

Department of Environmental Quality
INL Oversight Program

**ENVIRONMENTAL SURVEILLANCE PROGRAM
QUARTERLY DATA REPORT**

January - March, 2017



Boise Office
1410 N. Hilton
Boise, Idaho 83706
208-373-0428

Idaho Falls Office
900 N. Skyline, Suite B
Idaho Falls, Idaho 83402
208-528-2600

Table of Contents

Table of Acronyms	v
Introduction.....	1
Air and Precipitation Monitoring Results.....	1
Environmental Radiation Monitoring Results.....	7
Water Monitoring Results.....	9
Terrestrial Monitoring Results	13
Quality Assurance	14

List of Tables

Table 1. Sampling locations and sample type.....	4
Table 2. Range of gross alpha and gross beta concentrations for TSP filters, first quarter, 2017.	4
Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, first quarter, 2017.....	5
Table 4. Tritium concentrations in air from atmospheric moisture, first quarter, 2017.....	5
Table 5. Tritium and Cesium-137 concentrations from precipitation, first quarter, 2017.	6
Table 6. Annual radiochemical separation analysis data for TSP particulate filters collected during 2016....	6
Table 7. Summary of instrumentation at radiation monitoring stations.....	8
Table 8. Average gamma exposure rates, first quarter, 2017, from HPIC network.....	8
Table 9. Electret ionization chamber (EIC) cumulative average exposure rates, first quarter, 2017.....	9
Table 10. Enriched tritium concentrations for water samples from previous sampling quarters.....	12
Table 11. Gamma spectroscopy analysis data for milk samples, first quarter, 2017.	13
Table 12. Summary of the analytical performance and usability of the analyses performed for the DEQ- INL OP ESP, first quarter, 2017.	18
Table 13. Blank analysis results for gross alpha and beta in particulate air (TSP), first quarter, 2017.	19
Table 14. Blank analysis results for gamma spectroscopy for TSP particulate air filters, composite samples, first quarter, 2017.....	19
Table 15. Blank analysis results for tritium in water vapor from air samples, first quarter, 2017.....	19
Table 16. Blank analysis results for 2016 TSP annual radiochemical composites of air filters.	19
Table 17. Duplicate radiological analysis results in pCi/L for groundwater and/or surface water, first quarter, 2017.	20
Table 18. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), first quarter, 2017.	20
Table 19. Air sampling field equipment service reliability (percent operational), first quarter, 2017.....	21
Table A-1. Weekly concentrations (in 1×10^{-3} pCi/m ³) for gross alpha and gross beta analyses for TSP filters for all locations, first quarter, 2017	22
Table B.1. Results for all electret ionization chamber (EIC) locations, first quarter, 2017.....	26

List of Figures

Figure 1. Air and radiation (Rad) monitoring locations.....	3
Figure 2. Distant and Surface Water monitoring locations.....	10
Figure 3. Up-gradient, facility, boundary, and wastewater monitoring locations.....	11

Table of Acronyms

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

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, 2017 (**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. Starting midway through the 3rd quarter 2016 another model HVP 4304 TSP sampler was started at Idaho Falls air station alongside the current sampler (HVP 3804). The new sampler (HVP 4304) is being operated to test dependability and durability under field conditions. 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 spectroscopy. Typically, gamma spectroscopy results are only reported when exceeding a minimum detectable activity (MDA) or minimum detectable concentration (MDC). Gamma spectroscopy results for the first quarter of 2017 for TSP filters are presented in **Table 3**. The only reported gamma-emitting radionuclide was beryllium-7, a naturally occurring, cosmogenic radionuclide.

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 6**). 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 190 for Americium-241, 1900 for Strontium-90, 210 for Plutonium-238, and 200 for

Plutonium-239/240 (in 1×10^{-6} 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. There is one result which exceeded the ⁹⁰Sr MDC for the 2016 annual composite at the Rest Area sampling site. Though minimally exceeding the MDC, the result is 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. 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. All results are below MDCs and below the DEQ-INL OP action level of 150 pCi/m³ (40 CFR 61). Average atmospheric tritium concentrations are presented in **Table 4**.

Precipitation samples were collected at six monitoring locations during the first quarter of 2017. Precipitation samples were analyzed for tritium and 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 gamma-emitting radionuclides were below minimum detectable concentration in precipitation collected during the first quarter of 2017. Tritium and Cesium-137 analysis results are presented in **Table 5**.

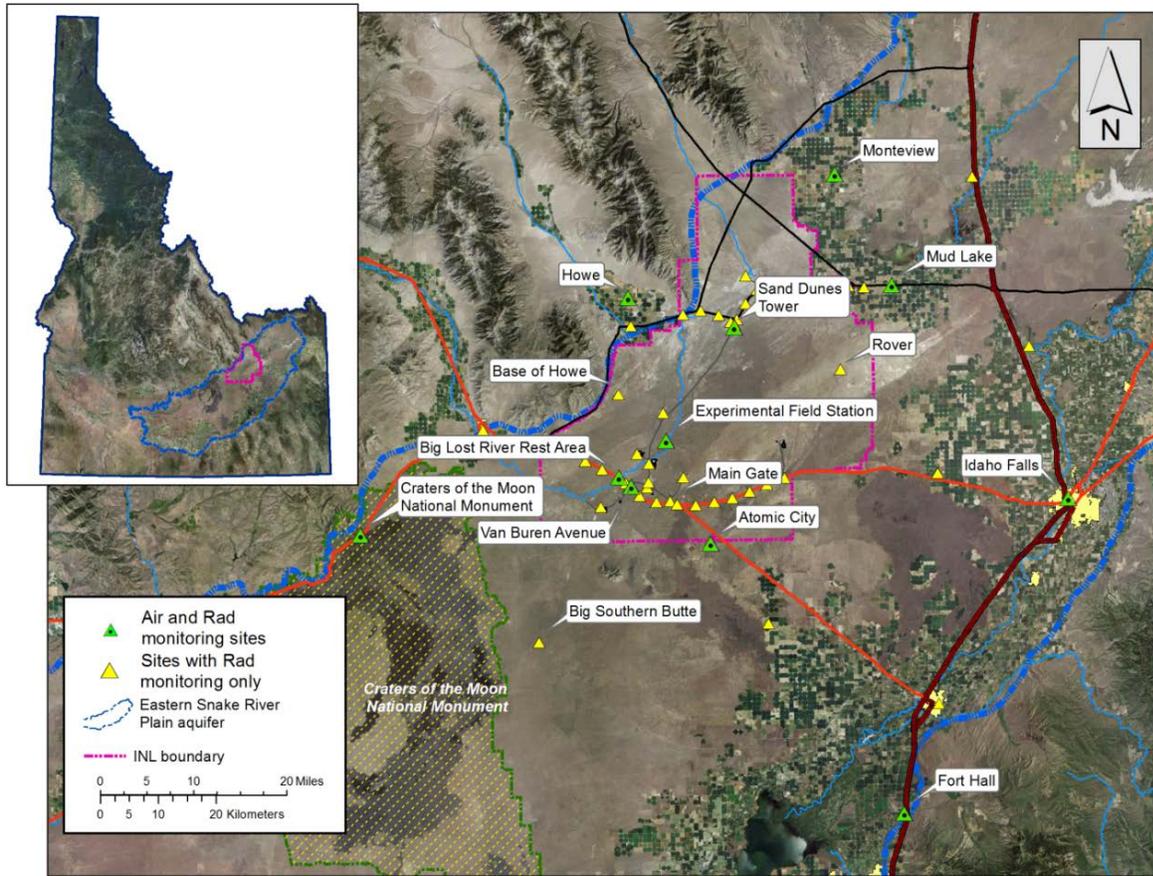


Figure 1. Air and radiation (Rad) monitoring locations.

