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 fourth 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). Gamma spectroscopy results for the fourth 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 fourth 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/m^3 (40 CFR 61). Average atmospheric tritium concentrations are presented in **Table 4**.

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

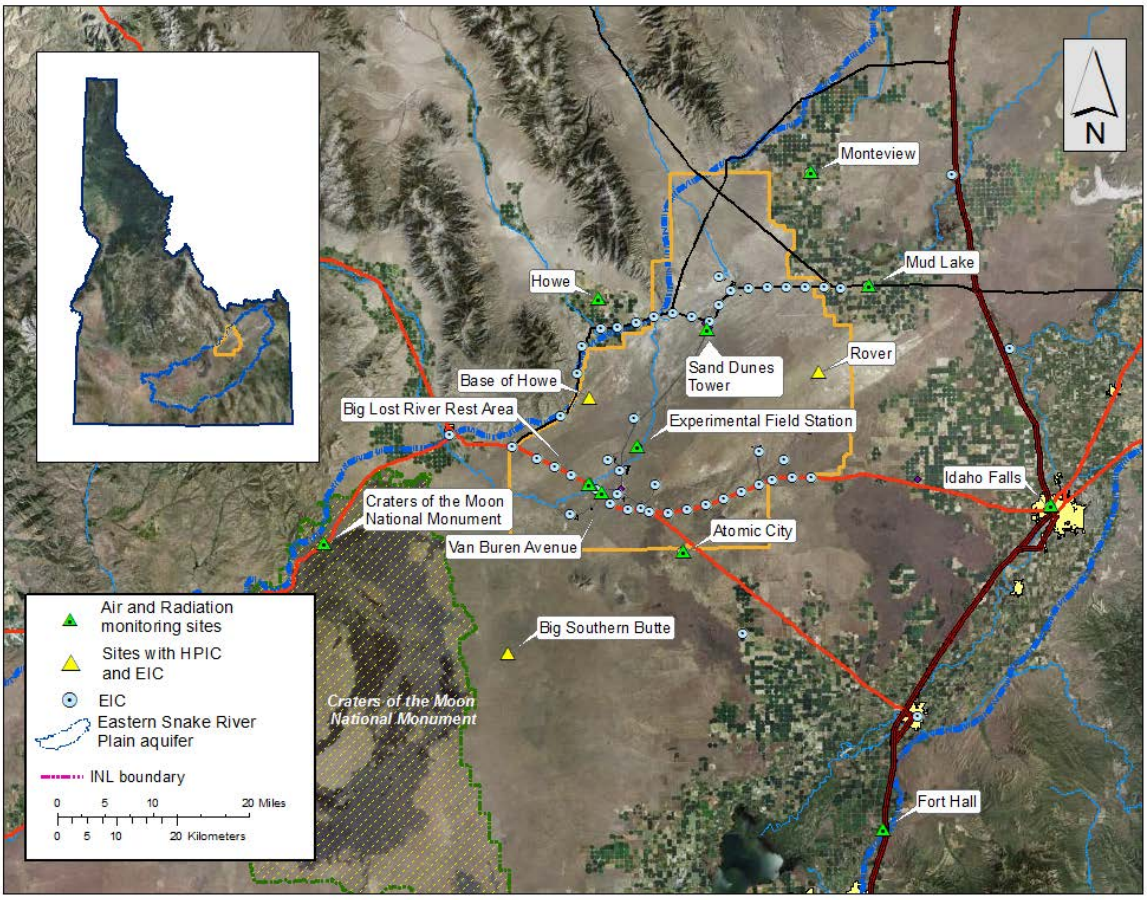

Figure 1. Air and radiation monitoring locations.

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, fourth quarter, 2017.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.5	-	1.7	23.6	-	77.9
Experimental Field Station	0.4	-	1.3	17.9	-	62.0
Sand Dunes Tower	0.3	-	1.0	16.1	-	53.8
Van Buren Avenue	0.5	-	0.9	15.6	-	51.0
Boundary Locations						
Atomic City	0.4	-	1.9	23.6	-	109.8
Howe	0.3	-	1.3	15.8	-	56.6
Monteview	0.4	-	1.3	18.9	-	60.7
Mud Lake	0.7	-	2.2	28.0	-	78.6
Distant Locations						
Craters of the Moon	0.2	-	0.8	11.3	-	39.5
Fort Hall[1]	0.6	-	1.5	28.4	-	50.1
Idaho Falls – HVP 3804	0.5	-	1.7	23.6	-	61.9
Idaho Falls – HVP 4304	0.4	-	0.9	17.1	-	37.3

[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, fourth 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	90.4	5.5	<MDC[2]	
Experimental Field Station	67.8	3.8	<MDC	
Sand Dunes Tower	57.9	3.3	<MDC	
Van Buren Avenue	55.7	3.2	<MDC	
Boundary Locations				
Atomic City	100.4	6.1	<MDC	
Howe	62.1	3.4	<MDC	
Monteview	75.3	4.1	<MDC	
Mud Lake	88.5	4.8	<MDC	
Distant Locations				
Craters of the Moon	62.5	3.9	<MDC	
Fort Hall[1]	108.6	6.2	<MDC	
Idaho Falls – HVP 3804	81.8	5.1	<MDC	
Idaho Falls – HVP 4304	58.7	3.3	<MDC	

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC for Cs-137 typically (0.05-0.10) x 10^{-3} pCi/m^3.
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, fourth quarter, 2017.

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.11	0.29	0.48
Experimental Field Station	0.25	0.33	0.57
Sand Dunes Tower	0.05	0.32	0.54
Van Buren Avenue	0.29	0.36	0.62
Boundary Locations			
Atomic City	0.00	0.16	0.27
Howe	0.26	0.24	0.40
Mud Lake	0.05	0.34	0.57
Monteview	0.38	0.44	0.73
Distant Locations			
Craters of the Moon	0.19	0.32	0.54
Fort Hall[1]	0.27	0.39	0.65
Idaho Falls	0.26	0.48	0.83

[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, fourth quarter, 2017.

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	-40	110	190	0.0	1.2	2.1
Boundary Locations						
Atomic City	-80	110	190	-1.1	1.9	3.2
Howe	10	120	190	0.7	1.7	2.8
Monteview	-100	110	190	-1.0	2.0	3.3
Mud Lake	-40	110	190	-1.1	1.9	3.2
Distant Locations						
Idaho Falls	10	120	190	-1.8	1.4	2.4

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

Environmental Radiation Monitoring Results

The ESP operated 13 environmental radiation stations during the fourth quarter of 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 fourth quarter 2017. **Table 8** lists the EIC monitoring results for fourth 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, fourth quarter, 2017, from HPIC network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
Base of Howe	15.7	1.4
Big Lost River Rest Area	15.1	1.2
Rover	15.5	1.4
Sand Dunes Tower	13.2	0.9
Boundary Locations		
Atomic City	12.0	5.8
[1]Big Southern Butte	14.6	1.8
Howe Met Tower	13.0	0.9
[2]Monteview	--	--
Mud Lake / Terreton	14.4	1.4
Distant Locations		
Fort Hall	12.5	1.2
Idaho Falls	12.6	1.4

[1]Big Southern Butte has experienced multiple electronic malfunctions in this quarter. Corrections for these anomalies can be applied when necessary by the data analyst. This location has experienced larger than normal electronic interference this quarter. The reported values for this location without these corrections are: 19.5 uR/hr average exposure rate, and a standard deviation of 84.4. Further justification for removing these anomalies from the data set includes the co-located EICs result of 12.2 ± 2.0 µR/hr average exposure rate for the same quarter at the same location (see 'Big Southern Butte' in Table 8).

[2]No data available for this location for fourth quarter 2017 due to electronic malfunctions in instrumentation.

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

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-Site Locations		
Base of Howe	11.1	2.9
Big Lost River Rest Area	13.7	1.6
Experimental Field Station	14.5	2.8
Rover	13.5	3.3
Sand Dunes Tower	15.3	2.3
Van Buren Avenue	15.3	3.4
Boundary Locations		
Atomic City	14.8	1.1
Big Southern Butte	12.2	2.0
Howe Met Tower	11.9	3.3
Monteview	12.3, 13.4	
Mud Lake/Terreton	12.7	0.6
Distant Locations		
Craters of the Moon	12.0	0.3
Fort Hall	13.4	1.9
Idaho Falls	15.7	1.7

[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. Samples are collected from groundwater (wells and springs), surface water (streams), and wastewater, with the vast majority being from groundwater. 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 samples are collected from 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, trace metals, and nutrients.[1] 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 fourth quarter of 2017, DEQ-INL OP sampled water at eighteen monitoring locations: three upgradient, eight facility, three boundary, eight distant, one surface water, and one wastewater. Analytical results are reported in **Tables 9 through 19** and summarized below.

