametric ANOVA, Second Reporting Period 2023

Mann-Kendall Trend Test Analysis
MW84A Trichloroethene July 2023



THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B4

URANIUM
STATISTICAL TEST 2

THIS PAGE INTENTIONALLY LEFT BLANK

Attachment B4: Uranium URGA, Statistical Test 2, Test of Proportions, Second Reporting Period 2023

Uranium (mg/L)					
Date	Background	Background	Compliance	Compliance	Compliance
	MW93A	MW420	MW84A	MW87A	MW90A
Jul-21	**7.90E-05**	1.00E-04	1.00E-04	1.00E-04	1.00E-04
Jan-22	**1.26E-04**	1.00E-04	1.00E-04	1.00E-04	1.00E-04
Jul-22	**7.60E-05**	1.00E-04	**6.80E-05**	1.00E-04	1.00E-04
Jan-23	1.00E-04	1.00E-04	1.00E-04	1.00E-04	1.00E-04
Jul-23	1.00E-04	1.00E-04	1.00E-04	1.00E-04	1.00E-04

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 =	3	X = number of samples above DL in background wells
Y =	1	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 =	0.160	P=(x+y)/n
nP =	4	$n=n_b+n_c$
n(1-P) =	21	

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

P_b =	3.00E-01	P_b = proportion of detects in background wells
P_c =	6.67E-02	P_c = proportion of detects in compliance wells
S_D =	1.50E-01	S_D = standard error of difference in proportions
Z =	1.56E+00	$Z = (P_b-P_c)/S_D$
absolute value of Z =	1.56E+00	

If the absolute value of Z exceeds the 97.5th percentile value of 1.96E+00 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 1.96E+00, 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).

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B5

STATISTICIAN STATEMENT

THIS PAGE INTENTIONALLY LEFT BLANK

FOUR RIVERS NUCLEAR PARTNERSHIP, LLC

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

October 19, 2023

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 2021 through July 2023 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
- Paired (nonparametric) 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

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C

2023 ANNUAL REPORT OF THE C-404 LANDFILL HYDRAULIC FLOW RATE AND DIRECTION

THIS PAGE INTENTIONALLY LEFT BLANK

2023 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 26, 2023, and July 24-25, 2023) 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 2023 semiannual sampling events.

Table C.1. Measurement Control Datums Used for Upper Regional Gravel Aquifer C-404 Monitoring Wells During 2023

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 1.33×10^{-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 2023 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 2023

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	0.0279 (9.83×10^{-6})	0.111 (3.93×10^{-5})
High K	0.186 (6.55×10^{-5})	0.743 (2.62×10^{-4})

Table C.3. Calculation Information for the C-404 Landfill Annual Groundwater Flow Rate 2023

Upper RGA K = 21 ft/d					
	i (ft/ft)	**q (ft/d)**	**q (cm/s)**	**v (ft/d)**	**v (cm/s)**
January 2023	-1.27×10^{-3}	0.0266	9.40×10^{-6}	0.107	3.76×10^{-5}
July 2023	-1.38×10^{-3}	0.0291	1.03×10^{-5}	0.116	4.10×10^{-5}
Annual Average	**-1.33×10^{-3}**	**0.0279**	**9.83×10^{-6}**	**0.111**	**3.93×10^{-5}**
Upper RGA K = 140 ft/d					
	i (ft/ft)	**q (ft/d)**	**q (cm/s)**	**v (ft/d)**	**v (cm/s)**
January 2023	-1.27×10^{-3}	0.178	6.27×10^{-5}	0.711	2.51×10^{-4}
July 2023	-1.38×10^{-3}	0.194	6.84×10^{-5}	0.775	2.73×10^{-4}
Annual Average	**-1.33×10^{-3}**	**0.186**	**6.55×10^{-5}**	**0.743**	**2.62×10^{-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

