Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM
QUARTERLY DATA REPORT

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Table of Contents

List of Tables

List of Figures

Table of Acronyms

aCi/L - attocuries per liter
ATR - Advanced Test Reactor
BEA - Battelle Energy Alliance, LLC
BLR - Big Lost River
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CFA - Central Facilities Area
CFR - Code of Federal Regulations
CITRC - Critical Infrastructure Test Range Complex
DEQ-INL OP - The State of Idaho, Department of Environmental Quality, Idaho National Laboratory Oversight Program
DOE - U.S. Department of Energy
EBR I & II - Experimental Breeder Reactors I & II
EFS - Experimental Field Station
EIC - electret ionization chamber
EML - Environmental Monitoring Laboratory
EPA - Environmental Protection Agency
ESER - Environmental Surveillance, Education and Research Program
ESP - Environmental Surveillance Program
ESRP - Eastern Snake River Plain
ESRPA - Eastern Snake River Plain Aquifer
Ft bls - feet below land surface
HPIC - high-pressure ion chamber
IBL - Idaho Bureau of Laboratories
ICPP - Idaho Chemical Processing Plant
ICP - Idaho Cleanup Project
ISB - In-situ bioremediation
IDL - instrument detection limit
IEC - Idaho Environmental Coalition, LLC
INL - Idaho National Laboratory
INTEC - Idaho Nuclear Technology and Engineering Center
ISU - Idaho State University
LLD - lower limit of detection
LSC - liquid scintillation counting
MCL - maximum contaminant level
MDA - minimum detectable activity
MDC - minimum detectable concentration
MFC - Materials and Fuels Complex
µg/L - micrograms per liter
mg/L - milligrams per liter
MP - milepost
mrem - millirem or $1/1000^{th}$ of a rem
mR - milliRoentgen
mR/hr - milliRoentgen per hour
µR/hr - microRoentgen per hour
MV - Magic Valley
NIST - National Institute of Standards and Technology
nCi/L - nanocuries per liter
NCRP - National Council on Radiation Protection and Measurements
NOAA - National Oceanic and Atmospheric Administration
NRF - Naval Reactors Facility
PBF - Power Burst Facility
pCi/g - picocuries per gram
pCi/L - picocuries per liter
pCi/m^3 - picocuries per cubic meter
QAPP - Quality Assurance Program Plan
QA/QC - Quality Assurance/Quality Control
RCRA - Resource Conservation and Recovery Act
RPD - relative percent difference
RTC - Reactor Technology Complex
RWMC - Radioactive Waste Management Complex
SD - Sample standard deviation
SMC - Specific Manufacturing Capability
SMCL - secondary maximum contaminant level
TAN - Test Area North
TDS - total dissolved solids
TMI - Three Mile Island
TRA - Test Reactor Area
TSP - total suspended particulate
TSS - total suspended solids
USGS - U.S. Geological Survey
VOC - volatile organic compound
WLAP - Wastewater Land Application Permit

Introduction

The State of Idaho, Department of Environmental Quality, Idaho National Laboratory Oversight Program (DEQ-INL OP) conducts an Environmental Surveillance Program (ESP) at locations on the INL, near the boundaries of the INL, and at distant locations to the INL in accordance with accepted monitoring procedures and management practices. This program is designed to provide the people of the state of Idaho with independently evaluated information about the impacts of the Department of Energy's (DOE) activities in Idaho.

The primary objective for DEQ-INL OP's ESP is to maintain an independent environmental monitoring and verification program designed to verify and supplement DOE's environmental data and programs. This program also provides the citizens of Idaho with information on current and proposed DOE programs that has been independently evaluated to enable them to reach informed conclusions about DOE activities in Idaho and potential impacts to public health and the environment.

Results of the ESP are published using two distinct reporting formats: quarterly data reports and an annual ESP report. The annual ESP report is designed for a broad audience and summarizes the results of the ESP for the previous four quarters. The annual report's primary emphasis is to focus on trends, ascertain the impacts of DOE operations on the environment, and confirm the validity of DOE monitoring programs. This quarterly report is designed to document the results of the ESP on a quarterly basis and provide detailed data. It is organized according to the media sampled and also provides a quality assurance assessment.

Air and Precipitation Monitoring Results

The ESP operated eight air monitoring stations on and near the INL as well as two monitoring stations distant from the INL during the fourth quarter, 2023 (**Figure 1**). These stations employed instrumentation for collecting airborne particulate matter, gaseous radioiodine, precipitation, and water vapor for tritium analysis (**Table 1**). The Shoshone-Bannock Tribes operated an air monitoring station located at Fort Hall. The Fort Hall station uses identical instrumentation and sampling protocol as the ten stations operated by the ESP. The DEQ-INL OP reports the Fort Hall station data as an additional distant site.

Airborne particulate matter was sampled using both high-volume (8x10-inch filter) and low-volume (47-mm filter) total suspended particulate (TSP) air samplers. Weekly gross alpha and gross beta particulate radioactivity results for 47-mm filters from the low-volume TSP samplers are presented in **Appendix A** and summarized as a range of results in **Table 2**. Results are within the expected historical range.

Composites of 47-mm filters collected from low-volume TSP samplers during a calendar quarter are analyzed using gamma spectrometry. Composites of 8x10-inch filters collected from high-volume TSP samplers during each calendar month are also analyzed using gamma spectrometry. Typically, gamma spectrometry results are only reported when exceeding a minimum detectable concentration (MDC). Gamma spectrometry results for the fourth quarter of 2023 for 47-mm and 8x10-inch TSP filters are presented in **Tables 3** and **4**. For the 47-mm and 8x10-inch filter composites, the only reported gamma-emitting radionuclide concentration greater than MDC was beryllium-7 (Be-7), a naturally occurring, cosmogenic radionuclide. The MDC for cesium-137 (Cs-137) is also reported for all locations since Cs-137 is the most likely of the man-made gamma emitting radionuclides to be detected.

Quarterly composites of high-volume 8x10-inch TSP filters are analyzed using radiochemical separation techniques. Results from these composite filter analyses are typically presented in the following

quarter's report. The samples are analyzed for Strontium-90, Plutonium-238, Plutonium-239/240, and Americium-241. Measurable quantities of these radionuclides are expected in the environment due to historic above ground testing of nuclear weapons, and possibly from INL programs. DEQ-INL OP's action levels of 19 for Americium-241 (Am-241), 190 for Strontium-90 (Sr-90), 21 for Plutonium-238 (Pu-238), and 20 for Plutonium-239/240 (Pu-239/240) (in 1 x 10^{-5} pCi/m^3) are 10 percent of the compliance values listed for the specific radionuclides in 40 CFR 61, Appendix E, Table 2. Field sample concentrations which exceed these levels require further investigation.

Radiochemical separation analysis results for 8x10-inch TSP particulate filter composites collected during third quarter 2023 are presented in **Table 5.** There were Sr-90 detections at all on-site, boundary, and distant locations for the third quarter of 2023. These results were all greater-than-MDC and greater-than-three sample standard deviations. This widespread distribution of detectable Sr-90 does not strongly suggest an INL source, although that is possible. There was a positive detection (greater than MDC and 3 SD) of Pu-239/240 at the on-site location Experimental Field Station. There were questionable Pu-239/240 detections (greater than MDC and less than 3 SD) at the boundary locations Atomic City and Mud Lake. There were no Am-241 detections for the third quarter of 2023.

Radioactive iodine samples are collected weekly. Samples are collected by drawing air through a canister filled with activated charcoal using a low-volume air pump. The activated charcoal contained in the canister traps the radioiodine by adsorption onto its porous surface. Each week, canisters are collected from all eleven air monitoring stations and analyzed together as a composite using gamma spectrometry (**Table 6**). If Iodine-131 is detected in this grouping, the canisters are individually analyzed. No radioactive isotopes of iodine, specifically Iodine-131, were detected on the weekly charcoal cartridges used to collect this nuclide during the fourth quarter of 2023.

Atmospheric moisture was collected by drawing air through hygroscopic media at each of the 11 monitoring stations. This moisture was stripped from the hygroscopic media and analyzed to calculate the atmospheric tritium concentration. Reported values are the result of either a single sample or a weighted mean based upon the volume of air sampled when more than one atmospheric moisture sample was collected during the calendar quarter. Atmospheric tritium concentrations and their weighted quarterly means are presented in **Table 7.** Individual sample tritium concentrations exceeded the MDC and 3 SD at the following six locations:

- On-Site - Experimental Field Station, Sand Dunes Tower, and Van Buren Avenue.
- Boundary – Atomic City and Howe.
- Distant – Craters of the Moon.

All weighted mean concentrations were less than the MDC and 3 SD. All results are well below the DEQ-INL OP action level of 150 pCi/m^3 (40 CFR 61).

Precipitation samples were collected at one on-site monitoring location (Big Lost River Rest Area), four boundary locations (Atomic City, Howe, Mud Lake, and Monteview) and one distant location (Idaho Falls) during the fourth quarter of 2023. Precipitation samples were analyzed for tritium and man-made gamma emitting radionuclides. Reported values were either the result of a single sample or a weighted mean when more than one precipitation sample was collected during the calendar quarter. Tritium and man-made gamma emitting radionuclides were below minimum detectable concentrations in precipitation collected during the fourth quarter of 2023. Analysis results for Tritium (H-3) and Cesium-137, the most likely to be detected of man-made gamma emitting radionuclides, are presented in **Table 8**.

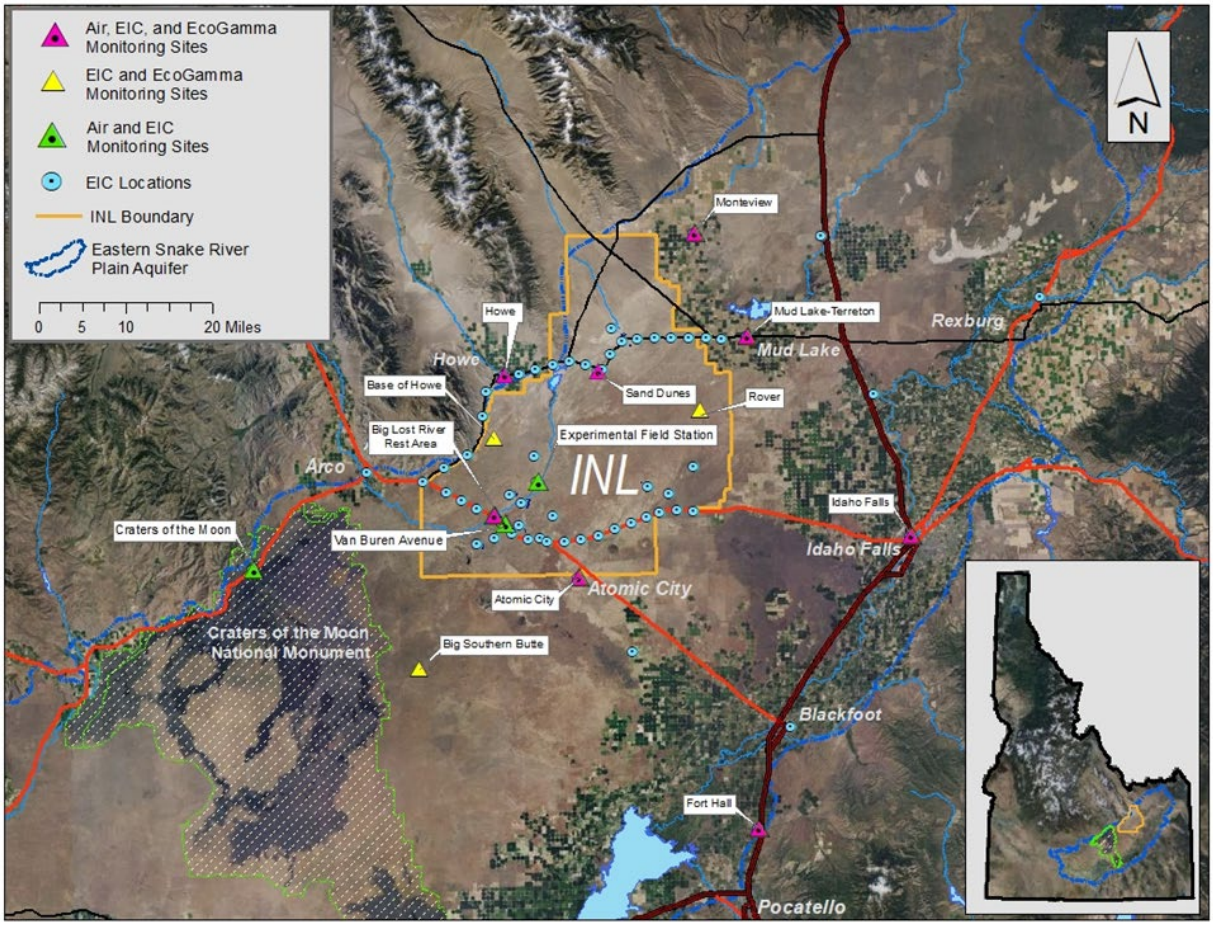

Figure 1. Air and radiation monitoring locations.

Table 1. Sampling locations and sample type

Station Locations	Sample type[1]			
	TSP	Radioiodine	Water Vapor	Precipitation
On-site Locations				
Big Lost River Rest Area	□	□	■	■
Experimental Field Station	□	□	■	
Sand Dunes Tower	□	□	■	
Van Buren Avenue	□	□	■	
Boundary Locations				
Atomic City	□	□	■	■
Howe	□	□	■	■
Monteview	□	□	■	■
Mud Lake	□	□	■	■
Distant Locations				
Craters of the Moon	□	□	■	
Fort Hall[2]	□	□	■	
Idaho Falls	□	□	■	■

[1] □Samples collected weekly; ■ Samples collected quarterly.
[2]TSP and radioiodine samples collected by Shoshone-Bannock Tribes.

Table 2. Range of gross alpha and gross beta concentrations for 47-mm TSP filters, fourth quarter, 2023.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.0	-	2.0	15.2	-	71.6
Experimental Field Station	0.2	-	2.0	14.5	-	67.3
Sand Dunes Tower	0.2	-	1.8	14.0	-	72.4
Van Buren Avenue	0.2	-	4.4	15.2	-	62.1
Boundary Locations						
Atomic City	0.4	-	5.2	16.8	-	66.0
Howe	0.3 J[2]	-	7.5 J	11.7 J	-	66.2 J
Monteview	0.2	-	1.8	13.1	-	57.6
Mud Lake	0.4	-	1.7	17.9	-	65.5
Distant Locations						
Craters of the Moon	0.0 J	-	3.3	14.2 J	-	54.3 J
Fort Hall[1]	0.1	-	1.4	17.5	-	53.2
Idaho Falls	0.9	-	1.6	15.5	-	54.4

Note: Concentrations are expressed in 1 x 10^{-3} pCi/m^3.
[1]Operated by Shoshone-Bannock Tribes.
[2] Faulty dry gas meter reading. Total air volume is estimated. Result is a (usable) estimate (J).

Table 3. Gamma spectrometry analysis data for 47-mm TSP filters, quarterly composite samples, fourth quarter, 2023.

Station Location	Naturally Occurring Radionuclide Beryllium-7			Man-Made Gamma Emitting Radionuclides		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC[2]
On-site Locations						
Big Lost River Rest Area	63.6	5.2	1.9	0.02	0.07	0.12
Experimental Field Station[5]	65.0	5.4	2.0	0.02	0.08	0.14
Sand Dunes Tower	64.5	4.4	1.9	0.00	0.07	0.13
Van Buren Avenue	65.0	4.3	2.3	-0.01	0.07	0.13
Boundary Locations						
Atomic City	59.2	4.0	1.7	-0.03	0.09	0.15
Howe	67.0 J[3]	4.5 J	1.8 J	0.02 J	0.09 J	0.16 J
Monteview	56.2	4.7	1.9	0.07	0.07	0.11
Mud Lake	55.2	3.8	1.8	0.01	0.07	0.12
Distant Locations						
Craters of the Moon	72.1 J[3]	5.9 J	2.2 J	-0.01 J	0.10 J	0.17 J
Fort Hall[1]	56.1	3.9	1.8	-0.02	0.07	0.12
Idaho Falls	55.9	3.8	1.7	-0.01	0.07	0.13

Note: Concentrations are reported in 1 x 10^{-3} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1]Operated by Shoshone-Bannock Tribes.
[2]MDC is for Cs-137. No man-made gamma emitting radionuclides were detected.
[3] Faulty dry gas meter readings for part of the quarter. Total air volume is estimated. Result is a (usable) estimate (J).

Table 4. Gamma spectrometry analysis data for 8x10-inch TSP filters, monthly composite samples, fourth quarter, 2023.

Station Location	Month[4]	Naturally Occurring Radionuclide Beryllium-7			Man-Made Gamma Emitting Radionuclides		
		Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC[2]
On-site Locations							
Big Lost River Rest Area	Oct	73.2	4.4	1.1	0.03	0.03	0.05
	Nov	70.0	4.0	0.6	0.00	0.02	0.03
	Dec	106.9	7.2	0.8	0.01	0.03	0.06
Experimental Field Station	Oct	82.2 J[5]	10.4 J	12.3 J	0.24 J	0.60 J	1.01 J
	Nov	62.9	3.9	0.6	0.00	0.02	0.04
	Dec	87.1	5.9	0.8	-0.01	0.03	0.05
Sand Dunes Tower	Oct	74.5	5.1	0.9	0.04	0.04	0.06
	Nov	86.5	5.9	0.7	0.02	0.03	0.05
	Dec	90.9	5.6	0.6	-0.01	0.04	0.07
Van Buren Avenue	Oct	91.7	6.2	0.9	0.02	0.03	0.05
	Nov	91.1	5.3	1.0	0.02	0.03	0.04
	Dec	96.9	6.0	0.6	0.00	0.02	0.04
Boundary Locations							
Atomic City	Oct	78.2	4.9	0.7	-0.03	0.02	0.04
	Nov	65.8	4.1	0.6	0.00	0.02	0.04
	Dec	75.6	4.7	0.6	-0.01	0.02	0.04
Howe	Oct	82.2	5.1	0.8	0.00	0.02	0.03
	Nov	70.2	4.8	0.6	0.00	0.03	0.05
	Dec	101.0	6.2	0.8	0.01	0.03	0.05
Monteview	Oct	73.9	4.6	0.8	0.00	0.02	0.04
	Nov	75.5	4.5	1.2	0.03	0.03	0.05
	Dec	95.7	5.8	0.9	0.00	0.05	0.08
Mud Lake	Oct	77.8	4.9	0.7	0.00	0.02	0.04
	Nov	79.1	5.4	0.6	0.03	0.03	0.06
	Dec	116.2	6.7	1.1	0.04	0.04	0.06
Distant Locations							
Craters of the Moon	Oct	65.4	4.1	0.7	0.00	0.03	0.05
	Nov	59.1	4.1	0.8	0.02	0.03	0.05
	Dec	74.6	4.7	0.7	0.01	0.03	0.05
Fort Hall[1]	Oct	63.8	4.0	0.8	0.00	0.02	0.04
	Nov	56.8	3.6	0.5	0.00	0.02	0.03
	Dec	69.4	4.3	0.6	0.00	0.02	0.04
Idaho Falls	Oct	78.3	5.3	0.7	0.03	0.03	0.06
	Nov	82.9	5.1	0.6	0.00	0.02	0.04
	Dec	129.3	7.5	1.1	0.01	0.03	0.06

Note: Concentrations are reported in 1 x 10^{-3} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

[1]Operated by Shoshone-Bannock Tribes.
[2] Concentration, SD, and MDC are for Cs-137.
[4] Four filters/composite for October and December; five filters/composite for November.
[5] The air volume was zero through three of the filters and low for one of the filters due to electrical power issues. This resulted in elevated 2 SD and MDC values. Data are considered estimates (J).