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"/>	
Sand Dunes Tower	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Van Buren Avenue	<input type="checkbox"/>	<input 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"/>	
Fort Hall ²	<input type="checkbox"/>	<input 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.

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

Table 2. Range of gross alpha and gross beta concentrations for TSP filters, first quarter, 2017.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.4	-	1.1	13.9	-	53.0
Experimental Field Station	0.2	-	1.3	10.6	-	57.9
Sand Dunes Tower	0.3	-	0.9	9.1	-	56.3
Van Buren Avenue	0.2	-	0.6	10.0	-	35.2
Boundary Locations						
Atomic City	0.2	-	0.7	9.8	-	43.4
Howe	0.2	-	0.8	11.0	-	38.9
Monteview	0.2	-	1.6	10.9	-	68.5
Mud Lake	0.4	-	1.4	16.4	-	77.3
Distant Locations						
Craters of the Moon	0.2	-	0.8	12.0	-	37.3
Fort Hall ¹	NS ²	-	NS ²	NS ²	-	NS ²
Idaho Falls – HVP 3804	0.3	-	1.2	14.7	-	58.7
Idaho Falls – HVP 4304	0.2	-	1.1	9.1	-	33.6

¹ Operated by Shoshone-Bannock Tribes.

²Sampler out of service.

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

Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, first quarter, 2017.

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	62.7	3.3	<MDC ²	
Experimental Field Station	50.4	2.7	<MDC	
Sand Dunes Tower	43.9	2.4	<MDC	
Van Buren Avenue	46.1	2.5	<MDC	
Boundary Locations				
Atomic City	50.1	2.7	<MDC	
Howe	46.7	2.6	<MDC	
Monteview	51.4	2.8	<MDC	
Mud Lake	65.3	3.4	<MDC	
Distant Locations				
Craters of the Moon	71.3	3.8	<MDC	
Fort Hall ¹	NS ³	NS ³	NS ³	
Idaho Falls – HVP 3804	67.0	3.5	<MDC	
Idaho Falls – HVP 4304	47.0	2.5	<MDC	

¹Operated by Shoshone-Bannock Tribes.

²MDC for Cs-137 typically $(0.05-0.10) \times 10^{-3}$ pCi/m³.

³NS – Sampler out of service.

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

Table 4. Tritium concentrations in air from atmospheric moisture, first quarter, 2017.

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.08	0.35	0.58
Experimental Field Station	0.28	0.27	0.44
Sand Dunes Tower	-0.04	0.31	0.52
Van Buren Avenue	0.20	0.30	0.50
Boundary Locations			
Atomic City	0.12	0.29	0.48
Howe	0.13	0.27	0.44
Mud Lake	0.12	0.22	0.36
Monteview	0.27	0.31	0.50
Distant Locations			
Craters of the Moon	0.11	0.33	0.53
Fort Hall ¹	-0.02	0.22	0.37
Idaho Falls	0.20	0.39	0.63

¹Operated by Shoshone-Bannock Tribes.

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

Table 5. Tritium and Cesium-137 concentrations from precipitation, first quarter, 2017.

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	-30	110	180	0.2	2.4	4.0
Boundary Locations						
Atomic City	-40	110	180	-0.1	1.5	2.6
Howe	-20	110	180	1.6	2.3	3.8
Monteview	-40	110	180	0.1	2.2	3.7
Mud Lake	120	110	180	0.3	1.3	2.3
Distant Locations						
Idaho Falls	100	110	180	0.5	1.4	2.4

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

Table 6. Annual radiochemical separation analysis data for TSP particulate filters collected during 2016.

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												
Rest Area	14.7	6.2	9.6	2.9	4.2	7.2	1.5	1.8	2.8	1.9	3.7	6.4
EFS ³	-1.3	5.4	10.5	-1.8	3.6	7.3	-3.3	3.0	6.8	1.4	3.3	5.8
Sand Dunes	-2.0	4.4	8.5	0.9	4.4	8.1	-4.3	3.3	7.6	3.3	2.9	4.4
Van Buren	-2.8	4.7	9.2	-1.3	2.9	5.9	0.7	1.2	2.0	0.8	2.4	4.3
Boundary Locations												
Atomic City	2.4	4.3	7.9	-0.9	3.7	7.2	-0.9	2.7	5.6	-0.8	2.7	5.4
Howe	6.3	5.7	10.1	2.0	3.7	6.5	0.7	2.3	4.3	1.2	3.3	5.9
Monteview	1.3	5.3	9.9	3.9	4.1	6.5	1.2	2.4	4.3	0.3	3.2	6.2
Mud Lake	5.3	5.3	9.5	1.5	3.0	5.2	-0.8	1.9	4.1	0.5	2.1	3.9
Distant Locations												
Craters of Moon	2.1	5.7	10.7	0.8	3.9	7.1	1.2	1.7	2.8	2.0	3.3	5.7
Fort Hall ²	3.5	6.7	12.4	5.9	6.7	11.0	2.9	2.8	3.7	-1.8	6.2	12.3
Idaho Falls 3804	0.4	3.8	7.3	0.3	4.9	9.4	-2.2	3.1	7.3	1.4	4.8	8.6
Idaho Falls 4304	NS ⁴	NS ⁴	NS ⁴	NS ⁴	NS ⁴	NS ⁴	NS ⁴	NS ⁴	NS ⁴	NS ⁴	NS ⁴	NS ⁴

Note: Concentrations are reported in 1×10^{-6} 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 190 for americium-241, 1900 for strontium-90, 210 for plutonium-238, and 200 for plutonium-239/240 (in 1×10^{-6} 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. The Ft. Hall sampler did not operate after September 1, 2016.

³ Experimental Field Station.

⁴ Idaho Falls 4304 Duplicate filters were not analyzed because different filter media was used at various times and there was no sampling for extended periods of time.

Environmental Radiation Monitoring Results

The ESP operated 14 environmental radiation stations during the first quarter of 2017 (**Figure 1**). To detect gamma radiation, each station is instrumented with triplicate electret ionization chambers (EIC), and 11 of the stations also are equipped with a high-pressure ion chamber (HPIC) (**Table 7**).

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

HPICs 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 HPICs at each location are radioed to DEQ-INL OP and presented graphically via the worldwide web at <http://www.deq.idaho.gov/inl-oversight/monitoring/gamma-radiation-measurements.aspx>.

