REVISION 0

IOWA ARMY AMMUNITION PLANT OPERABLE UNIT 8 ANNUAL ENVIRONMENTAL MONITORING DATA AND ANALYSIS REPORT FOR CALENDAR YEAR 2023

MIDDLETOWN, IOWA

JUNE 7, 2024

U.S. Army Corps of Engineers
St. Louis District Office
Formerly Utilized Sites Remedial Action Program

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prepared by

U.S. Army Corps of Engineers St. Louis District Office
Formerly Utilized Sites Remedial Action Program

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ACRONYMS AND ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CY	calendar year
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DQO	data quality objective
DU	depleted uranium
EDE	effective dose equivalent
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
EMDAR	Environmental Monitoring Data and Analysis Report
ER	Engineer Regulation
FS	firing site
FSA	Firing Sites Area
FSS	final status survey
FUSRAP	Formerly Utilized Sites Remedial Action Program
GIS	geographic information system
IAAAP	Iowa Army Ammunition Plant
IDA	Inert Disposal Area
LAP	load, assemble, and pack
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual*
MDA	minimum detectable activity
MDC	minimum detectable concentration
NAD	normalized absolute difference (unitless)
OU	operable unit
PDI	pre-design investigation
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
QSM	*Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* version 5.4
RA	remedial action
RCA	Radiation Control Area
RG	remediation goal
RI WP	*Remedial Investigation Work Plan for Line 1, Firing Sites Area, Yards C, G, and L, Warehouse 3-01 and the West Burn Pads Area South of the Road*
Rn	radon
ROD	*FUSRAP Record of Decision for the Iowa Army Ammunition Plant*
RPD	relative percent difference
RUSU	reuse soil survey unit
SOP	standard operating procedure
STSU	structure survey unit

ACRONYMS AND ABBREVIATIONS (Continued)

SU	survey unit
SW-846	*USEPA Publication SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*
TEDE	total effective dose equivalent
U	uranium
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VQ	validation qualifier

UNIT ABBREVIATIONS

Both English and metric units are used in this report. The units used in a specific situation are based on common unit usage or regulatory language (e.g., depths are given in feet, and areas are given in square meters). Units included in the following list are not defined at first use in this report.

$^{\circ}$C	degrees Celsius (centigrade)
µCi/cm^3	microcurie(s) per cubic centimeter
µCi/mL	microcurie(s) per milliliter
ug/L	microgram(s) per liter
Bq/mg	becquerel per milligram
Ci	curie(s)
cm	centimeter(s)
cm^3	cubic centimeter(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mL	milliliter(s)
mrem	millirem
pCi/g	picocurie(s) per gram
pCi/L	picocurie(s) per liter

EXECUTIVE SUMMARY

This annual Environmental Monitoring Data and Analysis Report (EMDAR) for calendar year (CY) 2023 applies to the Iowa Army Ammunition Plant (IAAAP) Operable Unit (OU)-8 (Figure 1-1), which is within the scope of the Formerly Utilized Sites Remedial Action Program (FUSRAP). This EMDAR provides an evaluation of the data collected as part of the environmental monitoring conducted for IAAAP OU-8. IAAAP OU-8 consists of the Firing Sites Area (FSA), Line 1 Structures; Yards C, G, and L; and Warehouse 3-01. The FSA contains five subareas named for the buildings located within them, grouped by proximity: Firing Site (FS)-1 and FS-2 Area (FS-1 and FS-2); FS-3, FS-4, and FS-5 Area (FS-3, FS-4, and FS-5); FS-6 Area (FS-6, FS-7, FS-8, and FS-15); FS-12 Area (FS-9, FS-10, FS-11, and FS-12); and FS-14 Area (FS-14) (Figure 1-2). M-Yard is not included as part of OU-8 in the *FUSRAP Record of Decision for the Iowa Army Ammunition Plant* (ROD) (USACE 2011); however, references to OU-8 include M-Yard for the purposes of this EMDAR. Environmental monitoring of various media at IAAAP OU-8 is required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and under the commitments in the ROD (USACE 2011).

The U.S. Army Corps of Engineers (USACE) St. Louis District collects environmental monitoring data as a component of the remedial action (RA). RA activities conducted included removal of radiologically contaminated soil at the FSA, physical treatment (soil sorting) to reduce the volume of soil requiring offsite disposal, and waste management. The environmental monitoring data collected during RA serve as a critical component in the evaluation of the current status and potential future migration of residual contaminants.

In addition to environmental monitoring purposes, radiological air data were also used as inputs to calculate the total effective dose equivalent (TEDE) to the hypothetical maximally exposed individual from IAAAP OU-8. The TEDE calculated for the hypothetical maximally exposed individual at IAAAP OU-8 for CY 2023 was less than 0.1 mrem per year. The results of the radiological air monitoring conducted at IAAAP OU-8 demonstrate compliance with the applicable or relevant and appropriate requirements (ARARs) for IAAAP OU-8.

Surface water and sediment sampling were completed as best management practices in April and December of CY 2023. Samples were collected from 10 surface water and sediment sampling locations to evaluate the radiological conditions of the branches of Long Creek running to the east and south of the FS-12 Area and Long Creek downgradient of the FS-12 Area. The results of the surface water and sediment sampling demonstrate no adverse impacts from the remedial activities at the FS-12 Area. No stormwater monitoring samples were collected in CY 2023.

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1.0 HISTORICAL SITE BACKGROUND AND CURRENT SITE STATUS

1.1 INTRODUCTION

This annual Environmental Monitoring Data and Analysis Report (EMDAR) for calendar year (CY) 2023 applies to the Iowa Army Ammunition Plant (IAAAP) Operable Unit (OU)-8, which is within the scope of the Formerly Utilized Sites Remedial Action Program (FUSRAP). This EMDAR provides an evaluation of the data collected as part of the environmental monitoring conducted for IAAAP OU-8. IAAAP OU-8 includes the Firing Sites Area (FSA), Line 1 Structures; Yards C, G, and L; and Warehouse 3-01 (Figure 1-1). The FSA consists of five subareas named for the buildings located within them, grouped for proximity: Firing Site (FS)-1 and FS-2 Area (FS-1 and FS-2); FS-3, FS-4, and FS-5 Area (FS-3, FS-4, and FS-5); FS-6 Area (FS-6, FS-7, FS-8, and FS-15); FS-12 Area (FS-9, FS-10, FS-11, and FS-12); and FS-14 Area (FS-14) (Figure 1-2). M-Yard is not included as part of OU-8 in the *FUSRAP Record of Decision for the Iowa Army Ammunition Plant* (ROD) (USACE 2011); however, references to OU-8 include M-Yard for the purposes of this EMDAR. Environmental monitoring of various media at IAAAP OU-8 is required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and under the commitments in the ROD (USACE 2011).

1.2 PURPOSE

The primary purpose of this EMDAR is to report the calculated total effective dose equivalent (TEDE) to the hypothetical maximally exposed individual and other receptors from radionuclide emissions (exclusive of radon) from IAAAP OU-8, where a reasonable potential for radionuclide emissions due to FUSRAP activities exists. The results of these calculations demonstrate compliance with the applicable or relevant and appropriate requirements (ARARs) or other federal and state benchmarks. During CY 2023, the FS-12 Area and the waste loadout area at M-Yard had a reasonable potential for radionuclide emissions due to FUSRAP activities. The air emissions from the FS-12 Area and M-Yard are releases of particulate radionuclides in soil as a result of windblown action and remedial action (RA) in the form of excavation, onsite treatment (i.e., soil sorting), stockpiling, and loadout of soil.

This EMDAR additionally serves to enhance the reader's awareness of the current condition of IAAAP OU-8; summarize the data collection efforts for CY 2023, including surface water and sediment sampling; and provide analysis of the CY 2023 environmental monitoring data results. This EMDAR presents the following information:

- IAAAP OU-8 sample collection data and interpretation of CY 2023 results, and
- The status of IAAAP OU-8 regarding compliance with the ARARs or other federal and state benchmarks.

1.3 PROGRAM AND SITE HISTORY

FUSRAP was initiated in 1974 to identify, investigate and, if necessary, clean up or control sites throughout the United States contaminated as a result of early Atomic Energy Commission (AEC) activities. FUSRAP was continued by the successor agencies to AEC until 1997, when the U.S. Congress transferred responsibility for the execution aspect of FUSRAP from the U.S. Department of Energy (DOE) to the U.S. Army Corps of Engineers (USACE).

IAAAP is a government-owned, contractor-operated facility that occupies approximately 76,890,000 m^2 (19,000 acres) in Des Moines County near Middletown, Iowa, approximately 10 miles west of the Mississippi River (Figure 1-1). Historically, the installation's mission was to load, assemble, and pack (LAP) ammunition items, including projectiles, mortar rounds, warheads, demolition charges, and munitions components such as fuses, primers, and boosters.

All IAAAP land is currently owned by and under the control of the U.S. Army. Approximately one-third of IAAAP property is occupied by active or formerly active munitions production or storage facilities. The remaining property is generally either forested (30,350,000 m^2 [7,500 acres]) or leased for agricultural use (31,160,000 m^2 [7,700 acres]).

Since operations began in 1941, IAAAP has used explosives and lead-based initiating compounds to produce a wide variety of ordnance items. During the summer of 1947, Mason & Hanger–Silas Mason Company, Inc., the operating contractor, entered into a contract with the Ordnance Department to assist in the design and engineering, to perform the construction, and to operate a facility for the purpose of supplying AEC with explosive components for nuclear weapons. From 1947 to 1975, IAAAP OU-8 areas were under the control of AEC or its successors for weapon assembly operations. Based on IAAAP project history reports, the first nuclear weapon assembly operations are believed to have begun in 1949. Throughout the remaining years of AEC control, IAAAP tested, assembled, conducted surveillance on, and disassembled a wide variety of nuclear weapons. Detailed descriptions and histories of IAAAP OU-8 areas are contained in the *Iowa Army Ammunition Plant FUSRAP Remedial Investigation Report for Firing Sites Area, Yards C, E, F, G, and L, Warehouse 3-01 and Area West of Line 5B* (USACE 2008a) and the ROD (USACE 2011).

1.4 CALENDAR YEAR 2023 ACTIVITIES

1.4.1 IAAAP Operable Unit 8 Calendar Year 2023 Documents

During CY 2023, the following OU-8 documents were finalized:

- *Pre-Design Investigation Work Plan for Consolidated Material Areas and Fill Areas at the Firing Sites Area at the Iowa Army Ammunition Plant* (Leidos 2023a);
- *Iowa Army Ammunition Plant Operable Unit 8 Annual Environmental Monitoring Data and Analysis Report for Calendar Year 2022* (USACE 2023a);
- *Post-Remediation Data Summary Report for Soil at the Firing Site 12 Area Former Test Fire Pit at the Iowa Army Ammunition Plant* (Leidos 2023b); and
- *Post-Remedial Action Report and Final Status Survey Evaluation for the Firing Site 12 Area East Central Survey Units at the Iowa Army Ammunition Plant* (USACE 2023b).

1.4.2 IAAAP Operable Unit 8 Calendar Year 2023 Remedial Actions

During CY 2023, RA was performed at the FS-12 Area. RA began at the FS-12 Area in the third quarter and continued through the fourth quarter. A total of 4,540 tons of soil were processed by radiological soil sorting, with approximately 656 tons of soil diverted as contaminated material for offsite disposal. Other waste material, including oversized material discharged from the screen plant, and debris and rocks from the excavation area were not processed through the soil sorting system but were stockpiled and then directly loaded into the railcars for shipment and offsite disposal.

In 2023, three transportation and disposal campaigns were conducted. A total of 2,429 tons of waste were shipped to US Ecology in Belleville, Michigan, in 23 rail cars, and total of 1,278.8 tons of waste were shipped to EnergySolutions in Clive, Utah, in 12 rail cars. All wastes were disposed of in accordance with applicable permits and procedures.

During CY 2023, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (DoD 2000) Class 1 verifications were completed at the FS-12 Area (soil survey units [SUs]-30 and 31 and structure survey unit [STSU]-4). Verifications at the FS-12 Area were performed to confirm that the ROD remediation goals (RGs) were achieved.

During CY 2023, MARSSIM Class 2 final status surveys (FSSs) were completed for reuse soil resulting from physical treatment of excavated soil from FS-12 Area (reuse soil survey units [RUSUs]-286 through RUSU-292).

During CY 2023, characterizations/pre-design investigations (PDIs) were performed at the FS-6 Area.

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2.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS EVALUATION

Section 2.8.2 of the ROD lists two ARARs that are evaluated in this EMDAR. The first ARAR, from 10 *Code of Federal Regulations (CFR)* 20.1403(b), requires that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group not exceed 25 mrem per year. The second ARAR, from 10 *CFR* 20.1101(d), requires that emissions of radioactive material to the environment, excluding radon (Rn)-222 and its progeny, be maintained so the highest individual dose to the public does not exceed 10 mrem per year. For the purposes of the CY 2023 evaluation, the critical group is a current IAAAP employee not engaged in FUSRAP RA (i.e., an employee working at the Inert Disposal Area [IDA], located approximately 613 m east of the FS-12 Area, and an employee working at the FS-1 and FS-2 Area, located approximately 521 m northwest of M-Yard).

The evaluation for compliance with the 10 *CFR* 20.1101(d) ARAR is accomplished using the U.S. Environmental Protection Agency (USEPA) computer code CAP88-PC, Version 4.1 (USEPA 2020) to determine dose from radioactive airborne emissions to members of the public located at specific distances and directions from the site. The evaluation for compliance with the 10 *CFR* 20.1403(b) ARAR is accomplished by calculating the total dose from contaminant exposures, resulting from soil excavation, soil sorting, stockpiling, and loadout activities at the FS-12 Area and M-Yard, to the closest onsite worker at the IDA and at the FS-1 and FS-2 Area, respectively, via the most significant migration pathway, which is airborne emissions. Consequently, both ARARs were evaluated against only the total dose from airborne emissions and all the radiological exposure routes (i.e., ingestion, inhalation, air immersion, ground surface, internal and external radiation) associated with airborne emissions. Additionally, compliance with 10 *CFR* 20.1101(d) will automatically ensure compliance with 10 *CFR* 20.1403(b), because both are dose-based limits of 10 mrem per year and 25 mrem per year, respectively, to the same receptor.

Exposures to potential trespassers and recreational users (e.g., hunters) are considered infrequent and insignificant because of access restrictions to IAAAP property, as well as the physical characteristics of each area.

Although not required to be followed, 40 *CFR* 61, Appendix E (the USEPA's equivalent regulation to 10 *CFR* 20.1101(d)), provides a procedure to determine compliance with radioactive airborne emissions. This procedure was followed to calculate dose to the potential receptors (e.g., residential, farm, business, and school receptors), and is described in the subsequent sections.

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3.0 EVALUATION OF RADIOLOGICAL AIR MONITORING DATA

3.1 METHOD

Emission rates for IAAAP OU-8 were modeled using guidance documents referenced in 40 *CFR* 61, Appendix E, *Compliance Procedures Methods for Determining Compliance with Subpart I* (USEPA 1989) and were measured by collection of environmental air particulate samples for radioactive particles. Emission rates were entered in the USEPA computer code CAP88-PC, Version 4.1 (USEPA 2020), along with appropriate meteorological data and distances to receptors[1], to obtain the effective dose equivalent (EDE) from the air emissions.

Although 40 *CFR* 61.103, *Determining Compliance,* requires the use of the USEPA computer code COMPLY, the USEPA no longer supplies technical support for COMPLY. Because the USEPA lists both COMPLY and CAP88-PC as "Atmospheric transport models for assessing dose and risk from radioactive air emissions" (USEPA 2015), and because USEPA still provides technical support for CAP88-PC, CAP88-PC was used as a comparable and conservative method to demonstrate compliance with the ARARs.

3.1.1 Emission Rate

The method used to determine particulate radionuclide emission rates from IAAAP OU-8 was 40 *CFR* 61, Appendix D, *Methods for Estimating Radionuclide Emissions*. Emissions during excavations, soil sorting, stockpiling, and waste loadout were evaluated using air particulate data collected at the excavation, soil sorting area, soil stockpile area, and waste loadout perimeters.

3.1.2 Effective Dose Equivalent

The EDE to receptors is obtained using the USEPA computer code CAP88-PC, Version 4.1 (USEPA 2020). CAP88-PC uses a Gaussian plume equation to estimate the dispersion of radionuclides. An area ground release at a height of 1 m is modeled for IAAAP OU-8.

The EDE is the dose from inhalation; exposures from ingestion, air immersion, and external ground surface are insignificant. CAP88-PC contains historical weather data libraries for major airports across the country, and the results can be modeled for receptors at multiple distances from the emission source.

3.2 METEOROLOGICAL DATA

Meteorological data were obtained from CAP88-PC for the Quad City International Airport in Moline, Illinois (wind file 14923.WND). The Quad City International Airport, located 60 miles northeast of IAAAP, is the closest airport to IAAAP with meteorological data. Data in the file were accumulated from 1988 through 1992.

- Average Annual Wind Velocity: 4.252 m per second
- Average Annual Precipitation Rate: 103 cm per year
- Average Annual Air Temperature: 11 ºC

Wind direction frequency was obtained from the CAP88-PC wind file, 14923.WND (Table 3-1).

[1] "Receptors," as used in this EMDAR, are the locations for the nearest residence, school, business, and farm.

Table 3-1. Quad City International Airport Wind Rose Frequency

Wind Direction		Wind Frequency (Percent)	Wind Direction		Wind Frequency (Percent)
Wind Toward	Wind From		Wind Toward	Wind From	
North	South	12.8	South	North	5.0
North-Northwest	South-Southeast	4.5	South-Southeast	North-Northwest	3.3
Northwest	Southeast	3.6	Southeast	Northwest	5.5
West-Northwest	East-Southeast	5.2	East-Southeast	West-Northwest	9.0
West	East	8.6	East	West	0.5
West-Southwest	East-Northeast	5.2	East-Northeast	West-Southwest	8.5
Southwest	Northeast	3.5	Northeast	Southwest	6.6
South-Southwest	North-Northeast	2.5	North-Northeast	South-Southwest	6.9

3.3 IAAAP OPERABLE UNIT 8 SITES UNDER ACTIVE REMEDIATION

3.3.1 Material Handling and Processing for Calendar Year 2023

At IAAAP OU-8 in CY 2023, remedial activities were performed at the FS-12 Area and waste loadout activities were conducted at M-Yard. Excavation was conducted at the FS-12 Area and the excavated material was stockpiled prior to treatment (i.e., soil sorting). Most of the excavated material, along with material remaining from 2022, (4,540 tons) was then sorted, with 656 tons of the material diverted to a post-sorting contaminated (i.e., greater than the soil RG) material pile. Contaminated material from remedial activities during 2022 and 2023 was transported to M-Yard via covered dump trucks, stockpiled, and loaded onto covered railcars for offsite disposal. At the conclusion of the 2022 construction season the remaining pre-sorting pile and the post-sorting contaminated material pile were not covered pending sorting and future transport to M-Yard for shipment, respectively. The post-sorting reuse soil (i.e., less than the soil RG) pile was not covered pending use as backfill. No soil piles (pre-sorting or post-sorting) remained at the FS-12 Area at the conclusion of the 2023 construction season.

General area air particulate samples were collected around active excavation perimeters, soil sorting activities, soil stockpiling, and waste loadout activities during CY 2023, with the results used to determine the site emissions. In-situ emissions from inactive areas of IAAAP OU-8 were not calculated because the ground surface soil at IAAAP is generally covered with vegetation that limits the potential for material to become airborne.

3.3.2 Source Description – Radionuclide Soil Concentrations

The averaged total alpha air particulate concentrations at the FS-12 Area and M-Yard, along with the three depleted uranium (DU) activity fractions listed in Section 2.5.7 of the ROD, were used to calculate the emission rate for each area (Appendix A). Activity fractions for the radiological constituents associated with DU (i.e., uranium [U]-234, U-235, and U-238) are as follows:

- 90.14 percent (U-238),
- 1.45 percent (U-235), and
- 8.40 percent (U-234).

3.3.3 List of Assumed Air Releases for Calendar Year 2023

Particulate radionuclide emissions were evaluated for potential wind erosion of soil during periods of RA excavations, soil sorting, and from soil stockpiles. The FS-12 Area and M-Yard were assumed to be contributing to air releases during the dates in CY 2023 when the SUs were undergoing excavation (open), and when the soil sorting and loadout piles were uncovered.

Verification data for the post-sorting reuse soil pile and non-backfilled excavation surfaces are less than the soil RG, and therefore are protective of human health and the environment and do not contribute to the emission determinations. Unexcavated areas do not contribute to the emission determinations for periods of inactivity due to the low activity and vegetative cover. Appendix A, Table A-1, lists the dates in CY 2023 of potential air releases by location.

3.3.4 Distances to Receptors

The distances to receptors are listed in Table 3-2. Distances and directions to receptors are determined by using tools in a geographic information system (GIS). The locations of the receptors are shown on Figure 3-1.

Table 3-2. IAAAP Operable Unit 8 Receptors for CY 2023

Sources	Resident		Farm		Business[a b]		School	
	Distance (m)	Direction	Distance (m)	Direction	Distance (m)	Direction	Distance (m)	Direction
FS-12 Area	2,714	West	2,714	West	613	East	7,894	Northwest
M-Yard	3,498	West Northwest	3,498	West Northwest	521	Northwest	9,463	Northwest

[a] The business receptors, an IAAAP employee at the IDA and at the FS-1 and FS-2 Area, are average members of the critical group.
[b] To account for dose from all sources, air emissions from M-Yard to the business receptor at the IDA (1,730 m north) and air emissions from the FS-12 Area to the business receptor at the FS-1 and FS-2 Area (945 m south) were also evaluated.

3.4 EMISSIONS DETERMINATION

3.4.1 Measured Airborne Radioactive Particulate Emissions

Air particulate samples were collected from several locations around the perimeter of the FS-12 Area and M-Yard to measure the radionuclide emissions from the RA, soil sorting, soil stockpile, and soil loadout. The air particulate samples provide the basis for determining the radionuclide emission rates during CY 2023 (Appendix A). Sample data for air particulate samples were determined through the use of calibrated field instruments. Appendix B, Table B-1, is a summary table of the air particulate sample data from the calibrated field instruments. Gross alpha particulate results (Table B-1) less than zero indicate the result was less than the average background value for the instrument. When calculating an average airborne concentration, negative data points were rounded to a zero value. The average gross alpha concentration (in µCi/mL) for CY 2023 was determined for the FS-12 Area and M-Yard and is presented in Table 3-3.

In CY 2023, seven samples were submitted to the FUSRAP St. Louis Radioanalytical Laboratory (i.e., project laboratory) for gross alpha/beta analysis to confirm the field instruments are not underestimating the results. Appendix B, Table B-2, presents data from the project laboratory.

Table 3-3. IAAAP Operable Unit 8 Average Gross Alpha Airborne Particulate Emissions for CY 2023

Sampler Location	Average Concentration (µCi/mL)
	Gross Alpha
FS-12 Area[a]	1.18E-14
M-Yard[b]	7.00E-14

[a] Includes the emission rates from the RA, soil sorting, and soil stockpiles.
[b] Includes the emission rates from the loadout activities.

The activity fractions for DU at IAAAP OU-8 were determined as described in Section 3.3.2. The product of the DU activity fraction and the gross concentration provides the radionuclide emission concentration (in μCi/mL) for that area. The gross average concentration (in μCi/mL) is converted to a release (i.e., emission) rate (in Ci per year) using Equations 1 and 2 from *A Guide for Determining Compliance with the Clean Air Act Standards for Radionuclide Emissions from NRC-Licensed and Non-DOE Federal Facilities* (USEPA 1989). Equation 1 is used, as follows, to determine the effective diameter of a non-circular stack or vent.

$$D = (1.3\ A)^{1/2}$$ *Equation 1*

where:

- D = effective diameter of the release (in m)
- A = area of the stack, vent, or release point (in m^2)

Table 3-4 provides (1) the effective surface area available for release of airborne radionuclides normalized to 1 year for the FS-12 Area and M-Yard and (2) the effective diameter for the FS-12 Area and M-Yard, where soil excavation, sorting, stockpiling and/or loadout was conducted in CY 2023. Calculation of the effective surface area is presented in Appendix A.

Table 3-4. IAAAP Operable Unit 8 Excavation Effective Surface Areas and Effective Diameters for CY 2023

IAAAP OU-8 Location	Effective Area (m^2)	Effective Diameter (m)
FS-12 Area	2,781	60
M-Yard	1,000	36

The average annual wind speed for the Quad City International Airport is provided in CAP88-PC as 4.252 m per second. Conversion of this wind speed to a flow rate through stacks with the listed effective diameters for each area is completed using Equation 2, shown as follows.

$$F = V\ \pi\ [(D)^2/4]*60$$ *Equation 2*

where:

- F = flow rate (in m^3 per minute)
- V = wind velocity (in m per second)
- π = mathematical constant
- D = effective diameter of the release using Equation 1 (in m)
- 60 = time conversion (seconds to minute)

Converting the velocity of emissions from the FS-12 Area and M-Yard to an effective flow rate results in the following site release flow rates for IAAAP OU-8 areas, as listed in Table 3-5. The product of the site release flow rate, the activity fraction associated with each radionuclide, and the appropriate conversion factors provide the site emission rate for each radionuclide, as illustrated in Table 3-6. Appendix A contains site release flow rates and average radionuclide concentration data.

Table 3-5. IAAAP Operable Unit 8 Areas Site Release Flow Rate for CY 2023

IAAAP OU-8 Location	Site Release Flow Rate (m^3/minute)
FS-12 Area	7.2E+05
M-Yard	2.6E+05

3.4.2 IAAAP Operable Unit 8 Total Airborne Radioactive Particulate Emission Rates

The CY 2023 emission rates for the FS-12 Area and M-Yard are presented in Table 3-6 and are based on the air particulate samples collected from the perimeter of the FS-12 Area and M-Yard.

Table 3-6. IAAAP Operable Unit 8 Airborne Radioactive Particulate Emission Rates Based on Perimeter Air Particulate Samples for CY 2023

Radionuclide	Emission Rate (Ci/year)[a]	
	FS-12 Area	M-Yard
U-238	4.1E-03	8.6E-03
U-235	6.5E-05	1.4E-04
U-234	3.8E-04	8.0E-04

[a] Emission rate based on a 365-day period at a respective site release flow rate (as presented in Table 3-5) as determined from the average annual wind speed (i.e., 4.252 m per second) and the effective site area (as presented in Table 3-4) for each location.

3.4.3 CAP88-PC Results

The CAP88-PC reports are contained in Appendix C. The effective area factor input was taken from Table 3-4. The individual dose results for the FS-12 Area and M-Yard were summed for the residential, farm, business, and school receptors. As shown in Table 3-7, this evaluation demonstrates that all IAAAP OU-8 receptors, including the hypothetical maximally exposed individuals at IAAAP OU-8 (i.e., the business receptors, an IAAAP employee at the IDA and at the FS-1 and FS-2 Area, who are average members of the critical group), receive less than the dose standards prescribed in 10 *CFR* 20.1101(d) (i.e., 10 mrem per year) and 10 *CFR* 20.1403(b) (i.e., 25 mrem per year).