Table 5. Radiochemical separation analysis results for 8x10-inch TSP particulate filter composites collected during third quarter 2023.

Station Location	^{90}Sr			^{238}Pu			$^{239/240}Pu$			^{241}Am		
	Value[1]	±2 SD	MDC	Value[1]	± 2 SD	MDC	Value[1]	±2 SD	MDC	Value[1]	±2 SD	MDC
On-Site Locations												
BLR[4] Rest Area	1.88	0.42	0.43	0.12	0.17	0.29	0.07	0.09	0.14	0.05	0.08	0.13
EFS[3]	2.26	0.47	0.43	0.03	0.09	0.18	0.26	0.12	0.12	0.11	0.11	0.18
Sand Dunes Tower	1.55	0.40	0.43	0.08	0.10	0.17	0.05	0.07	0.12	-0.01	0.10	0.21
Van Buren Avenue	1.68	0.39	0.39	0.04	0.08	0.15	0.04	0.05	0.08	0.06	0.10	0.18
Boundary Locations												
Atomic City	1.92	0.42	0.39	0.04	0.08	0.15	0.06 J[5]	0.05	0.03	0.02	0.09	0.18
Howe	1.59	0.38	0.38	0.06	0.09	0.16	0.08	0.08	0.10	0.05	0.10	0.18
Monteview	1.37	0.36	0.39	0.04	0.10	0.19	0.01	0.06	0.13	0.04	0.09	0.16
Mud Lake	1.41	0.38	0.42	0.06	0.08	0.14	0.07 J[5]	0.06	0.03	0.12	0.11	0.17
Distant Locations												
Craters of the Moon	1.74	0.39	0.38	0.10	0.15	0.25	0.12	0.12	0.18	-0.05	0.11	0.23
Fort Hall[2]	1.28	0.39	0.48	0.06	0.09	0.15	0.00	0.03	0.08	-0.04	0.08	0.18
Idaho Falls	1.57	0.39	0.41	0.01	0.10	0.19	0.02	0.06	0.13	-0.10	0.09	0.21

Note: Concentrations are reported in 1 x 10^{-5} pCi/m^3 with associated uncertainty (± 2 SD), minimum detectable concentration (MDC), and correspond to filter composites collected during the calendar quarter.

[1] Measurable quantities of these radionuclides are expected in the environment due to historic above-ground testing of nuclear weapons, and possibly from INL programs. DEQ-INL OP's action levels of 19 for americium-241, 190 for strontium-90, 21 for plutonium-238, and 20 for plutonium-239/240 (in 1 x 10^{-5} pCi/m^3) are 10 percent of the compliance values listed for the specific radionuclide in 40 CFR 61, Appendix E, Table 2.
[2] Operated by Shoshone-Bannock Tribes.
[3] EFS - Experimental Field Station.
[4] BLR – Big Lost River.
[5] Result is greater than MDC but less than 3 SD. This is a questionable detection and is qualified as an estimate (J).

Table 6. Iodine-131 activity in weekly charcoal filter composites, fourth quarter, 2023.

Start Date	Collection Date	Iodine-131 activity (pCi/composite)		
		Activity	± 2 SD	MDA[1]
09/28/23	10/05/23	-0.32	1.68	2.88
10/05/23	10/12/23	-0.38	2.08	3.56
10/12/23	10/19/23	-0.99	1.74	3.01
10/19/23	10/26/23	1.19	1.92	3.19
10/26/23	11/02/23	-0.06	2.35	3.97
11/02/23	11/09/23	0.27	1.75	2.97
11/09/23	11/16/23	0.63	1.81	3.04
11/16/23	11/22/23	-0.21	2.40	4.06
11/22/23	11/30/23	-1.37	2.37	4.08
11/30/23	12/07/23	-0.06	1.69	2.87
12/07/23	12/14/23	-0.26	2.92	4.93
12/14/23	12/21/23	-1.01	2.56	4.30
12/21/23	12/28/23	1.22	2.59	4.33

[1]The minimum detectable activity (MDA) is established for the least efficient counting position in the eleven-cartridge composite. Based on a typical 20,000 ft^3 (566 m^3) air volume per cartridge, and eleven cartridges per composite, the highest I-131 MDA of 4.93 pCi/composite is equivalent to a maximum MDC of 7.9 $x10^{-4}$ pCi/m^3.

Table 7. Tritium concentrations in air from atmospheric moisture, fourth quarter, 2023.

Station Location	Start Date	Collection Date	Tritium		
			Concentration	± 2 SD	MDC
On-site Locations					
Big Lost River Rest Area	09/28/2023	10/13/2023	0.12	0.37	0.62
Big Lost River Rest Area	10/13/2023	11/02/2023	0.10	0.29	0.43
Big Lost River Rest Area	11/02/2023	11/30/2023	-0.23	0.26	0.49
Big Lost River Rest Area	11/30/2023	01/04/2024	0.22	0.19	0.31
Big Lost River Rest Area Mean	**09/28/2023**	**01/04/2024**	**0.05**	**0.26**	**0.44**
Experimental Field Station	09/28/2023	11/09/2023	0.19	0.28	0.42
Experimental Field Station	11/09/2023	12/21/2023	-0.03	0.26	0.42
Experimental Field Station	12/21/2023	01/04/2024	0.57	0.24	0.42
Experimental Field Station Mean	**09/28/2023**	**01/04/2024**	**0.15**	**0.26**	**0.42**
Sand Dunes Tower	09/28/2023	10/19/2023	-0.17	0.34	0.57
Sand Dunes Tower	10/19/2023	11/30/2023	0.24	0.24	0.35
Sand Dunes Tower	11/30/2023	01/04/2024	0.48	0.19	0.32
Sand Dunes Tower Mean	**09/28/2023**	**01/04/2024**	**0.22**	**0.25**	**0.39**
Van Buren Avenue	09/28/2023	10/13/2023	-0.24	0.36	0.60
Van Buren Avenue	10/13/2023	11/09/2023	0.19	0.29	0.48
Van Buren Avenue	11/09/2023	12/14/2023	0.46	0.23	0.40
Van Buren Avenue	12/14/2023	01/04/2024	0.24	0.21	0.33
Van Buren Avenue Mean	**09/28/2023**	**01/04/2024**	**0.22**	**0.26**	**0.44**
Boundary Locations					
Atomic City	09/28/2023	10/13/2023	-0.18	0.35	0.59
Atomic City	10/13/2023	11/09/2023	0.09	0.32	0.51
Atomic City	11/09/2023	12/14/2023	0.22	0.22	0.35
Atomic City	12/14/2023	01/04/2024	0.50	0.24	0.34
Atomic City Mean	**09/28/2023**	**01/04/2024**	**0.17**	**0.27**	**0.43**
Howe	09/28/2023	10/13/2023	-0.06	0.36	0.61
Howe	10/13/2023	11/02/2023	0.18	0.27	0.45
Howe	11/02/2023	11/30/2023	-0.07	0.23	0.40
Howe	11/30/2023	01/04/2024	0.38	0.20	0.29
Howe Mean	**09/28/2023**	**01/04/2024**	**0.12**	**0.25**	**0.41**
Mud Lake	09/28/2023	10/13/2023	-0.06	0.38	0.64
Mud Lake	10/13/2023	11/02/2023	0.05	0.30	0.44
Mud Lake	11/02/2023	11/30/2023	0.26	0.30	0.48
Mud Lake	11/30/2023	01/04/2024	-0.01	0.19	0.32
Mud Lake Mean	**09/28/2023**	**01/04/2024**	**0.08**	**0.28**	**0.45**
Monteview	09/28/2023	10/19/2023	-0.24	0.36	0.59
Monteview	10/19/2023	11/16/2023	0.22	0.27	0.40
Monteview	11/16/2023	01/04/2024	0.08	0.16	0.27
Monteview Mean	**09/28/2023**	**01/04/2024**	**0.04**	**0.24**	**0.38**
Distant Locations					
Craters of the Moon	09/28/2023	10/19/2023	-0.16	0.32	0.53
Craters of the Moon	10/19/2023	11/09/2023	-0.08	0.13	0.19
Craters of the Moon	11/09/2023	12/07/2023	0.48	0.24	0.37
Craters of the Moon	12/07/2023	01/04/2024	0.21	0.18	0.30
Craters of the Moon Mean	**09/28/2023**	**01/04/2024**	**0.15**	**0.21**	**0.34**

Station Location	Start Date	Collection Date	Tritium		
			Concentration	± 2 SD	MDC
Fort Hall[1]	09/28/2023	10/12/2023	-0.07	0.40	0.67
Fort Hall	10/12/2023	11/02/2023	0.10	0.30	0.51
Fort Hall	11/02/2023	11/22/2023	0.32	0.28	0.41
Fort Hall	11/22/2023	12/14/2023	0.04	0.23	0.42
Fort Hall	12/14/2023	01/04/2024	0.23	0.20	0.33
Fort Hall Mean	**09/28/2023**	**01/04/2024**	**0.14**	**0.27**	**0.45**
Idaho Falls	09/28/2023	10/13/2023	-0.44	0.38	0.63
Idaho Falls	10/13/2023	11/02/2023	0.10	0.31	0.46
Idaho Falls	11/02/2023	11/30/2023	0.28	0.24	0.36
Idaho Falls	11/30/2023	01/04/2024	0.10	0.21	0.35
Idaho Falls Mean	**09/28/2023**	**01/04/2024**	**0.05**	**0.27**	**0.43**

Note: Concentrations are reported in pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1]Station operated by the Shoshone-Bannock Tribes.

Table 8. Tritium and gamma-emitting radionuclide concentrations from precipitation, fourth quarter, 2023.

Station Location	Start Date	Stop Date	Tritium			Cs-137		
			Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations								
Big Lost River Rest Area	09/28/23	11/02/23	-20	60	100	-0.7	1.4	2.5
Big Lost River Rest Area	11/02/23	01/04/24	30	60	100	1.0	1.6	2.5
Big Lost River Rest Area Mean	**09/28/23**	**01/04/24**	**-6**	**60**	**100**	**-0.2**	**1.5**	**2.5**
Boundary Locations								
Atomic City	**09/28/23**	**01/04/24**	**20**	**60**	**100**	**0.8**	**1.6**	**2.6**
Howe	**09/28/23**	**01/04/24**	**10**	**60**	**100**	**1.3**	**1.5**	**2.5**
Mud Lake	**09/28/23**	**01/04/24**	**0**	**60**	**100**	**-1.1**	**1.2**	**2.2**
Monteview	**09/28/23**	**01/04/24**	**30**	**60**	**100**	**0.2**	**1.2**	**2.1**
Distant Locations								
Idaho Falls	09/28/23	11/22/23	20	60	100	0.2	1.1	1.8
Idaho Falls	11/22/23	01/04/24	0	60	110	-0.2	1.1	2.0
Idaho Falls Mean	**09/28/23**	**01/04/24**	**12**	**60**	**104**	**0.0**	**1.1**	**1.9**

Note: Concentrations are reported in pCi/L with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the fourth quarter of 2023 (**Figure 1**). To detect gamma radiation, each station is instrumented with triplicate electret ionization chambers (EIC), and 10 of the stations also are equipped with an EcoGamma gamma radiation monitor with low and high range Geiger–Müller detectors. (**Table 9**).

The Shoshone-Bannock Tribes operate an air monitoring station at Fort Hall which is also equipped with EICs and an EcoGamma, both of which are owned and operated by the DEQ-INL OP. The DEQ-INL OP reports these results as a distant site.

EcoGammas are instruments capable of real-time measurements and are sensitive enough to detect small changes in gamma radiation levels. The real-time gamma radiation measurements collected by the EcoGammas at each location are transmitted to DEQ-INL OP and presented graphically via the worldwide web at https://www.deq.idaho.gov/idaho-national-laboratory-oversight/inl-oversight-program/gamma-radiation-measurements. Historically, DEQ-INL OP has used high-pressure ion chambers (HPIC) for real-time gamma radiation measurements. We completed a change-over of removing the old HPICs and replacing them with EcoGammas at each of our monitoring stations in the first quarter 2023. Slight differences between EcoGamma data and historical HPIC data are expected.

EICs are a passive-integrating system that provides a cumulative measure of environmental gamma radiation exposure in the field. EICs are deployed, collected, and analyzed quarterly. EICs offer an inexpensive methodology to measure gamma radiation over a wide area, particularly in regions which do not have a power source. EICs can also provide valuable gamma radiation data in the event of an emergency. For this reason, EICs are deployed at 67 locations by DEQ-INL OP in a widespread network around the INL measuring external radiation. This information is tabulated in **Appendix B.**

These two systems are used by DEQ-INL OP to measure external gamma radiation for various radiological monitoring objectives. **Table 10** lists the average and median radiation exposure rates and exposure rate ranges measured by EcoGammas for the fourth quarter 2023. **Table 11** lists the EIC monitoring results for fourth quarter of 2023. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

Table 9. Summary of instrumentation at radiation monitoring stations.

Station Location	Instrument Type	
	EcoGamma	EIC
On-site Locations		
Base of Howe	■	■
Big Lost River Rest Area	■	■
Experimental Field Station		■
Rover	■	■
Sand Dunes Tower	■	■
Van Buren Avenue		■
Boundary Locations		
Atomic City	■	■
Big Southern Butte	■	■
Howe Met Tower	■	■
Monteview	■	■
Mud Lake/Terreton	■	■
Distant Locations		
Craters of the Moon		■
Fort Hall	■	■
Idaho Falls	■	■

Table 10. Average, median, and range of gamma exposure rates, fourth quarter 2023, from EcoGamma network .

Station Location	Exposure Rate (µR/hr)			
	Quarterly Average*	± 2 SD	Median	Range**
On-site Locations				
Base of Howe	13.9	1.3	13.9	11.6 – 19.4
Big Lost River Rest Area	14.2	1.7	14.1	11.7 – 26.9
Rover[3]	14.7	1.5	14.7	12.1 – 20.5
Sand Dunes Tower	14.3	1.4	14.3	12.1 – 20.5
Boundary Locations				
Atomic City	13.7	1.6	13.7	11.2 – 21.9
Big Southern Butte[3]	14.2	1.5	14.2	11.7 – 18.2
Howe Met. Tower	13.3	1.3	13.3	10.9 – 20.0
Monteview[1]	13.3	1.4	13.3	11.0 – 19.4
Mud Lake / Terreton	13.2	1.6	13.1	10.8 – 20.6
Distant Locations				
Fort Hall	12.2	1.7	12.1	9.8 – 23.0
Idaho Falls[2]	14.2	1.6	14.1	11.9 – 22.4

*EcoGammas are sensitive electronic devices that can experience intermittent malfunctions and/or interference; this typically results in characteristic positive and/or negative data spikes. These aberrations are removed from the data set based on the judgement of the data analyst.
**The range of background exposure rates from EcoGamma data collected to date is approximately 7 – 34 µR/hr.
[1] No data from the EcoGamma at this location 11/16 – 11/21/23.
[2] No data from the EcoGamma at this location 10/12 – 11/15/23.
[3] The EcoGamma was in operation intermittently at this location, producing several minor gaps in the dataset.

Table 11. Electret ionization chamber (EIC) cumulative average exposure rates, fourth quarter, 2023.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	13.4	4.5
Big Lost River Rest Area	14.4	4.4
Experimental Field Station	14.6, 16.6	-
Rover	16.0	0.5
Sand Dunes Tower	14.1	0.8
Van Buren Avenue	16.6	3.8
Boundary Locations		
Atomic City	12.1	3.5
Big Southern Butte	11.2	2.2
Howe Met. Tower	12.3	4.4
Monteview	15.2	3.6
Mud Lake/ Terreton	14.8	1.7
Distant Locations		
Craters of the Moon	11.7	5.0
Fort Hall	10.5	4.7
Idaho Falls	8.9	2.9

[1]Results are the average of triplicate exposure rate measurements with the associated sample variability (±2 SD), or the 2 measured exposure rates remaining after removal of an outlying value. One of the triplicate measurements is rejected if it is outside the average of the triplicate measurements ±2 SD of the historical population variability. Typically, the two most consistent measurements are reported, based on judgment of the data analyst.

Water Monitoring Results

DEQ-INL OP collects groundwater samples from wells and springs located within, upgradient of, and downgradient of the INL in order to evaluate the effects of INL contaminants on water quality in the eastern Snake River Plain (ESRP) aquifer and verify the results of DOE and USGS monitoring. Each year, DEQ-INL OP samples approximately 85-90 locations concurrently with a DOE contractor or the USGS and 15-20 locations independently. Co-sampled locations are primarily on or near the INL Site and are usually sampled during the second and fourth calendar quarters. DEQ-INL OP publishes a comparison of its own analytical results with those obtained by co-samplers in the DEQ-INL Oversight Program Annual Report. Locations sampled independently by DEQ-INL OP are mostly in the Magic Valley and are typically sampled during the third calendar quarter.

