

Department of Environmental Quality
INL Oversight Program

**ENVIRONMENTAL SURVEILLANCE PROGRAM
QUARTERLY DATA REPORT**

January - March, 2023



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Table of Acronyms

aCi/L	-	attocuries per liter	nCi/L	-	nanocuries per liter
ATR	-	Advanced Test Reactor	NCRP	-	National Council on Radiation Protection and Measurements
BEA	-	Battelle Energy Alliance, LLC	NOAA	-	National Oceanic and Atmospheric Administration
BLR	-	Big Lost River	NRF	-	Naval Reactors Facility
CERCLA	-	Comprehensive Environmental Response, Compensation and Liability Act	PBF	-	Power Burst Facility
CFA	-	Central Facilities Area	pCi/g	-	picocuries per gram
CFR	-	Code of Federal Regulations	pCi/L	-	picocuries per liter
CITRC	-	Critical Infrastructure Test Range Complex	pCi/m ³	-	picocuries per cubic meter
DEQ-INL OP	-	The State of Idaho, Department of Environmental Quality, Idaho National Laboratory Oversight Program	QAPP	-	Quality Assurance Program Plan
DOE	-	U.S. Department of Energy	QA/QC	-	Quality Assurance/Quality Control
EBR I & II	-	Experimental Breeder Reactors I & II	RCRA	-	Resource Conservation and Recovery Act
EFS	-	Experimental Field Station	RPD	-	relative percent difference
EIC	-	electret ionization chamber	RTC	-	Reactor Technology Complex
EML	-	Environmental Monitoring Laboratory	RWMC	-	Radioactive Waste Management Complex
EPA	-	Environmental Protection Agency	SD	-	Sample standard deviation
ESER	-	Environmental Surveillance, Education and Research Program	SMC	-	Specific Manufacturing Capability
ESP	-	Environmental Surveillance Program	SMCL	-	secondary maximum contaminant level
ESRP	-	Eastern Snake River Plain	TAN	-	Test Area North
ESRPA	-	Eastern Snake River Plain Aquifer	TDS	-	total dissolved solids
Ft bls	-	feet below land surface	TMI	-	Three Mile Island
HPIC	-	high-pressure ion chamber	TRA	-	Test Reactor Area
IBL	-	Idaho Bureau of Laboratories	TSP	-	total suspended particulate
ICPP	-	Idaho Chemical Processing Plant	TSS	-	total suspended solids
ICP	-	Idaho Cleanup Project	USGS	-	U.S. Geological Survey
ISB	-	In-situ bioremediation	VOC	-	volatile organic compound
IDL	-	instrument detection limit	WLAP	-	Wastewater Land Application Permit
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			

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 first 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 first quarter of 2023 for 47-mm and 8x10-inch TSP filters are presented in **Tables 3** and **4**. For both filter sizes, the only reported gamma-emitting radionuclide concentration greater than MDC was beryllium-7 (Be-7), a naturally occurring, cosmogenic radionuclide. For the Fort Hall 8x10-inch filter March composite, the Cs-137 concentration was equal to the MDC and equal to 3 SD. The result is considered a questionable detection and J-flagged as an estimate. 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.

Beginning in the first quarter 2022, quarterly composites of 8x10-inch filters collected using high-volume TSP samplers 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 1×10^{-5} pCi/m³) 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 amounts require further investigation.

Radiochemical separation analysis results for 8x10-inch TSP particulate filter composites collected during fourth quarter 2023 are presented in **Table 5**. There are no greater-than-MDC results for Sr-90, Pu-238, Pu-239/240, or Am-241 for the fourth quarter of 2022.

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 first 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**. One or more individual sample atmospheric tritium concentrations exceeded the MDC and 3 SD (sample standard deviations) at Big Lost River Rest Area, Sand Dunes Tower, Van Buren Avenue, Atomic City, Mud Lake, Monteview, Craters of the Moon, and Idaho Falls. These individual sample concentrations ranged from 0.21 pCi/m³ at Craters of the Moon to 0.49 pCi/m³ at Monteview. Weighted mean concentrations exceeded the MDC and 3 SD at Big Lost River Rest Area, Van Buren Avenue, Atomic City, Mud Lake, Monteview, Craters of the Moon, and Idaho Falls. These weighted mean concentrations ranged from 0.24 pCi/m³ at Big Lost River Rest Area and Craters of the Moon to 0.45 pCi/m³ at Monteview. All results are well below the DEQ-INL OP action level of 150 pCi/m³ (40 CFR 61).

Precipitation samples were collected at six monitoring locations during the first 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 concentration in precipitation collected during the first 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**.

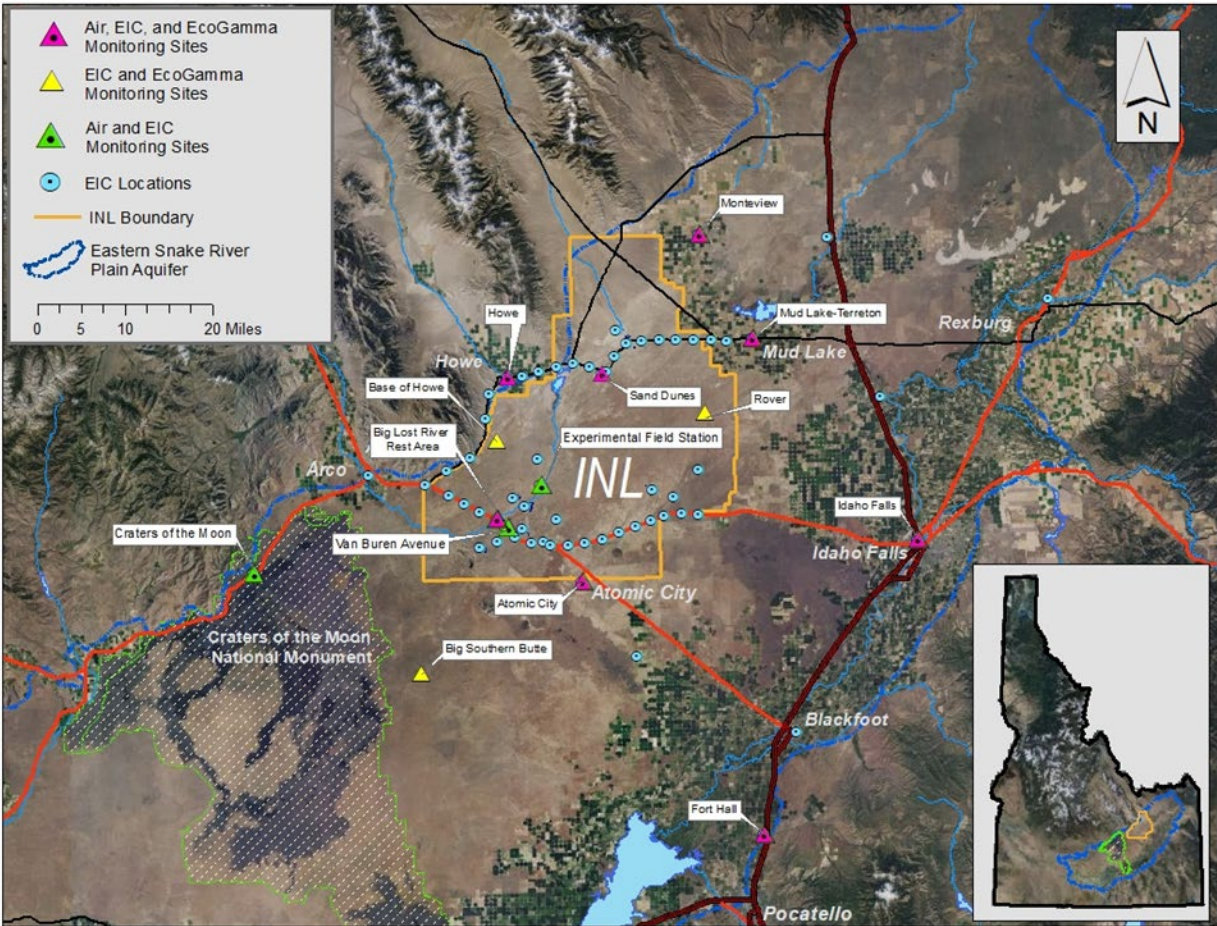


Figure 1. Air and radiation monitoring locations.

