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

Introduction

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

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

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

Air and Precipitation Monitoring Results

The ESP operated eight air monitoring stations on and near the INL as well as two monitoring stations distant from the INL during the third 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 of 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). Results for Ft. Hall sampling site are flagged as an estimate because volume was not recorded for one week of operation at the time of filter change. Atomic City was also flagged due to a malfunction with the mass flow meter. Gamma spectroscopy results for the third 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.

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 third 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. Weighted mean atmospheric tritium was below the minimum detectable concentration (MDC) during the third quarter of 2017. There is one individual sample within the weighted mean that exceeded MDC located at the Experimental Field Station sampling site: 0.88 pCi/m^3 (MDC 0.63 pCi/m^3).While this result is above MDC it is still well below the DEQ-INL OP action level of 150 pCi/m^3 (40 CFR 61).Average atmospheric tritium concentrations are presented in **Table 4**.

Precipitation samples were collected at six monitoring locations during the third 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 third quarter of 2017. Tritium and Cesium-137 analysis results are presented in **Table 5**.

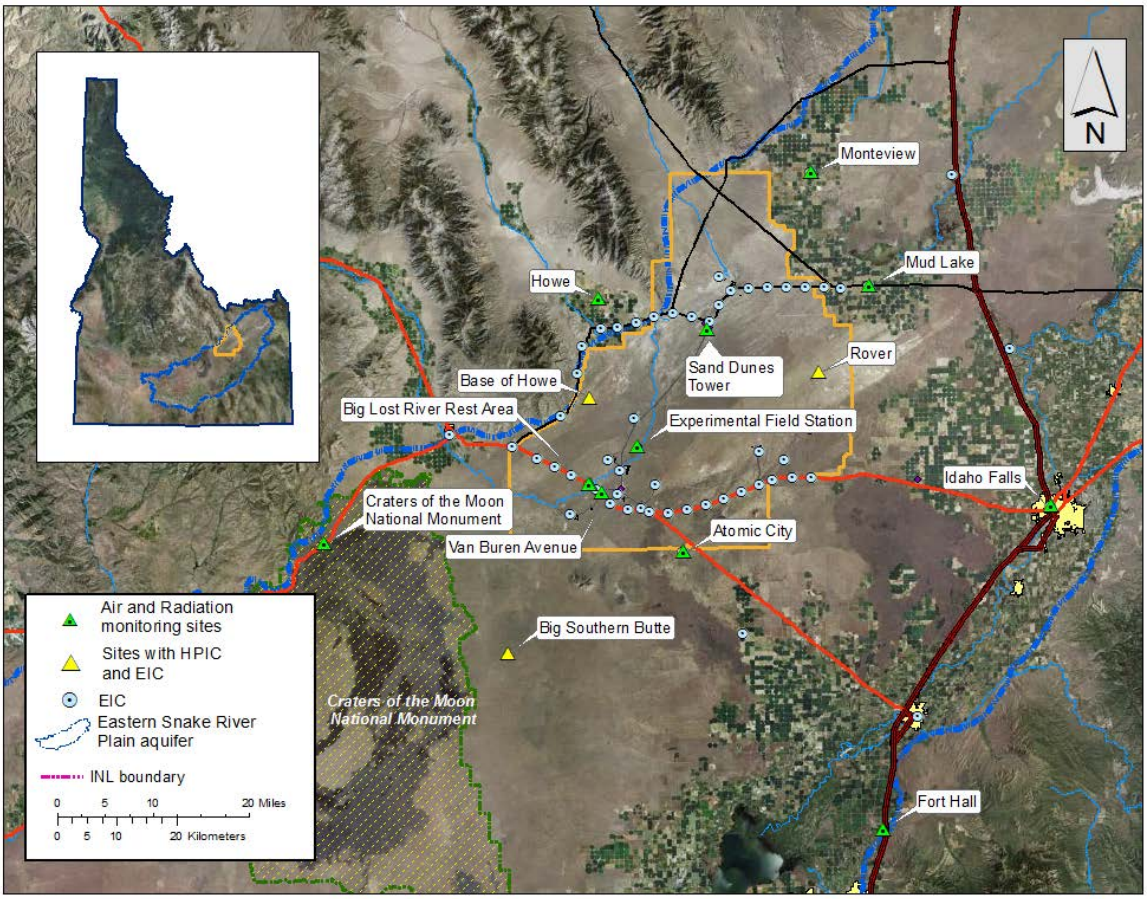

Figure 1. Air and radiation monitoring locations.

Table 1. Sampling locations and sample type

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

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

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

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.0	-	4.0	19.1	-	58.3
Experimental Field Station	0.4	-	4.8	16.6	-	41.9
Sand Dunes Tower	0.4	-	3.3	14.8	-	38.5
Van Buren Avenue	0.5	-	2.6	15.9	-	45.4
Boundary Locations						
Atomic City	0.9	-	2.5	28.6	-	30.8
Howe	0.4	-	3.0	13.9	-	33.6
Monteview	0.5	-	3.7	16.3	-	41.5
Mud Lake	0.7	-	3.5	22.9	-	48.2
Distant Locations						
Craters of the Moon	0.3	-	2.8	16.5	-	46.1
Fort Hall[1]	0.9	-	2.4	14.3	-	55.7
Idaho Falls – HVP 3804	0.7	-	3.7	23.1	-	47.5
Idaho Falls – HVP 4304	0.6	-	1.9	17.4	-	45.0

[1]Operated by Shoshone-Bannock Tribes.
Note: Concentrations are expressed in 1 x 10^{-3} pCi/m^3.

Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, third 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	115.6	5.8	<MDC[2]	
Experimental Field Station	84.3	4.3	<MDC	
Sand Dunes Tower	73.4	3.8	<MDC	
Van Buren Avenue	85.0	4.4	<MDC	
Boundary Locations				
Atomic City	35.3J[4]	2.1J[4]	<MDC	
Howe	71.2	3.8	<MDC	
Monteview	87.4	4.5	<MDC	
Mud Lake	112.7	5.8	<MDC	
Distant Locations				
Craters of the Moon	90.8	4.7	<MDC	
Fort Hall[1]	115.6J[3]	6.2J[3]	<MDC	
Idaho Falls – HVP 3804	104.4	5.3	<MDC	
Idaho Falls – HVP 4304	93.0	5.0	<MDC	

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC for Cs-137 typically (0.05-0.10) x 10^{-3} pCi/m^3.
[3]J – estimated value – sample volume estimated by OP because volume was not recorded once at the time of filter change.
[4]J – estimated value – mass flow meter malfunction in the TSP sampler resulting in estimated low concentration for Be-7.
Note: Concentrations are reported in 1 x 10^{-3} pCi/m^3 with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

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

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.36	0.51	0.87
Experimental Field Station	0.62	0.50	0.81
Sand Dunes Tower	0.21	0.58	1.02
Van Buren Avenue	0.56	0.61	1.02
Boundary Locations			
Atomic City	0.01	0.13	0.22
Howe	0.06	0.75	1.25
Mud Lake	-0.05	0.62	1.05
Monteview	0.01	0.74	1.25
Distant Locations			
Craters of the Moon	0.17	0.51	0.85
Fort Hall[1]	0.15	0.55	0.95
Idaho Falls	0.44	0.78	1.30

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

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

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	20	110	190	-0.1	1.6	2.8
Boundary Locations						
Atomic City	90	110	190	0.7	2.3	3.8
Howe	60	110	190	0.3	1.4	2.3
Monteview	100	110	190	-0.5	1.0	2.2
Mud Lake	20	110	190	0.5	1.1	1.9
Distant Locations						
Idaho Falls	-10	110	190	0.8	2.1	3.5

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

Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the third 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 6**).

