Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM QUARTERLY DATA REPORT

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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
CITRC	-	Critical Infrastructure Test Range Complex
CWI	-	CH2M-WG Idaho, LLC
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
GSS	-	Gonzales-Stoller Surveillance, LLC
HPIC	-	high-pressure ion chamber
LLD	-	lower limit of detection
IBL	-	Idaho Bureau of Laboratories
ICPP	-	Idaho Chemical Processing Plant
INL	-	Idaho National Laboratory
INTEC	-	Idaho Nuclear Technology and Engineering Center
LSC	-	liquid scintillation counting
MFC	-	Materials and Fuels Complex
µg/L	-	micrograms per liter
mg/L	-	milligrams per liter
mrem	-	millirem or 1/1000th of a rem
mR	-	milliRoentgen
mR/hr	-	milliRoentgen per hour
µR/hr	-	microRoentgen per hour
MCL	-	maximum contaminant level
MDA	-	minimum detectable activity
MDC	-	minimum detectable concentration
NIST	-	National Institute of Standards and Technology
nCi/L	-	nanocuries per liter
NOAA	-	National Oceanic and Atmospheric Administration
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
RWMC	-	Radioactive Waste Management Complex
RTC	-	Reactor Technology Complex
SD	-	standard deviation
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 to those who wish to "see the numbers." 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, 2013 (**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 in the first quarter of 2013 a new sampler (HVP 4304) is operating side by side at Idaho Falls air station with 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**.

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 2013 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. Atmospheric tritium was measured above the minimum detectable concentration (MDC) during the fourth quarter of 2013 at the Fort Hall monitoring station. Also, one individual sample within a weighted mean exceeded the MDC at Experimental Field Station: 0.63 pCi/m^3 (MDC 0.46 pCi/m^3). The DEQ-INL OP action level for atmospheric tritium is 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 2013. Precipitation samples were analyzed for tritium and gamma-emitting radionuclides. Tritium and Cesium-137 analysis results are presented in **Table 5**. 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 2013.

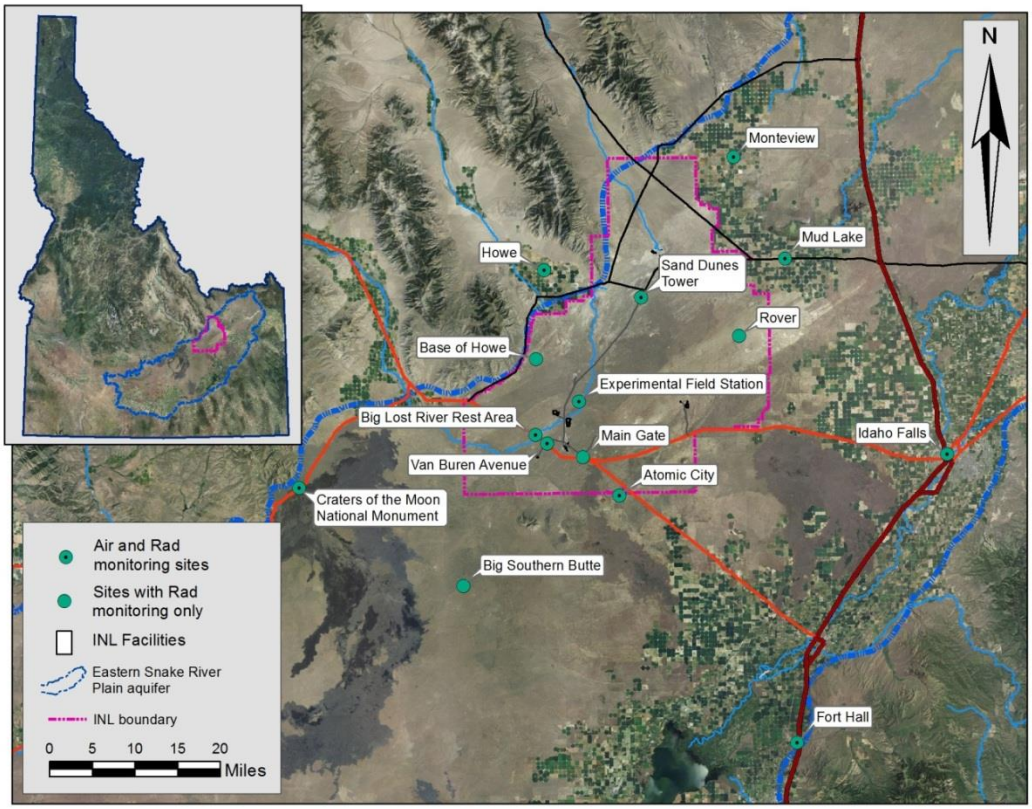

Figure 1. Air and radiation monitoring sites.

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, 2013.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.7	-	2.0	25.1	-	94.9
Experimental Field Station	0.6	-	2.0	21.0	-	102.2
Sand Dunes Tower	0.5	-	1.4	16.9	-	80.6
Van Buren Avenue	0.4	-	1.4	16.9	-	74.3
Boundary Locations						
Atomic City	0.6	-	1.6	19.6	-	87.0
Howe	0.6	-	1.6	19.0	-	72.3
Monteview	0.5	-	1.9	20.5	-	98.7
Mud Lake	0.9	-	2.6	28.6	-	105.8
Distant Locations						
Craters of the Moon	0.3	-	1.1	14.5	-	53.9
Fort Hall[1]	0.3	-	1.1	13.1	-	51.0
Idaho Falls – HVP 3804	0.7	-	1.7	22.0	-	93.4
Idaho Falls – HVP 4304	0.5	-	1.8	18.9	-	100.0

[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, fourth quarter, 2013.

Station Location	Naturally Occurring Radionuclide Beryllium-7		Man-Made Gamma Emitting Radionuclides
	Concentration	± 2 SD	
On-site Locations			
Big Lost River Rest Area	60.1	3.1	<MDC[2]
Experimental Field Station	50.1	3.5	<MDC
Sand Dunes Tower	40.8	2.3	<MDC
Van Buren Avenue	42.6	2.3	<MDC
Boundary Locations			
Atomic City	64.4	3.3	<MDC
Howe	41.2	2.3	<MDC
Monteview	46.0	2.6	<MDC
Mud Lake	61.8	3.3	<MDC
Distant Locations			
Craters of the Moon	41.3	2.3	<MDC
Fort Hall[1]	42.8	2.3	<MDC
Idaho Falls – HVP 3804	57.8	3.1	<MDC
Idaho Falls – HVP 4304	56.2	3.1	<MDC

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC for Cs-137 typically (5-10)x10^{-5} 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, 2013.

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	-0.06	0.21	0.36
Experimental Field Station	0.30	0.21	0.33
Sand Dunes Tower	0.22	0.22	0.36
Van Buren Avenue	0.21	0.21	0.34
Boundary Locations			
Atomic City	0.06	0.22	0.38
Howe	0.20	0.14	0.21
Mud Lake	-0.02	0.26	0.42
Monteview	0.00	0.25	0.42
Distant Locations			
Craters of the Moon	-0.03	0.21	0.35
Fort Hall[1]	0.49	0.25	0.39
Idaho Falls	0.01	0.28	0.49

[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, 2013.

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	50	80	130	0.3	1.5	2.5
Boundary Locations						
Atomic City	40	80	130	-0.3	1.3	2.4
Howe	70	80	140	-0.2	1.4	2.4
Monteview	60	80	130	1.7	1.8	3.0
Mud Lake	60	100	160	0.6	2.0	3.4
Distant Locations						
Idaho Falls	40	80	130	0.5	1.4	2.3

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

Environmental Radiation Monitoring Results

The ESP operated 14 environmental radiation stations during the fourth quarter of 2013 (**Figure 1**). To detect gamma radiation, each station is instrumented with an electret ionization chamber (EIC), and 11 of the stations also have high-pressure ion chambers (HPIC) (**Table 6**). The Shoshone-Bannock Tribes operate an environmental radiation station at Fort Hall using EICs and a HPIC provided by the DEQ-INL OP. The results for Fort Hall are reported by DEQ-INL OP.

The HPICs and EICs are used by DEQ-INL OP to measure external gamma radiation for various purposes. HPICs produce real-time measurements with sufficient sensitivity to detect small changes in gamma radiation levels. The real-time gamma radiation measurements are transmitted from each location to DEQ-INL OP, and are presented graphically at http://www.deq.idaho.gov/inl-oversight/monitoring/gamma-radiation-measurements.aspx.

EICs are a passive-integrating system for cumulative measurement of environmental gamma radiation exposure. EICs are deployed, collected, and analyzed quarterly. EICs are an inexpensive means for measuring gamma radiation on a regional scale, particularly at locations that do not have a power source. EICs can also provide valuable gamma radiation data in the event of an emergency. For this reason, DEQ-INL OP deploys EICs at an additional 40 locations in a widespread network around the INL. Results for these locations are tabulated in **Appendix B.**

Table 7 lists the average radiation exposure rates measured by the HPICs for fourth quarter 2013. **Table 8** lists the EIC monitoring results for fourth quarter 2013. 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		■
Main Gate	■	■
Rover	■	■
Sand Dunes Tower	■	■
Van Buren Avenue		■
Boundary Locations		
Atomic City	■	■
Big Southern Butte	■	■
Howe Met Tower	■	■
Monteview	■	■
Mud Lake/Terreton	■	■
Distant Locations		
Craters of the Moon		■
Fort Hall[1]	■	■
Idaho Falls	■	■

[1] HPIC operated by Shoshone-Bannock Tribes with the EIC maintained by DEQ-INL OP.