Table 3-7. IAAAP Operable Unit 8 CAP88-PC Results for Receptors for CY 2023

Source	Dose (mrem/year)			
	Resident[a]	School[b]	Business[b,c]	Farm[a]
FS-12 Area	<0.1	<0.1	<0.1	<0.1
M-Yard	<0.1	<0.1	<0.1	<0.1
Total Dose	<0.1	<0.1	<0.1	<0.1

[a] 100 percent occupancy factor.
[b] Corrected for the 23 percent occupancy factor (i.e., 40 hours per week for 50 weeks per year).
[c] The business receptors, an IAAAP employee at the IDA and at the FS-1 and FS-2 Area, are average members of the critical group.

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4.0 SURFACE WATER, SEDIMENT, AND STORMWATER MONITORING

4.1 SURFACE WATER AND SEDIMENT MONITORING

Surface water and sediment monitoring in the branches of Long Creek to the east and south of the FS-12 Area and in Long Creek downgradient of the FS-12 Area was performed as a best management practice. Surface water and sediment were sampled and analyzed for the uranium isotopes to evaluate/determine if runoff from the FS-12 Area affects the quality of surface water and sediment in Long Creek as a potential result of RA.

Surface water and sediment sampling was conducted during April and December of CY 2023. Grab samples were collected and analyzed for isotopic uranium according to the protocol defined in Appendix D of the *Remedial Investigation Work Plan for Line 1, Firing Sites Area, Yards C, G, and L, Warehouse 3-01 and the West Burn Pads Area South of the Road* (RI WP) (USACE 2008b). The sampling events were conducted at 10 monitoring stations. Of these 10 stations, 8 stations were established in 2007 during the remedial investigation, and the remaining 2 stations (i.e., IAAP177509 and IAAP177517) were established in December 2014. Location IAAP100164 is located in a drainage feature, and the other locations are all located along Long Creek. Locations of the 10 surface water and sediment monitoring stations are shown on Figure 4-1.

4.2 SURFACE WATER MONITORING RESULTS

The radiological monitoring results for the CY 2023 surface water sampling events are summarized in Table 4-1. FUSRAP surface water monitoring analyses were of unfiltered water samples for radionuclides associated with DU (i.e., U-234, U-235, and U-238). The monitoring results are presented in Appendix D, Table D-1, of this EMDAR.

Table 4-1. Radiological Results for CY 2023 Surface Water Monitoring

Monitoring Station	Collection Date	Monitoring Results (pCi/L)		
		U-234	U-235	U-238
IAAP100153	04/18/23	0.61	0.53[a]	0.50[a]
IAAP100153	12/05/23	0.66[a]	0.59[a]	0.66[a]
IAAP100154	04/18/23	0.83	0.42[a]	0.58
IAAP100154	12/05/23	0.48[a]	0.59[a]	0.58
IAAP100155	04/18/23	0.78	0.59[a]	0.48[a]
IAAP100155	12/06/23	0.56[a]	0.70[a]	0.40[a]
IAAP100164	[b]	[b]	[b]	[b]
IAAP100164	[b]	[b]	[b]	[b]
IAAP100165	04/18/23	0.52[a]	0.65[a]	0.48
IAAP100165	12/06/23	0.39[a]	0.67[a]	0.54[a]
IAAP100178	04/18/23	0.53	0.60[a]	0.35[a]
IAAP100178	12/06/23	0.62	0.50[a]	0.56[a]
IAAP100180	04/18/23	0.69	0.46[a]	0.38[a]
IAAP100180	12/06/23	0.44[a]	0.54[a]	0.60[a]
IAAP100187	04/18/23	0.86	0.66[a]	0.65
IAAP100187	12/06/23	0.52	0.50[a]	0.49[a]
IAAP177509	04/18/23	1.12	0.44[a]	0.43
IAAP177509	12/06/23	0.65[a]	0.81[a]	0.65[a]
IAAP177517	04/18/23	0.50[a]	0.61[a]	0.72
IAAP177517	12/05/23	0.52[a]	0.73[a]	0.51[a]

[a] Reported result is less than the minimum detectable concentration (MDC) and is therefore set equal to the MDC.
[b] No surface water was present at the sample location due to seasonal weather conditions. IAAP100164 is located in a drainage feature, and the other locations are all situated along Long Creek. No surface water sample was collected.

The historical radiological surface water monitoring data for all monitoring stations are summarized in Table 4-2. A graph of the total uranium concentrations in surface water plotted by sampling date for each monitoring locations is presented on Figure 4-2.

Table 4-2. Comparison of Historical Radiological Surface Water Results

Stations	Radionuclide	Units	December 2014	August 2015	December 2015	April 2016	November 2016	April 2017	November 2017	April 2018	November 2018	April 2019	November 2019	April 2020	November 2020	April 2021	November 2021	April 2022	November 2022	April 2023	December 2023
IAAP100153	U-234	pCi/L	0.59	0.92	0.36	0.64	1.28	1.28	1.46	0.83	1.17	1.07	1.84	0.60[a]	0.38[a]	1.08	0.57	0.68[a]	0.50[a]	0.61	0.66[a]
	U-235	pCi/L	0.16[a]	0.18[a]	0.63[a]	0.63[a]	0.20[a]	0.18[a]	0.23[a]	0.55[a]	0.57[a]	0.40[a]	0.41[a]	0.81[a]	0.43[a]	0.49[a]	0.55[a]	0.96[a]	0.45[a]	0.53[a]	0.59[a]
	U-238	pCi/L	0.67	0.18	0.65	0.30	0.91	1.31	1.36	0.79	1.81	0.54	1.85	0.75[a]	0.35[a]	0.39[a]	1.05	0.62[a]	0.50[a]	0.50[a]	0.66[a]
IAAP100154	U-234	pCi/L	0.63	0.56	0.52	0.48[a]	0.83	1.29	0.80	1.22	1.28	1.11	1.18	0.61[a]	0.51[a]	0.55[a]	0.71	0.74[a]	0.53	0.83	0.48[a]
	U-235	pCi/L	0.20[a]	0.22[a]	0.44[a]	0.22[a]	0.23[a]	0.19[a]	0.57[a]	0.44[a]	0.72[a]	0.67[a]	0.56[a]	0.86[a]	0.38[a]	0.64[a]	0.47[a]	1.00[a]	0.65[a]	0.42[a]	0.59[a]
	U-238	pCi/L	0.64	0.33	0.38	0.52	1.07	0.95	0.62	0.50[a]	0.46	0.95	1.77	0.74	0.61	0.37[a]	0.38[a]	0.93	0.45[a]	0.58	0.58
IAAP100155	U-234	pCi/L	0.95	0.54[a]	0.70	0.71[a]	0.62	1.65	1.23	1.09	0.61	1.20	0.64	0.94[a]	0.69[a]	0.57	0.44[a]	0.69[a]	0.47[a]	0.78	0.56[a]
	U-235	pCi/L	0.14[a]	0.22[a]	0.47[a]	0.23[a]	0.24[a]	0.18[a]	0.21[a]	0.51[a]	0.55[a]	0.55[a]	0.56[a]	0.83[a]	0.85[a]	0.60[a]	0.75[a]	0.93[a]	0.66[a]	0.59[a]	0.70[a]
	U-238	pCi/L	0.34	0.75	0.54[a]	0.42[a]	0.44[a]	1.26	1.17	0.5	0.46[a]	0.77	0.45[a]	0.86[a]	0.41[a]	0.52	0.99	0.69[a]	0.47[a]	0.48[a]	0.40[a]
IAAP100164	U-234	pCi/L	1.12	0.72	0.31[a]	0.37	[b]	[b]	[b]	[b]	[b]	0.4	[b]	2.25	[b]	[b]	[b]	0.76[a]	[b]	[b]	[b]
	U-235	pCi/L	0.16[a]	0.58[a]	0.47[a]	0.19[a]	[b]	[b]	[b]	[b]	[b]	0.37[a]	[b]	0.88[a]	[b]	[b]	[b]	0.93[a]	[b]	[b]	[b]
	U-238	pCi/L	1.44	0.64	0.13[a]	0.45	[b]	[b]	[b]	[b]	[b]	0.58	[b]	3.84	[b]	[b]	[b]	1.85	[b]	[b]	[b]
IAAP100165	U-234	pCi/L	0.68	0.24	0.45	0.61[a]	0.74	0.78	0.51	0.63	0.72	0.70	0.55[a]	0.67[a]	0.53[a]	0.50	0.54[a]	0.68[a]	0.42[a]	0.52[a]	0.39[a]
	U-235	pCi/L	0.16[a]	0.59	0.17[a]	0.48[a]	0.25[a]	0.41[a]	0.50[a]	0.52[a]	0.40[a]	0.74[a]	0.62[a]	0.90[a]	0.60[a]	0.43[a]	0.48[a]	0.84[a]	0.60[a]	0.65[a]	0.67[a]
	U-238	pCi/L	0.58	0.16[a]	0.36	0.68	0.20[a]	0.31	0.25	0.48[a]	0.72	0.56	0.50[a]	0.66[a]	0.68[a]	0.71	0.54[a]	0.68[a]	0.49[a]	0.48	0.54[a]
IAAP100178	U-234	pCi/L	0.39	0.36	0.67	0.60	0.42[a]	1.02	1.01	0.58[a]	0.50	0.66[a]	0.36[a]	0.81[a]	0.55	0.52	0.37[a]	0.76[a]	0.38	0.53	0.62
	U-235	pCi/L	0.16[a]	0.39[a]	0.42[a]	0.22[a]	0.52[a]	0.20[a]	0.52[a]	0.72[a]	0.66[a]	0.63[a]	0.49[a]	0.86[a]	0.40[a]	0.51[a]	0.63[a]	0.65[a]	0.60[a]	0.60[a]	0.50[a]
	U-238	pCi/L	0.37[a]	0.20[a]	0.41	0.49	0.80	0.74	0.54	0.42[a]	0.45[a]	0.62[a]	0.51[a]	0.91	0.37[a]	0.75	0.51[a]	0.53[a]	0.48[a]	0.35[a]	0.56[a]
IAAP100180	U-234	pCi/L	0.77	0.36	0.42	0.62	0.35[a]	0.67	0.82	0.71	0.40	1.24	0.37	0.67[a]	0.6	0.53	0.53[a]	0.75[a]	0.52[a]	0.69	0.44[a]
	U-235	pCi/L	0.16[a]	0.20[a]	0.15[a]	0.24[a]	0.20[a]	0.20[a]	0.19[a]	0.66[a]	0.63[a]	0.53[a]	0.49[a]	0.66[a]	0.73[a]	0.45[a]	0.56[a]	1.01[a]	0.65[a]	0.46[a]	0.54[a]
	U-238	pCi/L	0.48[a]	0.38[a]	0.40	0.58	0.35[a]	0.47	0.53	0.83	0.51[a]	0.71	0.44[a]	0.58[a]	0.78	0.43[a]	0.38[a]	0.81[a]	0.46[a]	0.38[a]	0.60[a]
IAAP100187	U-234	pCi/L	1.07	0.52	0.34[a]	0.43	0.39	0.43	0.61	0.56[a]	0.33[a]	0.53	1.06	0.79[a]	0.56	0.86	1.00	0.86[a]	0.46	0.86	0.52
	U-235	pCi/L	0.20[a]	0.55[a]	0.52[a]	0.21[a]	0.71[a]	0.16[a]	0.21[a]	0.65[a]	0.49[a]	0.44[a]	0.45[a]	0.89[a]	0.44[a]	0.47[a]	0.66[a]	1.07[a]	0.62[a]	0.66[a]	0.50[a]
	U-238	pCi/L	0.45	0.33	0.42	0.43	0.29	0.44	0.43	0.76	0.46[a]	0.54	0.62	0.78[a]	1.05	0.67	0.85	0.79[a]	0.43[a]	0.65	0.49[a]
IAAP177509	U-234	pCi/L	0.90	1.79	0.48	0.43[a]	1.06	1.08	0.55	0.89	0.55	1.30	0.74	0.54[a]	0.4	0.60	0.58	0.89[a]	0.71	1.12	0.65[a]
	U-235	pCi/L	0.17[a]	0.21[a]	0.19[a]	0.24[a]	0.20[a]	0.39[a]	0.18[a]	0.69[a]	0.45[a]	0.44[a]	0.49[a]	0.73[a]	0.62[a]	0.54[a]	0.61[a]	1.20[a]	0.59[a]	0.44[a]	0.81[a]
	U-238	pCi/L	0.43	1.17	0.29	0.19[a]	0.72	1.03	0.40	0.56	0.68	1.77	1.06	0.6	0.46	0.75	0.53	0.99	0.34[a]	0.43	0.65[a]
IAAP177517	U-234	pCi/L	0.71	0.54[a]	0.63	0.47	0.93	0.16[a]	0.41[a]	0.76	0.87	0.70	0.66	0.65[a]	0.76	0.75	0.89	0.95[a]	0.54	0.50[a]	0.52[a]
	U-235	pCi/L	0.16[a]	0.22[a]	0.17[a]	0.65[a]	0.57[a]	0.19[a]	0.41[a]	0.64[a]	0.41[a]	0.41[a]	0.72[a]	0.99[a]	0.73[a]	0.53[a]	0.49[a]	1.27[a]	0.66[a]	0.61[a]	0.73[a]
	U-238	pCi/L	0.52	0.43[a]	0.51	0.68	0.50	0.46[a]	0.51	0.83	0.33[a]	0.64	0.56[a]	0.92[a]	0.55	0.42[a]	0.65	1.03[a]	0.38[a]	0.72	0.51[a]

[a] Reported result is less than the MDC and is therefore set equal to the MDC.
[b] No surface water was present at the sample location due to seasonal weather conditions. No surface water sample was collected.

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4.3 SEDIMENT MONITORING RESULTS

Sediment samples were collected in depositional environments near each of the 10 previously described surface water locations (Figure 4-1). Sediment samples were evaluated for the DU constituents (i.e., U-234, U-235, and U-238). The analytical results from these monitoring activities are presented in Appendix D, Table D-2, of this EMDAR.

The radiological results for CY 2023 sediment sampling events are summarized in Table 4-3.

Table 4-3. Radiological Results for CY 2023 Sediment Monitoring

Monitoring Station	Collection Date	Monitoring Results (pCi/g)		
		U-234	U-235	U-238
IAAP100153	04/18/23	0.18	0.16[a]	0.16[a]
IAAP100153	12/05/23	0.22	0.19[a]	0.36
IAAP100154	04/18/23	0.68	0.28[a]	0.55
IAAP100154	12/05/23	0.61	0.18[a]	0.50
IAAP100155	04/18/23	0.22[a]	0.20[a]	0.27
IAAP100155	12/06/23	0.34	0.17[a]	0.34
IAAP100164	04/18/23	0.71	0.20[a]	1.16
IAAP100164	12/06/23	0.58	0.19[a]	1.76
IAAP100165	04/18/23	0.54	0.15[a]	0.38
IAAP100165	12/06/23	0.39	0.26[a]	0.42
IAAP100178	04/18/23	0.40	0.15[a]	0.58
IAAP100178	12/06/23	0.37	0.20[a]	0.47
IAAP100180	04/18/23	0.28	0.13[a]	0.32
IAAP100180	12/06/23	0.19	0.24[a]	0.25[a]
IAAP100187	04/18/23	0.25[a]	0.31[a]	0.16[a]
IAAP100187	12/06/23	0.32	0.29[a]	0.48
IAAP177509	04/18/23	0.60	0.15[a]	0.30
IAAP177509	12/06/23	0.49	0.19[a]	0.37
IAAP177517	04/18/23	0.44	0.31[a]	0.40
IAAP177517	12/05/23	0.26	0.26[a]	0.14[a]

[a] Reported result is less than the MDC and is therefore set equal to the MDC.

The historical radiological sediment monitoring data for all monitoring stations are summarized in Table 4-4. A graph of the total uranium concentrations in sediment plotted by sampling date for each monitoring location is presented on Figure 4-3.

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Table 4-4. Comparison of Historical Radiological Sediment Results

Stations	Radionuclide	Units	April 2007	December 2014	August 2015	December 2015	April 2016	November 2016	April 2017	November 2017	April 2018	November 2018	April 2019	November 2019	April 2020	November 2020	April 2021	November 2021	April 2022	November 2022	April 2023	December 2023
IAAP100153	U-234	pCi/g	[a]	0.56	0.51	0.43	0.99	0.42	0.75	0.37	0.22	0.20	0.09[b]	0.59	0.83	0.31	0.82	0.14	0.17	0.18[b]	0.18	0.22
	U-235	pCi/g	0.11[b]	0.05[b]	0.58[b]	0.13[b]	0.17[b]	0.21[b]	0.18[b]	0.10[b]	0.22[b]	0.16[b]	0.15[b]	0.19[b]	0.19[b]	0.22[b]	0.24[b]	0.18[b]	0.18[b]	0.22[b]	0.16[b]	0.19[b]
	U-238	pCi/g	0.50	0.43	1.00	0.20[b]	0.85	0.31[b]	1.02	0.50	0.17	0.23	0.16	0.74	0.7	0.41	0.89	0.25	0.18[b]	0.28[b]	0.16[b]	0.36
IAAP100154	U-234	pCi/g	[a]	0.37	0.53[b]	0.46	0.82	0.36[b]	0.54	0.20	0.92	0.73	0.24	0.44	0.82	0.56	0.54	0.59	0.36	0.34	0.68	0.61
	U-235	pCi/g	0.17[b]	0.13[b]	0.55[b]	0.28[b]	0.36[b]	0.44[b]	0.26[b]	0.04[b]	0.21[b]	0.17[b]	0.09[b]	0.37[b]	0.28[b]	0.24[b]	0.15[b]	0.21[b]	0.23[b]	0.40[b]	0.28[b]	0.18[b]
	U-238	pCi/g	0.49	0.50	0.44[b]	0.45	1.08	0.75	0.31	0.14	0.55	1.05	0.26	0.35	0.85	0.34	0.66	0.49	0.51	0.44	0.55	0.50
IAAP100155	U-234	pCi/g	[a]	0.19	0.61[b]	0.61	0.76	0.40	0.67	0.18	0.31	0.45	0.29	0.17[b]	0.20	0.54	0.37	0.25	0.20	0.26[b]	0.22[b]	0.34
	U-235	pCi/g	0.17[b]	0.12[b]	0.61[b]	0.24[b]	0.18[b]	0.20[b]	0.19[b]	0.04	0.26[b]	0.18[b]	0.10[b]	0.18[b]	0.27[b]	0.16[b]	0.34[b]	0.17[b]	0.24[b]	0.24[b]	0.20[b]	0.17[b]
	U-238	pCi/g	0.37	0.24	0.49	0.83	0.86	0.30[b]	0.85	0.19	0.50	0.62	0.48	0.14	0.22[b]	0.61	0.40	0.70	0.28	0.49	0.27	0.34
IAAP100164	U-234	pCi/g	[a]	0.79	0.52[b]	0.94	0.74	0.52	1.04	0.67	0.85	0.40	0.82	0.58	1.06	0.65	0.71	0.84	0.48	1.15	0.71	0.58
	U-235	pCi/g	0.22[b]	0.12[b]	0.57[b]	0.33[b]	0.14[b]	0.40[b]	0.31[b]	0.10[b]	0.17[b]	0.20[b]	0.13	0.34[b]	0.19[b]	0.22[b]	0.24[b]	0.23[b]	0.65[b]	0.34[b]	0.20[b]	0.19[b]
	U-238	pCi/g	0.87	0.84	0.59	1.01	0.47	0.84	0.84	0.81	0.91	0.66	0.82	0.95	1.25	1.06	0.77	0.79	0.52[b]	1.33	1.16	1.76
IAAP100165	U-234	pCi/g	[a]	0.17	0.20[b]	0.59	0.38	0.26	0.28	0.32	0.37	0.15[b]	0.26	0.58	0.15[b]	0.53	0.71	0.52	0.34	0.70	0.54	0.39
	U-235	pCi/g	0.13[b]	0.05[b]	0.24[b]	0.37[b]	0.26[b]	0.33[b]	0.13[b]	0.09[b]	0.16[b]	0.34[b]	0.09[b]	0.29[b]	0.17[b]	0.23[b]	0.20[b]	0.22[b]	0.23[b]	0.32[b]	0.15[b]	0.26[b]
	U-238	pCi/g	0.29	0.14	0.43	1.07	0.41	0.35	0.31	0.20	0.21[b]	0.33	0.25	0.50	0.19	0.76	1.13	0.47	0.50	0.52	0.38	0.42
IAAP100178	U-234	pCi/g	[a]	0.33	0.53	0.30[b]	0.62	0.39	0.41	0.50	0.71	0.42	0.31	0.55	0.46	1.05	0.79	0.38	0.57	0.48	0.40	0.37
	U-235	pCi/g	0.11[b]	0.13[b]	0.49[b]	0.17[b]	0.15[b]	0.19[b]	0.11[b]	0.10[b]	0.21[b]	0.28[b]	0.14[b]	0.20[b]	0.17[b]	0.19[b]	0.29[b]	0.13[b]	0.18[b]	0.22[b]	0.15[b]	0.20[b]
	U-238	pCi/g	0.23[b]	0.37	0.33	0.30[b]	0.18	0.29	0.44	0.38	0.55	0.57	0.33	0.52	0.53	0.92	0.57	0.29	0.14[b]	0.52	0.58	0.47
IAAP100180	U-234	pCi/g	[a]	0.26	0.23[b]	0.39	0.31[b]	0.40	0.36	0.23	0.31	0.43	0.24	0.35	0.30	0.35	0.37	0.35	0.28	0.35	0.28	0.19
	U-235	pCi/g	0.16[b]	0.13[b]	0.52[b]	0.27[b]	0.21[b]	0.28[b]	0.23[b]	0.09[b]	0.20[b]	0.18[b]	0.08[b]	0.18[b]	0.19[b]	0.21[b]	0.26[b]	0.13[b]	0.18[b]	0.20[b]	0.13[b]	0.24[b]
	U-238	pCi/g	0.41	0.19	0.23[b]	0.59	0.49	0.39	0.37	0.33	0.21	0.23	0.22	0.22	0.31	0.26	0.34	0.42	0.43	0.72	0.32	0.25[b]
IAAP100187	U-234	pCi/g	[a]	0.34	0.39	0.34	0.29[b]	0.58	0.29	0.35	0.35	0.75	0.10[b]	0.20	0.44	0.55	0.26	0.45	0.64	0.44	0.25[b]	0.32
	U-235	pCi/g	0.14[b]	0.16[b]	0.36[b]	0.27[b]	0.27[b]	0.15[b]	0.16[b]	0.03[b]	0.17[b]	0.17[b]	0.12[b]	0.21[b]	0.18[b]	0.21[b]	0.21[b]	0.15[b]	0.23[b]	0.29[b]	0.31[b]	0.29[b]
	U-238	pCi/g	0.30	0.37	0.29[b]	0.64	0.25	0.31	0.36	0.34	0.23[b]	0.64	0.25	0.34	0.60	0.41	0.39	0.34	0.45	0.44	0.16[b]	0.48
IAAP177509[c]	U-234	pCi/g	[d]	0.17	0.14[b]	0.62	0.32[b]	0.39	0.09[b]	0.32	0.33	0.22	0.41	0.37	0.67	0.51	0.58	0.56	0.29	0.59	0.60	0.49
	U-235	pCi/g	[d]	0.04[b]	0.33[b]	0.15[b]	0.21[b]	0.17[b]	0.10[b]	0.22[b]	0.31[b]	0.22[b]	0.08[b]	0.24[b]	0.17[b]	0.11[b]	0.14[b]	0.14[b]	0.22[b]	0.19[b]	0.15[b]	0.19[b]
	U-238	pCi/g	[d]	0.27	0.32[b]	0.68	0.81	0.25	0.31	0.71	0.31	0.51	0.57	0.63	0.72	0.56	0.43	0.43	0.38	0.84	0.30	0.37
IAAP177517[c]	U-234	pCi/g	[d]	0.27	0.41	0.40	0.32	0.47	0.13	0.17	0.29	0.90	0.18	0.42	0.40	0.43	0.28	0.16	0.40	0.63	0.44	0.26
	U-235	pCi/g	[d]	0.04[b]	0.23[b]	0.17[b]	0.16[b]	0.16[b]	0.21[b]	0.04	0.16[b]	0.20[b]	0.07[b]	0.21[b]	0.21[b]	0.23[b]	0.20[b]	0.16[b]	0.24[b]	0.29[b]	0.31[b]	0.26[b]
	U-238	pCi/g	[d]	0.18	0.41	0.54	0.28	0.28[b]	0.24	0.28	0.27	1.22	0.23	0.48	0.36	0.40	0.34	0.15	0.32	0.22	0.40	0.14[b]

[a] Sample was not analyzed for U-234.
[b] Reported result is less than the MDC and is therefore set equal to the MDC.
[c] Stations IAAP177509 and IAAP177517 were established and initially sampled in December 2014.
[d] Sample not collected in 2007.

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4.4 STORMWATER MONITORING

Stormwater was managed in accordance with the *Environmental Protection Plan for the Iowa Army Ammunition Plant Operable Unit 8* (Ohana Cabrera 2023a) and the *Material Handling Plan for the Iowa Army Ammunition Plant Operable Unit 8* (Ohana Cabrera 2023b). No stormwater monitoring samples were collected in CY 2023.

4.5 CONCLUSION

There is no RG for surface water in the ROD; however, an evaluation of surface water data was conducted. Although there is no established USEPA ambient water quality criteria for the uranium isotopes, the maximum contaminant level for elemental uranium is 30 ug/L. Converting 30 ug/L to a maximum contaminant level equivalent for U-238 (greater than 99 percent abundance in DU), assuming the specific activity of U-238 in DU (12.4 Bq/mg U-238) would equate to 10 pCi/L. None of the surface water samples collected as part of the environmental monitoring program have exceeded 10 pCi/L. The ROD established a soil RG for DU. Sediment sampling results were compared against the soil RG of 150 pCi/g. All sediment monitoring results were less than 2 percent of the soil RG. Therefore, the results of the surface water and sediment sampling from CY 2023 demonstrate no adverse effects to Long Creek or its tributary from the remedial activities at OU-8.

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5.0 ENVIRONMENTAL QUALITY ASSURANCE PROGRAM

5.1 PROGRAM OVERVIEW

The environmental quality assurance (QA) program includes management of the QA/quality control (QC) programs, plans, and procedures governing environmental monitoring activities at IAAAP, the project laboratory, and at a USACE-subcontracted vendor QA laboratory (currently Eurofins St. Louis). The environmental monitoring standards of FUSRAP and the goals for these programs, plans, and procedures are described in this section.

The environmental QA program provides FUSRAP with reliable, accurate, and precise monitoring data. The program furnishes guidance and directives to detect and prevent problems from the time a sample is collected until the associated data are evaluated.

Key elements in achieving the goals of this program are personnel training; compliance assessments; use of QC samples; documentation of field activities and laboratory analyses; and a review of data documents for precision, accuracy, and completeness.

General objectives of the program are to accomplish the following.