The Shoshone-Bannock Tribes operate an air monitoring station at Fort Hall which is also 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 51 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 7** lists the average radiation exposure rates measured by the HPICs for third quarter 2017. **Table 8** lists the EIC monitoring results for third quarter 2017. Overall exposure rates were within the expected historical range of values observed by DEQ-INL OP for background radiation.

Table 6. 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		■
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 7. Average gamma exposure rates, third quarter, 2017, from HPIC network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
Base of Howe	16.0	1.3
Big Lost River Rest Area	15.2	1.9
[2]Main Gate	--	--
[1]Rover	--	--
Sand Dunes Tower	13.6	1.3
Boundary Locations		
Atomic City	12.9	1.6
[1]Big Southern Butte	--	--
Howe Met Tower	12.7	0.9
Monteview	13.2	1.3
Mud Lake / Terreton	14.3	1.0
Distant Locations		
Fort Hall	11.5	2.8
Idaho Falls	11.6	3.5

[1]Rover and Big Southern Butte HPIC electronics had various electronic malfunctions and/or extreme temperature interference, no data is available for third quarter 2017 at these locations.
[2]This HPIC is being relocated to another NOAA weather station within the INL boundaries; when the exact location is defined, this table will be updated with that data. The Main Gate location will no longer be reported.

Table 8. Electret ionization chamber (EIC) cumulative average exposure rates, third quarter, 2017.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	11.1, 12.4	
Big Lost River Rest Area	16.5	2.0
Experimental Field Station	17.4	3.5
Rover	13.3	0.3
Sand Dunes Tower	13.9, 15.2	
Van Buren Avenue	12.5, 14.4	
Boundary Locations		
Atomic City	13.6, 14.6	
Big Southern Butte	12.2, 14.0	
Howe Met Tower	12.9	1.1
Monteview	11.2	2.6
Mud Lake/Terreton	13.0	2.9
Distant Locations		
Craters of the Moon	13.3	0.3
Fort Hall	15.2, 15.6	
Idaho Falls	13.4	0.6

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

Water Monitoring Results

The DEQ-INL OP collects water samples at sites within and downgradient from the INL in order to identify INL-related impacts to the eastern Snake River Plain aquifer, evaluate trends of known INL contaminants and other general groundwater quality indicators, and verify DOE and USGS monitoring results. Most samples are collected from groundwater (wells and springs); a few each year are also collected from surface water (streams) and wastewater. Most sites sampled by DEQ-INL OP are sampled concurrently with a DOE contractor or the USGS. DEQ-INL OP annually compares its own analytical results with those obtained by co-samplers to evaluate consistency. A summary of this comparison is published in the annual ESP report.

Each water monitoring site is categorized as upgradient, facility, boundary, distant, surface water, or wastewater depending on its location (**Figure 2** and **Figure 3**). Upgradient sites are situated north and northeast of INL facilities and have not been affected by INL operations. Facility sites are near facility complexes within the INL, including the Idaho Nuclear Technology and Engineering Center (INTEC), the Advanced Test Reactor Complex (ATR), Test Area North (TAN), the Radioactive Waste Management Complex (RWMC), the Central Facilities Area (CFA), and the Naval Reactors Facility (NRF). Many facility sites are in areas of known contamination and are sampled to monitor trends of specific contaminants. Boundary sites are on or near the southern boundary of the INL, downgradient of potential sources of INL contamination. Distant sites are farther downgradient of the INL, primarily in the Magic Valley, and include wells and springs used for agricultural, municipal, domestic, and industrial purposes. Surface water and wastewater sites are in various locations within and upgradient of the INL.

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, gamma-emitting radionuclides, tritium, common ions, dissolved trace metals, and nutrients. Selected sites are also sampled for specific radionuclides—including uranium isotopes (^{234}U, ^{235}U, and ^{238}U), plutonium isotopes (^{238}Pu, $^{239/240}$Pu), americium-241 (^{241}Am), strontium-90 (^{90}Sr), and technetium-99 (^{99}Tc)—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 may be collected and analyzed for specific radionuclides.

During the third quarter of 2017, fourteen distant sites were sampled. Analytical results are reported in **Tables 9 through 14** and summarized below.

Gross alpha radioactivity was detected at seven distant sites this quarter (**Table 9**). All concentrations were consistent with historical trends and within the range of naturally occurring background concentrations determined from historical DEQ data. No location had a gross alpha concentration that exceeded the EPA drinking water maximum contaminant level (MCL) for alpha particles of 15 pCi/L.

Gross beta radioactivity was detected at all fourteen locations sampled (**Table 9**). All concentrations were consistent with historical trends and within the range of naturally occurring background concentrations determined from historical DEQ data. Manmade gamma-emitting nuclides, including ^{137}Cs, were not detected at any location sampled this quarter (**Table 9**). The MCL for beta and gamma radioactivity is 4 mrem/year, which is equivalent to 8 pCi/L if the source is ^{90}Sr, 900 pCi/L if ^{99}Tc, 20,000 pCi/L if tritium (^{3}H), or 200 pCi/L if ^{137}Cs.

No locations were sampled for uranium isotopes, plutonium isotopes, ^{90}Sr, ^{99}Tc, or ^{241}Am this quarter.

Tritium concentrations are analyzed in water samples collected by DEQ-INL OP using two different methods. Samples from all locations are analyzed using the standard method, which has an MDC of about 130 pCi/L. Selected locations at which tritium levels are too low to be detected by the standard method are re-analyzed using an electrolytic enrichment method, which has an MDC of about 10-14 pCi/L. Using the standard method, tritium was not detected at any of the locations sampled this quarter (**Table 10**). No samples collected during the current quarter were analyzed using the enrichment method; however, analyses for 23 samples collected in previous quarters were completed and are presented in **Table 11**. Of these samples, tritium was detected in five from facility sites, five from boundary sites, and three from distant sites. Concentrations in most of these samples are at background levels or are consistent with historical trends. Distant site MV-57 (77 pCi/L) and boundary site USGS-014 (56 pCi/L) reported their highest concentrations since 1998 and 1999, respectively. USGS-014 will be sampled again in 2018 and MV-57 will be sampled again in 2019. A backlog of 69 samples to be analyzed by the enrichment method remains.

Samples from all locations were analyzed for metals, common ions, and nutrients (**Tables 12, 13,** and **14)**. All results were within expected ranges based on historical data.

No locations were sampled for VOCs this quarter.