Gross alpha and gross beta radioactivity were detected at low levels in most samples (**Table 9**). Most of these detections fall within the range of naturally-occurring radioactivity determined by historical DEQ data. Gross alpha and beta measurements in facility locations PW-9 and USGS-066 (both at ATR) and distant location MV-43 were slightly higher than typical background levels and previous results. Manmade gamma-emitting radionuclides, including ^{137}Cs, were not detected at any location sampled this quarter (**Table 9**). No location had a gross alpha concentration that exceeded the EPA drinking water maximum contaminant level (MCL) for alpha particles of 15 pCi/L. 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.

Two facility locations—both at RWMC—were sampled for plutonium isotopes and ^{241}Am (**Table 10 and 11**). No plutonium isotopes or ^{241}Am were detected.

Eight facility locations—four at ATR, two at RWMC, and two at or near CFA—were sampled for ^{90}Sr (**Table 12**). All had concentrations below MDC except for USGS-073 at ATR, which had a concentration of 1.18 ± 0.36 pCi/L, consistent with prior observations. The drinking water MCL for ^{90}Sr is 8 pCi/L. Three facility locations—two at or near CFA and one at RWMC—were sampled for ^{99}Tc (**Table 13**). All had low-level detectable concentrations consistent with historical data and well below the drinking water MCL of 900 pCi/L.

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 detected in groundwater from locations at ATR, CFA, and RWMC (**Table 14**). All concentrations were consistent with historical data and were measured in areas of known contamination related to past INL waste disposal practices. Tritium was not detected at any upgradient, boundary, distant, surface water, or wastewater location using the standard method. No samples collected during the current quarter were analyzed using the enrichment method; however, analyses of fourteen samples collected in previous quarters were completed and are presented in **Table 15**. The results of all enriched analyses are consistent with historical trends at these locations. A backlog of 73 samples to be analyzed by the enrichment method remains.

Samples from all locations were analyzed for metals, common ions, and nutrients. Results are shown in **Tables 16, 17,** and **18**. All results are within expected ranges based on historical data. All metal, common

[1] Distant locations Alpheus Spring, Bill Jones Hatchery, Clear Spring, Minidoka Water Supply, and Shoshone Water Supply and upgradient location Mud Lake Water Supply are sampled only for gross alpha and gross beta radioactivity, gamma-emitting radionuclides, and tritium during the second and fourth quarters. Samples for common ions, trace metals, and nutrients are collected at these locations during the third quarter.

ion, and nutrient concentrations are below drinking water MCLs except for the concentration of nitrate plus nitrite at MV-43, which is 35 mg/L (the MCL is 10 mg/L for nitrate and 1 mg/L for nitrite). High nitrogen concentrations at MV-43 are likely due to agriculture.

Two facility locations—both at RWMC—were sampled for VOCs. Both had detectable concentrations of at least one VOC. The concentration of carbon tetrachloride at RWMC Production (5.93 µg/L) exceeded the drinking water MCL of 5 µg/L. All VOC detections were consistent with historical data and were measured in areas of known contamination. **Table 19** shows VOCs that were detected in at least one location. A complete list of VOC analytes is shown in **Appendix C**.

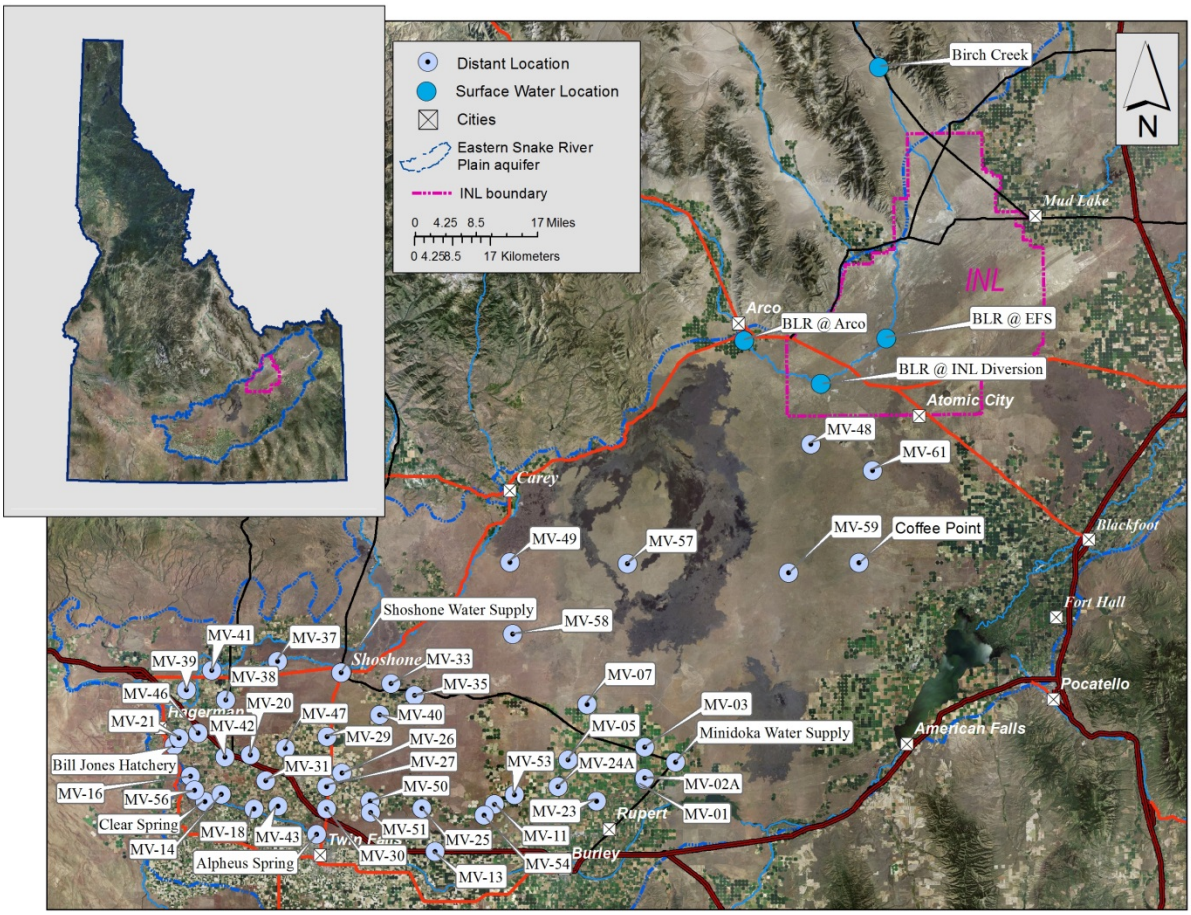

Figure 2. Distant and surface water monitoring locations.