- Provide data of sufficient quality and quantity to support ongoing environmental monitoring efforts.
- Ensure samples were collected using approved techniques and are representative of existing site conditions.

5.2 QUALITY ASSURANCE PROJECT PLAN

The quality assurance project plan (QAPP) for environmental monitoring activities performed at IAAAP OU-8 is contained in Appendix D of the RI WP (USACE 2008b). The QAPP provides the organization, objectives, functional activities, and specific QA/QC activities associated with environmental monitoring activities at IAAAP OU-8.

QA/QC procedures are performed in accordance with applicable professional technical standards, USEPA requirements, government regulations and guidelines, and specific project goals and requirements. The QAPP was prepared in accordance with USEPA and USACE guidance documents, including *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (USEPA 1991), *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (USEPA 1994), and Engineer Manual (EM) 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 2001).

The QAPP summarizes standard operating procedures (SOPs) and data quality requirements for collecting and analyzing environmental data. The QAPP integrates protocols and methodologies identified under various USACE and regulatory guidance. This plan documents administrative procedures for managing environmental data and governs sampling plan preparation; data review, evaluation, and validation; database administration; and data archiving.

5.3 FIELD SAMPLE COLLECTION AND MEASUREMENT

Prior to beginning field sampling, field personnel were trained, as necessary, and participated in a project-specific readiness review. These activities ensured standard procedures were followed in sample collection and in completion of field logbooks, chain-of-custody forms, labels, and custody seals. Documentation of training and readiness is retained in the project file.

The master field investigation documents are the site field logbooks. The primary purpose of these documents is to record daily field activities; personnel on each sampling team; and any administrative occurrences, conditions, or activities that may have affected the field work or data quality of any environmental samples for a given day. Guidance for documenting specific types of field sampling activities in field logbooks or on log sheets is contained in Appendix C of EM 200-1-3 (USACE 2001).

At any point in the process of surface water and sediment sample collection or data and document review, a non-conformance report may be initiated if non-conformances are identified (Leidos 2015a). Data entered into the database may be flagged accordingly.

5.4 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities were conducted to verify that sampling and analysis activities were performed in accordance with the procedures established in the QAPP.

5.4.1 Field Assessments

Internal assessments (i.e., audits or surveillances) of field activities were conducted by the QA/QC representative (or designee) for FUSRAP. Assessments included an examination of field sampling records, field instrument operating records, sample collection, handling and packaging procedures, and chain-of-custody forms. These assessments occurred throughout the duration of the project to verify all established procedures were followed.

External assessments may be conducted at the discretion of USACE, the USEPA Region 7, or the State of Iowa.

5.4.2 Project Laboratory Audits

The project laboratory is subject to periodic review(s) (i.e., laboratory internal audits) by the local USACE chemist to demonstrate compliance with the *Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* version 5.4 (QSM) (DoD and DOE 2021). Accordingly, the project laboratory participates in third-party performance evaluation studies (i.e., performance audits) at least twice per year, with results reported to the local USACE point(s) of contact. The U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) requires an annual audit and re-accreditation every 3 years. The annual ELAP audit was performed August 15 through 16, 2023. In addition, contract laboratories are required to be accredited under the DoD ELAP.

Laboratory internal audits are a yearly requirement for ELAP accreditation. All methods and SOPs, including examining laboratory documentation of sample receipt, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, and instrument operating records, are reviewed and documented on individual internal audit forms and included as attachments to internal audit SOPs. Internal audits are performed by laboratory staff and reviewed by other laboratory staff. Laboratory analysts undergo a technical method review with the auditor.

Performance audits consist of USACE laboratories receiving performance evaluation samples from an outside vendor twice per year for an ongoing assessment of laboratory precision and accuracy. The analytical results of performance evaluation samples are evaluated by the Laboratory QA Manager (or designee) and the local USACE chemist to ensure the laboratory maintains acceptable performance. The laboratory provides the results of the performance evaluation program to USACE in a deliverable memo.

Laboratory internal and performance audits were conducted by the Laboratory QA Manager as directed in the *Laboratory Quality Assurance Plan for the FUSRAP St. Louis Radiological Laboratory* (USACE 2013). Quarterly QA/QC reports are generated and provided to the local USACE authority; these reports document the ongoing QC elements and allow further monitoring of quality processes/status. In addition, QA plans and methodology are to follow the guidance presented in the QSM (DoD and DOE 2021).

5.5 SUBCONTRACTED LABORATORY PROGRAMS

All surface water and sediment samples and seven air particulate samples collected during environmental monitoring activities were analyzed by USACE-approved laboratories. The QA samples collected for surface water and sediment were analyzed by the designated USACE-subcontracted vendor QA laboratory. The laboratory supporting this work maintained statements of qualifications, including an organizational structure, QA manual, and SOPs. Additionally, the subcontracted laboratory is an accredited laboratory under the DoD ELAP.

Samples collected during these investigations were analyzed by the USEPA methods contained in USEPA Publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846) (USEPA 1993), and by other documented USEPA or nationally recognized methods. Laboratory SOPs are based on SW-846 methods.

5.6 QUALITY ASSURANCE AND QUALITY CONTROL SAMPLES

The surface water and sediment QA/QC samples were analyzed for the purpose of assessing the quality of the sampling effort and the reported analytical data. The QA/QC samples include duplicate samples (-1) and split samples (-2) (see Appendix D). The equations utilized for accuracy and precision are presented in Section 5.8.

5.6.1 Duplicate Samples

These samples, which measure precision, were collected by the sampling teams and were submitted to the project laboratory for analysis with the parent samples. The purpose of these samples is to provide activity-specific, field-originated information regarding the homogeneity of the sampled matrix and the consistency of the sampling effort. These samples were collected concurrently with the primary environmental samples and equally represent the medium at a given time and location. Duplicate samples were collected from surface water and sediment and were submitted to the project laboratory for analysis. One duplicate sample was collected for approximately every 20 field samples of each matrix and analyte. Precision is measured by the relative percent difference (RPD) or the normalized absolute difference (NAD) for radiological analyses.

The RPDs and NADs for radiological analyses are presented in Tables 5-1 and 5-2. The overall precision for CY 2023 environmental monitoring sampling activities was acceptable. See Section 5.8 for the evaluation process.

Table 5-1. Radiological Duplicate Sample Alpha Analysis for CY 2023 – Surface Water

Surface Water Sample Name[a]	U-234[b]		U-235[b]		U-238[b]	
	RPD (%)	NAD	RPD (%)	NAD	RPD (%)	NAD
IAAP266526 / IAAP266526-1	NC	NA	NC	NA	58.68	0.58

[a] Samples ending in "-1" are duplicate samples.
[b] RPD criterion for water matrix samples is less than or equal to 30 percent. If the RPD is greater than 30 percent, then the NAD shall be less than or equal to 1.96 to remain within the control limits.
NA – not applicable (see RPD)
NC – not calculated (due to one or both concentrations being below MDCs)

Table 5-2. Radiological Duplicate Sample Alpha Analysis for CY 2023 – Sediment

Sediment Sample Name[a]	U-234[b]		U-235[b]		U-238[b]	
	RPD (%)	NAD	RPD (%)	NAD	RPD (%)	NAD
IAAP271204 / IAAP271204-1	47.93	NA	NC	NA	34.50	NA

[a] Samples ending in "-1" are duplicate samples.
[b] RPD criterion for solid matrix samples is less than or equal to 50 percent. If the RPD is greater than 50 percent, then the NAD shall be less than or equal to 1.96 to remain within the control limits.
NA – not applicable (see RPD)
NC – not calculated (due to one or both concentrations being below MDCs)

5.6.2 Split Samples

Split samples measure accuracy and were collected by the sampling team and sent to the USACE-subcontracted vendor QA laboratory for analysis to provide an independent assessment of contractor and subcontractor laboratory performance. One split sample was collected for approximately every 20 field samples of each matrix for radiological analytes.

The RPDs and NADs for radiological analyses are presented in Tables 5-3 and 5-4. The overall accuracy for the CY 2023 environmental monitoring sampling activities was acceptable. See Section 5.8 for the evaluation process.

Table 5-3. Radiological Split Sample Alpha Analysis for CY 2023 – Surface Water

Surface Water Sample Name[a]	U-234[b]		U-235[b]		U-238[b]	
	RPD (%)	NAD	RPD (%)	NAD	RPD (%)	NAD
IAAP266526 / IAAP266526-2	NC	NA	NC	NA	NC	NA

[a] Samples ending in "-2" are split samples.
[b] RPD criterion for water matrix samples is less than or equal to 30 percent. If the RPD is greater than 30 percent, then the NAD shall be less than or equal to 1.96 to remain within the control limits.
NA – not applicable (see RPD)
NC – not calculated (due to one or both concentrations being below MDCs)

Table 5-4. Radiological Split Sample Alpha Analysis for CY 2023 – Sediment

Sediment Sample Name[a]	U-234[b]		U-235[b]		U-238[b]	
	RPD (%)	NAD	RPD (%)	NAD	RPD (%)	NAD
IAAP271204 / IAAP271204-2	14.80	NA	NC	NA	2.02	NA

[a] Samples ending in "-2" are split samples.
[b] RPD criterion for solid matrix samples is less than or equal to 50 percent. If the RPD is greater than 50 percent, then the NAD shall be less than or equal to 1.96 to remain within the control limits.
NA – not applicable (see RPD)
NC – not calculated (due to one or both concentrations being below MDCs)

5.6.3 Equipment Rinsate Blanks

Equipment rinsate blank samples are typically taken from the rinsate water collected from equipment decontamination activities. These samples consist of analyte-free water that has been rinsed over sampling equipment for the purposes of evaluating the effectiveness of equipment decontamination.

Sediment samples are collected from each station using a clean sampling spoon. These spoons are segregated after use and decontaminated according to Field Technical Procedure 400, *Equipment Decontamination* (Leidos 2015b). Because the process of collecting sediment occurs below the surface of the water, a rinsate blank would not represent the wetted surface of the sampling spoon at the time of sample collection and, therefore, would not apply. The surface water samples are collected using new nitrile gloves and new laboratory sample containers. Equipment rinsate blanks for these samples are also not required because no potential for contamination exists.

5.7 DATA REVIEW, EVALUATION, AND VALIDATION

All data packages received from the analytical laboratories were reviewed and either evaluated or validated by data management personnel. Data validation is the systematic process of ensuring that the precision and accuracy of the analytical data are adequate for their intended use. Validation was performed in accordance with *Data Verification and Validation* (Leidos 2015c), and/or with project-specific guidelines. General chemical data quality management guidance found in Engineer Regulation (ER)-1110-1-263, *Engineering and Design – Chemical Data Quality Management for Hazardous, Toxic, and Radioactive Waste Activities* (USACE 1998), was also used when planning for chemical data management and evaluation. Additional details of data review, evaluation, and validation are provided in *FUSRAP Laboratory Data Management Process for the St. Louis Site* (USACE 1999). Data assessment guidance to determine the usability of data from hazardous, toxic, and radioactive waste projects is provided in EM-200-1-6, *Chemical Quality Assurance for Hazardous, Toxic, and Radioactive Waste (HTRW) Projects* (USACE 1997).

One hundred (100) percent of the data generated from all analytical laboratories was independently reviewed and either evaluated or validated. The data review process documents the possible effects on the data from various QC failures; it does not determine data usability, nor does it include assignment of data validation qualifier (VQ) flags. The data evaluation process uses the results of the data review to determine the usability of the data. The process of data evaluation summarizes the potential effects of QA/QC failures on the data, and a USACE District Chemist or District Health Physicist assesses their impact on the attainment of the project-specific data quality objectives (DQOs). Consistent with the data quality requirements, as defined in the DQOs, approximately 10 percent of all project data were validated.

5.8 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPARABILITY, COMPLETENESS, AND SENSITIVITY

The data evaluation process considers precision, accuracy, representativeness, comparability, completeness, and sensitivity. The following subsections detail the particular parameters and the data evaluation method for each.

Accuracy and precision can be measured by the RPD or the NAD using the following equations:

$$RPD = \left(\frac{[S - D]}{\frac{S + D}{2}} \right) x\ 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

where:

S = Parent Sample Result
D = Duplicate/Split Sample Result
U_S = Parent Sample Uncertainty
U_D = Duplicate/Split Sample Uncertainty
RPD has units of percent (%); NAD is unitless

The RPD is calculated for all samples for which a detectable result is reported for both the parent and the QA field split or field duplicate. For surface water radiological samples, when the RPD is greater than 30 percent, the NAD is used to determine the accuracy or precision of the method. The RPD criterion for sediment samples is greater than 50 percent. The NAD accounts for uncertainty in the results; the RPD does not. The NAD should be equal to or less than a value of 1.96. Neither equation is used when the analyte in one or both of the samples is not detected. In cases in which neither equation can be used, the comparison is counted as acceptable in the overall number of comparisons.

Precision is a measure of mutual agreement among individual measurements performed under the same laboratory controls. To evaluate for precision, a field duplicate is submitted to the same laboratory as the original sample to be analyzed under the same laboratory conditions.

The RPD and NAD between the two results was calculated and used as an indication of the precision of the analyses performed (Tables 5-1 and 5-2). Sample collection precision was evaluated in the laboratory by the analyses of duplicates. The overall precision for the CY 2023 environmental monitoring sampling activities was acceptable.

Accuracy provides a gauge or measure of the agreement between an observed result and the true value for an analysis. The RPD and NAD between the two results was calculated and used as an indication of the accuracy of the analyses performed (Tables 5-3 and 5-4). For this EMDAR, accuracy is evaluated using field split samples through a comparison of the prime laboratory results versus the results of an independent laboratory. The overall accuracy for the CY 2023 environmental monitoring sampling activities was acceptable.

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that depends upon the proper design of the sampling program and proper laboratory protocols. Representativeness is satisfied through proper design of the sampling network, use of proper sampling techniques, following proper analytical procedures, and not exceeding holding times of the samples.

Representativeness was determined by assessing the combined aspects of the QA program, QC measures, and data evaluations. The sampling protocol from the RI WP QAPP was followed, and analytical procedures were conducted in accordance with the QAPP. The overall representativeness of the CY 2023 environmental monitoring sampling activities was acceptable for the media and sampling described in this EMDAR.

Comparability expresses the confidence with which one dataset can be compared with another. The extent to which analytical data will be comparable depends upon the similarity of sampling and analytical methods, as well as sample-to-sample and historical comparability. Standardized and consistent procedures used to obtain analytical data are expected to provide comparable results. Some data (e.g., radiological monitoring) have values that are primarily useful in the present, thus the comparison to historical data is not as relevant. The overall comparability of the applicable environmental monitoring sampling data met the project DQOs and was acceptable.

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under normal conditions. Laboratories are expected to provide data meeting QC acceptance criteria for all samples tested. For the CY 2023 environmental monitoring sampling activities, the data completeness was 100 percent (i.e., FUSRAP DQO for completeness is 90 percent) and was acceptable.

Sensitivity is the determination of minimum detectable concentration (MDC) values that allows the investigation to assess the relative confidence that can be placed in an analytical result in comparison to the magnitude or level of analyte concentration observed. For this report, MDC is a term generically used to represent the minimum detectable activity (MDA) for radiological analytes. The closer a measured value to the MDC, the lower the established confidence and the greater the variation in the measured value. Project sensitivity goals were expressed as quantitation level goals in the RI WP QAPP. These levels were achieved or exceeded throughout the analytical process; therefore, sensitivity was acceptable. The MDC is reported for each result obtained by laboratory analysis. These very low MDCs are achieved using alpha spectroscopy. Variations in MDCs for the same radiological analyte reflect variability in the detection efficiencies and conversion factors due to factors such as individual sample aliquot, sample density, and variations in analyte background radioactivity for alpha spectroscopy at the laboratory. To complete the data evaluation (i.e., precision, accuracy, representativeness, and comparability), analytical results that exceed the MDC of the analyte are desired.

5.9 DATA QUALITY ASSESSMENT SUMMARY

The overall quality of the data meets the established project objectives. Through proper implementation of the project data review, evaluation, validation, and assessment process, project information has been determined to be acceptable for use.

Data, as presented, have been qualified as usable, but estimated when necessary. Data that have been estimated have concentrations/activities that are below the quantitation limit or are indicative of accuracy, precision, or sensitivity being less than desired but adequate for interpretation.

These data can withstand scientific scrutiny, are appropriate for the intended purpose, and are technically defensible. Confidence in the presented environmental information has been established, allowing the information to be utilized for the project objectives and providing data for future needs.

5.10 RESULTS FOR PARENT SAMPLES AND THE ASSOCIATED DUPLICATE AND SPLIT SAMPLES

A summary of the QA parent sample results and associated duplicate and/or split sample results are presented in Tables 5-5 and 5-6.

Table 5-5. Radiological Parent Samples and Associated Duplicate and Split Samples for CY 2023 – Surface Water

Surface Water Sample Name[a]	U-234[b]				U-235[b]				U-238[b]			
	Result	Error	MDC	VQ	Result	Error	MDC	VQ	Result	Error	MDC	VQ
	pCi/L				pCi/L				pCi/L			
IAAP266526	0.47	0.39	0.50	UJ	0.17	0.29	0.61	UJ	0.72	0.45	0.36	J
IAAP266526-1	0.47	0.37	0.37	J	0.00	0.24	0.63	UJ	0.40	0.34	0.37	J
IAAP266526-2	0.69	0.36	0.29	J	0.13	0.19	0.31	UJ	0.23	0.21	0.25	UJ

[a] Samples ending in "-1" are duplicate samples. Samples ending in "-2" are split samples.
[b] Results from alpha spectroscopy.
VQ symbols indicate: "J" for analyte was identified as estimated quantity, and "UJ" for analyte was not detected and had QC deficiencies.

Table 5-6. Radiological Parent Samples and Associated Duplicate and Split Samples for CY 2023 – Sediment

Sediment Sample Name[a]	U-234[b]				U-235[b]				U-238[b]			
	Result	Error	MDC	VQ	Result	Error	MDC	VQ	Result	Error	MDC	VQ
	pCi/g				pCi/g				pCi/g			
IAAP271204	0.34	0.21	0.14	J	0.03	0.07	0.17	UJ	0.34	0.21	0.14	J
IAAP271204-1	0.21	0.17	0.15	J	0.00	0.11	0.28	UJ	0.49	0.25	0.15	J
IAAP271204-2	0.40	0.14	0.08	=	0.03	0.04	0.07	UJ	0.35	0.13	0.07	=

[a] Samples ending in "-1" are duplicate samples. Samples ending in "-2" are split samples.
[b] Results from alpha spectroscopy.
VQ symbols indicate: "=" for positively identified results, "J" for analyte was identified as estimated quantity, and "UJ" for analyte was not detected and had QC deficiencies.

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40 *CFR* 61.103. *Determining Compliance.*

FIGURES

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Path: U:\GPS\IAAAP\EMDAR\CY2022\Rev0\Figure 1-1 FUSRAP Areas at IAAAP.mxd

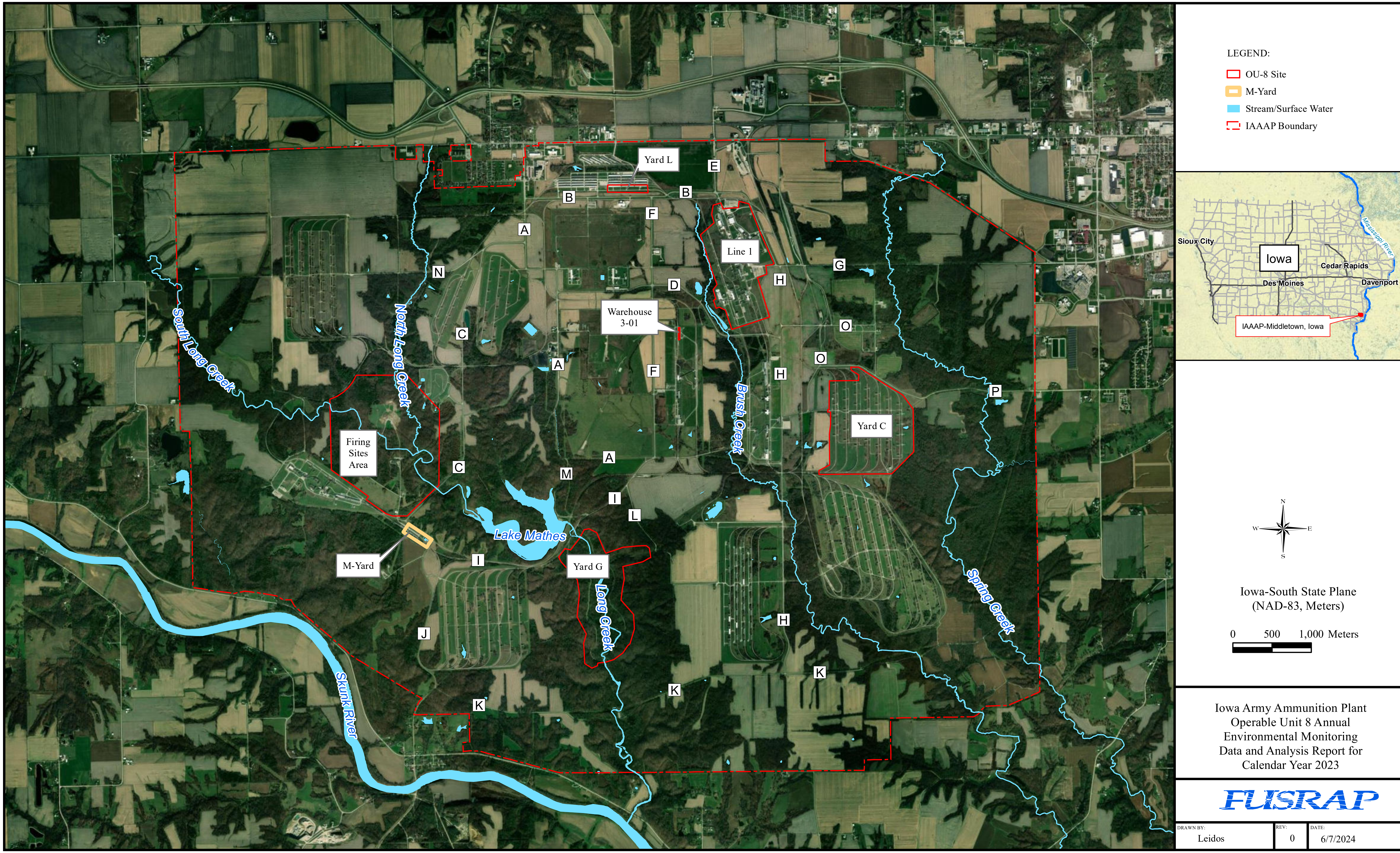

Figure 1-1. FUSRAP Areas at IAAAP

Path: U:\GPS\IAAAP\Firing Sites\PDI Sampling Plan for FSA Roadways\Figure 2 Layout of Firing Site Area.mxd