$v = q/n_e$

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

Table C.4. January 2023 RGA Potentiometric Surface Data

C-404 Landfill (January 2023) 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)
1/26/2023	8:01	MW67	374.91	30.11	0.00	52.49	322.42	52.49	322.42
1/26/2023	8:16	MW76	376.56	30.11	0.00	54.08	322.48	54.08	322.48
1/26/2023	8:03	MW84A	375.29	30.11	0.00	53.08	322.21	53.08	322.21
1/26/2023	8:04	MW87A	375.30	30.11	0.00	53.08	322.22	53.08	322.22
1/26/2023	8:08	MW90A	374.15	30.11	0.00	51.94	322.21	51.94	322.21
1/26/2023	8:13	MW93A	378.67	30.11	0.00	56.02	322.65	56.02	322.65
1/26/2023	8:19	MW227	378.81	30.11	0.00	56.02	322.79	56.02	322.79
1/26/2023	8:15	MW333	377.19	30.11	0.00	54.47	322.72	54.47	322.72
1/26/2023	7:56	MW337	374.41	30.11	0.00	51.91	322.50	51.91	322.50
1/26/2023	7:55	MW338	374.72	30.11	0.00	52.23	322.49	52.23	322.49
1/26/2023	8:10	MW420	377.55	30.11	0.00	55.00	322.55	55.00	322.55
Reference Barometric Pressure			**30.11**						

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 2023 RGA Potentiometric Surface Data

C-404 Landfill (July 2023) 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)
7/24/2023	12:50	MW67	374.91	30.06	0.00	50.32	324.59	50.32	324.59
7/25/2023	6:45	MW76	376.56	30.07	-0.01	52.01	324.55	52.00	324.57
7/25/2023	6:47	MW84A	375.29	30.07	-0.01	50.91	324.38	50.90	324.40
7/25/2023	6:49	MW87A	375.30	30.07	-0.01	50.99	324.31	50.98	324.32
7/24/2023	13:01	MW90A	374.15	30.05	0.01	49.81	324.34	49.82	324.33
7/24/2023	13:08	MW93A	378.67	30.05	0.01	53.90	324.77	53.91	324.76
7/24/2023	13:20	MW227	378.81	30.05	0.01	53.92	324.89	53.93	324.88
7/24/2023	13:11	MW333	377.19	30.05	0.01	52.28	324.91	52.29	324.90
7/24/2023	12:33	MW337	374.41	30.06	0.00	49.71	324.70	49.71	324.70
7/24/2023	12:36	MW338	374.72	30.06	0.00	50.04	324.68	50.04	324.68
7/24/2023	13:03	MW420	377.55	30.05	0.01	52.90	324.65	52.91	324.64
Reference Barometric Pressure			**30.06**						