Table 7. Average gamma exposure rates, fourth quarter, 2013, from HPIC network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
Base of Howe	16.2	0.6
Big Lost River Rest Area	15.7	0.6
Main Gate[1]	NA	NA
Rover[1]	NA	NA
Sand Dunes Tower[1]	NA	NA
Boundary Locations		
Atomic City	13.5	0.6
Big Southern Butte	15.5	0.6
Howe Met Tower	13.4	0.8
Monteview[1]	NA	NA
Mud Lake/Terreton	15.0	1.6
Distant Locations		
Fort Hall[2,3]	10.7	2.1
Idaho Falls[3]	12.6	3.8

[1]The Main Gate HPIC was out of service for the entire 4th quarter, and the Rover, Monteview, and Sand Dunes tower HPICs each were out of service over 75% of the quarter.
[2]Operated by Shoshone-Bannock Tribes.
[3] The results for Fort Hall and Idaho Falls are unusually variable because of problems with the HPICs, probably related to power supplies. The reported quarterly average exposure rates for these locations are considered to represent the actual exposure conditions.

Table 8. Electret ionization chamber (EIC) cumulative average exposure rates, fourth quarter, 2013.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average[1]	± 2 SD
On-site Locations		
Base of Howe	11.7	2.4
Big Lost River Rest Area	15.4	2.5
Experimental Field Station	19.2, 21.1	
Main Gate	15.1	1.9
Rover	14.2	2.6
Sand Dunes Tower	14.5, 14.0	
Van Buren Avenue	15.2	2.6
Boundary Locations		
Atomic City	14.0	2.5
Big Southern Butte	14.4	2.9
Howe Met Tower	14.3	3.0
Monteview	16.0, 15.4	
Mud Lake / Terreton	16.7, 15.8	
Distant Locations		
Craters of the Moon	11.2	2.4
Fort Hall[2]	9.0	2.3
Idaho Falls	12.2	2.3

[1] Results are the average of triplicate measurements with the associated variability (±2 SD), or the 2 measured exposure rates remaining after deletion of an outlying value, based on the historical population variability (reject if outside of ± 2 SD) and judgment of the data analyst.
[2] Station operated by Shoshone-Bannock Tribes.

Water Monitoring

Water monitoring sites are sampled for the purposes of examining trends of INL contaminants and other general ground water quality indicators, and for verifying DOE monitoring results. Sites sampled include ground water locations (wells and springs), surface water locations (streams), and selected wastewater sites. Sample sites have been selected to aid in identifying INL impacts on the Eastern Snake River Plain Aquifer (ESRPA), and are categorized as up-gradient, facility, boundary, distant, surface water, and waste water (**Figure 2 and Figure 3**). Up-gradient locations are not impacted by INL operations and are considered representative of background ground water quality conditions. Facility sites are sample locations on the INL near facilities, in areas of known contamination, or wells selected to illustrate trends for specific INL contaminants or indicators of ground water quality. Boundary locations are on or near the perimeter of the INL and are down-gradient of potential sources of INL contamination. Distant locations are monitored to provide trends in water quality down-gradient of the INL and include wells and springs used for irrigation, public water supply, livestock, domestic, and industrial purposes. During the fourth quarter of 2013, 2 up-gradient, 13 facility, 5 distant, 3 boundary, and 1 surface water location were sampled.

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

Gross alpha and gross beta analyses are conducted as a screening tool for alpha and beta emitting radionuclides potentially released from INL operations. Quantitative gamma analyses are conducted to identify and determine concentrations of gamma emitting radionuclides. Selected sites are sampled for the man-made, alpha emitting isotopes of plutonium (^{238}Pu, $^{239/240}$Pu), uranium (^{234}U, ^{235}U, and ^{238}U), and americium (^{241}Am); and beta emitting radionuclides technetium-99 (^{99}Tc) and strontium-90 (^{90}Sr), based on historic INL contamination. In the event of suspect or unexpected levels of gross radioactivity, additional samples may also be analyzed for other specific radionuclides.

Gross alpha radioactivity was detected at 7 facility locations and was within the range of concentrations observed for naturally-occurring radioactivity. The EPA maximum contaminant level (MCL) for alpha particles is 15 pCi/L.

Gross beta radioactivity was detected at every location sampled this quarter. Concentrations observed at most locations, including up-gradient, facility, boundary, distant and surface water, are consistent with historical trends; however, there are three sites that do show higher concentrations of gross beta when compared to results from the last few years. These sites are located down-gradient from the INTEC (CFA-2), and RWMC (M1S, and USGS-120) facilities. The MCL for beta and gamma radioactivity is 4 mrem/year, equivalent to 8 pCi/L if the source is ^{90}Sr; 900 pCi/L if ^{99}Tc; 20,000 pCi/L if tritium (^{3}H); or 200 pCi/L if ^{137}Cs. Man-made, gamma emitting radioactivity was not detected at any of the sampled locations. Results for gross alpha; gross beta; and man-made, gamma emitting ^{137}Cs are shown in **Table 9**.

Four sites were sampled for isotopes of plutonium, with all results reporting as non-detectable (**Table 10**). Five sites were sampled for isotopes of uranium. All sites had detectable results for ^{234}U and ^{238}U. For ^{235}U only TRA-07 had a result that was greater than the MDC; however it is less than three standard deviations so is therefore considered a non-detection (**Table 11**). The results observed at the five sample sites cannot be distinguished from background values, which means the uranium found in the samples is likely to be naturally occurring. Four sites were sampled for ^{241}Am this quarter. There were no detections (**Table 12**).

Two of the thirteen samples analyzed for ^{90}Sr had detectable results this quarter (**Table 13**). Both samples were collected from areas of known contamination. All twelve locations sampled for ^{99}Tc had detectable results this quarter, with all but one of the results within the expected ranges of concentrations (**Table 14**). Sample location A11A31 showed a concentration that is more than double the values typically reported at this site, but well below the MCL of 900 pCi/L.

Using the standard analytical method, ^{3}H was detected at nine facility locations (**Table 15**). Tritium levels found at these wells are similar to historic concentrations for these sites and are consistent with INL waste disposal influences at each facility. Sample location TAN-10A has shown an increase in ^{3}H over the last few years with a concentration of 280±120 pCi/L in 2009 to 560±110 pCi/L in 2013. Selected water samples with tritium concentrations not measurable using the standard method (typically a MDC of 130 pCi/L) are analyzed using an electrolytic enrichment method with a much lower MDC of 10 to 14 pCi/L. There were no samples analyzed using the enrichment method for the current quarter; however sample analyses from twelve sites collected during previous quarters were completed and presented during this quarter (**Table 16**). A backlog of 34 samples remains.

Samples were also analyzed for metals and the results shown in **Table 17**. All results were within their expected ranges. Common ion results are shown in **Table 18** and nutrient results are shown in **Table 19**. All results are consistent with historical values at those locations.

Volatile Organic Compounds (VOCs) were sampled at four locations this quarter in an area of known contamination at RWMC. All four locations had detectable concentrations for two analytes, including carbon tetrachloride and trichloroethylene. Results are illustrated in **Table 20** and are consistent with previous concentrations found at these locations. The background concentrations for these VOCs should be zero. The results discussed in this section only refer to detectable VOC concentrations; a complete list of analytes is shown in **Appendix C**.