Most water samples are collected from wells drilled into the aquifer or springs formed by the intersection of the aquifer water table with the surface. Each aquifer well or spring is categorized as upgradient, facility, boundary, or distant based on its location (**Figure 2** and **Figure 3**):

- *Upgradient* sites are situated north or northeast of INL facilities in areas that have not been affected by INL operations. They are used to monitor background concentrations in the aquifer.

- *Facility* sites are located near facility complexes within the INL, including the Advanced Test Reactor complex (ATR), the Central Facilities Area (CFA), the Idaho Nuclear Technology and Engineering Center (INTEC), the Materials and Fuels Complex (MFC), the Naval Reactors Facility (NRF), the Radioactive Waste Management Complex (RWMC), and Test Area North (TAN). Facility sites are located within or immediately downgradient of known areas of contamination and are sampled to monitor the concentrations and migration of specific contaminants.

- *Boundary* sites are located near the southern boundary of the INL, downgradient of potential sources of INL contamination. These include several wells equipped with Westbay Multilevel Groundwater Monitoring Systems ("Westbay wells"), which offer a look at the vertical distribution of constituents in the aquifer.

- *Distant* sites are located farther downgradient of the INL, primarily in the Magic Valley, and include wells and springs used for agricultural, municipal, domestic, and industrial purposes.

A small number of samples are also collected each year from streams, waste-pond effluent, and wells drilled into perched groundwater (groundwater that sits above the aquifer).

Samples collected from water-monitoring sites are analyzed for radiological and non-radiological constituents, many of which are present in the aquifer both naturally and as a result of INL operations. All locations are sampled for gross alpha and gross beta radioactivity, manmade gamma-emitting nuclides, tritium, chloride, chromium, and nitrate-plus-nitrite.[1] Samples from locations at which tritium concentrations are too low to be detected by the standard method are re-analyzed for tritium using an electrolytic enrichment method (referred to as the low-level method), which has a minimum detectable concentration (MDC) about ten times lower than the standard method. Selected sites are also sampled for specific radionuclides—including uranium isotopes (^{234}U, ^{235}U, and ^{238}U), plutonium isotopes (^{238}Pu, $^{239/240}$Pu), americium-241 (^{241}Am), strontium-90 (^{90}Sr), iodine-129 (^{129}I), and technetium-99 (^{99}Tc)—selected trace metals, common ions, total phosphorus, and/or volatile organic compounds (VOCs) based

[1] Distant locations Alpheus Spring, Bill Jones Hatchery, Clear Spring, Minidoka Water Supply, and Shoshone Water Supply and upgradient location Mud Lake Water Supply are sampled for gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium during the second quarter. In the fourth quarter, samples are collected for common ions, metals, nitrate-plus-nitrate, and other constituents along with gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium.

on past and present INL operations or a history of elevated concentrations. If unexpected levels of radioactivity are detected in gross measurements, additional samples will be collected and analyzed for specific radionuclides.

During the fourth quarter of 2023, DEQ-INL OP sampled groundwater from the aquifer at 11 facility locations, 3 boundary locations, 5 distant locations, and 1 upgradient location. DEQ-INL OP also sampled water from 4 perched water locations, 2 surface water locations, and 2 wastewater locations. **Table 12** lists the sample date, co-sampler, well depth, and analyses requested for the locations sampled this quarter. Analytical results are reported in **Tables 14 through 24** and summarized below. The results of low-level tritium analyses for seven samples collected in third quarter, 2023 are reported in **Table 16** and discussed below.

Table 13 shows the range of background concentrations for each constituent in the ESRP aquifer and the EPA drinking water maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL). Background concentrations depend on local geology, and the concentrations of constituents at sites not influenced by INL activities may on occasion be higher than the given background ranges due to local factors and natural variability.

Gross alpha and gross beta radioactivity

Gross alpha and gross beta analyses are used to screen for unexpectedly high levels of radioactivity in samples. DEQ-INL OP has determined from past sampling that background concentration ranges for gross alpha and gross beta radioactivity in the ESRP aquifer are approximately 0-5.6 pCi/L and 0-8.6 pCi/L, respectively. Occasional measurements of concentrations above these background ranges in uncontaminated samples are statistically probable due to uncertainties inherent in measuring low levels of radioactivity. Additionally, some samples will have levels of radioactivity slightly higher than background ranges due to higher-than-average concentrations of naturally occurring uranium, thorium, or potassium-40.

Low quantities of gross alpha and beta radioactivity were detected in most samples **(Table 14)**. Gross alpha radioactivity was measured at concentrations within the known background range at all locations. PW-11 exhibited an increase in gross beta concentration at 18.3 ± 1.2 pCi/L, which is significantly higher than the previous maximum concentration in 2015 of 8.0 ± 1.1 pCi/L. A strontium-90 sample was not collected this year but is scheduled to be collected in 2024. The INL OP will continue to monitor gross beta and strontium-90 trends. Gross beta radioactivity elevated above the natural background was also observed at ATR perched well PW-12 (76.9 ± 2.2 pCi/L), TAN aquifer well TAN-37A (25.6 ± 1.4 pCi/L), and INTEC aquifer well USGS-115 (9.3 ± 1.0 pCi/L). All results are consistent with historical trends.

Manmade gamma-emitting radionuclides

No manmade gamma-emitting radionuclides were detected at any location sampled this quarter. Results for cesium-137 (^{137}Cs), the manmade gamma-emitter most likely to be detected in groundwater, are reported in **Table 14**.

Tritium

Tritium was analyzed for all locations sampled during this quarter **(Table 15).** Elevated levels of tritium were detected in aquifer wells located at or near ATR, INTEC, RWMC, TAN, CFA, and the southern boundary of INL. Among these, CFA-2 exhibited the highest concentration of tritium in a facility well, measuring at 2110 ± 120 pCi/L. Additionally, notably elevated concentrations of tritium were found in ATR well USGS-140 (830 ± 90 pCi/L), ATR well TRA-08 (630 ± 70 pCi/L), INTEC well USGS-115 (500 ± 80 pCi/L), TAN well TAN-37A (480 ± 80 pCi/L), and RWMC well RWMC Production (390 ±

70 pCi/L). USGS-104, located downgradient of CFA-2, displayed the highest tritium concentration among boundary wells, measuring at 430 ± 60 pCi/L.

In perched groundwater wells, elevated tritium concentrations ranged from 330 ± 60 pCi/L at PW-11 (ATR) to 3640 ± 110 pCi/L at PW-12 (ATR). The tritium concentration at PW-12 has increased from 1561 ± 160 pCi/L in 2022. Results will continue to be monitored for trends in the future.

Seven samples from third quarter 2023 were analyzed for low-level tritium, with results reported in **Table 16**. A backlog of 11 low level tritium analyses from this quarter still exists. All tritium concentrations reported in this quarter were well below the drinking water MCL of 20,000 pCi/L.

Strontium-90

Three aquifer facility wells and two ATR perched water wells were sampled for ^{90}Sr this quarter (**Table 17**)**.** All wells with detections were labeled as estimates because the contract lab's method blank exceeded the Method Detection Limit (MDC). TAN-37A displayed the highest ^{90}Sr concentration at 180 ± 15 pCi/L, which is significantly lower than the historical median of 369 ± 87 pCi/L. PW-12 also had an elevated ^{90}Sr concentration of 28.5 ± 2.6 pCi/L. This is lower than the historical maximum (32.9 ± 7.9 pCi/L) collected in 2019.

Technicium-99

Three locations were sampled for ^{99}Tc (**Table 18**). There were two low level detections consistent with previous values, well below the MCL of 900 pCi/L: INTEC well USGS-115 at 3.87 ± 0.70 pCi/L and CFA 2 at 2.31 ± 0.59 pCi/L. The other sample analyzed this quarter for ^{99}Tc resulted in a non-detection.

Actinides

Five locations were analyzed for uranium isotopes this quarter (**Table 19**), and all exceeded their respective MDCs for ^{234}U. TAN-37A exhibited an above background ^{234}U concentration of 3.32 ± 0.51 pCi/L, as did USGS-120 (1.95 ± 0.62 pCi/L). Though these results were above the natural concentration range, they are within the historical ranges for these locations. The concentration for USGS-115 (1.48 ± 0.85 pCi/L; MDC = 1.01 pCi/L) was elevated compared to 2021 results at 0.67 ± 0.04 pCi/L (MDC = 0.17 pCi/L); however, there is also a significant difference between the MDCs. All other samples were within background range for ^{234}U.

For ^{235}U, Both RWMC Production (0.0437 ± 0.0311 pCi/L) and TAN-37A (0.182 ± 0.121 pCi/L) exhibited detections with concentrations above the natural background. Both results are within expected ranges.

For ^{238}U, USGS-112 (0.806 ± 0.367 pCi/l), USGS-120 (1.1 ± 0.46 pCi/L), and TAN-37A (0.785 ± 0.218 pCi/L) all had detections above background concentrations. All results were within the expected ranges.

Two locations were sampled for plutonium isotopes and ^{241}Am this quarter **(Table 20)**. Neither plutonium isotopes nor ^{241}Am were detected in either well.

Common ions, trace metals, and nutrients

All locations were sampled for chloride, chromium, sulfate, alkalinity, and dissolved nutrients (nitrate-plus-nitrite). Six locations (Alpheus Spring, Clear Spring, Bill Jones Hatchery, Minidoka Water Supply, Mud Lake Water Supply and Shoshone Water Supply) were sampled for other common ions. Three locations (TAN-37A, TRA Cold Waste Pond, and MFC–Industrial Waste Pipe) were sampled for other common ions, trace metals, and phosphorus during the quarter (**Tables 21, 22, and 23**).

Most analyses were within the historical range. CFA-2, USGS-073, TAN-37A, PW-12 and PW-9 exceeded background concentrations of chloride. PW-12 displayed a significant increase in chloride concentration (95.5 mg/L), up from the previous historical maximum of 55.3 mg/L. All other chloride concentrations were similar to prior years' results. PW-11 displayed sulfate concentrations well above background (146 mg/L, SMCL 250 mg/L), but this value was within the expected range. Well TAN-37A also showed elevated concentrations of magnesium, sodium, potassium, chloride, and alkalinity. Bioremediation injections at the TAN facility likely influence these analyte concentrations to fluctuate beyond background ranges.

Chromium concentrations were elevated above background levels in the following aquifer wells: TAN-37A (35 µg/L; MCL 100 µg/L), PW-11 (19 µg/L), TRA-08 (19 µg/L), USGS-099 (5.9 µg/L), USGS-140 (17 µg/L), RWMC Production (12 µg/L), USGS-112 (11 µg/L), Middle-1823 (10 µg/L), CFA 2 (9.9 µg/L), USGS-120 (9.0 µg/L), and USGS-104 (8.3 µg/l). Results from the following perched water wells were above background chromium levels: PW-9 (50 µg/L) and USGS-073 (18 µg/L). TAN-37A also displayed elevated concentrations of iron, manganese, and barium, which are likely influenced by remediation efforts at the TAN facility.

USGS-073 had the highest nitrate + nitrite concentration above background at 27 mg/L. This result is within the expected range and down from the peak detection of 32 mg/L in October of 2020. TAN-37A displayed the highest phosphorous concentration above background at 5.3 mg/L, but it is within the expected range.

Volatile organic compounds (VOCs)

VOCs were measured in aquifer wells RWMC Production, USGS-120, and TAN-37A (**Table 24**). A chloromethane result was reported by the lab for the first time at USGS-120 (0.27 µg/L) at greater than the method detection level (0.18 µg/L) but less than the lab's reporting level (0.50 µg/L). This result is considered a detected estimate (J qualifier). However, chloromethane was also detected in the associated spike sample which did not contain this analyte, suggesting that the reported result is a false positive detection. Carbon tetrachloride, trichloroethene (TCE), and chloroform continue to be detected at the RWMC Production well at levels consistent with previous observations.

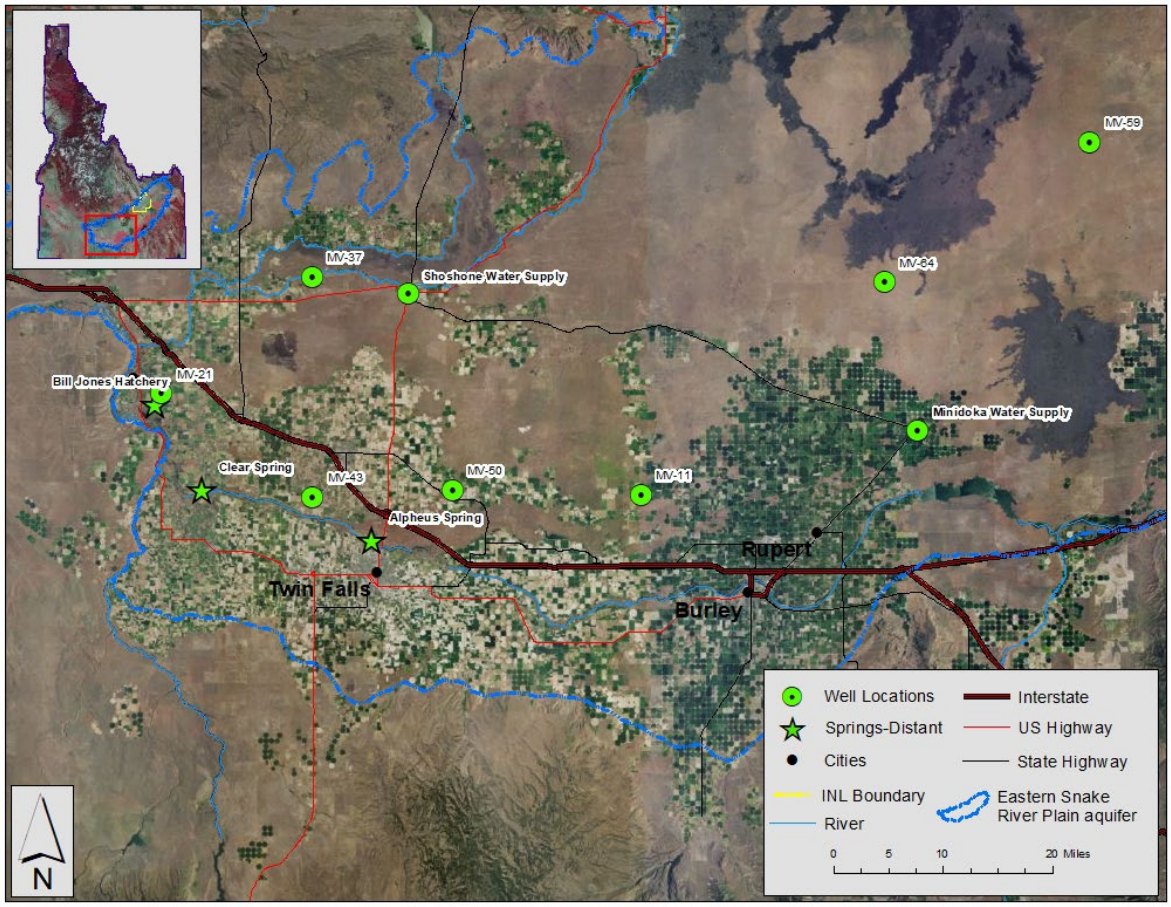

Figure 2. Distant water monitoring locations.

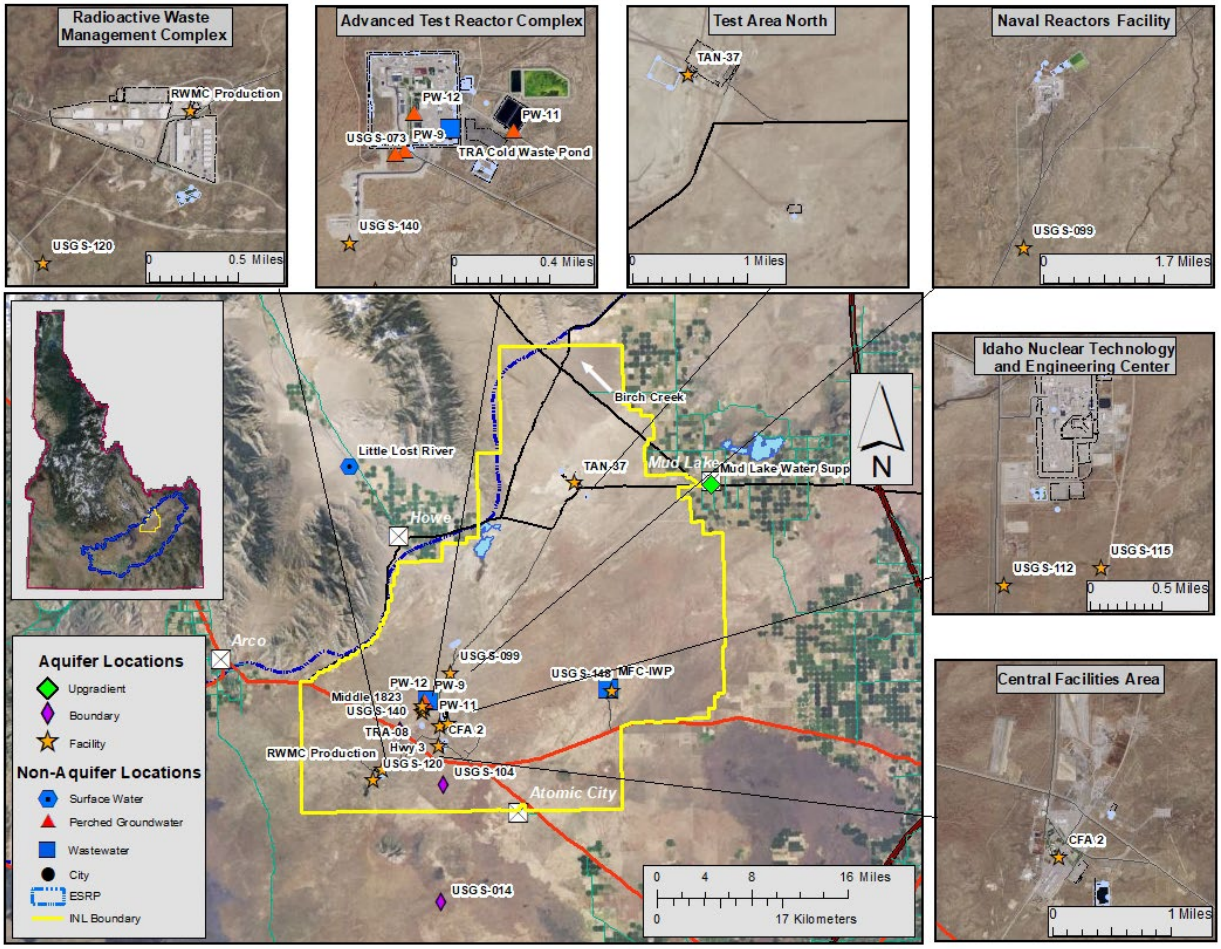

Figure 3. Up-gradient, facility, boundary, perched groundwater (GW), surface water, and wastewater monitoring locations.