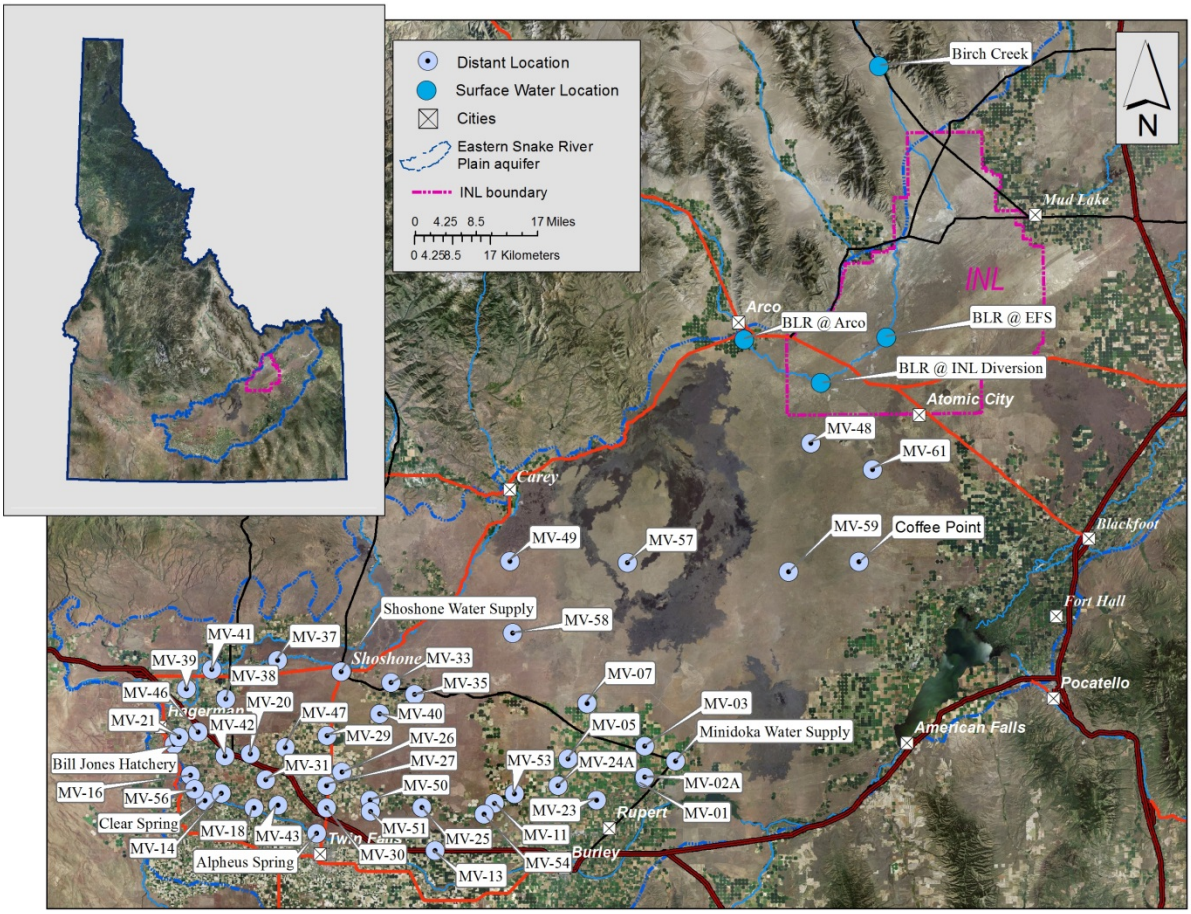

Figure 2. Distant and Surface Water monitoring locations.

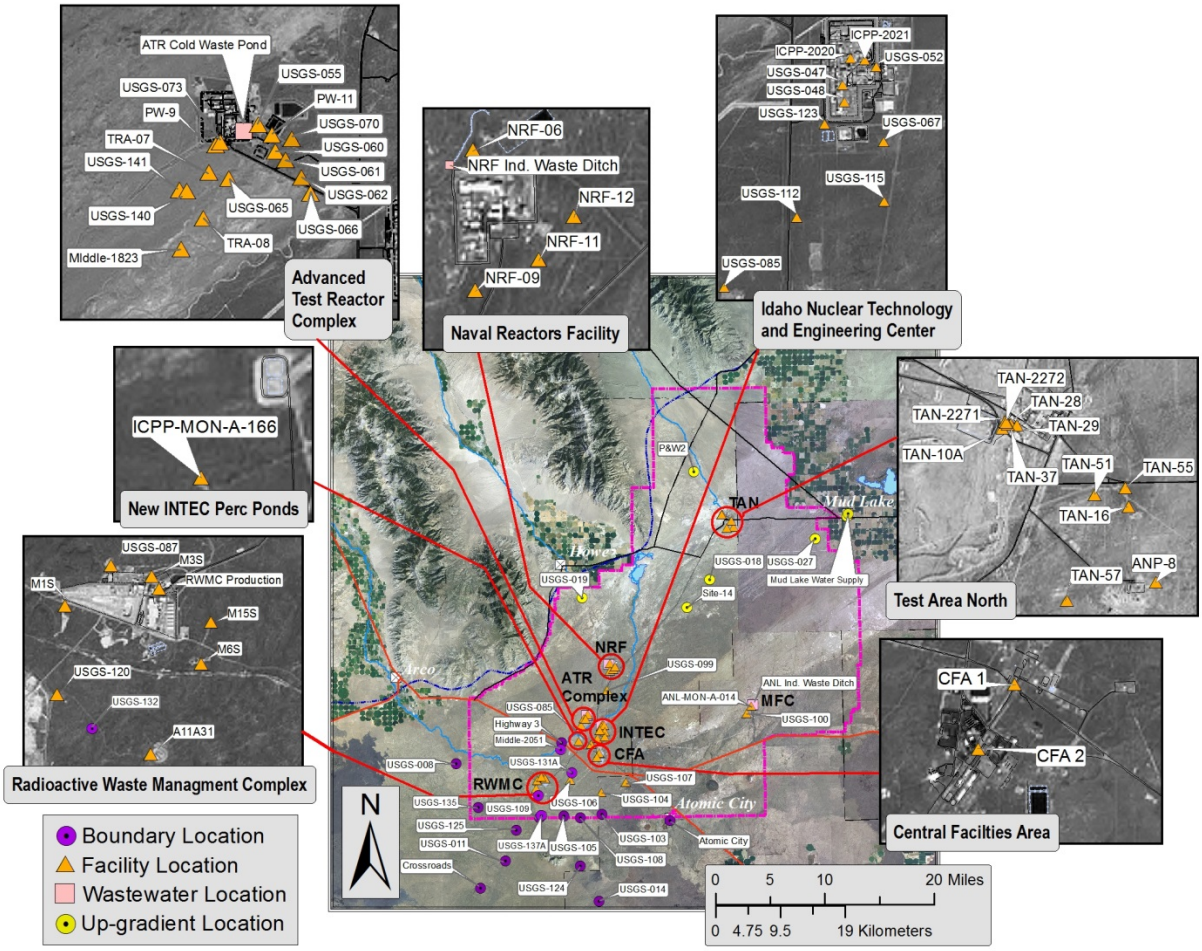

Figure 3. Up-gradient, facility, boundary, and wastewater monitoring locations.

Table 9. Gross alpha, gross beta, and gamma-emitting radionuclide concentrations (pCi/L) for water samples, third quarter, 2017.