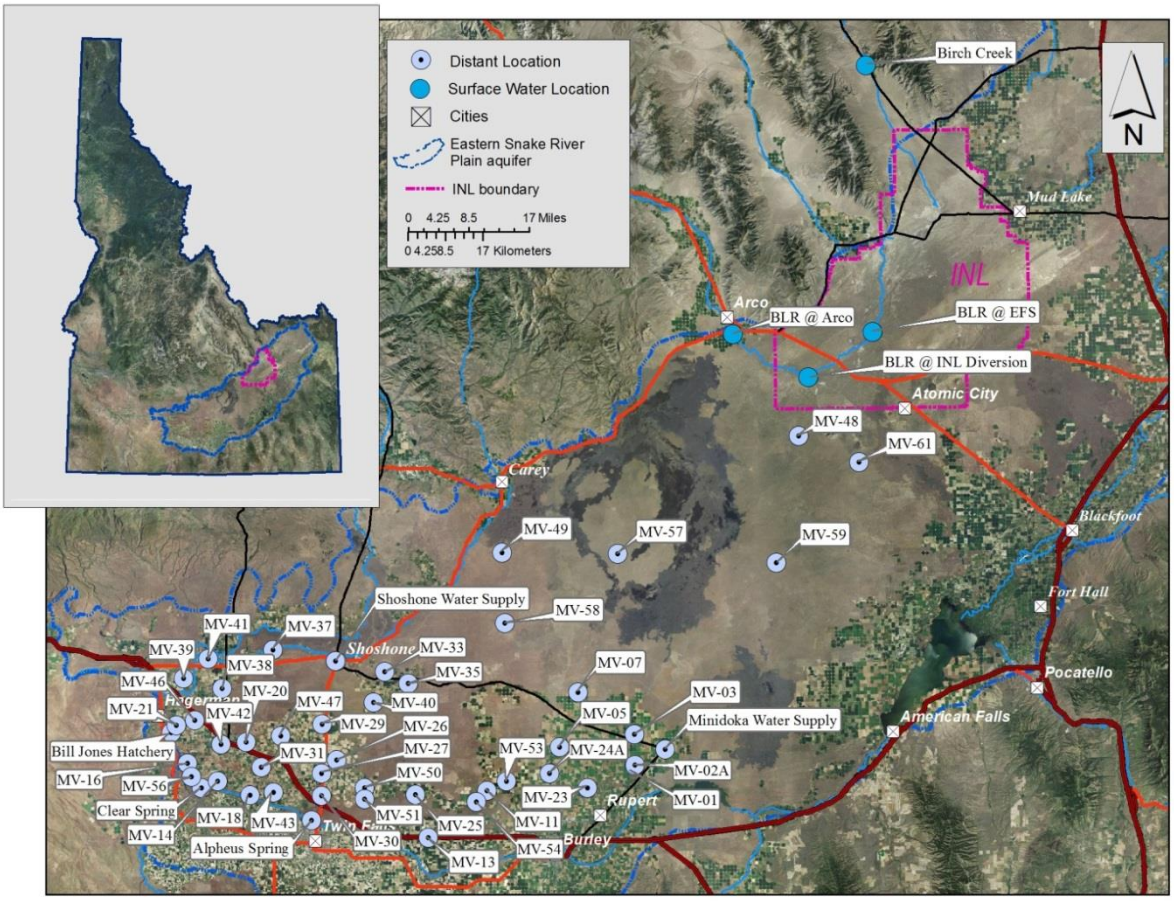

Figure 2. Distant and surface water monitoring locations.

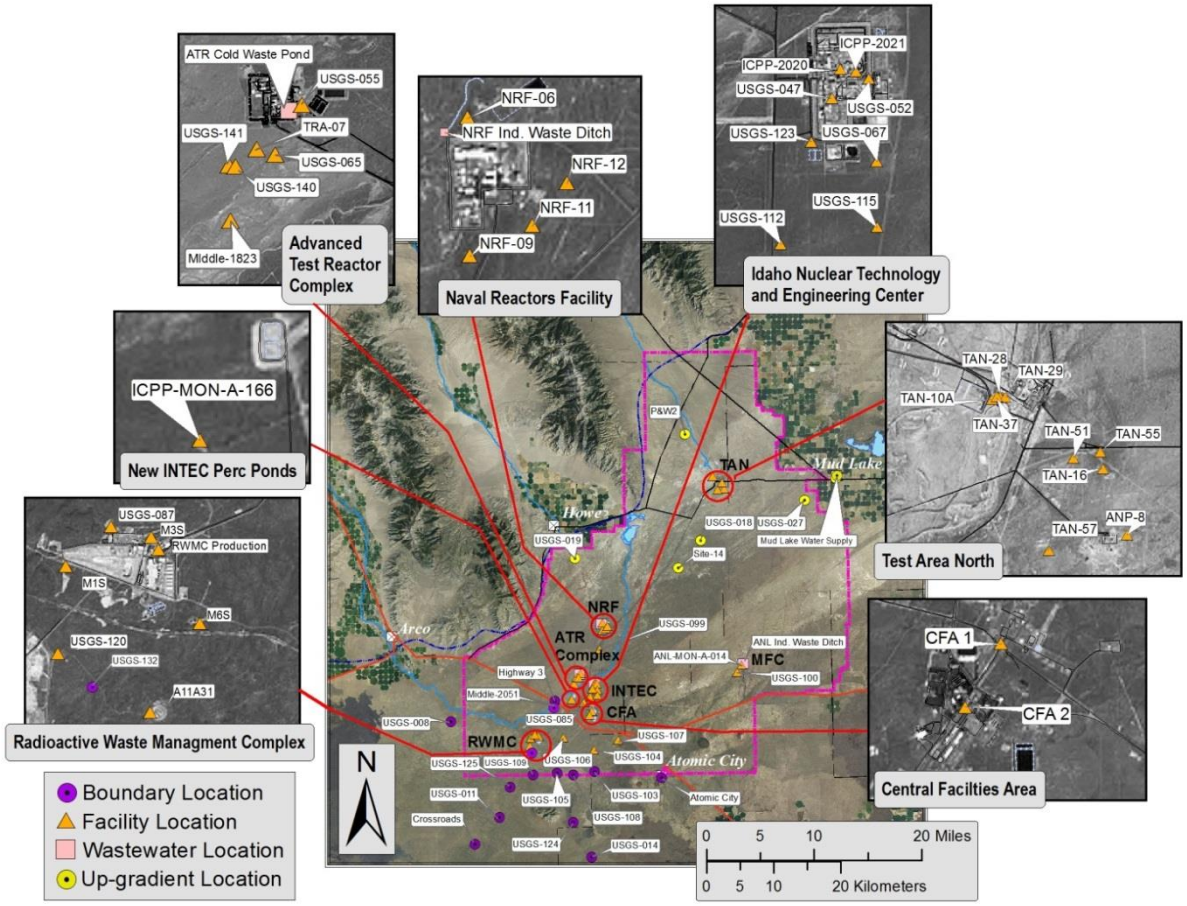

Figure 3. Upgradient, facility, boundary, and wastewater monitoring locations.

Table 9. Alpha, beta, and gamma concentrations for water samples, fourth quarter, 2013.

Sample Location	Sample Date	Gross Alpha			Gross Beta			Man-made gamma-emitting radionuclide Cesium-137		
		Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD
Up-gradient										
Mud Lake Water Supply	11/20/2013	-0.3	U	0.5	4.1		0.8	0.3	U	1.5
Site-14	10/31/2013	0.1	U	1.0	4.7		0.9	-1.3	U	2.7
Facility										
A11A31	11/5/2013	1.3		0.8	5.9		0.9	0.3	U	2.0
CFA 2	10/31/2013	1.7	U	1.8	7.9		2.0	1.4	U	2.1
M1S	11/4/2013	3.8		1.1	7.5		1.0	0.9	U	1.6
M3S	11/4/2013	1.1	U	0.8	5.1		0.9	-1.6	U	1.5
M6S	11/5/2013	2.2		1.1	4.5		1.0	-0.3	U	1.6
Middle-1823	10/7/2013	-1.1	UJ	1.1	1.7		0.9	-0.4	U	1.9
RWMC Production	10/24/2013	0.1	U	1.1	3.1		0.9	-0.5	U	1.6
TAN-10A	10/15/2013	8.7	J	2.5	169.3		5.0	-0.1	U	2.4
TRA-07	10/8/2013	3.4		1.4	4.8		1.1	-0.1	U	1.3
USGS-104	10/30/2013	0.7	U	0.7	4.0	J	0.8	0.2	U	1.3
USGS-112	10/22/2013	2.0		0.9	24.1		1.4	0.1	U	2.1
USGS-115	10/22/2013	0.9	U	1.1	8.4		1.0	0.2	U	1.3
USGS-120	10/29/2013	1.4		0.8	7.8		1.0	-1.2	U	1.4
Boundary										
Highway 3	10/30/2013	-0.1	U	0.8	3.8	J	0.8	-0.7	U	1.4
USGS-014	10/29/2013	0.3	U	1.1	3.6		0.9	1.1	U	1.6
USGS-125	10/29/2013	0.9	U	0.8	5.2		0.9	-1.2	U	1.2
Distant										
Alpheus Spring	11/19/2013	0.7	U	0.8	4.0	J	0.9	0.5	U	1.8
Bill Jones Hatchery	11/19/2013	1.8	U	1.2	8.0	J	1.1	0.3	U	1.7
Clear Spring	11/19/2013	0.8	U	0.8	4.2		0.9	0.2	U	1.5
Minidoka Water Supply	11/19/2013	1.0	U	1.0	3.7		0.9	-0.4	U	1.3
Shoshone Water Supply	11/19/2013	0.6	U	0.8	3.8		0.9	0.7	U	1.9
Surface water										
Birch Creek	10/30/2013	1.5	U	1.2	2.3	J	0.9	0.9	U	1.4

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.

Table 10. Reported concentrations of plutonium isotopes in water samples, fourth quarter, 2013.

Sample Location	Sample Date	Plutonium-238			Plutonium-239/240			Plutonium-241		
		Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD
Facility										
A11A31	11/5/2013	0.015	U	0.033	-0.007	U	0.033	NR	-	-
M1S	11/4/2013	0.004	U	0.048	-0.014	U	0.048	NR	-	-
M3S	11/4/2013	0.008	U	0.044	0.027	U	0.044	NR	-	-
M6S	11/5/2013	0.017	U	0.037	-0.004	U	0.037	NR	-	-

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected, NR = analysis not requested.
[2]Concentrations expressed in pCi/L.

Table 11. Reported concentrations of uranium isotopes in water samples, fourth quarter, 2013.

Sample Location	Sample Date	Uranium-234			Uranium-235			Uranium-238		
		Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD	Concentration[1,2]		±2 SD
Facility										
A11A31	11/5/2013	0.96		0.25	0.030	U	0.042	0.53		0.17
M1S	11/4/2013	0.85		0.23	0.052	U	0.052	0.47		0.16
M3S	11/4/2013	1.28		0.32	0.013	U	0.048	0.70		0.21
M6S	11/5/2013	1.24		0.31	0.037	U	0.046	0.36		0.14
TRA-07	10/8/2013	2.42		0.51	0.097*	U	0.075	1.26		0.31

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.
*The result is greater than the MDC but is less than 3 SD so is therefore considered a non-detection.