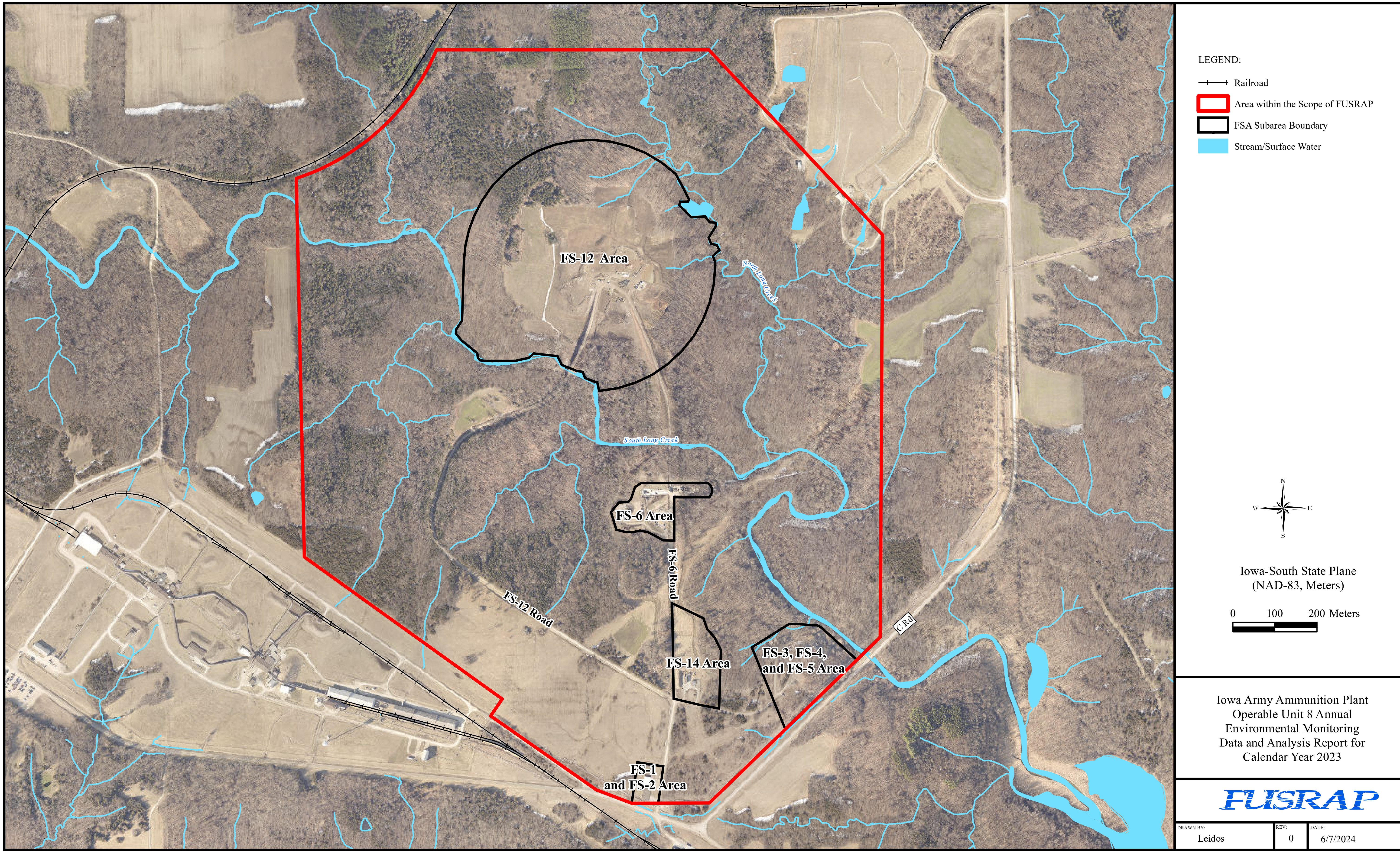

Figure 1-2. Layout of the Firing Sites Area

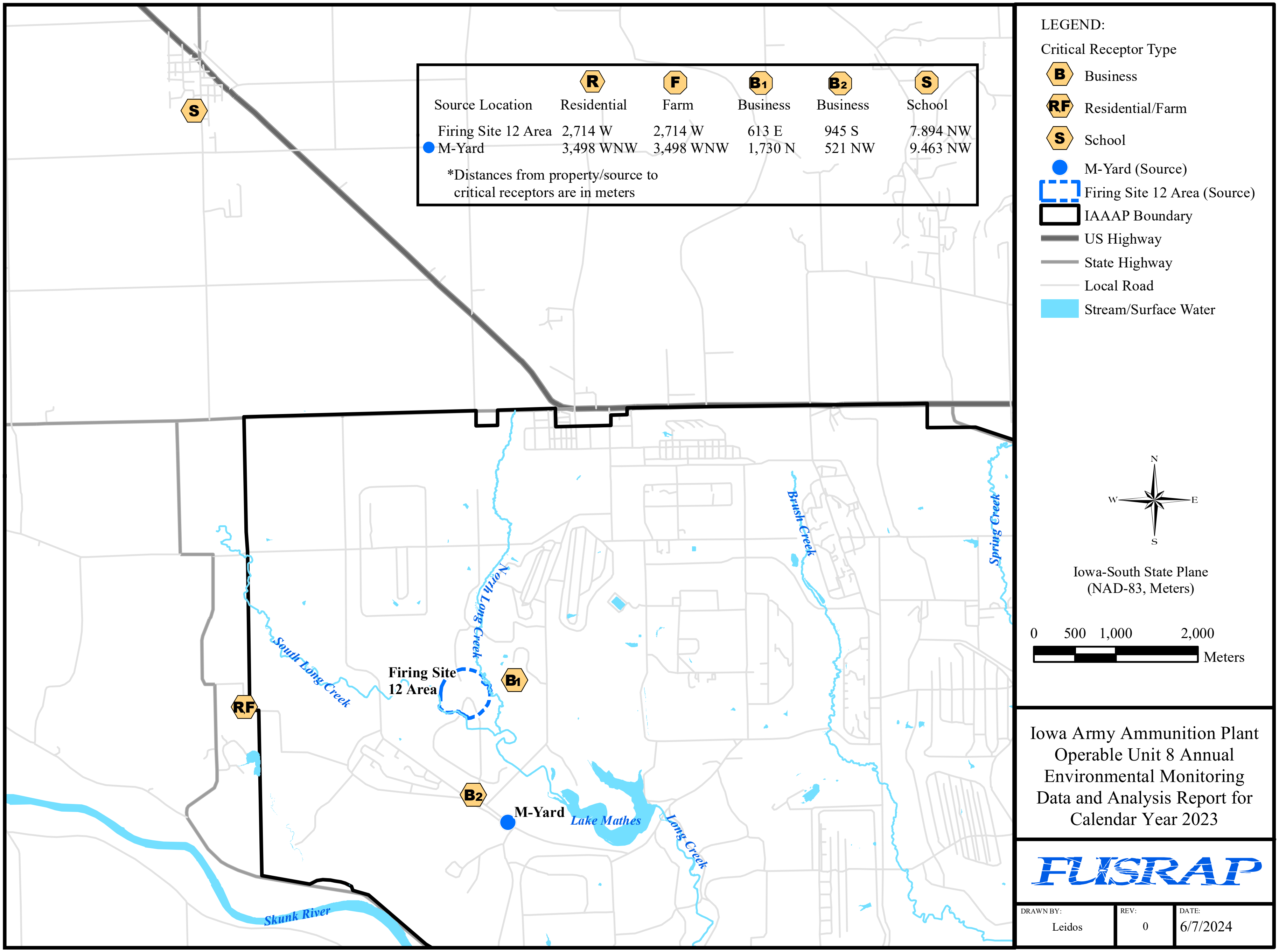

Figure 3-1. IAAAP Firing Sites Area Receptors

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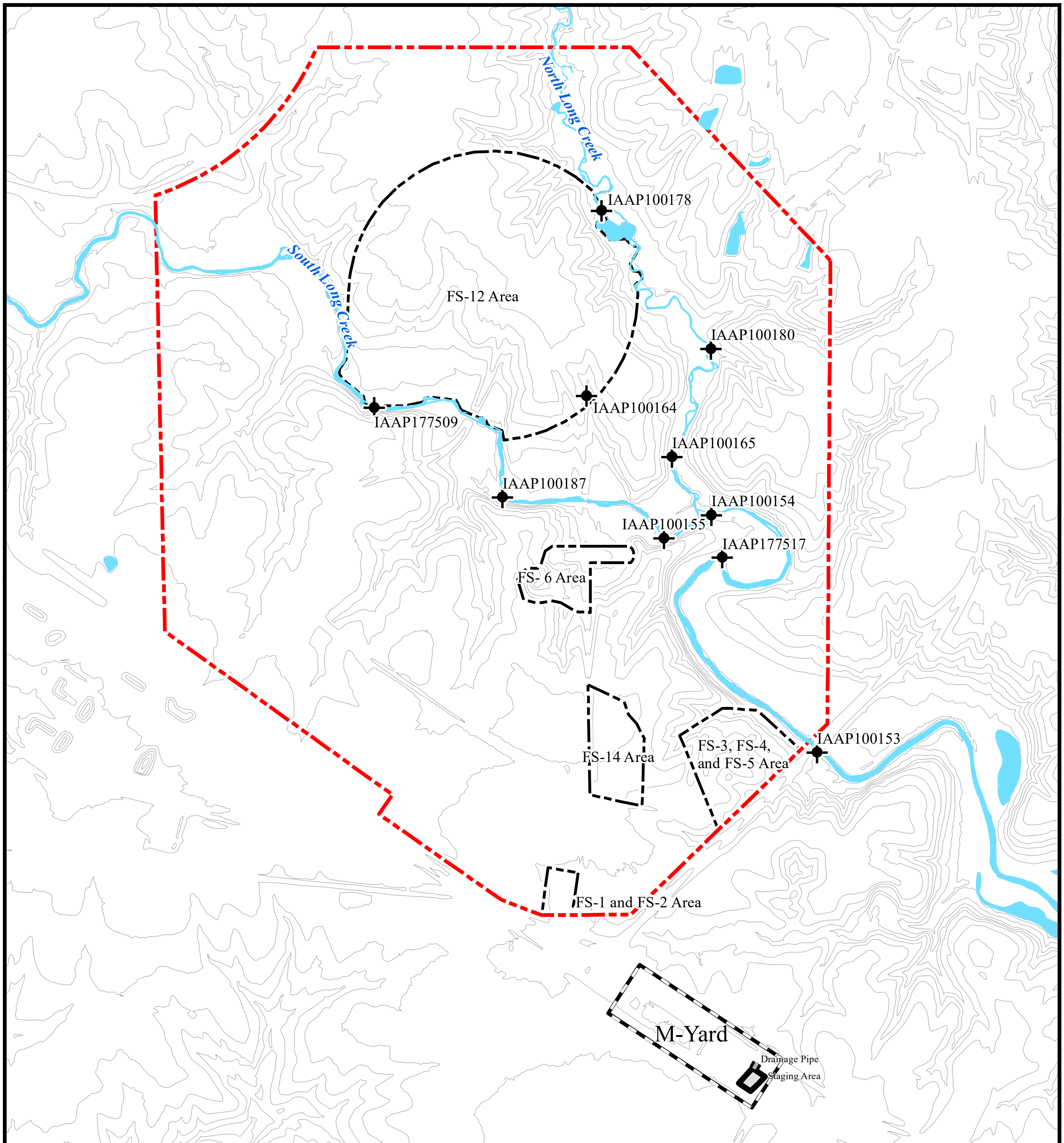
Path: U:\GPS\IAAAP\EMDAR\CY2022\Rev0\Figure 4-1 Firing Sites Sediment Sample Locations Emdar.mxd



LEGEND:

- Environmental Monitoring Sample Locations
- Firing Sites Area
- Firing Site Boundaries
- M-Yard
- M-Yard Staging Area
- Drainage Pipe
- 10ft Contour
- Stream/Surface Water

N
W E
S

IA-South State Plane
(NAD-83, Meters)

0 500 1,000 Feet

Iowa Army Ammunition Plant
Operable Unit 8 Annual
Environmental Monitoring
Data and Analysis Report for
Calendar Year 2023

FUSRAP

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Figure 4-1. Surface Water
and Sediment Monitoring Locations

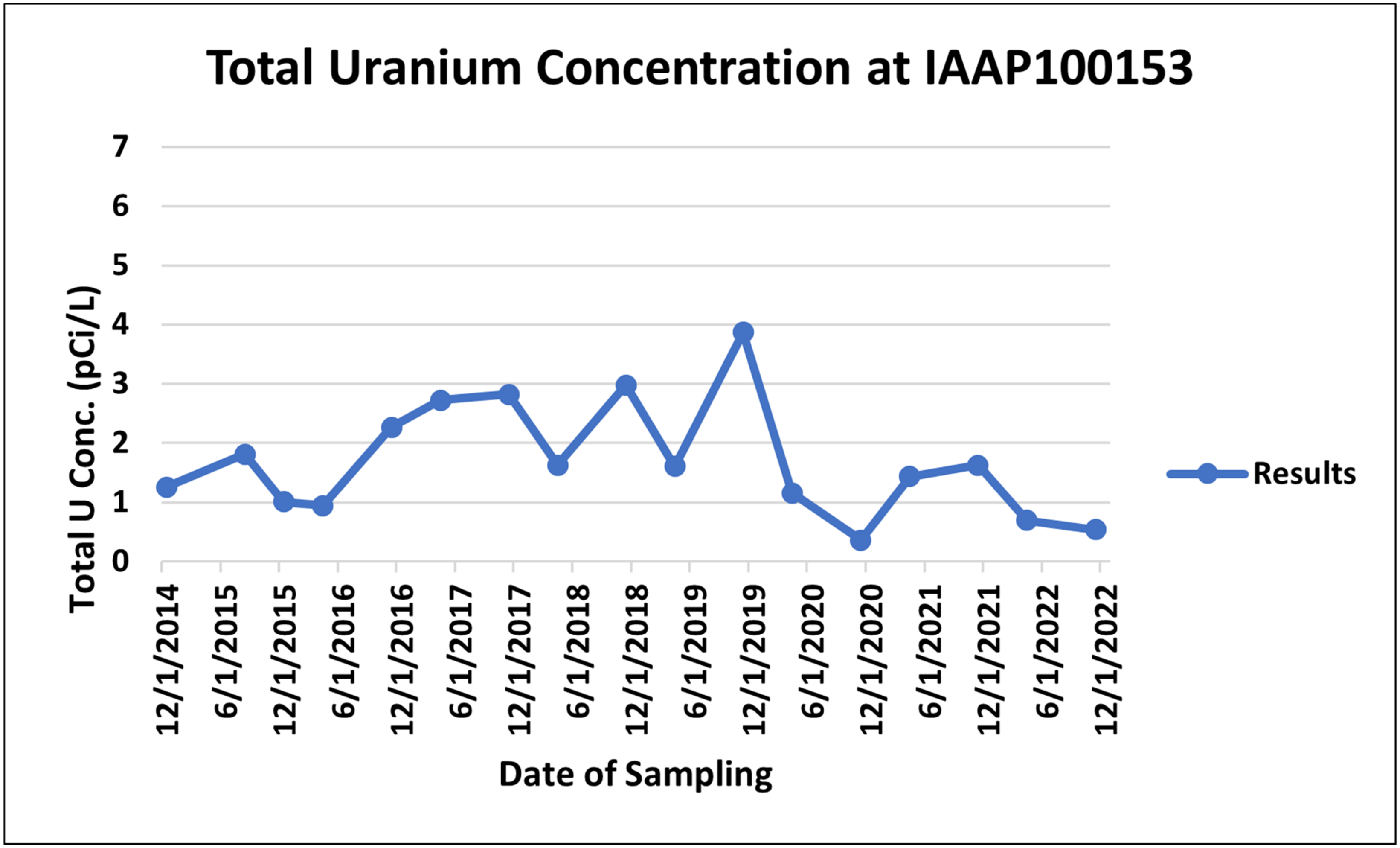

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Figure 4-2. Total Uranium Concentrations in Surface Water Versus Sampling Date

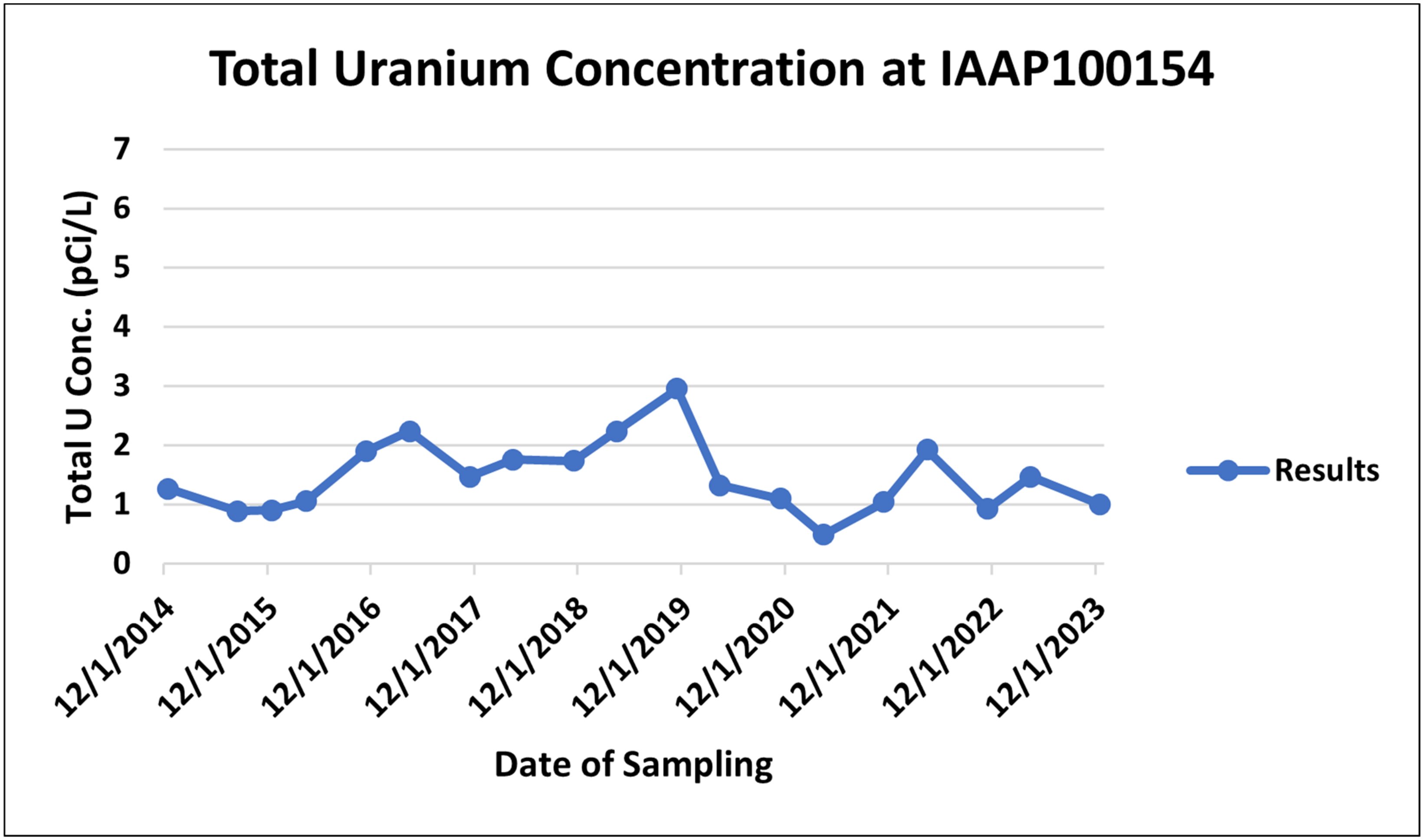

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Figure 4-2. Total Uranium Concentrations in Surface Water Versus Sampling Date (Continued)

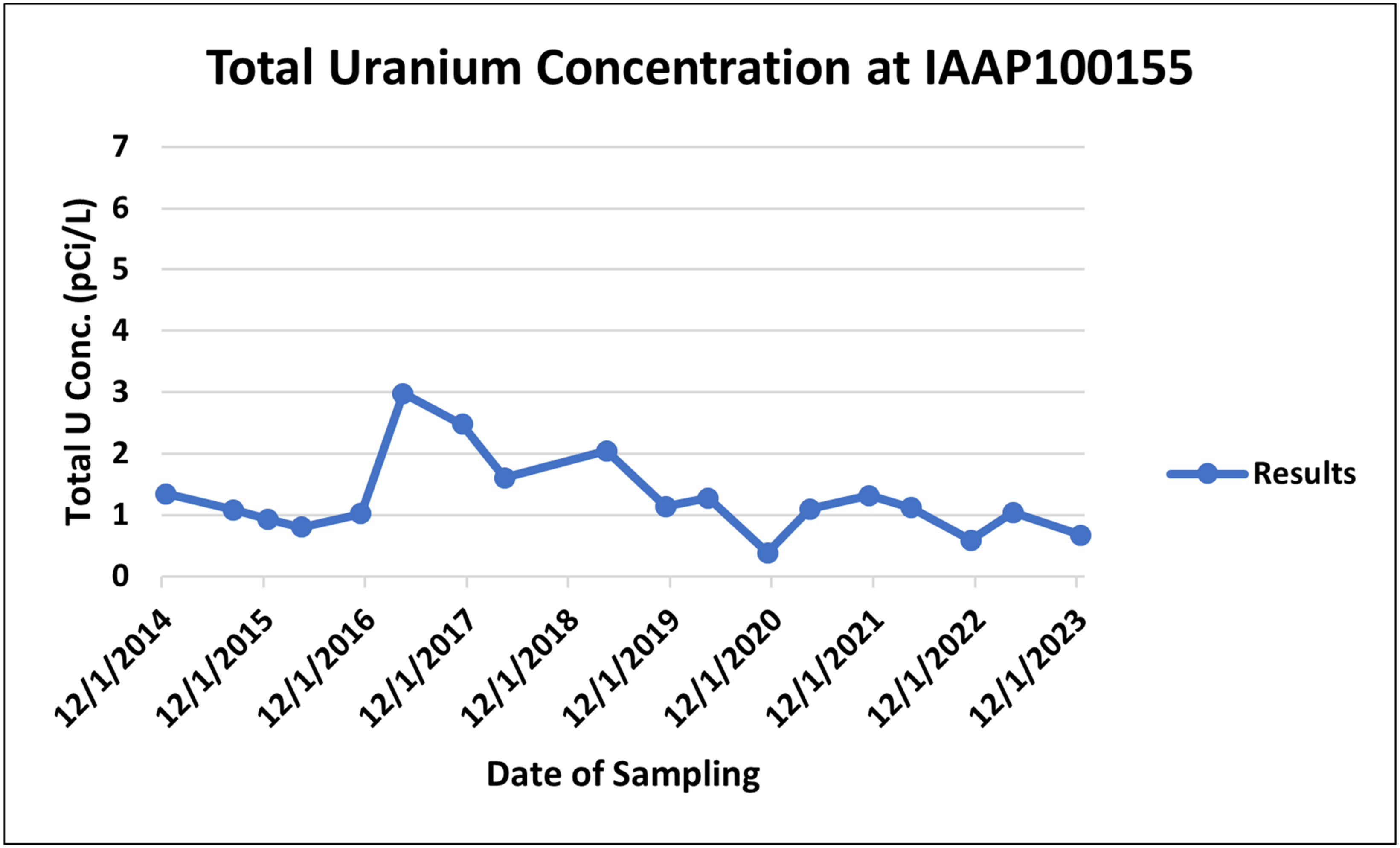

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Figure 4-2. Total Uranium Concentrations in Surface Water Versus Sampling Date (Continued)

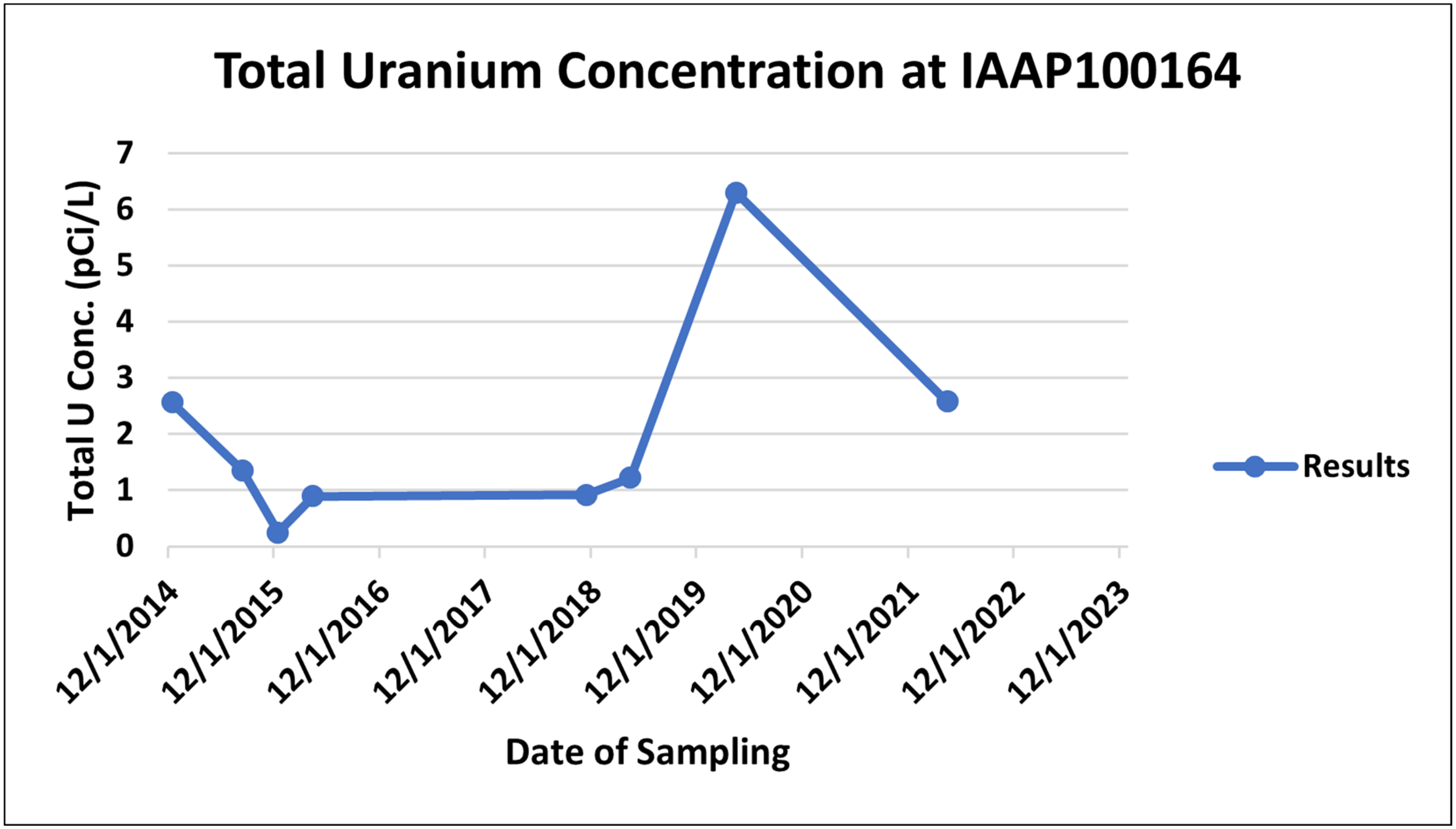

Figure 4-2. Total Uranium Concentrations in Surface Water Versus Sampling Date (Continued)

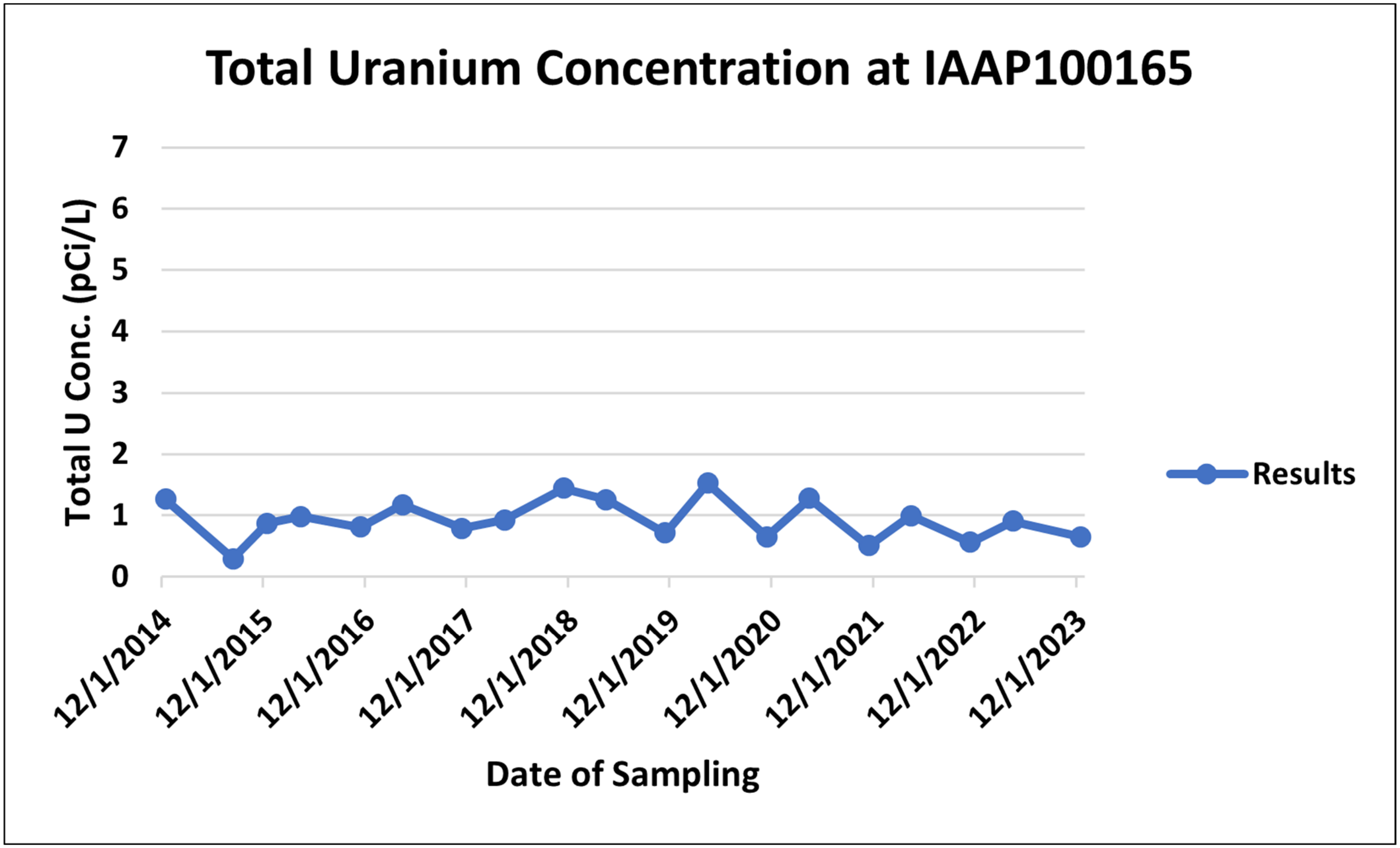

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Figure 4-2. Total Uranium Concentrations in Surface Water Versus Sampling Date (Continued)