Sample Location	Sample Date	Gross Alpha			Gross Beta			Man-made gamma-emitting radionuclide Cesium-137		
		Concentration		±2 SD	Concentration		±2 SD	Concentration		±2 SD
Distant										
Alpheus Spring	8/3/2017	2.8	J+	1.5	6.7		1.5	0.3	U	1.0
Bill Jones Hatchery	8/3/2017	0.6	U	1.2	5.1		0.9	0.4	U	2.3
Clear Spring	8/3/2017	0.4	U	1.4	6.0		1.0	2.0	U	2.3
Minidoka Water Supply	8/3/2017	0.6	U	1.4	6.0		1.0	-0.4	U	1.3
MV-01	7/25/2017	-0.8	U	1.4	9.5		1.1	0.6	U	1.4
MV-11	7/25/2017	3.8		2.0	9.2		1.7	0.2	U	1.1
MV-18	8/3/2017	1.1	U	1.5	7.5		1.1	0.3	U	1.3
MV-23	7/25/2017	2.8		1.5	7.8		1.4	-1.1	U	2.1
MV-24A	7/25/2017	4.6		2.1	9.6		1.6	0.8	U	1.9
MV-29	8/3/2017	1.8		1.2	3.7		0.8	0.3	U	2.6
MV-30	7/25/2017	3.7		2.1	9.9		1.7	0.5	U	1.5
MV-50	7/25/2017	2.1	U	1.8	7.2		1.1	0.3	U	1.5
MV-59	6/27/2017	1.4		0.9	4.2		0.9	0.1	U	2.1
Shoshone Water Supply	8/3/2017	1.5	U	1.1	3.6		0.8	0.1	U	2.3

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

Table 10. Tritium concentrations (pCi/L) for water samples, third quarter, 2017.

Sample Location	Sample Date	Tritium		
		Concentration		±2 SD
Distant				
Alpheus Spring	8/3/2017	20	U	130
Bill Jones Hatchery	8/3/2017	30	U	130
Clear Spring	8/3/2017	-20	U	130
Minidoka Water Supply	8/3/2017	10	U	130
MV-01	7/25/2017	-10	U	130
MV-11	7/25/2017	40	U	130
MV-18	8/3/2017	50	U	130
MV-23	7/25/2017	10	U	130
MV-24A	7/25/2017	-20	U	130
MV-29	8/3/2017	-50	U	120
MV-30	7/25/2017	10	U	130
MV-50	7/25/2017	-10	U	130
MV-59	6/27/2017	30	U	130
Shoshone Water Supply	8/3/2017	-10	U	130

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

Table 11. Enriched tritium concentrations (pCi/L) in water samples collected during various quarters and analyzed in the third quarter of 2017.

Sample Location	Sample Date	Enriched Tritium		
		Concentration		2 SD
Upgradient				
P&W-2	4/11/2016	-4	U	7
USGS-019	4/11/2016	0	U	7
USGS-027	4/11/2016	2	U	6
Facility				
ICPP-MON-A-166	4/12/2016	70		9
NRF-06	5/9/2017	21		7
NRF-09	5/17/2016	65		8
NRF-12	5/17/2016	13		7
USGS-099	5/18/2016	11		6
USGS-100	4/12/2016	-1	U	6
Boundary				
Atomic City	4/13/2016	3	U	6
Crossroads	4/12/2016	9	U	8
Highway 3	7/7/2016	94		10
USGS-008	4/12/2016	13		6
USGS-011	4/13/2016	9	U	6
USGS-014	10/11/2016	56		9
USGS-105 (1072 ft bls)	6/16/2016	180		12
USGS-108 (1172 ft bls)	6/15/2016	26		7
USGS-124	4/13/2016	-2	U	7
Distant				
Bill Jones Hatchery	5/16/2016	10		6
MV-05	7/18/2016	16		7
MV-57	6/9/2016	77		10
MV-58	6/9/2016	6	U	7
Shoshone Water Supply	5/16/2016	9	U	7

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

ft bls = feet below land surface.

Table 12. Dissolved trace metals concentrations (µg/L) in water samples, third quarter, 2017.

Sample Location	Sample Date	Concentration															
		Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Distant																	
Alpheus Spring	8/3/2017	2.5		88		1.4		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
Bill Jones Hatchery	8/3/2017	2.3		22		3.2		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
Clear Spring	8/3/2017	2.3		37		2.2		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
Minidoka Water Supply	8/3/2017	<2.0	U	37		1.5		<10	U	<1.0	U	<1.0	U	<2.0	U	21	
MV-01	7/25/2017	3.3		71		1.3		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
MV-11	7/25/2017	2.5		110		2.3		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
MV-18	8/3/2017	2.5		70		1.5		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
MV-23	7/25/2017	2.5		93		1.2		<10	U	<1.0	U	<1.0	U	<2.0	U	39	
MV-24A	7/25/2017	2.3		140		1.6		<10	U	<1.0	U	<1.0	U	<2.0	U	34	
MV-29	8/3/2017	2.1		21		3.1		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
MV-30	7/25/2017	2.3		78		1.4		<10	U	<1.0	U	<1.0	U	<2.0	U	9.4	
MV-50	7/25/2017	2.1		62		1.6		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
MV-59	6/27/2017	<2.0	U	12		4.3		<10	U	<1.0	U	<1.0	U	<2.0	U	100	
Shoshone Water Supply	8/3/2017	<2.0	U	43		1.7		<10	U	<1.0	U	<1.0	U	<2.0	U	9.7	

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.

Table 13. Common ion concentrations (mg/L) in water samples, third quarter, 2017.

Sample Location	Sample Date	Calcium*		Magnesium*		Sodium*		Potassium*		Fluoride		Chloride		Sulfate		Alkalinity†	
Distant																	
Alpheus Spring	8/3/2017	56		20		34		6.5		0.703		41.4		57.3		181	
Bill Jones Hatchery	8/3/2017	32		16		17		3.6		0.636		12.0		27.4		138	
Clear Spring	8/3/2017	45		19		26		4.2		0.720		34.0		47.6		149	
Minidoka Water Supply	8/3/2017	47		16		21		3.6		0.745		33.5		43.9		140	
MV-01	7/25/2017	48		19		36		6.6		0.507		42.9		47.8		174	
MV-11	7/25/2017	71		28		47		6.7		0.346		71.2		88.0		210	
MV-18	8/3/2017	63		26		38		5.6		0.630		50.9		67.4		198	
MV-23	7/25/2017	67		19		28		5.6		0.224		30.9		52.2		212	
MV-24A	7/25/2017	76		32		43		6.6		0.229		64.3		87.2		234	
MV-29	8/3/2017	31		15		17		3.4		0.741		16.2		31.3		121	
MV-30	7/25/2017	61		23		37		5.8		0.390		49.4		65.9		195	
MV-50	7/25/2017	58		22		36		5.0		0.437		53.3		67.2		179	
MV-59	6/27/2017	26		13		16		3.2		0.457		13.5		20.4		116	
Shoshone Water Supply	8/3/2017	43		15		14		3.0		0.424		7.50		18.8		169	

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 filtered in the field.

† As $CaCO_3$.

Table 14. Dissolved nutrient concentrations (mg/L) in water samples, third quarter, 2017.