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 an additional 40 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 8** lists the average radiation exposure rates measured by the HPICs for first quarter 2017. **Table 9** lists the EIC monitoring results for first quarter 2017. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

Table 7. Summary of instrumentation at radiation monitoring stations.

Station Location	Instrument Type	
	HPIC	EIC
On-site Locations		
Base of Howe	■	■
Big Lost River Rest Area	■	■
Experimental Field Station		■
Main Gate	■	■
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 8. Average gamma exposure rates, first quarter, 2017, from HPIC network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
¹ Base of Howe	--	--
Big Lost River Rest Area	12.4	2.8
Main Gate	12.7	2.5
¹ Rover	--	--
Sand Dunes Tower	12.0	1.7
Boundary Locations		
Atomic City	9.8	2.7
¹ Big Southern Butte	--	--
Howe Met Tower	10.2	2.9
Monteview	11.7	1.9
Mud Lake / Terreton	12.8	2.2
Distant Locations		
Fort Hall	11.3	2.5
Idaho Falls	11.4	2.5

¹Base of Howe, Rover, and Big Southern Butte locations HPIC electronics had various electronic malfunctions and/or extreme temperature interference, no data is available for first quarter 2017 at these locations.

Table 9. Electret ionization chamber (EIC) cumulative average exposure rates, first quarter, 2017.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average ¹	± 2 SD
On-Site Locations		
² Base of Howe	8.8	0.6
Big Lost River Rest Area	10.8	2.8
Experimental Field Station	11.9	1.1
Main Gate	13.8, 14.5	
³ Rover	9.7, 11.1	
Sand Dunes Tower	11.7	1.4
Van Buren Avenue	10.3	2.2
Boundary Locations		
Atomic City	7.7	1.8
⁴ Big Southern Butte	8.2	1.4
Howe Met Tower	12.7	0.5
Monteview	11.4, 11.7	
Mud Lake/Terreton	9.5	2.6
Distant Locations		
Craters of the Moon	7.8	2.4
Fort Hall	8.8	2.1
Idaho Falls	8.9	3.4

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

^{2,3,4} Base of Howe, Big Southern Butte, and Rover EIC's could not be collected in January due to weather/road conditions. The data reported in this table for these locations represents the average exposure rate from October 2016 through April 2017.

Water Monitoring Results

Water monitoring sites are sampled for the purposes of examining trends of INL contaminants and other general ground water quality indicators and for verifying DOE monitoring results. Sites sampled include ground water locations (wells and springs), surface water locations (streams), and selected wastewater sites. Sample sites have been selected to aid in identifying INL impacts on the Eastern Snake River Plain Aquifer (ESRPA), and are categorized as up-gradient, facility, boundary, distant, surface water, and waste water, (**Figure 2 and Figure 3**). Up-gradient locations are not impacted by INL operations and are considered representative of background ground water quality conditions. Facility sites are sample locations on the INL near facilities, in areas of known contamination, or wells selected to illustrate trends for specific INL contaminants or indicators of ground water quality. Boundary locations are on or near the perimeter of the INL and are down-gradient of potential sources of INL contamination. Distant locations are monitored to provide trends in water quality down-gradient of the INL and include wells and springs used for irrigation, public water supply, livestock, domestic, and industrial purposes. During the first quarter of 2017, no water monitoring sites were sampled.

Most sites sampled by DEQ-INL OP are sampled with another agency or organization. Samples are collected at about the same time using the same collection equipment as the other agency or organization (co-sampled). DEQ-INL OP verifies work by these agencies monitoring on behalf of DOE by comparing results from co-sampled sites.

Gross alpha and gross beta analyses are conducted as a screening tool for alpha and beta emitting radionuclides potentially released from INL operations. Quantitative gamma analyses are conducted to

identify and determine concentrations of gamma emitting radionuclides. Selected sites are sampled for the man-made, alpha emitting isotopes of plutonium (^{238}Pu , $^{239/240}\text{Pu}$), uranium (^{234}U , ^{235}U , and ^{238}U), and americium (^{241}Am); and beta emitting radionuclides technetium-99 (^{99}Tc), strontium-90 (^{90}Sr), and tritium (^3H), based on historic INL contamination. In the event of suspect or unexpected levels of gross radioactivity, additional samples may also be analyzed for other specific radionuclides.

No locations were sampled and no analyses were performed for gross alpha, gross beta, or quantitative gamma for this quarter. The EPA maximum contaminant level (MCL) for alpha particles is 15 pCi/L. The MCL for beta and gamma radioactivity is 4 mrem/year, equivalent to 8 pCi/L if the source is ^{90}Sr ; 900 pCi/L if ^{99}Tc ; 20,000 pCi/L if tritium (^3H); or 200 pCi/L if ^{137}Cs .

No locations were sampled and no analyses were performed for isotopes of plutonium, isotopes of uranium, ^{241}Am , ^{99}Tc , ^{90}Sr or ^3H for this quarter. Selected water samples with tritium concentrations not measurable using the standard method (typically a MDC of 130 pCi/L) are analyzed using an electrolytic enrichment method with a much lower MDC of 10 to 14 pCi/L. There were no samples analyzed using the enrichment method for the current quarter. However, sample analyses from eleven sites collected during previous quarters were completed and presented this quarter (**Table 10**). A backlog of 78 samples remains.

No locations were sampled and no analyses were performed for metals, common ions, nutrients, or volatile organic compounds (VOC's) this quarter.