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	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Experimental Field Station	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Sand Dunes Tower	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Van Buren Avenue	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Boundary Locations				
Atomic City	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Howe	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Monteview	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mud Lake	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Distant Locations				
Craters of the Moon	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Fort Hall ²	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Idaho Falls	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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, first quarter, 2023.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.0	-	0.7	10.7	-	37.4
Experimental Field Station	-0.2	-	1.1	10.6	-	42.2
Sand Dunes Tower ³	-0.2	-	1.0	11.3	-	44.9
Van Buren Avenue	-0.2	-	0.8	10.1	-	37.1
Boundary Locations						
Atomic City	-0.1	-	1.2	9.1	-	35.8
Howe	-0.2	-	1.4	13.0	-	44.4
Monteview	-0.1	-	1.1	10.7	-	45.4
Mud Lake	-0.1	-	1.3	9.6	-	44.5
Distant Locations						
Craters of the Moon	-0.2	-	0.8	10.3	-	29.8
Fort Hall ^{1,2}	-0.2 J	-	1.4 J	10.0 J	-	29.7 J
Idaho Falls	0.0	-	0.9	9.8	-	35.1

Note: Concentrations are expressed in 1×10^{-3} pCi/m³.

¹ Operated by Shoshone-Bannock Tribes.

² Improper sampling orientation with the filter not fully exposed to the ambient air. Results are J-flagged as (usable) estimates.

³ Partial samples due to planned power outage for weeks 01/26-02/02 and 02/02-02/09/23.

Table 3. Gamma spectrometry analysis data for 47-mm TSP filters, quarterly composite samples, first 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	52.4	3.5	2.0	0.09	0.10	0.16
Experimental Field Station	50.2	3.5	1.5	0.00	0.07	0.12
Sand Dunes Tower ⁴	47.2	3.3	1.6	0.04	0.08	0.13
Van Buren Avenue	49.5	3.5	2.0	0.09	0.10	0.22
Boundary Locations						
Atomic City	52.0	3.6	1.6	0.06	0.09	0.14
Howe	57.3	4.0	2.0	0.02	0.10	0.17
Monteview	53.0	3.9	2.6	-0.10	0.09	0.15
Mud Lake	49.5	3.5	1.9	0.07	0.09	0.14
Distant Locations						
Craters of the Moon	59.9	4.0	1.4	-0.01	0.06	0.11
Fort Hall ¹	49.5 J ³	3.4 J ³	1.6 J ³	0.03 J ³	0.07 J ³	0.11 J ³
Idaho Falls	49.4	3.4	1.1	-0.01	0.05	0.09

Note: Concentrations are reported in 1×10^{-3} pCi/m³ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

¹Operated by Shoshone-Bannock Tribes.

²MDC is for Cs-137. No man-made gamma emitting radionuclides were detected.

³Improper sampling orientation with the filter not fully exposed to the ambient air. Results are J-flagged as estimates.

⁴Partial samples due to planned power outage for weeks 01/26-02/02 and 02/02-02/09/23.

Table 4. Gamma spectrometry analysis data for 8x10-inch TSP filters, monthly composite samples, first 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	Jan	47.6	2.9	0.8	0.03	0.04	0.06
	Feb	87.6	5.1	0.8	0.02	0.04	0.06
	Mar	52.8	3.3	0.6	0.01	0.02	0.03
Experimental Field Station	Jan	48.6	3.1	0.6	0.00	0.03	0.05
	Feb ⁶	64.5	4.1	0.7	-0.01	0.02	0.04
	Mar ⁶	77.4	4.4	0.6	0.01	0.03	0.05
Sand Dunes Tower	Jan	57.5	3.4	0.6	0.01	0.03	0.05
	Feb	88.0	5.5	0.9	-0.01	0.03	0.05
	Mar	58.8	3.4	0.5	0.00	0.01	0.02
Van Buren Avenue	Jan	47.9	2.9	1.0	0.05	0.04	0.07
	Feb	90.3	5.2	1.0	0.00	0.04	0.06
	Mar	63.5	3.7	0.6	0.00	0.02	0.04
Boundary Locations							
Atomic City	Jan	60.1	3.5	0.7	0.01	0.04	0.07
	Feb	93.5	5.5	0.6	0.01	0.03	0.06
	Mar ⁷	47.6	2.8	0.5	-0.01	0.02	0.06
Howe	Jan	53.1	3.2	0.7	0.02	0.03	0.05
	Feb	88.5	5.2	0.7	-0.02	0.03	0.06
	Mar	70.6	4.1	0.6	0.02	0.03	0.04
Montevieu	Jan ⁵	51.1	3.2	0.9	0.01	0.05	0.08
	Feb	90.2	5.3	1.1	0.02	0.03	0.06
	Mar	73.2	4.2	0.6	0.00	0.02	0.04
Mud Lake	Jan	62.5	3.6	0.7	0.01	0.03	0.05
	Feb	93.0	5.5	1.2	0.04	0.04	0.06
	Mar ⁷	68.0	4.1	1.0	0.03	0.04	0.07
Distant Locations							
Craters of the Moon	Jan	48.6	2.9	0.6	-0.01	0.03	0.05
	Feb	85.9	5.1	1.3	0.03	0.04	0.06
	Mar	60.5	3.6	0.7	0.04	0.00	0.05
Fort Hall ¹	Jan	53.4	3.4	0.5	0.00	0.02	0.04
	Feb	107.8	6.3	0.7	-0.02	0.03	0.05
	Mar	81.2	4.7	0.7	0.06 J ⁸	0.04	0.06
Idaho Falls	Jan	55.8	3.4	0.9	0.03	0.04	0.06
	Feb	98.4	6.1	0.6	0.00	0.02	0.04
	Mar	74.4	4.3	0.5	0.00	0.02	0.04
Idaho Falls Duplicate ³	Jan	54.6	3.4	0.6	-0.01	0.02	0.04
	Feb	99.3	5.7	0.8	0.00	0.03	0.06
	Mar	66.6	4.1	0.5	0.00	0.02	0.03

Note: Concentrations are reported in 1×10^{-3} pCi/m³ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

¹Operated by Shoshone-Bannock Tribes.

²MDC is for Cs-137. No man-made gamma emitting radionuclides were detected.

³A duplicate 8x10-inch filter TSP sampler is currently being operated at the Idaho Falls location.

⁴Four filters/composite for January and February; five filters/composite for March, with exceptions noted.

⁵Three filters/composite for January at Montevieu.

⁶Three filters/composite for February and March at Experimental Field Station, with one filter running for two weeks because the station was inaccessible on 2/16/23 and 3/02/23 from heavy snow conditions.

⁷Four filters/composite for March at Atomic City and Mud Lake because the samplers were out of service for repair.

⁸Concentration is equal to MDC and equal to 3 SD. Result is considered a questionable detection and J-flagged as an estimate.

Table 5. Radiochemical separation analysis results for 8x10-inch TSP particulate filter composites collected during fourth quarter 2022.

Station Location	⁹⁰ Sr			²³⁸ Pu			^{239/240} Pu			²⁴¹ Am		
	Value ^{1,8}	±2SD	MDC	Value ¹	± 2SD	MDC	Value ¹	±2SD	MDC	Value ¹	±2SD	MDC
On-Site Locations												
BLR ⁴ Rest Area	-1.24	2.03	3.62	0.00	0.03	0.07	0.03	0.06	0.09	0.03	0.06	0.10
EFS ³	-6.74	2.74	5.12	0.03	0.09	0.17	0.18	0.15	0.19	0.10	0.12	0.15
Sand Dunes	0.55	2.21	3.80	0.00	0.06	0.14	0.03	0.07	0.11	0.01	0.07	0.14
Van Buren	-1.34	0.99	1.92	0.01	0.03	0.06	0.05	0.06	0.08	0.00	0.08	0.19
Boundary Locations												
Atomic City	0.28	2.33	4.04	-0.02	0.04	0.10	0.00	0.05	0.10	-0.02	0.04	0.13
Howe	0.55	2.77	4.76	0.01	0.06	0.13	0.03	0.08	0.12	0.07	0.08	0.09
Montevieu	-3.31	2.65	4.86	0.01	0.05	0.09	-0.01	0.05	0.13	-0.02	0.04	0.12
Mud Lake	-5.83	2.30	4.36	0.00	0.07	0.15	0.06	0.09	0.12	0.00	0.06	0.13
Distant Locations												
Craters of the Moon	2.16	1.93	3.07	0.02	0.05	0.09	-0.02	0.06	0.14	-0.01	0.08	0.19
Fort Hall ²	-5.90	5.38	9.73	-0.05	0.05	0.14	0.09	0.08	0.12	0.01	0.10	0.21
Idaho Falls	2.08	3.41	5.73	0.02	0.06	0.10	0.04	0.08	0.14	0.01	0.04	0.08
Idaho Falls Duplicate ⁵	-1.39	2.58	4.56	0.00	0.04	0.06	0.06	0.10	0.14	0.03	0.07	0.11

Note: Concentrations are reported in 1×10^{-5} pCi/m³ 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 1×10^{-5} pCi/m³) 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 Dup – Duplicate TSP sampler being run at the Idaho Falls location.