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

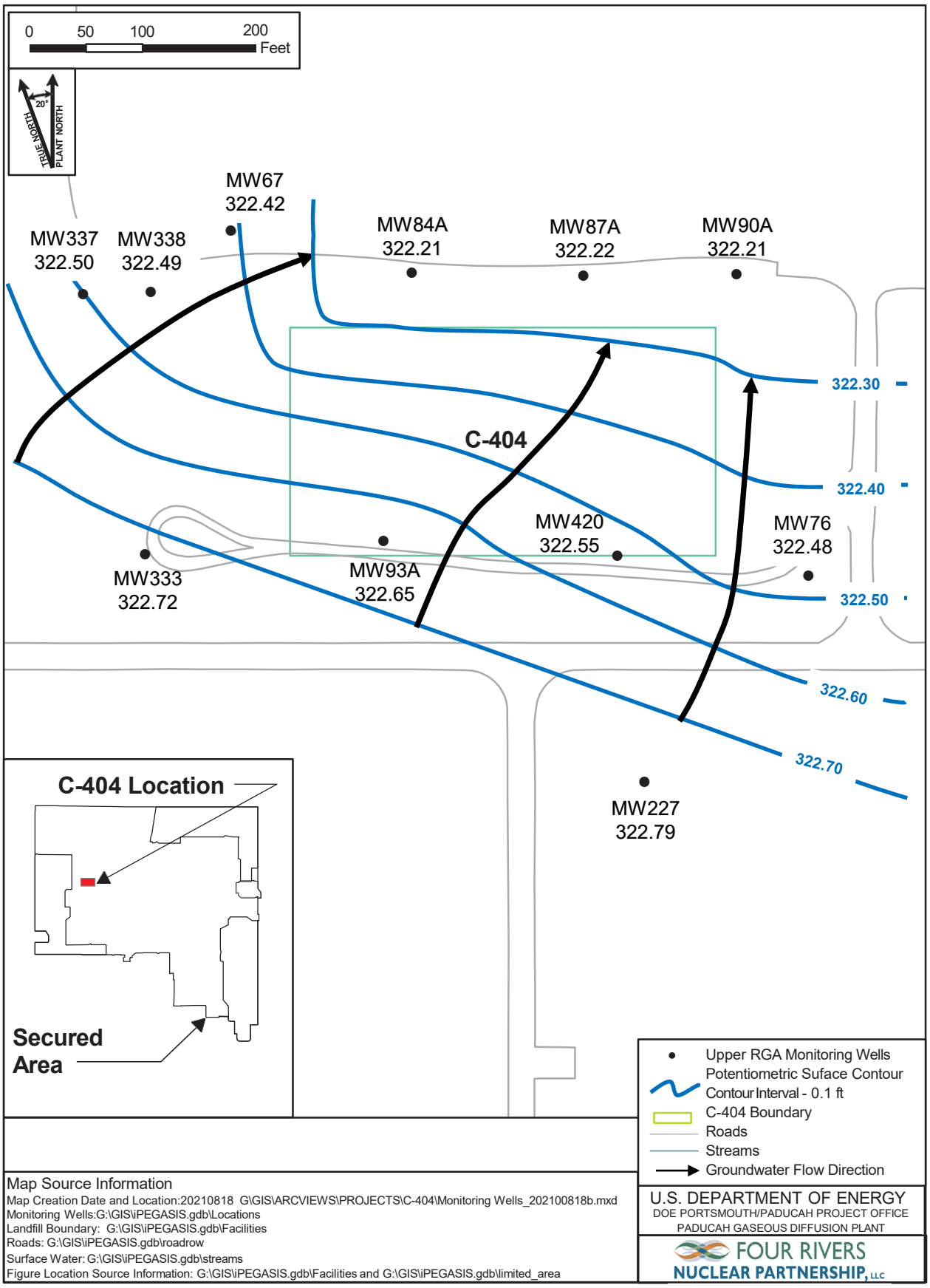


Figure C.1. Potentiometric Surface of the Upper Regional Gravel Aquifer at the C-404 Landfill, January 26, 2023

