

Department of Environmental Quality
INL Oversight Program

**ENVIRONMENTAL SURVEILLANCE PROGRAM
QUARTERLY DATA REPORT**

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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, 2021 (**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 high-volume total suspended particulate (TSP) air samplers. Many of these air samplers were found to be operating outside of their expected flow rate range in the first quarter, 2021. A calibrated flow rate gauge was taken into the field weekly to measure the sample start and stop flow rates of these samplers. The calibrated flow rate gauge measurements were used for the activity concentration calculations in the suspect measurements and have been J flagged as estimates. Weekly gross alpha and gross beta particulate radioactivity results for filters from the 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 filters collected using TSP samplers during the course of a calendar quarter are analyzed using gamma spectrometry. Typically, gamma spectrometry results are only reported when exceeding a minimum detectable activity (MDA) or minimum detectable concentration (MDC). Gamma spectrometry results for the first quarter of 2021 for TSP filters are presented in **Table 3**. The only reported gamma-emitting radionuclide was beryllium-7, a naturally occurring, cosmogenic radionuclide. The MDC for Cs-137 is also reported since Cs-137 is the most likely of the man-made gamma emitting radionuclides to be detected.

Annual composites of filters collected using TSP samplers are also analyzed using radiochemical separation techniques. Results from the annual composite analyses are typically presented in the

following year's first quarter report. The samples are analyzed for Strontium-90, Plutonium-238, Plutonium-239/240, and Americium-241 (**Table 7**). Measurable quantities of these radionuclides are expected in the environment due to historic above ground testing of nuclear weapons. 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 radionuclides in 40 CFR 61, Appendix E, Table 2. Field sample concentrations which exceed these amounts require further investigation. One result, from the Mud Lake location, exceeded the ^{89/90}Sr MDC for the 2021 annual composite. Eight results exceeded the ^{239/240}Pu MDC for the 2021 annual composite at Craters of the Moon, Experimental Field Station, Fort Hall, Howe, Mud Lake, Rest Area, Sand Dunes, and Van Buren sampling sites. No results exceeded the ²³⁸Pu or ²⁴¹Am MDC for the 2021 annual composite. Though minimally exceeding the MDCs, all of these detectable results are well under the specified regulatory limits and DEQ-INL OP's action levels.

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 4**). 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.

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. The Idaho Falls sample taken from 01/06/21 to 02/17/21 exceeded its MDC (tritium concentration = 0.52 ± 0.28 pCi/m³, MDC = 0.44 pCi/m³). All other results are below MDCs, and all results are well below the DEQ-INL OP action level of 150 pCi/m³ (40 CFR 61). Atmospheric tritium concentrations and their weighted quarterly means are presented in **Table 5**.

Precipitation samples were collected at six monitoring locations during the first quarter of 2021. 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 2021. 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 6**.

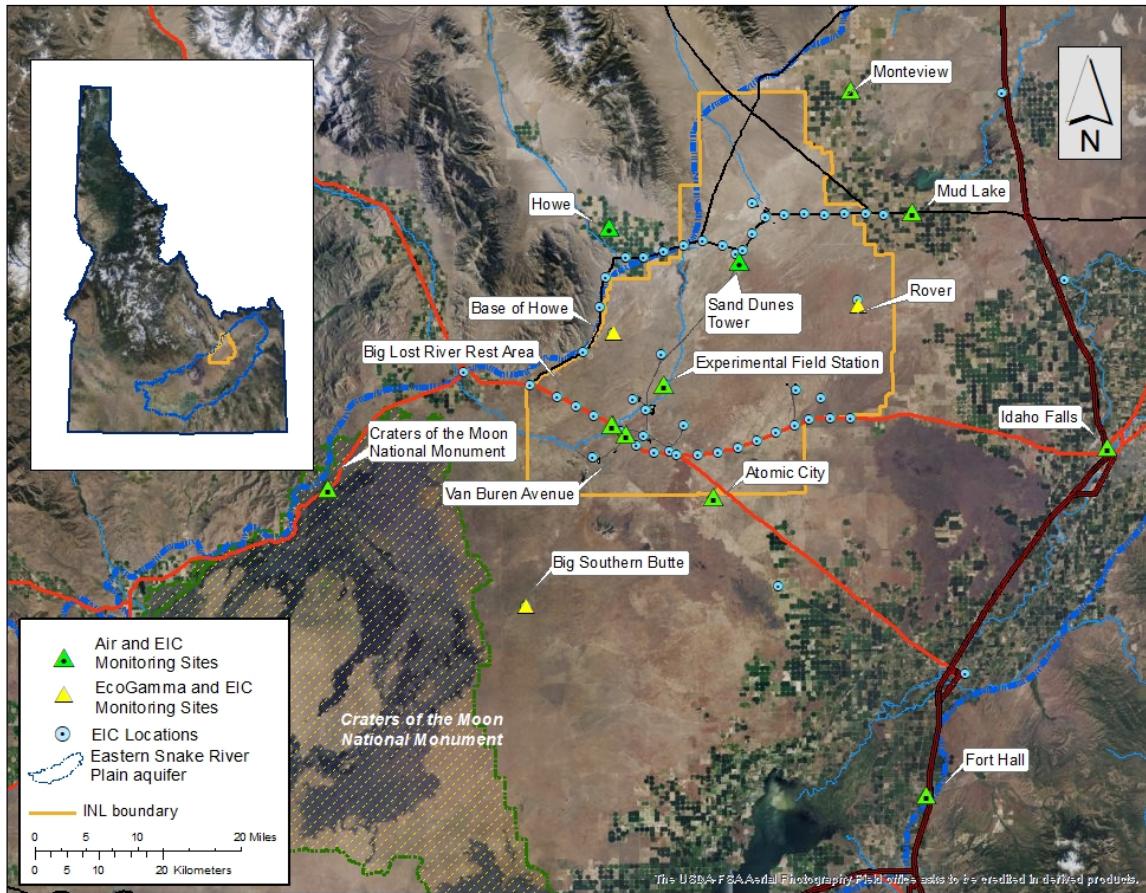


Figure 1. Air and radiation monitoring locations.

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.

²TSP and radioiodine samples collected by Shoshone-Bannock Tribes.

Table 2. Range of gross alpha and gross beta concentrations for TSP filters, first quarter, 2021.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.3 J ²	-	1.5 J	14.6 J	-	58.1 J
Experimental Field Station	0.3 J ²	-	1.2 J	17.1 J	-	49.5 J
Sand Dunes Tower	0.4	-	1.8 J ²	19.5	-	74.4 J
Van Buren Avenue	0.3 J ²	-	0.7	11.6 J	-	33.9
Boundary Locations						
Atomic City	0.3 J ²	-	0.7	17.9 J	-	38.8
Howe	0.3	-	2.0	16.2	-	28.7
Monteview	0.4	-	1.8 J ²	18.3 J	-	58.5 J
Mud Lake	0.4 J ²	-	1.8 J	22.1 J	-	63.4 J
Distant Locations						
Craters of the Moon	0.2	-	1.1 J ²	10.8 J	-	41.1 J
Fort Hall ¹	0.3	-	1.7	11.8	-	61.1
Idaho Falls	0.3 J ²	-	1.3 J	11.7	-	50.6 J
Idaho Falls Duplicate	0.4	-	1.5 J ²	9.9	-	50.5

¹Operated by Shoshone-Bannock Tribes.

²Air volume was estimated. Results are J-flagged as estimates.

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

Table 3. Gamma spectrometry analysis data for TSP filters, composite samples, first quarter, 2021.