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

Start Date	Collection Date	Iodine-131 activity (pCi/composite)		
		Activity	± 2 SD	MDA ¹
12/29/22	01/05/23	-0.15	2.13	3.62
01/05/23	01/12/23	0.34	1.47	2.50
01/12/23	01/19/23	-0.16	1.48	2.55
01/19/23	01/26/23	0.25	1.53	2.60
01/26/23	02/02/23	1.04	2.78	4.64
02/02/23	02/09/23	1.78	1.84	3.02
02/09/23	02/16/23	-0.13	1.75	3.07
02/16/23	02/23/23	-0.07	1.50	2.57
02/23/23	03/02/23	-0.73	1.73	3.01
03/02/23	03/09/23	-0.80	1.65	2.88
03/09/23	03/16/23	0.00	1.65	2.82
03/16/23	03/23/23	0.57	1.59	2.68
03/23/23	03/30/23	0.74	1.53	2.57

¹The minimum detectable activity (MDA) is established for the least efficient counting position in the eleven-cartridge composite. Based on a typical 20,000 ft³ (566 m³) air volume per cartridge, and eleven cartridges per composite, the highest I-131 MDA of 4.64 pCi/composite is equivalent to a maximum MDC of 7.4×10^{-4} pCi/m³.

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

Station Location	Start Date	Collection Date	Tritium		
			Concentration	± 2 SD	MDC
On-site Locations					
Big Lost River Rest Area	12/28/2022	02/23/2023	0.33	0.12	0.21
Big Lost River Rest Area	02/23/2023	03/30/2023	0.11	0.14	0.26
Big Lost River Rest Area Mean	12/28/2022	03/30/2023	0.24	0.13	0.23
Experimental Field Station	12/28/2022	02/02/2023	0.02	0.14	0.22
Experimental Field Station	02/23/2023	03/23/2023	0.18	0.11	0.20
Experimental Field Station	03/23/2023	03/30/2023	0.24	0.17	0.31
Experimental Field Station Mean	12/28/2022	03/30/2023	0.12	0.13	0.22
Sand Dunes Tower	12/28/2022	03/09/2023	0.07	0.14	0.24
Sand Dunes Tower	03/09/2023	03/30/2023	0.46	0.20	0.32
Sand Dunes Tower Mean	12/28/2022	03/30/2023	0.17	0.16	0.26
Van Buren Avenue	12/28/2022	03/23/2023	0.34	0.16	0.25
Van Buren Avenue	03/23/2023	03/30/2023	0.04	0.28	0.49
Van Buren Avenue Mean	12/28/2022	03/30/2023	0.31	0.17	0.27
Boundary Locations					
Atomic City	12/28/2022	03/09/2023	0.24	0.12	0.19
Atomic City	03/09/2023	03/30/2023	0.21	0.19	0.33
Atomic City Mean	12/28/2023	03/30/2023	0.23	0.13	0.22
Howe	12/28/2022	03/09/2023	0.18	0.13	0.21
Howe	03/09/2023	03/30/2023	0.14	0.17	0.31
Howe Mean	12/28/2022	03/30/2023	0.17	0.14	0.24
Mud Lake	12/28/2022	02/23/2023	0.39	0.14	0.21
Mud Lake	02/23/2023	03/30/2023	0.00	0.07	0.10
Mud Lake Mean	12/28/2022	03/30/2023	0.17	0.10	0.14
Montevieu	12/28/2022	02/09/2023	0.41	0.16	0.25
Montevieu	02/09/2023	03/30/2023	0.49	0.20	0.33
Montevieu Mean	12/28/2022	03/30/2023	0.45	0.19	0.29
Distant Locations					
Craters of the Moon	12/28/2022	01/19/2023	0.03	0.17	0.26
Craters of the Moon	01/19/2023	02/16/2023	0.21	0.11	0.17
Craters of the Moon	02/16/2023	03/16/2023	0.39	0.15	0.22
Craters of the Moon	03/16/2023	03/30/2023	0.33	0.18	0.27
Craters of the Moon Mean	12/28/2022	03/30/2023	0.24	0.15	0.22
Fort Hall ^{1,2}	12/28/2022	02/02/2023	0.11	0.22	0.35
Fort Hall	02/02/2023	03/30/2023	0.13	0.16	0.28
Fort Hall Mean	12/28/2022	03/30/2023	0.12	0.18	0.31
Idaho Falls	12/28/2022	02/09/2023	0.28	0.17	0.25
Idaho Falls	02/09/2023	03/30/2023	0.55	0.16	0.25
Idaho Falls Mean	12/28/2022	03/30/2023	0.42	0.17	0.25

Note: Concentrations are reported in pCi/m³ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

¹ Operated by the Shoshone-Bannock Tribes.

² New gas meter deployed during this sampling period.

Table 8. Tritium and gamma-emitting radionuclide concentrations from precipitation, first 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	12/28/22	03/30/23	10	90	160	-0.5	1.7	2.9
Boundary Locations								
Atomic City	12/28/22	03/09/23	110	110	180	1.2	1.4	2.2
Atomic City	03/09/23	03/30/23	0	90	170	-0.3	1.2	2.2
Atomic City Mean	12/28/22	03/30/23	66	102	176	0.5	1.3	2.2
Howe	12/28/22	03/02/23	50	100	160	0.7	1.1	1.9
Howe	03/02/23	03/30/23	50	100	160	1.5	1.5	2.5
Howe Mean	12/28/22	03/30/23	50	100	160	1.1	1.3	2.2
Mud Lake	12/28/22	02/23/23	30	100	160	0.1	1.2	2.1
Mud Lake	02/23/23	03/30/23	20	90	160	0.1	1.2	2.1
Mud Lake Mean	12/28/22	03/30/23	25	95	160	0.1	1.2	2.1
Monteview	12/28/22	03/16/23	90	100	160	-0.7	1.7	2.9
Monteview	03/16/23	03/30/23	50	100	160	2.0	2.5	4.1
Monteview	12/28/22	03/30/23	88	100	160	-0.5	1.7	3.0
Distant Locations								
Idaho Falls	12/28/22	02/02/23	-10	100	160	0.4	1.3	2.1
Idaho Falls	02/02/23	03/30/23	40	100	170	0.3	1.5	2.5
Idaho Falls Mean	12/28/22	03/30/23	16	100	165	0.3	1.4	2.3

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 first 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 have now completed a change-over of removing the old HPICs and replacing them with EcoGammas at each of our monitoring stations. 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 first quarter 2023. **Table 11** lists the EIC monitoring results for first 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 gamma exposure rates, first quarter, 2023, EcoGamma* network.

Station Location	Exposure Rate (µR/hr)			
	Quarterly Average*	± 2 SD	Median	Range**
On-site Locations				
Base of Howe	10.6	1.6	10.5	8.2 – 16.8
Big Lost River Rest Area	10.9	2.1	10.8	8.1 – 16.8
Rover	11.7	1.7	11.6	9.2 – 18.4
Sand Dunes Tower	12.1	1.6	12.0	9.7 – 16.8
Boundary Locations				
Atomic City	10.6	1.9	10.5	7.9 – 16.8
Big Southern Butte	9.6	1.8	9.5	7.2 – 15.0
Big Southern Butte duplicate ¹	9.9	2.0	9.7	7.5 – 15.4
Howe Met Tower	11.0	1.4	11.0	8.8 – 15.9
Monteview	10.5	1.6	10.5	8.2 – 15.1
Mud Lake / Terreton	10.7	1.5	10.6	8.7 – 16.7
Distant Locations				
Fort Hall	11.4	1.6	11.4	9.1 – 19.7
Idaho Falls	12.8	1.6	12.7	10.7 – 20.2

*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.

¹A duplicate EcoGamma was operated intermittently at Big Southern Butte from 01/08/23 to 03/30/23.

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

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average ¹	± 2 SD
On-Site Locations		
Base of Howe ²	11.7	2.2
Big Lost River Rest Area	14.1	4.4
Experimental Field Station	12.2	2.6
Rover ²	10.0	2.6
Sand Dunes	12.8	3.4
Van Buren Avenue	10.8, 11.9	-
Boundary Locations		
Atomic City	10.1	1.9
Big Southern Butte ²	10.3	4.6
Howe Met. Tower	13.3	2.3
Monteview	10.5	3.2
Mud Lake/ Terreton	9.8	2.9
Distant Locations		
Craters of the Moon	9.7	2.7
Ft. Hall	11.8	0.0
Idaho Falls	8.7	2.4

¹Results 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.

²Electrets deployed for two quarters. Could not change out electrets in fourth quarter of 2022 due to impassable road.

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, sulfate, alkalinity, 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 (²³⁴U, ²³⁵U, and ²³⁸U), plutonium isotopes (²³⁸Pu, ^{239/240}Pu), americium-241 (²⁴¹Am), strontium-90 (⁹⁰Sr), iodine-129 (¹²⁹I), and technetium-99 (⁹⁹Tc)—selected trace metals, common ions, total phosphorous, and/or volatile organic compounds (VOCs) based 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 first quarter of 2023, DEQ-INL OP sampled groundwater from the aquifer at 1 facility location. **Table 12** lists the sample date, co-sampler, well depth, and analyses requested for the location sampled this quarter. Analytical results are reported in **Tables 14 through 22** and summarized 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.