Sample Location	Sample Date	Concentration			
		Nitrite + Nitrate		Phosphorus	
Distant					
Alpheus Spring	8/3/2017	2.1		0.020	
Bill Jones Hatchery	8/3/2017	1.5		0.017	
Clear Spring	8/3/2017	2.1		0.029	
Minidoka Water Supply	8/3/2017	1.2		0.013	
MV-01	7/25/2017	1.2		0.016	
MV-11	7/25/2017	5.5		0.019	
MV-18	8/3/2017	4.2		0.023	
MV-23	7/25/2017	4.6		0.036	
MV-24A	7/25/2017	6.0		0.021	
MV-29	8/3/2017	0.71		0.012	
MV-30	7/25/2017	3.2		0.022	
MV-50	7/25/2017	2.3		0.024	
MV-59	6/27/2017	0.73		0.012	
Shoshone Water Supply	8/3/2017	1.5		0.029	

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 third 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 15**. ^{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 15. Gamma spectroscopy analysis data for milk samples, third quarter, 2017.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131[1]
		Concentration[3]	± 2 SD	
Monitoring Samples				
Gooding/Glanbia	07/20/2017	1413	111	<MDC
	08/22/2017	1370	110	<MDC
	09/28/2017	1422	107	<MDC
Riverside	07/03/2017	1828	130	<MDC
	08/07/2017	1835	114	<MDC
	09/18/2017	1915	134	<MDC
Verification Samples[2]				
Howe	07/03/2017	1445	113	<MDC
Dietrich	07/03/2017	1440	108	<MDC
Rupert	08/01/2017	1539	98	<MDC
Terreton	08/01/2017	1452	113	<MDC
Dietrich	09/11/2017	1335	109	<MDC
Idaho Falls	09/12/2017	1334	93	<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 third quarter of 2017 for the DEQ-INL OP's ESP (Environmental Surveillance Program). 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 third quarter of 2017, the DEQ-INL OP submitted 68 QC samples for various radiological and non-radiological analyses (**Table 16**).

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 used to monitor for contamination introduced during sample collection, storage, shipment, and analysis.

For all analyses except enriched tritium in water, a blank sample result is considered acceptable if it is less than or equal to the minimum detectable concentration (MDC). For enriched tritium analyses in water samples, a blank sample result is acceptable if it is less than or equal to 30 pCi/L.[1] 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.

Blank sample results submitted for gross alpha and gross beta screening in air for the third quarter of 2017 are presented in **Table 17**. Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 18**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 19**. Blank analyses results for radiological and non-radiological analytes in groundwater are presented in **Tables 20, 21,** and **22.**

All blank sample results passed acceptance criteria in the third quarter of 2017.

[1] Natural and bomb-pulse tritium occur at measureable concentrations in the water used by DEQ-INL OP to create blank samples. The highest tritium concentration that DEQ considers acceptable in a blank is calculated as the mean tritium concentration in DEQ blanks from 2012 to 2016 plus two standard deviations.

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 acceptable 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 acceptable agreement if their absolute difference is less than or equal to the MDC.

Duplicate results for water samples are presented in **Table 23** for radiological analyses and **Table 24** and **25** for non-radiological analyses. One duplicate analysis for gross beta radioactivity and one duplicate analysis for enriched tritium did not pass the acceptance criteria. No results were qualified due to these failures.

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 acceptable if the percent recovery is 100 ± 25%. If the percent recovery of a spiked sample is 50-74%, above-MDC results of samples analyzed in the same batch as the spiked sample are qualified as low-biased estimates (J-), and below-MDC results are qualified as undetected estimates (UJ). If the percent recovery of a spiked sample is 126-150%, above-MDC results of associated samples are qualified as high-biased estimates (J+), and below-MDC results are qualified as undetected (U). If the percent recovery of a spiked sample is <50% or >150%, the results of all associated samples are qualified as rejected (R), except for sample results below MDC associated with a spiked-sample analysis having a percent recovery >150%, in which case the sample result remains qualified as undetected (U).

No spiked samples were analyzed during the third quarter of 2017.

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 ± 25% when compared to the known irradiated quantity. The irradiation results for third quarter 2017 are presented in **Table 26**. 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

There were no laboratory QC issues to report in the third quarter of 2017.

Analytical QA/QC Assessment

Other than those listed above, no issues involving sample chain of custody, sample holding times, and the analysis of blank, duplicate, and spiked samples were observed during the third 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 third 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 third quarter of 2017 met the minimum criteria of the DEQ-INL OP ESP and is summarized in **Table 16**.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. During the third quarter of 2017 the radioiodine pump was replaced at the Van Buren sampling station. The TSP blower was replaced at Van Buren and the TSP sampling unit was replaced at Craters of the Moon. Fort Hall results were flagged for the 3rd quarter because the volume was not recorded one week. Atomic City results were flagged due to a malfunction in the mass flow meter. The Atomic City TSP sampler was replaced at the end of the third quarter. Service reliability for air sampling equipment for the third quarter of 2017 is summarized in **Table 27**.

Conclusion

All data collected for the third 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 16. Summary of the analytical performance and usability of the analyses performed for the DEQ-INL OP ESP, third 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	152	13	0	0	21	ISU-EML
		Gross beta	152	13	0	0	21	ISU-EML
		Gamma emitters	12	1	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	46	6	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	14	2	1	0	0	ISU-EML
		Gross beta	14	2	1	0	0	ISU-EML
		Gamma emitters	14	2	1	0	0	ISU-EML
		Tritium	14	2	1	0	0	ISU-EML
		Enriched tritium	23	4	1	0	0	ISU-EML
		Technetium-99	0	0	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
		Metals	14	2	1	0	0	IBL
		Common Ions	14	2	1	0	0	IBL
		Nutrients	14	2	1	0	0	IBL
		Volatile Organics	0	0	0	0	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	12	0	0	0	0	ISU-EML
Soil	*in situ*	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	65	0	0	9	0	DEQ-INL OP
	HPICs	Gamma Radiation	8	NA	NA	NA	0	DEQ-INL OP
Total Analyses			**593**	**51**	**8**	**9**	**42**	
Total QC Analyses (blanks, duplicates, and spikes)			**68**					
QC Analyses as a percentage of total Test Analyses[3]			**11.5%**					
Percentage of usable data[4]			**92.9%**					

[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 17. Blank analysis results for gross alpha and beta in particulate air (TSP), third quarter, 2017.

Collection Period		Corrected volume (m^3)[1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
06/29/17	07/06/17	1971	0.0	0.1	-0.2	0.5
07/06/17	07/13/17	1971	0.1	0.1	0.2	0.5
07/13/17	07/20/17	1971	0.0	0.1	0.2	0.5
07/20/17	07/27/17	1971	0.0	0.1	0.0	0.5
07/27/17	08/03/17	1971	0.0	0.1	-0.3	0.5
08/03/17	08/10/17	1971	0.0	0.1	0.0	0.5
08/10/17	08/17/17	1971	0.1	0.1	-0.1	0.5
08/17/17	08/24/17	1971	-0.1	0.1	0.1	0.5
08/24/17	08/31/17	1971	0.1	0.1	-0.5	0.5
08/31/17	09/07/17	1971	-0.1	0.1	-0.1	0.5
09/07/17	09/14/17	1971	0.0	0.1	-0.1	0.5
09/14/17	09/21/17	1971	0.0	0.1	0.3	0.5
09/21/17	09/28/17	1971	-0.1	0.1	-0.1	0.5