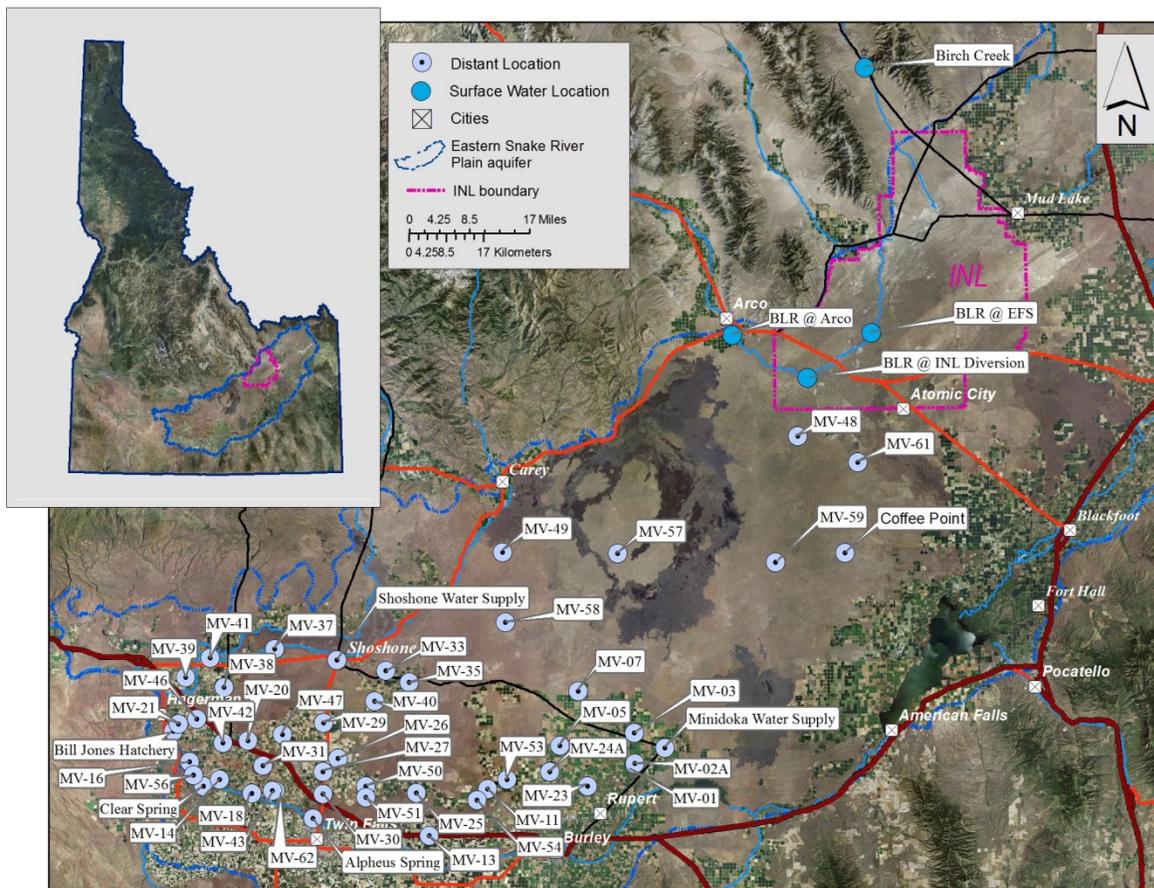


Figure 2. Distant and Surface Water monitoring locations.

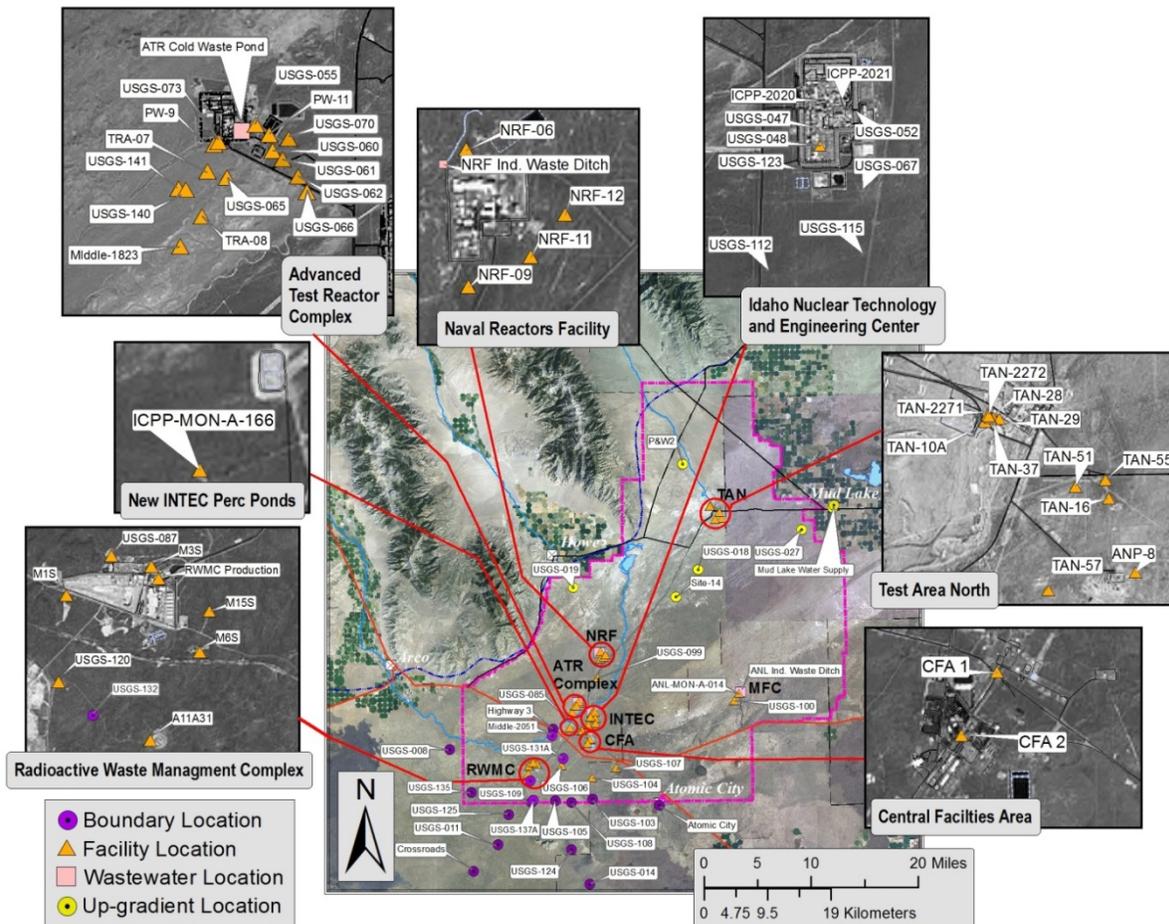


Figure 3. Up-gradient, facility, boundary, and wastewater monitoring locations.

Table 10. Enriched tritium concentrations for water samples from previous sampling quarters.

Sample Location	Sample Date	Enriched Tritium		
		Concentration ^{1,2}		±2 SD
Facility				
NRF-11	5/12/2015	26		8
M1S	11/2/2015	5	U	6
Boundary				
Atomic City	4/15/2015	5	U	6
USGS-105	6/17/2015	234		15
USGS-131A	6/29/2016	808	J	10
USGS-132	6/09/2015	207		14
Middle-2051	6/30/2016	178	J	11
Distant				
Alpheus Spring	5/11/2015	16		7
Shoshone Water Supply	5/11/2015	10		6
MV-42	6/29/2015	15		7
MV-58	6/09/2016	11	UJ	7

¹Data qualifiers: U = non-detection, J = estimate, R = rejected.

²Concentrations expressed in pCi/L.

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 2017.

Milk

DEQ-INL OP monitors milk for the naturally occurring radionuclide potassium-40 (^{40}K) and man-made iodine-131 (^{131}I). Milk samples are collected on a monthly basis. Results for analyses of milk samples are presented in **Table 11**. ^{40}K was detected in all samples within the expected range of concentration. ^{131}I was not detected. Based on measurements of radionuclides in milk, there were no discernable impacts to the off-site environment from INL operations.

Table 11. Gamma spectroscopy analysis data for milk samples, first quarter, 2017.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131 ¹
		Concentration ³	± 2 SD	
Monitoring Samples				
Riverside	01/08/2017	1789	129	<MDC
	02/06/2017	1435	112	<MDC
	03/05/2017	1513	116	<MDC
Gooding/Glanbia	01/10/2017	1392	115	<MDC
	03/07/2017	1274	104	<MDC
Verification Samples²				
Dietrich	01/03/2017	1295	111	<MDC
Howe	01/03/2017	1371	107	<MDC
Terreton	02/07/2017	1410	99	<MDC
Rupert	02/06/2017	1381	116	<MDC
Dietrich	03/07/2017	1323	95	<MDC
Idaho Falls	03/07/2017	1383	115	<MDC

¹ <MDC – Less than Minimum Detectable Concentration (approximately 4 pCi/L for iodine-131).