Table 12. Reported concentrations of americium-241 in water samples, fourth quarter, 2013.

Sample Location	Sample Date	Americium-241		
		Concentration[1,2]		±2 SD
Facility				
A11A31	11/5/2013	-0.010	U	0.018
M1S	11/4/2013	-0.008	U	0.016
M3S	11/4/2013	-0.006	U	0.018
M6S	11/5/2013	-0.010	U	0.016

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.

Table 13. Reported concentrations of strontium-90 in water samples, fourth quarter 2013.

Sample Location	Sample Date	Strontium-90		
		Concentration[1,2]		±2 SD
Facility				
A11A31	11/5/2013	0.08	U	0.26
CFA 2	10/31/2013	0.26	U	0.23
M1S	11/4/2013	-0.12	U	0.25
M3S	11/4/2013	-0.10	U	0.24
M6S	11/5/2013	0.63	U	0.41
Middle-1823	10/7/2013	-0.01	U	0.24
RWMC Production	10/24/2013	-0.03	U	0.28
TAN-10A	10/15/2013	61		14
TRA-07	10/8/2013	0.18	U	0.30
USGS-104	10/30/2013	0.23	U	0.27
USGS-112	10/22/2013	6.4		1.6
USGS-115	10/22/2013	0.22	U	0.19
USGS-120	10/29/2013	0.27	U	0.27

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.

Table 14. Reported concentrations of technetium-99 in water samples, fourth quarter, 2013.

Sample Location	Sample Date	Technetium-99		
		Concentration[1,2]		±2 SD
Facility				
A11A31 (dissolved)	11/5/2013	2.7		0.2
CFA 2 (dissolved)	10/31/2013	2.6		0.2
M1S (dissolved)	11/4/2013	0.6		0.1
M3S (dissolved)	11/4/2013	1.3		0.1
M6S (dissolved)	11/5/2013	0.6		0.1
Middle-1823 (dissolved)	10/7/2013	0.7		0.1
RWMC Production (dissolved)	10/24/2013	1.2		0.2
TRA-07 (dissolved)	10/8/2013	1.5		0.2
USGS-104 (dissolved)	10/30/2013	1.1		0.1
USGS-112 (dissolved)	10/22/2013	2.8		0.2
USGS-115 (dissolved)	10/22/2013	6.4		0.2
USGS-120 (dissolved)	10/29/2013	1.1		0.1

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.

Table 15. Tritium concentrations for water samples, fourth quarter, 2013.

Sample Location	Sample Date	Tritium		
		Concentration[1,2]		±2 SD
Up-gradient				
Mud Lake Water Supply	11/20/2013	-60	U	80
Site-14	10/31/2013	-60	U	130
Facility				
A11A31	11/5/2013	40	U	110
CFA 2	10/31/2013	3790		190
M1S	11/4/2013	10	U	110
M3S	11/4/2013	670		110
M6S	11/5/2013	80	U	110
Middle-1823	10/7/2013	880		120
RWMC Production	10/24/2013	600		110
TAN-10A	10/15/2013	560		110
TRA-07	10/8/2013	7280		220
USGS-104	10/30/2013	554		110
USGS-112	10/22/2013	1100		130
USGS-115	10/22/2013	1230		130
USGS-120	10/29/2013	150	U	140
Boundary				
Highway 3	10/30/2013	30	U	130
USGS-014	10/29/2013	20	U	130
USGS-125	10/29/2013	-50	U	130
Distant				
Alpheus Spring	11/19/2013	-70	U	80
Bill Jones Hatchery	11/19/2013	-160	U	80
Clear Spring	11/19/2013	-120	U	80
Minidoka Water Supply	11/19/2013	-40	U	90
Shoshone Water Supply	11/19/2013	-70	U	80
Surface water				
Birch Creek	10/30/2013	10	U	130

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.

Table 16. Enriched Tritium concentrations for water samples from previous sampling quarters, 2013.

Sample Location	Sample Date	Enriched Tritium		
		Concentration[1,2]		±2 SD
Facility				
ANP-8	5/21/2013	56		8
NRF-12	5/15/2013	33	J	7
Boundary				
USGS-011	4/10/2013	18		8
Distant				
MV-03	6/24/2013	11		7
MV-13	6/24/2013	11		5
MV-53	6/24/2013	13		6
MV-56	6/25/2013	2	U	6
MV-57	6/24/2013	32		8
Surface water				
BLR @ Arco	6/12/2013	12		7

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected.
[2]Concentrations expressed in pCi/L.

Table 17. Reported metals concentrations in water samples, fourth quarter, 2013.

Sample Location	Sample Date	Concentration[1,2]															
		Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Up-gradient																	
Site-14 (dissolved)	10/31/2013	<5.0	U	62		5.4		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
Facility																	
A11A31 (dissolved)	11/5/2013	<5.0	U	33		12		<10	U	<5.0	U	<2.0	U	<10	U	94	
CFA 2 (dissolved)	10/31/2013	<5.0	U	110		10		23		<5.0	U	3.0		<10	U	<5.0	U
M1S (dissolved)	11/4/2013	<5.0	U	22		34		47		<5.0	U	<2.0	U	<10	U	<5.0	U
M3S (dissolved)	11/4/2013	<5.0	U	44		13		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
M6S (dissolved)	11/5/2013	<5.0	U	26		30		26		<5.0	U	2.5		<10	U	<5.0	U
Middle-1823 (dissolved)	10/7/2013	<5.0	U	65		9.9		<10	U	<5.0	U	2.8		<10	U	<5.0	U
RWMC Production (dissolved)	10/24/2013	<5.0	U	40		13		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
TAN-10A (total)	10/15/2013	<5.0	U	250		<5.0	U	2400		<5.0	U	920		<10	U	51	
TRA-07 (dissolved)	10/8/2013	<5.0	U	62		83		<10	U	<5.0	U	<2.0	U	<10	U	18	
USGS-104 (dissolved)	10/30/2013	<5.0	U	32		8.4		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
USGS-112 (dissolved)	10/22/2013	<5.0	U	93		12		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
USGS-115 (dissolved)	10/22/2013	<5.0	U	62		6.0		13		<5.0	U	2.0		<10	U	650	
USGS-120 (dissolved)	10/29/2013	<5.0	U	46		11		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
Boundary																	
Highway 3 (dissolved)	10/30/2013	<5.0	U	54		<5.0	U	<10	U	<5.0	U	<2.0	U	<10	U	56	
USGS-014 (dissolved)	10/29/2013	<5.0	U	22		<5.0	U	<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
USGS-125 (dissolved)	10/29/2013	<5.0	U	35		<5.0	U	46		<5.0	U	13		<10	U	<5.0	U
Surface water																	
Birch Creek (dissolved)	10/30/2013	<5.0	U	72		<5.0	U	<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected, "<" = a result below the Minimum Detectable Concentration (MDC), NR = analysis not requested.
[2]Concentrations are expressed in µg/L. Samples are filtered unless otherwise indicated.

Table 18. Reported common ion concentrations in water samples, fourth quarter, 2013.

Sample Location	Sample Date	Concentration[1,2]															
		Calcium		Magnesium		Sodium		Potassium		Fluoride		Chloride		Sulfate		Alkalinity[3]	
Up-gradient																	
Site-14*	10/31/2013	34		14		15		3.1		0.460		9.73		24.9		129	
Facility																	
A11A31*	11/5/2013	37		17		23		3.9		0.264		24.6		43.0		133	
CFA 2*	10/31/2013	86		29		36		4.9		<0.200	U	142		51.9		139	
M1S*	11/4/2013	28		12		12		2.5		0.300		13.5		21.4		95	
M3S*	11/4/2013	45		15		8.6		2.7		0.253		15.5		25.9		140	
M6S*	11/5/2013	39		20		18		3.7		0.239		28.4		62.0		98	
Middle-1823*	10/7/2013	54		18		11		1.9		<0.200	U	11.6		36.6		170	
RWMC Production*	10/24/2013	48		17		9.6		2.8		0.250		25.6		29.8		138	
TAN-10A	10/15/2013	86		23		45		4.0		0.206		104		36.3		221	
TRA-07*	10/8/2013	88		19		17		3.1		<0.200	U	21.9		160		138	
USGS-104*	10/30/2013	36		14		9.4		2.7		0.221		14.3		21.0		124	
USGS-112*	10/22/2013	52		14		15		2.8		0.256		21.6		29.6		152	
USGS-115*	10/22/2013	44		13		17		3.9		0.294		40.1		24.2		111	
USGS-120*	10/29/2013	38		18		18		3.5		0.275		18.1		32.9		142	
Boundary																	
Highway 3*	10/30/2013	47		12		6.4		2.5		<0.200	U	6.18		21.1		142	
USGS-014*	10/29/2013	38		16		18		3.0		0.673		22.0		22.1		138	
USGS-125*	10/29/2013	39		16		12		2.9		0.265		12.3		24.1		138	
Surface water																	
Birch Creek*	10/30/2013	44		16		5.4		1.1		<0.200	U	4.68		25.6		150	

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected. * = samples are filtered for calcium, magnesium, sodium and potassium. "<" = a result below the Minimum Detectable Concentration (MDC). NR = analysis not requested.
[2]Concentrations are expressed in mg/L.
[3]As $CaCO_3$.