Table 12. Locations sampled for water, fourth quarter, 2023.

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
Aquifer Samples				
Upgradient				
Mud Lake Water Supply	11/28/2023	BEA	330	α, β, γ, ^{3}H, com. ions, Cr, As, NO_3+NO_2
Facility				
Advanced Test Reactor Complex:				
Middle-1823	10/05/2023	IEC	729.1	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
TRA-08	10/05/2023	IEC	501.5	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-140	10/11/2023	USGS	546	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Idaho Nuclear Technology and Engineering Center:				
USGS-112	10/02/2023	USGS	507	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, U iso, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-115	10/02/2023	USGS	581	α, β, γ, ^{3}H, ^{90}Sr, ^{99}Tc, U Iso, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Radioactive Waste Management Complex:				
RWMC Production	10/16/2023	USGS	685	α, β, γ, ^{3}H, ^{241}Am, U iso, Pu Iso, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
USGS-120	10/16/2023	USGS	705	α, β, γ, ^{3}H, ^{241}Am, U iso, Pu Iso, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2, VOCs
Test Area North:				
TAN-37A	10/17/2023	IEC	240	α, β, γ, ^{3}H, ^{90}Sr, U iso, com. ions, trace metals, NO_3+NO_2, P, VOCs
Central Facilities Area:				
CFA 2	10/17/2023	USGS	507	α, β, γ, ^{3}H, ^{99}Tc, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Materials and Fuels Complex:				
USGS-148	10/12/2023	USGS	680	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Naval Reactors Facility:				
USGS-099	10/11/2023	USGS	426	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Boundary				
Highway 3	10/10/2023	USGS	750	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-014	10/12/2023	USGS	751	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-104	10/11/2023	USGS	700	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Distant				
Alpheus Spring	11/27/2023	BEA	0	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Bill Jones Hatchery	11/27/2023	BEA	0	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Clear Spring	11/27/2023	BEA	0	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Minidoka Water Supply	11/27/2023	BEA	282	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Shoshone Water Supply	11/27/2023	BEA	n/a	α, β, γ, ^{3}H, com. ions, Cr, NO_3+NO_2
Other Samples				
Perched Groundwater				
Advanced Test Reactor Complex:				
PW-9	10/17/2023	USGS	200	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
PW-11	10/04/2023	IEC	134.5	α, β, γ, ^{3}H, ^{90}Sr, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
PW-12	10/04/2023	IEC	128	α, β, γ, ^{3}H, ^{90}Sr, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
USGS-073	10/09/2023	USGS	127	α, β, γ, ^{3}H, ^{90}Sr, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Surface Water				
Birch Creek	10/18/2023	USGS	0	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Little Lost River	10/18/2023	USGS	0	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, Cr, NO_3+NO_2
Wastewater				
TRA Cold Waste Pond	10/10/2023	BEA	0	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, trace metals, NO_3+NO_2, P
MFC-Industrial Waste Pipeline	10/03/2023	BEA	0	α, β, γ, ^{3}H, Cl^-, SO_4^{2-}, trace metals, NO_3+NO_2, P

ft bgs = feet below ground surface.
*α = gross alpha radioactivity; β = gross beta radioactivity; γ = manmade gamma-emitting radionuclides; ^{3}H = tritium; ^{90}Sr = Strontium-90; ^{99}Tc = Technetium-99; ^{241}Am = Americium-241; P iso. = ^{238}Pu, $^{239/240}Pu$; ^{129}I = Iodine-129; U iso. = ^{234}U, ^{235}U, ^{238}U; Cl^- = chloride; Cr = chromium; com. ions = calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), chloride (Cl^-), sulfate (SO_4^{2-}), alkalinity; trace metals = arsenic (As), barium (Ba), chromium (Cr), iron (Fe), manganese (Mn), lead (Pb); selenium (Se); NO_3+NO_2 = nitrate plus nitrite; P = phosphorus, and VOCs = volatile organic compounds.

Table 13. Constituent background concentration ranges and EPA drinking water standards.

Constituent	Background[1]	MCL or SMCL[2]
Radiological Constituents (pCi/L)		
Gross alpha	0-5.6[a]	15
Gross beta	0-8.6[a]	4 mrem/yr
Cesium-137	0	200
Tritium	0-33[a]	20,000
Strontium-90	0	8
Technetium-99	0	900
Iodine-129	0.0000054[e]	1
Uranium-234	0.043-1.9[b]	30 µg/L (total U)
Uranium-235	0-0.048[b]	
Uranium-238	0.021-0.719[b]	
Plutonium-238	0	---
Plutonium-239/240	0	---
Americium-241	0	---
Non-radiological Constituents		
Common Ions (mg/L)		
Alkalinity (as $CaCO_3$)	91-261[a]	---
Calcium	23 – 71[a]	---
Chloride	4.9 – 66.6[a]	250*
Fluoride	0.1 – 1.50[a]	4
Magnesium	10.1 – 27.4[a]	---
Potassium	1.2 – 5.8[a]	---
Sodium	2.6 – 27.0[a]	---
Sulfate	9.6 – 40.4[a]	250*
Trace Metals (µg/L)		
Arsenic	2 – 3[c]	10
Barium	50 – 70[c]	2000
Chromium	<1.0 – 5.2[a]	100
Iron	4 – 16[d]	300*
Lead	<5[c]	15
Manganese	<1 – 4[a]	50*
Selenium	<1[c]	50
Zinc	<3 – 10.5[d]	5000*
Nutrients (mg/L)		
Nitrate plus nitrite	<0.04 – 3.59[b]	10 for NO_3^-, 1 for NO_2^-
Phosphorus	<0.01 – 0.02[d]	---
Volatile Organic Compounds (µg/L)		
Tetrachloroethene (PCE)	0	5
Trichloroethene (TCE)	0	5
1,1-Dichloroethene	0	7
cis-1,2-dichloroethene	0	70
trans-1,2-dichloroethene	0	100
Vinyl chloride	0	2
Carbon tetrachloride	0	5
Chloroform	0	80[f]
Chloromethane	0	---
Methylene Chloride	0	5
Methyl Ethyl Ketone	0	---
1,1-Dichloroethane	0	---

[1] Sources for background ranges are: [a] DEQ data compiled from distant, boundary, and surface water sites from 1993-2018.
[b] Bartholomay and Hall, 2016 (DOE/ID-22237); [c] Knobel and others, 1992; [d] Knobel and others, 1999 (DOE/ID-22164). [e] Cecil and others, 2003 (DOE/ID-22186); [f]MCL is for total trihalomethanes.
[2] Maximum Contaminant Levels (MCLs) are the highest levels of contaminants legally allowed in public drinking water systems in Idaho. Most wells sampled by DEQ-INL OP are not used for drinking water. A * designates a Secondary MCL (SMCL), which is a guideline recommended by the EPA for constituents that may affect the taste, color, or odor of drinking water. [f] MCL is for total trihalomethanes.

Table 14. Gross alpha, gross beta, and man-made gamma-emitting radionuclide concentrations (pCi/L) for water samples, fourth quarter, 2023.

Sample Location	Sample Date	Gross Alpha			Gross Beta			Cesium-137*		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Upgradient										
Mud Lake Water Supply	11/28/2023	0.6	U	0.7	4.1	-	0.8	1.4	U	1.9
Facility										
Advanced Test Reactor Complex										
Middle-1823	10/05/2023	0.2	U	1.0	2.4	-	0.8	0.6	U	1.3
TRA-08	10/05/2023	1.2	U	1.1	3.6	-	0.9	2.3	U	1.4
USGS-140	10/11/2023	1.7	-	1.0	2.2	-	0.9	-0.1	U	1.3
Idaho Nuclear Technology and Engineering Center										
USGS-112	10/02/2023	1.4	U	1.1	3.1	-	0.9	-0.7	U	2.1
USGS-115	10/02/2023	0.1	U	1.1	9.3	-	1.0	0.5	U	1.2
Radioactive Waste Management Complex										
RWMC Production	10/16/2023	0.6	U	1.0	2.7	-	0.9	1.6	U	1.4
USGS-120	10/16/2023	1.7	-	0.9	2.9	-	0.9	-0.2	U	1.5
Test Area North										
TAN-37A	10/17/2023	-0.6	U	0.8	25.6	-	1.4	1.6	U	1.8
Central Facilities Area										
CFA 2	10/17/2023	1.7	-	1.1	7.5	-	1.1	0.7	U	1.4
Materials and Fuels Complex										
USGS-148	10/12/2023	1.8	-	1.0	3.3	-	0.9	0.9	U	1.6
Naval Reactors Facility										
USGS-099	10/11/2023	2.4	-	1.3	0.5	U	0.9	0.7	U	1.2
Boundary										
Highway 3	10/10/2023	0.1	U	1.0	1.8	-	0.9	0.6	U	1.1
USGS-014	10/12/2023	2.1	-	1.1	2.4	-	0.9	-0.5	U	1.5
USGS-104	10/11/2023	1.2	U	0.9	1.6	-	0.8	-0.1	U	1.8
Distant										
Alpheus Spring	11/27/2023	0.9	U	1.1	5.8	J+	0.9	1.1	U	1.3
Bill Jones Hatchery	11/27/2023	-0.6	U	0.9	3.9	J+	0.9	-0.4	U	1.3
Clear Spring	11/27/2023	0.8	U	1.0	6.7	J+	1.0	-1.1	U	1.1
Minidoka Water Supply	11/27/2023	-0.5	U	0.9	5.2	J+	0.9	0.2	U	1.2
Shoshone Water Supply	11/27/2023	0.4	U	1.1	4.7	J+	1.0	-0.4	U	1.6
Other Samples										
Perched Groundwater										
Advanced Test Reactor Complex										
PW-9	10/17/2023	-0.3	U	1.1	2.3	-	1.0	0.4	U	1.6
PW-11	10/04/2023	2.9	-	1.1	18.3	-	1.2	1.0	U	1.8
PW-12	10/04/2023	2.2	-	1.1	76.9	-	2.2	0.9	U	2.0
USGS-073	11/09/2023	-0.9	U	2.7	6.6	-	2.4	0.0	U	1.3
Surface Water										
Birch Creek	10/18/2023	2.0	-	0.8	1.6	-	0.8	-0.2	U	1.7
Little Lost River (LLR)	10/18/2023	0.3	U	0.9	-0.4	U	0.8	0.8	U	1.4
Wastewater										
TRA Cold Waste Pond	10/10/2023	1.2	U	0.9	0.5	U	0.8	0.1	U	1.4
MFC-Industrial Waste Pipeline	10/03/2023	1.1	U	1.0	3.2	-	0.9	1.0	U	1.4

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
*ISU-EML analyzes water samples for all common manmade gamma-emitting radionuclides. If none are detected, only the results for ^{137}Cs, the manmade gamma-emitter most likely to be detected in groundwater, are reported in this table. MDC range (gross alpha) 1.1– 5.0 pCi/L. MDC range (gross beta) 1.2 – 3.7 pCi/L. MDC range (cesium-137) 1.9 – 3.6 pCi/L.

Table 15. Tritium concentrations (pCi/L) for water samples, fourth quarter, 2023.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Upgradient				
Mud Lake Water Supply	11/28/2023	-20	U	60
Facility				
Advanced Test Reactor Complex				
Middle-1823	10/05/2023	390	-	60
TRA-08	10/05/2023	630	-	70
USGS-140	10/11/2023	830	-	90
Idaho Nuclear Technology and Engineering Center				
USGS-112	10/02/2023	330	-	60
USGS-115	10/02/2023	500	-	80
Radioactive Waste Management Complex				
RWMC Production	10/16/2023	390	-	70
USGS-120	10/16/2023	140	-	70
Test Area North				
TAN-37A	10/17/2023	480	-	80
Central Facilities Area				
CFA 2	10/17/2023	2110	-	120
Materials and Fuels Complex				
USGS-148	10/12/2023	90	U	60
Naval Reactors Facility				
USGS-099	10/11/2023	-40	U	70
Boundary				
Highway 3	10/10/2023	-40	U	60
USGS-014	10/12/2023	0	U	60
USGS-104	10/11/2023	430	-	60
Distant				
Alpheus Spring	11/27/2023	30	U	60
Bill Jones Hatchery	11/27/2023	-20	U	60
Clear Spring	11/27/2023	-20	U	60
Minidoka Water Supply	11/27/2023	-50	U	60
Shoshone Water Supply	11/27/2023	20	U	60
Other Samples				
Perched Groundwater				
Advanced Test Reactor Complex				
PW-9	10/17/2023	710	-	80
PW-11	10/04/2023	330	-	60
PW-12	10/04/2023	3640	-	110
USGS-073	11/09/2023	1170	-	80
Surface Water				
Birch Creek	10/18/2023	-50	U	60
Little Lost River (LLR)	10/18/2023	-10	U	60
Wastewater				
TRA Cold Waste Pond	10/10/2023	50	U	60
MFC-Industrial Waste Pipeline	10/03/2023	0	U	60

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC range 90 – 120 pCi/L.

Table 16. Low-level tritium concentrations (pCi/L) in water samples analyzed using the electrolytic enrichment method, fourth quarter of 2023.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Distant				
MV-37	07/20/2023	7	-	4
MV-43	07/20/2023	9	-	4
MV-50	07/19/2023	7	U	4
MV-21	07/20/2023	2	U	5
MV-11	07/19/2023	7	U	4
MV-59	07/27/2023	0	U	4
MV-64	08/24/2023	1	U	4

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively. ft bgs = feet below ground surface.
MDC range 6 - 8 pCi/L.

Table 17. Strontium-90 concentrations (pCi/L) for water samples, fourth quarter, 2023.

Sample Location	Sample Date	Strontium-90		
		Concentration		2 SD
Aquifer Samples				
Facility				
Idaho Nuclear Technology and Engineering Center				
USGS-112	10/02/20203	5.50	J+	0.69
USGS-115	10/02/2023	0.175	U	0.300
Test Area North				
TAN-37A	10/17/2023	180	J+	15
Other Samples				
Perched Groundwater				
Advanced Test Reactor Complex				
PW-12	10/04/2023	28.5	J+	2.6
USGS-073	11/09/2023	0.239	U	0.164

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively. All detections were labeled as biased-high estimates (J+) due to vendor's method blanks exceeding MDC.
MDC range 0.25 – 0.68 pCi/L.

Table 18. Technetium-99 concentrations (pCi/L) for water samples, fourth quarter, 2023.

Sample Location	Sample Date	Technetium-99		
		Concentration		2 SD
Aquifer Samples				
Facility				
Idaho Nuclear Technology and Engineering Center				
USGS-112	10/02/2023	0.796	U	0.521
USGS-115	10/02/2023	3.87	-	0.70
Central Facilities Area				
CFA-2	10/17/2023	2.31	-	0.59

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC range 0.839 – 0.851 pCi/L.

Table 19. Uranium isotope concentrations (pCi/L) for water samples, fourth quarter, 2023.

Sample Location	Sample Date	Uranium-234			Uranium-235			Uranium-238		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Idaho Nuclear Technology and Engineering Center										
USGS-112	10/02/2023	1.62	-	0.58	0.151	J+[1]	0.175	0.806		0.367
USGS-115	10/02/2023	1.48	-	0.85	0.307	U	0.458	0.657	U	0.617
Radioactive Waste Management Complex										
RWMC Production	10/16/2023	1.25	-	0.18	0.0437	J#	0.0311	0.644		0.119
USGS-120	10/16/2023	1.95	-	0.62	0.095	U	0.135	1.1		0.46
Test Area North										
TAN-37A	10/17/2023	3.32	-	0.51	0.182	J+[1]	0.121	0.785		0.218

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
[1]Result is qualified as biased-high estimates (J+) due to vendor's method blanks exceeding MDC.
[#]Result is >MDC and >2SD but <3SD and is therefore considered questionable and J-flagged as an estimate.
MDC range (U-234) 0.0132-1.01 pCi/L. MDC range (U-235) 0.0164-0.783 pCi/L. MDC range (U-238) 0.0132-0.908 pCi/L.

Table 20. Plutonium isotope and americium-241 concentrations (pCi/L) for water samples, fourth quarter, 2023

Sample Location	Sample Date	Plutonium-238			Plutonium-239/240			Americium-241		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Aquifer Samples										
Facility										
Radioactive Waste Management Complex:										
RWMC Production	10/16/2023	0.0254	U	0.0508	0.0254	U	0.0509	0.0640	U	0.0602
USGS-120	10/16/2023	0.0045	U	0.0089	0.0000	U	0.0089	0.0485	U	0.0444

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
MDC range (Pu-238) 0.0133 – 0.0762 pCi/L. MDC range (Pu-239/240) 0.0134 – 0.0762 pCi/L. MDC range (Am-241) 0.0674 – 0.0884 pCi/L.

Table 21. Common ion concentrations (mg/L) in water samples, fourth quarter, 2023.