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.

Gross alpha and beta radioactivity were detected at low levels and within the known background ranges at USGS-123 - Gross alpha 1.5 ± 1.0 pCi/L; MDC = 1.6 pCi/L and Gross beta 2.7 ± 0.9 pCi/L; MDC = 1.4 pCi/L (**Table 14**). All values were consistent with historical trends.

Manmade gamma-emitting radionuclides

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

Tritium

A tritium concentration of 1345 ± 160 pCi/L (MDC = 180 pCi/L) was measured in water from USGS-123 using the standard analytical method (**Table 15**). USGS-123 is located in a known tritium plume that extends south from INTEC. The tritium concentration at this location has been steadily decreasing since 2003. The concentration measured this quarter is the lowest measured by DEQ-INL OP to date.

Tritium concentrations reported this quarter were well below the drinking water MCL of 20,000 pCi/L.

Strontium-90

USGS-123 was sampled for ^{90}Sr this quarter (**Table 16**) with non-detectable ^{90}Sr results.

Technetium-99

USGS-123 was sampled for ^{99}Tc this quarter (**Table 17**) with non-detectable ^{99}Tc concentrations.

Uranium Isotopes

USGS-123 was sampled for uranium isotopes this quarter (**Table 18**). This location yielded positive results for ^{234}U and ^{238}U . Due to a change in laboratories and methods of analyses, both the results and the MDCs were elevated compared to historical results. Duplicates were also analyzed, and although the results were more consistent with background and historical values, the MDCs were also slightly higher than historical MDCs. DEQ will continue to work with the laboratory to address the MDCs. All results were below the MCL of 30 $\mu\text{g/L}$.

Plutonium Isotopes

USGS-123 was sampled for plutonium isotopes this quarter (**Table 19**), with non-detectable results for ^{238}Pu and $^{239/240}\text{Pu}$.

Common ions, trace metals, and nutrients

USGS-123 was sampled for chloride, sulfate, alkalinity, chromium, and dissolved nutrients (nitrate-plus-nitrite) (**Tables 20, 21, and 22**). All concentrations were consistent with past observations and below their respective MCLs and secondary MCLs.

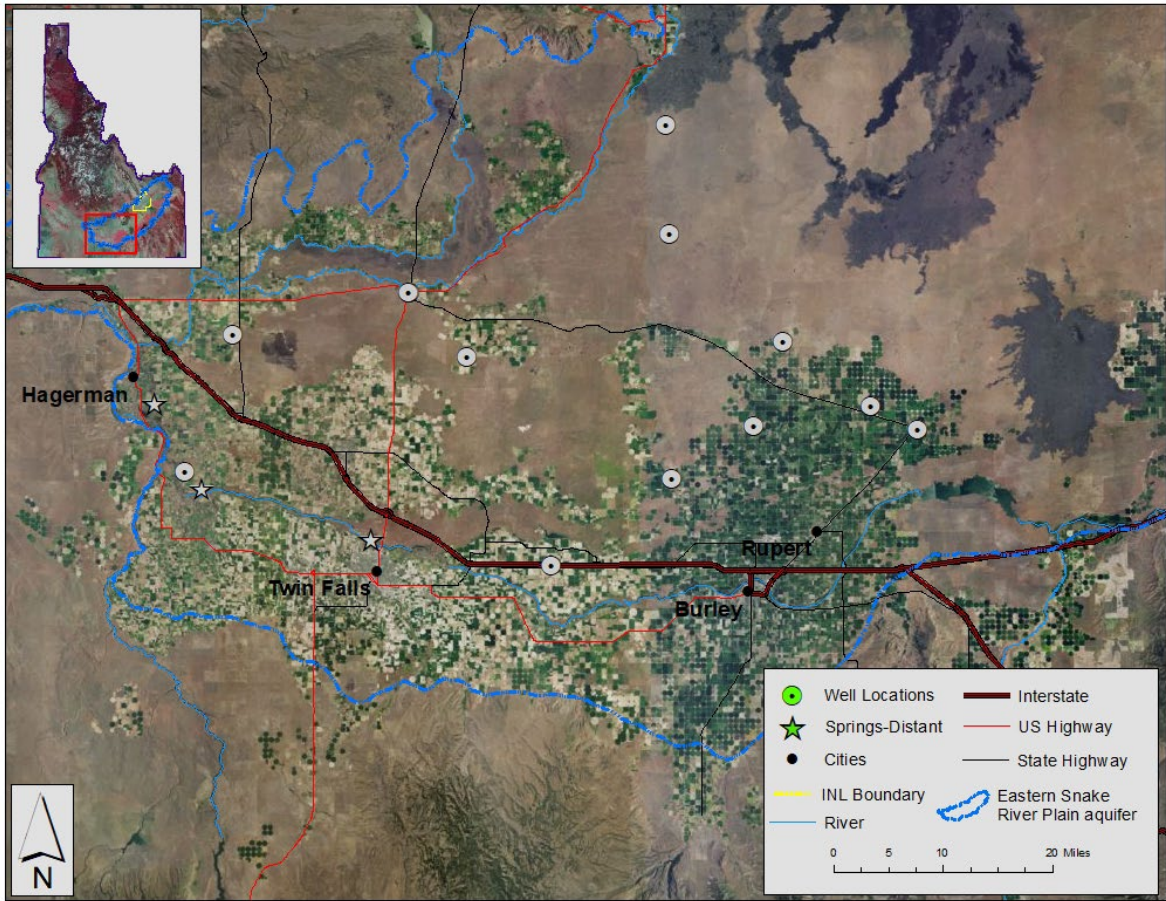


Figure 2. Distant water monitoring locations. No distant water monitoring sites were sampled during reporting period.

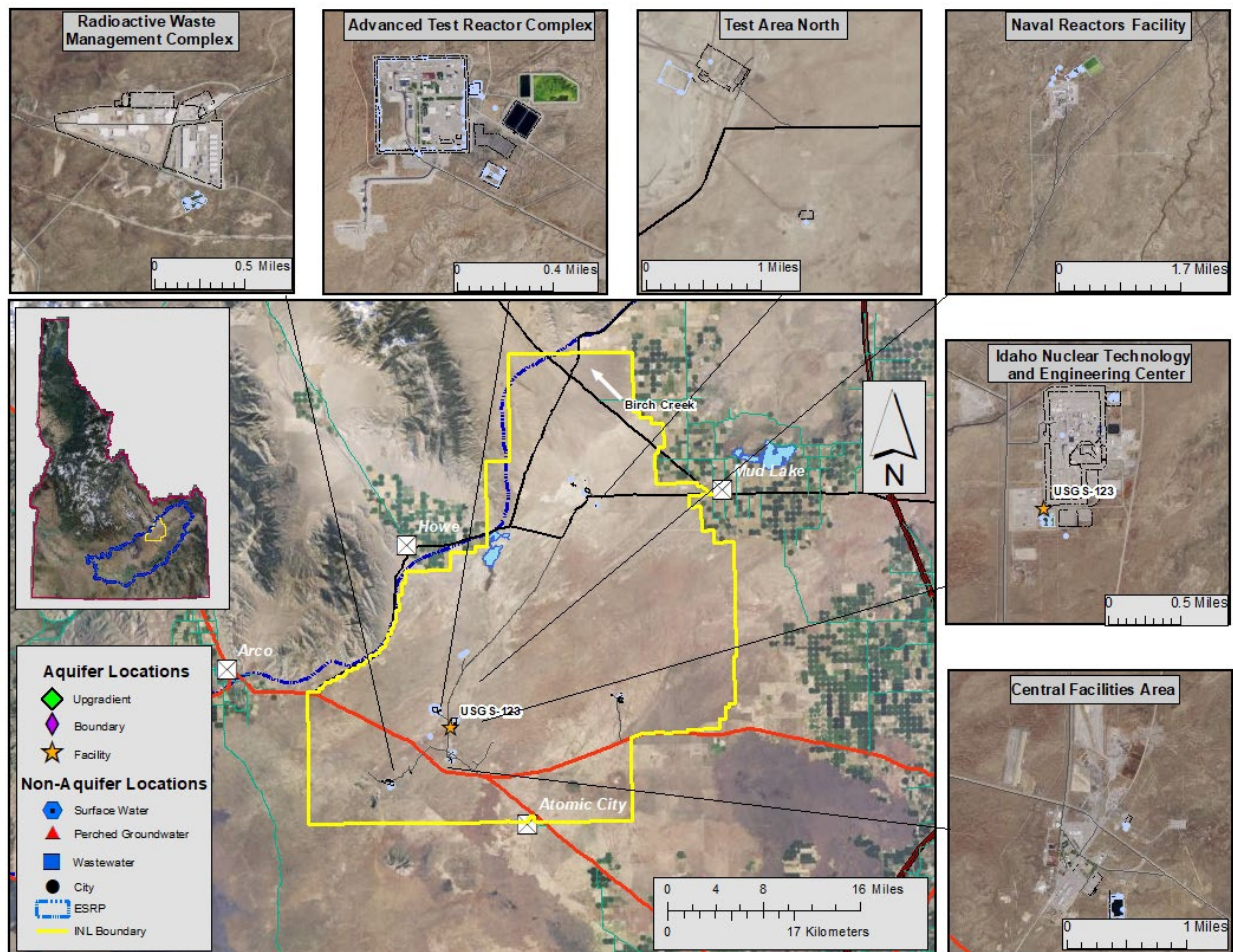


Figure 3. Up-gradient, facility, boundary, perched groundwater (GW), surface water, and wastewater monitoring locations.