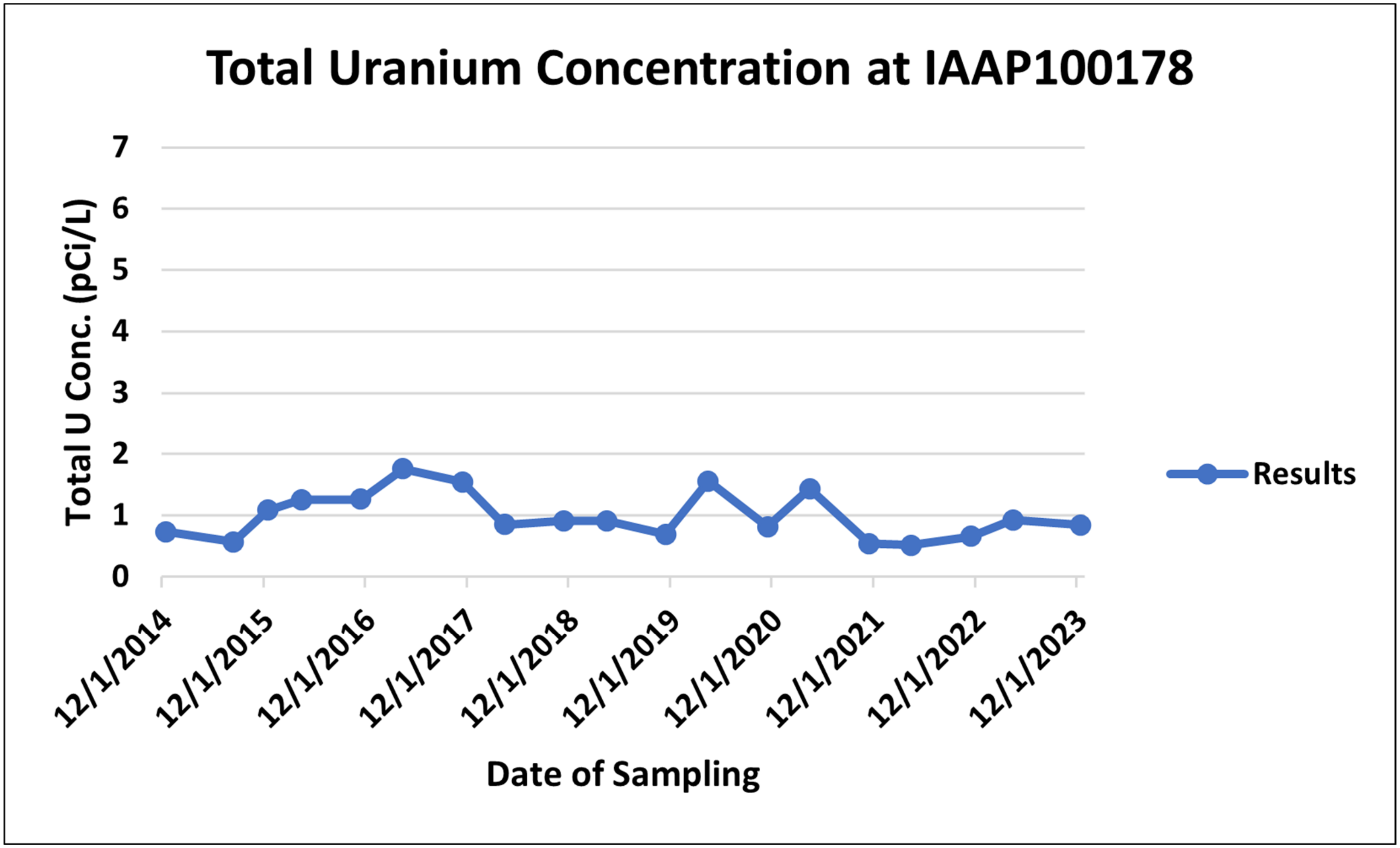

Figure 4-2. Total Uranium Concentrations in Surface Water Versus Sampling Date (Continued)

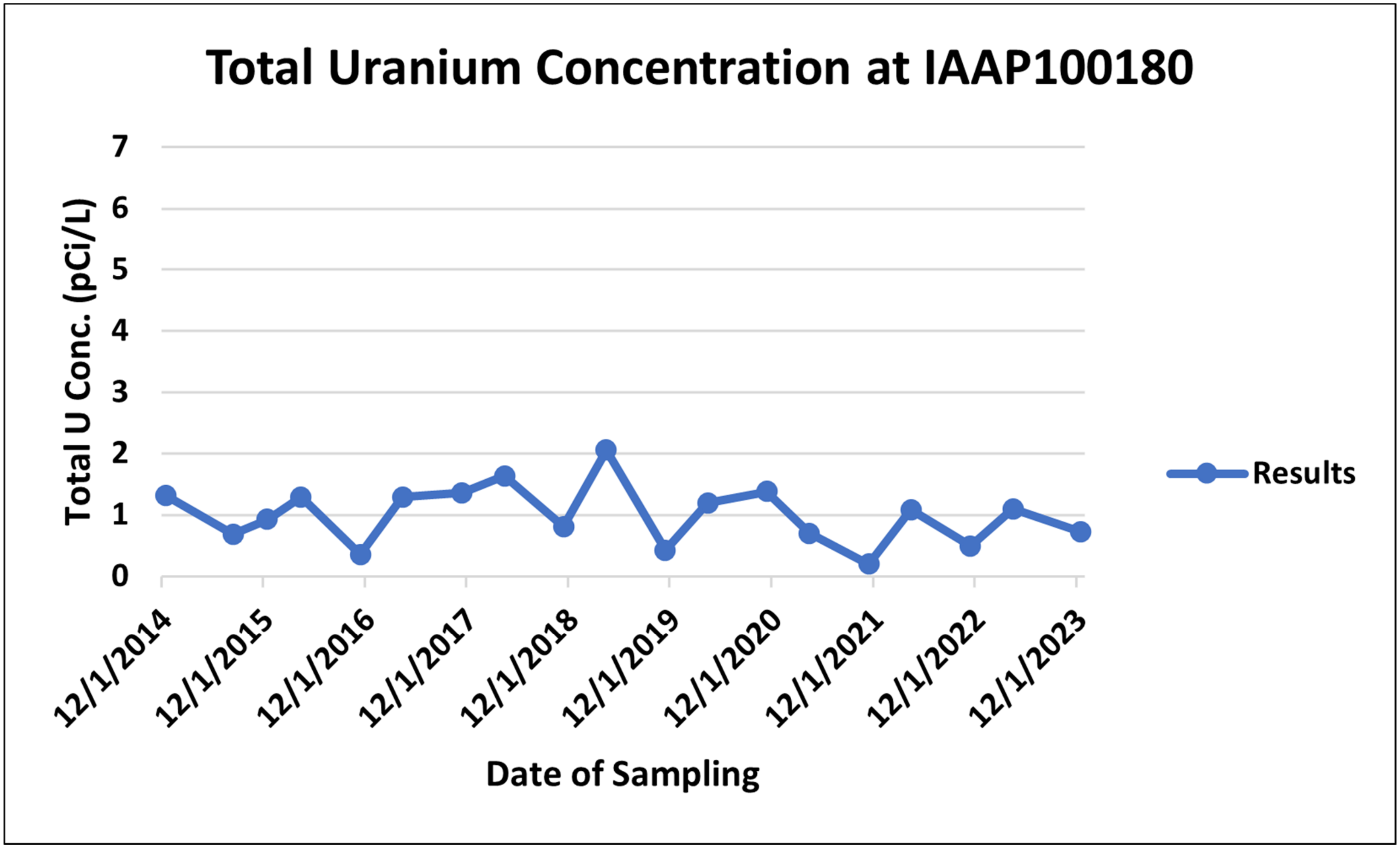

Figure 4-2. Total Uranium Concentrations in Surface Water Versus Sampling Date (Continued)

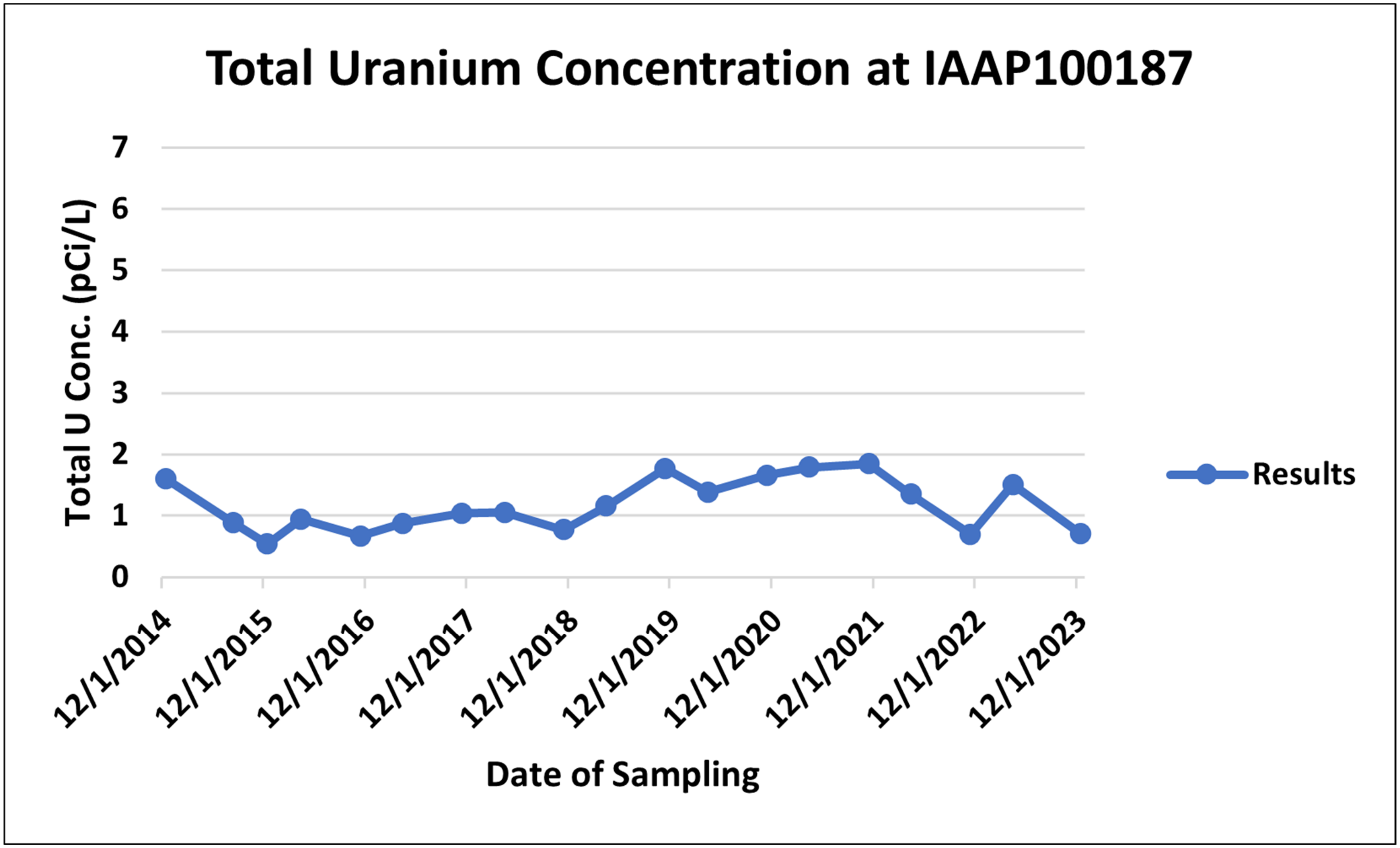

Figure 4-2. Total Uranium Concentrations in Surface Water Versus Sampling Date (Continued)

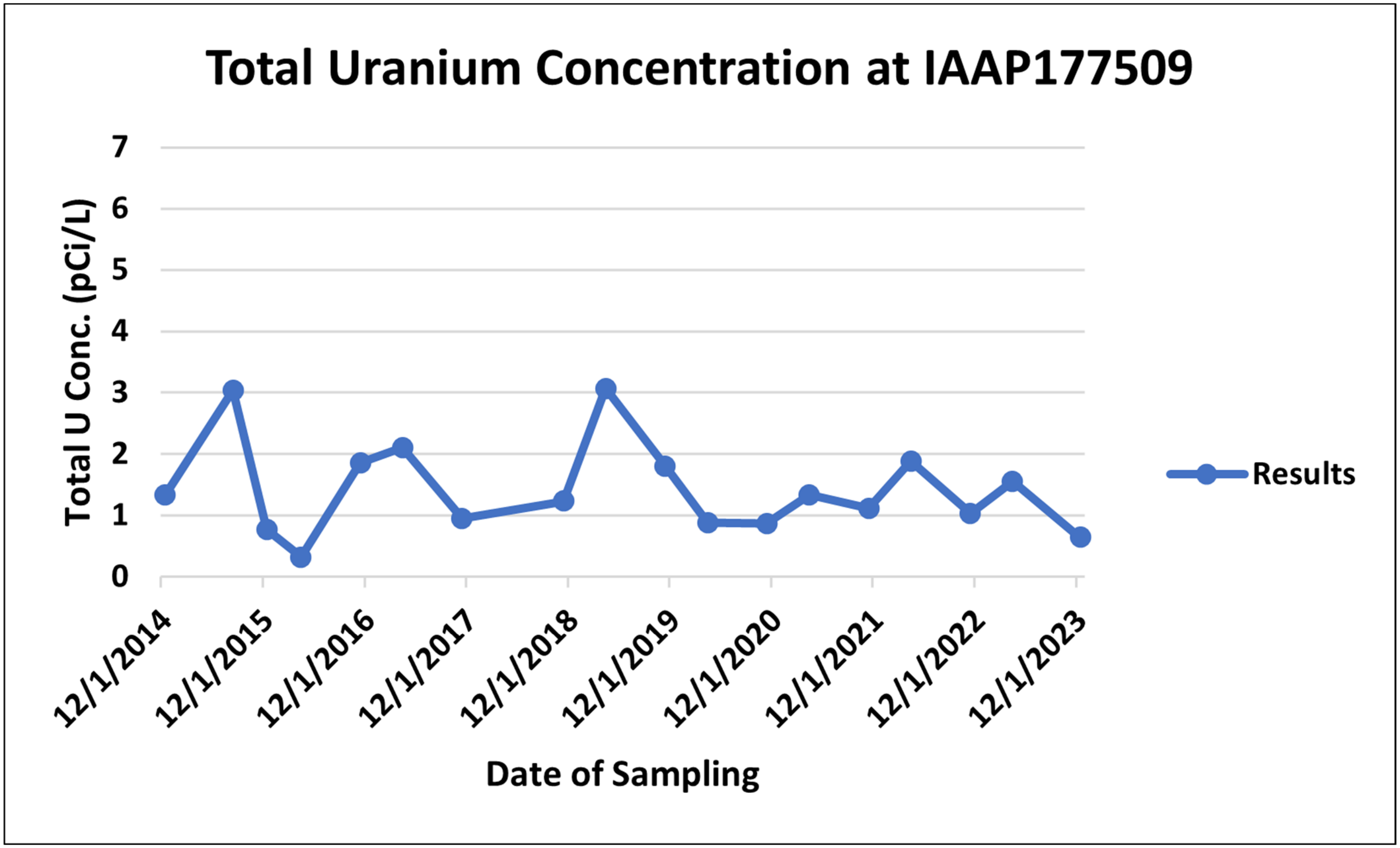

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Figure 4-2. Total Uranium Concentrations in Surface Water Versus Sampling Date (Continued)

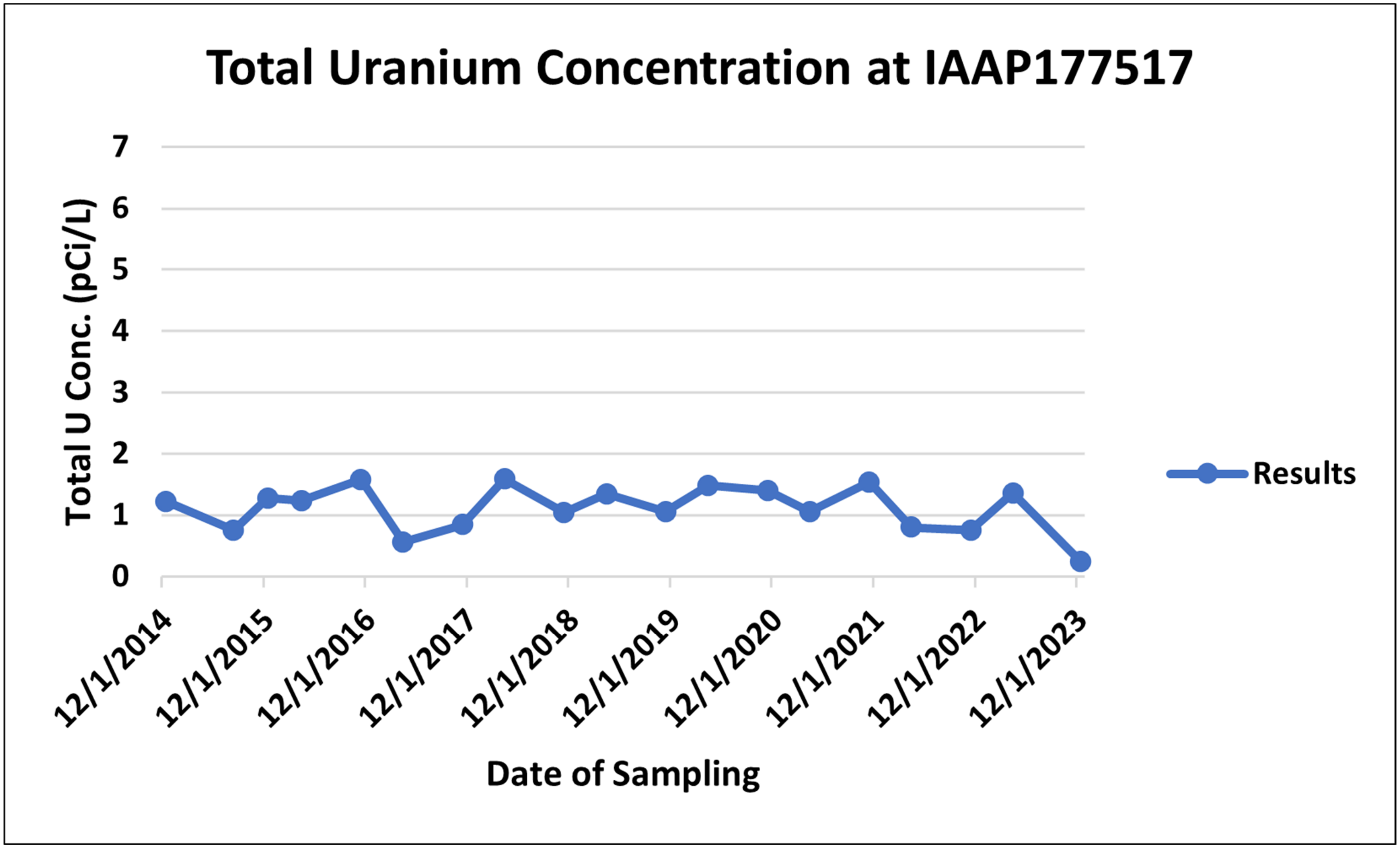

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Figure 4-2. Total Uranium Concentrations in Surface Water Versus Sampling Date (Continued)

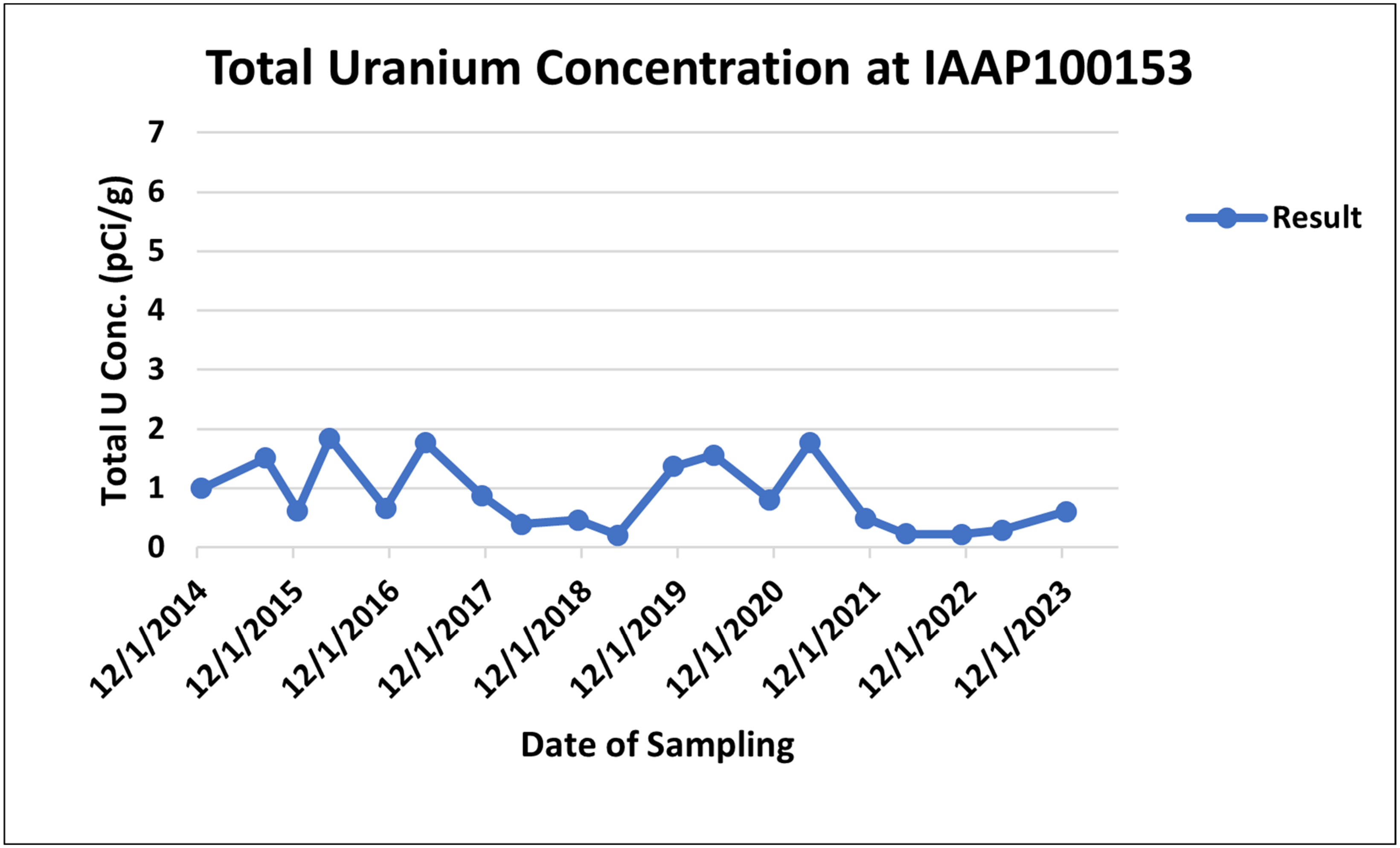

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Figure 4-3. Total Uranium Concentrations in Sediment Versus Sampling Date

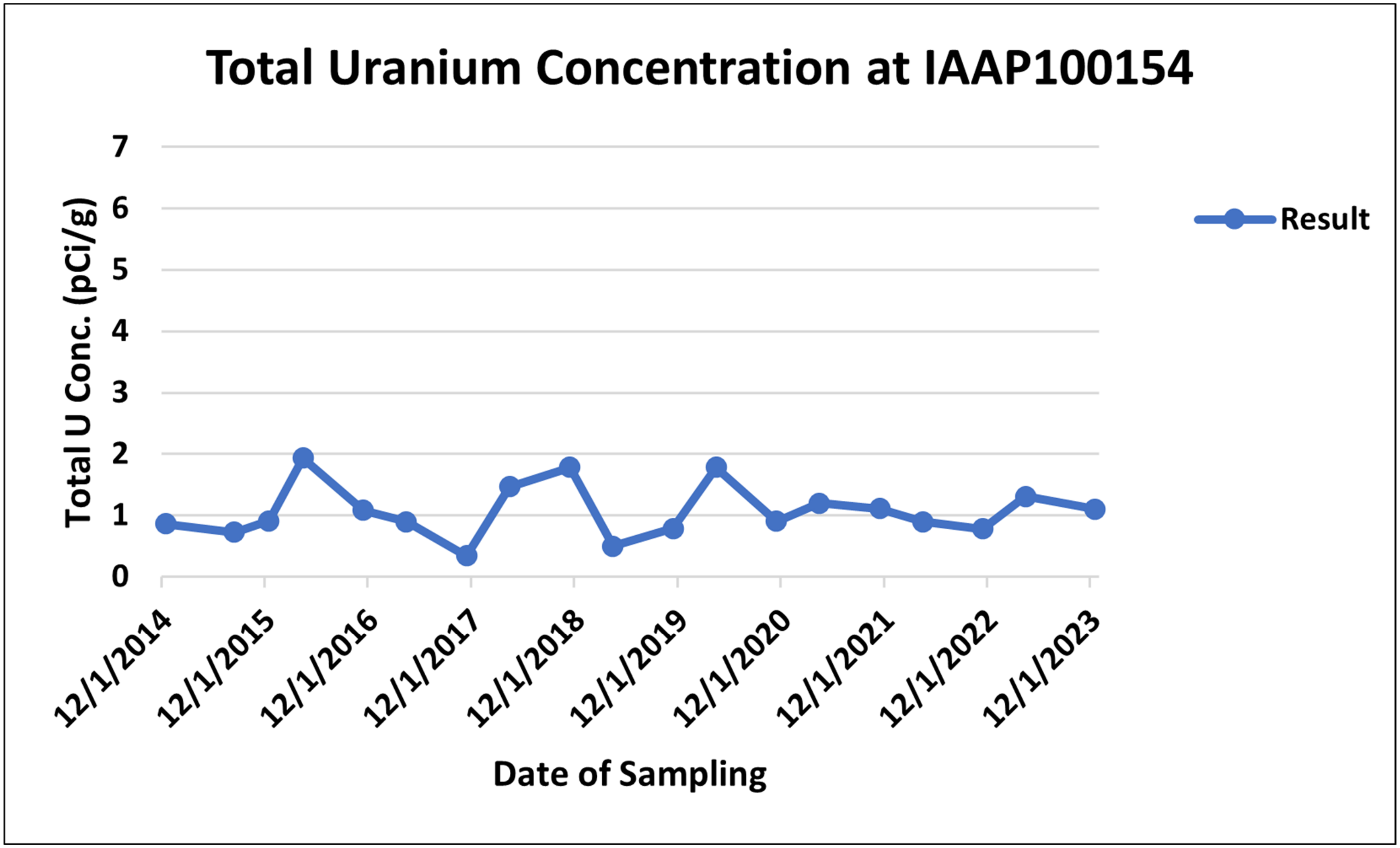
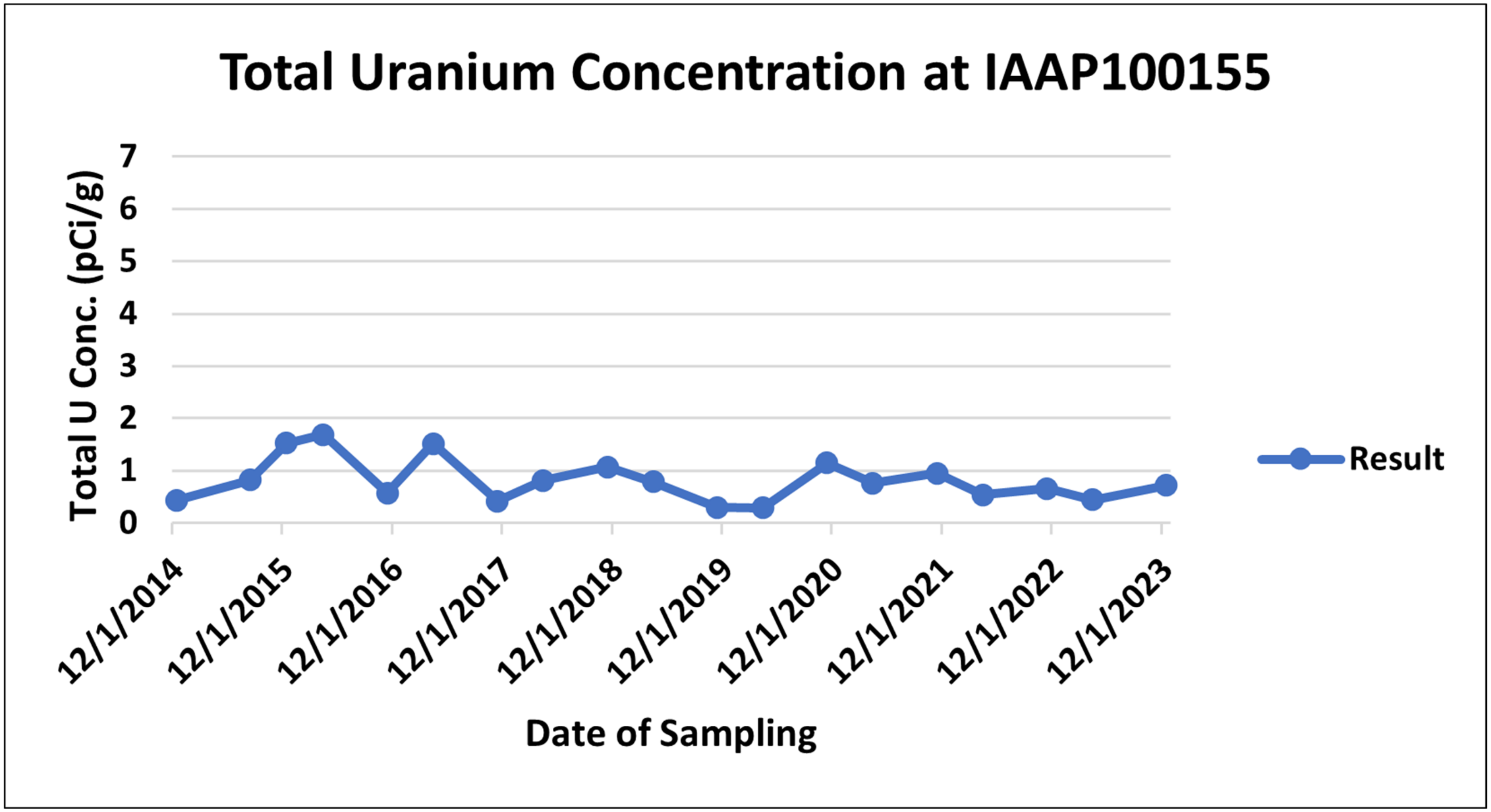