Station Location	Naturally Occurring Radionuclide Beryllium-7		Man-Made Gamma Emitting Radionuclides	
	Concentration	± 2 SD	Concentration	MDC
On-site Locations				
Big Lost River Rest Area	104.5 J ³	5.6 J	0.03 J	0.10 J
Experimental Field Station	75.1 J	4.2 J	-0.03 J	0.07 J
Sand Dunes Tower	105.2 J	5.7 J	0.00 J	0.08 J
Van Buren Avenue	60.1 J	3.7 J	0.00 J	0.13 J
Boundary Locations				
Atomic City	97.9 J	5.3 J	0.03 J	0.10 J
Howe	88.7 J	4.8 J	0.05 J	0.10 J
Monteview	86.4 J	4.7 J	0.00 J	0.06 J
Mud Lake	87.5 J	4.8 J	0.00 J	0.08 J
Distant Locations				
Craters of the Moon	94.6 J	5.2 J	-0.05 J	0.10 J
Fort Hall ¹	106.0	5.6	0.00	0.05
Idaho Falls	86.5 J	4.7 J	-0.07 J	0.10 J
Idaho Falls Duplicate	99.4 J	5.2 J	0.01 J	0.06 J

¹Operated by Shoshone-Bannock Tribes.

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

³Air volume was estimated in at least one weekly TSP sample. Results are J-flagged as estimates.

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

Table 4. Iodine-131 activity in weekly charcoal filter composites, first quarter, 2021.

Start Date	Collection Date	Iodine-131 activity (pCi/composite)		
		Activity	± 2 SD	MDA
12/30/20	01/06/21	-0.89	1.26	2.22
01/06/21	01/13/21	-0.35	1.51	2.59
01/13/21	01/20/21	0.22	1.60	2.70
01/20/21	01/27/21	-0.03	1.42	2.42
01/27/21	02/03/21	0.87	1.38	2.29
02/03/21	02/10/21	1.36	2.25	3.73
02/10/21	02/17/21	1.08	1.75	2.90
02/17/21	02/24/21	0.24	1.45	2.45
02/24/21	03/03/21	0.14	1.54	2.61
03/03/21	03/10/21	-0.68	1.35	2.35
03/10/21	03/17/21	0.26	1.29	2.18
03/17/21	03/24/21	0.42	1.41	2.37
03/24/21	03/31/21	1.02	1.37	2.25

Table 5. Tritium concentrations in air from atmospheric moisture, first quarter, 2021.

Station Location	Start Date	Collection Date	Tritium		
			Concentration	± 2 SD	MDC
On-site Locations					
Big Lost River Rest Area	1/06/21	2/17/21	-0.11	0.20	0.36
Big Lost River Rest Area	2/17/21	3/31/21	0.30 J ²	0.33 J	0.53 J
Big Lost River Rest Area Mean	1/06/21	3/31/21	0.10 J²	0.27 J	0.45 J
Experimental Field Station	1/06/21	2/17/21	0.30	0.24	0.39
Experimental Field Station	2/17/21	3/31/21	-0.15	0.23	0.41
Experimental Field Station Mean	1/06/21	3/31/21	0.08	0.23	0.40
Sand Dunes Tower	1/06/21	2/17/21	0.23	0.23	0.37
Sand Dunes Tower	2/17/21	3/31/21	0.10	0.22	0.36
Sand Dunes Tower Mean	1/06/21	3/31/21	0.17	0.22	0.37
Van Buren Avenue	1/06/21	2/17/21	0.11	0.22	0.35
Van Buren Avenue	2/17/21	3/31/21	0.26 J ²	0.29 J	0.47 J
Van Buren Avenue Mean	1/06/21	3/31/21	0.19 J²	0.26 J	0.41 J
Boundary Locations					
Atomic City	1/06/21	2/17/21	-0.07	0.21	0.37
Atomic City	2/17/21	3/31/21	0.17	0.22	0.37
Atomic City Mean	1/06/21	3/31/21	0.05	0.21	0.37
Howe	1/06/21	2/17/21	0.02	0.21	0.34
Howe	2/17/21	3/31/21	0.08	0.23	0.38
Howe Mean	1/06/21	3/31/21	0.05	0.22	0.36
Mud Lake	1/06/21	3/31/21	-0.05	0.25	0.44
Mud Lake	2/17/21	3/31/21	0.08	0.23	0.39
Mud Lake Mean	1/06/21	3/31/21	0.05	0.24	0.40
Monteview	1/06/21	2/17/21	0.29	0.27	0.44
Monteview	2/17/21	3/31/21	0.19	0.22	0.36
Monteview Mean	1/06/21	3/31/21	0.24	0.24	0.40
Distant Locations					
Craters of the Moon	1/06/21	2/17/21	0.09	0.22	0.37
Craters of the Moon	2/17/21	3/31/21	0.24	0.22	0.35
Craters of the Moon Mean	1/06/21	3/31/21	0.17	0.22	0.36
Fort Hall ¹	1/06/21	2/17/21	0.06	0.30	0.48
Fort Hall	2/17/21	3/31/21	0.20	0.29	0.46
Fort Hall Mean	1/06/21	3/31/21	0.14	0.30	0.47
Idaho Falls	1/06/21	2/17/21	0.52	0.28	0.44
Idaho Falls	2/17/21	3/31/21	0.06	0.26	0.44
Idaho Falls Mean	1/06/21	3/31/21	0.30	0.27	0.44

¹Operated by Shoshone-Bannock Tribes.

²Results are estimates (J-flagged). Mass of water collected was estimated.

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

Table 6. Tritium and gamma-emitting radionuclide concentrations from precipitation, first quarter, 2021.

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-Site Locations						
Big Lost River Rest Area	40	90	160	0.7	1.8	3.0
Boundary Locations						
Atomic City	20	90	160	-0.5	1.1	2.1
Howe	30	90	160	1.6	2.0	3.3
Monteview	10	90	160	-0.3	1.6	2.8
Mud Lake	10	90	160	0.5	1.8	3.1
Distant Locations						
Idaho Falls	-60	90	160	0.6	1.2	1.9

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

Table 7. Annual radiochemical separation analysis data for TSP particulate filters collected during 2020.

Station Location	⁹⁰ Sr			²³⁸ Pu			^{239/240} Pu			²⁴¹ Am		
	Value ¹	±2SD	MDC	Value ¹	± 2SD	MDC	Value ¹	±2SD	MDC	Value ¹	±2SD	MDC
On-Site Locations												
BLR ⁴ Rest Area J ⁶	0.58	0.59	0.94	0.01	0.01	0.01	0.03	0.02	0.02	0.02	0.02	0.03
EFS ³ J ⁶	0.95	1.09	1.75	-0.01	0.03	0.07	0.09	0.05	0.04	0.02	0.03	0.05
Sand Dunes J ⁶	0.77	0.66	1.02	0.01	0.01	0.02	0.05	0.03	0.01	0.01	0.01	0.03
Van Buren	0.82	1.41	2.34	-0.01	0.02	0.04	0.06	0.03	0.02	0.03	0.02	0.03
Boundary Locations												
Atomic City	0.83	0.70	1.09	0.01	0.02	0.01	0.03	0.03	0.03	0.01	0.02	0.04
Howe J ⁶	0.71	0.59	0.92	0.02	0.04	0.06	0.08	0.05	0.02	0.02	0.04	0.06
Monteview J ⁶	1.04	0.69	1.04	0.01	0.02	0.01	0.02	0.02	0.03	0.01	0.02	0.04
Mud Lake	1.37	0.81	1.19	0.01	0.02	0.01	0.04	0.03	0.03	0.00	0.02	0.04
Distant Locations												
Craters of Moon J ⁶	-0.17	0.37	0.62	0.01	0.02	0.01	0.03	0.02	0.01	0.00	0.02	0.04
Fort Hall ²	-1.54	1.15	1.92	0.00	0.02	0.03	0.04	0.03	0.03	0.01	0.02	0.03
Idaho Falls J ⁶	1.81	1.21	1.93	0.00	0.02	0.04	0.03	0.03	0.04	0.01	0.02	0.03
Idaho Falls Dup ⁵ J ⁶	0.39	1.47	2.43	0.02	0.04	0.02	0.04	0.04	0.05	0.00	0.04	0.08

Note: Concentrations are reported in 1 x 10⁻⁵ pCi/m³ with associated uncertainty (± 2 SD), minimum detectable concentration (MDC), and correspond to filter composites collected during the calendar year.