Table 19. Reported nutrient concentrations in water samples, fourth quarter, 2013.

Sample Location	Sample Date	Concentration[1,2]			
		Nitrite + Nitrate		Phosphorus	
Up-gradient					
Site-14	10/31/2013	0.62		0.022	
Facility					
A11A31	11/5/2013	0.87		0.020	
CFA 2	10/31/2013	4.00		0.024	
M1S	11/4/2013	1.00		0.027	
M3S	11/4/2013	0.85		0.025	
M6S	11/5/2013	2.10		0.024	
Middle-1823	10/7/2013	1.00		0.031	J
RWMC Production	10/24/2013	1.00		0.130	
TAN-10A	10/15/2013	0.036		0.075	
TRA-07	10/8/2013	1.10		0.026	
USGS-104	10/30/2013	0.86		0.027	
USGS-112	10/22/2013	1.30		0.032	
USGS-115	10/22/2013	1.50		0.011	
USGS-120	10/29/2013	0.89		0.020	
Boundary					
Highway 3	10/30/2013	0.46		0.028	
USGS-014	10/29/2013	1.30		0.017	
USGS-125	10/29/2013	0.62		0.020	
Surface water					
Birch Creek	10/30/2013	0.26		<0.005	U

[1]Data qualifiers: U = non-detection, J = estimate, R = rejected, NR = analysis not requested.
[2]Concentrations expressed in mg/L. Samples are filtered unless otherwise noted.

Table 20. Reported VOC concentrations in water samples, fourth quarter, 2013.

Sample Location	Sample Date	Concentrations[1,2]						
		1,1-Dichloroethene	Carbon tetrachloride	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Tetrachloroethylene (PERC)	Trichloroethylene	Vinyl chloride
A11A31	11/5/2013	<0.5	1.7	<0.5	<0.5	<0.5	0.8	<0.5
M3S	11/4/2013	<0.5	3.2	<0.5	<0.5	<0.5	1.1	<0.5
M6S	11/5/2013	<0.5	2.2	<0.5	<0.5	<0.5	0.9	<0.5
RWMC Production	10/24/2013	<0.5	5.8	<0.5	<0.5	<0.5	3.2	<0.5

[1]Data qualifiers: J = estimate, R = rejected. <DL = less than detection limit.

[2]Concentrations expressed in µg/L.

Terrestrial Monitoring Results

The DEQ-INL OP conducts terrestrial (soil and milk) monitoring to characterize deposition and migration of contaminants, and provide independent verification of DOE's terrestrial monitoring programs. 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.

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 gamma spectroscopic analyses of milk samples are presented in **Table 21**. ^{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 21. Gamma spectroscopy analysis data for milk samples, fourth quarter, 2013.

Sample Location/Dairy	Sample Date	Naturally occurring gamma-emitting radionuclide Potassium-40		Man-made gamma-emitting radionuclide Iodine-131[1]
		Concentration[3]	± 2 SD	
Monitoring Samples				
Gooding	10/4/2013	1500	118	<MDC
	11/7/2013	1477	114	<MDC
	12/5/2013	1844	127	<MDC
Riverside	10/7/2013	2269	141	<MDC
	11/3/2013	2248	140	<MDC
	12/1/2013	2113	146	<MDC
Fort Hall	10/7/2013	1465	113	<MDC
	11/4/2013	1432	115	<MDC
	12/2/2013	1518	115	<MDC
Verification Samples[2]				
Dietrich	10/1/2013	1367	112	<MDC
Howe	10/1/2013	1505	108	<MDC
Terreton	11/5/2013	1487	114	<MDC
Rupert	11/5/2013	1611	113	<MDC
Rupert	12/3/2013	1372	112	<MDC
Idaho Falls	12/3/2013	1584	111	<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 the concentrations of radionuclides in soil using gamma spectroscopic analysis of soil samples and in-situ measurement of gamma-emitting radionuclides. This monitoring provides insight to transport, deposition, and potential long-term accumulation of radionuclides in the environment from INL operations or historical above ground testing of nuclear weapons.

In-Situ gamma spectroscopic measurements were performed at 30 locations (**Figure 4**) during the fourth calendar quarter 2013. The *in-situ* measurements were performed onsite and at boundary and distant monitoring locations. No man-made radionuclides other than cesium-137 (^{137}Cs) were identified. In-situ gamma spectroscopic analysis results for ^{137}Cs concentrations are shown in **Table 22**.

Table 22. In-Situ gamma spectroscopic analysis results for (^{137}Cs) soil monitoring, fourth quarter 2013.

Sample Location	Sample Date	Concentration[1]	±2 SD	MDA
Boundary Sampling Locations				
Howe Air Station	11/19/2013	0.135	0.035	0.010
Atomic City	11/19/2013	0.120	0.025	0.011
Large Grid 18-4	11/20/2013	0.175	0.022	0.008
Large Grid 12-5	11/20/2013	0.173	0.045	0.010
Large Grid 12-4	11/20/2013	0.199	0.032	0.009
Big Southern HPIC	11/20/2013	0.216	0.029	0.010
Monteview Air Station	12/4/2013	0.102	0.029	0.010
Reno Ranch	12/4/2013	0.257	0.033	0.010
Mud Lake/Terreton	12/10/2013	0.047	0.025	0.009
Distant Sampling Locations				
Idaho Falls[2]	12/10/2013	0.059	0.024	0.008
Roberts	12/10/2013	0.111	0.028	0.010
Sage Junction	12/10/2013	0.166	0.042	0.012
Idaho Falls CMS[3]	12/10/2013	0.045	0.021	0.007
On site Sampling Locations				
Large Grid 18-1	12/4/2013	0.201	0.053	0.013
Large Grid 18-7	12/4/2013	0.197	0.030	0.010
Large Grid 30-1	12/4/2013	0.228	0.031	0.010
Large Grid 24-9	12/4/2013	0.195	0.029	0.009
Large Grid 24-8	12/4/2013	0.269	0.039	0.012
Large Grid 18-3	11/13/2013	0.145	0.027	0.008
Large Grid 18-8	11/13/2013	0.216	0.027	0.008
Large Grid 24-2	11/13/2013	0.250	0.030	0.009
Large Grid 24-7	11/13/2013	0.218	0.032	0.008
Rover	11/13/2013	0.166	0.036	0.012
Van Buren	11/19/2013	0.255	0.032	0.011
Big Lost River Rest Area	11/19/2013	0.147	0.035	0.012
Base of Howe	11/19/2013	0.168	0.024	0.007
Sand Dunes	12/6/2013	0.183	0.029	0.009
Experimental Field Station (EFS)	12/6/2013	0.204	0.050	0.014
Large Grid 6-3	12/6/2013	0.204	0.027	0.009
INL Main Gate	12/6/2013	0.276	0.047	0.012

[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 from *in-situ* soil sampling was 0.178 picocuries per gram (pCi/g) with a minimum value of 0.045 pCi/g and a maximum of 0.276 pCi/g, well below the DEQ-INL OP action level of 6.8 pCi/g for cesium-137 (NCRP Report 129). Based upon terrestrial radiological measurements of soil and milk, there were no discernible impacts to the 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.