Note: Concentrations and associated uncertainties (± 2 SD) are expressed in 1 x 10^{-3} pCi/m^3.
[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 18. Blank analysis results for gamma spectroscopy for TSP particulate air filters, composite samples, third 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
10/18/17	5	5	29	26	42	69	1	5	9

Analysis Date	Cesium-134			Cesium-137		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC
10/18/17	-3	2	4	2	2	3

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

Table 19. Blank analysis results for tritium in water vapor from air samples, third quarter, 2017.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP172ZTR01	09/13/17	09/19/17	09/22/17	-0.08	0.08	0.15
OP172ZTR02	09/13/17	09/19/17	09/22/17	0.08	0.09	0.15
OP172ZTR03	09/27/17	10/17/17	10/26/17	0.02	0.09	0.15
OP172ZTR04	09/27/17	10/11/17	10/23/17	0.03	0.11	0.18
OP172ZTR05	09/27/17	10/11/17	10/26/17	-0.04	0.09	0.15
OP172ZTR06	09/27/17	10/17/17	10/23/17	0.00	0.11	0.18

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

Table 20. Blank analysis results (pCi/L) for radiological constituents in water, third quarter, 2017.

Sample Number	Sample Date	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha					
171W024	8/3/2017	0.2 U	0.2	0.4	Yes
171W013	8/3/2017	0.4	0.3	0.4	Yes
Gross Beta					
171W024	8/3/2017	0.2 U	0.6	0.9	Yes
171W013	8/3/2017	0.1 U	0.6	0.9	Yes
Cesium-137					
171W024	8/3/2017	0.4 U	1.4	2.3	Yes
171W013	8/3/2017	-0.7 U	1.3	2.4	Yes
Tritium					
171W025	8/3/2017	-40 U	130	150	Yes
171W014	8/3/2017	-30 U	130	150	Yes
Enriched Tritium					
161W023	4/11/2016	19	7	10	Yes
161W041	5/18/2016	13	6	9	Yes
161W035	6/8/2016	9 U	6	10	Yes
161W359	6/30/2016	15	7	12	Yes

MDC = minimum detectable concentration.

Table 21. Blank analysis results (µg/L) for metals in groundwater and/or surface water, third quarter, 2017.

Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
171W027	8/3/2017	<2.0	<1.0	<1.0	<10	<1.0	<1.0	<2.0	<5.0
171W016	8/3/2017	<2.0	<1.0	<1.0	<10	<1.0	<1.0	<2.0	<5.0

Table 22. Blank analysis results (mg/L) for common ions and nutrients in groundwater and/or surface water, third quarter, 2017.

Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total Phosphorus
171W027,026	8/3/2017	<0.10	<0.10	<0.10	<0.10	<0.20	<0.40	<0.80	<1.0	<0.01	<0.005
171W016,015	8/3/2017	0.10	<0.10	<0.10	<0.10	<0.20	<0.40	<0.80	<1.0	<0.01	<0.005

† As $CaCO_3$.

Table 23. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, third quarter, 2017.

Analysis/Sample Location	Original Sample Number	Concentration	± 2 SD	Duplicate Sample Number	Concentration	± 2 SD	$\lvert R_1-R_2 \rvert$	$3(S_1^2+S_2^2)^{1/2}$	Within Criteria?
Gross Alpha									
MV-30	171W414	3.7	2.1	171W378	3.4	1.6	0.3	4.0	Yes
Gross Beta									
MV-30	171W414	9.9	1.7	171W378	4.2	1.4	5.7	3.3	No
Cesium-137									
MV-30	171W414	0.5 U	1.5	171W378	0.1 U	1.1	0.4	2.8	Yes
Tritium									
MV-30	171W416	10 U	130	171W380	-30 U	130	40	276	Yes
Enriched Tritium									
Highway 3	161W383	94	10	161W389	67	8	27	19	No

Table 24. Duplicate results for metals c in groundwater, third quarter, 2017.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
MV-30	171W418	7/25/2017	2.3	78	1.4	<10	<1.0	<1.0	<2.0	9.4
MV-30	171W382	7/25/2017	2.3	80	1.8	<10	<1.0	<1.0	<2.0	9.6
RPD			**0**	**-3**	**-25***	**0**	**0**	**0**	**0**	**-2**

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

* Sample passes criteria because at least one result is less than five times the MDC and $\lvert R_1-R_2 \rvert$ is less than the MDC.

Table 25. Duplicate results for common ions and nutrients (mg/L) in groundwater, third quarter, 2017.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total Phosphorus
MV-30	171W418,417	7/25/2017	61	23	37	5.8	0.390	49.4	65.9	165	3.2	0.022
MV-30	171W382,381	7/25/2017	61	23	37	5.8	0.392	49.5	65.9	166	3.1	0.022
RPD			**0**	**0**	**0**	**0**	**-1**	**0**	**0**	**-1**	**3**	**0**

Relative Percent Difference (RPD) = $(R_1-R_2) / ((R_1+R_2)/2)*100$.

† As $CaCO_3$.

Table 26. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), third quarter, 2017.

Electret #	Exposure Received		Net Measured Exposure[1]		%R	Within Spec?
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)		
SHY950	40.0	2.0	37.9	1.3	94.8	Y
SIR554	40.0	2.0	37.2	1.4	93.1	Y
SHY830	40.0	2.0	37.0	1.3	92.6	Y
				Triplicate AVG:	**93.5**	**Y**
SHY891	30.2	1.5	26.7	1.3	88.3	Y
SHY888	30.2	1.5	29.1	1.3	96.2	Y
SHY872	30.2	1.5	28.3	1.4	93.6	Y
				Triplicate AVG:	**92.7**	**Y**
SIR404	22.0	2.0	19.6	1.3	89.3	Y
SIR497	22.0	2.0	16.9	1.4	76.8	Y
SFK447	22.0	2.0	17.8	1.3	80.8	Y
				Triplicate AVG:	**82.3**	**Y**

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

Table 27. Air sampling field equipment service reliability (percent operational), third 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	92%	100%	100%	NC[1]
Van Buren Avenue	92%	92%	100%	NC[1]
Boundary Locations				
Atomic City	100%	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	92%	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.