¹ Measurable quantities of these radionuclides are expected in the environment due to historic above-ground testing of nuclear weapons. 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/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 Experimental Field Station.

⁴ BLR – Big Lost River.

⁵ Dup – Duplicate TSP sampler being run at the Idaho Falls location in 2020.

⁶ Air volume was estimated in at least one weekly TSP sample. Results are therefore J-flagged as (usable) estimates.

Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the first quarter of 2021 (**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 dual Geiger–Müller gamma radiation monitor (**Table 8**).

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 <http://www.deq.idaho.gov/inl-oversight/monitoring/gamma-radiation-measurements.aspx>. 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 9** lists the average radiation exposure rates measured by the EcoGammas for first quarter 2021. **Table 10** lists the EIC monitoring results for first quarter 2021. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation

Table 8. 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 9. Average gamma exposure rates, first quarter, 2021, EcoGamma* network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
Base of Howe	18.1	2.2
Big Lost River Rest Area	15.7	1.9
Rover	16.5	1.6
Sand Dunes Tower	15.3	1.8
Boundary Locations		
Atomic City	15.5	1.7
Big Southern Butte	18.7	2.8
Howe Met Tower	14.7	1.6
Monteview	13.4	1.6
Mud Lake / Terreton	14.7	1.5
Distant Locations		
Fort Hall	14.3	1.3
Idaho Falls	15.9	1.7

*The 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.

Table 10. Electret ionization chamber (EIC) cumulative average exposure rates, first quarter, 2021.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average ¹	± 2 SD
On-Site Locations		
Base of Howe	12.3	1.9
Big Lost River Rest Area	13.6	2.3
Experimental Field Station	15.5	4.1
Rover	13.3	4.9
Sand Dunes Tower	11.2	5.1
Van Buren Avenue	15.0	4.2
Boundary Locations		
Atomic City	9.9	1.7
Big Southern Butte	11.6	4.2
Howe Met Tower	12.3	3.2
Monteview	12.8	3.3
Mud Lake/Terreton	9.8	3.7
Distant Locations		
Craters of the Moon	10.9	1.7
Fort Hall	11.7	5.3
Idaho Falls	8.7	1.8

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.

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 (²³⁴U, ²³⁵U, and ²³⁸U), plutonium isotopes (²³⁸Pu, ^{239/240}Pu), americium-241 (²⁴¹Am), strontium-90 (⁹⁰Sr), 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 2021, DEQ-INL OP sampled groundwater from the aquifer at one facility location. **Table 11** lists the sample date, co-sampler, well depth, and analyses requested for the location sampled this quarter. Analytical results are reported in **Tables 13 through 22** and summarized below. The results of low-level tritium analyses for 20 samples collected in 2020 are reported in **Table 15** and discussed below.

Table 12 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 only for gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium during the second quarter. Samples for chloride, chromium, nitrate-plus-nitrate, and other constituents are collected at these locations during the fourth quarter.

Gross alpha and beta radioactivity were detected at low levels at the INTEC facility location USGS-123 (**Table 13**). Gross alpha and beta radioactivity were measured at concentrations within the known background range at this location.

Manmade gamma-emitting radionuclides

No manmade gamma-emitting radionuclides were detected at the USGS-123 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 13**.

Tritium

Tritium was analyzed at USGS-123 (**Table 14**) and showed an elevated tritium concentration. This was expected due to the proximity to INTEC.

Eight samples from third quarter 2020, and ten from fourth quarter 2020 requiring low-level tritium analysis were analyzed this quarter, and the results are reported in **Table 15**.

One sample is from a boundary well, three are from facility wells, 11 are from distant wells, two are from upgradient wells, and one is from a surface water location. All concentrations are within the background range (0-33 pCi/L) excepting USGS-120. USGS-120 results have an elevated tritium concentration of 73 ± 10 pCi/L, indicating an INL influence.

All tritium concentrations reported in this quarter are well below the drinking water MCL of 20,000 pCi/L.

Strontium

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

Technetium

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

Uranium Isotopes

USGS-123 was sampled for uranium isotopes this quarter (**Table 18**). This location yielded positive results for ^{234}U , ^{235}U , and ^{238}U . However, the $^{234}\text{U}/^{238}\text{U}$ ratio of 2.3 suggests that the source is natural. Results are consistent with historical data.

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**).

Results were consistent with past results, with a chromium value (6.7 ug/L) elevated compared to background concentrations.

Volatile organic compounds (VOCs)

VOCs are measured in aquifer wells at and near RWMC and Test Area North. No VOC samples were collected at USGS-123 (INTEC).

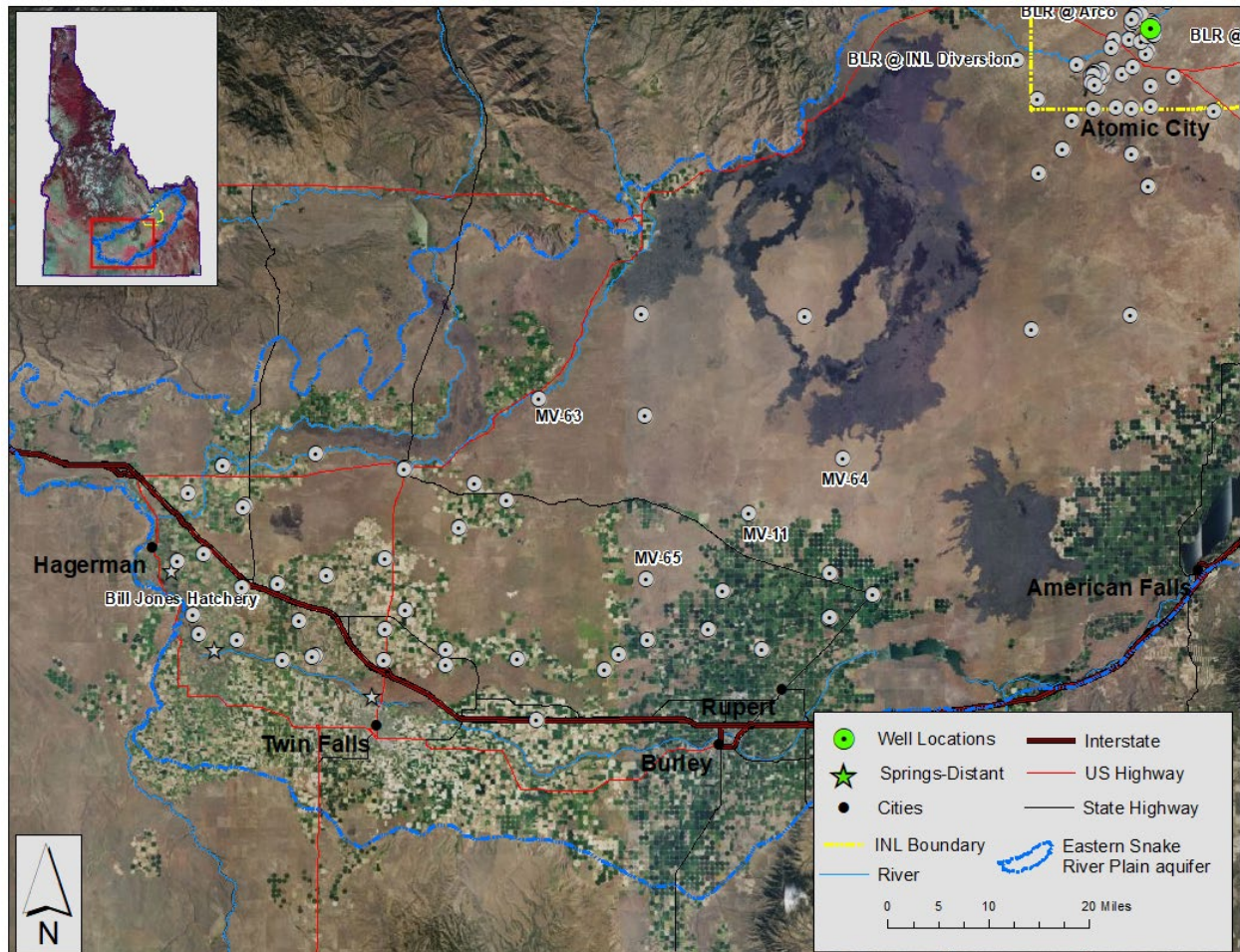


Figure 2. Distant and Surface Water monitoring locations. Sites in gray were not sampled during report period.