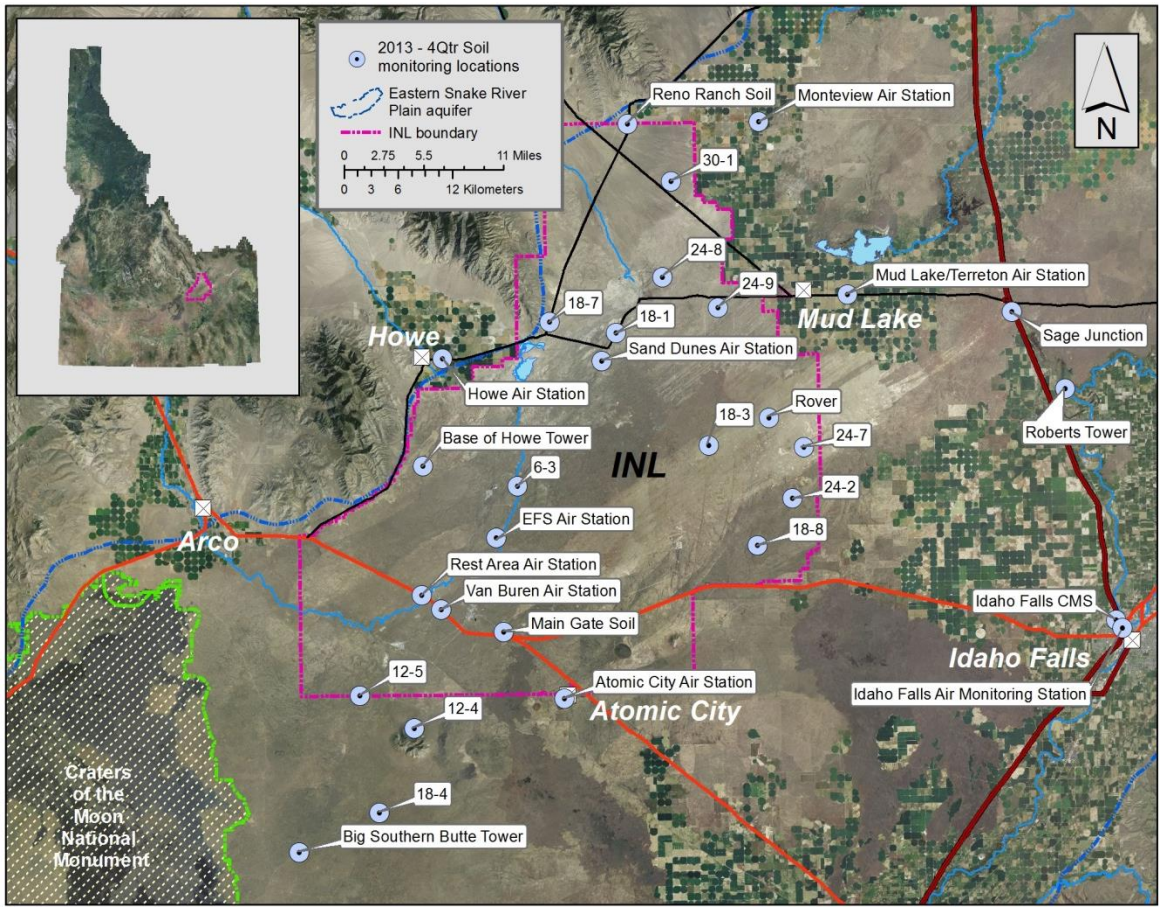

Figure 4. In-situ soil monitoring sites, fourth quarter 2013.

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 2013 for the DEQ-INL OP's ESP. It also summarizes the quality control (QC) samples (spikes, blanks, and duplicates) submitted to the Idaho Bureau of Laboratories-Boise (IBL) for non-radiological analyses and to Idaho State University's Environmental Monitoring Laboratory (ISU-EML) for radiological analyses during the quarter. All analyses and QC measures at the analytical laboratories used by the ESP are performed in accordance with approved written procedures maintained by each respective analytical laboratory. Sample collection is performed in accordance with written procedures maintained by the DEQ-INL OP.

Analytical results for blanks, duplicates, and spikes are used to assess the precision, accuracy, and representativeness of results from analyzing laboratories. During the fourth quarter of 2013, the DEQ-INL OP submitted 103 QC samples for various radiological and non-radiological analyses (**Table 23**).

Blank Samples

Blank samples consist of matrices that have negligible, acceptably low, or immeasurable amounts of the analyte(s) of interest in them. They are designed to determine if an analysis will yield a "zero" result when no contaminant is present, or a sufficiently low result to serve as an acceptable measure of "background." Blank samples are used to monitor for bias introduced during sample collection, storage, shipment, and analysis. Blank sample results submitted for gross alpha and gross beta screening in air for the fourth quarter of 2013 are presented in **Table 24**.

Blank sample results for select gamma emitters in air from composited air filters are presented in **Table 25**. Data for blank analyses used to assess data quality for tritium in water vapor in air are presented in **Table 26**. Blank analyses results for radiological and non-radiological analytes in ground and surface water are presented in **Table 27**, **Table 28**, **Table 29**, and **Table 30**.

There were two anomalies noticed during the assessment of field blank water samples as measured by the analytical laboratories used by DEQ-INL OP for the fourth quarter of 2013. The first anomaly included detection for gross beta in a blank sample (**Table 27**). There were three samples (USGS-104, Highway 3, and Birch Creek) collected on the same day as the blank sample with all showing detections for gross beta that are consistent with expected values; however, all three of these samples will be flagged with a "J" and qualified as estimates based on the gross beta detection in the blank sample. The other anomaly was a detection for manganese in a blank sample with a concentration of 18 mg/L (**Table 28**). Three other samples were collected on the same day as the blank sample. They were all non-detectable for manganese and will not be flagged.

Duplicate Samples

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

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

Where:

R_1 = First sample result.

R_2 = Second sample result.

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

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

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

Where:

R_1 = First sample result.

R_2 = Second sample result.

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

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

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

Duplicate results for ground and surface water are presented in **Table 31** for radiological analyses, and **Table 32** and **Table 33** for non-radiological analyses. Duplicate results for radiological analyses are presented in **Table 34** for *in-situ* soil analyses.

Five duplicate comparisons did not pass DEQ-INL criteria for the fourth quarter of 2013. Two sets of gross alpha duplicate analyses (Middle-1823 and TAN-10A) failed criteria. One other set of duplicate samples (USGS-112) analyzed on the same days as the failed duplicates, passed criteria. Other field samples (NRF-06 and TRA-07) not associated with these failed duplicates, but analyzed on the same days, were consistent with historical values and will not be flagged. Only the samples that failed duplicate criteria will be J-flagged and qualified as estimates. One set of gross-beta duplicates (Bill Jones Hatchery) failed criteria. There were six total samples analyzed with the duplicates, with all but one of the samples consistent with historical values. The one inconsistent value (Alpheus Spring) and the abnormally high duplicate sample value will be flagged with a "J" and qualified as an estimate. A set of enriched tritium field duplicates (NRF-12) failed criteria. The first NRF-12 result was analyzed and reported in the third quarter INL Oversight Program report and was compared with its duplicate which was analyzed and reported with fourth quarter samples. There were two sets of field duplicate samples (USGS-011 and MV-07 with MV-44) that were analyzed on the same day and both passed criteria. Only the sample (NRF-12) that failed duplicate criteria will be J-flagged and qualified as an estimate. The last anomaly includes a duplicate for phosphorous (Middle-1823) that failed RPD comparison criteria; however, another set of duplicate samples (TAN-10A) analyzed at the same time passed. There was one other sample (TRA-07) that was analyzed on the same day as both sets of duplicates and its phosphorous concentration is consistent with historic values found at the site. It will not be flagged. Only the failed duplicate sample will be flagged with a "J" and qualified as an estimate.

Spiked Samples

Spiked samples are samples to which known concentrations of specific analytes have been added in order to assess the bias a laboratory may have in accurately measuring these analytes. To determine agreement after laboratory analysis, DEQ-INL OP calculates the ratio of the spike concentration determined from the laboratory measurement to the known spike concentration in the sample. This result is known as percent recovery (%R) and the acceptable range used by DEQ-INL OP is 100 ± 25 percent. Additionally, all results were qualified as "estimates (J)" if the associated quality control spike sample had a recovery of 50 – 74% or 126 – 150%, provided that each result was greater than the instrument detection limit (IDL). All results were qualified as "rejected (R)" if the associated quality control spike sample had a recovery of < 50% or > 150%, provided each result was also greater than the IDL.

During fourth quarter 2013, no field matrices were spiked to assess the influence of the sample media on laboratory performance; however, several non-radiological spiked samples were created using de-ionized water and submitted to the analytical laboratories for analyses. These non-radiological constituents were used to assess ground water analyte recovery rates and the results are presented in **Table 35**, **Table 36** and **Table 37**. Spiked samples for VOC analyses did not achieve recovery limits for styrene; however, styrene was not detected in any of the samples analyzed with the spiked sample. No samples will be flagged.

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 agrees within 25% relative difference when compared to the known irradiated quantity. The irradiation results for fourth quarter 2013 are presented in **Table 38**. Real-time pressure correction is used to calculate the net exposure measured by these EIC control sets. All EIC spiked samples passed the DEQ-INL OP criteria.

There were no other anomalies observed from the assessment of spiked samples as measured by the analytical laboratories used by DEQ-INL OP for the fourth quarter of 2013.

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 fourth quarter of 2013, 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 2013.

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 2013 met the minimum criteria of the DEQ-INL OP ESP and is summarized in **Table 23**.

Preventative Maintenance and Equipment Reliability

All equipment was calibrated and checked according to pre-described periodicity. During the fourth quarter of 2013 the radioiodine pump at the Sand Dunes sampling station was replaced. Service reliability for air sampling equipment for the fourth quarter of 2013 is summarized in **Table 39**.

Conclusion

All data collected for the fourth quarter of 2013 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 23. Summary of the analytical performance and usability of the analyses performed for the DEQ-INL OP ESP, fourth quarter, 2013.

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	168	14	0	0	2	ISU-EML
		Gross beta	168	14	0	0	2	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	2	0	0	0	ISU-EML
Gaseous	Charcoal filter	Iodine-131	14	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	1	5	0	0	ISU-EML
		Gross beta	24	1	5	0	0	ISU-EML
		Gamma emitters	24	1	5	0	0	ISU-EML
		Tritium	24	1	5	0	0	ISU-EML
		Enriched tritium	9	1	3	0	0	ISU-EML
		Technetium-99	12	0	2	0	0	ISU-EML
		Radiochemical	26	0	3	0	0	ISU Sub
		Metals	18	1	4	1	0	IBL
		Common Ions	18	1	4	1	0	IBL
		Nutrients	18	1	4	1	0	IBL
		Volatile Organics	4	2	0	1	0	IBL
Terrestrial								
Milk	Grab or composite	Gamma emitters	15	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	30	0	9	0	0	DEQ-INL OP
	Grab – "puck"	Gamma emitters	0	0	0	0	0	ISU-EML
Radiation								
Ambient	EICs	Gamma Radiation	55	0	0	9	0	DEQ-INL OP
	HPICs	Gamma Radiation	12	NA	NA	NA	4	DEQ-INL OP
Total Test Analyses			**712**	**41**	**49**	**13**	**8**	
Total of QC Analyses (blanks, duplicates, and spikes)			**103**					
Percentage of QC analyses of total test analyses[3]			**14.5%**					
Percentage of usable data[4]			**98.9%**					

[1] Combined Laboratory and DEQ-INL OP rejection criteria (data were 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 24. Blank analysis results for gross alpha and beta in particulate air (TSP), fourth quarter, 2013.