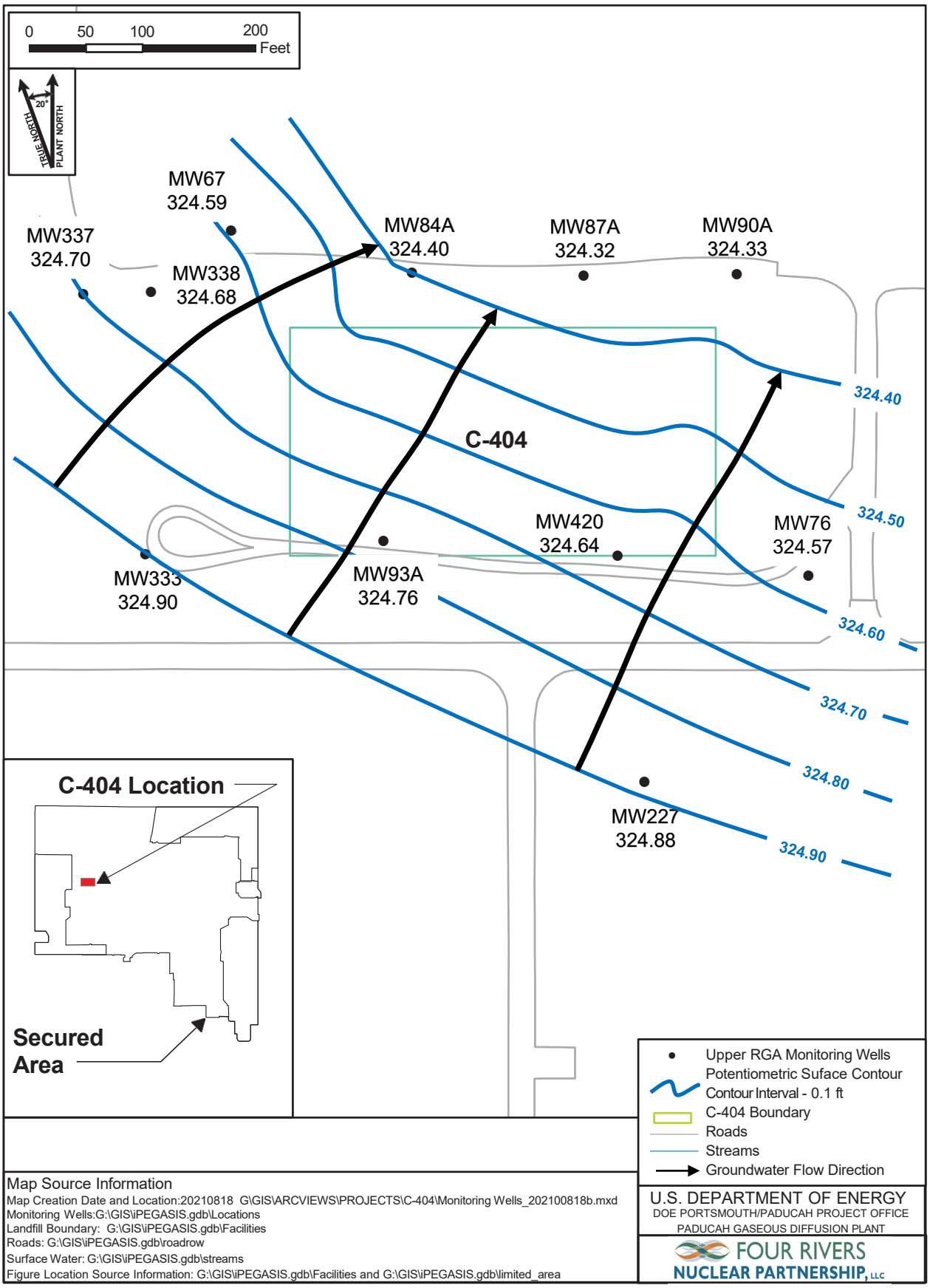


Figure C.2. Potentiometric Surface of the Upper Regional Gravel Aquifer at the C-404 Landfill, July 24-25, 2023

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D

C-404 HAZARDOUS WASTE LANDFILL LEACHATE ANALYTICAL RESULTS

THIS PAGE INTENTIONALLY LEFT BLANK

Paducah OREIS Report for 404L23-02

Sample ID: **L1404L2-23** Station: C404L Date Collected: 5/11/2023 MedType: WW SmpMethod: GR

Comments: Water level is 5' from top of ground surface. Peristaltic pump used for sampling. CB 5-11-23