² DEQ-INL OP samples collected by the off-site INL environmental surveillance contractor.

³ Concentrations with associated uncertainties (± 2 SD) are expressed in pCi/L.

Quality Assurance

The measurement of any physical quantity is subject to inaccuracy from errors that may be introduced during sample collection, measurement, calibration, and the reading and reporting of results. While all of these inaccuracies cannot be quantified with certainty for each analytical result, a quality assurance program can evaluate the overall quality of a data set and, in many cases, identify and address errors or inaccuracies. The DEQ-INL OP quality assurance program is designed to (1) ensure sample integrity, (2) ensure precision and accuracy in the analytical results, and (3) ensure that the environmental data are representative and complete.

This section summarizes the results of the quality assurance (QA) assessment of the data collected for the first quarter of 2017 for the DEQ-INL OP's ESP. It also summarizes the quality control (QC) samples (spikes, blanks, and duplicates) submitted to the Idaho Bureau of Laboratories-Boise (IBL) for non-radiological analyses and to Idaho State University's Environmental Monitoring Laboratory (ISU-EML) for radiological analyses during the quarter. All analyses and QC measures at the analytical laboratories used by the ESP are performed in accordance with approved written procedures maintained by each respective analytical laboratory. Sample collection is performed in accordance with written procedures maintained by the DEQ-INL OP.

Analytical results for blanks, duplicates, and spikes are used to assess the precision, accuracy, and representativeness of results from analyzing laboratories. During the first quarter of 2017, the DEQ-INL OP submitted 43 QC samples for various radiological analyses (**Table 12**).

Blank Samples

Blank samples consist of matrices that have negligible, acceptably low, or immeasurable amounts of the analyte(s) of interest in them. They are designed to determine if an analysis will yield a "zero" result when no contaminant is present, or a sufficiently low result to serve as an acceptable measure of "background." Blank samples are used to monitor for bias introduced during sample collection, storage, shipment, and analysis. Blank sample results submitted for gross alpha and gross beta screening in air for the first quarter of 2017 are presented in **Table 13**.

Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 14**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 15**. Blank analysis results for radiochemical separation analyses for annual composites of TSP particulate filters collected during 2016 are presented in **Table 16**. No blank ground water, surface water, or wastewater samples were submitted for analysis during the quarter. There were no anomalies observed from the assessment of field blank samples as measured by the analytical laboratories used by DEQ-INL OP for the first quarter of 2017.

Duplicate Samples

A laboratory's analytical precision capability, i.e., its ability to reproduce results, is assessed by comparing duplicate sample results. Duplicate samples are samples collected from the same location at approximately the same time and are considered to be essentially identical in composition. The difference between duplicate sample results is expressed as the relative percent difference (RPD), calculated from the following equation:

$$RPD = (R_1 - R_2) / ((R_1 + R_2) / 2) * 100$$

Where:

R_1 = First sample result.

R_2 = Second sample result.

A relative percent difference of up to ± 20 percent is acceptable. For non-radiological analysis, the RPD is used to compare each set of duplicate samples in which both of the results exceed five times the detection level. If one or both of the duplicate sample results are less than five times the detection level, the absolute difference between the two results is acceptable if it is less than or equal to the method detection limit.

For radiological analysis, the RPD is calculated (using the above equation) to compare duplicate samples if both duplicate results are greater than the sample-specific minimum detectable concentration (MDC). DEQ-INL OP also considers duplicate sample results that have an absolute difference of no more than three times the pooled error (or "3 sigma") to be in acceptable agreement. This is accomplished using the following equation:

$$|R_1 - R_2| \leq 3(S_1^2 + S_2^2)^{1/2}$$

Where:

R_1 = First sample result.

R_2 = Second sample result.

S_1 = Uncertainty (one standard deviation) associated with the laboratory measurement of the first sample.

S_2 = Uncertainty (one standard deviation) associated with the laboratory measurement of the second sample.

Radiological duplicate sample results satisfying either the RPD or pooled error test are considered acceptable.

Duplicate results for ground and surface water are presented in **Table 17** for enriched tritium analyses. The duplicate analysis for enriched tritium failed both the RPD and pooled error tests. All sample results from the same batch as the failed duplicate were qualified with an "estimate (J)" flag in **Table 10**.

Spiked Samples

Spiked samples are samples to which known concentrations of specific analytes have been added in order to assess the bias a laboratory may have in accurately measuring these analytes. To determine agreement after laboratory analysis, DEQ-INL OP calculates the ratio of the spike concentration determined from the laboratory measurement to the known spike concentration in the sample. This result is known as percent recovery (%R) and the acceptable range used by DEQ-INL OP is 100 ± 25 percent. Additionally, all results were qualified as “estimates (J)” if the associated quality control spike sample had a recovery of 50 – 74% or 126 – 150%, provided that each result was greater than the instrument detection limit (IDL). All results were qualified as “rejected (R)” if the associated quality control spike sample had a recovery of < 50% or > 150%, provided each result was also greater than the IDL. During first quarter 2017, no field matrices were spiked to assess the influence of the sample media on laboratory performance.

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 2017 are presented in **Table 18**. 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.

There were no anomalies observed from the assessment of spiked samples as measured by the analytical laboratories used by DEQ-INL OP for the first quarter of 2017.

Laboratory QC Issues

There were no laboratory QC issues for this quarter.

Analytical QA/QC Assessment

Other than the one failed duplicate analysis for enriched tritium, 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 2017, which significantly affected data quality. Methodologies and data reports issued by the contracting laboratories generally conformed to the requirements of DEQ-INL OP during the first quarter of 2017.

Data usability is the measure of data that is not rejected compared to the amount that was expected to be obtained. The overall data usability rate for the first quarter of 2017 met the minimum criteria of the DEQ-INL OP ESP and is summarized in **Table 12**.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. During the first quarter of 2017 the TSP blower at the Atomic City sampling station was replaced and the radioiodine pump at Idaho Falls was replaced. Service reliability for air sampling equipment for the first quarter of 2017 is summarized in **Table 19**.

Conclusion

All data collected for the first quarter of 2017 have been assigned the applicable qualifiers to designate the appropriate use of the data. In addition, all data has been verified and deemed complete meeting the requirements and data quality objectives established by DEQ-INL OP.

Table 12. Summary of the analytical performance and usability of the analyses performed for the DEQ-INL OP ESP, first quarter, 2017.