Collection Period		Corrected volume (m^3)[1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
09/26/13	10/03/13	2022	0.0	0.1	0.2	0.4
10/03/13	10/10/13	2022	0.1	0.1	0.1	0.4
10/10/13	10/17/13	2022	0.0	0.1	0.2	0.4
10/17/13	10/24/13	2022	0.0	0.1	-0.6	0.4
10/24/13	10/31/13	2022	-0.1	0.1	0.0	0.4
10/31/13	11/07/13	2022	0.0	0.1	-0.4	0.4
11/07/13	11/14/13	2022	-0.1	0.1	-0.1	0.5
11/14/13	11/21/13	2022	0.0	0.1	-0.1	0.4
11/21/13	11/27/13	2022	-0.1	0.1	0.3	0.4
11/27/13	12/05/13	2022	0.0	0.1	0.6	0.4
12/05/13	12/12/13	2022	0.0	0.1	0.3	0.4
12/12/13	12/19/13	2022	0.1	0.1	0.0	0.4
12/19/13	12/26/13	2022	0.1	0.1	0.1	0.4
12/26/13	01/02/14	2022	0.0	0.1	0.3	0.4

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 25. Blank analysis results for gamma spectroscopy for TSP particulate air filters, fourth quarter, 2013.

Analysis Date	Beryllium-7			Ruthenium-106/Rhodium-106			Antimony-125		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
01/21/14	-5	23	36	4	34	56	6	10	18

Analysis Date	Cesium-134			Cesium-137		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC
01/21/14	1	4	6	4	5	9

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 26. Blank analysis results for tritium in water vapor from air samples, fourth quarter, 2013.

Sample Number	Start Date	Collection Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP134ZTR01	12/04/13	12/11/13	02/03/14	0.07	0.11	0.19
OP134ZTR02	01/14/14	01/22/14	02/03/14	-0.05	0.11	0.18

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

Table 27. Blank analysis results for radiological analytes in ground and surface water, fourth quarter, 2013.

Sample Number	Sample Date	Concentration[1]	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha					
131W552	10/30/2013	-0.6	0.3	0.6	Yes
Gross Beta					
131W552	10/30/2013	1.9	0.7	1.0	No
Cesium-137					
131W552	10/30/2013	0.5	1.2	2.1	Yes
Tritium					
131W553	10/30/2013	60	110	180	Yes
Enriched Tritium					
131W456	6/25/2013	-2	7	11	Yes

[1] Concentrations are expressed in pCi/L with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

Table 28. Blank analysis results (µg/L) for metals in ground and surface water, fourth quarter, 2013.

Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
131W555	10/30/2013	<5.0	<2.0	<5.0	<10	<5.0	18	<10	<5.0

Table 29. Blank analysis results (mg/L) for common ions and nutrients in ground and surface water, fourth quarter, 2013.

Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus
131W556,555,554	10/30/2013	<0.1	<0.1	<0.1	<0.1	<0.2	<0.4	<0.8	<1.0	<0.01	<0.005

Table 30. Blank analysis results (ug/L) for VOCs in groundwater and/or surface water, fourth quarter, 2013.

Sample Number	Sample Date	1,1-Dichloroethene	Carbon tetrachloride	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Tetrachloroethylene (PERC)	Trichloroethylene	Vinyl chloride
131W133	10/24/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
131W750	11/5/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table 31. Duplicate radiological analysis results in pCi/L for ground and surface water, fourth quarter, 2013.

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?[1]
Gross Alpha									
Site-14	131W589	0.1	1.0	131W594	1.6	0.8	1.5	1.9	Yes
Middle-1823	131W574	-1.1	1.1	131W678	1.7	1.0	2.8	2.2	No
TAN-10A	131W599	8.7	2.5	131W605	2.8	2.3	5.9	5.1	No
USGS-112	131W631	2.0	0.9	131W671	0.4	1.2	1.6	2.3	Yes
Bill Jones Hatchery	131W759	1.8	1.2	131W761	2.1	1.3	0.3	2.7	Yes
Gross Beta									
Site-14	131W589	4.7	0.9	131W594	4.0	0.8	0.7	1.8	Yes
Middle-1823	131W574	1.7	0.9	131W678	1.8	0.9	0.1	1.9	Yes
TAN-10A	131W599	169.3	5.0	131W605	175.7	4.3	6.4	9.9	Yes
USGS-112	131W631	24.1	1.4	131W671	22.2	1.3	1.9	2.9	Yes
Bill Jones Hatchery	131W759	8.0	1.1	131W761	3.2	1.0	4.8	2.2	No
Gamma Spectroscopy Cesium-137									
Site-14	131W589	-1.3	2.7	131W594	-0.3	1.3	1.0	4.5	Yes
Middle-1823	131W574	-0.4	1.9	131W678	0.5	1.5	0.9	3.6	Yes
TAN-10A	131W599	-0.1	2.4	131W605	0.1	1.9	0.2	4.6	Yes
USGS-112	131W631	0.1	2.1	131W671	-0.9	1.7	1.0	4.1	Yes
Bill Jones Hatchery	131W759	0.3	1.7	131W761	0.0	1.5	0.3	3.4	Yes
Tritium									
Site-14	131W590	-60	130	131W595	-50	130	10	276	Yes
Middle-1823	131W577	880	120	131W681	1020	120	140	255	Yes
TAN-10A	131W601	560	110	131W607	540	110	20	233	Yes
USGS-112	131W634	1100	130	131W674	1020	120	80	265	Yes
Bill Jones Hatchery	131W760	-160	80	131W762	-100	80	60	170	Yes
Enriched Tritium									
USGS-011	131W197	18	8	131W202	16	6	2	15	Yes
MV-07(MV-44)	131W401	-4	7	131W431	6	6	10	14	Yes
NRF-12	131W285	33	7	131W291	18	6	15	14	No
Strontium-90									
Middle-1823	131W575	-0.01	0.24	131W679	0.02	0.25	0.03	0.52	Yes
TAN-10A	131W600	61	14	131W606	61	15	0	31	Yes
USGS-112	131W632	6.4	1.6	131W672	7.4	1.8	1.0	3.6	Yes
Technetium-99									
Middle-1823	131W576	0.7	0.1	131W680	0.5	0.1	0.2	0.2	Yes
USGS-112	131W633	2.8	0.2	131W673	2.8	0.2	0.0	0.4	Yes

[1] $\lvert R_1-R_2 \rvert \leq 3(S_1^2+S_2^2)^{1/2}$.

Table 32. Duplicate results for metals (µg/L) in ground water and/or surface water, fourth quarter, 2013.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
Site-14	131W592	10/31/2013	<5.0	62	5.4	<10	<5.0	<2.0	<10	<5.0
Site-14	131W597	10/31/2013	<5.0	63	5.5	<10	<5.0	<2.0	<10	<5.0
RPD			**0.0**	**-1.6**	**-1.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Middle-1823	131W579	10/7/2013	<5.0	65	9.9	<10	<5.0	2.8	<10	<5.0
Middle-1823	131W683	10/7/2013	<5.0	66	10	<10	<5.0	3.1	<10	<5.0
RPD			**0.0**	**-1.5**	**-1.0**	**0.0**	**0.0**	**-10**	**0.0**	**0.0**
TAN-10A	131W603	10/15/2013	<5.0	250	<5.0	2400	<5.0	920	<10	51
TAN-10A	131W609	10/15/2013	<5.0	250	<5.0	2500	<5.0	920	<10	56
RPD			**0.0**	**0.0**	**0.0**	**-4.1**	**0.0**	**0.0**	**0.0**	**-9.3**
USGS-112	131W636	10/22/2013	<5.0	93	12	<10	<5.0	<2.0	<10	<5.0
USGS-112	131W676	10/22/2013	<5.0	91	12	<10	<5.0	<2.0	<10	<5.0
RPD			**0.0**	**2.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

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

Table 33. Duplicate results for common ions and nutrients (mg/L) in ground water and/or surface water, fourth quarter, 2013.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus
Site-14	131W593,592,591	10/31/2013	34	14	15	3.1	0.46	9.73	24.9	129	0.62	0.022
Site-14	131W598,597,596	10/31/2013	34	14	15	3.1	0.51	9.66	24.8	130	0.61	0.021
RPD			**0.0**	**0.0**	**0.0**	**0.0**	**-10.3**	**0.7**	**0.4**	**-0.8**	**1.6**	**4.7**
Middle-1823	131W580,579,578	10/7/2013	54	18	11	1.9	<0.2	11.6	36.6	170	1.0	0.031
Middle-1823	131W684,683,682	10/7/2013	52	18	11	1.8	<0.2	11.6	36.6	169	1.0	0.025
RPD			**3.8**	**0.0**	**0.0**	**5.4**	**0.0**	**0.0**	**0.0**	**0.6**	**0.0**	**21.4**
TAN-10A	131W604,603,602	10/15/2013	86	23	45	4.0	0.206	104	36.3	221	0.036	0.075
TAN-10A	131W610,609,608	10/15/2013	86	23	45	4.0	<0.2	106	36.2	222	0.036	0.075
RPD			**0.0**	**0.0**	**0.0**	**0.0**	**3.0**	**-1.9**	**0.3**	**-0.5**	**0.0**	**0.0**
USGS-112	131W637,636,635	10/22/2013	52	14	15	2.8	0.256	21.6	29.6	152	1.3	0.032
USGS-112	131W677,676,675	10/22/2013	52	14	15	2.8	<0.2	21.6	29.6	151	1.3	0.031
RPD			**0.0**	**0.0**	**0.0**	**0.0**	**24.6**[1]	**0.0**	**0.0**	**0.7**	**0.0**	**3.2**

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

[1]Both results were less than five times the detection limit; their absolute difference is acceptable (≤ the method detection limit of 0.20 mg/L).