Analysis	Results	Units	Result Qual	Foot Note	Reporting Limit	Counting Error	TPU**	Method	LabCode	V/V/A*
ANION										
Fluoride	5.84	mg/L	W		4			SW846-9056A	GEL	I / X /
FS										
Conductivity	487	umho/cm						FS	FS	/ /
Dissolved Oxygen	7.64	mg/L						FS	FS	/ /
Eh (approx)	449.6	mV						FS	FS	/ /
pH	8.02	Std Unit						FS	FS	/ /
Temperature	64.4	deg F						FS	FS	/ /
METAL										
Arsenic	0.00876	mg/L	J		0.03			SW846-6010D	GEL	S / X /
Arsenic	0.00213	mg/L	J		0.005			SW846-6020B	GEL	/ X /
Barium	0.0829	mg/L			0.004			SW846-6020B	GEL	/ X /
Cadmium	0.001	mg/L	U		0.001			SW846-6020B	GEL	/ X /
Chromium	0.01	mg/L	U		0.01			SW846-6020B	GEL	/ X /
Copper	0.00635	mg/L			0.002			SW846-6020B	GEL	/ X /
Iron	0.1	mg/L	U		0.1			SW846-6020B	GEL	/ X /
Lead	0.002	mg/L	U		0.002			SW846-6020B	GEL	/ X /
Mercury	0.0002	mg/L	U		0.0002			SW846-7470A	GEL	/ X /
Nickel	0.00296	mg/L			0.002			SW846-6020B	GEL	S / X /
Selenium	0.005	mg/L	U		0.005			SW846-6020B	GEL	/ X /
Silver	0.001	mg/L	U		0.001			SW846-6020B	GEL	/ X /
Uranium	64.7	mg/L			0.2			SW846-6020B	GEL	I / X /
Zinc	0.02	mg/L	U		0.02			SW846-6020B	GEL	/ X /
PPCB										
PCB-1016	0.1	ug/L	UY2		0.1			SW846-8082A	GEL	/ X /
PCB-1221	0.1	ug/L	U		0.1			SW846-8082A	GEL	/ X /
PCB-1232	0.1	ug/L	U		0.1			SW846-8082A	GEL	/ X /
PCB-1242	0.1	ug/L	U		0.1			SW846-8082A	GEL	/ X /
PCB-1248	0.581	ug/L	Y2		0.1			SW846-8082A	GEL	/ X /
PCB-1254	0.1	ug/L	U		0.1			SW846-8082A	GEL	/ X /
PCB-1260	0.1	ug/L	UY2		0.1			SW846-8082A	GEL	/ X /
Polychlorinated biphenyl	0.581	ug/L	Y2		0.1			SW846-8082A	GEL	I / X /
RADS										
Cesium-137	5.59	pCi/L	U		10.3	5.07	5.09	EPA-901.1	GEL	/ X /
Neptunium-237	0.387	pCi/L	U		1.29	0.764	0.766	ASTM-1475-00M	GEL	/ X /
Plutonium-239/240	0.149	pCi/L	U		0.446	0.418	0.419	HASL 300, Pu-11-RC M	GEL	/ X /
Technetium-99	168	pCi/L			18.9	15	23.9	HASL 300, Tc-02-RC M	GEL	/ X /
Thorium-230	0.372	pCi/L	U		1.8	1	1.01	HASL 300, Th-01-RC M	GEL	/ X /
Uranium-234	1950	pCi/L			66.7	185	304	HASL 300, U-02-RC M	GEL	/ X /
Uranium-235	339	pCi/L			41.8	87.1	96.6	HASL 300, U-02-RC M	GEL	/ X /
Uranium-238	21600	pCi/L			54.4	607	2730	HASL 300, U-02-RC M	GEL	/ X /
VOA										
Trichloroethene	1	ug/L	U		1			SW846-8260D	GEL	/ X /
WETCHEM										
Ammonia as Nitrogen	0.05	mg/L	U		0.05			EPA-350.1	GEL	/ X /

*Verification/Validation/Assessment ** TPU reported at 1.96 sigma Report Generated on 10/19/2023

Paducah OREIS Report for 404L23-02

Sample ID: **TB404L2-23** Station: QC Date Collected: 5/11/2023 MedType: WQ SmpMethod:

Comments:

Analysis	Results	Units	Result Qual	Foot Note	Reporting Limit	Counting Error	TPU**	Method	LabCode	V/V/A*
VOA										
Trichloroethene	1	ug/L	U		1			SW846-8260D	GEL	/ X /