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

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
Aquifer Samples				
Facility				
<i>Idaho Nuclear Technology and Engineering Center:</i>				
USGS-123	03/13/2023	USGS	744.2	α , β , γ , ^3H , ^{90}Sr , ^{99}Tc , Cl, SO_4 , Alkalinity, Cr, NO_3+NO_2 , U iso, Pu iso

ft bgs = feet below ground surface. * α = gross alpha radioactivity; β = gross beta radioactivity; γ = manmade gamma-emitting radionuclides; ^3H = tritium; ^{90}Sr = Strontium-90; ^{99}Tc = Technetium-99; ^{241}Am = Americium-241; P iso. = ^{238}Pu , $^{239/240}\text{Pu}$; ^{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 ^e
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).

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. ^e MCL is for total trihalomethanes.

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

Sample Location	Sample Date	Gross Alpha		Gross Beta		Cesium-137*				
		Concentration	2 SD	Concentration	2 SD	Concentration	2 SD			
Aquifer Samples										
Facility										
<i>Idaho Nuclear Technology and Engineering Center</i>										
USGS-123	03/13/2023	1.5	U	1.0	2.7	-	0.9	-0.7	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 ¹³⁷Cs, the manmade gamma-emitter most likely to be detected in groundwater, are reported in this table. MDC (gross alpha) 1.6 pCi/L. MDC (gross beta) 1.4 pCi/L. MDC (cesium-137) 2.5 pCi/L.

Table 15. Tritium concentrations (pCi/L) in water samples, first quarter, 2023.

Sample Location	Sample Date	Tritium		
		Concentration	2 SD	
Aquifer Samples				
Facility				
<i>Idaho Nuclear Technology and Engineering Center</i>				
USGS-123	03/13/2023	1345	-	160

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.

MDC 180 pCi/L.

Table 16. Strontium-90 concentrations (pCi/L) in water samples, first quarter, 2023.

Sample Location	Sample Date	Strontium-90		
		Concentration	2 SD	
Aquifer Samples				
Facility				
<i>Idaho Nuclear Technology and Engineering Center</i>				
USGS-123	03/13/2023	0.379	U	0.304

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.

MDC 0.478 pCi/L.

Table 17. Technetium-99 concentrations (pCi/L) for water samples, first quarter, 2023.

Sample Location	Sample Date	Technetium-99		
		Concentration	2 SD	
Aquifer Samples				
Facility				
<i>Idaho Nuclear Technology and Engineering Center</i>				
USGS-123	03/13/2023	-0.215	U	0.511

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.

MDC 0.87 pCi/L.

Table 18. Uranium isotope concentrations (pCi/L) for water samples, first quarter, 2023.

Sample Location	Sample Date	Uranium-234			Uranium-235			Uranium-238		
		Concentration	2 SD		Concentration	2 SD		Concentration	2 SD	
Aquifer Samples										
Facility										
<i>Test Area North</i>										
USGS-123	03/13/2023	2.0	-	1.2	0.636	U*	0.737	1.74	-	1.15
USGS-123	03/13/2023	1.15	-	0.459	-0.013	U	0.026	0.548	-	0.315

Data qualifiers: U = undetected, J = estimate, R = rejected, "+" or "-" after a J means that the estimated result is biased high or low, respectively.

U* – result is equal to the MDC but less than 2 SD and is therefore considered a non-detection.

Sample: MDC (U-234) 0.825 pCi/L. MDC (U-235) 0.636 pCi/L. MDC (U-238) 1.05 pCi/L.

Duplicate: MDC (U-234) 0.295 pCi/L. MDC (U-235) 0.25 pCi/L. MDC (U-238) 0.256 pCi/L.

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

Sample Location	Sample Date	Plutonium-238		Plutonium-239/240	
		Concentration	2 SD	Concentration	2 SD
Aquifer Samples					
Facility					
<i>Idaho Nuclear Technology and Engineering Center</i>					
USGS-123	03/13/2023	0.022	U	0.031	0.0

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.

MDC (Pu-238) 0.033 pCi/L. MDC (Pu-239/240) 0.084 pCi/L.

Table 20. Common ion concentrations (mg/L) in water samples, first quarter, 2023.

Sample Location	Sample Date	Calcium*	Magnesium*	Sodium*	Potassium*	Fluoride	Chloride	Sulfate	Alkalinity†
Aquifer Samples									
Facility									
<i>Idaho Nuclear Technology and Engineering Center</i>									
USGS-123	03/13/2023	-	-	-	-	-	20.5	21.6	124

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.

*Samples are filtered for calcium, magnesium, sodium, and potassium.

"-" = not analyzed.

Table 21. Dissolved metals concentrations (µg/L) in water samples, first quarter, 2023.

Sample Location	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
Aquifer Samples									
Facility									
<i>Idaho Nuclear Technology and Engineering Center</i>									
USGS-123	03/13/2023	-	-	7.9	-	-	-	-	-

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.

Table 22. Dissolved nutrient concentrations (mg/L) in water samples, first quarter, 2023.

Sample Location	Sample Date	Nitrate + Nitrite*		Total Phosphorus	
Aquifer Samples					
Facility					
<i>Idaho Nuclear Technology and Engineering Center</i>					
USGS-123	03/13/2023	1.0	-	-	-

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.

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. . No *in-situ* gamma spectroscopic measurements of soil were performed during the first calendar quarter of 2023, and 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. Ten milk samples were analyzed during the quarter.

Milk

DEQ-INL OP monitors milk for the naturally occurring radionuclide potassium-40 (⁴⁰K) and man-made iodine-131 (¹³¹I). Milk samples are collected monthly. Results for gamma spectrometric analyses of milk samples are presented in **Table 23**. ⁴⁰K was detected in all samples within the expected range of concentrations. ¹³¹I was not detected. Based on measurements of radionuclides in milk, there were no discernable impacts to the off-site environment from INL operations.

Table 23. Gamma spectrometry analysis data for milk samples, first 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	01/18/23	1390	115	0.3	1.5	2.6
Gooding	02/20/23	1049	95	-0.8	1.4	2.5
Gooding	03/14/23	1512	122	-0.2	1.6	2.7
Monteview	01/23/23	1357	113	0.7	2.1	3.5
Monteview	02/20/23	1334	106	0.7	2.2	3.7
Monteview	03/14/23	1396	110	-1.3	2.4	4.2
Tetonia	03/11/23	1345	113	-0.1	2.2	3.8
Verification Samples¹						
Terreton	01/04/23	1350	112	1.7	2.2	3.6
Terreton	02/01/23	1426	104	0.6	1.1	1.9
Minidoka	03/08/23	1515	122	0.1	1.4	2.4

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

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 first 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 first quarter of 2023, DEQ-INL OP submitted 50 QC samples for various radiological and non-radiological analyses (**Table 24**).

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, a blank sample consists of 18-megaohm deionized water from the DEQ-Idaho Falls Regional office and 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). Most water blank samples submitted to laboratories by DEQ-INL OP are field blanks.

For all analyses except low-level tritium in water, a blank sample result is considered acceptable if it is less than or equal to the minimum detectable concentration (MDC). For low-level tritium analyses in water samples, a blank sample result is acceptable if it is less than or equal to 33 pCi/L.² 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 TSP filters submitted for gross alpha and gross beta screening in air for the first quarter of 2023 are presented in **Table 25**. 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 26**. Blank sample results for radiochemical analysis of 8x10-inch TSP filter quarterly composites from fourth quarter 2022 are presented in **Table 27**. Data for blank analyses used to assess data quality for tritium in

² The water used by DEQ-INL OP to create blank samples contains measurable concentrations of tritium produced cosmogenically and by above-ground testing of nuclear weapons during the twentieth century. The highest tritium concentration that DEQ considers acceptable in a blank is calculated as the mean tritium concentration in DEQ blanks from 2013 to 2017 plus two standard deviations (33 pCi/L).

water vapor in air are presented in **Table 28**. All blank sample results were acceptable at less-than-MDC values.