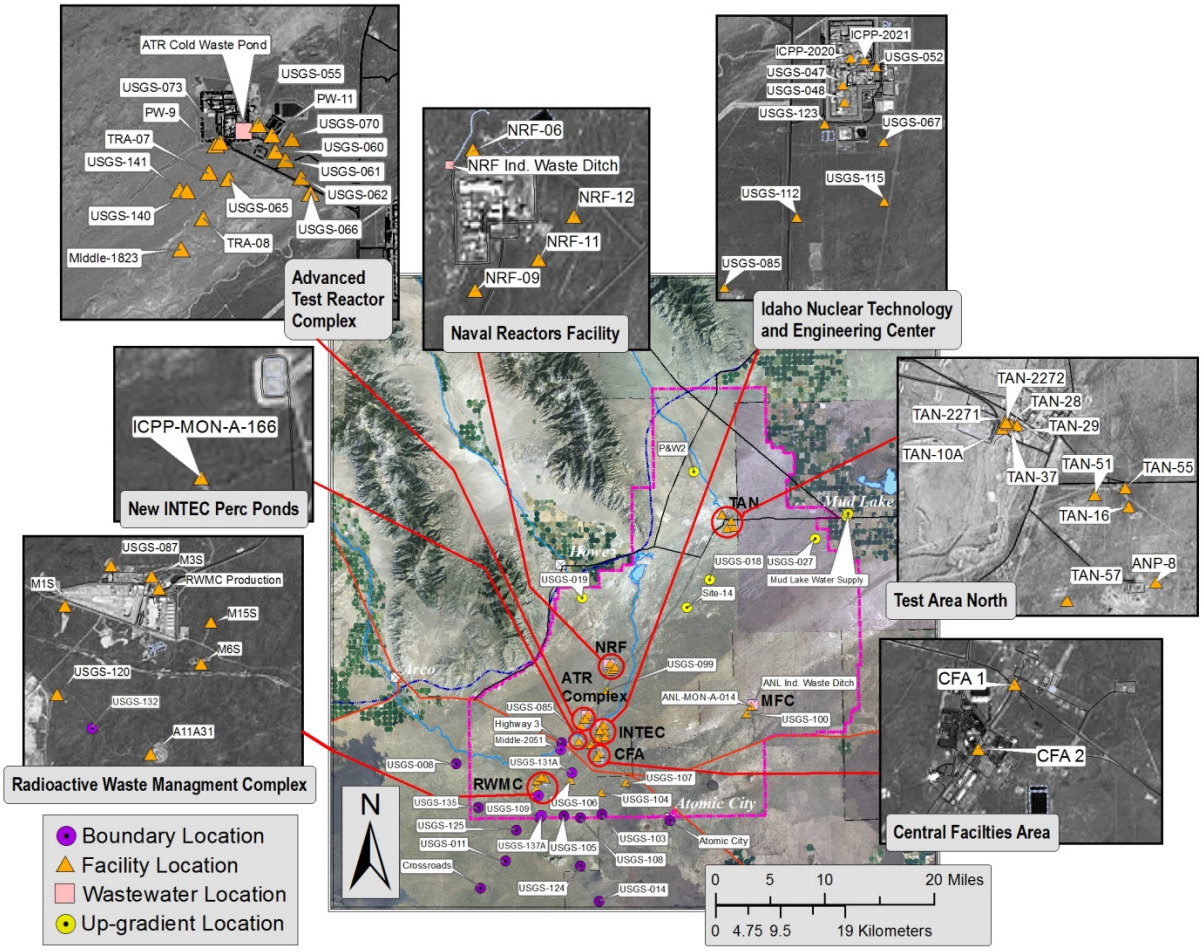

Figure 3. Up-gradient, facility, boundary, and wastewater monitoring locations.

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

Sample Location	Sample Date	Gross Alpha			Gross Beta			Cesium-137		
		Concentration		2 SD	Concentration		2 SD	Concentration		2 SD
Upgradient										
Mud Lake Water Supply	9/27/2017	0.6	U	0.5	4.9		0.8	-0.9	U	2.0
Mud Lake Water Supply	11/14/2017	-0.1	U	0.5	3.5		0.8	-0.9	U	1.9
Site-14	10/10/2017	2.5		1.0	3.6		0.8	-0.4	U	2.0
Facility										
CFA 2	10/10/2017	6.5		2.0	6.2		1.5	0.4	U	1.5
PW-9	10/17/2017	10.8		2.3	15.3		1.8	-0.7	U	1.9
RWMC Production	11/15/2017	1.3		0.9	3.5		0.9	1.3	U	1.8
USGS-060	10/10/2017	3.8		1.2	4.2		0.9	1.5	U	1.5
USGS-066	10/17/2017	7.4		2.0	11.9		1.3	0.5	U	1.9
USGS-073	10/17/2017	2.8		1.5	9.3		1.6	-0.2	U	1.5
USGS-104	10/12/2017	2.8		1.0	3.9		0.8	0.5	U	1.3
USGS-120	10/11/2017	2.0		1.0	3.6		0.9	-0.3	U	1.1
Boundary										
Highway 3	10/12/2017	2.9		1.0	4.5		0.9	-0.2	U	1.5
USGS-014	10/11/2017	2.0		0.9	3.8		0.9	-0.1	U	1.1
USGS-125	10/11/2017	1.0	U	0.8	3.8		0.8	0.3	U	1.4
Distant										
Alpheus Spring	11/13/2017	3.0		1.3	9.0		1.1	-1.0	U	1.2
Bill Jones Hatchery	11/13/2017	1.6		0.9	4.7		0.9	0.5	U	1.1
Clear Spring	11/13/2017	2.0		1.1	5.3		1.0	1.0	U	1.6
Minidoka Water Supply	11/13/2017	2.3		1.0	4.2		0.9	-1.0	U	2.1
MV-21	9/26/2017	1.5		0.9	5.3		0.9	-0.6	U	2.0
MV-37	9/26/2017	2.6		1.2	6.0		1.0	-1.0	U	1.0
MV-43	9/26/2017	8.6		2.9	11.4		2.4	0.4	U	1.5
Shoshone Water Supply	11/13/2017	3.2		1.1	4.9		0.9	-0.6	U	1.1
Surface Water										
Birch Creek	10/16/2017	3.6		1.2	2.5		0.8	0.1	U	1.7
Wastewater										
ATR Cold Waste Pond	12/12/2017	2.3		1.1	2.5		0.9	-0.2	U	1.2

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. Plutonium isotope concentrations (pCi/L) in water samples, fourth quarter, 2017.

Sample Location	Sample Date	Plutonium-238			Plutonium-239/240		
		Concentration		2 SD	Concentration		2 SD
Facility							
RWMC Production	11/15/2017	0	U	0.017	0	U	0.017
USGS-120	10/11/2017	-0.004	U	0.018	0	U	0.018

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. Americium-241 concentration (pCi/L) in water samples, fourth quarter, 2017.

Sample Location	Sample Date	Americium-241		
		Concentration		2 SD
Facility				
RWMC Production	11/15/2017	-0.010	U	0.016
USGS-120	10/11/2017	-0.008	U	0.016

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

Table 12. Strontium-90 concentrations (pCi/L) in water samples, fourth quarter, 2017.

Sample Location	Sample Date	Strontium-90		
		Concentration		2 SD
Facility				
CFA 2	10/10/2017	0.29	U	0.25
PW-9	10/17/2017	0.10	U	0.18
RWMC Production	11/15/2017	0.09	U	0.18
USGS-060	10/10/2017	0.25	U	0.24
USGS-066	10/17/2017	-0.03	U	0.17
USGS-073	10/17/2017	1.18		0.36
USGS-104	10/12/2017	0.24	U	0.25
USGS-120	10/11/2017	-0.05	U	0.21

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

Table 13. Technetium-99 concentrations (pCi/L) in water samples, fourth quarter, 2017.

Sample Location	Sample Date	Technetium-99		
		Concentration		2 SD
Facility				
CFA 2	10/10/2017	3.1		0.2
USGS-104	10/12/2017	1.2		0.2
USGS-120	10/11/2017	1.1		0.2

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

Table 14. Tritium concentrations (pCi/L) for water samples, fourth quarter, 2017.

Sample Location	Sample Date	Tritium		
		Concentration		2 SD
Upgradient				
Mud Lake Water Supply	9/27/2017	-10	U	160
Mud Lake Water Supply	11/14/2017	-10	U	140
Site-14	10/10/2017	40	U	170
Facility				
CFA 2	10/10/2017	3090		260
PW-9	10/17/2017	2940		290
RWMC Production	11/15/2017	500		180
USGS-060	10/10/2017	90	U	170
USGS-066	10/17/2017	10	U	150
USGS-073	10/17/2017	990		200
USGS-104	10/12/2017	750		190
USGS-120	10/11/2017	100	U	140
Boundary				
Highway 3	10/12/2017	-10	U	130
USGS-014	10/11/2017	10	U	170
USGS-125	10/11/2017	20	U	170
Distant				
Alpheus Spring	11/13/2017	-20	U	170
Bill Jones Hatchery	11/13/2017	50	U	170
Clear Spring	11/13/2017	110	U	180
Minidoka Water Supply	11/13/2017	-60	U	140
MV-21	9/26/2017	10	U	170
MV-37	9/26/2017	-40	U	130
MV-43	9/26/2017	-70	U	130
Shoshone Water Supply	11/13/2017	-70	U	140
Surface Water				
Birch Creek	10/16/2017	-80	U	130
Waste Water				
TRA Cold Waste Pond	12/12/2017	10	U	140

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

Table 15. Enriched tritium concentrations (pCi/L) in water samples collected during various quarters and analyzed in the fourth quarter of 2017.

Sample Location	Sample Date	Enriched Tritium		
		Concentration		2 SD
Upgradient				
Mud Lake Water Supply	5/18/2016	7	U	6
P&W-2	4/25/2017	4	U	7
Facility				
USGS-052	4/25/2016	717		22
USGS-066	10/19/2016	136		9
Boundary				
Atomic City	4/19/2017	5	U	6
Middle-2051 (1091 ft bls)	6/8/2016	159		11
Middle-2051 (749 ft bls)	6/8/2016	193		12
USGS-105 (952 ft bls)	6/16/2016	163		13
USGS-132 (765 ft bls)	6/7/2016	215		17
Distant				
Clear Spring	5/16/2016	1	U	9
Minidoka Water Supply	11/4/2016	7	U	6
MV-03	7/18/2016	7	U	10
MV-07	7/18/2016	-1	U	9
MV-27	7/18/2016	15	U	12

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 16. Dissolved metals concentrations (µg/L) in water samples, fourth quarter, 2017.