Appendix A

Table A-1. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, third 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	06/29/17	07/06/17	1.5	0.3	43.2	1.4
	07/06/17	07/13/17	1.9	0.3	43.6	1.4
	07/13/17	07/20/17	1.9	0.3	40.9	1.4
	07/20/17	07/27/17	2.3	0.4	58.3	1.9
	07/27/17	08/03/17	2.3	0.3	44.4	1.5
	08/03/17	08/10/17	3.1	0.4	43.4	1.6
	08/10/17	08/17/17	0.7	0.2	19.1	1.0
	08/17/17	08/24/17	2.2	0.3	39.3	1.4
	08/24/17	08/31/17	2.4	0.4	44.5	1.5
	08/31/17	09/07/17	4.0	0.5	43.5	1.5
	09/07/17	09/14/17	2.5	0.4	46.6	1.5
	09/14/17	09/21/17	0.0	0.1	21.7	1.1
	09/21/17	09/28/17	0.8	0.2	29.1	1.2
Experimental Field Station	06/29/17	07/06/17	1.0	0.3	32.6	1.3
	07/06/17	07/13/17	1.4	0.3	32.5	1.3
	07/13/17	07/20/17	1.8	0.3	30.9	1.3
	07/20/17	07/27/17	1.3	0.3	31.5	1.3
	07/27/17	08/03/17	1.5	0.3	34.3	1.4
	08/03/17	08/10/17	2.2	0.3	29.1	1.2
	08/10/17	08/17/17	1.5	0.3	34.5	1.3
	08/17/17	08/24/17	1.7	0.3	28.7	1.2
	08/24/17	08/31/17	2.4	0.4	36.0	1.4
	08/31/17	09/07/17	4.8	0.6	41.9	1.8
	09/07/17	09/14/17	2.5	0.4	38.6	1.4
	09/14/17	09/21/17	0.4	0.2	16.6	1.0
	09/21/17	09/28/17	0.7	0.2	21.1	1.1
Sand Dunes Tower	06/29/17	07/06/17	0.8	0.2	24.5	1.1
	07/06/17	07/13/17	1.0	0.2	26.9	1.1
	07/13/17	07/20/17	1.1	0.2	25.6	1.1
	07/20/17	07/27/17	1.1	0.2	26.8	1.1
	07/27/17	08/03/17	1.1	0.2	26.5	1.1
	08/03/17	08/10/17	NS[1]	NS[1]	NS[1]	NS[1]
	08/10/17	08/17/17	1.0	0.2	27.4	1.1
	08/17/17	08/24/17	1.3	0.3	23.8	1.1
	08/24/17	08/31/17	2.0	0.3	32.2	1.2
	08/31/17	09/07/17	3.3	0.4	35.0	1.3
	09/07/17	09/14/17	2.0	0.3	38.5	1.4
	09/14/17	09/21/17	0.4	0.2	14.8	1.0
	09/21/17	09/28/17	0.9	0.3	27.3	1.3

[1]NS – No sample – sampler not started previous week.

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, third quarter, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	06/29/17	07/06/17	1.4	0.3	28.0	1.2
	07/06/17	07/13/17	1.1	0.2	29.0	1.2
	07/13/17	07/20/17	1.4	0.3	29.7	1.2
	07/20/17	07/27/17	1.1	0.3	28.9	1.2
	07/27/17	08/03/17	1.3	0.3	30.2	1.2
	08/03/17	08/10/17	1.9	0.3	30.9	1.2
	08/10/17	08/17/17	1.8	0.3	33.8	1.3
	08/17/17	08/24/17	1.5	0.3	27.7	1.2
	08/24/17	08/31/17	2.2	0.3	36.7	1.3
	08/31/17	09/07/17	2.6	0.5	37.7	1.7
	09/07/17	09/14/17	2.5	0.4	45.4	1.6
	09/14/17	09/21/17	R[2]	R[2]	R[2]	R[2]
	09/21/17	09/28/17	0.5	0.2	15.9	0.9
Boundary Locations						
Atomic City	06/29/17	07/06/17	0.9	0.2	30.8	1.2
	07/06/17	07/13/17	1.1	0.3	29.0	1.5
	07/13/17	07/20/17	1.8	0.3	28.6	1.2
	07/20/17	07/27/17	R[2]	R[2]	R[2]	R[2]
	07/27/17	08/03/17	R[2]	R[2]	R[2]	R[2]
	08/03/17	08/10/17	2.5	0.3	28.7	1.2
	08/10/17	08/17/17	0.4J[3]	0.2J[3]	7.1J[3]	0.7J[3]
	08/17/17	08/24/17	0.3J[3]	0.2J[3]	5.1J[3]	0.6J[3]
	08/24/17	08/31/17	0.6J[3]	0.2J[3]	6.4J[3]	0.7J[3]
	08/31/17	09/07/17	1.4J[3]	0.4J[3]	12.4J[3]	1.3J[3]
	09/07/17	09/14/17	0.4J[3]	0.2J[3]	7.4J[3]	0.7J[3]
	09/14/17	09/21/17	0.1J[3]	0.1J[3]	2.9J[3]	0.5J[3]
	09/21/17	09/28/17	0.0J[3]	0.1J[3]	3.3J[3]	0.6J[3]
Howe	06/29/17	07/06/17	0.8	0.2	25.8	1.2
	07/06/17	07/13/17	1.1	0.2	28.1	1.2
	07/13/17	07/20/17	1.0	0.2	26.0	1.2
	07/20/17	07/27/17	1.3	0.3	25.5	1.1
	07/27/17	08/03/17	1.1	0.3	25.6	1.2
	08/03/17	08/10/17	NS[1]	NS[1]	NS[1]	NS[1]
	08/10/17	08/17/17	1.5	0.3	26.1	1.2
	08/17/17	08/24/17	1.5	0.3	25.8	1.2
	08/24/17	08/31/17	1.7	0.3	29.0	1.2
	08/31/17	09/07/17	3.0	0.4	31.4	1.3
	09/07/17	09/14/17	1.8	0.3	33.6	1.3
	09/14/17	09/21/17	0.4	0.2	13.9	0.9
	09/21/17	09/28/17	0.5	0.2	16.8	1.0

[1]NS – No sample – Sampler not restarted previous week.
[2]R – Results rejected due to insufficient sample volume.
[3]J – estimate value - mass flow meter malfunction in the TSP sampler resulting in an incorrect (low) concentration for gross alpha, gross beta, and Be-7. Sampler replaced at the end of 3rd quarter.

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, third quarter, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	06/29/17	07/06/17	1.1	0.3	32.9	1.3
	07/06/17	07/13/17	1.7	0.3	35.2	1.3
	07/13/17	07/20/17	1.6	0.3	33.1	1.3
	07/20/17	07/27/17	1.5	0.3	34.7	1.3
	07/27/17	08/03/17	1.6	0.3	28.7	1.2
	08/03/17	08/10/17	2.0	0.4	36.2	1.6
	08/10/17	08/17/17	2.0	0.4	36.1	1.9
	08/17/17	08/24/17	1.7	0.3	29.6	1.2
	08/24/17	08/31/17	2.2	0.4	35.2	1.3
	08/31/17	09/07/17	3.7	0.5	41.5	1.8
	09/07/17	09/14/17	2.3	0.4	38.5	1.4
	09/14/17	09/21/17	0.6	0.2	16.3	1.0
	09/21/17	09/28/17	0.5	0.2	20.4	1.1
Mud Lake	06/29/17	07/06/17	1.4	0.3	44.9	1.5
	07/06/17	07/13/17	1.6	0.3	42.9	1.4
	07/13/17	07/20/17	1.7	0.3	38.0	1.4
	07/20/17	07/27/17	2.1	0.4	48.2	1.9
	07/27/17	08/03/17	1.6	0.4	44.2	1.8
	08/03/17	08/10/17	R[2]	R[2]	R[2]	R[2]
	08/10/17	08/17/17	R[2]	R[2]	R[2]	R[2]
	08/17/17	08/24/17	2.1	0.4	38.7	1.6
	08/24/17	08/31/17	R[2]	R[2]	R[2]	R[2]
	08/31/17	09/07/17	3.5	0.4	39.4	1.4
	09/07/17	09/14/17	R[2]	R[2]	R[2]	R[2]
	09/14/17	09/21/17	0.7	0.2	22.9	1.1
	09/21/17	09/28/17	0.7	0.2	24.7	1.1
Distant Locations						
Craters of the Moon	06/29/17	07/06/17	1.1	0.3	34.9	1.3
	07/06/17	07/13/17	1.9	0.3	46.1	1.5
	07/13/17	07/20/17	1.7	0.3	35.8	1.3
	07/20/17	07/27/17	1.2	0.3	34.2	1.3
	07/27/17	08/03/17	1.6	0.3	34.0	1.3
	08/03/17	08/10/17	2.6	0.4	29.0	1.2
	08/10/17	08/17/17	1.5	0.3	37.9	1.3
	08/17/17	08/24/17	NS[1]	NS[1]	NS[1]	NS[1]
	08/24/17	08/31/17	2.2	0.4	41.0	1.4
	08/31/17	09/07/17	2.8	0.4	29.3	1.3
	09/07/17	09/14/17	NS[3]	NS[3]	NS[3]	NS[3]
	09/14/17	09/21/17	0.5	0.2	16.5	0.9
	09/21/17	09/28/17	0.3	0.2	18.3	1.0