Figure 4-3. Total Uranium Concentrations in Sediment Versus Sampling Date (Continued)



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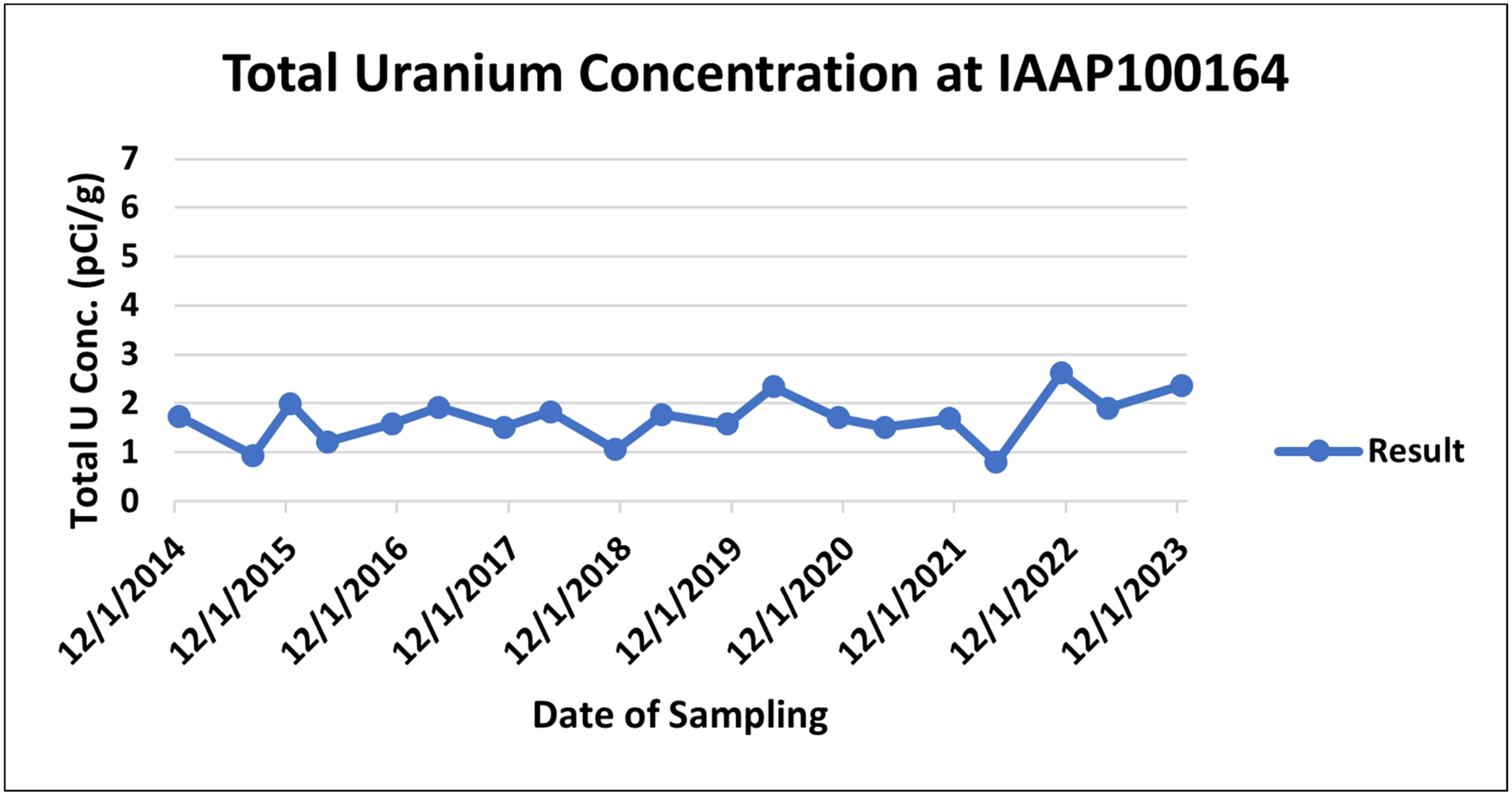

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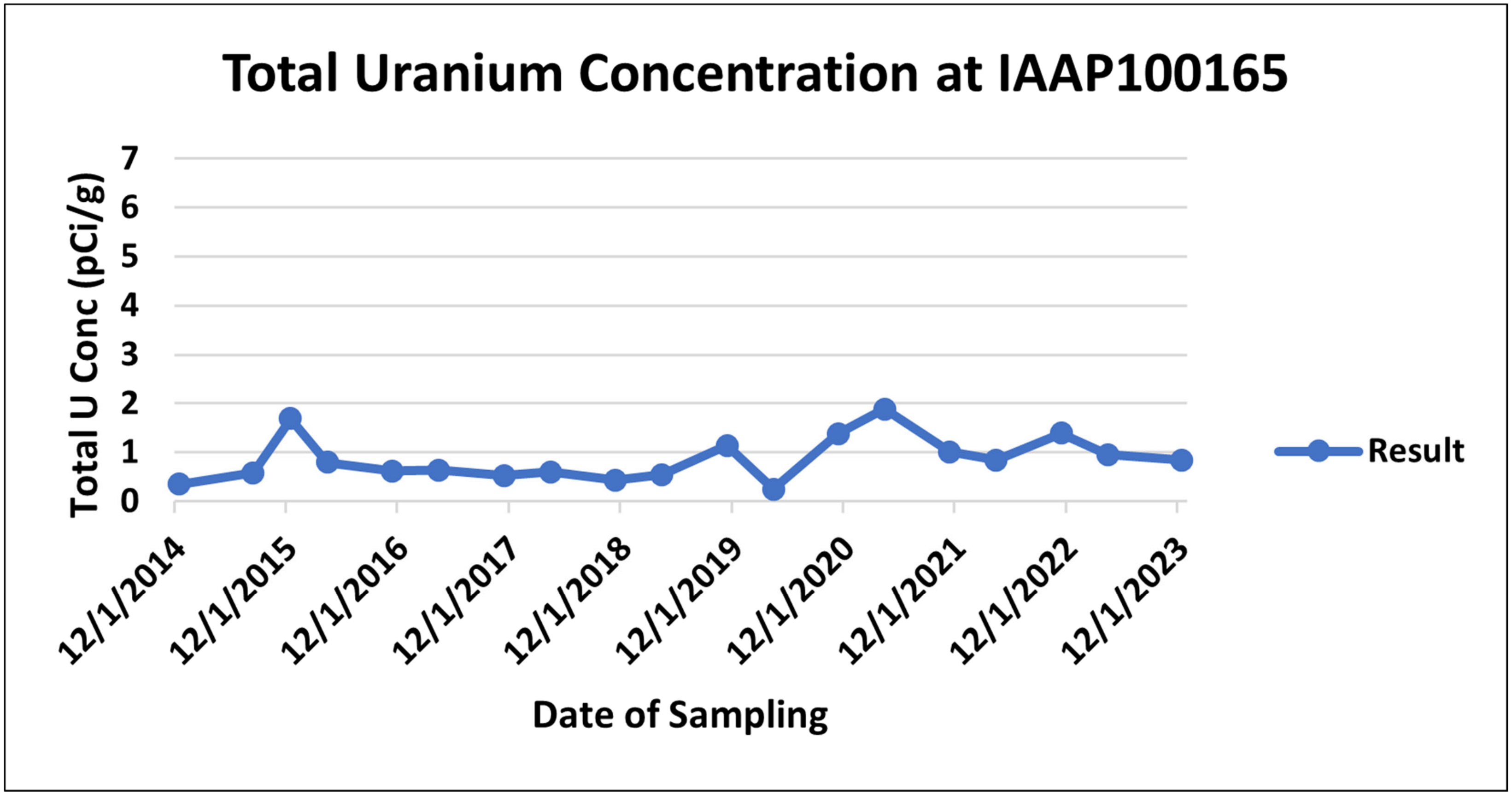

Figure 4-3. Total Uranium Concentrations in Sediment Versus Sampling Date (Continued)

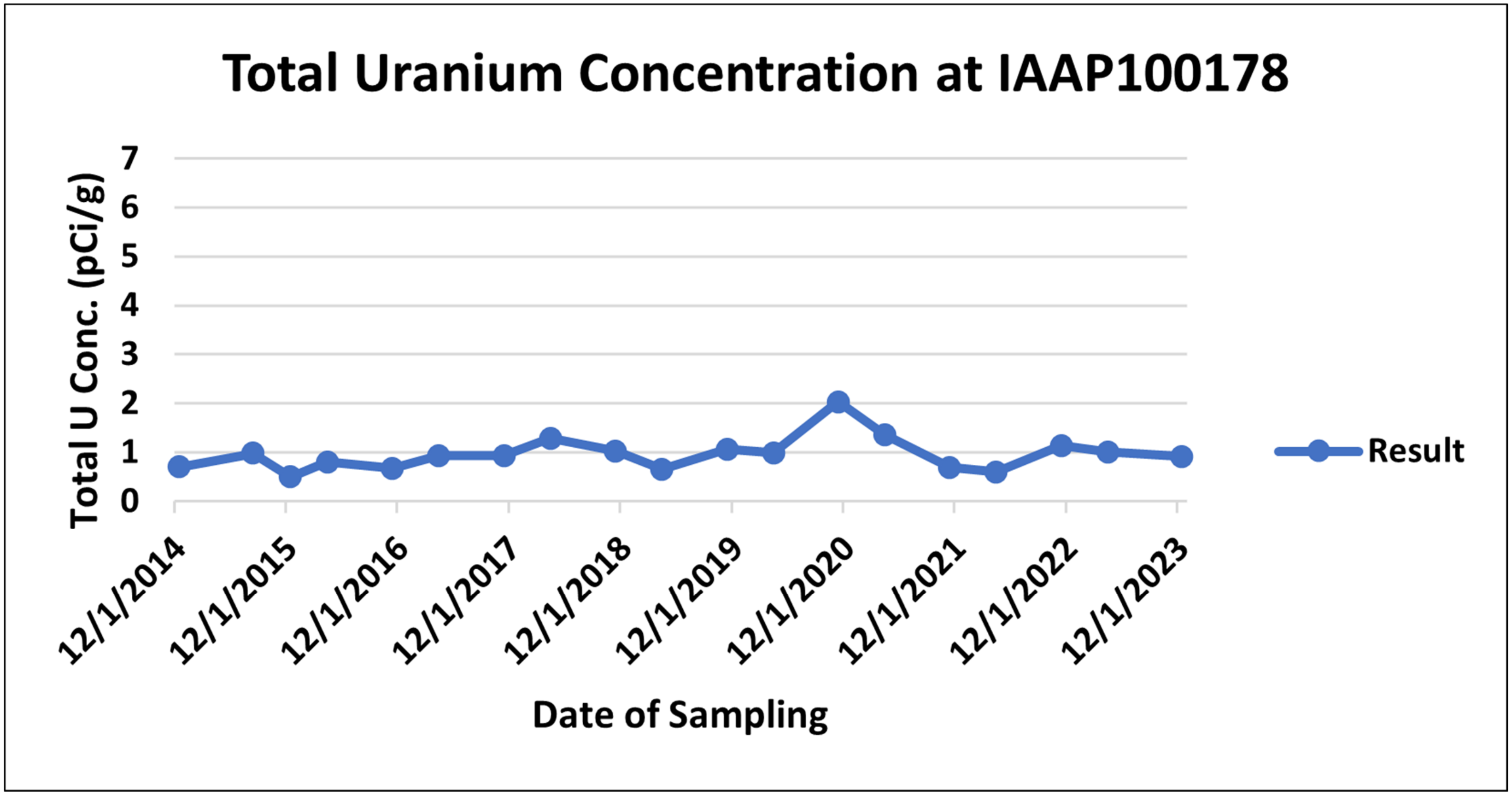

Figure 4-3. Total Uranium Concentrations in Sediment Versus Sampling Date (Continued)

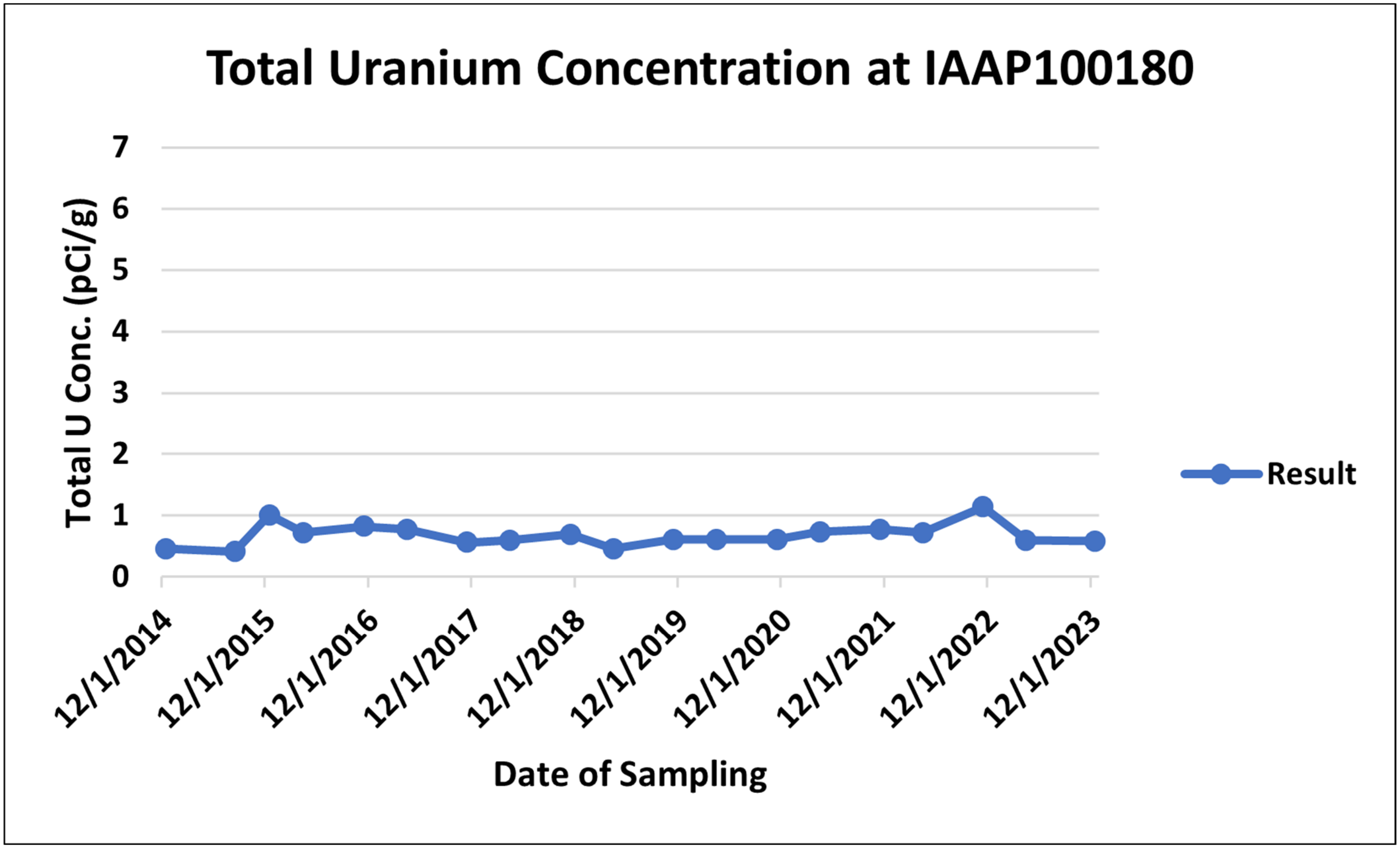

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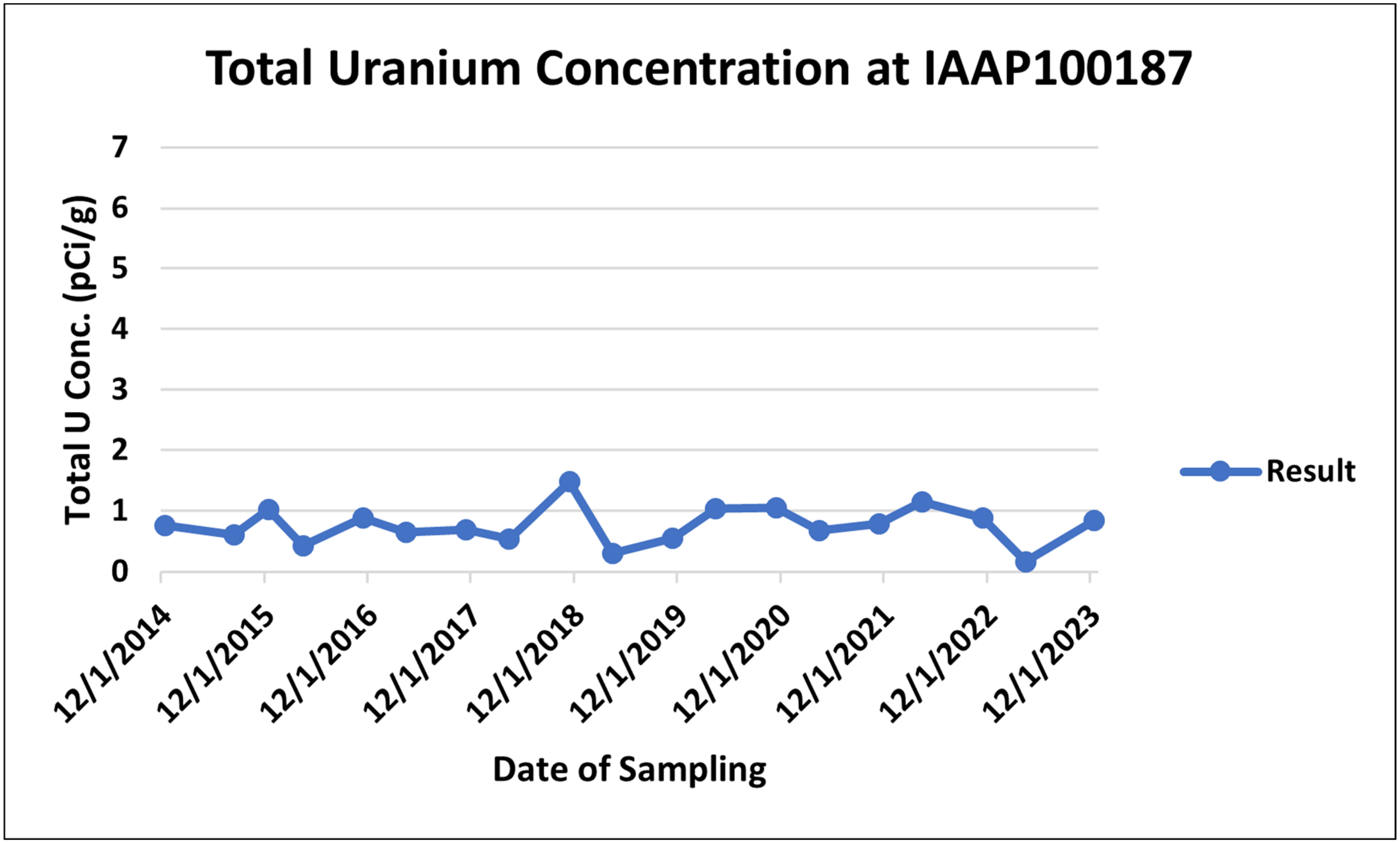
Figure 4-3. Total Uranium Concentrations in Sediment Versus Sampling Date (Continued)



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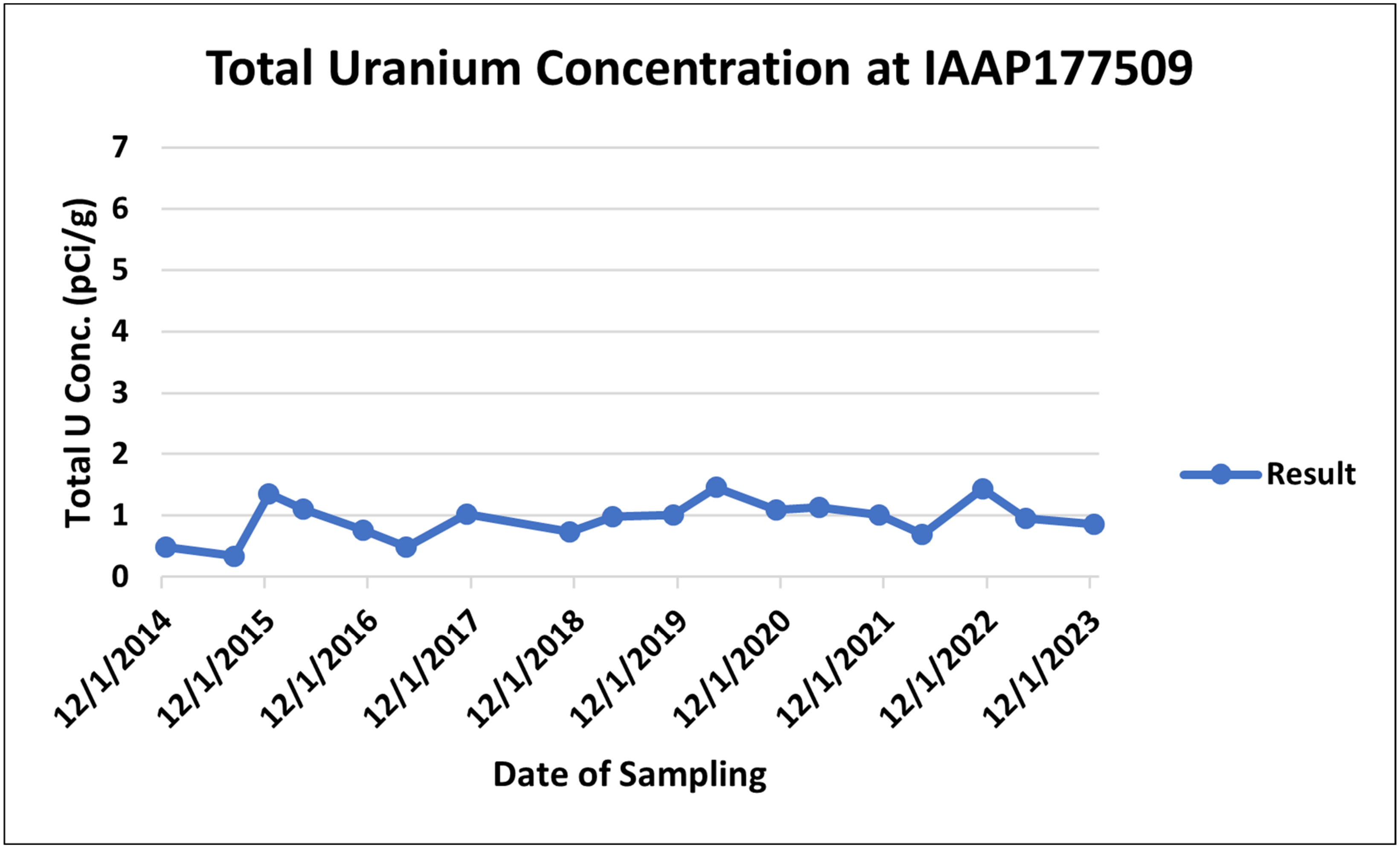

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Figure 4-3. Total Uranium Concentrations in Sediment Versus Sampling Date (Continued)