Media Sampled	Collection Device	Analyte	Test Analyses	Blank Analyses	Duplicate Analyses	Spike Analyses	Data Rejected ¹	Analyzing Lab ²
Air								
Particulate	4-inch filter	Gross alpha	140	13	0	0	4	ISU-EML
		Gross beta	140	13	0	0	4	ISU-EML
		Gamma emitters	11	1	0	0	0	ISU-EML
		Radiochemical	44	4	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	22	2	0	0	ISU-EML	
Gaseous	Charcoal filter	Iodine-131	13	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	0	0	0	0	0	ISU-EML
		Gross beta	0	0	0	0	0	ISU-EML
		Gamma emitters	0	0	0	0	0	ISU-EML
		Tritium	0	0	0	0	0	ISU-EML
		Enriched tritium	11	0	1	0	0	ISU-EML
		Technetium-99	0	0	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
		Metals	0	0	0	0	0	IBL
		Common Ions	0	0	0	0	0	IBL
Nutrients	0	0	0	0	0	IBL		
Volatile Organics	0	0	0	0	0	IBL		
Terrestrial								
Milk	Grab or composite	Gamma emitters	11	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	54	0	0	9	0	DEQ-INL OP
	HPICs	Gamma Radiation	9	NA	NA	NA	0	DEQ-INL OP
Total Test Analyses			467	33	1	9	8	
Total of QC Analyses (blanks, duplicates, and spikes)			43					
Percentage of QC analyses of total Test analyses³			9.2%					
Percentage of usable data⁴			98.3%					

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 Analyzing quality control samples at a rate of approximately 5 to 10 percent of the total number of test analyses performed for the year is deemed appropriate for the DEQ-INL OP ESP.

⁴ Data usability rate [total analyses – rejected data]/[total analyses] of 90 percent or higher is acceptable for the DEQ-INL OP ESP.

Table 13. Blank analysis results for gross alpha and beta in particulate air (TSP), first quarter, 2017.

Collection Period		Corrected volume (m ³) ¹	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
12/29/16	01/05/17	2009	0.0	0.1	0.0	0.5
01/05/17	01/12/17	2009	-0.1	0.1	0.8	0.5
01/12/17	01/19/17	2009	0.0	0.1	0.2	0.5
01/19/17	01/26/17	2009	-0.1	0.1	0.3	0.5
01/26/17	02/02/17	2009	-0.1	0.1	-0.1	0.5
02/02/17	02/09/17	2009	0.1	0.1	0.2	0.5
02/09/17	02/16/17	2009	0.0	0.1	0.6	0.5
02/16/17	02/23/17	2009	0.0	0.1	-0.5	0.5
02/23/17	03/02/17	2009	0.1	0.1	-0.2	0.5
03/02/17	03/09/17	2009	0.0	0.1	-0.2	0.5
03/09/17	03/16/17	2009	0.2	0.1	0.1	0.5
03/16/17	03/22/17	2009	0.0	0.1	-0.1	0.5
03/22/17	03/30/17	2009	-0.1	0.1	-0.4	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 14. Blank analysis results for gamma spectroscopy for TSP particulate air filters, composite samples, first quarter, 2017.

Analysis Date	Beryllium-7			Ruthenium-106/Rhodium-106			Antimony-125		
	Concentration ¹	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
04/14/17	25	22	36	15	6	97	-4	6	11
Analysis Date	Cesium-134			Cesium-137					
	Concentration ¹	± 2 SD	MDC	Concentration	± 2 SD	MDC			
04/14/17	0	3	5	2	3	4			

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 15. Blank analysis results for tritium in water vapor from air samples, first quarter, 2017.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP171ZTR01	03/20/17	03/21/17	04/26/17	-0.03	0.09	0.15
OP171ZTR02	04/05/17	04/18/17	04/28/17	-0.04	0.08	0.15

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

Table 16. Blank analysis results for 2016 TSP annual radiochemical 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	-0.30	0.37	0.73	0.40	0.45	0.74	0.00	0.22	0.22	0.40	0.33	0.51

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 17. Duplicate radiological analysis results in pCi/L for groundwater and/or surface water, first quarter, 2017.

Analysis/Sample Location	Original Sample Number	Concentration	± 2 SD	Duplicate Sample Number	Concentration	± 2 SD	R ₁ -R ₂	3(S ₁ ² +S ₂ ²) ^{1/2}	Within Criteria? ¹
Enriched Tritium									
USGS-131A	161W345	808	24	161W346	1012	27	204	54	No

¹ | R₁-R₂ | ≤ 3(S₁²+S₂²)^{1/2} and RPD = -22%.

Table 18. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), first quarter, 2017.

Electret #	Exposure Received		Net Measured Exposure ¹		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SIR502	41.4	2.1	36.7	1.4	88.6	Y
SIR561	41.4	2.1	38.0	1.4	91.8	Y
SIR740	41.4	2.1	39.1	1.4	94.4	Y
Triplicate AVG:					91.6	Y
SIR437	30	1.5	26.8	1.4	89.3	Y
SIR497	30	1.5	26.1	1.4	87.0	Y
SIR615	30	1.5	25.0	1.4	83.3	Y
Triplicate AVG:					86.6	Y
SIR490	22.4	1.1	23.4	1.4	104.3	Y
SIR456	22.4	1.1	20.4	1.4	91.0	Y
SIR663	22.4	1.1	19.2	1.4	85.5	Y
Triplicate AVG:					93.6	Y

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

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

Table 19. Air sampling field equipment service reliability (percent operational), first quarter, 2017.

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	100%	100%	100%	NC ¹
Van Buren Avenue	100%	100%	100%	NC ¹
Boundary Locations				
Atomic City	92%	100%	100%	100%
Howe	100%	100%	100%	100%
Monteview	100%	100%	100%	100%
Mud Lake	100%	100%	100%	100%
Distant Locations				
Craters of the Moon	100%	100%	100%	NC ¹
Idaho Falls	100%	92%	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.