Sample Location	Sample Date	Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Upgradient																	
Mud Lake Water Supply	9/27/2017	8.9		20		<1.0	U	<10	U	<1.0	U	36		<2.0	U	<5.0	U
Site-14	10/10/2017	4.2		62		5.5		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
Facility																	
CFA 2	10/10/2017	<2.0	U	93		10		12		<1.0	U	1.4		2.9		<5.0	U
PW-9	10/17/2017	<2.0	U	53		15		54		<1.0	U	26		<2.0	U	<5.0	U
RWMC Production	11/15/2017	<2.0	U	41		11		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
USGS-060	10/10/2017	9.5		67		5.1		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
USGS-066	10/17/2017	<2.0	U	42		9.7		33		<1.0	U	2.4		<2.0	U	7.7	J+
USGS-073	10/17/2017	<2.0	U	130		39		15		<1.0	U	<1.0	U	<2.0	U	<5.0	U
USGS-104	10/12/2017	<2.0	U	32		8.1		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
USGS-120	10/11/2017	2.3		45		11		<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
Boundary																	
Highway 3	10/12/2017	<2.0	U	52		2.3		<10	U	<1.0	U	<1.0	U	<2.0	U	110	
USGS-014	10/11/2017	2.5		22		3.8		16		<1.0	U	2.8		<2.0	U	<5.0	U
USGS-125	10/11/2017	<2.0	U	34		4.2		62		<1.0	U	15		<2.0	U	<5.0	U
Distant																	
MV-21	9/26/2017	<2.0	U	25		3.0		<10	U	<1.0	U	1.4		<2.0	U	7.7	
MV-37	9/26/2017	<2.0	U	44		<1.0	U	<10	U	<1.0	U	<1.0	U	<2.0	U	15	
MV-43	9/26/2017	3.2		200		<1.0	U	12		<1.0	U	<1.0	U	<2.0	U	<5.0	U
Surface Water																	
Birch Creek	10/16/2017	<2.0	U	67		<1.0	U	<10	U	<1.0	U	<1.0	U	<2.0	U	<5.0	U
Waste Water																	
TRA Cold Waste Pond	12/12/2017	<2.0	U	52		4.2		13		<1.0	U	<1.0	U	<2.0	U	<5.0	U

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 17. Common ion concentrations (mg/L) in water samples, fourth quarter, 2017.

Sample Location	Sample Date	Calcium*		Magnesium*		Sodium*		Potassium*		Fluoride		Chloride		Sulfate		Alkalinity†	
Upgradient																	
Mud Lake Water Supply	9/27/2017	8.9		2.8		31		5.0		0.701		4.97		8.51		92	
Site-14	10/10/2017	34		13		14		3.0		0.502		9.56		24.1		129	
Facility																	
CFA 2	10/10/2017	74		25		30		4.4		0.220		120		44.3		132	
PW-9	10/17/2017	56		18		20		2.6		<0.200	U	56.3		59.4		111	
RWMC Production	11/15/2017	47		16		9.4		2.7		0.312		27.8		31.0		139	
USGS-060	10/10/2017	56		16		12		2.6		0.262		12.7		49.3		159	
USGS-066	10/17/2017	84		18		14		2.1		<0.200	U	19.1		133		143	
USGS-073	10/17/2017	93		21		20		2.9		0.262		79.8		43.7		184	
USGS-104	10/12/2017	35		14		8.8		2.5		0.214		14.4		20.7		123	
USGS-120	10/11/2017	35		18		21		3.6		0.279		19.2		34.1		144	
Boundary																	
Highway 3	10/12/2017	45		12		6.0		2.4		0.220		5.95		20.3		142	
USGS-014	10/11/2017	37		16		17		2.9		0.936		20.7		21.0		135	
USGS-125	10/11/2017	38		15		11		2.7		0.221		11.8		23.9		140	
Distant																	
MV-21	9/26/2017	32		17		18		3.7		0.524		13.7		28.4		137	
MV-37	9/26/2017	46		16		19		3.5		0.392		14.1		27.9		170	
MV-43	9/26/2017	140		51		49		6.9		0.424		79.5		115		315	
Surface Water																	
Birch Creek	10/16/2017	42		15		5.1		0.97		0.216		4.89		25.8		147	
Waste Water																	
TRA Cold Waste Pond	12/12/2017	51		19		9.9		1.9		<0.200	U	12.0		48.6		160	

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 18. Dissolved nutrient concentrations (mg/L) in water samples, fourth quarter, 2017.

Sample Location	Sample Date	Nitrate + Nitrite		Phosphorus	
Upgradient					
Mud Lake Water Supply	9/27/2017	<0.01	U	0.034	
Site-14	10/10/2017	0.61		0.013	
Facility					
CFA 2	10/10/2017	3.6		0.017	
PW-9	10/17/2017	2.4		<0.005	U
RWMC Production	11/15/2017	1.0		0.180	
USGS-060	10/10/2017	1.2		0.180	
USGS-066	10/17/2017	1.5		0.024	
USGS-073	10/17/2017	6.5		0.028	
USGS-104	10/12/2017	0.87		0.016	
USGS-120	10/11/2017	0.90		0.017	
Boundary					
Highway 3	10/12/2017	0.48		0.021	
USGS-014	10/11/2017	1.3		0.010	
USGS-125	10/11/2017	0.62		0.012	
Distant					
MV-21	9/26/2017	2.8		0.016	
MV-37	9/26/2017	2.0		0.053	
MV-43	9/26/2017	35		0.022	
Surface Water					
Birch Creek	10/16/2017	0.27		<0.005	U
Waste Water					
TRA Cold Waste Pond	12/12/2017	1.0		0.160	

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 19. Volatile organic compound concentrations (µg/L) in water samples, fourth quarter, 2017.

Sample Location	Sample Date	PCE	TCE	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	Carbon tetrachloride	Chloroform	Chloro-methane	1,1-DCA
RWMC Production	11/15/2017	<0.50 U	3.20	<0.50 U	<0.50 U	<0.50 U	<0.50 U	5.93	1.88	<0.5 U	<0.5 U
USGS-120	10/11/2017	<0.50 U	<0.50 U	<0.50 U	<0.50 U	<0.50 U	<0.50 U	1.45	<0.50 U	<0.5 U	<0.5 U

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

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 physical soil sampling was performed during the fourth 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 20**. ^{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 20. Gamma spectroscopy analysis data for milk samples, fourth quarter, 2017.

Sample Location/Dairy	Sample Date	Naturally occurring Potassium-40		Man-made Iodine-131[1]
		Concentration[3]	± 2 SD	
Monitoring Samples				
Gooding	10/17/2017	1364	109	<MDC
	12/07/2017	1453	121	<MDC
Riverside	10/10/2017	1910	134	<MDC
	11/06/2017	1701	125	<MDC
	12/05/2017	1666	131	<MDC
Verification Samples[2]				
Rupert	10/03/2017	1426	113	<MDC
Howe	10/03/2017	1383	95	<MDC
Rupert	11/07/2017	1519	116	<MDC
Howe	11/07/2017	1399	96	<MDC
Rupert	12/05/2017	1489	99	<MDC
Idaho Falls	12/05/2017	1405	120	<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 are expressed in pCi/L.

Soil

DEQ-INL OP monitors long-term radiological conditions via physical soil sampling as well as field instrumentation capable of identifying and measuring *in-situ* concentrations of gamma-emitting radionuclides in soil. Monitoring concentrations of gamma-emitting radionuclides in surface soil provides some insight to transport, deposition, and accumulation of radioactive material in the environment as a result of INL operations as well as historical above ground testing of nuclear weapons.

In-Situ gamma spectroscopic measurements were performed at 34 locations (**Figure 4**) during the fourth calendar quarter of 2017. ^{137}Cs was the only man made gamma emitting radionuclide detected. Analysis results for ^{137}Cs concentrations for *in-situ* soil monitoring are shown in **Table 21.**

Table 21. *In-Situ* gamma spectroscopic analysis results (^{137}Cs) for soil monitoring conducted during the fourth quarter of 2017.