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:

$$|R_1 - R_2| \leq 3\sqrt{S_1^2 + S_2^2}$$

R_1 = Original sample result

R_2 = Duplicate sample result

S_1 = Analytical uncertainty (1 SD) of the original result

S_2 = Analytical uncertainty (1 SD) 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 results for radiological analyses in groundwater and surface water are presented in **Table 29**. Duplicate results for metals and common ions and nutrients in groundwater are presented in **Tables 30** and **31**. All duplicate sample results were in agreement for the quarter.

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 $100 \pm 25\%$. 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).

No spiked samples were analyzed during the first quarter of 2023.

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 $100 \pm 25\%$ 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 $100 \pm 25\%$. Real-time pressure correction is used to calculate the net exposure measured by these EIC control sets. The ISU irradiation results for first quarter 2023 are presented in **Table 32**. All individual EIC readings 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 exceptions³ that apply primarily to radionuclide concentrations in water samples:

1. Results $>MDC$ but $\leq 2SD$ 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 detections and J-flagged as estimates.

Analytical QA/QC Assessment

No issues involving sample chain of custody, sample holding times, and the analysis of blank, duplicate, and spiked samples were observed during the first quarter of 2023 which significantly affected data quality. The ratio of total QC analyses to total field sample analyses of 9.5% is slightly below the DEQ-INL OP minimum requirement of 10%. This was due to only one location being sampled for water during the quarter, with minimal associated quality control analyses. Methodologies and data reports issued by the contracting laboratories conformed to the requirements of DEQ-INL OP during the first 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 first quarter of 2023 is well above the acceptable value of 90% for the DEQ-INL OP ESP and is summarized in **Table 24**. The overall data completeness (usable results divided by the total number of field sample results expected) of 99.1% 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 first quarter of 2023 is summarized in **Table 33**.

³ Monitoring and Surveillance Committee, Consistency in Reporting Results Subcommittee Meeting Summary, 2/5/04 and 4/1/04.

Conclusion

All data collected for the first 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 99.1% 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.

Table 24. Summary of the analyses performed, first 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 filters	Gamma emitters	36	3	0	0	0	ISU-EML
		Radiochemical ⁶ :						
		Sr-90	12	1	0	0	0	ISU-Sub
		Pu-238, 239/240	12	1	0	0	0	ISU-Sub
Am-241	12	1	0	0	0	ISU-Sub		
Water Vapor	Desiccant column	Tritium	25	6	0	0	0	ISU-EML
Gaseous	Charcoal filter	Iodine-131	13	0	0	0	0	ISU-EML
Precipitation	Poly bottle	Tritium	11	0	0	0	0	ISU-EML
		Gamma emitters	11	0	0	0	0	ISU-EML
Water								
Ground water, perched ground water, waste pond effluent, and surface water	Grab or composite	Gross alpha	1	0	1	0	0	ISU-EML
		Gross beta	1	0	1	0	0	ISU-EML
		Gamma emitters	1	0	1	0	0	ISU-EML
		Tritium	1	0	1	0	0	ISU-EML
		Low-level tritium	0	0	0	0	0	ISU-EML
		Radiochemical ⁷ :						
		Sr-90	1	0	1	0	0	ISU-Sub
		Tc-99	1	0	1	0	0	ISU-Sub
		U-234, 235,238	1	0	1	0	0	ISU-Sub
		Pu-238, 239/240	1	0	1	0	0	ISU-Sub
		I-129	0	0	0	0	0	ISU-Sub
		Metals	1	0	1	0	0	IBL
		Common Ions	1	0	1	0	0	IBL
		Nutrients	1	0	1	0	0	IBL
Volatile Organics	0	0	0	0	0	IBL		
Terrestrial								
Milk	Grab or composite	Gamma emitters	10	0	0	0	0	ISU-EML
Soil	<i>in situ</i>	Gamma emitters	0	0	0	0	0	DEQ-INL OP
	Grab – “puck”	Gamma emitters	0	0	0	0	0	ISU-EML
Radiation								
Ambient	EICs	Gamma Radiation	67	0	0	0	0	DEQ-INL OP
	EcoGamma	Gamma Radiation	11	NA	NA	NA	0	DEQ-INL OP
Total analyses performed			524	39	11	0	0	
Total QC analyses performed (blanks, duplicates, and spikes)			50					
Ratio of total QC analyses to total sample analyses³			9.5%					
Data usability⁴, percent			100.0%					
Data completeness⁵, percent			99.1%					

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.

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).

Table 25. Blank analysis results for gross alpha and beta in 47-mm particulate air (TSP) filters, first quarter, 2023.

Collection Period		Corrected volume (m ³) ¹	Gross alpha			Gross beta		
Start	Stop		Value	± 2 SD	MDC	Value	±2 SD	MDC
12/28/22	01/05/23	543	0.0	0.3	0.6	-0.3	0.6	1.0
01/05/23	01/12/23	543	-0.2	0.3	0.6	-0.3	0.6	1.0
01/12/23	10/19/23	543	-0.2	0.3	0.6	-0.5	0.6	1.0
10/19/23	01/26/23	543	-0.2	0.3	0.6	-0.8	0.6	1.1
01/26/23	02/02/23	543	0.1	0.2	0.4	0.6	0.5	0.9
02/02/23	02/09/23	543	-0.2	0.3	0.5	-0.6	0.6	1.0
02/09/23	02/16/23	543	0.1	0.3	0.5	-0.2	0.6	1.1
02/16/23	02/23/23	543	0.0	0.3	0.6	0.0	0.6	1.0
02/23/23	03/02/23	543	0.2	0.3	0.5	0.6	0.6	1.0
03/02/23	03/09/23	543	-0.4	0.3	0.7	-1.0	0.6	1.1
03/09/23	03/16/23	543	-0.1	0.3	0.6	-0.6	0.6	1.1
03/16/23	03/23/23	543	0.0	0.3	0.6	-0.9	0.6	1.1
03/23/23	03/30/23	543	-0.1	0.3	0.5	0.4	0.6	1.0

Note: Concentrations, associated uncertainties (± 2 SD), and minimum detectable concentrations (MDC) are expressed in 1 x 10⁻³ pCi/m³.

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 26. Blank results for gamma spectrometry analysis of monthly composites of 8x10-inch TSP air filters, and quarterly composites of 47-mm TSP air filters, first 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 composites¹ of 8x10-inch TSP air filters															
Jan	-7	23	39	-21	47	84	0	6	11	1	3	5	0	3	5
Feb	-9	33	57	2	1	137	6	8	13	-1	3	7	3	4	6
Mar	-9	22	39	-32	5	90	-1	6	11	1	3	5	3	3	5
Quarterly composite² of 47-mm TSP air filters															
1 st Qtr.	-50	57	105	63	142	243	-13	16	29	0	7	13	4	7	11

Note: Concentrations (Conc) are expressed in 1×10^{-5} pCi/m³ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

¹These concentrations (Conc) are from blank 8x10-inch filters collected weekly, composited, and analyzed for the calendar month. ²These 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 was actually passed through the blank filters.

Table 27. Blank results for radiochemical analysis of 8x10-inch TSP air filters, quarterly composite samples, from fourth quarter, 2022.

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
Blank	0.23	2.56	4.41	-0.01	0.04	0.11	0.03	0.08	0.14	0.00	0.03	0.07

Note: Concentrations are expressed in 1×10^{-5} pCi/m³ with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

¹These 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 28. Blank analysis results for tritium in water vapor from air samples, first quarter, 2023.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP231ZTR01	01/17/23	01/24/23	02/27/23	-0.01	0.06	0.10
OP231ZTR02	01/24/23	01/26/23	02/22/23	-0.01	0.06	0.09
OP231ZTR03	03/21/23	03/23/23	04/07/23	0.05	0.08	0.13
OP231ZTR04	03/28/23	03/30/23	04/15/23	0.04	0.05	0.09
OP231 Fridge	01/24/23	04/12/23	04/24/23	0.00	0.05	0.09
OP231 Sink	01/24/23	04/12/23	04/24/23	0.02	0.05	0.09

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

Table 29. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, first quarter, 2023.