Sample Location	Sample Date	Calcium*	Magnesium*	Sodium*	Potassium*	Fluoride	Chloride	Sulfate	Alkalinity†
Aquifer Samples									
Upgradient									
Mud Lake Water Supply	11/28/2023	8.3	2.7	30	5.0	-	4.98	8.69	90.9
Facility									
Advanced Test Reactor Complex									
Middle-1823	10/05/23	-	-	-	-	-	11.5	32.7	168
TRA-08	10/05/23	-	-	-	-	-	11.9	44.4	156
USGS-140	10/11/23	-	-	-	-	-	15.3	34.0	163
Idaho Nuclear Technology and Engineering Center									
USGS-112	10/02/23	-	-	-	-	-	13.8	28.8	144
USGS-115	10/02/23	-	-	-	-	-	61.2[2]	29.1	97.0
Radioactive Waste Management Complex									
RWMC Production	10/16/23	-	-	-	-	-	22.9	29.4	139
USGS-120	10/16/23	-	-	-	-	-	14.3	31.1	144
Test Area North									
TAN-37A	10/17/23	34[2]	51[2]	1200[2]	28[2]	-	90.0[4]	6.3[4] J[5]	2540[3]
Central Facilities Area									
CFA 2	10/17/23	-	-	-	-	-	143[3]	49.6	146
Materials and Fuels Complex									
USGS-148	10/12/23	-	-	-	-	-	16.0	18.0	133
Naval Reactors Facility									
USGS-099	10/22/23	-	-	-	-	-	20.6	27.3	197
Boundary									
Highway 3	10/10/2023	-	-	-	-	-	6.35	21.1	142
USGS-014	10/12/2023	-	-	-	-	-	21.4	22.0	140
USGS-104	10/11/2023	-	-	-	-	-	15.7	21.6	123
Distant									
Alpheus Spring	11/27/2023	53	19	33	6.3	-	40.1[1]	57.1	179
Clear Spring	11/27/2023	44	19	26	4.2	-	33.8	48.7	152
Bill Jones Hatchery	11/27/2023	29	16	16	3.5	-	12.1	27.4	131
Shoshone Water Supply	11/27/2023	44	15	15	3.0	-	8.82	20.3	176
Minidoka Water Supply	11/27/2023	48	17	21	3.7	-	37.9[1]	48.1	142
Other Samples									
Perched Groundwater									
Advanced Test Reactor Complex									
PW-09	10/17/2023	-	-	-	-	-	77.9[2]	44.2[2]	116
PW-11	10/04/2023	-	-	-	-	-	17.6	146[2]	156
PW-12	10/04/2023	-	-	-	-	-	95.5[2]	27.5	198
USGS-073	11/09/2023	-	-	-	-	-	189[3]	48.2	135
Surface Water									
Birch Creek	10/18/2022	-	-	-	-	-	4.73	25.7	147
Little Lost River	10/18/2022	-	-	-	-	-	4.62	17.8	144
Wastewater									
TRA Cold Waste Pond	10/10/2023	45	17	8.6	1.7	-	11.0	29.6	163
MFC-Industrial Waste Pipeline	10/03/2023	38	12	20	3.5	-	20.9	20.5	141

Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
Note 1. Lab indicated that a 2:1 dilution of this sample was required for this analyte.
Note 2. Lab indicated that a 5:1 dilution of this sample was required for this analyte.
Note 3. Lab indicated that a 10:1 dilution of this sample was required for this analyte.
Note 4. Lab indicated that a 20:1 dilution of this sample was required for this analyte. This raised the lab's reporting level by a factor of 20.
Note 5. The result is greater than the method detection limit but less than the lab's reporting detection limit. The result is considered a detected estimate.

Table 22. Dissolved metals concentrations (µg/L) in water samples, fourth quarter, 2023.

Sample Location	Sample Date	Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Aquifer Samples																	
Upgradient																	
Mud Lake Water Supply	11/28/23	-		-		0.27	J[2]	-		-		-		-		-	
Facility																	
Advanced Test Reactor Complex																	
Middle-1823	10/05/23	-		-		10		-		-		-		-		-	
TRA-08	10/05/23	-		-		19		-		-		-		-		-	
USGS-140	10/11/23	-		-		17		-		-		-		-		-	
Idaho Nuclear Technology and Engineering Center																	
USGS-112	10/02/23	-		-		11		-		-		-		-		-	
USGS-115	10/02/23	-		-		4.9		-		-		-		-		-	
Radioactive Waste Management Complex																	
RWMC Production	10/16/23	-		-		12		-		-		-		-		-	
USGS-120	10/16/23	-		-		9.0		-		-		-		-		-	
Test Area North																	
TAN-37A	10/17/23	4.6[1]	J[2]	540[1]		35[1]		3900[1]		<5[1]	U	480[1]		-		-	
Central Facilities Area																	
CFA 2	10/17/23	-		-		9.9		-		-		-		-		-	
Materials and Fuels Complex																	
USGS-148	10/12/23	-		-		1.9		-		-		-		-		-	
Naval Reactors Facility																	
USGS-099	10/11/23	-		-		5.9		-		-		-		-		-	
Boundary																	
Highway 3	10/10/2023	-		-		2.2		-		-		-		-		-	
USGS-014	10/12/2023	-		-		3.9		-		-		-		-		-	
USGS-104	10/11/2023	-		-		8.3		-		-		-		-		-	
Distant																	
Alpheus Spring	11/27/2023	-		-		1.5		-		-		-		-		-	
Clear Spring	11/27/2023	-		-		2.6		-		-		-		-		-	
Bill Jones Hatchery	11/27/2023	-		-		3.7		-		-		-		-		-	
Shoshone Water Supply	11/27/2023	-		-		2.2		-		-		-		-		-	
Minidoka Water Supply	11/27/2023	-		-		2.1		-		-		-		-		-	
Other Samples																	
Perched Groundwater																	
Advanced Test Reactor Complex																	
PW-09	10/17/2023	-		-		50		-		-		-		-		-	
PW-11	10/04/2023	-		-		19		-		-		-		-		-	
PW-12	10/04/2023	-		-		4.1		-		-		-		-		-	
USGS-073	11/09/2023	-		-		18		-		-		-		-		-	
Surface Water																	
Birch Creek	10/18/2023	-		-		0.97	J[2]	-		-		-		-		-	
Little Lost River	10/18/2023	-		-		0.87	J[2]	-		-		-		-		-	
Waste Water																	
TRA Cold Waste Pond	10/10/2023	1.6	J[2]	46		4.2		<10	U	<1	U	0.2	J[2]	1.1	J[2]	-	
MFC-Industrial Waste Pipeline	10/03/2023	2.2		37		2.0		5.7	J[2]	<1	U	0.4	J[2]	0.6	J[2]	-	

Samples were filtered in the field unless otherwise noted.
Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
"-" = not analyzed.
Note 1. Lab indicated that a 5:1 dilution of this sample was required for this analyte. This raised the lab's reporting level by a factor of 5.
Note 2. The result is greater than the method detection limit but less than the lab's reporting detection limit. The result is considered a detected estimate.

Table 23. Dissolved nutrient concentrations (mg/L) in water samples, fourth quarter, 2023.

Sample Location	Sample Date	Nitrate + Nitrite*		Total Phosphorus	
Aquifer Samples					
Facility					
Advanced Test Reactor Complex					
Middle-1823	10/0523	1.0		-	
TRA-08	10/05/23	1.0		-	
USGS-140	10/11/23	1.1		-	
Idaho Nuclear Technology and Engineering Center					
USGS-112	10/02/23	1.8		-	
USGS-115	10/02/23	0.83		-	
Radioactive Waste Management Complex					
RWMC Production	10/16/23	0.98		-	
USGS-120	10/16/23	0.83		-	
Test Area North					
TAN-37A	10/17/23	0.033		5.3[3]	
Central Facilities Area					
CFA-2	10/17/23	4.2[2]		-	
Materials and Fuels Complex					
USGS-148	10/12/23	2.5[1]			
Naval Reactors Facility					
USGS-099	10/11/23	1.8		-	
Boundary					
Highway 3	10/10/23	0.55		-	
USGS-014	10/1223	1.3		-	
USGS-104	10/11/23	0.86		-	
Distant					
Alpheus Spring	11/27/23	2.1[2]		-	
Clear Spring	11/27/23	2.3[1]		-	
Bill Jones Hatchery	11/27/23	1.7		-	
Shoshone Water Supply	11/27/23	1.7		-	
Minidoka Water Supply	11/27/23	1.4		-	
Other Samples					
Perched Groundwater					
Advanced Test Reactor Complex					
PW-9	10/17/23	3.2[2]		-	
PW-11	10/04/23	1.3		-	
PW-12	10/04/23	3.4[1]		-	
USGS-073	11/09/23	27[4]		-	
Surface Water					
Birch Creek	10/18/23	0.24		-	
Little Lost River (LLR)	10/18/23	0.15		-	
Wastewater					
TRA Cold Waste Pond	10/10/23	0.91		0.068	
MFC-Industrial Waste Pipeline	10/03/23	2.8[2]		0.10	
Upgradient					
Mud Lake	11/28/23	0.0086	J[5]	-	

Samples were filtered in the field unless otherwise noted.
Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
* As N.
"-" = not analyzed.
Note 1. Lab indicated that a 2:1 dilution of this sample was required for this analyte.
Note 2. Lab indicated that a 4:1 dilution of this sample was required for this analyte.
Note 3. Lab indicated that a 20:1 dilution of this sample was required for this analyte.
Note 4. Lab indicated that a 40:1 dilution of this sample was required for this analyte.
Note 5. The result is greater than the method detection limit but less than the lab's reporting detection limit. The result is considered a detected estimate.

Table 24. Volatile organic compound concentrations (µg/L) in water samples, fourth quarter, 2023. Only VOCs detected this quarter or in the recent past are shown.

Sample Location	Sample Date	PCE		TCE		1,1-DCE		cis-1,2-DCE		trans-1,2-DCE		Vinyl chloride		Carbon tetrachloride		Chloroform		Chloro-methane		Toluene	
Aquifer Samples																					
Facility																					
Radioactive Waste Management Complex:																					
RWMC Production	10/16/2023	0.30	J[1]	2.55	-	<0.50	U	<0.50	U	<0.50	U	<0.50	U	4.41	-	1.26	-	<0.50	U	<0.50	U
USGS-120	10/16/2023	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	<0.50	U	1.05	-	<0.50	U	0.27	J[1]	<0.50	U
Test Area North:																					
TAN-37A	10/17/2023	<0.50	U	0.40	J[1]	<0.50	U	<0.50	U	4.72	-	<0.50	U	<0.50	U	<0.50	U	<0.50	U	0.26	J[1]

Abbreviations: PCE = tetrachloroethene; TCE = trichloroethene; 1,1-DCE = 1,1-dichloroethene; cis-1,2-DCE = cis-1,2-dichloroethene; trans-1,2-DCE = trans-1,2-dichloroethene; 1,1-DCA = 1,1-dichloroethane.
Data qualifiers: U = undetected, J = estimate, R = rejected, "<" = less than detection limit, "+" or "-" after a J means that the estimated result is biased high or low, respectively.
Note 1. The result is greater than the method detection limit but less than the lab's reporting detection limit. The result is considered a detected estimate.

Terrestrial Monitoring Results

The DEQ-INL OP conducts terrestrial (soil and milk) monitoring to characterize deposition and migration of contaminants and provide independent verification of DOE's terrestrial monitoring programs. Physical soil sampling and *in-situ* gamma spectrometry are used to characterize actual deposition and accumulation of radioactive contaminants in soils. *In-situ* gamma spectroscopic measurements of soil were performed at 41 locations during the fourth calendar quarter of 2023. No physical soil samples were collected during the quarter. Milk samples are collected to evaluate the potential for ingestion of radioactivity by the population around the INL. Nine milk samples were analyzed during the quarter.

Milk

DEQ-INL OP monitors milk for the naturally occurring radionuclide potassium-40 (^{40}K) and man-made iodine-131 (^{131}I). Milk samples are collected on a monthly basis. Results for analyses of milk samples are presented in **Table 25**. ^{40}K was detected in all samples within the expected range of concentrations. ^{131}I was not detected. Based on measurements of radionuclides in milk, there were no discernable impacts to the off-site environment from INL operations.

Table 25. Gamma spectroscopy analysis data for milk samples, fourth quarter, 2023.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131		
		Concentration[2]	± 2 SD	Concentration[2]	± 2 SD	MDC
Monitoring Samples						
Gooding	11/01/23	1447	105	1.1	1.5	2.5
Gooding	11/21/23	1296	110	0.6	1.7	2.9
Monteview	10/18/23	1335	110	1.7	2.0	3.3
Monteview	11/08/23	1433	104	-0.7	1.8	3.1
Monteview	12/06/23	1418	103	-0.5	2.2	3.7
Tetonia	10/28/23	1530	122	0.7	1.8	3.0
Tetonia	11/25/23	1360	112	0.3	1.5	2.5
Verification Samples[1]						
Minidoka	10/16/23	1455	119	-0.3	2.2	3.7
Rigby	11/14/23	1345	112	-0.3	1.5	2.6

[1]DEQ-INL OP samples collected by the off-site INL environmental surveillance contractor.
[2]Concentrations with associated uncertainties (± 2 SD) and minimum detectable concentrations (MDC) are expressed in pCi/L.

Soil

DEQ-INL OP monitors long-term radiological conditions via physical soil sampling as well as field instrumentation capable of identifying and measuring *in-situ* concentrations of gamma-emitting radionuclides in soil. Monitoring concentrations of gamma-emitting radionuclides in surface soil provides some insight to transport, deposition, and accumulation of radioactive material in the environment as a result of INL operations as well as historical above ground testing of nuclear weapons. *In-Situ* gamma spectroscopic measurements were performed at 41 locations (see **Figure 4**) during the fourth calendar quarter of 2023. The gamma spectra were analyzed using a uniform homogeneous distribution of nuclides with depth as recommended by

NCRP (NCRP report 129). ^{137}Cs was the only man made gamma emitting radionuclide detected. Analysis results for ^{137}Cs concentrations for *in-situ* soil monitoring are shown in **Table 26**.

Table 26. *In-Situ* gamma spectroscopic analysis results (^{137}Cs) for soil, fourth quarter, 2023.

Location	Date Acquired	Concentration[1]	2-sigma	MDA
Boundary Sampling Locations				
Big Southern Butte	10/17/2023	0.437	0.096	0.026
ESER Soil Site Monteview	10/31/2023	0.324	0.065	0.020
Monteview air station	10/31/2023	0.092	0.047	0.018
ESER Soil Site Mud Lake #2	10/31/2023	0.158	0.060	0.020
Mud Lake Air station	10/31/2023	0.063	0.042	0.018
ESER Soil Site Frenchman's Cabin	10/18/2023	0.352	0.072	0.023
Large Grid 18-4	10/18/2023	0.371	0.082	0.024
Large Grid 12-5	10/18/2023	0.335	0.063	0.021
ESER Soil Site Butte City	10/27/2023	0.396	0.073	0.023
Atomic City Air Station	10/27/2023	0.227	0.078	0.024
Howe Met Tower	11/7/2023	0.168	0.053	0.019
Distant Sampling Locations				
IF air station[2]	10/17/2023	0.122	0.042	0.016
IF CMS[3]	10/17/2023	0.093	0.035	0.012
St Anthony	10/17/2023	0.439	0.081	0.024
Sage Junction	10/17/2023	0.319	0.134	0.025
Roberts Met Tower	10/17/2023	0.317	0.089	0.022
ESER Soil Site Blackfoot	11/2/2023	0.189	0.044	0.018
Crystal Ice Caves	11/2/2023	0.407	0.070	0.022
ESER Soil Site Carey	10/18/2023	0.374	0.088	0.025
On site Sampling Locations				
EFS[4] field air station	11/2/2023	0.539	0.079	0.026
Rover	11/1/2023	0.142	0.057	0.021
Large Grid 18-8	11/1/2023	0.356	0.068	0.023
Large Grid 24-2	11/1/2023	0.444	0.074	0.023
Large Grid 18-3	11/1/2023	0.308	0.071	0.023
Large Grid 24-7	11/1/2023	0.154	0.040	0.017
Large Grid 6-3	11/1/2023	0.548	0.096	0.028
Sand Dunes Air station	10/27/2023	0.278	0.076	0.022
ESER Soil Site Atomic City	10/27/2023	0.468	0.068	0.017
ESER Soil Site FAA tower	10/31/2023	0.485	0.076	0.022
Large Grid 24-9	11/2/2023	0.322	0.048	0.018
Large Grid 24-8	11/3/2023	0.422	0.077	0.022
Large Grid 18-1	11/3/2023	0.152	0.059	0.022
Large Grid 18-7	11/3/2023	0.315	0.069	0.017
Large Grid 30-1	11/3/2023	0.389	0.082	0.022
Large Grid 12-4	10/18/2023	0.467	0.069	0.018
ESER Soil Site Reno Ranch	11/3/2023	0.542	0.082	0.023
INL Main Gate	11/3/2023	0.409	0.077	0.024
Van Buren Air station	11/7/2023	0.468	0.094	0.028
Big Lost River Rest Area	11/7/2023	0.312	0.065	0.022
Base of Howe	11/7/2023	0.257	0.063	0.021
ESER Soil Site Howe	11/7/2023	0.410	0.082	0.021

[1]Concentrations with associated uncertainties (± 2 SD), and minimum detectable concentrations (MDC) are reported in pCi/g.
[2]DEQ-INL OP HPIC air monitoring station near Idaho Falls, ID.
[3]DEQ-INL OP HPIC Community Monitoring Station (CMS) near John's Hole Bridge,4 Idaho Falls, ID.
[4]Experimental Field Station.

The average Cesium-137 value was 0.33 picocuries per gram (pCi/g) with a minimum value of 0.06 pCi/g and a maximum of 0.55 pCi/g, well below the DEQ-INL OP action level of 6.4 pCi/g and the recommended federal screening limit for surface soil of 6.8 pCi/g (NCRP Report 129).

Based upon terrestrial radiological measurements of soil, there were no discernable impacts to the off-site environment from INL operations. Long-term accumulation of radionuclides observed by soil monitoring was consistent with historical measurements and was in the range of concentrations expected as a result of historic above-ground testing of nuclear weapons.