Location	Date Acquired	Concentration[1]	2-sigma	MDA
Boundary Sampling Locations				
Monteview ESER Soil Site	11/15/2017	0.152	0.029	0.008
Monteview Air Station	11/15/2017	0.074	0.018	0.008
Mud Lake ESER Soil Site #2	11/15/2017	0.103	0.027	0.009
Mud Lake Air Station	11/15/2017	0.046	0.021	0.008
Reno Ranch ESER Soil Site	11/28/2017	0.219	0.026	0.007
Frenchman's Cabin ESER Soil Site	11/29/2017	0.117	0.041	0.009
Big Southern Butte HPIC	11/29/2017	0.183	0.032	0.010
Large Grid 18-4	11/29/2017	0.134	0.025	0.008
Large Grid 12-4	11/29/2017	0.153	0.023	0.008
Large Grid 12-5	11/29/2017	0.186	0.026	0.009
Howe Met Tower	12/1/2017	0.076	0.038	0.009
Atomic City ESER Soil Site	12/5/2017	0.113	0.023	0.010
Atomic City Air Station	12/5/2017	0.060	0.023	0.008
Distant Sampling Locations				
Roberts Met. Tower	11/15/2017	0.137	0.025	0.011
Idaho Falls CMS[3]	11/14/2017	0.052	0.022	0.008
Idaho Falls Air Station[2]	11/14/2017	0.046	0.019	0.009
On site Sampling Locations				
Large Grid 18-8	11/21/2017	0.199	0.028	0.009
Large Grid 24-2	11/21/2017	0.173	0.028	0.008
Large Grid 24-7	11/21/2017	0.120	0.025	0.008
Large Grid 18-3	11/21/2017	0.107	0.026	0.010
Rover	11/21/2017	0.133	0.028	0.010
Large Grid 24-9	11/28/2017	0.151	0.054	0.012
Large Grid 24-8	11/28/2017	0.191	0.024	0.007
Large Grid 18-1	11/28/2017	0.098	0.027	0.009
Large Grid 30-1	11/28/2017	0.174	0.025	0.008
Large Grid 18-7	11/28/2017	0.140	0.028	0.006
Van Buren Air Station	12/1/2017	0.230	0.033	0.010
Big Lost River Rest Area	12/1/2017	0.118	0.031	0.011
Base of Howe HPIC	12/1/2017	0.081	0.032	0.008
Howe ESER Soil Site	12/1/2017	0.170	0.029	0.009
INL Main Gate	12/5/2017	0.158	0.025	0.010
Experimental Field Station	12/5/2017	0.259	0.027	0.010
Large Grid 6-3	12/5/2017	0.162	0.025	0.009
Sand Dunes Air Station	12/5/2017	0.116	0.026	0.010

[1]Concentrations are reported in pCi/g.
[2]DEQ-INL OP HPIC air monitoring station near Idaho Falls, ID.
[3]DEQ-INL OP HPIC Community Monitoring Station (CMS) near John's Hole Bridge Idaho Falls, ID.

The average Cesium-137 value was 0.14 picocuries per gram (pCi/g) with a minimum value of 0.05 pCi/g and a maximum of 0.26 pCi/g, well below the DEQ-INL OP action level of 6.4 pCi/g and the recommended federal screening limit for surface soil of 6.8 pCi/g (NCRP Report 129). Based upon terrestrial radiological measurements of soil and milk, there were no discernable impacts to the off-site environment from INL operations. Long-term accumulation of radionuclides observed by soil monitoring was consistent with historical measurements and was in the range of concentrations expected as a result of historic above-ground testing of nuclear weapons.

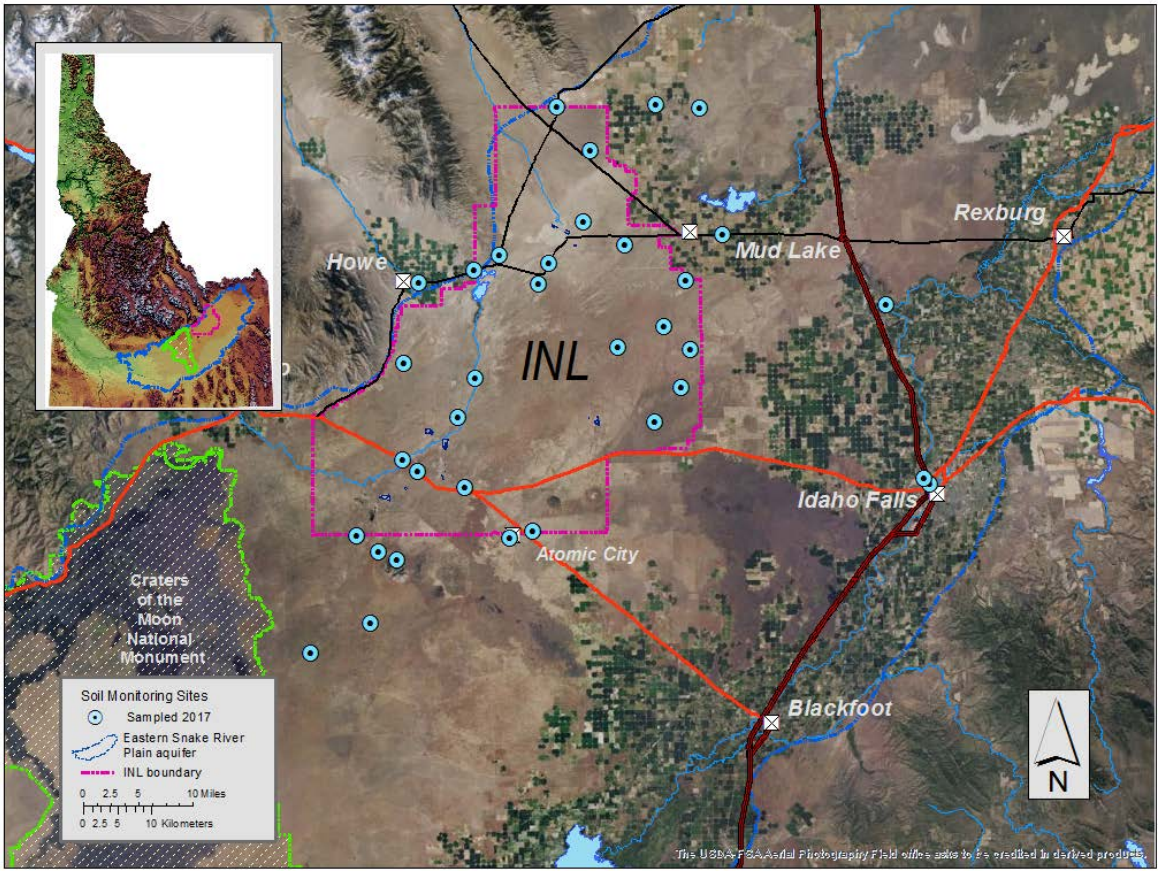

Figure 4. In-Situ soil monitoring sites, fourth quarter 2017.

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 fourth 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 fourth quarter of 2017, the DEQ-INL OP submitted 80 QC samples for various radiological and non-radiological analyses (**Table 22**).

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.[2] If a blank result exceeds acceptance criteria, above-MDC results in other samples collected, transported, or analyzed together with the failed blank may be qualified as biased high (J+) or rejected (R), or may remain unqualified, depending on the relative sizes of the blank detection and other sample results.

Blank sample results submitted for gross alpha and gross beta screening in air for the fourth quarter of 2017 are presented in **Table 23**. Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 24**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 25**. Blank sample results for radiological and non-radiological analytes in ground and surface water are presented in **Table 26**, **Table 27**, and **Table 28**.

Zinc was detected at a concentration of 5.8 µg/L in one water-sample blank. The zinc concentration reported for USGS-066 (7.7 µg/L), which was analyzed on the same date as the failed blank, has been qualified as a high-biased estimate (J+). All other samples collected or analyzed for zinc on the same date as the blank had zinc concentrations below MDC.

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

[2] 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 radiological and non-radiological analyses in groundwater and surface water are presented in **Tables 29**, **30,** and **31**. Duplicate results for radiological analyses of *in-situ* soil samples are presented in **Table 32**.

All duplicate results passed acceptance criteria in the fourth quarter of 2017.

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 fourth 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 fourth quarter 2017 are presented in **Table 33**. 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 fourth quarter of 2017.

Analytical QA/QC Assessment

Other than the one 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 fourth 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 fourth 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 fourth quarter of 2017 met the minimum criteria of the DEQ-INL OP ESP and is summarized in **Table 22**.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to prescribed periodicity. During the fourth quarter of 2017 the TSP blower at the Idaho Falls sampling station was replaced and the radioiodine pump at Experimental Field Station was replaced. The Idaho Falls TSP sampler was inoperable for less than one day. Service reliability for air sampling equipment for the fourth quarter of 2017 is summarized in **Table 34**.