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, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Big Lost River Rest Area	12/29/16	01/05/17	0.7	0.2	42.2	1.4
	01/05/17	01/12/17	0.5	0.2	19.9	1.0
	01/12/17	01/19/17	0.8	0.2	53.0	1.5
	01/19/17	01/26/17	0.7	0.2	33.2	1.3
	01/26/17	02/02/17	1.1	0.3	49.5	1.5
	02/02/17	02/09/17	0.5	0.2	19.4	1.0
	02/09/17	02/16/17	0.5	0.2	28.2	1.2
	02/16/17	02/23/17	0.5	0.2	13.9	0.9
	02/23/17	03/02/17	0.4	0.2	17.6	1.0
	03/02/17	03/09/17	0.7	0.2	18.7	1.0
	03/09/17	03/16/17	0.6	0.2	23.4	1.1
	03/16/17	03/22/17	0.9	0.2	30.8	1.3
	03/22/17	03/30/17	0.4	0.2	14.9	0.9
Experimental Field Station	12/29/16	01/05/17	1.3	0.3	36.0	1.4
	01/05/17	01/12/17	0.3	0.2	19.6	1.0
	01/12/17	01/19/17	0.8	0.2	44.9	1.5
	01/19/17	01/26/17	0.4	0.2	29.6	1.2
	01/26/17	02/02/17	0.6	0.2	57.9	1.7
	02/02/17	02/09/17	R ¹	R ¹	R ¹	R ¹
	02/09/17	02/16/17	0.4	0.2	22.8	1.1
	02/16/17	02/23/17	0.2	0.1	10.6	0.9
	02/23/17	03/02/17	0.3	0.2	14.2	0.9
	03/02/17	03/09/17	0.5	0.2	14.0	0.9
	03/09/17	03/16/17	0.6	0.2	19.6	1.0
	03/16/17	03/22/17	0.6	0.2	23.8	1.2
	03/22/17	03/30/17	0.2	0.2	12.2	0.8
Sand Dunes Tower	12/29/16	01/05/17	0.8	0.2	41.8	1.3
	01/05/17	01/12/17	0.3	0.2	20.2	1.0
	01/12/17	01/19/17	0.9	0.2	51.5	1.5
	01/19/17	01/26/17	0.4	0.2	31.2	1.2
	01/26/17	02/02/17	0.8	0.2	56.3	1.5
	02/02/17	02/09/17	0.4	0.2	15.0	0.9
	02/09/17	02/16/17	0.3	0.1	19.7	1.0
	02/16/17	02/23/17	0.3	0.1	9.1	0.8
	02/23/17	03/02/17	0.3	0.1	12.5	0.8
	03/02/17	03/09/17	0.3	0.1	13.9	0.9
	03/09/17	03/16/17	0.5	0.2	16.3	0.9
	03/16/17	03/22/17	0.5	0.2	19.8	1.1
	03/22/17	03/30/17	0.4	0.2	10.3	0.7

¹R – Results rejected due to insufficient sample volume caused by a tripped breaker.

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, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	12/29/16	01/05/17	0.6	0.2	32.9	1.2
	01/05/17	01/12/17	0.4	0.2	15.4	0.9
	01/12/17	01/19/17	0.6	0.2	35.2	1.3
	01/19/17	01/26/17	0.6	0.2	26.6	1.1
	01/26/17	02/02/17	NS ¹	NS ¹	NS ¹	NS ¹
	02/02/17	02/09/17	0.5	0.2	14.1	0.9
	02/09/17	02/16/17	0.5	0.2	20.2	1.0
	02/16/17	02/23/17	0.2	0.1	10.2	0.8
	02/23/17	03/02/17	0.4	0.2	11.4	0.8
	03/02/17	03/09/17	0.4	0.2	14.1	0.9
	03/09/17	03/16/17	0.5	0.2	15.8	0.9
	03/16/17	03/22/17	0.5	0.2	21.4	1.1
	03/22/17	03/30/17	0.3	0.2	10.0	0.7
Boundary Locations						
Atomic City	12/29/16	01/05/17	0.7	0.3	43.1	1.6
	01/05/17	01/12/17	R ²	R ²	R ²	R ²
	01/12/17	01/19/17	0.7	0.2	41.8	1.3
	01/19/17	01/26/17	0.4	0.2	22.4	1.0
	01/26/17	02/02/17	0.7	0.2	43.4	1.4
	02/02/17	02/09/17	0.7	0.3	23.4	1.4
	02/09/17	02/16/17	0.4	0.2	22.3	1.0
	02/16/17	02/23/17	0.2	0.1	9.8	0.8
	02/23/17	03/02/17	0.2	0.1	13.5	0.9
	03/02/17	03/09/17	0.6	0.2	12.8	0.9
	03/09/17	03/16/17	0.5	0.2	16.4	0.9
	03/16/17	03/22/17	0.6	0.2	22.2	1.1
	03/22/17	03/30/17	0.3	0.2	11.6	0.8
Howe	12/29/16	01/05/17	0.8	0.2	34.1	1.3
	01/05/17	01/12/17	0.3	0.2	16.8	1.0
	01/12/17	01/19/17	0.6	0.2	35.1	1.3
	01/19/17	01/26/17	0.6	0.2	27.7	1.3
	01/26/17	02/02/17	0.6	0.2	38.9	1.4
	02/02/17	02/09/17	NS ¹	NS ¹	NS ¹	NS ¹
	02/09/17	02/16/17	0.4	0.2	20.4	1.0
	02/16/17	02/23/17	0.2	0.1	11.1	0.9
	02/23/17	03/02/17	0.3	0.1	14.3	0.9
	03/02/17	03/09/17	0.5	0.2	15.3	1.0
	03/09/17	03/16/17	0.8	0.2	17.2	1.0
	03/16/17	03/22/17	0.5	0.2	18.8	1.1
	03/22/17	03/30/17	0.3	0.2	11.0	0.8

¹NS – No sample – Sampler not operating, restarted without incident.

²R – Results rejected due to insufficient sample volume caused by a tripped breaker.

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, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Montevieu	12/29/16	01/05/17	1.6	0.4	47.7	1.9
	01/05/17	01/12/17	0.5	0.2	25.3	1.1
	01/12/17	01/19/17	0.6	0.2	45.1	1.5
	01/19/17	01/26/17	0.6	0.2	29.1	1.2
	01/26/17	02/02/17	0.9	0.2	68.5	1.8
	02/02/17	02/09/17	0.4	0.2	19.6	1.1
	02/09/17	02/16/17	0.5	0.3	20.8	1.1
	02/16/17	02/23/17	0.4	0.2	10.9	0.9
	02/23/17	03/02/17	0.3	0.2	13.7	0.9
	03/02/17	03/09/17	0.5	0.2	15.0	1.0
	03/09/17	03/16/17	0.6	0.2	17.9	1.0
	03/16/17	03/22/17	0.9	0.3	24.3	1.3
	03/22/17	03/30/17	0.2	0.2	12.1	0.8
Mud Lake	12/29/16	01/05/17	1.3	0.3	58.2	1.7
	01/05/17	01/12/17	0.6	0.2	28.9	1.2
	01/12/17	01/19/17	1.0	0.2	62.9	1.7
	01/19/17	01/26/17	1.2	0.3	60.4	2.0
	01/26/17	02/02/17	1.4	0.3	77.3	1.9
	02/02/17	02/09/17	0.4	0.2	17.7	1.0
	02/09/17	02/16/17	0.5	0.2	30.2	1.2
	02/16/17	02/23/17	0.4	0.2	16.4	1.0
	02/23/17	03/02/17	0.5	0.2	19.4	1.0
	03/02/17	03/09/17	0.7	0.2	22.0	1.1
	03/09/17	03/16/17	1.1	0.2	25.8	1.2
	03/16/17	03/22/17	1.1	0.3	34.4	1.4
	03/22/17	03/30/17	0.5	0.2	16.7	0.9
Distant Locations						
Craters of the Moon	12/29/16	01/05/17	0.7	0.2	37.3	1.3
	01/05/17	01/12/17	NS ¹	NS ¹	NS ¹	NS ¹
	01/12/17	01/19/17	0.8 [†]	0.1 [†]	34.1 [†]	0.9 [†]
	01/19/17	01/26/17	0.3	0.2	21.4	1.0
	01/26/17	02/02/17	0.4	0.2	31.4	1.2
	02/02/17	02/09/17	0.4	0.2	20.9	1.0
	02/09/17	02/16/17	0.5	0.2	25.2	1.1
	02/16/17	02/23/17	0.4	0.2	12.0	0.9
	02/23/17	03/02/17	0.6	0.2	21.7	1.1
	03/02/17	03/09/17	0.4	0.2	15.3	0.9
	03/09/17	03/16/17	0.5	0.2	19.7	1.0
	03/16/17	03/22/17	0.8	0.2	25.5	1.2
	03/22/17	03/30/17	0.2	0.1	14.4	0.8

¹NS – No sample for 01/05/2017 – 01/12/2017 due to inaccessibility of sampling site caused by weather.