[1]NS – No sample – Sampler not restarted previous week.
[2]R – Results rejected due to insufficient sample volume.
[3]NS – No sample – Sampler would not restart from previous week – sampler replaced 9/14/17.

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, third quarter, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[1]	06/29/17	07/06/17	1.4	0.3	41.3	1.5
	07/06/17	07/13/17	2.4	0.4	55.7	2.0
	07/13/17	07/20/17	0.9	0.2	14.3	0.9
	07/20/17	07/27/17	R[3]	R[3]	R[3]	R[3]
	07/27/17	08/03/17	1.0J[4]	0.3J[4]	27.9J[4]	1.4J[4]
	08/03/17	08/10/17	R[3]	R[3]	R[3]	R[3]
	08/10/17	08/17/17	R[3]	R[3]	R[3]	R[3]
	08/17/17	08/24/17	R[3]	R[3]	R[3]	R[3]
	08/24/17	08/31/17	R[3]	R[3]	R[3]	R[3]
	08/31/17	09/07/17	R[3]	R[3]	R[3]	R[3]
	09/07/17	09/14/17	R[3]	R[3]	R[3]	R[3]
	09/14/17	09/21/17	1.3	0.3	31.0	1.2
	09/21/17	09/28/17	1.1	0.3	32.1	1.2
Idaho Falls - HVP 3804	06/29/17	07/06/17	1.3	0.3	39.1	1.4
	07/06/17	07/13/17	1.5	0.3	41.9	1.4
	07/13/17	07/20/17	1.7	0.3	38.5	1.4
	07/20/17	07/27/17	1.6	0.3	38.7	1.4
	07/27/17	08/03/17	1.8	0.3	39.5	1.4
	08/03/17	08/10/17	2.6	0.4	41.6	1.5
	08/10/17	08/17/17	2.2	0.4	38.0	1.5
	08/17/17	08/24/17	1.8	0.3	34.5	1.3
	08/24/17	08/31/17	2.4	0.4	44.6	1.5
	08/31/17	09/07/17	3.7	0.5	47.5	1.6
	09/07/17	09/14/17	2.5	0.4	45.0	1.5
	09/14/17	09/21/17	0.9	0.2	23.1	1.1
	09/21/17	09/28/17	0.7	0.2	25.8	1.2
Idaho Falls - HVP 4304[2]	06/29/17	07/06/17	1.1	0.3	30.9	1.2
	07/06/17	07/13/17	1.9	0.4	45.0	1.8
	07/13/17	07/20/17	1.8	0.4	40.3	1.6
	07/20/17	07/27/17	R[3]	R[3]	R[3]	R[3]
	07/27/17	08/03/17	R[3]	R[3]	R[3]	R[3]
	08/03/17	08/10/17	R[3]	R[3]	R[3]	R[3]
	08/10/17	08/17/17	R[3]	R[3]	R[3]	R[3]
	08/17/17	08/24/17	1.8	0.4	33.7	1.7
	08/24/17	08/31/17	R[3]	R[3]	R[3]	R[3]
	08/31/17	09/07/17	R[3]	R[3]	R[3]	R[3]
	09/07/17	09/14/17	R[3]	R[3]	R[3]	R[3]
	09/14/17	09/21/17	0.8	0.2	17.4	1.0
	09/21/17	09/28/17	0.6	0.2	19.8	1.0

[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] R – Results rejected due to insufficient sample volume.

[4] J = estimated value – sample volume estimated by OP because volume was not recorded at time of filter change.

Appendix B

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

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
Arco	14.9	2.9
Craters of the Moon	13.3	0.3
Rest Area	16.5	2.0
Van Buren Avenue	12.5, 14.4	
Experimental Field Station	17.4	3.5
Main Gate	14.1	1.8
Atomic City	13.6, 14.6	
Taber	15.4	1.7
Blackfoot	10.8, 11.9	
Ft. Hall	15.2, 15.6	
Idaho Falls	13.4	0.6
Mud Lake/ Terreton	13.0	2.9
Monteview	11.2	2.6
Sand Dunes	13.9, 15.2	
Howe Met. Tower	12.9	1.1
[2]MP282 -20	12.1	1.1
[2]MP280 -20	13.4	2.9
[2]MP278 -20	15.4, 17.2	
MP276 -20	11.8	2.4
MP274 -20	10.8	3.0
MP272 -20	11.3, 11.5	
MP270 -20	14.2	0.8
MP268 -20	13.2	0.8
MP266 -20	15.7	3.6
MP264 -20	14.9, 15.2	
MP270 -20/26	12.3, 14.8	
MP268 -20/26	14.5	1.0
MP266 -20/26	13.5	2.1
MP263 -20/26	16.6	2.2
MP261 -20/26	15.2	2.2
MP259 -20/26	14.4	2.7
[2]MP256 -20/26	10.3	1.2
MFC (EBR II)	14.7, 15.8	
EBR I	12.6	2.6
RWMC	12.5	1.2
CFA	17.8, 18.3	
CITRC (PBF)	14.4	2.6
INTEC	18.6	3.7
ATR (TRA)	13.4, 14.1	
NRF	14.8	0.9
TAN/SMC	14.1	2.0
Mud Lake Bank of Commerce	14.5	1.1
MP43-33	15.1, 15.6	
MP41-33	15.5	1.3
MP39-33	13.4, 14.8	
MP37-33	15.1	0.8

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

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
MP35-33	11.3, 14.6	
MP33-33	16.5, 17.2	
MP31-33	15.7	1.2
MP29-33	14.2	2.3
MP27-33	17.7, 18.0	
MP25-33	13.2	2.3
MP23-33	13.0	2.9
[2]MP21-33	10.2, 10.5	
[2]MP19-33	11.7, 12.9	
[2]MP14-33	12.2	2.4
[2]MP11-33	13.2	2.0
[2]MP09-33	12.7	2.4
[2]MP03-33	14.1, 15.3	
Base of Howe	11.1, 12.4	
Rover	13.3	0.3
Hamer	15.3	1.7
Sugar City	15.3	1.9
Roberts	12.4	3.1
Big Southern Butte	12.2, 14.0	

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

[2]These locations are new to the EIC monitoring program starting in 3rd QTR 2017.