Conclusion

All data collected for the fourth 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 22. Summary of the analytical performance and usability of the analyses performed for the DEQ-INL OP ESP, fourth 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	150	13	0	0	0	ISU-EML
		Gross beta	150	13	0	0	0	ISU-EML
		Gamma emitters	12	1	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	24	4	0	0	0	ISU-EML
Gaseous	Charcoal filter	Iodine-131	13	0	0	0	0	ISU-EML
Precipitation	Poly bottle	Tritium	6	0	0	0	0	ISU-EML
		Gamma emitters	6	0	0	0	0	ISU-EML
Water								
Groundwater & Surface Water	Grab or composite	Gross alpha	24	2	3	0	0	ISU-EML
		Gross beta	24	2	3	0	0	ISU-EML
		Gamma emitters	24	2	3	0	0	ISU-EML
		Tritium	24	2	3	0	0	ISU-EML
		Enriched tritium	14	0	0	0	0	ISU-EML
		Technetium-99	3	0	0	0	0	ISU-EML
		Radiochemical	12	0	0	0	0	ISU Sub
		Metals	18	1	2	0	0	IBL
		Common Ions	18	1	2	0	0	IBL
		Nutrients	18	1	2	0	0	IBL
		Volatile Organics	2	0	0	0	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	11	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	34	0	11	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	10	NA	NA	NA	0	DEQ-INL OP
Total Test Analyses			**662**	**42**	**29**	**9**	**0**	
Total of QC Analyses (blanks, duplicates, and spikes)			**80**					
QC Analyses as a percentage of total Test Analyses[3]			**12.1%**					
Percentage of usable data[4]			**100%**					

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

Collection Period		Corrected volume (m^3)[1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
09/28/17	10/05/17	2016	0.1	0.1	0.0	0.5
10/05/17	10/12/17	2016	0.1	0.1	-0.3	0.5
10/12/17	10/19/17	2016	0.0	0.1	0.8	0.5
10/19/17	10/26/17	2016	-0.1	0.1	0.4	0.4
10/26/17	11/02/17	2016	0.0	0.1	0.1	0.5
11/02/17	11/09/17	2016	0.0	0.1	0.3	0.5
11/09/17	11/16/17	2016	0.0	0.1	-0.7	0.5
11/16/17	11/22/17	2016	-0.1	0.1	-0.2	0.5
11/22/17	11/30/17	2016	0.0	0.1	-0.2	0.4
11/30/17	12/07/17	2016	0.0	0.1	0.5	0.5
12/07/17	12/14/17	2016	0.0	0.2	0.1	0.5
12/14/17	12/21/17	2016	0.0	0.1	-0.3	0.5
12/21/17	12/28/17	2016	0.1	0.1	-0.2	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 24. Blank analysis results for gamma spectroscopy for TSP particulate air filters, composite samples, fourth 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
01/19/2018	14	53	88	27	100	167	-2	14	24
Analysis Date	**Cesium-134**			**Cesium-137**		
	Concentration[1]	**± 2 SD**	**MDC**	**Concentration**	**± 2 SD**	**MDC**
01/19/2018	1	4	7	1	4	7

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 25. Blank analysis results for tritium in water vapor from air samples, fourth quarter, 2017.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP174ZTR01	12/20/2017	12/29/2017	1/17/2018	-0.01	0.08	0.15
OP174ZTR02	12/20/2017	12/29/2017	1/17/2018	0.01	0.11	0.19
OP174ZTR03	12/20/2017	12/29/2017	1/17/2018	0.03	0.09	0.15
OP174ZTR04	12/29/2017	12/29/2017	1/17/2018	0.09	0.11	0.19

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

Table 26. Blank analysis results (pCi/L) for radiological constituents in water, fourth quarter, 2017.

Sample Number	Sample Date	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha					
171W579	10/16/2017	0.1	0.2	0.4	Yes
171W598	11/13/2017	0.3	0.2	0.3	Yes
Gross Beta					
171W579	10/16/2017	-0.1	0.5	0.9	Yes
171W598	11/13/2017	0.0	0.6	0.9	Yes
Cesium-137					
171W579	10/16/2017	0.9	1.5	2.5	Yes
171W598	11/13/2017	0.1	2.0	3.4	Yes
Tritium					
171W580	10/16/2017	0	130	150	Yes
171W599	11/13/2017	-60	140	170	Yes

MDC = minimum detectable concentration.

Table 27. Blank analysis results (µg/L) for metals in water, fourth quarter, 2017.

Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
171W582	10/16/2017	<2.0	<1.0	<1.0	<10	<1.0	<1.0	<2.0	5.8

Table 28. Blank analysis results (mg/L) for common ions and nutrients in water, fourth quarter, 2017.

Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total Phosphorus
171W582,581	10/16/2017	<0.10	<0.10	<0.10	<0.10	<0.20	<0.40	<0.80	<1.0	<0.01	<0.005

† As $CaCO_3$.

Table 29. Duplicate sample results (pCi/L) for radiological constituents in groundwater and/or surface water, fourth 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									
Mud Lake Water Supply	171W432	0.6	0.5	171W487	0.5	0.6	0.1	1.2	Yes
Mud Lake Water Supply	171W592	-0.1	0.5	171W596	0.3	0.5	0.4	1.1	Yes
USGS-125	171W569	1.0	0.8	171W574	2.9	1.0	1.9	1.9	Yes
Gross Beta									
Mud Lake Water Supply	171W432	4.9	0.8	171W487	5.8	0.8	0.9	1.7	Yes
Mud Lake Water Supply	171W592	3.5	0.8	171W596	4.5	0.8	1.0	1.7	Yes
USGS-125	171W569	3.8	0.8	171W574	3.9	0.9	0.1	1.8	Yes
Cesium-137									
Mud Lake Water Supply	171W432	-0.9	2.0	171W487	-1.7	2.4	0.8	4.7	Yes
Mud Lake Water Supply	171W592	-0.9	1.9	171W596	-1.0	1.9	0.1	4.0	Yes
USGS-125	171W569	0.3	1.4	171W574	-1.7	1.9	2.0	3.5	Yes
Tritium									
Mud Lake Water Supply	171W434	-10	160	171W488	10	170	20	350	Yes
Mud Lake Water Supply	171W593	-10	140	171W597	-50	140	40	297	Yes
USGS-125	171W570	20	170	171W575	140	170	120	361	Yes

Table 30. Duplicate sample results for metals (µg/L) in groundwater, fourth quarter, 2017.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
Mud Lake Water Supply	171W436	9/27/2017	8.9	20	<1.0	<10	<1.0	36	<2.0	<5.0
Mud Lake Water Supply	171W490	9/27/2017	9.0	20	<1.0	<10	<1.0	36	<2.0	<5.0
RPD			**-1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
USGS-125	171W572	10/11/2017	<2.0	34	4.2	62	<1.0	15	<2.0	<5.0
USGS-125	171W577	10/11/2017	<2.0	33	4.1	71	<1.0	15	<2.0	<5.0
RPD			**0**	**3**	**2**	**-14**	**0**	**0**	**0**	**0**

RPD = relative percent difference.

Table 31. Duplicate results for common ions and nutrients (mg/L) in groundwater, fourth quarter, 2017.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity†	Total Nitrogen	Total Phosphorus
Mud Lake Water Supply	171W436,435	9/27/2017	8.9	2.8	31	5.0	0.701	4.97	8.51	92	<0.01	0.034
Mud Lake Water Supply	171W490,489	9/27/2017	8.9	2.8	31	5.0	0.693	4.98	8.52	94	<0.01	0.034
RPD			**0**	**0**	**0**	**0**	**1**	**0**	**0**	**-2**	**0**	**0**
USGS-125	171W572,571	10/11/2017	38	15	11	2.7	0.221	11.8	23.9	140	0.62	0.012
USGS-125	171W577,576	10/11/2017	37	15	11	2.8	0.259	11.8	24.0	140	0.62	0.012
RPD			**3**	**0**	**0**	**-4**	**-16**	**0**	**0**	**0**	**0**	**0**

RPD = relative percent difference.

† As $CaCO_3$.

Table 32. Duplicate *in-situ* analyses of gamma emitting radionuclides in soil, fourth quarter, 2017.