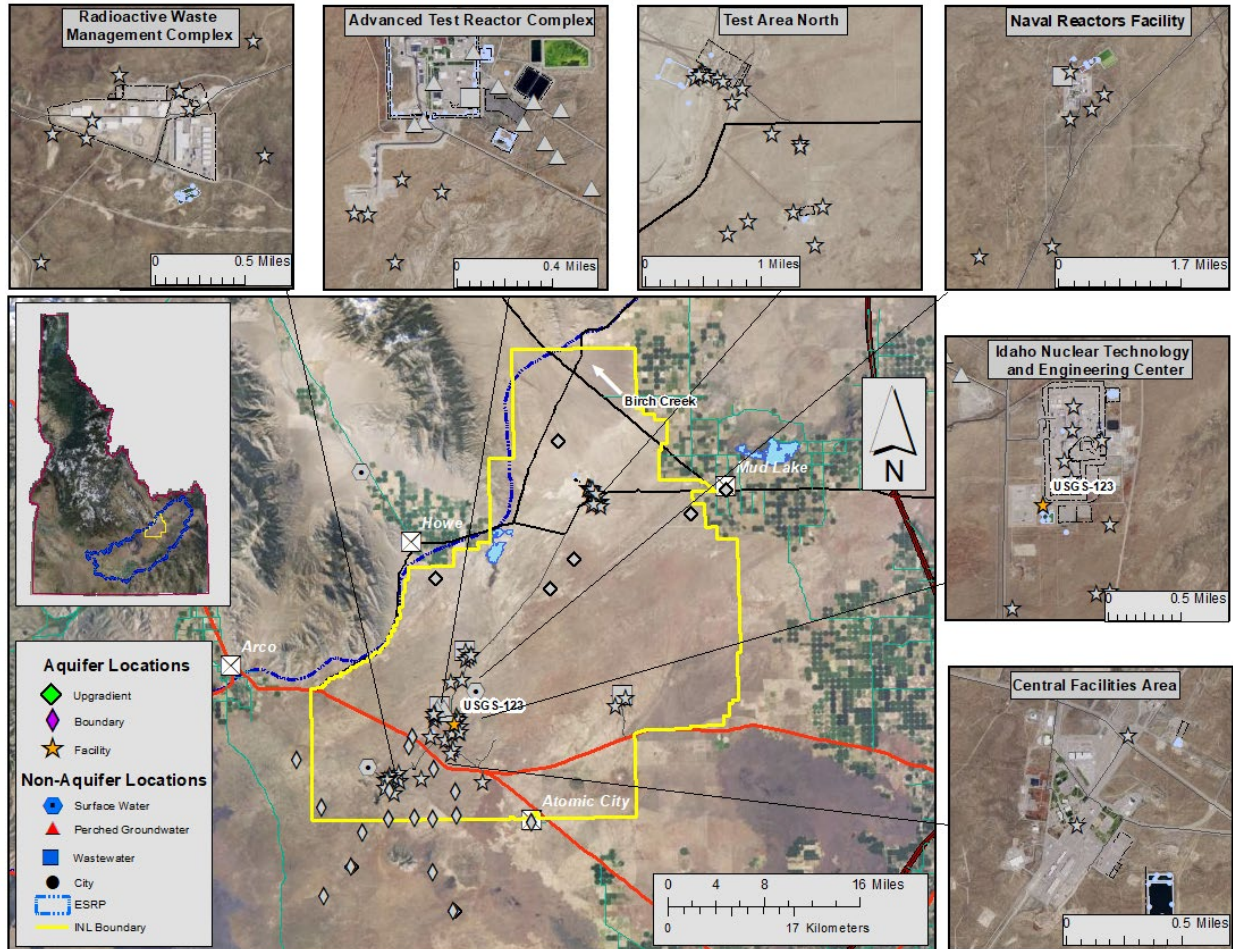


Figure 3. Up-gradient, facility, boundary, perched groundwater (GW), and wastewater monitoring locations. Sites in gray were not sampled during reporting period

Table 11. Locations sampled for water, first quarter, 2021.

Sample Location	Date Sampled	Co-sampler	Well Depth (ft bgs)	Analyses*
Aquifer Samples				
Facility				
<i>Idaho Nuclear Technology and Engineering Center:</i>				
USGS-123	03/02/2021	USGS	476.69	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, U iso. = uranium isotopes ^{234}U , ^{235}U , ^{238}U ; Pu iso = plutonium isotopes ^{238}Pu and $^{239/240}\text{Pu}$; Cl = chloride; Cr = chromium; com. ions = Ca^{2+} , Mg^{2+} , Na^+ , K^+ , Cl^- , SO_4^{2-} ; alkalinity; trace metals (metals) = arsenic (As), barium (Ba), chromium (Cr), iron (Fe), manganese (Mn), lead (Pb), selenium (Se); NO_3+NO_2 = nitrate plus nitrite; P = phosphorus.

n/a = well depth not available.

Table 12. 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
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		
<i>Common Ions (mg/L)</i>		
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*
<i>Trace Metals (µg/L)</i>		
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*
<i>Nutrients (mg/L)</i>		
Nitrate plus nitrite	<0.04 – 3.59 ^b	10 for NO ₃ ⁻ , 1 for NO ₂ ⁻
Phosphorous	<0.01 – 0.02 ^d	---
<i>Volatile Organic Compounds (µg/L)</i>		
Tetrachloroethene	0	5
Trichloroethene	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	5

¹ Sources for background ranges are: ^a DEQ data compiled from distant, boundary, and surface water sites in previous years;

^b Bartholomay and Hall, 2016 (DOE/ID-22237); ^c Knobel and others, 1992; ^d Knobel and others, 1999 (DOE/ID-22164).

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 13. Gross alpha, gross beta, and man-made gamma-emitting radionuclide concentrations (pCi/L) in water samples, first quarter, 2021.

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	3/2/2021	1.7 J**	0.7 J**	5.9	1.0	0.4 U	1.5

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.

**Gross alpha results were qualified as estimates (J-flagged) by the ISU-EML lab due to a failure in the alpha analysis for an associated external proficiency water sample.

Table 14. Tritium concentrations (pCi/L) in water samples, first quarter, 2021.

Sample Location	Sample Date	Tritium	
		Concentration	2 SD
Aquifer Samples			
Facility			
<i>Idaho Nuclear Technology and Engineering Center</i>			
USGS-123	03/02/2021	1540	190

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

Table 15. Low-level tritium concentrations (pCi/L) in water samples collected during 2020 analyzed using the electrolytic enrichment, first quarter 2021.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Aquifer Samples				
Facility				
<i>Naval Reactor Facility</i>				
USGS-099	9/30/2020	3	U	6
<i>Radioactive Waste Management Complex</i>				
USGS-120	10/14/2020	73		10
<i>Materials and Fuels Complex</i>				
USGS-148	10/21/2020	3	U	6
Other Samples				
Boundary				
Highway 3	10/13/2020	25		7
Distant				
MV-01	7/13/2020	14		9
MV-18	7/14/2020	11		5
Shoshone Water Supply	7/13/2020	6	U	7
MV-44	7/14/2020	13		7
MV-63	8/20/2020	5	U	5
MV-65	8/20/2020	3	U	6
Alpheus Spring	11/9/2020	9	U	7
Bill Jones Hatchery	11/9/2020	11	U	8
Clear Spring	11/9/2020	8	U	7
Minidoka Water Supply	11/9/2020	7	U	9
Shoshone Water Supply	11/9/2020	7	U	7
Upgradient				
Mud Lake Water Supply	7/16/2020	1	U	8
Mud Lake Water Supply	11/10/2020	2	U	6
Surface Water				
Little Lost River	10/13/2020	15		8

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.