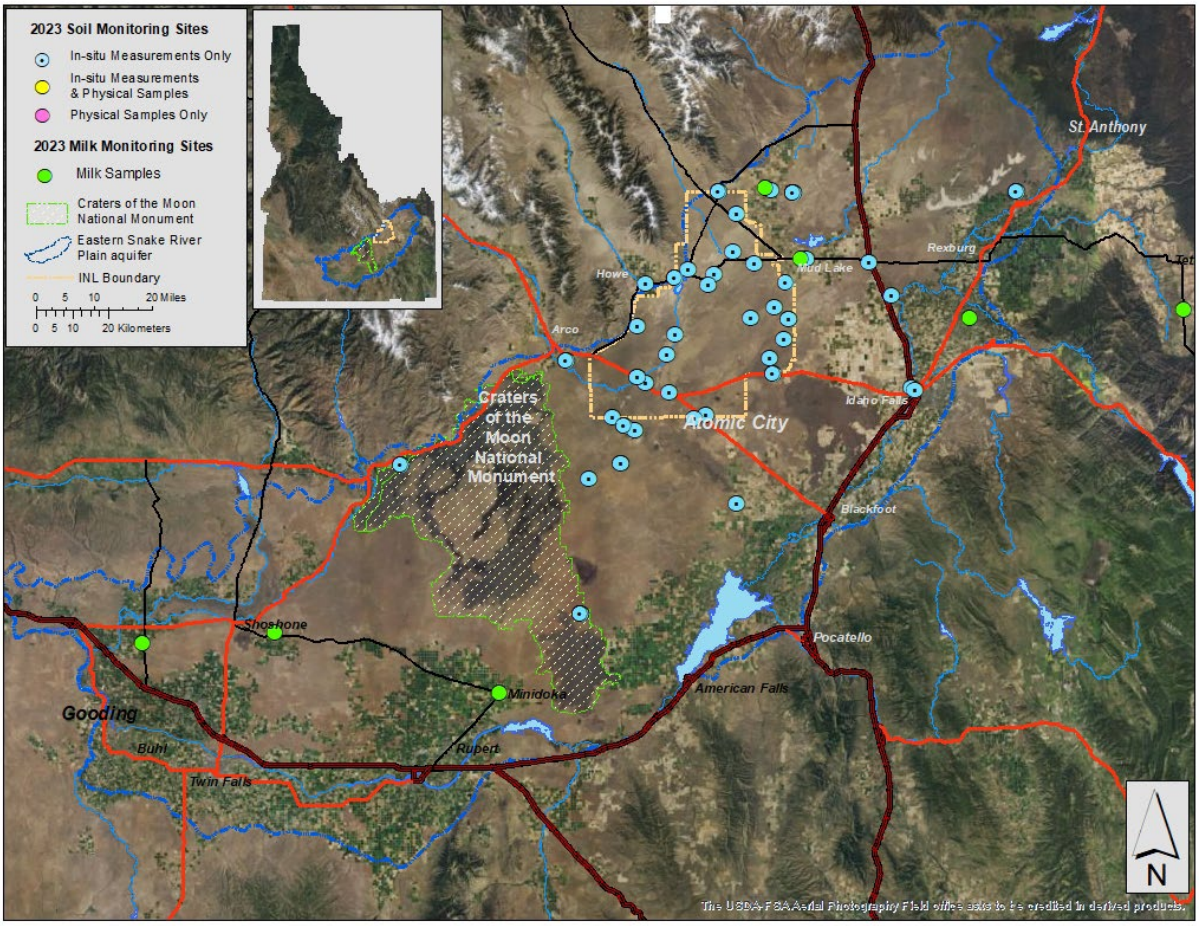

Figure 4. *In-situ* soil monitoring sites, fourth quarter 2023.

Quality Assurance

Measurements of constituent concentrations in environmental media are subject to inaccuracy from errors that may be introduced during the collection, transportation, and analysis of samples, calibration of equipment, and recording and reporting of results. While it is impossible to quantify every error that may affect a result, a quality assurance (QA) program can evaluate the overall quality of a dataset and, in many cases, identify and address errors or inaccuracies. DEQ-INL OP's QA program is designed to (1) ensure sample integrity, (2) evaluate the precision and accuracy of analytical results, and (3) ensure that the environmental data are representative and complete.

This section summarizes the quality assurance assessment of the data collected by DEQ-INL OP in the fourth quarter of 2023. Included are the results of quality control (QC) samples (blanks, duplicates, and spikes) that DEQ-INL OP submitted to Idaho State University's Environmental Monitoring Laboratory (ISU-EML) for radiological analyses and to the Idaho Bureau of Laboratories-Boise (IBL) for non-radiological analyses during the quarter. The analytical results of QC samples are used to assess the precision, accuracy, and representativeness of the environmental data presented in this report. During the fourth quarter of 2023, DEQ-INL OP submitted 100 QC samples for various radiological and non-radiological analyses (**Table 27**).

All samples referenced in this report were collected in accordance with written procedures maintained by the DEQ-INL OP. Analytical methods and QC procedures used by the laboratories were performed in accordance with approved written procedures maintained by each lab. QC samples analyzed by the labs as part of each lab's internal QA program are not discussed in this report.

Blank Samples

Blank samples consist of matrices that contain immeasurable or acceptably low concentrations of the analyte(s) of interest. They are used to monitor contamination introduced during sample collection, storage, shipment, and analysis. For water matrices other than tritium, a blank sample consists of 18-megaohm deionized water from the DEQ-Idaho Falls Regional office. Mud Lake Well #2 serves as the water source for tritium analysis blanks, notable for its low atmospheric recharge, which results in tritium concentrations below detectable levels.

A blank sample is categorized as a field blank, equipment blank, or trip blank depending on how the blank is handled. A field blank is used to monitor for contamination introduced from the environment during sample collection, an equipment blank is used to monitor for contamination introduced by contaminated equipment, and a trip blank is used to monitor for contamination introduced during transportation of samples (trip blanks are typically only used for VOCs). Also, method blanks for airborne tritium are used to monitor for contamination introduced during processing of molecular sieve sample material. Most water blank samples submitted to laboratories by DEQ-INL OP are field blanks.

For all analyses a blank sample result is considered acceptable if it is less than or equal to the minimum detectable concentration (MDC). If a blank result exceeds acceptance criteria, above-MDC results in other samples collected, transported, or analyzed together with the failed blank may be qualified as biased high (J+) or rejected (R), or may remain unqualified, depending on the relative sizes of the blank detection and other sample results.

Sample results for blank 47-mm TSP filters submitted for gross alpha and gross beta screening in air for the fourth quarter of 2023 are presented in **Table 28**. Blank sample results for selected gamma emitters in air from 47-mm TSP filter quarterly composites and 8x10-inch monthly composites are presented in **Table 29**. Blank sample results for radiochemical analysis of 8x10-inch TSP filter quarterly composites from third quarter 2023 are presented in **Table 30.** All TSP filter blank results met acceptance criteria for fourth quarter 2023.

Method blank and control sample analysis results used to assess data quality for tritium in water vapor in air are presented in **Table 31**. Method blanks are prepared by vaporizing tritium-free water and passing the air-vapor mixture through molecular sieve columns. The molecular sieve material is then processed identically to the field samples. Control samples are used to determine if tritium contamination is introduced into the samples from areas used for processing field samples and storage of the processed water. All method blank and control sample results met acceptance criteria for fourth quarter 2023.

Blank sample results for radiological constituents in water are presented in **Table 32**. The result for the field blank taken on 11/27/23 did not meet acceptance criteria for gross beta. Associated field sample results from 11/27/23 have been qualified as biased high estimates (J+). Blank sample results for metals in water are presented in **Table 33**. Blank sample results for common ions and nutrients in water are presented in **Table 34**. All of these other blank sample results for water met acceptance criteria for fourth quarter 2023.

Duplicate Samples

A duplicate sample is one that is collected at the same location and approximately the same time as another sample (referred to as the "original" sample). Duplicate sample results are compared to the original sample's results to evaluate reproducibility. Significant differences between the two could indicate poor analytical precision or a non-uniform sample matrix.

The difference between the results of an original and duplicate sample (referred to below as a "duplicate-sample pair") is evaluated differently for radiological and non-radiological analyses. For radiological analyses, the results of a duplicate-sample pair are considered to be in agreement if their absolute difference is less than or equal to three times the pooled error of the results:

$$|R_1 - R_2| \leq 3\sqrt{SD_1^2 + SD_2^2}$$

R_1 = Original sample result
R_2 = Duplicate sample result
SD_1 = Analytical uncertainty (1 sample standard deviation) of the original result
SD_2 = Analytical uncertainty (1 sample standard deviation) of the duplicate result

Duplicate radiological results are also considered to be in agreement if their relative percent difference (RPD) is no more than ±20 percent. RPD is calculated as:

$$RPD = \frac{R_1 - R_2}{(R_1 + R_2)/2} \times 100$$

For non-radiological analyses, the RPD is used to evaluate duplicate sample pairs in which both results exceed five times the MDC. An RPD of up to ±20 percent is acceptable. If one or both sample results are less than five times the MDC, the results agree if their absolute difference is less than or equal to the MDC.

Duplicate sample results for selected gamma emitters in air from 8x10-inch monthly TSP filter composites from the Idaho Falls monitoring location are presented in **Table 35**. Duplicate sample results for radiochemical analysis of 8x10-inch TSP filter quarterly composites from third quarter 2023, from the Idaho Falls monitoring location, are presented in **Table 36.**

Duplicate results for quarterly average EcoGamma readings from the Big Southern Butte monitoring location are presented in **Table 37.**

Duplicate results for radiological analyses in groundwater and surface water are presented in **Table 38**. Duplicate results for metals and common ions and nutrients in groundwater are presented in **Tables 39** and **40.** Duplicate *in-situ* analyses of gamma emitting radionuclides in soil are presented in **Table 41.** The Mud Lake Water Supply duplicate results for chromium did not meet acceptance criteria. However, these results are below the lab's reporting limit and are considered estimates. Associated samples are not qualified. All other duplicate sample results met acceptance criteria for the fourth quarter 2023.

Spiked Samples

Spiked samples are samples to which known concentrations of specific analytes have been added. They are used to assess a laboratory's analytical accuracy. The percent recovery (%R) of each spiked-sample analysis is calculated as the ratio of the spike concentration determined by the lab to the known spike concentration. DEQ-INL OP considers the lab's result to be in control if the percent recovery is 100 ± 25%. If the percent recovery of a spiked sample is 50-74%, above-MDC results of samples analyzed in the same batch as the spiked sample may be qualified as low-biased estimates (J-), and below-MDC results may be qualified as undetected estimates (UJ). If the percent recovery of a spiked sample is 126-150%, above-MDC results of associated samples may be qualified as high-biased estimates (J+), and below-MDC results may be qualified as undetected (U). If the percent recovery of a spiked sample is <50% or >150%, the results of all associated samples may be qualified as rejected (R), except for sample results below MDC associated with a spiked-sample analysis having a percent recovery >150%, in which case the sample result remains qualified as undetected (U).

Spiked sample results for metals in water are presented in **Table 42.** Spiked sample results for common ions and nutrients in water are presented in **Table 43.** Spiked sample results for VOCs in water are presented in **Table 44**. The spike sample result for styrene did not meet acceptance criteria at 67% recovery. However, all field sample styrene results were below detection levels and are not reported in **Table 21.** Also, chloromethane was detected in the spiked sample but was not listed in the spike sample Certificate of Analysis. Chloromethane results were below the lab's method detection levels in two of the three associated field samples and were qualified as undetected (U). The third result, from USGS-120, was greater than the method detection level but less than the reporting level of 0.50 µg/L and is qualified as a detected estimate (J). This result is likely a false positive detection. All other spike sample results met acceptance criteria.

DEQ-INL OP also prepares additional "spike-like" quality control samples to assess ambient radiation measurement bias. Once per quarter, DEQ-INL OP irradiates several electret ionization chambers (EICs) at ISU to verify EIC response. Irradiations of EICs are conducted in a repeatable geometry to a known exposure of near 30 mR and two additional higher and lower exposures, ranging from 15 to 60 mR. EIC responses are compared directly with the exposure received from the NIST traceable cesium-137 source provided by ISU-EML. EIC response is considered acceptable if each measurement has a percent recovery of 100 ± 25% when compared to the known irradiated quantity. Overall response for each control set is considered acceptable if the average of the three individual results for the set has a percent recovery of 100 ± 25%. Real-time pressure correction is used to calculate the net exposure measured by these EIC control sets. The ISU irradiation results for the fourth quarter 2023 are presented in **Table 45**. All individual EIC results and all EIC control set averages passed the DEQ-INL OP acceptance criterion.

Laboratory QC Issues

None.

DEQ-INL OP Equipment QC Issue

None.

Qualification of Low Level Sample Results

Sample results >MDC are generally considered detections, with the following exceptions[2] that apply primarily to radionuclide concentrations in water samples:

1. Results >MDC but ≤ 2SD are considered non-detections and U-flagged as undetected, where SD is the sample standard deviation.
2. Results >MDC and >2SD but <3SD are considered questionable and J-flagged as estimates.

Analytical QA/QC Assessment

Other than those discussed above, no issues involving sample chain of custody, sample holding times, and the analysis of blank, duplicate, and spiked samples were observed during the fourth quarter of 2023 which significantly affected data quality. The ratio of total QC analyses to total field sample analyses of 12.8% is above the DEQ-INL OP minimum requirement of 10%. Methodologies and data reports issued by the contracting laboratories conformed to the requirements of DEQ-INL OP during the fourth quarter of 2023.

Data usability is the measure of field sample results that are not rejected divided by the total number of field sample results obtained. The overall data usability (non-rejected results divided by the total number of field sample results reported) of 100.0% for the fourth quarter of 2023 is well above the acceptable value of 90% for the DEQ-INL OP ESP and is summarized in **Table 27**. The overall data completeness (usable results divided by the total number of field sample results expected) of 99.5% is also well above the acceptable value of 90%.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. Service reliability for air sampling equipment for the fourth quarter of 2023 is summarized in **Table 46.**

Conclusion

All data collected for the fourth quarter of 2023 have been assigned the applicable qualifiers to designate the appropriate use of the data. The overall data usability of 100.0% and data completeness of 99.5% are well above the acceptable value of 90% for the quarter, with the data meeting the requirements and data quality objectives established by DEQ-INL OP.

[2] Monitoring and Surveillance Committee, Consistency in Reporting Results Subcommittee Meeting Summary, 2/5/04 and 4/1/04.

Table 27. Summary of the analyses performed in the fourth quarter, 2023.

Media Sampled	Collection Device	Analyte	Sample Analyses	Blank Analyses	Duplicate Analyses	Spike Analyses	Data Rejected[1]	Analyzing Lab[2]
Air								
Total Suspended Particulate	47-mm filters	Gross alpha	141	13	0	0	0	ISU-EML
		Gross beta	141	13	0	0	0	ISU-EML
		Gamma emitters	11	1	0	0	0	ISU-EML
	8x10-inch filter	Gamma emitters	33	3	3	0	0	ISU-EML
		Radiochemical[6]:						
		Sr-90	11	1	1	0	0	ISU-Sub
		Pu-238, 239/240	11	1	1	0	0	ISU-Sub
		Am-241	11	1	1	0	0	ISU-Sub
Water Vapor	Desiccant column	Tritium	42	6[8]	0	0	0	ISU-EML
Gaseous	Charcoal filter	Iodine-131	13	0	0	0	0	ISU-EML
Precipitation	Poly bottle	Tritium	8	0	0	0	0	ISU-EML
		Gamma emitters	8	0	0	0	0	ISU-EML
8								
Ground water, perched ground water, waste pond effluent, and surface water	Grab or composite	Gross alpha	28	2	3	0	0	ISU-EML
		Gross beta	28	2	3	0	0	ISU-EML
		Gamma emitters	28	2	3	0	0	ISU-EML
		Tritium	28	2	3	0	0	ISU-EML
		Low-level tritium	7	0	0	0	0	ISU-EML
		Radiochemical[7]:						
		Sr-90	5	0	1	0	0	ISU-Sub
		Tc-99	3	1	0	0	0	ISU-Sub
		U-234, 235,238	5	0	0	0	0	ISU-Sub
		Pu-238, 239/240	2	0	0	0	0	ISU-Sub
		Am-241	2	0	0	0	0	ISU-Sub
		I-129	0	0	0	0	0	ISU-Sub
		Metals	28	2	3	1	0	IBL
		Common Ions	28	2	3	1	0	IBL
		Nutrients	28	2	3	1	0	IBL
		Volatile Organics	3	0	0	1	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	9	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	41	0	4	0	0	DEQ-INL OP
	Grab – "puck"	Gamma emitters	0	0	0	0	0	ISU-EML
Radiation								
Ambient	EICs	Gamma Radiation	67	0	0	9	0	DEQ-INL OP
	EcoGamma	Gamma Radiation	11	NA	1	NA	0	DEQ-INL OP
Total analyses performed			**781**	**54**	**33**	**13**	**0**	
Total QC analyses performed (blanks, duplicates, and spikes)			**100**					
Ratio of total QC analyses to total sample analyses[3]			**12.8%**					
Data usability[4], percent			**100.0%**					
Data completeness[5], percent			**99.5%**					

[1] Combined Laboratory and DEQ-INL OP rejection criteria (data was rejected for any reason).

[2] ISU-EML = Idaho State University – Environmental Monitoring Laboratory; ISU Sub = Subcontract laboratory to ISU-EML; IBL = Idaho Bureau of Laboratories, Boise; IBL Sub = Subcontract laboratory to IBL; DEQ-INL OP = Analyzed by INL Oversight Program, Idaho Department of Environmental Quality.

[3] DEQ-INL OP requires that the number of QC analyses performed be at least 10 percent of the number of sample analyses performed.

[4] Data usability is calculated as [total analyses – rejected data]/[total analyses]. DEQ-INL OP considers a data usability rate of 90 percent or higher to be acceptable.

[5] Data completeness is calculated as usable results divided by the total number of field sample results expected. DEQ-INL OP considers a data completeness rate of 90 percent or higher to be acceptable.
[6] Radiochemical analyses for these filter composites include Strontium-90 (Sr-90), Plutonium-238 and 239/240 (Pu-238, 239/240), and Americium-241 (Am-241).
[7] Radiochemical analyses for these water samples may include Strontium-90, Technetium-99 (Tc-99), Uranium 234, 235, and 238 (U-234, 235, 238), Plutonium-238 and 239/240, Americium-241, and Iodine-129 (I-129).
[8] Method blanks and control samples are included here.

Table 28. Blank analysis results for gross alpha and beta in 47-mm total suspended particulate (TSP) filters, fourth quarter, 2023.

Collection Period		Corrected volume (m^3)[1]	Gross alpha			Gross beta		
Start	Stop		Value	± 2 SD	MDC	Value	±2 SD	MDC
09/28/23	10/05/23	555	0.0	0.3	0.5	-0.5	0.5	1.0
10/05/23	10/12/23	555	0.1	0.2	0.3	-0.3	0.5	0.9
10/12/23	10/19/23	555	-0.1	0.3	0.5	0.1	0.6	1.0
10/19/23	10/26/23	555	-0.1	0.3	0.6	-0.9	0.6	1.1
10/26/23	11/02/23	555	0.1	0.2	0.4	0.4	0.6	0.9
11/02/23	11/09/23	555	0.0	0.3	0.5	0.0	0.6	0.9
11/09/23	11/16/23	555	0.0	0.3	0.5	0.0	0.6	1.0
11/16/23	11/22/23	555	0.1	0.4	0.6	-0.5	0.6	1.0
11/22/23	11/30/23	555	-0.3	0.3	0.6	0.2	0.6	0.9
11/30/23	12/07/23	555	-0.2	0.3	0.6	0.4	0.6	0.9
12/07/23	12/14/23	555	0.1	0.4	0.6	0.5	0.6	0.9
12/14/23	12/21/23	555	-0.2	0.3	0.6	-0.7	0.6	1.1
12/21/23	12/28/23	555	-0.2	0.3	0.7	-0.7	0.6	1.2

Note: Concentrations, associated uncertainties (± 2 SD), and minimum detectable concentrations (MDC) are expressed in 1 x 10^{-3} pCi/m^3.