[†] - This filter was deployed for two weeks.

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, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall¹	12/29/16	01/05/17	NS ³	NS ³	NS ³	NS ³
	01/05/17	01/12/17	NS ³	NS ³	NS ³	NS ³
	01/12/17	01/19/17	NS ³	NS ³	NS ³	NS ³
	01/19/17	01/26/17	NS ³	NS ³	NS ³	NS ³
	01/26/17	02/02/17	NS ³	NS ³	NS ³	NS ³
	02/02/17	02/09/17	NS ³	NS ³	NS ³	NS ³
	02/09/17	02/16/17	NS ³	NS ³	NS ³	NS ³
	02/16/17	02/23/17	NS ³	NS ³	NS ³	NS ³
	02/23/17	03/02/17	NS ³	NS ³	NS ³	NS ³
	03/02/17	03/09/17	NS ³	NS ³	NS ³	NS ³
	03/09/17	03/16/17	NS ³	NS ³	NS ³	NS ³
	03/16/17	03/22/17	NS ³	NS ³	NS ³	NS ³
	03/22/17	03/30/17	NS ³	NS ³	NS ³	NS ³
Idaho Falls - HVP 3804	12/29/16	01/05/17	R ⁴	R ⁴	R ⁴	R ⁴
	01/05/17	01/12/17	0.6	0.2	25.5	1.1
	01/12/17	01/19/17	1.1	0.2	50.3	1.5
	01/19/17	01/26/17	0.5	0.2	25.3	1.1
	01/26/17	02/02/17	1.2	0.3	58.7	1.7
	02/02/17	02/09/17	0.4	0.2	22.5	1.1
	02/09/17	02/16/17	0.5	0.2	26.3	1.2
	02/16/17	02/23/17	R ⁴	R ⁴	R ⁴	R ⁴
	02/23/17	03/02/17	0.4	0.2	14.7	0.9
	03/02/17	03/09/17	0.6	0.2	17.5	1.0
	03/09/17	03/16/17	0.7	0.2	24.8	1.1
	03/16/17	03/22/17	1.2	0.4	30.2	1.7
	03/22/17	03/30/17	0.3	0.2	15.4	0.9
Idaho Falls - HVP 4304²	12/29/16	01/05/17	0.5	0.2	26.6	1.1
	01/05/17	01/12/17	0.5	0.2	14.7	0.9
	01/12/17	01/19/17	0.5	0.2	28.9	1.2
	01/19/17	01/26/17	0.4	0.2	16.2	0.9
	01/26/17	02/02/17	0.5	0.2	33.6	1.2
	02/02/17	02/09/17	0.2	0.1	13.0	0.9
	02/09/17	02/16/17	0.4	0.2	15.7	0.9
	02/16/17	02/23/17	0.3	0.2	9.1	0.8
	02/23/17	03/02/17	0.3	0.1	9.1	0.8
	03/02/17	03/09/17	0.5	0.2	10.8	0.8
	03/09/17	03/16/17	0.6	0.2	13.8	0.9
	03/16/17	03/22/17	1.1	0.3	27.9	1.3
	03/22/17	03/30/17	0.2	0.2	10.8	0.8

¹ Operated by Shoshone Bannock-Tribes.

² HVP 4304 – This is a new sampler model being operated side by side with sampler HVP 3804 to test the dependability and durability in field conditions.

³ NS – Sampler out of service.

⁴ R – Results rejected due to insufficient sample volume caused by a tripped breaker.

Appendix B

Table B.1. Results for all electret ionization chamber (EIC) locations, first quarter, 2017.

Sample Location	Net Corrected Exposure Rate ($\mu\text{R/hr}$) ¹	± 2 SD ($\mu\text{R/hr}$)
Arco	7.0	3.2
Craters of the Moon	7.8	2.4
Big Lost River Rest Area	10.8	2.8
Van Buren Avenue	10.3	2.2
Experimental Field Station	11.9	1.1
Main Gate	13.8, 14.5	
Atomic City	7.7	1.8
Taber	8.9	2.4
Blackfoot	10.6	1.8
Ft. Hall	8.8	2.1
Idaho Falls	8.9	3.4
Mud Lake/ Terreton	9.5	2.6
Montevieu	11.4, 11.7	
Sand Dunes Tower	11.7	1.4
Howe Met. Tower	12.7	0.5
MP276 -20	10.9, 12.8	
MP274 -20	9.6	2.2
MP272 -20	9.6	1.7
MP270 -20	10.0	2.7
MP268 -20	12.4, 12.5	
MP266 -20	11.2	0.5
MP264 -20	14.0, 14.4	
MP270 -20/26	11.2, 12.1	
MP268 -20/26	12.1	2.4
MP266 -20/26	10.9, 11.8	
MP263 -20/26	13.5	1.0
MP261 -20/26	***	***
MP259 -20/26	12.4	0.9
MFC (EBR II)	11.8	3.0
EBR I	9.5	0.3
RWMC	8.4	2.0
CFA	12.1, 13.7	
CITRC (PBF)	8.6, 9.8	
INTEC	12.5	3.0
ATR (TRA)	10.9	3.0
NRF	11.5	1.9
TAN/SMC	12.2, 13.2	
Mud Lake Bank of Commerce	12.1, 14.8	
MP43-33	13.0	1.2
MP41-33	12.2	1.2
MP39-33	12.9	3.0
MP 37-33	9.4, 10.1	
MP35-33	8.9	1.1
MP33-33	10.4	1.8
MP31-33	11.8	0.7
MP29-33	12.1	2.1
MP27-33	13.1, 13.6	
MP25-33	11.4	2.0
MP23-33	9.1	2.5
² Base of Howe	8.8	0.6

Table B.1. continued. Results for all electret ionization chamber (EIC) locations, first quarter, 2017.

Sample Location	Net Corrected Exposure Rate ($\mu\text{R/hr}$) ¹	± 2 SD ($\mu\text{R/hr}$)
³ Rover	9.7, 11.1	
Hamer	13.5	3.9
Sugar City	12.1	1.4
Roberts	8.7	3.5
⁴ Big Southern Butte	8.2	1.4
<p>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.</p> <p>^{2,3,4}Base of Howe, Big Southern Butte, and Rover EIC's could not be collected in January due to weather/road conditions. The data reported in this table for these locations represents the average exposure rate from October 2016 through April 2017.</p> <p>*** No data available for this location for 1st quarter 2017.</p>		