Table 16. Strontium-90 concentrations (pCi/L) in water samples, first quarter, 2021.

Sample Location	Sample Date	Strontium-90	
		Concentration	2 SD
Aquifer Samples			
Facility			
<i>Idaho Nuclear Technology and Engineering Center</i>			
USGS-123	03/02/2021	0.03 U	0.22

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

Table 17. Technetium-99 concentrations (pCi/L) for water samples, first quarter, 2021.

Sample Location	Sample Date	Technetium-99	
		Concentration	2 SD
Aquifer Samples			
Facility			
<i>Idaho Nuclear Technology and Engineering Center</i>			
USGS-123	03/02/2021	0.5 U	3.0

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

Table 18. Uranium isotope concentrations (pCi/L) for water samples, first quarter, 2021.

Sample Location	Sample Date	Uranium-234		Uranium-235		Uranium-238	
		Concentration	2 SD	Concentration	2 SD	Concentration	2 SD
Aquifer Samples							
Facility							
<i>Idaho Nuclear Technology and Engineering Center</i>							
USGS-123	03/02/2021	1.40	0.33	0.091 J*	0.072	0.61	0.18

*Result is > MDC and > 2 SD but < 3 SD, and is therefore considered questionable and J-flagged as an estimate.

Table 19. Plutonium isotope concentrations (pCi/L) for water samples, first quarter, 2021.

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	03/02/2021	-0.006	U	0.026	0.007 U

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.

Table 20. Common ion concentrations (mg/L) in water samples, first quarter, 2021.

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	03/02/2021	-	-	-	-	-	22.1	23.0	128
Other Samples									
None									

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.

* Sample was not filtered in the field.

[†] As CaCO₃.

"-" = not analyzed.

Table 21. Dissolved metals concentrations (µg/L) in water samples, first quarter, 2021.

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	03/02/2021	-	-	6.7	-	-	-	-	-
Other Samples									
None									

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, 2021.

Sample Location	Sample Date	Nitrate + Nitrite*	Total Phosphorus
Aquifer Samples			
Facility			
<i>Idaho Nuclear Technology and Engineering Center</i>			
USGS-123	03/02/2021	1.1	-
Other Samples			
None			

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. Milk samples are collected to evaluate the potential for ingestion of radioactivity by the population around the INL. No *in-situ* gamma spectroscopic measurements were performed, nor were any soil samples physically collected during the first calendar quarter of 2021.

Milk

DEQ-INL OP monitors milk for the naturally occurring radionuclide potassium-40 (⁴⁰K) and man-made iodine-131 (¹³¹I). Milk samples are collected on a monthly basis. Results for gamma spectrometric analyses of milk samples are presented in **Table 23**. ⁴⁰K was detected in all samples within the expected range of concentration. 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 spectroscopy analysis data for milk samples, first quarter, 2021.

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	01/28/21	1551	132	-1.4	2.0	3.4
	02/16/21	1467	129	-0.9	2.4	4.1
	03/16/21	1506	132	1.5	2.7	4.5
Verification Samples¹						
Terreton	01/04/21	1549	134	-0.1	2.9	4.9
Minidoka	01/05/21	1510	90	0.7	1.5	2.5
Dietrich	02/02/21	1347	83	-0.7	1.2	2.1
Idaho Falls	02/02/21	1546	133	-0.9	1.7	3.0
Howe	03/04/21	1492	130	-0.4	1.3	2.1
Minidoka	03/04/21	1377	113	0.0	1.0	1.7

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 2021. 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 2021, DEQ-INL OP submitted 47 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 for contamination introduced during sample collection, storage, shipment, and analysis. For water matrices, a blank sample consists of 18-megohm 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 2021 are presented in **Table 25**. Blank sample results for select gamma emitters in air from TSP filters composited for the quarter are presented in **Table 26**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 27**. Blank analysis results for radiochemical separation analyses for annual composited TSP filters collected during 2020 are presented in **Table 28**. Blank sample results for radiological analytes in groundwater are presented in **Table 29**.

² The water used by DEQ-INL OP to create blank samples contains measureable 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).

All blank sample results passed acceptance criteria in the first quarter of 2021.

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

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 of the sample results is less than five times the MDC, the results are in agreement 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 30**.

All duplicate results passed acceptance criteria in the first quarter of 2021.

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 water samples were analyzed during the first quarter of 2021.

DEQ-INL OP also prepares additional “spike-like” quality control samples to assess ambient radiation measurement bias. Once per quarter, DEQ-INL OP irradiates a number of electret ionization chambers

(EICs) 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. The irradiation results for first quarter 2021 are presented in **Table 31**. Real-time pressure correction is used to calculate the net exposure measured by these EIC control sets. All EIC spiked samples passed the DEQ-INL OP criteria.

Laboratory QC Issues

For the first quarter of 2021, the gross alpha results for groundwater from USGS-123 were qualified as estimates (J-flagged) by the ISU-EML lab due to failures in two gross alpha analyses for an associated external QA proficiency water sample. The two gross alpha analyses exceeded the vendor's (Environmental Resource Associates, ERA) upper control limit. This type of failure also occurred with one of the two ERA QA gross alpha samples in the ISU-EML report for the 4th quarter of 2020. There is still an ongoing effort at ISU-EML to understand how these failures occurred, but no definitive reason(s) have been found to date. ISU-EML noted that gross alpha results from their internal and another external QA program published in the 4th quarter of 2020 report did pass. An analysis of historical data published in the 4th quarter of 2020 report indicated that there was no positive bias in the recent gross alpha field data.

DEQ-INL OP Equipment QC Issue

Many of the TSP air samplers were found to be operating outside of their expected flow rate range in the first quarter, 2021. A calibrated flow rate gauge was taken into the field weekly to measure the sample start and stop flow rates of these samplers. The calibrated flow rate gauge measurements were used for the activity concentration calculations in the suspect measurements, and results have been J-flagged as estimates. DEQ-INL OP is currently testing and evaluating other similar methods for obtaining more accurate TSP values.

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 2021 which significantly affected data quality. The ratio of total QC analyses to total field sample analyses of 9.2% is slightly less than the DEQ-INL OP requirement of 10%, due primarily to fewer QC water analyses for the quarter. Methodologies and data reports issued by the contracting laboratories generally conformed to the requirements of DEQ-INL OP during the first quarter of 2021.

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 of 94.5% for the first quarter of 2021 is 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 93.2% is also acceptable.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. The TSP sampler at the Howe sampling station was taken out of service from 3/3/21 to 3/15/21 for repair/replacement. The sampler was replaced on 3/15/21. The Sand Dunes Tower TSP sampler was out of service for repair/replacement from 3/17/21 to 3/31/21. The Van Buren Avenue TSP sampler was out of service for

repair/replacement from 3/03/21 to 3/31/21. Service reliability for air sampling equipment for the first quarter of 2021 is summarized in **Table 32**.

Conclusion

All data collected for the first quarter of 2021 have been assigned the applicable qualifiers to designate the appropriate use of the data. The overall data usability of 94.5% and data completeness of 93.2% are acceptable for the quarter, with the data meeting the requirements and data quality objectives established by DEQ-INL OP, other than the slightly low number of QC analyses performed.

Table 24. Summary of the analyses performed, first quarter, 2021.