[1] A volume equal to the average of the weekly volumes collected through each valid field filter was used to compute "concentrations" for the blank for meaningful comparison to sample results. No air was passed through the blank filters.

Table 29. Blank results for gamma spectrometry analysis of monthly composites of 8x10-inch TSP air filters, and quarterly composites of 47-mm TSP air filters, fourth quarter, 2023.

Time period	Beryllium-7			Ruthenium-106/ Rhodium-106			Antimony-125			Cesium-134			Cesium-137		
	Conc	± 2 SD	MDC	Conc	± 2 SD	MDC	Conc	± 2 SD	MDC	Conc	± 2 SD	MDC	Conc	± 2 SD	MDC
Monthly composites[1] of 8x10-inch TSP air filters															
Oct	2	31	54	-40	58	107	2	9	15	1	3	6	2	3	5
Nov	-1	14	24	-18	31	57	4	5	8	-1	3	5	-1	2	3
Dec	-12	30	52	-39	58	107	-6	8	14	3	4	6	4	4	7
Quarterly composite[2] of 47-mm TSP air filters															
4th Qtr.	13	89	150	4	188	321	0	11	19	0	10	16	-1	7	12

Note: Concentrations (Conc) are expressed in 1 x 10^{-5} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

[1]These concentrations (Conc)are from blank 8x10-inch filters collected weekly, composited, and analyzed for the calendar month. [2]These concentrations are from blank 47-mm filters collected weekly, composited, and analyzed for the calendar quarter. A composite volume equal to the sum of the weekly average volumes collected through each valid field filter was used to compute "air concentrations" for the blank for meaningful comparison to sample results. No air actually passed through the blank filters.

Table 30. Blank results for radiochemical analysis of 8x10-inch TSP air filters, quarterly composite samples, from third quarter, 2023.

Sample Description	^{90}Sr			^{238}Pu			$^{239}Pu/^{240}Pu$			^{241}Am		
	Value[1]	± 2 SD	MDC	Value[1]	± 2 SD	MDC	Value[1]	± 2 SD	MDC	Value[1]	± 2 SD	MDC
3Q 23 Blank	0.09	0.22	0.38	0.03	0.07	0.14	0.01	0.04	0.09	0.01	0.10	0.20

Note: Concentrations are expressed in 1 x 10^{-5} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).
[1] These concentrations are from blank filters collected weekly, composited, and analyzed for the calendar quarter. A composite volume equal to the sum of the weekly average volumes collected through each valid field filter was used to compute "air concentrations" for the blank for meaningful comparison to sample results. No air was passed through the blank filters.

Table 31. Method blank and control sample analysis results for tritium in water vapor from air samples fourth quarter, 2023.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
Method Blanks						
OP234ZTR01	10/02/23	10/06/23	11/03/23	0.00	0.06	0.10
OP234ZTR02	10/13/23	10/20/23	11/03/23	-0.04	0.06	0.10
OP234ZTR03	12/13/23	12/15/23	02/07/24	0.06	0.08	0.13
OP234ZTR04	12/20/23	12/22/23	02/07/24	0.03	0.08	0.13
Control Samples						
OP234 FRIDGE	12/22/23	12/22/23	01/26/24	0.05	0.06	0.09
OP234 SINK	12/22/23	12/22/23	01/26/24	0.07	0.06	0.09

Note: Concentrations are expressed in nCi/L with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Table 32. Blank analysis results (pCi/L) for radiological constituents in water, fourth quarter, 2023.

Sample Number	Sample Date	Blank Type	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha						
231W667	10/17/23	Field	-0.2	0.2	0.5	Yes
231W774	11/27/23	Field	0.0	0.8	1.5	Yes
Gross Beta						
231W667	10/17/23	Field	-0.9	0.6	1.0	Yes
231W774	11/27/23	Field	1.9	0.8	1.2	No
Cesium-137						
231W667	10/17/23	Field	1.1	1.5	2.4	Yes
231W774	11/27/23	Field	1.5	1.6	2.6	Yes
Tritium (standard method)						
231W669	10/17/23	Field	-10	60	100	Yes
231W775	11/27/23	Field	-10	60	100	Yes
Technetium-99						
231W668	10/17/23	Field	0.057	0.494	0.833	Yes

MDC = minimum detectable concentration.

Table 33. Blank analysis results (µg/L) for metals in water, fourth quarter, 2023.

Sample Number	Sample Date	Blank Type	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
231W671	10/17/2023	Field	-	-	<1.0	-	-	-	-	-
231W777	11/27/2023	Field	-	-	<1.0	-	-	-	-	-

Table 34. Blank analysis results (mg/L) for common ions and nutrients in water, fourth quarter, 2023.

Sample Number	Sample Date	Blank Type	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Alkalinity†	NO_3+NO_2*	Total Phosphorus
231W670, 672	10/17/2023	Field	-	-	-	-	-	<0.4	<0.8	<1.0	<0.01	-
231W776,777, 778	11/27/2023	Field	<0.10	<0.10	<0.10	<0.10	-	<0.4	<0.8	<1.0	<0.01	-

† As $CaCO_3$.

* As N.

Table 35. Duplicate sample results for gamma emitters from monthly composited 8x10-inch TSP air filters, fourth quarter, 2023.

Month and Nuclide	Original Sample ID	Concentration (R_1)	± 2 SD_1	Duplicate Sample ID	Concentration (R_2)	± 2 SD_2	RPD (%)	$\lvert R_1-R_2 \rvert$	$3(SD_1^2+SD_2^2)^{1/2}$	Within either criterion?
October 2023										
^{7}Be	Idaho Falls	78.3	5.3	Idaho Falls Dup	86.0	5.1	-9	7.7	11.0	Yes
$^{106}Ru/^{106}Rh$		-0.19	0.57		-0.14	0.68	30	0.05	1.33	Yes
^{125}Sb		-0.02	0.09		-0.07	0.08	-111	0.05	0.18	Yes
^{134}Cs		0.01	0.03		0.00	0.03	200	0.01	0.06	Yes
^{137}Cs		0.03	0.03		0.06	0.04	-67	0.03	0.08	Yes
November 2023										
^{7}Be	Idaho Falls	82.9	5.1	Idaho Falls Dup	73.2	5.0	12	9.7	10.7	Yes
$^{106}Ru/^{106}Rh$		-0.15	0.38		-0.02	0.46	153	0.13	0.89	Yes
^{125}Sb		0.00	0.09		-0.01	0.08	-200	0.01	0.18	Yes
^{134}Cs		0.01	0.02		0.01	0.02	0	0.00	0.04	Yes
^{137}Cs		0.00	0.02		0.00	0.03	0	0.00	0.05	Yes
December 2023										
^{7}Be	Idaho Falls	129.3	7.5	Idaho Falls Dup	120.3	8.1	7	9.0	16.6	Yes
$^{106}Ru/^{106}Rh$		-0.35	0.65		0.07	0.70	300	0.42	1.43	Yes
^{125}Sb		-0.02	0.12		-0.06	0.12	-100	0.04	0.25	Yes
^{134}Cs		0.01	0.03		0.01	0.04	0	0.00	0.08	Yes
^{137}Cs		0.01	0.03		0.02	0.04	-67	0.01	0.08	Yes

RPD = relative percent difference. Air concentrations and uncertainties (2 SD) are expressed in units of 10^{-3} pCi/m^3.

Table 36. Duplicate sample results for radiochemical analyses of composited 8x10 inch TSP air filters from the third quarter of 2023.

Nuclide	Original Sample ID	Concentration (R_1)	± 2 SD_1	Duplicate Sample ID	Concentration (R_2)	± 2 SD_2	RPD (%)	$\lvert R_1-R_2 \rvert$	$3(SD_1^2+SD_2^2)^{1/2}$	Within either criterion?
$^{89/90}Sr$	Idaho Falls	1.57	0.39	Idaho Falls Dup	1.55	0.38	1	0.02	0.82	Yes
^{238}Pu		0.01	0.10		0.02	0.07	-67	0.01	0.18	Yes
$^{239}Pu/^{240}Pu$		0.02	0.06		0.03	0.05	-40	0.01	0.12	Yes
^{241}Am		-0.10	0.09		0.02	0.09	300	0.12	0.19	Yes

RPD = relative percent difference. Air concentrations and uncertainties (2 SD) are expressed in units of 10^{-5} pCi/m^3.

Table 37. Duplicate results for quarterly average EcoGamma readings (µR/hr) for the fourth quarter of 2023.

Original Sample ID	Quarterly Average (R_1)	± 2 SD_1	Duplicate Sample ID	Quarterly Average (R_2)	± 2 SD_2	RPD (%)	$\lvert R_1-R_2 \rvert$	$3(SD_1^2+SD_2^2)^{1/2}$	Within either criterion?
Big Southern Butte[1]	14.2	1.5	Big Southern Butte Dup[1]	13.9	1.5	2	0.3	3.2	Yes

RPD = relative percent difference.
[1] The EcoGamma was in operation intermittently at this location, producing several minor gaps in the dataset.

Table 38. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, fourth quarter, 2023

Analysis/Sample Location	Original Sample Number	Concentration (R_1)	± 2 SD_1	Duplicate Sample Number	Concentration (R_2)	± 2 SD_2	RPD (%)	$\lvert R_1-R_2 \rvert$	$3(SD_1^2+SD_2^2)^{1/2}$	Within either criterion?
Gross Alpha										
PW-12	231W585	2.2	1.1	231W591	2.0	1.4	10	0.2	2.7	Yes
Mud Lake Water Supply	231W759	0.6	0.7	231W769	-0.3	0.6	600	0.9	1.4	Yes
USGS-148	231W629	1.8	1.0	231W656	2.8	1.1	-43	1.0	2.2	Yes
Gross Beta										
PW-12	231W585	76.9	2.2	231W591	84.7	2.3	-10	7.8	4.8	Yes
Mud Lake Water Supply	231W759	4.1	0.8	231W769	3.5	0.8	16	0.6	1.7	Yes
USGS-148	231W629	3.3	0.9	231W656	3.8	0.9	-14	0.5	1.9	Yes
Cesium-137										
PW-12	231W585	0.9	2.0	231W591	0.3	1.1	100	0.6	3.4	Yes
Mud Lake Water Supply	231W759	1.4	1.9	231W769	1.0	1.5	33	0.4	3.6	Yes
USGS-148	231W629	0.9	1.6	231W656	1.1	1.2	-20	0.2	3.0	Yes
Tritium (standard method)										
PW-12	231W587	3640	110	231W593	3620	110	0.6	20	233	Yes
Mud Lake Water Supply	231W760	-20	60	231W770	20	60	ND[1]	40	127	Yes
USGS-148	231W630	90	60	231W657	-20	60	314	110	127	Yes
Strontium-90										
PW-12	231W586	28.5 J+[2]	2.6	231W592	34.1 J+[2]	3.1	-18	5.6	6.1	Yes

RPD = relative percent difference.
[1] ND = not defined due to division by zero.
[2] Laboratory blank associated with this sample had a result greater-than-MDC. Result is qualified as a biased-high estimate (J+).

Table 39. Duplicate results for metals (µg/L) in groundwater, fourth quarter, 2023.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
PW-12	231W589	10/04/23	-	-	4.1	-	-	-	-	-
PW-12	231W595	10/04/23	-	-	4.3	-	-	-	-	-
RPD (%)			**-**	**-**	**-4.8**	**-**	**-**	**-**	**-**	**-**
USGS-148	231W632	10/12/23	-	-	1.9	-	-	-	-	-
USGS-148	231W659	10/12/23	-	-	1.8	-	-	-	-	-
RPD (%)			**-**	**-**	**5.4**	**-**	**-**	**-**	**-**	**-**
Mud Lake Water Supply	231W762	11/28/2023	-	-	0.3 J	-	-	-	-	-
Mud Lake Water Supply	231W772	11/28/2023	-	-	0.4 J	-	-	-	-	-
RPD (%)			**-**	**-**	**-29 J**	**-**	**-**	**-**	**-**	**-**

RPD = relative percent difference. J = estimated value, greater than the detection limit but less than the reporting limit.

Table 40. Duplicate sample results for common ions and nutrients (mg/L) in groundwater, fourth quarter, 2023.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total Phosphorus
PW-12	231W588, 590	10/04/23	-	-	-	-	-	95.5	27.5	198	3.4	-
PW-12	231W594, 596	10/04/23	-	-	-	-	-	95.7	27.6	199	3.4	-
RPD (%)			**-**	**-**	**-**	**-**	**-**	**-0.2**	**-0.4**	**-0.5**	**0.0**	**-**
USGS-148	231W631, 633	10/12/23	-	-	-	-	-	16.0	18.0	133	2.5	-
USGS-148	231W658, 660	10/12/23	-	-	-	-	-	16.0	18.0	133	2.5	-
RPD (%)			**-**	**-**	**-**	**-**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**-**
Mud Lake[1]	231W761, 762, 763	11/28/23	8.3	2.7	30	5.0	-	4.98	8.69	90.9	0.0086 J	-
Mud Lake[1]	231W771,772, 773	11/28/23	8.3	2.7	30	5.0	-	4.96	8.64	89.9	0.0084 J	-
RPD(%)			**0.0**	**0.0**	**0.0**	**0.0**	**-**	**0.4**	**0.6**	**1.1**	**2.3 J**	**-**

RPD = relative percent difference. J = estimated value, greater than the detection limit but less than the reporting limit.
[1]Mud Lake = Mud Lake Water Supply
† As $CaCO_3$.

Table 41. Duplicate *in-situ* analyses of gamma emitting radionuclides in soil, fourth quarter, 2023.

Analysis/Sample Location	Sample Date	Original Result (pCi/g)	± 2 SD_1	Duplicate Result (pCi/g)	± 2 SD_2	RPD (%)	$\lvert R_1-R_2 \rvert$	$3(SD_1^2+SD_2^2)^{1/2}$	Within either criterion?

Cs-137									
St. Anthony	10/17/23	0.439	0.081	0.370	0.086	17	0.069	0.177	Yes
ESER Soil Site Carey	10/18/23	0.374	0.088	0.451	0.098	-19	0.077	0.198	Yes
EFS field air station	11/02/23	0.539	0.079	0.525	0.056	3	0.014	0.145	Yes
Big Lost River Rest Area	11/07/23	0.312	0.065	0.256	0.044	20	0.056	0.118	Yes
K-40									
St. Anthony	10/17/23	22.1	0.9	22.1	0.9	0	0.0	1.9	Yes
ESER Soil Site Carey	10/18/23	16.3	0.7	15.7	0.7	3.7	0.6	1.5	Yes
EFS field air station	11/02/23	19.9	0.9	20.3	1.0	-2.0	0.4	2.0	Yes
Big Lost River Rest Area	11/07/23	19.0	0.8	18.7	0.9	1.6	0.3	1.8	Yes

RPD = relative percent difference.
[1]Community Monitoring Station.

Table 42. Spiked sample results (µg/L) for metals in water, fourth quarter, 2023.

Sample Number	Sample Date	Barium			Chromium			Lead			Manganese			Zinc		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W729	10/17/2023	-	-	-	45.8	48	105	-	-	-	-	-	-	-	-	-

Note: A percent recovery (%R) of 100 ± 25 is considered acceptable.

Table 43. Spiked sample results (mg/L) for common ions and nutrients in water, fourth quarter, 2023.

Sample Number	Sample Date	Calcium			Magnesium			Sodium			Potassium			Fluoride		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W726, 731	10/17/2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 43. (Continued) Spiked sample results (mg/L) for common ions and nutrients in water, fourth quarter, 2023.

Sample Number	Sample Date	Chloride			Sulfate			Total Alkalinity			$NO_3 + NO_2$*			Total Phosphorus		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W726, 731	10/17/2023	80.5	86.2	107	26.8	27.4	102	90.2	83.8	93	1.40	1.4	100	-	-	-

*As N.

Table 44. Spiked sample results (µg/L) for VOCs in water, fourth quarter, 2023.

Sample Number	Sample Date	Carbon Tetrachloride	Styrene	Tetrachloroethene	Trichloroethene	Vinyl Chloride

		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W732	10/17/2023	14.1	13.0	92	10.6	7.07	67	5.86	5.06	86	15.2	14.9	98	8.00	7.26	91

Table 44 (continued). Spiked sample results (µg/L) for VOCs in water, fourth quarter, 2023.

Sample Number	Sample Date	1,1-Dichloroethene			Trans-1,2-Dichloroethene			Cis-1,2-Dichloroethene			1,2-Dichloroethane			Methylene Chloride		
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W732	10/17/2023	7.99	6.87	86	9.21	9.45	103	18.3	16.6	91	8.41	8.49	101	15.1	14.6	97

Table 44. (continued). Spiked sample results (µg/L) for VOCs in water, fourth quarter, 2023.

Sample Number	Sample Date	Chloromethane														
		Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
231W732	10/17/2023	NL[1]	32.5	-	-	-	-	-	-	-	-	-	-	-	-	-

[1]Chloromethane is not listed (NL) in the spike sample Certificate of Analysis.

Table 45. ISU-EML electret ionization chamber (EIC) irradiation results (categorized as spiked samples), fourth quarter, 2023.

Electret #	Exposure Received		Net Measured Exposure[1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SMD637	39.8	1.4	37.9	1.3	95.2%	Yes
SMD091	39.8	1.4	41.0	1.3	103.1%	Yes
SMD520	39.8	1.4	37.9	1.2	95.2%	Yes
				Triplicate AVG:	**97.8%**	**Yes**
SMV074	30.0	1.1	29.2	1.3	97.2%	Yes
SMV098	30.0	1.1	28.9	1.3	96.4%	Yes
SMD318	30.0	1.1	32.3	1.3	107.6%	Yes
				Triplicate AVG:	**100.4%**	**Yes**
SMV124	20.2	0.7	20.3	1.3	100.5%	Yes
SMV024	20.2	0.7	21.8	1.3	107.8%	Yes
SMV029	20.2	0.7	18.3	1.3	90.5%	Yes
				Triplicate AVG:	**99.6%**	**Yes**

Note: A percent recovery (%R) of 100 ± 25 is considered acceptable.
[1] Net measured exposure estimate includes a correction for atmospheric pressure.