Sample Location	Sample Date	Original Result K-40 (pCi/g)[1]	QA Result K-40 (pCi/g)[1]	K-40 RPD (%)	K-40 Less than 3 sigma test	K-40 Meets either criterion?	Original Result Cs-137 (pCi/g)[1]	QA Result Cs-137 (pCi/g)[1]	Cs-137 RPD (%)	Cs-137 Less than 3 sigma test	Cs-137 Meets either criterion?
Monteview Soil	11/15/2017	22.8 ± 0.9	21.6 ± 0.8	-5.7	In Spec	Yes	0.152 ± 0.029	0.174 ± 0.029	13.2	In Spec	Yes
Mud Lake Soil	11/15/2017	10.1 ± 0.6	10.4 ± 0.6	2.6	In Spec	Yes	0.103 ± 0.027	0.114 ± 0.031	9.8	In Spec	Yes
LG 18-3	11/21/2017	18.8 ± 0.8	19.4 ± 0.8	2.9	In Spec	Yes	0.107 ± 0.026	0.099 ± 0.030	-7.6	In Spec	Yes
LG 24-9	11/28/2017	17.8 ± 0.8	16.4 ± 0.8	-7.9	In Spec	Yes	0.151 ± 0.054	0.165 ± 0.041	8.9	In Spec	Yes
LG 18-1	11/28/2017	14.9 ± 0.7	16.4 ± 0.8	9.6	In Spec	Yes	0.098 ± 0.027	0.125 ± 0.020	24.0	In Spec	Yes
LG 18-4	11/29/2017	14.7 ± 0.7	14.9 ± 0.7	1.0	In Spec	Yes	0.134 ± 0.025	0.134 ± 0.026	0.1	In Spec	Yes
LG 12-5	11/29/2017	13.6 ± 0.7	13.4 ± 0.7	-1.6	In Spec	Yes	0.186 ± 0.026	0.197 ± 0.024	5.7	In Spec	Yes
Rest Area	12/1/2017	16.8 ± 0.8	17.2 ± 0.8	2.6	In Spec	Yes	0.118 ± 0.031	0.181 ± 0.046	41.8	In Spec	Yes
Howe Soil	12/1/2017	9.4 ± 0.6	9.6 ± 0.6	2.6	In Spec	Yes	0.170 ± 0.029	0.197 ± 0.026	14.9	In Spec	Yes
EFS	12/5/2017	15.9 ± 0.7	16.9 ± 0.7	6.2	In Spec	Yes	0.259 ± 0.027	0.254 ± 0.028	-1.9	In Spec	Yes
Sand Dunes	12/5/2017	14.3 ± 0.7	15.9 ± 0.7	11.0	No	Yes	0.116 ± 0.026	0.082 ± 0.026	-33.7	In Spec	Yes

[1]Result ±2 SD.

Table 33. Electret ionization chamber (EIC) irradiation results (categorized as spiked samples), fourth 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 34. Air sampling field equipment service reliability (percent operational), fourth 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%	92%	100%	NC[1]
Sand Dunes Tower	100%	100%	100%	NC[1]
Van Buren Avenue	100%	100%	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	100%	100%	100%	NC[1]
Idaho Falls	100%	100%	100%	100%

Note: The values in this table were calculated by dividing the number of weeks the equipment was in operation by the number of weeks in the quarter.
[1] NC = Sample not collected at this location.

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, fourth 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	09/28/17	10/05/17	1.0	0.2	32.1	1.2
	10/05/17	10/12/17	1.1	0.2	33.2	1.3
	10/12/17	10/19/17	1.4	0.3	35.3	1.3
	10/19/17	10/26/17	1.4	0.3	23.6	1.1
	10/26/17	11/02/17	1.2	0.3	33.6	1.3
	11/02/17	11/09/17	0.8	0.2	31.5	1.2
	11/09/17	11/16/17	0.7	0.2	25.3	1.1
	11/16/17	11/22/17	0.6	0.2	26.4	1.3
	11/22/17	11/30/17	0.5	0.2	24.0	1.0
	11/30/17	12/07/17	0.6	0.2	35.5	1.3
	12/07/17	12/14/17	1.7	0.3	77.9	1.9
	12/14/17	12/21/17	1.2	0.3	66.7	1.7
	12/21/17	12/28/17	0.9	0.2	34.2	1.3
Experimental Field Station	09/28/17	10/05/17	0.7	0.2	24.6	1.1
	10/05/17	10/12/17	0.8	0.2	22.4	1.1
	10/12/17	10/19/17	1.1	0.3	28.7	1.2
	10/19/17	10/26/17	1.2	0.3	30.2	1.4
	10/26/17	11/02/17	0.7	0.2	29.4	1.4
	11/02/17	11/09/17	0.9	0.2	23.3	1.1
	11/09/17	11/16/17	0.7	0.2	20.4	1.1
	11/16/17	11/22/17	0.4	0.2	21.0	1.2
	11/22/17	11/30/17	0.4	0.2	17.9	0.9
	11/30/17	12/07/17	0.8	0.2	29.8	1.2
	12/07/17	12/14/17	1.3	0.3	62.0	1.8
	12/14/17	12/21/17	0.7	0.2	53.2	1.6
	12/21/17	12/28/17	0.6	0.2	29.2	1.2
Sand Dunes Tower	09/28/17	10/05/17	0.6	0.2	20.1	1.0
	10/05/17	10/12/17	0.9	0.2	21.7	1.0
	10/12/17	10/19/17	0.7	0.2	22.6	1.0
	10/19/17	10/26/17	0.7	0.2	22.3	1.0
	10/26/17	11/02/17	0.5	0.2	23.0	1.0
	11/02/17	11/09/17	0.7	0.2	20.1	1.0
	11/09/17	11/16/17	0.5	0.2	18.9	1.0
	11/16/17	11/22/17	0.6	0.2	18.4	1.0
	11/22/17	11/30/17	0.3	0.2	16.1	0.8
	11/30/17	12/07/17	0.8	0.2	23.6	1.0
	12/07/17	12/14/17	1.0	0.3	53.8	1.5
	12/14/17	12/21/17	0.8	0.2	43.6	1.4
	12/21/17	12/28/17	0.6	0.2	27.6	1.1

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, fourth quarter, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren Avenue	09/28/17	10/05/17	0.8	0.2	18.4	1.0
	10/05/17	10/12/17	0.8	0.2	20.2	1.0
	10/12/17	10/19/17	0.9	0.2	22.0	1.0
	10/19/17	10/26/17	0.7	0.2	21.4	1.0
	10/26/17	11/02/17	0.6	0.2	20.8	1.0
	11/02/17	11/09/17	0.7	0.2	20.1	1.0
	11/09/17	11/16/17	0.7	0.2	17.3	1.0
	11/16/17	11/22/17	0.5	0.2	17.2	1.1
	11/22/17	11/30/17	0.6	0.2	15.6	0.8
	11/30/17	12/07/17	0.6	0.2	22.3	1.0
	12/07/17	12/14/17	0.9	0.3	51.0	1.5
	12/14/17	12/21/17	0.8	0.2	46.3	1.4
	12/21/17	12/28/17	0.5	0.2	22.8	1.1
Boundary Locations						
Atomic City	09/28/17	10/05/17	1.1	0.3	38.1	1.5
	10/05/17	10/12/17	1.4	0.3	34.0	1.6
	10/12/17	10/19/17	1.5	0.3	36.9	1.3
	10/19/17	10/26/17	1.7	0.3	37.3	1.3
	10/26/17	11/02/17	1.8	0.5	53.3	2.4
	11/02/17	11/09/17	1.0	0.3	31.5	1.5
	11/09/17	11/16/17	0.8	0.2	29.6	1.5
	11/16/17	11/22/17	1.0	0.3	25.3	1.2
	11/22/17	11/30/17	0.4	0.2	23.6	1.0
	11/30/17	12/07/17	0.7	0.3	40.1	1.6
	12/07/17	12/14/17	1.9	0.3	109.8	2.2
	12/14/17	12/21/17	1.2	0.3	69.1	1.7
	12/21/17	12/28/17	1.0	0.2	45.8	1.4
Howe	09/28/17	10/05/17	0.5	0.2	18.7	1.0
	10/05/17	10/12/17	0.8	0.2	19.4	1.0
	10/12/17	10/19/17	0.5	0.2	20.9	1.0
	10/19/17	10/26/17	0.9	0.2	20.9	1.0
	10/26/17	11/02/17	0.7	0.2	20.4	1.1
	11/02/17	11/09/17	0.7	0.2	18.8	1.0
	11/09/17	11/16/17	0.5	0.2	16.5	1.0
	11/16/17	11/22/17	0.4	0.2	19.3	1.1
	11/22/17	11/30/17	0.3	0.2	15.8	0.9
	11/30/17	12/07/17	0.5	0.2	23.2	1.1
	12/07/17	12/14/17	1.3	0.3	56.6	1.6
	12/14/17	12/21/17	0.8	0.2	40.5	1.4
	12/21/17	12/28/17	0.8	0.2	23.3	1.1