Media Sampled	Collection Device	Analyte	Sample Analyses	Blank Analyses	Duplicate Analyses	Spike Analyses	Data Rejected ¹	Analyzing Lab ²
Air								
Particulate	4-inch filter	Gross alpha	149	13	0	0	14	ISU-EML
		Gross beta	149	13	0	0	14	ISU-EML
		Gamma emitters	12	1	0	0	0	ISU-EML
		Radiochemical	36	3	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	22	4	0	0	0	ISU-EML
Gaseous	Charcoal filter	Iodine-131	13	0	0	0	0	ISU-EML
Precipitation	Poly bottle	Tritium	6	0	0	0	0	ISU-EML
		Gamma emitters	6	0	0	0	0	ISU-EML
Water								
Groundwater & Surface Water	Grab or composite	Gross alpha	1	0	0	0	0	ISU-EML
		Gross beta	1	0	0	0	0	ISU-EML
		Gamma emitters	1	0	0	0	0	ISU-EML
		Tritium	1	0	0	0	0	ISU-EML
		Low-level tritium	18	2	2	0	0	ISU-EML
		Technetium-99	1	0	0	0	0	ISU Sub
		Radiochemical	4	0	0	0	0	ISU Sub
		Metals	1	0	0	0	0	IBL
		Common Ions	1	0	0	0	0	IBL
Nutrients	1	0	0	0	0	IBL		
Volatile Organics	0	0	0	0	0	IBL		
Terrestrial								
Milk	Grab or composite	Gamma emitters	9	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	9	0	DEQ-INL OP
	Eco Gammas	Gamma Radiation	11	NA	NA	NA	0	DEQ-INL OP
Total analyses performed			510	36	2	9	28	
Total QC analyses performed (blanks, duplicates, and spikes)			47					
Ratio of total QC analyses to total sample analyses³			9.2%					
Data usability⁴, percent			94.5%					
Data completeness⁵, percent			93.2%					

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.

Table 25. Blank analysis results for gross alpha and beta in particulate air (TSP), first quarter, 2021.

Collection Period		Corrected volume ¹ (m ³)	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
12/30/2020	01/06/2021	2063	-0.1	0.1	-0.1	0.5
01/06/2021	01/13/2021	2063	-0.1	0.1	-0.4	0.5
01/13/2021	01/20/2021	2063	-0.1	0.1	-0.1	0.5
01/20/2021	01/27/2021	2063	0.1	0.1	0.2	0.5
01/27/2021	02/03/2021	2063	0.0	0.1	-0.2	0.5
02/03/2021	02/10/2021	2063	0.1	0.1	0.4	0.5
02/10/2021	02/17/2021	2063	0.1	0.1	-0.2	0.5
02/17/2021	02/24/2021	2063	0.0	0.1	-0.9	0.5
02/24/2021	03/03/2021	2063	0.1	0.1	-0.1	0.5
03/03/2021	03/10/2021	2063	0.0	0.1	-0.3	0.5
03/10/2021	03/17/2021	2063	0.0	0.1	-0.2	0.5
03/17/2021	03/24/2021	2063	0.0	0.1	0.4	0.5
03/24/2021	03/31/2021	2063	-0.1	0.1	0.1	0.5

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

¹ A volume equal to the average of the 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 analysis results for gamma spectroscopy for TSP particulate air filters, composite samples, first quarter, 2021.

Analysis Date	Beryllium-7			Ruthenium-106/Rhodium-106			Antimony-125		
	Concentration ¹	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
04/19/2021	22	47	79	-21	73	62	-1	11	20
Analysis Date	Cesium-134			Cesium-137					
	Concentration ¹	± 2 SD	MDC	Concentration	± 2 SD	MDC			
04/19/2021	-6	4	8	0	4	6			

Note: Concentrations are expressed in 1 x 10⁻⁵ pCi/m³ 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 actually passed through the blank filters.

Table 27. Blank analysis results for tritium in water vapor from air samples, first quarter, 2021.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP211ZTR01	02/16/2021	02/26/2021	03/02/2021	0.09	0.15	0.25
OP211ZTR02	02/16/2021	02/26/2021	03/02/2021	0.09	0.10	0.17
OP211 Sink	01/25/2021	04/13/2021	04/29/2021	-0.03	0.09	0.16
OP211 Fridge	01/25/2021	04/13/2021	04/29/2021	-0.06	0.09	0.16

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

Table 28. Blank analysis results for 2020 TSP annual radiological composites of air filters.

Location	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	-0.08	0.16	0.27	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.01	0.02

Note: Concentrations are expressed in 1 x 10⁻⁵ pCi/m³ 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 year. 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 29. Blank analysis results (pCi/L) for radiological constituents in water, first quarter, 2021.

Sample Number	Sample Date	Blank Type	Concentration	± 2 SD	MDC	Within Blank Criteria?
Tritium (low-level method)						
201W556	07/13/2020	Field	13	8	13	Yes
201W767	11/09/2020	Field	11	7	12	Yes

MDC = minimum detectable concentration.

Table 30. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, first quarter, 2021.

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 Criteria?
Tritium (low-level method)										
MV-18	201W471	11	5	201W551	9	8	20	2	14	Yes
MV-65	201W571	3	6	201W576	7	8	-80	4	15	Yes

Table 31. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), first quarter, 2021.

Electret #	Exposure Received		Net Measured Exposure ¹		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SKR267	40.0	2.0	32.2	1.3	80.6%	Yes
SKR342	40.0	2.0	36.7	1.4	91.9%	Yes
SJX015	40.0	2.0	31.9	1.3	79.7%	Yes
Triplicate AVG:					84.1	Yes
SKR589	30.0	1.5	26.6	1.4	88.7%	Yes
SJX031	30.0	1.5	22.9	1.3	76.3%	Yes
SKR401	30.0	1.5	24.8	1.3	82.7%	Yes
Triplicate AVG:					82.6%	Yes
SKR353	20.0	1.0	16.8	1.3	84.0%	Yes
SJX054	20.0	1.0	17.1	1.3	85.5%	Yes
SKR496	20.0	1.0	16.8	1.4	84.0%	Yes
Triplicate AVG:					84.5%	Yes

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

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

Table 32. Air sampling field equipment service reliability (percent operational), first quarter, 2021.

Station Locations	Sample Type			
	TSP	Radioiodine	Atmospheric Moisture	Precipitation
Onsite Locations				
Big Lost River Rest Area	100%	100%	100%	100%
Experimental Field Station	100%	100%	100%	NC ¹
Sand Dunes Tower	85%	100%	100%	NC ¹
Van Buren Avenue	69%	100%	100%	NC ¹
Boundary Locations				
Atomic City	100%	100%	100%	100%
Howe	92%	100%	100%	100%
Monteview	100%	100%	100%	100%
Mud Lake	100%	100%	100%	100%
Distant Locations²				
Craters of the Moon	100%	100%	100%	NC ¹
Idaho Falls	100%	100%	100%	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.