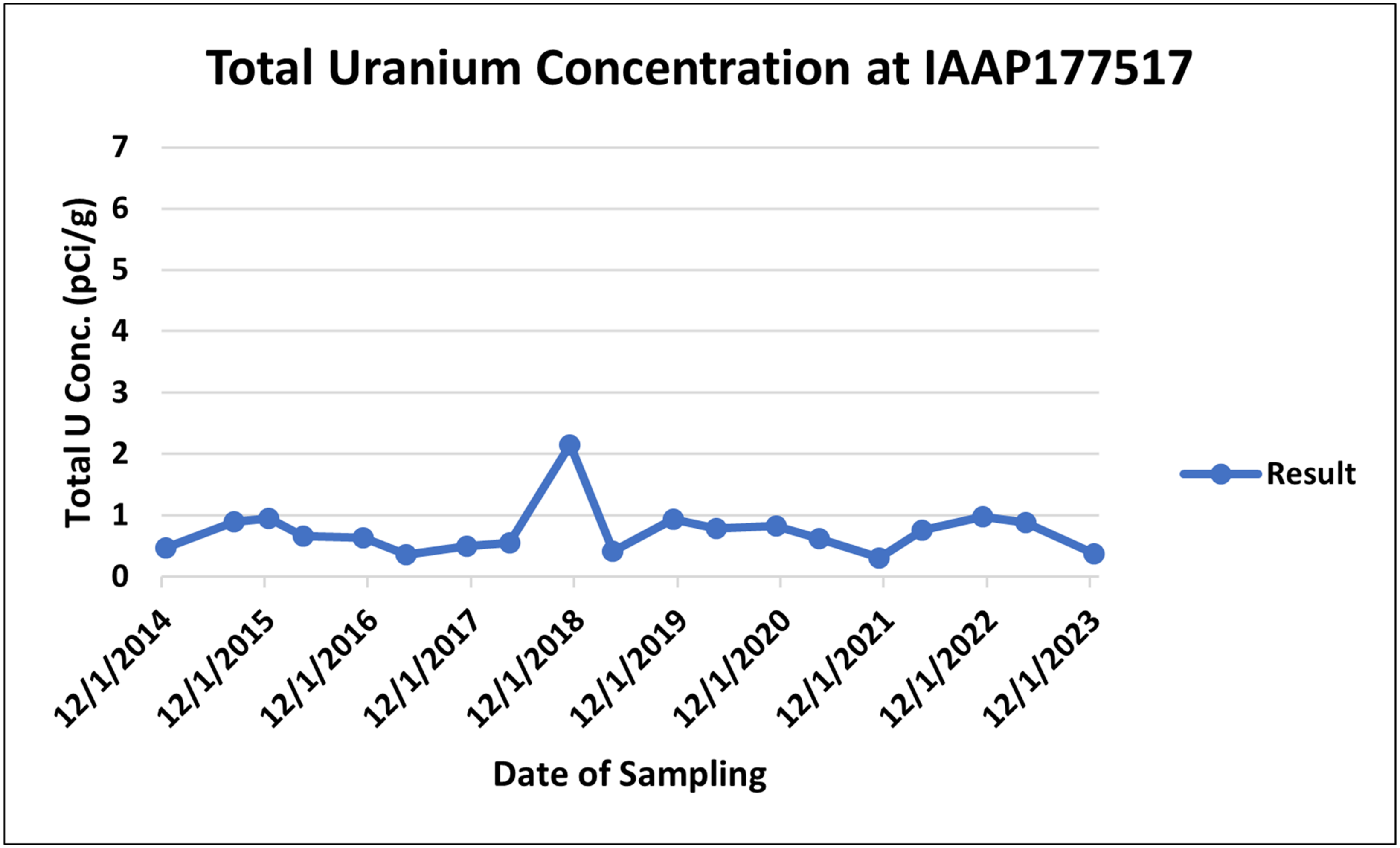

Figure 4-3. Total Uranium Concentrations in Sediment Versus Sampling Date (Continued)

APPENDIX A

CALCULATED EMISSION RATES FROM IAAAP OPERABLE UNIT 8 AREAS

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Table A-1. Total Days for CY 2023

Location	Open Date	Close Date	Total Days
FS-12 Area SUs (30 & 31, corral area)	10/13/23	11/17/23	36
FS-12 Area Pre-Sorting Pile	1/1/23	11/17/23	321
FS-12 Area Post-Sorting Contaminated Pile	1/1/23	12/8/23	342
M-Yard Post-Sorting Contaminated Pile	1/1/23	12/31/23	365

Table A-2. OU-8 Area Effective Surface Area and Site Release Flow Rate for CY 2023

Location	Surface Area (m^2)	Total Days[b]	Surface Area × Total Days	Effective Area (A)[c] (m^2)	Effective Diameter (D) = $(1.3\ A)^{1/2}$ (m)	Site Release Flow Rate[d] $F = V\ \pi\ [(D)^2 / 4]*60$ (m^3/minute)
FS-12 Area						
SUs (30 & 31, corral area)	5,615	36	202,140			
Pre-Sorting Pile[a]	2,000	321	642,000			
Post-Sorting Contaminated Pile[a]	500	342	171,000			
		Total	1,015,140	2,781	60	**7.2E+05**
M-Yard						
Post-Sorting Contaminated Pile[a]	1,000	365	365,000	1000	36	**2.6E+05**

[a] No data identifying the area associated with the pre- and post-sorting piles existed. Therefore, the pre-sorting contaminated pile area was set at 2,000 m^2 (conservative value selected based on previous years' area values). The post-sorting contaminated pile at the FS-12 Area was set at 500 m^2, which corresponds to 25 percent of the pre-sorting pile. The average volume ratio of post-sorting contaminated pile to pre-sorting pile in 2023 was 15 percent.
[b] Total days were based on the dates in 2023 in which potential wind erosion occurred, as listed in Table A-1.
[c] Average surface area/year (A) = [Σ(surface area x total days)]/365
[d] V = 4.252 m per second

Table A-3. Airborne Radioactive Particulate Emissions Based on Perimeter Air Particulate Samples

Radionuclide	Gross Alpha Concentration (μCi/cm^3)	Activity Fraction[a]	Emission Concentration (μCi/cm^3)[b]	Emission Rate (Ci/year)[c]
FS-12 Area				
U-238	1.18E-14	0.9014	1.1E-14	4.1E-03
U-235	1.18E-14	0.0145	1.7E-16	6.5E-05
U-234	1.18E-14	0.0840	9.9E-16	3.8E-04
M-Yard				
U-238	7.00E-14	0.9014	6.3E-14	8.6E-03
U-235	7.00E-14	0.0145	1.0E-15	1.4E-04
U-234	7.00E-14	0.0840	5.9E-15	8.0E-04

[a] As listed in the ROD (USACE 2011).
[b] Emission concentration is equal to the activity fraction multiplied by the gross alpha airborne particulate concentrations.
[c] Emission rate is based on a 365-day period calculated flow rate (as presented in Table A-2) for each site as determined from the average annual wind speed (i.e., 4.252 m per second) and calculated site area (as presented in Table A-2). (Note: 1 mL = 1 cm^3.)

Table A-4. CAP88 Summed Effective Dose Equivalent (mrem/year) at the FS-12 Area and the M-Yard

Receptor	Parameter	FS-12 Area	M-Yard	Total Dose (TEDE)
Resident	Distance (m)	2,714	3,498	
	Direction	W	WNW	
	Dose (mrem/year)	**8.1E-03**	**8.9E-03**	**<0.1**
Farm	Distance (m)	2,714	3,498	
	Direction	W	WNW	
	Dose (mrem/year)	**8.1E-03**	**8.9E-03**	**<0.1**
Business (IDA)	Distance (m)	613	1,730	
	Direction	E	N	
	Dose (mrem/year)	**1.6E-02**[a]	**8.1E-03**[a]	**<0.1**
Business (FS-1 and FS-2 Area)	Distance (m)	945	521	
	Direction	S	NW	
	Dose (mrem/year)	**3.0E-03**[a]	**1.9E-02**[a]	**<0.1**
School	Distance (m)	7,894	9,463	
	Direction	NW	NW	
	Dose (mrem/year)	**4.8E-04**[a]	**9.9E-04**[a]	**<0.1**

[a] Corrected for the 23 percent occupancy factor (40 hours/week for 50 weeks/year), using the following equation.

$$\text{EDE} = \textit{Dose} \text{ for } 100\% \text{ occupancy (mrem/yr)} \times \frac{2000 \text{ hours / work year}}{8760 \text{ hours / total year}}$$

APPENDIX B

CALENDAR YEAR 2023 AIR MONITORING DATA

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Table B-1. CY 2023 IAAAP Air Particulate Sample Summary Table

Collect Start Date	Collect End Date	Count Date	Area	Gross Alpha Concentration (µCi/mL)
09/28/23	09/28/23	10/04/23	Background	3.45E-15
09/28/23	09/28/23	10/04/23	Background	6.14E-15
---		**---**	**Average Background Concentration**	**4.80E-15**
10/05/23	10/05/23	10/11/23	FS-12 RCA	2.31E-14
10/06/23	10/06/23	10/11/23	FS-12 RCA	1.65E-14
10/12/23	10/12/23	10/17/23	FS-12 RCA	-1.05E-15
10/17/23	10/17/23	10/20/23	FS-12 RCA	8.92E-15
10/18/23	10/18/23	10/20/23	FS-12 RCA	2.48E-14
10/19/23	10/19/23	10/24/23	FS-12 RCA	6.12E-15
10/20/23	10/20/23	10/24/23	FS-12 RCA	9.71E-15
10/24/23	10/24/23	11/01/23	FS-12 RCA	9.22E-15
10/25/23	10/25/23	11/01/23	FS-12 RCA	4.42E-15
10/31/23	10/31/23	11/01/23	FS-12 RCA	2.07E-14
10/17/23	10/31/23	11/02/23	FS-12	2.24E-15
10/17/23	10/31/23	11/02/23	FS-12	8.93E-16
11/01/23	11/01/23	11/07/23	FS-12 RCA	2.22E-14
11/02/23	11/02/23	11/07/23	FS-12 RCA	1.56E-15
11/03/23	11/03/23	11/07/23	FS-12 RCA	4.97E-15
11/07/23	11/07/23	11/10/23	FS-12 RCA	2.50E-14
11/08/23	11/08/23	11/14/23	FS-12 RCA	1.41E-16
11/09/23	11/09/23	11/14/23	FS-12 RCA	1.68E-14
11/10/23	11/14/23	11/16/23	FS-12 RCA	5.20E-14
11/15/23	11/15/23	11/28/23	FS-12 RCA	8.39E-15
11/16/23	11/16/23	11/28/23	FS-12 RCA	1.14E-14
11/01/23	11/17/23	11/29/23	FS-12	1.71E-15
11/01/23	11/17/23	11/29/23	FS-12	1.60E-15
---		**---**	**Average FS-12 Area Concentration**	**1.18E-14**

Table B-1. CY 2023 IAAAP Air Particulate Sample Summary Table (Continued)

Collect Start Date	Collect End Date	Count Date	Area	Gross Alpha Concentration (µCi/mL)
07/12/23	07/12/23	07/21/23	M-Yard	6.66E-16
07/12/23	07/12/23	07/21/23	M-Yard	6.44E-15
07/13/23	07/13/23	07/21/23	M-Yard	1.08E-14
07/13/23	07/13/23	07/21/23	M-Yard	1.22E-14
07/14/23	07/14/23	07/21/23	M-Yard	2.11E-15
07/14/23	07/14/23	07/21/23	M-Yard	6.44E-15
07/17/23	07/17/23	07/21/23	M-Yard	1.08E-14
07/17/23	07/17/23	07/21/23	M-Yard	2.38E-14
07/18/23	07/18/23	07/21/23	M-Yard	1.22E-14
07/18/23	07/18/23	07/21/23	M-Yard	1.37E-14
07/19/23	07/19/23	07/21/23	M-Yard	2.23E-14
07/19/23	07/19/23	07/21/23	M-Yard	2.09E-14
07/20/23	07/20/23	07/21/23	M-Yard	2.09E-14
07/20/23	07/20/23	07/21/23	M-Yard	2.23E-14
07/24/23	07/24/23	07/26/23	M-Yard	1.36E-13
07/24/23	07/24/23	07/26/23	M-Yard	2.91E-13
07/25/23	07/25/23	07/26/23	M-Yard	9.59E-14
07/25/23	07/25/23	07/26/23	M-Yard	6.17E-13
11/29/23	12/07/23	12/20/23	M-Yard	4.76E-15
---		**---**	**Average M-Yard Concentration**	**7.00E-14**

[a] Negative results indicate result was less than the average background value for the instrument and are counted a zero value in the area average.

Notes:

RCA - Radiation Control Area

Table B-2. CY 2023 IAAAP Air Particulate Sample Laboratory Analysis Summary Table

Station Name	Sample Name	Collect Date	Analyte	Result	Error	Detection Limit	Units	VQ
Perimeter	IAAP273520	10/31/23	Gross Alpha	3.97E-15	1.46E-15	8.25E-16	uCi/mL	=
			Gross Beta	1.83E-14	3.02E-15	2.27E-15	uCi/mL	=
Perimeter	IAAP273521	10/31/23	Gross Alpha	8.27E-15	2.12E-15	8.16E-16	uCi/mL	=
			Gross Beta	2.74E-14	3.76E-15	2.25E-15	uCi/mL	=
Perimeter	IAAP273522	11/29/23	Gross Alpha	5.32E-15	1.16E-15	3.73E-16	uCi/mL	=
			Gross Beta	1.43E-14	1.87E-15	1.03E-15	uCi/mL	=
Perimeter	IAAP273523	11/29/23	Gross Alpha	3.58E-15	9.42E-16	3.75E-16	uCi/mL	=
			Gross Beta	1.36E-14	1.81E-15	1.03E-15	uCi/mL	=
Perimeter	IAAP273524	09/28/23	Gross Alpha	2.06E-14	8.69E-15	5.66E-15	uCi/mL	=
			Gross Beta	6.22E-14	1.51E-14	1.56E-14	uCi/mL	=
Perimeter	IAAP273525	09/28/23	Gross Alpha	9.57E-15	6.04E-15	5.61E-15	uCi/mL	J
			Gross Beta	4.33E-14	1.32E-14	1.54E-14	uCi/mL	=
Perimeter	IAAP273526	12/07/23	Gross Alpha	2.00E-14	4.40E-15	1.42E-15	uCi/mL	J
			Gross Beta	1.31E-13	1.32E-14	3.90E-15	uCi/mL	J

Notes:
Negative results are less than the laboratory system's background level.
VQs:
= - Indicates that the data met all QA/QC requirements, and that the parameter has been positively identified and the associated value is accurate.
J - Indicates that the parameter was positively identified; the associated numerical value is the approximate concentration of the parameter in concentration the sample.

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APPENDIX C

CAP88-PC OUTPUT REPORTS FOR IAAAP OPERABLE UNIT 8 AREAS

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IAAAP FS-12

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                D O S E   A N D   R I S K   S U M M A R I E S

                        Non-Radon Individual Assessment
                             Wed Feb 28 08:16:37 2024


         Facility:  FS-12 IAAAP
          Address:  Iowa Army Ammunition Plant
             City:  Middletown
            State:  IA          Zip:  52638


    Source Category:  Area
        Source Type:  Area
      Emission Year:  2023
     DOSE Age Group:  Adult

           Comments:  FS-12 Emissions
                    FS-12 Emissions


       Dataset Name:  2023 FS12.
       Dataset Date:  Feb 28, 2024 08:16 AM
          Wind File:  C:\Users\randy\OneDrive\Documents\CAP88\Wind
Files\14923.WND
```

Wed Feb 28 08:16:37 2024 SUMMARY
Page 1

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenals	1.07E-02
UB_Wall	1.13E-02
Bone_Sur	1.57E-01
Brain	1.10E-02
Breasts	1.28E-02
St_Wall	1.13E-02
SI_Wall	1.10E-02
ULI_Wall	1.20E-02
LLI_Wall	1.38E-02
Kidneys	5.72E-02
Liver	2.55E-02
Muscle	1.25E-02
Ovaries	1.08E-02
Pancreas	1.06E-02
R_Marrow	2.15E-02
Skin	2.04E+00
Spleen	1.13E-02
Testes	1.28E-02
Thymus	1.12E-02
Thyroid	1.18E-02
GB_Wall	1.08E-02
Ht_Wall	1.11E-02
Uterus	1.09E-02
ET_Reg	1.32E-01
Lung	5.29E-01
Effectiv	9.76E-02

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	2.36E-03
INHALATION	6.80E-02
AIR IMMERSION	1.82E-08
GROUND SURFACE	2.72E-02
INTERNAL	7.04E-02
EXTERNAL	2.72E-02
TOTAL	9.76E-02

Wed Feb 28 08:16:37 2024 SUMMARY
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NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
U-234	6.99E-03
Th-230	4.09E-09
Ra-226	4.97E-10
Rn-222	2.77E-11
Po-218	4.94E-16
Pb-214	1.81E-08
At-218	1.86E-15
Bi-214	1.06E-07
Rn-218	1.08E-17
Po-214	5.85E-12
Tl-210	4.12E-11
Pb-210	6.91E-11
Bi-210	1.12E-09
Hg-206	9.02E-17
Po-210	2.87E-13
Tl-206	2.61E-15
U-235	1.58E-03
Th-231	5.24E-05
Pa-231	8.69E-08
Ac-227	2.92E-10
Th-227	1.39E-07
Fr-223	1.31E-09
Ra-223	1.56E-07
Rn-219	6.74E-08
At-219	0.00E+00
Bi-215	3.03E-13
Po-215	2.06E-10
Pb-211	1.32E-07
Bi-211	5.45E-08
Tl-207	6.86E-08
Po-211	2.63E-11
U-238	6.24E-02
Th-234	1.78E-03
Pa-234m	2.43E-02
Pa-234	4.80E-04
TOTAL	9.76E-02

Wed Feb 28 08:16:37 2024 SUMMARY
Page 3

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
Esophagu	9.82E-11
Stomach	3.45E-10
Colon	1.13E-09
Liver	3.40E-10
LUNG	7.20E-08
Bone	1.70E-10
Skin	2.03E-09
Breast	4.30E-10
Ovary	1.27E-10
Bladder	2.40E-10
Kidneys	3.12E-10
Thyroid	2.90E-11
Leukemia	4.49E-10
Residual	1.25E-09
Total	7.91E-08
TOTAL	7.91E-08

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	7.98E-10
INHALATION	7.25E-08
AIR IMMERSION	9.64E-15
GROUND SURFACE	5.77E-09
INTERNAL	7.33E-08
EXTERNAL	5.77E-09
TOTAL	7.91E-08

Wed Feb 28 08:16:37 2024 SUMMARY Page 4

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
U-234	7.34E-09
Th-230	1.74E-15
Ra-226	2.70E-16
Rn-222	1.51E-17
Po-218	2.21E-22
Pb-214	9.66E-15
At-218	2.29E-22
Bi-214	5.58E-14
Rn-218	5.89E-24
Po-214	3.21E-18
Tl-210	2.20E-17
Pb-210	3.10E-17
Bi-210	1.24E-16
Hg-206	4.00E-23
Po-210	1.57E-19
Tl-206	2.93E-22
U-235	1.39E-09
Th-231	2.39E-11
Pa-231	4.53E-14
Ac-227	1.09E-16
Th-227	7.54E-14
Fr-223	4.89E-16
Ra-223	8.41E-14
Rn-219	3.69E-14
At-219	0.00E+00
Bi-215	1.35E-19
Po-215	1.13E-16
Pb-211	4.73E-14
Bi-211	2.98E-14
Tl-207	8.81E-15
Po-211	1.44E-17
U-238	6.49E-08
Th-234	9.21E-10
Pa-234m	4.26E-09
Pa-234	2.61E-10
TOTAL	7.91E-08

Wed Feb 28 08:16:37 2024 SUMMARY
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INDIVIDUAL EFFECTIVE DOSE EQUIVALENT (mrem)
(All Radionuclides and Pathways)

Direction	Distance (m) 613	945	2714	7894	
N	9.8E-02	4.4E-02	8.6E-03	3.0E-03	
NNW	3.8E-02	1.7E-02	4.3E-03	2.2E-03	
NW	3.0E-02	1.4E-02	3.7E-03	2.1E-03	School
WNW	5.4E-02	2.5E-02	5.4E-03	2.4E-03	
W	9.1E-02	4.1E-02	8.1E-03	2.9E-03	Residence and Farm
WSW	4.3E-02	2.0E-02	4.7E-03	2.3E-03	
SW	2.2E-02	1.1E-02	3.2E-03	2.0E-03	
SSW	1.6E-02	8.1E-03	2.8E-03	1.9E-03	
S	2.7E-02	1.3E-02	3.6E-03	2.1E-03	Business
SSE	1.9E-02	9.5E-03	3.0E-03	2.0E-03	
SE	2.4E-02	1.2E-02	3.5E-03	2.1E-03	
ESE	4.1E-02	1.9E-02	4.7E-03	2.3E-03	
E	7.1E-02	3.2E-02	6.7E-03	2.7E-03	Business
ENE	8.4E-02	3.8E-02	7.6E-03	2.8E-03	
NE	5.9E-02	2.7E-02	5.7E-03	2.5E-03	
NNE	5.4E-02	2.4E-02	5.4E-03	2.4E-03	

Wed Feb 28 08:16:37 2024 SUMMARY
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INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

Direction	613	945	2714	7894
	Distance (m)			
N	7.9E-08	3.5E-08	6.0E-09	1.6E-09
NNW	3.0E-08	1.3E-08	2.6E-09	9.5E-10
NW	2.3E-08	1.0E-08	2.1E-09	8.6E-10
WNW	4.4E-08	1.9E-08	3.5E-09	1.1E-09
W	7.4E-08	3.2E-08	5.6E-09	1.5E-09
WSW	3.4E-08	1.5E-08	2.9E-09	1.0E-09
SW	1.7E-08	7.7E-09	1.7E-09	7.9E-10
SSW	1.2E-08	5.8E-09	1.4E-09	7.3E-10
S	2.1E-08	9.6E-09	2.0E-09	8.5E-10
SSE	1.5E-08	6.9E-09	1.6E-09	7.7E-10
SE	1.9E-08	8.7E-09	1.9E-09	8.4E-10
ESE	3.3E-08	1.5E-08	2.9E-09	1.0E-09
E	5.7E-08	2.5E-08	4.5E-09	1.3E-09
ENE	6.8E-08	3.0E-08	5.2E-09	1.4E-09
NE	4.7E-08	2.1E-08	3.8E-09	1.2E-09
NNE	4.3E-08	1.9E-08	3.5E-09	1.1E-09

IAAAP M-YARD

```
            D O S E   A N D   R I S K   S U M M A R I E S

                  Non-Radon Individual Assessment
                      Tue Feb 27 14:17:11 2024



          Facility:  M-Yard IAAAP
           Address:  Iowa Army Ammunition Plant
              City:  Middletown
             State:  IA         Zip:  52638


    Source Category:  Area
        Source Type:  Area
      Emission Year:  2023
     DOSE Age Group:  Adult