Analysis/Sample Location	Original Sample Number	Concentration	± 2 SD	Duplicate Sample Number	Concentration	± 2 SD	RPD (%)	R ₁ -R ₂	3(S ₁ ² +S ₂ ²) ^{1/2}	Within either criterion?
Gross Alpha										
USGS-123	231W009	1.5	1.0	231W023	2.2	1.0	-38	0.7	2.1	Yes
Gross Beta										
USGS-123	231W009	2.7	0.9	231W023	1.2	0.9	77	1.5	1.9	Yes
Cesium-137										
USGS-123	231W009	-0.7	1.4	231W023	0.5	1.8	1200	1.2	3.4	Yes
Tritium (standard method)										
USGS-123	231W013	1345	157	231W027	1318	156	2.0	27	332	Yes
Tritium (low level method)										
None	-	-	-	-	-	-	-	-	-	-
Strontium-90										
USGS-123	231W011	0.379	0.304	231W025	-0.003	0.254	203	0.382	0.594	Yes
Technetium-99										
USGS-123	231W012	-0.215	0.511	231W026	0.159	0.525	1336	0.374	1.10	Yes
Uranium-234										
USGS-123	231W015	2.00	1.20	231W028	1.15	0.46	54	0.85	1.93	Yes
Uranium-235										
USGS-123	231W015	0.636	0.737	231W028	-0.013	0.026	208	0.649	1.11	Yes
Uranium-238										
USGS-123	231W015	1.74	1.15	231W028	0.548	0.315	104	1.19	1.79	Yes
Plutonium-238										
USGS-123	231W010	0.0218	0.0309	231W024	-0.0095	0.0190	509	0.0313	0.0544	Yes
Plutonium-239/240										
USGS-123	231W010	0.000	0.031	231W024	0.0095	0.033	-200	0.0095	0.068	Yes

RPD = relative percent difference.

Table 30. Duplicate results for metals (µg/L) in groundwater, first quarter, 2023.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
USGS-123	231W019	03/13/2023	-	-	7.9	-	-	-	-	-
USGS-123	231W030	03/13/2023	-	-	7.7	-	-	-	-	-
RPD (%)			-	-	2.6	-	-	-	-	-

RPD = relative percent difference.

Table 31. Duplicate sample results for common ions and nutrients (mg/L) in groundwater, first quarter, 2023.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total Phosphorus
USGS-123	231W017, 021	03/13/23	-	-	-	-	-	20.5	21.6	124	1.0	-
USGS-123	231W029, 031	03/13/23	-	-	-	-	-	20.6	21.6	124	0.95	-
RPD (%)			-	-	-	-	-	-0.5	0.0	0.0	5.1	-

RPD = relative percent difference.

† As CaCO₃.

Table 32. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), first quarter, 2023.

Electret #	Exposure Received		Net Measured Exposure ¹		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SKR540	40.0	1.4	35.7	1.3	89.3%	Yes
SKR398	40.0	1.4	35.4	1.3	88.5%	Yes
SMV133	40.0	1.4	39.8	1.4	99.5%	Yes
Triplicate AVG:					92.4%	Yes
SKR589	30.0	1.1	31.2	1.3	104.0%	Yes
SMD594	30.0	1.1	29.0	1.3	96.7%	Yes
SMD582	30.0	1.1	26.8	1.3	89.3%	Yes
Triplicate AVG:					96.7%	Yes
SKR506	20.0	0.7	21.1	1.3	105.5%	Yes
SMD613	20.0	0.7	20.3	1.3	101.5%	Yes
SKR514	20.0	0.7	19.1	1.3	95.5%	Yes
Triplicate AVG:					100.8%	Yes

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

¹ Net measured exposure estimate includes a correction for atmospheric pressure.

Table 33. Air sampling field equipment service reliability (percent operational), first 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	100%	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%	92%	100%	100%	100%
Howe	100%	100%	100%	100%	100%
Monteview	100%	100%	100%	100%	100%
Mud Lake	100%	92%	100%	100%	100%
Distant Locations²					
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 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, first 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	12/28/22	01/05/23	0.0	0.3	18.6	1.1
	01/05/23	01/12/23	0.0	0.4	14.0	1.1
	01/12/23	01/19/23	0.2	0.3	22.8	1.4
	01/19/23	01/26/23	0.3	0.4	28.6	1.5
	01/26/23	02/02/23	0.7	0.3	37.4	1.6
	02/02/23	02/09/23	0.7	0.4	25.7	1.5
	02/09/23	02/16/23	0.6	0.4	31.0	1.5
	02/16/23	02/23/23	0.6	0.4	34.1	1.6
	02/23/23	03/02/23	0.3	0.3	15.2	1.2
	03/02/23	03/09/23	0.1	0.4	15.6	1.2
	03/09/23	03/16/23	0.1	0.3	10.7	1.1
	03/16/23	03/23/23	0.4	0.4	21.2	1.4
	03/23/23	03/30/23	0.1	0.3	13.9	1.1
	Experimental Field Station	12/28/22	01/05/23	-0.2	0.3	17.3
01/05/23		01/12/23	-0.1	0.3	15.2	1.1
01/12/23		01/19/23	0.4	0.4	22.9	1.4
01/19/23		01/26/23	0.5	0.4	32.8	1.6
01/26/23		02/02/23	1.1	0.4	42.2	1.7
02/02/23		02/09/23	0.5	0.4	30.6	1.5
02/09/23		02/16/23	NS ¹	NS	NS	NS
02/09/23		02/23/23	0.7	0.2	30.2	1.0
02/23/23		03/02/23	NS ¹	NS	NS	NS
02/23/23		03/09/23	0.2	0.2	14.5	0.8
03/09/23		03/16/23	0.3	0.4	10.6	1.1
03/16/23		03/23/23	0.5	0.4	24.4	1.4
03/23/23		03/30/23	0.5	0.4	14.7	1.1
Sand Dunes Tower		12/28/22 ⁵	01/05/23	0.0	0.3	17.1
	01/05/23	01/12/23	-0.2	0.3	14.4	1.1
	01/12/23	01/19/23	0.4	0.3	22.5	1.3
	01/19/23	01/26/23	0.5	0.4	30.3	1.5
	01/26/23	02/02/23 ²	1.0	0.4	44.9	1.9
	02/02/23	02/09/23 ²	-0.1	1.0	13.9	2.7
	02/09/23	02/16/23	0.8	0.4	36.9	1.6
	02/16/23	02/23/23	0.7	0.4	36.9	1.6
	02/23/23	03/02/23	0.9	0.4	15.7	1.1
	03/02/23	03/09/23	-0.2	0.3	15.6	1.2
	03/09/23	03/16/23	-0.1	0.3	11.3	1.0
	03/16/23	03/23/23	0.6	0.4	22.8	1.3
	03/23/23	03/30/23	0.5	0.3	16.4	1.1

Table A-1 continued. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, first quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	12/28/22	01/05/23	-0.1	0.3	18.4	1.1
	01/05/23	01/12/23	-0.2	0.3	14.1	1.1
	01/12/23	01/19/23	0.4	0.4	22.8	1.4
	01/19/23	01/26/23	0.5	0.4	24.5	1.4
	01/26/23	02/02/23	0.8	0.3	37.1	1.6
	02/02/23	02/09/23	0.4	0.4	25.5	1.4
	02/09/23	02/16/23	0.5	0.3	29.0	1.5
	02/16/23	02/23/23	0.4	0.4	36.2	1.6
	02/23/23	03/02/23	0.3	0.3	14.2	1.1
	03/02/23	03/09/23	-0.2	0.4	15.1	1.2
	03/09/23	03/16/23	0.3	0.4	10.1	1.1
	03/16/23	03/23/23	0.3	0.4	23.9	1.4
	03/23/23	03/30/23	0.1	0.3	13.1	1.1
Boundary Locations						
Atomic City	12/28/22	01/05/23	0.1	0.3	17.1	1.1
	01/05/23	01/12/23	0.1	0.4	15.1	1.1
	01/12/23	01/19/23	0.3	0.4	21.8	1.3
	01/19/23	01/26/23	0.2	0.4	29.1	1.8
	01/26/23	02/02/23	1.0	0.4	35.8	1.6
	02/02/23	02/09/23	1.2	0.4	24.8	1.4
	02/09/23	02/16/23	0.7	0.4	29.5	1.5
	02/16/23	02/23/23	0.3	0.4	34.5	1.9
	02/23/23	03/02/23	0.4	0.3	14.1	1.1
	03/02/23	03/09/23	-0.1	0.4	12.9	1.2
	03/09/23	03/16/23	0.1	0.4	9.1	1.0
	03/16/23	03/23/23	0.4	0.4	22.8	1.4
	03/23/23	03/30/23	0.1	0.3	12.4	1.1
Howe	12/28/22	01/05/23	0.0	0.3	15.4	1.1
	01/05/23	01/12/23	-0.1	0.3	16.1	1.2
	01/12/23	01/19/23	-0.1	0.3	21.7	1.3
	01/19/23	01/26/23	0.4	0.4	31.1	1.6
	01/26/23	02/02/23	1.1	0.4	43.6	1.8
	02/02/23	02/09/23	0.8	0.4	37.5	1.8
	02/09/23	02/16/23	0.6	0.4	35.0	1.7
	02/16/23	02/23/23	1.4	0.5	44.4	1.9
	02/23/23	03/02/23	0.8	0.4	18.7	1.4
	03/02/23	03/09/23	-0.2	0.4	17.4	1.4
	03/09/23	03/16/23	0.2	0.4	13.0	1.2
	03/16/23	03/23/23	0.5	0.4	27.3	1.6
	03/23/23	03/30/23	0.2	0.4	18.3	1.3