Appendix A

Table A-1. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	12/30/20	01/06/21	0.7 J ¹	0.3 J	49.9 J	1.6 J
	01/06/21	01/13/21	0.8 J ¹	0.3 J	58.1 J	1.8 J
	01/13/21	01/20/21	0.3 J ¹	0.2 J	27.8 J	1.3 J
	01/20/21	01/27/21	1.2 J ¹	0.3 J	57.3 J	1.7 J
	01/27/21	02/03/21	0.6 J ¹	0.2 J	26.9 J	1.3 J
	02/03/21	02/10/21	0.6 J ¹	0.2 J	23.1 J	1.2 J
	02/10/21	02/17/21	1.3 J ¹	0.3 J	47.8 J	1.6 J
	02/17/21	02/24/21	0.4 J ²	0.2 J	14.6 J	1.2 J
	02/24/21	03/03/21	0.6 J ¹	0.3 J	23.6 J	1.5 J
	03/03/21	03/10/21	1.3 J ¹	0.4 J	43.9 J	2.0 J
	03/10/21	03/17/21	1.5 J ¹	0.4 J	42.1 J	2.0 J
	03/17/21	03/24/21	0.7 J ¹	0.3 J	30.1 J	1.7 J
	03/24/21	03/31/21	1.1 J ¹	0.4 J	25.1 J	1.7 J
Experimental Field Station	12/30/20	01/06/21	0.4	0.2	28.8	1.2
	01/06/21	01/13/21	0.6	0.2	30.0	1.2
	01/13/21	01/20/21	0.5	0.2	19.9	1.0
	01/20/21	01/27/21	0.7	0.2	31.7	1.2
	01/27/21	02/03/21	0.3 J ¹	0.2 J	21.4 J	1.2 J
	02/03/21	02/10/21	0.4 J ¹	0.2 J	20.4 J	1.4 J
	02/10/21	02/17/21	1.2 J ¹	0.3 J	49.5 J	2.0 J
	02/17/21	02/24/21	0.7 J ¹	0.4 J	17.5 J	1.6 J
	02/24/21	03/03/21	0.3 J ¹	0.2 J	17.1 J	1.2 J
	03/03/21	03/10/21	1.0 J ¹	0.3 J	29.9 J	1.5 J
	03/10/21	03/17/21	1.0 J ¹	0.3 J	30.8 J	1.4 J
03/17/21	03/24/21	0.6 J ³	0.3 J	22.3 J	1.3 J	
03/24/21	03/31/21	0.9 J ¹	0.3 J	19.5 J	1.2 J	
Sand Dunes Tower	12/30/20	01/06/21	1.2	0.3	65.8	1.7
	01/06/21	01/13/21	0.9	0.2	69.5	1.7
	01/13/21	01/20/21	0.5	0.2	41.5	1.4
	01/20/21	01/27/21	1.2	0.3	64.7	1.7
	01/27/21	02/03/21	1.1 J ¹	0.3 J	43.3 J	1.6 J
	02/03/21	02/10/21	0.8	0.2	31.3	1.2
	02/10/21	02/17/21	1.5 J ¹	0.3 J	74.4 J	2.1 J
	02/17/21	02/24/21	0.4	0.2	19.5	1.0
	02/24/21	03/03/21	0.6 J ¹	0.2 J	27.5 J	1.2 J
	03/03/21	03/10/21	1.8 J ¹	0.4 J	55.5 J	1.9 J
	03/10/21	03/17/21	1.5 J ⁴	0.4 J	58.2 J	2.1 J
	03/17/21	03/24/21	NS ⁵	NS	NS	NS
	03/24/21	03/31/21	NS ⁵	NS	NS	NS

Table A-1 continued. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	12/30/20	01/06/21	0.4	0.2	26.9	1.2
	01/06/21	01/13/21	0.4	0.2	33.9	1.3
	01/13/21	01/20/21	0.4	0.2	15.3	0.9
	01/20/21	01/27/21	0.7	0.2	31.9	1.2
	01/27/21	02/03/21	0.4	0.2	17.7	1.2
	02/03/21	02/10/21	R ⁶	R	R	R
	02/10/21	02/17/21	R ⁶	R	R	R
	02/17/21	02/24/21	0.3 J ¹	0.3 J	11.6 J	1.4 J
	02/24/21	03/03/21	R ⁶	R	R	R
	03/03/21	03/10/21	NS ⁵	NS	NS	NS
	03/10/21	03/17/21	NS ⁵	NS	NS	NS
	03/17/21	03/24/21	NS ⁵	NS	NS	NS
	03/24/21	03/31/21	NS ⁵	NS	NS	NS
Boundary Locations						
Atomic City	12/29/20	01/06/21	0.5 ⁷	0.2	33.9	1.2
	01/06/21	01/13/21	0.7	0.2	37.0	1.3
	01/13/21	01/20/21	0.4	0.2	19.2	1.0
	01/20/21	01/27/21	0.7	0.2	38.8	1.4
	01/27/21	02/03/21	0.3 J ¹	0.2 J	20.1 J	1.2 J
	02/03/21	02/10/21	0.5 J ¹	0.3 J	25.6 J	1.6 J
	02/10/21	02/17/21	R ⁶	R	R	R
	02/17/21	02/24/21	R ⁶	R	R	R
	02/24/21	03/03/21	0.5 J ¹	0.2 J	17.9 J	1.3 J
	03/03/21	03/10/21	R ⁶	R	R	R
	03/10/21	03/17/21	R ⁶	R	R	R
	03/17/21	03/24/21	R ⁶	R	R	R
	03/24/21	03/31/21	R ⁶	R	R	R
Howe	12/30/20	01/06/21	0.6	0.2	25.5	1.1
	01/06/21	01/13/21	0.3	0.2	28.7	1.2
	01/13/21	01/20/21	0.5	0.2	16.2	1.0
	01/20/21	01/27/21	0.6	0.2	25.8	1.1
	01/27/21	02/03/21	0.4 J ¹	0.2 J	19.0 J	1.3 J
	02/03/21	02/10/21	R ⁶	R	R	R
	02/10/21	02/17/21	R ⁶	R	R	R
	02/17/21	02/24/21	R ⁶	R	R	R
	02/24/21	03/03/21	R ⁶	R	R	R
	03/03/21	03/10/21	NS ⁵	NS	NS	NS
	03/15/21	03/17/21	R ^{6,8}	R	R	R
	03/17/21	03/24/21	1.0	0.3	28.4	1.2
	03/24/21	03/31/21	2.0	0.4	26.3	1.3

Table A-1 continued. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Montevieu	12/29/20	01/06/21	0.6 ⁷	0.2	46.6	1.4
	01/06/21	01/13/21	0.7	0.2	52.7	1.5
	01/13/21	01/20/21	0.4	0.2	32.9	1.3
	01/20/21	01/27/21	1.0	0.2	52.9	1.6
	01/27/21	02/03/21	0.5	0.2	27.9	1.2
	02/03/21	02/10/21	0.5 J ¹	0.2 J	24.9 J	1.2 J
	02/10/21	02/17/21	1.8 J ¹	0.3 J	58.5 J	1.8 J
	02/17/21	02/24/21	0.4 J ¹	0.2 J	18.3 J	1.1 J
	02/24/21	03/03/21	0.5 J ¹	0.2 J	25.7 J	1.2 J
	03/03/21	03/10/21	1.1 J ¹	0.3 J	36.6 J	1.4 J
	03/10/21	03/17/21	1.1 J ¹	0.3 J	34.9 J	1.4 J
	03/17/21	03/24/21	0.8 J ¹	0.3 J	30.0 J	1.3 J
	03/24/21	03/31/21	0.9 J ¹	0.3 J	24.8 J	1.2 J
Mud Lake	12/30/20	01/06/21	0.7	0.2	45.6	1.4
	01/06/21	01/13/21	0.7	0.2	50.7	1.5
	01/13/21	01/20/21	0.5	0.2	30.5	1.2
	01/20/21	01/27/21	1.1	0.2	49.9	1.5
	01/27/21	02/03/21	0.5 J ¹	0.2 J	30.6 J	1.4 J
	02/03/21	02/10/21	0.6 J ¹	0.2 J	27.8 J	1.3 J
	02/10/21	02/17/21	1.8 J ¹	0.3 J	63.4 J	1.9 J
	02/17/21	02/24/21	0.4 J ¹	0.2 J	22.1 J	1.3 J
	02/24/21	03/03/21	0.7 J ¹	0.2 J	29.2 J	1.4 J
	03/03/21	03/10/21	1.3 J ¹	0.3 J	45.6 J	1.8 J
	03/10/21	03/17/21	1.5 J ¹	0.3 J	38.8 J	1.6 J
	03/17/21	03/24/21	0.7 J ¹	0.3 J	27.1 J	1.3 J
	03/24/21	03/31/21	1.2 J ¹	0.4 J	25.8 J	1.5 J
Distant Locations						
Craters of the Moon	12/30/20	01/06/21	0.4	0.2	29.4	1.2
	01/06/21	01/13/21	0.5	0.2	29.4	1.2
	01/13/21	01/20/21	0.2	0.2	15.7	0.9
	01/20/21	01/27/21	0.6	0.2	38.8	1.4
	01/27/21	02/03/21	0.5 J ¹	0.2 J	18.8 J	1.1 J
	02/03/21	02/10/21	0.4 J ¹	0.2 J	19.6 J	1.2 J
	02/10/21	02/17/21	1.1 J ¹	0.3 J	41.1 J	1.7 J
	02/17/21	02/24/21	0.2 J ¹	0.2 J	10.8 J	1.1 J
	02/24/21	03/03/21	0.5 J ¹	0.3 J	22.6 J	1.6 J
	03/03/21	03/10/21	0.8 J ¹	0.3 J	35.6 J	1.7 J
	03/10/21	03/17/21	0.8 J ¹	0.3 J	36.3 J	1.7 J
	03/17/21	03/24/21	0.5 J ¹	0.3 J	25.0 J	1.5 J
	03/24/21	03/31/21	0.7 J ¹	0.3 J	21.5 J	1.4 J