           Comments:  M-Yard Emissions
                    M-Yard Emissions


       Dataset Name:  2023 M yard.
       Dataset Date:  Feb 27, 2024 02:17 PM
          Wind File:  C:\Users\randy\OneDrive\Documents\CAP88\Wind
Files\14923.WND
```

Tue Feb 27 14:17:11 2024 SUMMARY
Page 1

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem)
Adrenals	3.00E-02
UB_Wall	3.15E-02
Bone_Sur	4.30E-01
Brain	3.07E-02
Breasts	3.57E-02
St_Wall	3.15E-02
SI_Wall	3.08E-02
ULI_Wall	3.30E-02
LLI_Wall	3.75E-02
Kidneys	1.57E-01
Liver	7.02E-02
Muscle	3.51E-02
Ovaries	3.02E-02
Pancreas	2.96E-02
R_Marrow	5.94E-02
Skin	5.79E+00
Spleen	3.16E-02
Testes	3.59E-02
Thymus	3.12E-02
Thyroid	3.31E-02
GB_Wall	3.00E-02
Ht_Wall	3.10E-02
Uterus	3.04E-02
ET_Reg	3.80E-01
Lung	1.52E+00
Effectiv	2.78E-01

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem)
INGESTION	5.50E-03
INHALATION	1.95E-01
AIR IMMERSION	5.36E-08
GROUND SURFACE	7.73E-02
INTERNAL	2.01E-01
EXTERNAL	7.73E-02
TOTAL	2.78E-01

Tue Feb 27 14:17:11 2024 SUMMARY
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NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem)
U-234	2.00E-02
Th-230	1.16E-08
Ra-226	1.41E-09
Rn-222	7.87E-11
Po-218	1.41E-15
Pb-214	5.14E-08
At-218	5.29E-15
Bi-214	3.00E-07
Rn-218	3.06E-17
Po-214	1.66E-11
Tl-210	1.17E-10
Pb-210	1.97E-10
Bi-210	3.18E-09
Hg-206	2.57E-16
Po-210	8.16E-13
Tl-206	7.42E-15
U-235	4.61E-03
Th-231	1.53E-04
Pa-231	2.53E-07
Ac-227	8.49E-10
Th-227	4.05E-07
Fr-223	3.82E-09
Ra-223	4.53E-07
Rn-219	1.96E-07
At-219	0.00E+00
Bi-215	8.83E-13
Po-215	5.99E-10
Pb-211	3.85E-07
Bi-211	1.59E-07
Tl-207	2.00E-07
Po-211	7.64E-11
U-238	1.78E-01
Th-234	5.04E-03
Pa-234m	6.90E-02
Pa-234	1.36E-03
TOTAL	2.78E-01

Tue Feb 27 14:17:11 2024 SUMMARY
Page 3

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
Esophagu	2.75E-10
Stomach	9.69E-10
Colon	3.04E-09
Liver	9.36E-10
LUNG	2.07E-07
Bone	4.64E-10
Skin	5.77E-09
Breast	1.21E-09
Ovary	3.55E-10
Bladder	6.70E-10
Kidneys	8.53E-10
Thyroid	8.14E-11
Leukemia	1.27E-09
Residual	3.52E-09
Total	2.26E-07
TOTAL	2.26E-07

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	1.86E-09
INHALATION	2.08E-07
AIR IMMERSION	2.84E-14
GROUND SURFACE	1.64E-08
INTERNAL	2.10E-07
EXTERNAL	1.64E-08
TOTAL	2.26E-07

Tue Feb 27 14:17:11 2024 SUMMARY Page 4

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
U-234	2.11E-08
Th-230	4.94E-15
Ra-226	7.68E-16
Rn-222	4.29E-17
Po-218	6.28E-22
Pb-214	2.75E-14
At-218	6.52E-22
Bi-214	1.59E-13
Rn-218	1.68E-23
Po-214	9.14E-18
Tl-210	6.26E-17
Pb-210	8.81E-17
Bi-210	3.52E-16
Hg-206	1.14E-22
Po-210	4.48E-19
Tl-206	8.34E-22
U-235	4.08E-09
Th-231	6.97E-11
Pa-231	1.32E-13
Ac-227	3.17E-16
Th-227	2.20E-13
Fr-223	1.42E-15
Ra-223	2.45E-13
Rn-219	1.07E-13
At-219	0.00E+00
Bi-215	3.94E-19
Po-215	3.29E-16
Pb-211	1.38E-13
Bi-211	8.67E-14
Tl-207	2.57E-14
Po-211	4.19E-17
U-238	1.86E-07
Th-234	2.61E-09
Pa-234m	1.21E-08
Pa-234	7.39E-10
TOTAL	2.26E-07

Tue Feb 27 14:17:11 2024 SUMMARY
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INDIVIDUAL EFFECTIVE DOSE EQUIVALENT (mrem)
(All Radionuclides and Pathways)

Direction	Distance (m) 521	1730	3498	9463	
N	2.8E-01	3.5E-02	1.3E-02	5.8E-03	Business
NNW	1.1E-01	1.5E-02	7.3E-03	4.5E-03	
NW	8.3E-02	1.3E-02	6.5E-03	4.3E-03	Business (521) and School (9463)
WNW	1.5E-01	2.0E-02	8.9E-03	4.8E-03	Residence and Farm
W	2.6E-01	3.2E-02	1.3E-02	5.5E-03	
WSW	1.2E-01	1.7E-02	7.8E-03	4.6E-03	
SW	6.1E-02	1.0E-02	5.8E-03	4.1E-03	
SSW	4.5E-02	8.5E-03	5.2E-03	4.0E-03	
S	7.5E-02	1.2E-02	6.4E-03	4.3E-03	
SSE	5.4E-02	9.6E-03	5.6E-03	4.1E-03	
SE	6.8E-02	1.1E-02	6.1E-03	4.2E-03	
ESE	1.2E-01	1.7E-02	7.9E-03	4.6E-03	
E	2.0E-01	2.6E-02	1.1E-02	5.2E-03	
ENE	2.4E-01	3.0E-02	1.2E-02	5.4E-03	
NE	1.7E-01	2.2E-02	9.3E-03	4.9E-03	
NNE	1.5E-01	2.0E-02	8.9E-03	4.8E-03	

Tue Feb 27 14:17:11 2024 SUMMARY
Page 6

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)			
Direction	521	1730	3498	9463
N	2.3E-07	2.6E-08	8.8E-09	2.8E-09
NNW	8.6E-08	1.1E-08	4.1E-09	1.8E-09
NW	6.6E-08	8.4E-09	3.4E-09	1.7E-09
WNW	1.2E-07	1.5E-08	5.3E-09	2.1E-09
W	2.1E-07	2.4E-08	8.2E-09	2.6E-09
WSW	9.7E-08	1.2E-08	4.5E-09	1.9E-09
SW	4.8E-08	6.5E-09	2.8E-09	1.6E-09
SSW	3.5E-08	5.0E-09	2.4E-09	1.5E-09
S	6.0E-08	7.9E-09	3.3E-09	1.7E-09
SSE	4.2E-08	5.9E-09	2.7E-09	1.6E-09
SE	5.4E-08	7.3E-09	3.1E-09	1.7E-09
ESE	9.2E-08	1.2E-08	4.5E-09	1.9E-09
E	1.6E-07	1.9E-08	6.8E-09	2.4E-09
ENE	1.9E-07	2.2E-08	7.7E-09	2.6E-09
NE	1.4E-07	1.6E-08	5.7E-09	2.1E-09
NNE	1.2E-07	1.5E-08	5.3E-09	2.1E-09

APPENDIX D

CALENDAR YEAR 2023 SURFACE WATER AND SEDIMENT DATA

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Table D-1. Surface Water Data for CY 2023

Station Name	Sample Name	Collection Date	Method	Analyte	Result	Error	Detection Limit	Units	VQ
IAAP100153	IAAP266508	4/18/2023	ML-018	Gross Alpha	-3.29	6.51	11.90	pCi/L	UJ
IAAP100153	IAAP266508	4/18/2023	ML-018	Gross Beta	4.44	7.36	12.20	pCi/L	UJ
IAAP100153	IAAP266508	4/18/2023	ML-015	Uranium-234	0.61	0.43	0.50	pCi/L	J
IAAP100153	IAAP266508	4/18/2023	ML-015	Uranium-235	-0.04	0.18	0.53	pCi/L	UJ
IAAP100153	IAAP266508	4/18/2023	ML-015	Uranium-238	0.20	0.27	0.50	pCi/L	UJ
IAAP100154	IAAP266512	4/18/2023	ML-018	Gross Alpha	-1.29	6.67	11.90	pCi/L	UJ
IAAP100154	IAAP266512	4/18/2023	ML-018	Gross Beta	3.42	7.31	12.20	pCi/L	UJ
IAAP100154	IAAP266512	4/18/2023	ML-015	Uranium-234	0.83	0.49	0.47	pCi/L	J
IAAP100154	IAAP266512	4/18/2023	ML-015	Uranium-235	0.06	0.16	0.42	pCi/L	UJ
IAAP100154	IAAP266512	4/18/2023	ML-015	Uranium-238	0.58	0.41	0.47	pCi/L	J
IAAP100155	IAAP266514	4/18/2023	ML-018	Gross Alpha	-5.01	6.36	11.90	pCi/L	UJ
IAAP100155	IAAP266514	4/18/2023	ML-018	Gross Beta	5.98	7.44	12.20	pCi/L	UJ
IAAP100155	IAAP266514	4/18/2023	ML-015	Uranium-234	0.78	0.48	0.48	pCi/L	J
IAAP100155	IAAP266514	4/18/2023	ML-015	Uranium-235	0.00	0.23	0.59	pCi/L	UJ
IAAP100155	IAAP266514	4/18/2023	ML-015	Uranium-238	0.26	0.29	0.48	pCi/L	UJ
IAAP100165	IAAP266518	4/18/2023	ML-018	Gross Alpha	-5.30	6.34	11.90	pCi/L	UJ
IAAP100165	IAAP266518	4/18/2023	ML-018	Gross Beta	-2.91	7.01	12.20	pCi/L	UJ
IAAP100165	IAAP266518	4/18/2023	ML-015	Uranium-234	0.43	0.38	0.52	pCi/L	UJ
IAAP100165	IAAP266518	4/18/2023	ML-015	Uranium-235	0.00	0.25	0.65	pCi/L	UJ
IAAP100165	IAAP266518	4/18/2023	ML-015	Uranium-238	0.48	0.38	0.38	pCi/L	J
IAAP100178	IAAP266520	4/18/2023	ML-018	Gross Alpha	-5.59	6.31	11.90	pCi/L	UJ
IAAP100178	IAAP266520	4/18/2023	ML-018	Gross Beta	2.56	7.27	12.20	pCi/L	UJ
IAAP100178	IAAP266520	4/18/2023	ML-015	Uranium-234	0.53	0.40	0.49	pCi/L	J
IAAP100178	IAAP266520	4/18/2023	ML-015	Uranium-235	0.08	0.23	0.60	pCi/L	UJ
IAAP100178	IAAP266520	4/18/2023	ML-015	Uranium-238	0.31	0.30	0.35	pCi/L	UJ
IAAP100180	IAAP266522	4/18/2023	ML-018	Gross Alpha	-3.29	6.51	11.90	pCi/L	UJ
IAAP100180	IAAP266522	4/18/2023	ML-018	Gross Beta	3.59	7.32	12.20	pCi/L	UJ
IAAP100180	IAAP266522	4/18/2023	ML-015	Uranium-234	0.69	0.46	0.38	pCi/L	J
IAAP100180	IAAP266522	4/18/2023	ML-015	Uranium-235	0.07	0.18	0.46	pCi/L	UJ
IAAP100180	IAAP266522	4/18/2023	ML-015	Uranium-238	0.34	0.32	0.38	pCi/L	UJ
IAAP100187	IAAP266524	4/18/2023	ML-018	Gross Alpha	-3.01	6.53	11.90	pCi/L	UJ

Table D-1. Surface Water Data for CY 2023 (Continued)

Station Name	Sample Name	Collection Date	Method	Analyte	Result	Error	Detection Limit	Units	VQ
IAAP100187	IAAP266524	4/18/2023	ML-018	Gross Beta	7.18	7.50	12.20	pCi/L	UJ
IAAP100187	IAAP266524	4/18/2023	ML-015	Uranium-234	0.86	0.51	0.39	pCi/L	J
IAAP100187	IAAP266524	4/18/2023	ML-015	Uranium-235	0.00	0.25	0.66	pCi/L	UJ
IAAP100187	IAAP266524	4/18/2023	ML-015	Uranium-238	0.65	0.46	0.53	pCi/L	J
IAAP177509	IAAP266510	4/18/2023	ML-018	Gross Alpha	-4.73	6.38	11.90	pCi/L	UJ
IAAP177509	IAAP266510	4/18/2023	ML-018	Gross Beta	1.20	7.20	12.20	pCi/L	UJ
IAAP177509	IAAP266510	4/18/2023	ML-015	Uranium-234	1.12	0.56	0.36	pCi/L	J
IAAP177509	IAAP266510	4/18/2023	ML-015	Uranium-235	-0.02	0.17	0.44	pCi/L	UJ
IAAP177509	IAAP266510	4/18/2023	ML-015	Uranium-238	0.43	0.36	0.43	pCi/L	J
IAAP177517	IAAP266526	4/18/2023	ML-018	Gross Alpha	-4.44	6.41	11.90	pCi/L	UJ
IAAP177517	IAAP266526	4/18/2023	ML-018	Gross Beta	0.86	7.18	12.20	pCi/L	UJ
IAAP177517	IAAP266526	4/18/2023	ML-015	Uranium-234	0.47	0.39	0.50	pCi/L	UJ
IAAP177517	IAAP266526	4/18/2023	ML-015	Uranium-235	0.17	0.29	0.61	pCi/L	UJ
IAAP177517	IAAP266526	4/18/2023	ML-015	Uranium-238	0.72	0.45	0.36	pCi/L	J
IAAP177517	IAAP266526-1	4/18/2023	ML-018	Gross Alpha	-0.72	6.72	11.90	pCi/L	UJ
IAAP177517	IAAP266526-1	4/18/2023	ML-018	Gross Beta	-4.10	6.95	12.20	pCi/L	UJ
IAAP177517	IAAP266526-1	4/18/2023	ML-015	Uranium-234	0.47	0.37	0.37	pCi/L	J
IAAP177517	IAAP266526-1	4/18/2023	ML-015	Uranium-235	0.00	0.24	0.63	pCi/L	UJ
IAAP177517	IAAP266526-1	4/18/2023	ML-015	Uranium-238	0.40	0.34	0.37	pCi/L	J
IAAP177517	IAAP266526-2	4/18/2023	EML A-01-R MOD	Uranium-234	0.69	0.36	0.29	pCi/L	J
IAAP177517	IAAP266526-2	4/18/2023	EML A-01-R MOD	Uranium-235	0.13	0.19	0.31	pCi/L	UJ
IAAP177517	IAAP266526-2	4/18/2023	EML A-01-R MOD	Uranium-238	0.23	0.21	0.25	pCi/L	UJ
IAAP100153	IAAP271197	12/5/2023	ML-018	Gross Alpha	-4.73	5.73	10.90	pCi/L	UJ
IAAP100153	IAAP271197	12/5/2023	ML-018	Gross Beta	1.28	7.08	12.00	pCi/L	UJ
IAAP100153	IAAP271197	12/5/2023	ML-015	Uranium-234	0.27	0.36	0.66	pCi/L	UJ
IAAP100153	IAAP271197	12/5/2023	ML-015	Uranium-235	-0.03	0.23	0.59	pCi/L	UJ
IAAP100153	IAAP271197	12/5/2023	ML-015	Uranium-238	0.45	0.44	0.66	pCi/L	UJ
IAAP100154	IAAP271201	12/5/2023	ML-018	Gross Alpha	2.72	6.43	10.90	pCi/L	UJ
IAAP100154	IAAP271201	12/5/2023	ML-018	Gross Beta	4.02	7.21	12.00	pCi/L	UJ
IAAP100154	IAAP271201	12/5/2023	ML-015	Uranium-234	0.43	0.41	0.48	pCi/L	UJ
IAAP100154	IAAP271201	12/5/2023	ML-015	Uranium-235	-0.03	0.23	0.59	pCi/L	UJ
IAAP100154	IAAP271201	12/5/2023	ML-015	Uranium-238	0.58	0.48	0.57	pCi/L	J

Table D-1. Surface Water Data for CY 2023 (Continued)

Station Name	Sample Name	Collection Date	Method	Analyte	Result	Error	Detection Limit	Units	VQ
IAAP100155	IAAP271203	12/6/2023	ML-018	Gross Alpha	-1.00	6.08	10.90	pCi/L	UJ
IAAP100155	IAAP271203	12/6/2023	ML-018	Gross Beta	4.53	7.24	12.00	pCi/L	UJ
IAAP100155	IAAP271203	12/6/2023	ML-015	Uranium-234	0.38	0.38	0.56	pCi/L	UJ
IAAP100155	IAAP271203	12/6/2023	ML-015	Uranium-235	0.00	0.27	0.70	pCi/L	UJ
IAAP100155	IAAP271203	12/6/2023	ML-015	Uranium-238	0.29	0.31	0.40	pCi/L	UJ
IAAP100165	IAAP271207	12/6/2023	ML-018	Gross Alpha	0.43	6.22	10.90	pCi/L	UJ
IAAP100165	IAAP271207	12/6/2023	ML-018	Gross Beta	5.04	7.27	12.00	pCi/L	UJ
IAAP100165	IAAP271207	12/6/2023	ML-015	Uranium-234	0.35	0.34	0.39	pCi/L	UJ
IAAP100165	IAAP271207	12/6/2023	ML-015	Uranium-235	0.00	0.26	0.67	pCi/L	UJ
IAAP100165	IAAP271207	12/6/2023	ML-015	Uranium-238	0.30	0.33	0.54	pCi/L	UJ
IAAP100178	IAAP271209	12/6/2023	ML-018	Gross Alpha	-3.87	5.81	10.90	pCi/L	UJ
IAAP100178	IAAP271209	12/6/2023	ML-018	Gross Beta	6.07	7.32	12.00	pCi/L	UJ
IAAP100178	IAAP271209	12/6/2023	ML-015	Uranium-234	0.62	0.47	0.57	pCi/L	J
IAAP100178	IAAP271209	12/6/2023	ML-015	Uranium-235	-0.02	0.20	0.50	pCi/L	UJ
IAAP100178	IAAP271209	12/6/2023	ML-015	Uranium-238	0.23	0.31	0.56	pCi/L	UJ
IAAP100180	IAAP271211	12/6/2023	ML-018	Gross Alpha	3.87	6.53	10.90	pCi/L	UJ
IAAP100180	IAAP271211	12/6/2023	ML-018	Gross Beta	0.94	7.06	12.00	pCi/L	UJ
IAAP100180	IAAP271211	12/6/2023	ML-015	Uranium-234	0.23	0.29	0.44	pCi/L	UJ
IAAP100180	IAAP271211	12/6/2023	ML-015	Uranium-235	-0.03	0.21	0.54	pCi/L	UJ
IAAP100180	IAAP271211	12/6/2023	ML-015	Uranium-238	0.49	0.44	0.60	pCi/L	UJ
IAAP100187	IAAP271213	12/6/2023	ML-018	Gross Alpha	-0.43	6.14	10.90	pCi/L	UJ
IAAP100187	IAAP271213	12/6/2023	ML-018	Gross Beta	8.63	7.45	12.00	pCi/L	UJ
IAAP100187	IAAP271213	12/6/2023	ML-015	Uranium-234	0.52	0.41	0.41	pCi/L	J
IAAP100187	IAAP271213	12/6/2023	ML-015	Uranium-235	-0.02	0.20	0.50	pCi/L	UJ
IAAP100187	IAAP271213	12/6/2023	ML-015	Uranium-238	0.19	0.27	0.49	pCi/L	UJ
IAAP177509	IAAP271199	12/6/2023	ML-018	Gross Alpha	-2.43	5.95	10.90	pCi/L	UJ
IAAP177509	IAAP271199	12/6/2023	ML-018	Gross Beta	5.73	7.30	12.00	pCi/L	UJ
IAAP177509	IAAP271199	12/6/2023	ML-015	Uranium-234	0.18	0.31	0.65	pCi/L	UJ
IAAP177509	IAAP271199	12/6/2023	ML-015	Uranium-235	0.11	0.31	0.81	pCi/L	UJ
IAAP177509	IAAP271199	12/6/2023	ML-015	Uranium-238	0.35	0.40	0.65	pCi/L	UJ

Table D-1. Surface Water Data for CY 2023 (Continued)

Station Name	Sample Name	Collection Date	Method	Analyte	Result	Error	Detection Limit	Units	VQ
IAAP177517	IAAP271215	12/5/2023	ML-018	Gross Alpha	0.14	6.19	10.90	pCi/L	UJ
IAAP177517	IAAP271215	12/5/2023	ML-018	Gross Beta	3.50	7.19	12.00	pCi/L	UJ
IAAP177517	IAAP271215	12/5/2023	ML-015	Uranium-234	0.12	0.24	0.52	pCi/L	UJ
IAAP177517	IAAP271215	12/5/2023	ML-015	Uranium-235	0.00	0.28	0.73	pCi/L	UJ
IAAP177517	IAAP271215	12/5/2023	ML-015	Uranium-238	0.12	0.24	0.51	pCi/L	UJ

Negative results are less than the laboratory system's background level.

VQs:

= - Indicates that the data met all QA/QC requirements, and that the parameter has been positively identified and the associated concentration value is accurate.

J - Indicates that the parameter was positively identified; the associated numerical value is the approximate concentration of the parameter in the sample.

U - Indicates that the data met all QA/QC requirements, and that the parameter was analyzed for but was not detected above the reported sample quantitation limit.

UJ - Indicates that the parameter was not detected above the reported sample quantitation limit and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. However, the reported quantitation limit is approximate.

Table D-2. Sediment Data for CY 2023

Station Name	Sample Name	Collection Date	Method	Analyte	Result	Error	Detection Limit	Units	VQ
IAAP100153	IAAP266509	04/18/23	ML-015	Uranium-234	0.18	0.14	0.17	pCi/g	J
IAAP100153	IAAP266509	04/18/23	ML-015	Uranium-235	-0.01	0.06	0.16	pCi/g	UJ
IAAP100153	IAAP266509	04/18/23	ML-015	Uranium-238	0.11	0.11	0.16	pCi/g	UJ
IAAP100154	IAAP266513	04/18/23	ML-015	Uranium-234	0.68	0.31	0.15	pCi/g	=
IAAP100154	IAAP266513	04/18/23	ML-015	Uranium-235	0.08	0.13	0.28	pCi/g	UJ
IAAP100154	IAAP266513	04/18/23	ML-015	Uranium-238	0.55	0.27	0.18	pCi/g	=
IAAP100155	IAAP266515	04/18/23	ML-015	Uranium-234	0.18	0.16	0.22	pCi/g	UJ
IAAP100155	IAAP266515	04/18/23	ML-015	Uranium-235	-0.01	0.07	0.20	pCi/g	UJ
IAAP100155	IAAP266515	04/18/23	ML-015	Uranium-238	0.27	0.19	0.22	pCi/g	J
IAAP100164	IAAP266517	04/18/23	ML-015	Uranium-234	0.71	0.27	0.13	pCi/g	=
IAAP100164	IAAP266517	04/18/23	ML-015	Uranium-235	0.03	0.08	0.20	pCi/g	UJ
IAAP100164	IAAP266517	04/18/23	ML-015	Uranium-238	1.16	0.35	0.17	pCi/g	=
IAAP100165	IAAP266519	04/18/23	ML-015	Uranium-234	0.54	0.25	0.12	pCi/g	=
IAAP100165	IAAP266519	04/18/23	ML-015	Uranium-235	0.03	0.07	0.15	pCi/g	UJ
IAAP100165	IAAP266519	04/18/23	ML-015	Uranium-238	0.38	0.21	0.15	pCi/g	J
IAAP100178	IAAP266521	04/18/23	ML-015	Uranium-234	0.40	0.21	0.19	pCi/g	J
IAAP100178	IAAP266521	04/18/23	ML-015	Uranium-235	0.03	0.06	0.15	pCi/g	UJ
IAAP100178	IAAP266521	04/18/23	ML-015	Uranium-238	0.58	0.25	0.18	pCi/g	=
IAAP100180	IAAP266523	04/18/23	ML-015	Uranium-234	0.28	0.16	0.16	pCi/g	J
IAAP100180	IAAP266523	04/18/23	ML-015	Uranium-235	0.00	0.05	0.13	pCi/g	UJ
IAAP100180	IAAP266523	04/18/23	ML-015	Uranium-238	0.32	0.17	0.10	pCi/g	J
IAAP100187	IAAP266525	04/18/23	ML-015	Uranium-234	0.10	0.14	0.25	pCi/g	UJ
IAAP100187	IAAP266525	04/18/23	ML-015	Uranium-235	0.00	0.12	0.31	pCi/g	UJ
IAAP100187	IAAP266525	04/18/23	ML-015	Uranium-238	0.06	0.10	0.16	pCi/g	UJ
IAAP177509	IAAP266511	04/18/23	ML-015	Uranium-234	0.60	0.26	0.12	pCi/g	=
IAAP177509	IAAP266511	04/18/23	ML-015	Uranium-235	0.06	0.09	0.15	pCi/g	UJ
IAAP177509	IAAP266511	04/18/23	ML-015	Uranium-238	0.30	0.18	0.18	pCi/g	J
IAAP177517	IAAP266527	04/18/23	ML-015	Uranium-234	0.44	0.26	0.25	pCi/g	J
IAAP177517	IAAP266527	04/18/23	ML-015	Uranium-235	0.04	0.12	0.31	pCi/g	UJ
IAAP177517	IAAP266527	04/18/23	ML-015	Uranium-238	0.40	0.24	0.16	pCi/g	J

Table D-2. Sediment Data for CY 2023 (Continued)

Station Name	Sample Name	Collection Date	Method	Analyte	Result	Error	Detection Limit	Units	VQ
IAAP100153	IAAP271198	12/5/2023	ML-015	Uranium-234	0.217	0.175	0.182	pCi/g	J
IAAP100153	IAAP271198	12/5/2023	ML-015	Uranium-235	0.0334	0.0814	0.191	pCi/g	UJ
IAAP100153	IAAP271198	12/5/2023	ML-015	Uranium-238	0.356	0.229	0.238	pCi/g	J
IAAP100154	IAAP271202	12/5/2023	ML-015	Uranium-234	0.609	0.29	0.224	pCi/g	J
IAAP100154	IAAP271202	12/5/2023	ML-015	Uranium-235	-0.00626	0.0761	0.179	pCi/g	UJ
IAAP100154	IAAP271202	12/5/2023	ML-015	Uranium-238	0.495	0.259	0.206	pCi/g	J
IAAP100155	IAAP271204	12/6/2023	ML-015	Uranium-234	0.344	0.207	0.139	pCi/g	J
IAAP100155	IAAP271204	12/6/2023	ML-015	Uranium-235	0.0299	0.0729	0.171	pCi/g	UJ
IAAP100155	IAAP271204	12/6/2023	ML-015	Uranium-238	0.343	0.206	0.138	pCi/g	J
IAAP100155	IAAP271204-1	12/6/2023	ML-015	Uranium-234	0.211	0.166	0.147	pCi/g	J
IAAP100155	IAAP271204-1	12/6/2023	ML-015	Uranium-235	0	0.108	0.28	pCi/g	UJ
IAAP100155	IAAP271204-1	12/6/2023	ML-015	Uranium-238	0.486	0.254	0.146	pCi/g	J
IAAP100155	IAAP271204-2	12/6/2023	ML-015	Uranium-234	0.399	0.143	0.0818	pCi/g	=
IAAP100155	IAAP271204-2	12/6/2023	ML-015	Uranium-235	0.026	0.0409	0.0652	pCi/g	UJ
IAAP100155	IAAP271204-2	12/6/2023	ML-015	Uranium-238	0.35	0.131	0.0653	pCi/g	=
IAAP100164	IAAP271206	12/6/2023	ML-015	Uranium-234	0.575	0.288	0.235	pCi/g	J
IAAP100164	IAAP271206	12/6/2023	ML-015	Uranium-235	0.0328	0.08	0.188	pCi/g	UJ
IAAP100164	IAAP271206	12/6/2023	ML-015	Uranium-238	1.76	0.529	0.217	pCi/g	=
IAAP100165	IAAP271208	12/6/2023	ML-015	Uranium-234	0.389	0.219	0.16	pCi/g	J
IAAP100165	IAAP271208	12/6/2023	ML-015	Uranium-235	0.0351	0.0993	0.258	pCi/g	UJ
IAAP100165	IAAP271208	12/6/2023	ML-015	Uranium-238	0.415	0.226	0.159	pCi/g	J
IAAP100178	IAAP271210	12/6/2023	ML-015	Uranium-234	0.368	0.231	0.162	pCi/g	J
IAAP100178	IAAP271210	12/6/2023	ML-015	Uranium-235	0.0767	0.12	0.199	pCi/g	UJ
IAAP100178	IAAP271210	12/6/2023	ML-015	Uranium-238	0.467	0.261	0.161	pCi/g	J
IAAP100180	IAAP271212	12/6/2023	ML-015	Uranium-234	0.192	0.169	0.19	pCi/g	J
IAAP100180	IAAP271212	12/6/2023	ML-015	Uranium-235	0.153	0.17	0.235	pCi/g	UJ
IAAP100180	IAAP271212	12/6/2023	ML-015	Uranium-238	0.236	0.194	0.249	pCi/g	UJ
IAAP100187	IAAP271214	12/6/2023	ML-015	Uranium-234	0.322	0.218	0.237	pCi/g	J
IAAP100187	IAAP271214	12/6/2023	ML-015	Uranium-235	0.0398	0.113	0.293	pCi/g	UJ
IAAP100187	IAAP271214	12/6/2023	ML-015	Uranium-238	0.482	0.265	0.236	pCi/g	J

Table D-2. Sediment Data for CY 2023 (Continued)

Station Name	Sample Name	Collection Date	Method	Analyte	Result	Error	Detection Limit	Units	VQ
IAAP177509	IAAP271200	12/6/2023	ML-015	Uranium-234	0.493	0.261	0.177	pCi/g	J
IAAP177509	IAAP271200	12/6/2023	ML-015	Uranium-235	-0.00647	0.0787	0.185	pCi/g	UJ
IAAP177509	IAAP271200	12/6/2023	ML-015	Uranium-238	0.371	0.223	0.149	pCi/g	J
IAAP177517	IAAP271216	12/5/2023	ML-015	Uranium-234	0.26	0.186	0.213	pCi/g	J
IAAP177517	IAAP271216	12/5/2023	ML-015	Uranium-235	0	0.101	0.263	pCi/g	UJ
IAAP177517	IAAP271216	12/5/2023	ML-015	Uranium-238	0.11	0.116	0.137	pCi/g	UJ

Negative results are less than the laboratory system’s background level.

VQs:

= - Indicates that the data met all QA/QC requirements, and that the parameter has been positively identified and the associated concentration value is accurate.

J - Indicates that the parameter was positively identified; the associated numerical value is the approximate concentration of the parameter in the sample.

U - Indicates that the data met all QA/QC requirements, and that the parameter was analyzed for but was not detected above the reported sample quantitation limit.

UJ - Indicates that the parameter was not detected above the reported sample quantitation limit and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. However, the reported quantitation limit is approximate.

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