Table A-1 continued. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, first quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Montevieu	12/28/22	01/05/23	0.2	0.3	17.4	1.1
	01/05/23	01/12/23	0.0	0.3	15.5	1.1
	01/12/23	01/19/23	0.2	0.3	18.8	1.2
	01/19/23	01/26/23	0.4	0.4	35.1	1.6
	01/26/23	02/02/23	1.1	0.4	41.3	1.7
	02/02/23	02/09/23	0.4	0.4	39.1	1.7
	02/09/23	02/16/23	0.8	0.4	36.9	1.7
	02/16/23	02/23/23	0.9	0.4	45.4	1.8
	02/23/23	03/02/23	0.6	0.4	17.4	1.2
	03/02/23	03/09/23	-0.1	0.4	15.8	1.2
	03/09/23	03/16/23	0.2	0.3	10.7	1.0
	03/16/23	03/23/23	0.5	0.4	20.5	1.3
	03/23/23	03/30/23	0.7	0.4	17.5	1.2
Mud Lake	12/28/22	01/05/23	0.3	0.3	18.2	1.1
	01/05/23	01/12/23	-0.1	0.3	16.5	1.1
	01/12/23	01/19/23	0.4	0.4	23.7	1.3
	01/19/23	01/26/23	0.3	0.4	34.8	1.6
	01/26/23	02/02/23	0.9	0.4	40.5	1.7
	02/02/23	02/09/23	0.5	0.4	37.5	1.6
	02/09/23	02/16/23	1.3	0.4	43.3	1.7
	02/16/23	02/23/23	1.1	0.4	44.5	1.8
	02/23/23	03/02/23	0.4	0.3	16.4	1.1
	03/02/23	03/09/23	-0.1	0.4	17.4	1.2
	03/09/23	03/16/23	0.0	0.3	9.6	1.0
	03/16/23	03/23/23	0.3	0.4	20.0	1.3
	03/23/23	03/30/23	0.2	0.3	15.7	1.1
Distant Locations						
Craters of the Moon	12/28/22	01/05/23	-0.1	0.3	15.6	1.1
	01/05/23	01/12/23	-0.2	0.3	10.6	1.0
	01/12/23	01/19/23	0.1	0.3	15.3	1.2
	01/19/23	01/26/23	0.0	0.3	19.3	1.3
	01/26/23	02/02/23	0.5	0.3	29.8	1.5
	02/02/23	02/09/23	0.2	0.3	20.3	1.3
	02/09/23	02/16/23	0.4	0.3	23.6	1.4
	02/16/23	02/23/23	0.5	0.4	23.3	1.4
	02/23/23	03/02/23	0.8	0.4	11.7	1.1
	03/02/23	03/09/23	-0.2	0.4	14.3	1.2
	03/09/23	03/16/23	0.2	0.4	10.3	1.1
	03/16/23	03/23/23	0.7	0.4	25.0	1.5
	03/23/23	03/30/23	0.4	0.4	14.5	1.2

Table A-1 continued. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses of 47-mm TSP filters for all locations, first quarter, 2023.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall³	12/28/22	01/05/23 ⁴	0.2	0.3	14.1	1.0
	01/05/23	01/12/23 ⁴	-0.2	0.4	10.8	1.1
	01/12/23	01/19/23 ⁴	0.2	0.3	17.6	1.2
	01/19/23	01/26/23 ⁴	0.4	0.3	25.8	1.3
	01/26/23	02/02/23 ⁴	1.4	0.4	29.7	1.4
	02/02/23	02/09/23 ⁴	0.7	0.4	22.6	1.3
	02/09/23	02/16/23 ⁴	0.9	0.4	25.3	1.3
	02/16/23	02/23/23 ⁴	1.2	0.4	24.0	1.3
	02/23/23	03/02/23 ⁴	0.7	0.3	10.6	0.9
	03/02/23	03/09/23 ⁴	0.3	0.4	10.8	1.0
	03/09/23	03/16/23 ⁴	0.6	0.4	10.0	1.0
	03/16/23	03/23/23 ⁴	0.8	0.4	20.0	1.3
	03/23/23	03/30/23 ⁴	0.2	0.3	10.9	0.9
	Idaho Falls	12/28/22	01/05/23	0.0	0.3	12.9
01/05/23		01/12/23	0.0	0.3	13.4	1.1
01/12/23		01/19/23	0.2	0.3	19.4	1.2
01/19/23		01/26/23	0.5	0.4	27.8	1.5
01/26/23		02/02/23	0.5	0.3	35.1	1.6
02/02/23		02/09/23	0.3	0.3	27.1	1.4
02/09/23		02/16/23	0.9	0.4	31.6	1.5
02/16/23		02/23/23	0.5	0.4	33.0	1.6
02/23/23		03/02/23	0.4	0.3	14.7	1.1
03/02/23		03/09/23	0.0	0.4	13.0	1.1
03/09/23		03/16/23	0.3	0.4	9.8	1.0
03/16/23		03/23/23	0.4	0.4	20.8	1.3
03/23/23		03/30/23	0.0	0.3	12.9	1.1

Note: MDCs typically range from $(0.4 \text{ to } 0.8) \times 10^{-3}$ pCi/m³ for gross alpha and from $(0.8 \text{ to } 1.4) \times 10^{-3}$ pCi/m³ for gross beta.

¹ NS – No sample. Sampler ran for two weeks with the same filter because the station was inaccessible on 2/16/23 and 3/02/23 due to heavy snow conditions.

² Partial sample. Power was out during 2/02/23 filter changeout.

³ Operated by Shoshone-Bannock Tribes.

⁴ Improper sampling orientation with the filter not fully exposed to the ambient air. Results are considered (usable) estimates.

⁵ Power was out during 12/28/22 filter changeout.

Appendix B

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

Sample Location	Net Corrected Exposure Rate ($\mu\text{R/hr}$) ¹	± 2 SD ($\mu\text{R/hr}$)
Arco	11.5	2.7
Craters of the Moon	9.7	2.7
Big Lost River Rest Area	14.1	4.4
Van Buren Avenue	10.8, 11.9	-
Experimental Field Station	12.2	2.6
Main Gate	13.0	5.1
Atomic City	10.1	1.9
Taber	10.1	3.3
Blackfoot	9.5	1.8
Fort Hall	11.8	0.0
Idaho Falls	8.7	2.4
Mud Lake/ Terreton	9.8	2.9
Monteview	10.5	3.2
Sand Dunes Tower	12.8	3.4
Howe Met. Tower	13.3	2.3
MP282 -20	6.0	4.9
MP280 -20	7.2	3.8
MP278 -20	9.9	1.6
MP276 -20	9.2	3.3
MP274 -20	7.2	1.8
MP272 -20	8.0	1.1
MP270 -20	10.6	1.2
MP268 -20	8.8	3.3
MP266 -20	7.2	2.0
MP264 -20	12.2	4.5
MP270 -20/26	9.9	3.3
MP268 -20/26	10.0	1.7
MP266 -20/26	9.6	1.1
MP263 -20/26	9.6	0.6
MP261 -20/26	8.6	5.0
MP259 -20/26	8.4	3.6
MP256 -20/26	9.3	3.6
MFC (EBR II)	10.7	3.0
EBR I	11.6	3.5
RWMC	13.9	4.9
CFA	13.9	1.6
CITRC (PBF)	12.0	2.4
INTEC	19.2	2.4
ATR (TRA)	12.0	2.1
NRF	10.2	5.2
TAN/SMC	8.1	3.9
Mud Lake Bank of Commerce	10.7	4.2
MP43-33	9.4	2.9
MP41-33	10.2	3.0
MP39-33	10.1	4.0
MP37-33	11.3	2.9
MP35-33	9.8	2.6
MP33-33	12.6	4.7
MP31-33	9.3	1.4
MP29-33	10.9	2.8

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

Sample Location	Net Corrected Exposure Rate ($\mu\text{R/hr}$) ¹	± 2 SD ($\mu\text{R/hr}$)
MP27-33	10.2	2.4
MP25-33	8.2	2.4
MP23-33	NS ²	NS
MP21-33	9.2	2.4
MP19-33	9.4	4.7
MP14-33	9.4	0.4
MP11-33	9.7	3.8
MP06-33	6.7	4.1
MP03-33	9.2	3.7
Base of Howe	11.7 ³	2.2
Rover	10.0 ³	2.6
Hamer	13.5	3.3
Sugar City	12.3	3.5
Roberts	14.5	4.6
Big Southern Butte	10.3 ³	4.6
T4 North	14.3 ³	4.3
T4 South	9.2 ³	1.6

¹Results 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.

²NS – No sample. Electrets not deployed. No milepost found.

³Electrets deployed for two quarters. Could not change out electrets in fourth quarter of 2022 due to impassable road.