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, fourth quarter, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	09/28/17	10/05/17	0.6	0.2	21.7	1.1
	10/05/17	10/12/17	1.1	0.2	23.0	1.1
	10/12/17	10/19/17	1.3	0.3	28.8	1.2
	10/19/17	10/26/17	1.0	0.3	24.2	1.1
	10/26/17	11/02/17	1.0	0.2	24.3	1.1
	11/02/17	11/09/17	1.0	0.2	26.2	1.1
	11/09/17	11/16/17	0.6	0.2	22.1	1.1
	11/16/17	11/22/17	0.6	0.2	22.6	1.2
	11/22/17	11/30/17	0.4	0.2	18.9	0.9
	11/30/17	12/07/17	0.7	0.2	26.8	1.2
	12/07/17	12/14/17	1.3	0.3	60.7	1.7
	12/14/17	12/21/17	1.2	0.3	55.1	1.6
	12/21/17	12/28/17	0.8	0.2	32.6	1.3
Mud Lake	09/28/17	10/05/17	1.2	0.3	31.6	1.3
	10/05/17	10/12/17	1.3	0.3	30.0	1.2
	10/12/17	10/19/17	1.5	0.3	35.1	1.3
	10/19/17	10/26/17	2.2	0.3	37.5	1.4
	10/26/17	11/02/17	1.2	0.3	30.8	1.2
	11/02/17	11/09/17	1.4	0.3	30.3	1.2
	11/09/17	11/16/17	1.0	0.2	29.4	1.2
	11/16/17	11/22/17	1.2	0.3	33.3	1.4
	11/22/17	11/30/17	0.7	0.2	28.0	1.1
	11/30/17	12/07/17	0.9	0.2	33.5	1.3
	12/07/17	12/14/17	2.1	0.3	78.6	1.9
	12/14/17	12/21/17	1.2	0.3	55.2	1.6
	12/21/17	12/28/17	0.9	0.2	33.1	1.3
Distant Locations						
Craters of the Moon	09/28/17	10/05/17	0.7	0.2	19.9	1.0
	10/05/17	10/12/17	0.8	0.2	21.2	1.1
	10/12/17	10/19/17	0.7	0.3	20.6	1.3
	10/19/17	10/26/17	0.6	0.2	23.6	1.1
	10/26/17	11/02/17	0.7	0.2	19.5	1.0
	11/02/17	11/09/17	0.5	0.2	16.5	0.9
	11/09/17	11/16/17	0.4	0.2	15.0	0.9
	11/16/17	11/22/17	0.2	0.2	11.3	0.9
	11/22/17	11/30/17	0.2	0.2	12.1	0.8
	11/30/17	12/07/17	0.3	0.2	17.1	0.9
	12/07/17	12/14/17	0.8	0.2	39.5	1.4
	12/14/17	12/21/17	0.7	0.2	32.0	1.2
	12/21/17	12/28/17	0.3	0.2	15.8	0.9

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, fourth quarter, 2017.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[1]	09/28/17	10/05/17	1.1	0.2	37.5	1.3
	10/05/17	10/12/17	1.5	0.3	33.2	1.3
	10/12/17	10/19/17	1.5	0.3	36.3	1.3
	10/19/17	10/26/17	1.2	0.3	30.1	1.2
	10/26/17	11/02/17	1.5	0.3	32.6	1.2
	11/02/17	11/09/17	NS[3]	NS[3]	NS[3]	NS[3]
	11/09/17	11/16/17	NS[3]	NS[3]	NS[3]	NS[3]
	11/16/17	11/22/17	NS[3]	NS[3]	NS[3]	NS[3]
	11/22/17	11/30/17	NS[3]	NS[3]	NS[3]	NS[3]
	11/30/17	12/07/17	NS[3]	NS[3]	NS[3]	NS[3]
	12/07/17	12/14/17	NS[3]	NS[3]	NS[3]	NS[3]
	12/14/17	12/21/17	1.1	0.3	50.1	1.6
	12/21/17	12/28/17	0.6	0.2	28.4	1.2
Idaho Falls - HVP 3804	09/28/17	10/05/17	1.1	0.3	31.4	1.3
	10/05/17	10/12/17	1.1	0.2	29.3	1.2
	10/12/17	10/19/17	0.9	0.3	30.2	1.3
	10/19/17	10/26/17	1.1	0.3	26.5	1.2
	10/26/17	11/02/17	1.3	0.3	27.2	1.2
	11/02/17	11/09/17	1.1	0.3	26.0	1.2
	11/09/17	11/16/17	0.9	0.2	24.8	1.2
	11/16/17	11/22/17	0.5	0.2	24.0	1.2
	11/22/17	11/30/17	0.5	0.2	23.6	1.0
	11/30/17	12/07/17	0.7	0.2	29.5	1.2
	12/07/17	12/14/17	1.7	0.3	61.9	1.7
	12/14/17	12/21/17	1.2	0.3	51.9	1.6
	12/21/17	12/28/17	0.6	0.2	26.2	1.2
Idaho Falls - HVP 4304[2]	09/28/17	10/05/17	0.9	0.2	26.6	1.1
	10/05/17	10/12/17	0.9	0.2	23.1	1.1
	10/12/17	10/19/17	0.9	0.2	23.1	1.1
	10/19/17	10/26/17	0.8	0.2	17.4	0.9
	10/26/17	11/02/17	0.9	0.2	17.6	1.0
	11/02/17	11/09/17	0.6	0.2	22.0	1.0
	11/09/17	11/16/17	0.7	0.2	18.6	1.0
	11/16/17	11/22/17	0.4	0.2	20.5	1.1
	11/22/17	11/30/17	0.4	0.2	17.1	0.9
	11/30/17	12/07/17	0.5	0.2	19.5	1.0
	12/07/17	12/14/17	0.5	0.2	37.3	1.3
	12/14/17	12/21/17	0.6	0.2	34.0	1.3
	12/21/17	12/28/17	0.4	0.2	18.9	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] NS – No sample – TSP not operational.

Appendix B

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

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
Arco	12.8	2.2
Craters of the Moon	12.0	0.3
Rest Area	13.7	1.6
Van Buren Avenue	15.3	3.4
Experimental Field Station	14.5	2.8
Main Gate	15.9	1.1
Atomic City	14.8	1.1
Taber	13.7	3.0
Blackfoot	12.0	2.5
Ft. Hall	13.4	1.9
Idaho Falls	15.7	1.7
Mud Lake/ Terreton	12.7	0.6
Monteview	12.3, 13.4	
Sand Dunes	15.3	2.3
Howe Met. Tower	11.9	3.3
MP282 -20	16.0	2.6
MP280 -20	14.9	3.6
MP278 -20	15.6	2.8
MP276 -20	13.6	2.0
MP274 -20	14.8	1.7
MP272 -20	13.4	3.4
MP270 -20	13.6, 14.5	
MP268 -20	14.7	1.2
MP266 -20	17.1	0.9
MP264 -20	15.6	1.2
MP270 -20/26	15.7	1.9
MP268 -20/26	12.1, 14.0	
MP266 -20/26	15.2	2.3
MP263 -20/26	15.0	2.5
MP261 -20/26	13.0	3.0
MP259 -20/26	11.8	1.6
MP256 -20/26	8.8, 9.4	
MFC (EBR II)	15.1	3.1
EBR I	11.6	1.7
RWMC	17.6, 18.9	
CFA	18.0, 18.5	
CITRC (PBF)	14.7	0.3
INTEC	18.0, 19.2	
ATR (TRA)	13.2	0.8
NRF	15.1	3.4

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

Sample Location	Net Corrected Exposure Rate (µR/hr)[1]	± 2 SD (µR/hr)
TAN/SMC	14.4, 15.0	
Mud Lake Bank of Commerce	17.9	2.2
MP43-33	15.8	2.6
MP41-33	16.5, 18.7	
MP39-33	18.0	2.0
MP37-33	12.5, 13.0	
MP35-33	17.1	2.8
MP33-33	15.4, 15.6	
MP31-33	15.6	1.0
MP29-33	15.6	3.5
MP27-33	16.9	0.5
MP25-33	12.2	3.0
MP23-33	12.4, 13.3	
MP21-33	12.9	0.6
MP19-33	14.3	2.3
MP14-33	14.5, 14.6	
MP11-33	12.6	1.6
MP09-33	12.7, 13.6	
MP03-33	11.4	0.8
Base of Howe	11.1	2.9
Rover	13.5	3.3
Hamer	14.9	3.3
Sugar City	17.9, 19.0	
Roberts	11.8	1.3
Big Southern Butte	12.2	2.0

[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.

Appendix C

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

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

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

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