Table 46. Air sampling field equipment service reliability (percent operational), fourth quarter, 2023.

Station Locations	Sample Type

	47-mm TSP	8x10-inch TSP	Radioiodine	Atmospheric Moisture	Precipitation
Onsite Locations					
Big Lost River Rest Area	100%	100%	100%	100%	100%
Experimental Field Station	85%	100%	100%	100%	NC[1]
Sand Dunes Tower	100%	100%	100%	100%	NC[1]
Van Buren Avenue	100%	100%	100%	100%	NC[1]
Boundary Locations					
Atomic City	100%	100%	100%	100%	100%
Howe	100%	100%	100%	100%	100%
Monteview	100%	100%	100%	100%	100%
Mud Lake	100%	100%	100%	100%	100%
Distant Locations[2]					
Craters of the Moon	100%	100%	100%	100%	NC[1]
Idaho Falls	100%	100%	100%	100%	100%
Idaho Falls Duplicate[3]	NC[1]	100%	-	-	-

Note: The values in this table were calculated by dividing the number of weeks the equipment was in operation by the number of weeks in the quarter.

[1] NC = Sample not collected at this location.

[2] The Fort Hall Station, operated by the Shoshone-Bannock Tribes, is not included here.

[3] A duplicate 8x10-inch filter TSP sampler is currently installed at the Idaho Falls location.

Appendix A

Table A-1. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, fourth quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	09/28/23	10/05/23	0.2	0.3	16.0	1.1
	10/05/23	10/12/23	0.7	0.3	19.4	1.2
	10/12/23	10/19/23	0.9	0.4	23.6	1.3
	10/19/23	10/26/23	0.8	0.4	36.2	1.6
	10/26/23	11/02/23	1.6	0.4	42.8	1.7
	11/02/23	11/09/23	0.6	0.4	31.0	1.5
	11/09/23	11/16/23	1.5	0.5	49.6	1.9
	11/16/23	11/22/23	0.8	0.5	33.2	1.8
	11/22/23	11/30/23	0.8	0.4	43.1	1.6
	11/30/23	12/07/23	0.4	0.4	29.6	1.5
	12/07/23	12/14/23	0.0	0.4	15.2	1.1
	12/14/23	12/21/23	2.0	0.5	71.6	2.2
	12/21/23	12/28/23	1.1	0.5	37.7	1.7
Experimental Field Station	09/28/23	10/05/23	NS[3]	NS	NS	NS
	10/05/23	10/12/23	NS[3]	NS	NS	NS
	10/12/23	10/19/23	1.6[4]	0.5	29.4	1.6
	10/19/23	10/26/23	0.9	0.4	34.7	1.6
	10/26/23	11/02/23	1.6	0.4	42.7	1.7
	11/02/23	11/09/23	0.6	0.3	29.5	1.4
	11/09/23	11/16/23	1.6	0.5	46.7	1.8
	11/16/23	11/22/23	0.9	0.5	34.9	1.7
	11/22/23	11/30/23	1.1	0.4	41.9	1.6
	11/30/23	12/07/23	2.0	0.5	37.7	1.6
	12/07/23	12/14/23	0.2	0.4	14.5	1.1
	12/14/23	12/21/23	1.6	0.5	67.3	2.1
	12/21/23	12/28/23	0.9	0.5	37.2	1.7
Sand Dunes Tower	09/28/23	10/05/23	0.5	0.3	16.9	1.2
	10/05/23	10/12/23	0.9	0.3	22.0	1.3
	10/12/23	10/19/23	1.2	0.4	24.5	1.3
	10/19/23	10/26/23	0.7	0.4	34.9	1.6
	10/26/23	11/02/23	1.6	0.4	40.9	1.7
	11/02/23	11/09/23	0.7	0.4	33.1	1.5
	11/09/23	11/16/23	1.8	0.5	53.3	1.9
	11/16/23	11/22/23	0.4	0.4	37.8	1.8
	11/22/23	11/30/23	0.8	0.4	43.5	1.6
	11/30/23	12/07/23	0.6	0.4	50.5	1.9
	12/07/23	12/14/23	0.2	0.4	14.0	1.1
	12/14/23	12/21/23	1.6	0.5	72.4	2.2
	12/21/23	12/28/23	0.9	0.5	40.7	1.8

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, fourth quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	09/28/23	10/05/23	0.6	0.4	17.3	1.2
	10/05/23	10/12/23	0.8	0.3	20.4	1.2
	10/12/23	10/19/23	0.8	0.4	23.9	1.3
	10/19/23	10/26/23	1.0	0.4	35.2	1.6
	10/26/23	11/02/23	1.7	0.4	42.3	1.7
	11/02/23	11/09/23	0.7	0.4	27.9	1.4
	11/09/23	11/16/23	1.8	0.5	50.2	1.9
	11/16/23	11/22/23	4.4	0.8	38.7	1.9
	11/22/23	11/30/23	0.5	0.4	42.9	1.6
	11/30/23	12/07/23	0.2	0.3	29.2	1.5
	12/07/23	12/14/23	0.3	0.4	15.2	1.1
	12/14/23	12/21/23	1.5	0.5	62.1	2.1
	12/21/23	12/28/23	0.6	0.4	35.5	1.7
Boundary Locations						
Atomic City	09/28/23	10/05/23	2.8	0.6	18.5	1.2
	10/05/23	10/12/23	3.2	0.5	25.3	1.4
	10/12/23	10/19/23	0.4	0.3	22.5	1.3
	10/19/23	10/26/23	3.6	0.6	38.9	1.7
	10/26/23	11/02/23	3.0	0.5	44.2	1.7
	11/02/23	11/09/23	3.7	0.6	28.8	1.4
	11/09/23	11/16/23	5.2	0.7	50.7	1.9
	11/16/23	11/22/23	0.5	0.4	26.8	1.5
	11/22/23	11/30/23	2.4	0.5	42.8	1.6
	11/30/23	12/07/23	2.7	0.6	31.6	1.5
	12/07/23	12/14/23	1.8	0.5	16.8	1.2
	12/14/23	12/21/23	3.5	0.8	66.0	2.6
	12/21/23	12/28/23	2.7	0.6	36.7	1.7
Howe	09/28/23	10/05/23	0.8	0.4	18.0	1.2
	10/05/23	10/12/23	0.7	0.3	20.4	1.3
	10/12/23	10/19/23	0.5[4]	0.4	24.9	1.5
	10/19/23	10/26/23	0.5[4]	0.5	36.3	1.9
	10/26/23	11/02/23	1.6 J[1]	0.4 J	36.3 J	1.6 J
	11/02/23	11/09/23	0.9 J[1]	0.4 J	29.1 J	1.4 J
	11/09/23	11/16/23	1.4 J[1]	0.4 J	47.9 J	1.8 J
	11/16/23	11/22/23	0.8 J[1]	0.5 J	32.4 J	1.7 J
	11/22/23	11/30/23	1.3 J[1]	0.4 J	35.2 J	1.5 J
	11/30/23	12/07/23	7.5 J[1]	0.9 J	66.2 J	2.1 J
	12/07/23	12/14/23	0.3 J[1]	0.4 J	11.7 J	1.0 J
	12/14/23	12/21/23	1.7 J[1]	0.5 J	53.2 J	1.9 J
	12/21/23	12/28/23	0.5 J[1]	0.4 J	33.5 J	1.6 J

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for 47-mm TSP filters for all locations, fourth quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	09/28/23	10/05/23	0.4	0.3	16.5	1.1
	10/05/23	10/12/23	0.7	0.3	19.8	1.2
	10/12/23	10/19/23	1.0	0.4	22.0	1.3
	10/19/23	10/26/23	0.9	0.4	30.5	1.5
	10/26/23	11/02/23	1.3	0.4	37.0	1.6
	11/02/23	11/09/23	0.8	0.4	33.3	1.5
	11/09/23	11/16/23	1.8	0.5	46.0	1.8
	11/16/23	11/22/23	0.9	0.5	31.7	1.7
	11/22/23	11/30/23	0.8	0.4	40.1	1.5
	11/30/23	12/07/23	0.4	0.4	43.6	1.7
	12/07/23	12/14/23	0.2	0.4	13.1	1.1
	12/14/23	12/21/23	1.7	0.5	57.6	2.0
	12/21/23	12/28/23	0.9	0.5	43.6	1.8
Mud Lake	09/28/23	10/05/23	0.7	0.4	19.0	1.2
	10/05/23	10/12/23	1.2	0.4	23.1	1.3
	10/12/23	10/19/23	1.0	0.4	25.9	1.4
	10/19/23	10/26/23	0.9	0.4	35.7	1.7
	10/26/23	11/02/23	1.7	0.4	38.4	1.7
	11/02/23	11/09/23	1.2	0.4	33.7	1.6
	11/09/23	11/16/23	1.4	0.4	47.5	1.8
	11/16/23	11/22/23	1.2	0.5	33.8	1.7
	11/22/23	11/30/23	0.9	0.4	37.2	1.5
	11/30/23	12/07/23	0.4	0.4	42.5	1.7
	12/07/23	12/14/23	1.0	0.5	17.9	1.2
	12/14/23	12/21/23	1.6	0.5	65.5	2.1
	12/21/23	12/28/23	0.9	0.5	39.7	1.7
Distant Locations						
Craters of the Moon	09/28/23	10/05/23	0.4	0.3	15.4	1.2
	10/05/23	10/12/23	0.4	0.3	19.8	1.3
	10/12/23	10/19/23	3.3	0.6	27.7	1.5
	10/19/23	10/26/23	0.8	0.4	32.8	1.6
	10/26/23	11/02/23	1.5	0.4	43.4	1.8
	11/02/23	11/09/23	0.3	0.3	17.2	1.2
	11/09/23	11/16/23	2.2	0.5	49.3	1.9
	11/16/23	11/22/23	0.5	0.5	29.4	1.7
	11/22/23	11/30/23	0.3 J[1]	0.3 J	33.1 J	1.4 j
	11/30/23	12/07/23	0.5 J[1]	0.4 J	20.6 J	1.2 J
	12/07/23	12/14/23	0.0 J[1]	0.4 J	14.2 J	1.1 J
	12/14/23	12/21/23	1.2 J[1]	0.4 J	54.3 J	1.9 J
	12/21/23	12/28/23	0.7 J[1]	0.4 J	30.6 J	1.5 J

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, fourth quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[2]	09/28/23	10/05/23	0.3	0.3	17.5	1.2
	10/05/23	10/12/23	0.1	0.4	20.3	1.3
	10/12/23	10/19/23	0.6	0.3	20.6	1.2
	10/19/23	10/26/23	0.7	0.4	31.7	1.5
	10/26/23	11/02/23	1.3	0.4	31.8	1.5
	11/02/23	11/09/23	0.6	0.4	21.4	1.2
	11/09/23	11/16/23	1.4	0.5	42.4	1.7
	11/16/23	11/22/23	0.7	0.5	22.1	1.5
	11/22/23	11/30/23	0.4	0.3	34.3	1.4
	11/30/23	12/07/23	0.6	0.4	21.9	1.3
	12/07/23	12/14/23	0.4	0.4	18.8	1.2
	12/14/23	12/21/23	1.4	0.4	53.2	1.9
	12/21/23	12/28/23	1.2	0.4	26.7	1.5
Idaho Falls	09/28/23	10/05/23	0.5	0.3	16.2	1.1
	10/05/23	10/12/23	1.2	0.4	20.5	1.2
	10/12/23	10/19/23	0.7	0.4	21.5	1.3
	10/19/23	10/26/23	1.0	0.4	33.7	1.6
	10/26/23	11/02/23	1.3	0.4	34.0	1.5
	11/02/23	11/09/23	0.8	0.4	23.5	1.3
	11/09/23	11/16/23	1.6	0.5	43.6	1.7
	11/16/23	11/22/23	1.0	0.5	29.8	1.6
	11/22/23	11/30/23	0.5	0.4	35.9	1.5
	11/30/23	12/07/23	0.7	0.4	27.9	1.4
	12/07/23	12/14/23	0.0	0.4	15.5	1.1
	12/14/23	12/21/23	1.5	0.5	54.4	1.9
	12/21/23	12/28/23	0.5	0.4	31.6	1.5

Note: MDCs typically range from (0.3 to 0.8) x 10^{-3} pCi/m^3 for gross alpha and from (0.8 to 1.4) x 10^{-3} pCi/m^3 for gross beta.
[1] Faulty dry gas meter reading. Total air volume is estimated. Result is a (usable) estimate (J).
[2] Operated by Shoshone-Bannock Tribes.
[3] NS - No sample due to power outage.
[4] Partial sample due to power outage for part of the sampling period

Appendix B

Table B-1. Results for all electret ionization chamber (EIC) locations, fourth quarter, 2023.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
Arco	14.5	5.5
Craters of the Moon	11.7	5.0
Rest Area	14.4	4.4
Van Buren Avenue	16.6	3.8
Experimental Field Station	14.6, 16.6	-
Main Gate	14.0	3.0
Atomic City	12.1	3.5
Taber	12.4	2.5
Blackfoot	12.0	4.6
Ft. Hall	10.5	4.7
Idaho Falls	8.9	2.9
Mud Lake/ Terreton	14.8	1.7
Monteview	15.2	3.6
Sand Dunes	14.1	0.8
Howe Met. Tower	12.3	4.4
MP282 -20	10.2	2.7
MP280 -20	11.8	1.6
MP278 -20	13.8	4.2
MP276 -20	12.7	1.3
MP274 -20	9.9	0.4
MP272 -20	13.0	1.9
MP270 -20	12.2	2.3
MP268 -20	12.6	0.9
MP266 -20	14.0	3.6
MP264 -20	16.1, 18.0	-
MP270 -20/26	16.1	3.9
MP268 -20/26	12.1	0.3
MP266 -20/26	15.4	5.0
MP263 -20/26	15.0, 17.7	-
MP261 -20/26	11.5	1.1
MP259 -20/26	13.9	0.4
MP256 -20/26	11.9	2.0
MFC (EBR II)	15.6	4.0
EBR I	12.9	2.8
RWMC	13.9	5.2
CFA	17.2	2.1
CITRC (PBF)	16.1	1.0
INTEC	19.8, 22.3	-
ATR (TRA)	14.1	2.3
NRF	14.9	3.8
TAN/SMC	11.1	5.3
Mud Lake Bank of Commerce	14.4	4.7
MP43-33	17.0, 17.7	-
MP41-33	14.1	2.0
MP39-33	12.4	3.3
MP37-33	14.4	0.7
MP35-33	12.3	1.9
MP33-33	12.1	2.9
MP31-33	12.0	3.2
MP29-33	13.4	4.4

Table B-1 continued. Results for all electret ionization chamber (EIC) locations, fourth quarter, 2023.

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
MP27-33	9.5	2.4
MP25-33	12.1	1.8
MP23-33	12.1	4.6
MP21-33	12.5	4.2
MP19-33	11.5, 13.6	-
MP14-33	11.1	1.9
MP11-33	11.7	3.0
MP06-33	9.6	3.4
MP03-33	9.7, 10.6	-
Base of Howe	13.4	4.5
Rover	16.0	0.5
Hamer	13.0	4.1
Sugar City	16.9	2.8
Roberts	15.1	3.9
Big Southern Butte	11.2	2.2
T4 North	14.1	4.3
T4 South	11.0	2.4

[1]Results are the average of triplicate exposure rate measurements with the associated sample variability (±2 SD), or the 2 measured exposure rates remaining after removal of an outlying value. One of the triplicate measurements is rejected if it is outside the average of the triplicate measurements ±2 SD of the historical population variability. Typically, the two most consistent measurements are reported, based on judgment of the data analyst.

Appendix C

Table C-1. List of volatile organic compounds (VOCs) analyzed for water samples.

Analyte	Minimum detectable concentrations (MDC) (expressed in µg/L)
Benzene	0.5
Carbon tetrachloride	0.5
Chlorobenzene	0.5
1,4-Dichlorobenzene	0.5
1,2-Dichlorobenzene	0.5
1,2-Dichloroethane	0.5
1,1-Dichloroethene	0.5
cis-1,2-Dichloroethene	0.5
trans-1,2-Dichloroethene	0.5
1,2-Dichloropropane	0.5
Ethylbenzene	0.5
Methylene Chloride	0.5
Styrene	0.5
Tetrachloroethene (PCE)	0.5
Toluene	0.5
1,2,4-Trichlorobenzene	0.5
1,1,1-Trichloroethane	0.5
1,1,2-Trichloroethane	0.5
Trichloroethene (TCE)	0.5
Vinyl chloride	0.5
Xylenes (total)	0.5
Bromodichloromethane	0.5
Dibromochloromethane	0.5
Bromoform	0.5
Chloroform	0.5
Bromobenzene	0.5
Bromochloromethane	0.5
Bromomethane	0.5
n-Butylbenzene	0.5
sec-Butylbenzene	1.0
tert-Butylbenzene	0.5
Chloroethane	0.5
Chloromethane	0.5
2-Chlorotoluene	0.5

Table C-1 continued. List of volatile organic compounds (VOCs) analyzed for water samples.

Analyte	Minimum detectable concentrations (MDC) (expressed in µg/L)
4-Chlorotoluene	0.5
1,2-Dibromo-3-chloropropane (DBCP)	0.5
1,2-Dibromoethane (EDB)	0.5
Dibromomethane	0.5
1,3-Dichlorobenzene	0.5
Dichlorodifluoromethane	0.5
1,1-Dichloroethane	0.5
1,3-Dichloropropane	0.5
2,2-Dichloropropane	0.5
1,1-Dichloropropene	0.5
cis-1,3-Dichloropropene	0.5
trans-1,3-Dichloropropene	1.0
Hexachlorobutadiene	0.5
Isopropylbenzene	0.5
p-Isopropyltoluene	0.5
Methyl Tert Butyl Ether (MTBE)	0.5
Naphthalene	0.5
n-Propylbenzene	0.5
1,1,1,2-Tetrachloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
1,2,3-Trichlorobenzene	0.5
Trichlorofluoromethane	0.5
1,2,3-Trichloropropane	0.5
1,2,4-Trimethylbenzene	1.0
1,3,5-Trimethylbenzene	0.5