Table A-1 continued. Weekly concentrations (in 1×10^{-3} pCi/m³) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2021.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall¹	12/30/20	01/06/21	0.9	0.3	37.9	1.3
	01/06/21	01/13/21	1.3	0.3	49.5	1.5
	01/13/21	01/20/21	0.7	0.2	29.8	1.2
	01/20/21	01/27/21	1.6	0.3	61.1	1.6
	01/27/21	02/03/21	0.7	0.2	26.6	1.1
	02/03/21	02/10/21	0.8	0.2	20.0	1.0
	02/10/21	02/17/21	1.5	0.3	38.4	1.3
	02/17/21	02/24/21	0.3	0.2	11.8	0.9
	02/24/21	03/03/21	0.8	0.2	21.1	1.0
	03/03/21	03/10/21	1.7	0.3	42.0	1.4
	03/10/21	03/17/21	1.2	0.3	36.5	1.3
	03/17/21	03/24/21	1.1	0.3	28.6	1.2
	03/24/21	03/31/21	1.1	0.3	22.2	1.1
Idaho Falls	12/30/20	01/06/21	0.4	0.2	23.6	1.1
	01/06/21	01/13/21	0.5	0.2	30.4	1.2
	01/13/21	01/20/21	0.4	0.2	19.8	1.0
	01/20/21	01/27/21	0.7	0.2	31.0	1.2
	01/27/21	02/03/21	0.3 J ¹	0.2 J	18.5 J	1.2 J
	02/03/21	02/10/21	0.6 J ¹	0.3 J	23.8 J	1.7 J
	02/10/21	02/17/21	1.3 J ¹	0.4 J	50.6 J	2.3 J
	02/17/21	02/24/21	0.4 ¹⁰	0.3	11.7	1.3
	02/24/21	03/03/21	0.5	0.2	17.7	1.0
	03/03/21	03/10/21	1.2 J ³	0.3 J	39.4 J	1.5 J
	03/10/21	03/17/21	0.7	0.2	32.5	1.3
	03/17/21	03/24/21	0.8 J ¹	0.2 J	25.9 J	1.2 J
	03/24/21	03/31/21	0.7	0.2	19.9	1.0
Idaho Falls^{DP}	12/30/20	01/06/21	0.5 ¹¹	0.2	35.1	1.3
	01/06/21	01/13/21	1.1	0.2	47.0	1.4
	01/13/21	01/20/21	0.5	0.2	29.8	1.2
	01/20/21	01/27/21	1.1	0.2	50.5	1.5
	01/27/21	02/03/21	0.5	0.2	22.3	1.0
	02/03/21	02/10/21	0.8	0.2	22.5	1.0
	02/10/21	02/17/21	1.1 J ¹	0.3 J	47.2 J	1.6 J
	02/17/21	02/24/21	0.4	0.2	9.9	0.8
	02/24/21	03/03/21	0.4 J ¹	0.2 J	18.7 J	1.1 J
	03/03/21	03/10/21	1.5 J ³	0.3 J	44.1 J	1.8 J
	03/10/21	03/17/21	1.1 J ¹	0.3 J	35.5 J	1.5 J
	03/17/21	03/24/21	0.9 J ¹	0.3 J	30.2 J	1.4 J
	03/24/21	03/31/21	1.0 J ¹	0.2 J	17.6 J	1.0 J

¹Faulty sampler indicated flow rate – air volume was estimated. Values are qualified as estimates (J).

²Deployed a new Model HVP-4304VFC TSP Sampler on 2/19/21 – estimated air volume.

³Power outage - airflow totalizer failure – estimated air volume.

⁴Partial sample – air volume was estimated.

⁵NS – No sample - instrument taken out of service for repair/replacement.

⁶Insufficient air sample volume for valid analysis; result was rejected (R).

⁷Deployed a new Model HVP-4304VFC TSP Sampler on 12/29/20.

⁸Partial air sample – Sampler started on 3/15/21.

⁹Sampler owned and operated by the Shoshone-Bannock Tribes.

¹⁰Sampler was shut down for service on 2/22/21.

¹¹Deployed a new Model HVP-4304VFC TSP Sampler on 12/30/20.

^{DP}Sampler being run as a duplicate.

Appendix B

Table B.1. Results for all electret ionization chamber (EIC) locations, first quarter, 2021.

Sample Location	Net Corrected Exposure Rate ($\mu\text{R/hr}$) ¹	± 2 SD ($\mu\text{R/hr}$)
Arco	13.6	4.4
Craters of the Moon	10.9	1.7
Big Lost River Rest Area	13.6	2.3
Van Buren Avenue	15.0	4.2
Experimental Field Station	15.5	4.1
Main Gate	12.5	3.7
Atomic City	9.9	1.7
Taber	10.0, 10.4	-
Blackfoot	9.9	2.3
Ft. Hall	11.7	5.3
Idaho Falls	8.7	1.8
Mud Lake/ Terreton	9.8	3.7
Monteview	12.8	3.3
Sand Dunes	11.2	5.1
Howe Met. Tower	12.3	3.2
MP282 -20	11.2	3.3
MP280 -20	11.1	3.3
MP278 -20	10.3	2.2
MP276 -20	12.3	2.8
MP274 -20	8.7	2.1
MP272 -20	13.3	5.5
MP270 -20	15.2	1.2
MP268 -20	13.0	4.5
MP266 -20	11.0	4.8
MP264 -20	10.8	3.8
MP270 -20/26	15.9, 17.6	-
MP268 -20/26	10.3, 11.5	-
MP266 -20/26	12.6	3.7
MP263 -20/26	13.3	4.7
MP261 -20/26	8.6	2.4
MP259 -20/26	13.7	3.2
MP256 -20/26	9.9	3.0
MFC (EBR II)	13.2	3.1
EBR I	11.1	1.8
RWMC	11.2	3.3
CFA	13.4	1.9
CITRC (PBF)	12.5	1.2
INTEC	18.1	2.3
ATR (TRA)	11.5	2.8
NRF	12.4	1.6
TAN/SMC	12.4	3.2
Mud Lake Bank of Commerce	14.9	4.6
MP43-33	13.4	2.9
MP41-33	14.0	4.7
MP39-33	11.8	2.4
MP37-33	11.8, 14.4	-
MP35-33	11.8	4.4
MP33-33	14.1	1.7
MP31-33	12.1	1.9
MP29-33	14.3	4.5

Table B.1 cont. Results for all electret ionization chamber (EIC) locations, first quarter, 2021.

Sample Location	Net Corrected Exposure Rate ($\mu\text{R/hr}$) ¹	± 2 SD ($\mu\text{R/hr}$)
MP27-33	12.7	0.7
MP25-33	12.3	3.5
MP23-33	12.9	4.4
MP21-33	11.1	1.1
MP19-33	12.4	0.6
MP14-33	8.9	3.3
MP11-33	9.3	1.7
MP06-33	10.1	2.2
MP03-33	10.0	0.3
Base of Howe	12.3	1.9
Rover	13.3	4.9
Hamer	12.5	3.7
Sugar City	15.0	1.4
Roberts	13.0	5.1
Big Southern Butte	11.6	4.2
T4 North	11.1	4.1
T4 South	9.2	2.6

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.