Table 34. Duplicate in-situ analyses of gamma emitting radionuclides in soil, fourth quarter, 2013.

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?
Large Grid 18-4	11/20/13	15.0 ± 0.8	15.1 ± 0.8	1.3	In Spec	Yes	0.175 ± 0.022	0.179 ± 0.024	2.5	In Spec	Yes
Large Grid 12-5	11/20/13	15.1 ± 0.8	14.7 ± 0.7	2.2	In Spec	Yes	0.173 ± 0.045	0.230 ± 0.028	28.7	In Spec	Yes
Large Grid 18-3	11/13/13	20.6 ± 0.8	19.9 ± 0.8	3.4	In Spec	Yes	0.145 ± 0.027	0.141 ± 0.031	3.4	In Spec	Yes
Large Grid 24-8	12/4/13	15.6 ± 0.8	15.9 ± 0.7	2.3	In Spec	Yes	0.269 ± 0.039	0.253 ± 0.028	6.2	In Spec	Yes
Reno Ranch	12/4/13	13.0 ± 0.7	12.2 ± 0.7	6.5	In Spec	Yes	0.257 ± 0.033	0.248 ± 0.026	3.4	In Spec	Yes
Sage Junction	12/10/13	17.1 ± 0.9	16.5 ± 0.8	3.5	In Spec	Yes	0.166 ± 0.042	0.182 ± 0.025	9.1	In Spec	Yes
Big Lost River Rest Area	11/19/13	19.7 ± 0.8	20.3 ± 0.9	2.9	In Spec	Yes	0.147 ± 0.035	0.167 ± 0.030	12.5	In Spec	Yes
Base of Howe	11/19/13	15.2 ± 0.8	15.3 ± 0.7	0.7	In Spec	Yes	0.168 ± 0.024	0.152 ± 0.025	10.1	In Spec	Yes
Large Grid 6-3	12/6/13	18.4 ± 0.9	19.3 ± 0.8	4.4	In Spec	Yes	0.204 ± 0.027	0.173 ± 0.027	16.4	In Spec	Yes

[1]Result ±2 SD.

Table 35. De-ionized water spike results (in µg/L) and percent recovery for metals in groundwater and/or surface water, fourth quarter, 2013.

Spike Sample Number	Sample Date	Barium			Chromium			Lead			Manganese			Zinc		
		Spike	Result	%R[1]	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
131W754	11/4/2013	49	49	100	7.01	7.5	107	7.75	8.2	105.8	7.82	8.5	108.7	38.4	36	93.8

[1]A percent recovery of 100 ± 25 is considered acceptable and is recorded as %R.

Table 36. De-ionized water spike results (in mg/L) and percent recovery for common ions and nutrients in groundwater and/or surface water, fourth quarter, 2013.

Spike Sample Number	Sample Date	Calcium			Magnesium			Sodium			Potassium			Fluoride		
		Spike	Result	%R[1]	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
131W755,753	11/4/2013	8.85	9.2	104	3.51	3.5	99.7	7.89	8.2	103.9	1.71	1.8	105.3	1.67	1.53	91.6

[1]A percent recovery of 100 ± 25 is considered acceptable and is recorded as %R.

Table 36. continued. De-ionized water spike results (in mg/L) and percent recovery for common ions and nutrients in groundwater and/or surface water, fourth quarter, 2013.

Spike Sample Number	Sample Date	Chloride			Sulfate			Total Alkalinity as $CaCO_3$			Total Nitrogen			Total Phosphorus		
		Spike	Result	%R[1]	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
131W755,753	11/4/2013	105	106	101	33.0	33.8	102.4	59.8	58	97	2.61	2.6	99.6	0.0213	0.018	84.5

[1]A percent recovery of 100 ± 25 is considered acceptable and is recorded as %R.

Table 37. De-ionized water spike results (in µg/L) and percent recovery for VOCs in groundwater and/or surface water, fourth quarter, 2013.

Spike Sample Number	Sample Date	Carbon Tetrachloride			Styrene			Tetrachloroethylene			Trichloroethylene			Vinyl Chloride		
		Spike	Result	%R[1]	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R	Spike	Result	%R
131W756	11/4/2013	15.1	14	92.7	11.2	8.2	73.2	10.1	8.3	82.2	10.5	10.2	97.1	13.0	16.2	124.6

[1]A percent recovery of 100 ± 25 is considered acceptable and is recorded as %R.

Table 38. Electret ionization chamber irradiation results (categorized as spiked samples), fourth quarter, 2013.

Electret #	Exposure Received		Net Measured Exposure[1]		%R
	(mR)	Uncertainty (±1 SD, mR)	(mR)	Uncertainty (±1 SD, mR)	
SFV783	40.1	2.0	43.6	1.3	109
SFV800	40.1	2.0	45.1	1.3	112
SFV819	40.1	2.0	41.6	1.3	104
SGJ031	30.0	1.5	29.0	1.3	97
SFV811	30.0	1.5	30.7	1.3	102
SGJ063	30.0	1.5	30.3	1.3	101
SFV707	25.0	1.2	23.5	1.3	94
SFV824	25.0	1.2	24.6	1.3	98
SFV845	25.0	1.2	22.4	1.3	90

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

Table 39. Air sampling field equipment service reliability (percent operational), fourth quarter, 2013.

Station Locations	Sample Type			
	TSP	Radioiodine	Atmospheric Moisture	Precipitation
Onsite Locations				
Big Lost River Rest Area	100%	100%	100%	100%
Experimental Field Station	100%	100%	100%	NC[1]
Sand Dunes Tower	100%	92%	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, 2013.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
On-Site Locations						
Rest Area	09/26/13	10/03/13	0.8	0.2	25.1	1.1
	10/03/13	10/10/13	0.9	0.2	33.7	1.2
	10/10/13	10/17/13	1.4	0.3	44.6	1.4
	10/17/13	10/24/13	1.5	0.3	46.6	1.4
	10/24/13	10/31/13	1.0	0.2	56.6	1.6
	10/31/13	11/07/13	0.8	0.2	28.9	1.2
	11/07/13	11/14/13	1.3	0.3	47.6	1.4
	11/14/13	11/21/13	0.7	0.2	30.9	1.2
	11/21/13	11/27/13	1.5	0.3	63.8	1.8
	11/27/13	12/05/13	1.4	0.2	67.6	1.6
	12/05/13	12/12/13	1.3	0.3	73.4	1.8
	12/12/13	12/19/13	2.0	0.3	94.9	2.0
	12/19/13	12/26/13	1.0	0.2	39.7	1.3
	12/26/13	01/02/14	1.3	0.3	65.8	1.7
Experimental Field Station	09/26/13	10/03/13	1.0	0.2	21.0	1.1
	10/03/13	10/10/13	0.7	0.2	30.4	1.2
	10/10/13	10/17/13	1.3	0.3	36.7	1.3
	10/17/13	10/24/13	1.3	0.3	42.0	1.4
	10/24/13	10/31/13	1.0	0.2	46.6	1.5
	10/31/13	11/07/13	0.8	0.2	25.8	1.1
	11/07/13	11/14/13	1.2	0.2	42.1	1.4
	11/14/13	11/21/13	0.6	0.2	26.7	1.2
	11/21/13	11/27/13	1.0	0.3	57.3	1.7
	11/27/13	12/05/13	1.2	0.2	57.2	1.5
	12/05/13	12/12/13	1.4	0.3	66.7	1.7
	12/12/13	12/19/13	2.0	0.3	102.2	2.1
	12/19/13	12/26/13	0.7	0.2	41.4	1.4
	12/26/13	01/02/14	1.2	0.2	64.6	1.7
Sand Dunes	09/26/13	10/03/13	0.5	0.2	16.9	0.9
	10/03/13	10/10/13	0.6	0.2	23.7	1.0
	10/10/13	10/17/13	R[1]	R[1]	R[1]	R[1]
	10/17/13	10/24/13	R[1]	R[1]	R[1]	R[1]
	10/24/13	10/31/13	0.9	0.2	38.6	1.3
	10/31/13	11/07/13	0.7	0.2	24.0	1.0
	11/07/13	11/14/13	1.0	0.2	39.4	1.3
	11/14/13	11/21/13	0.7	0.2	26.8	1.1
	11/21/13	11/27/13	0.8	0.2	50.7	1.5
	11/27/13	12/05/13	0.9	0.2	52.1	1.3
	12/05/13	12/12/13	1.3	0.2	57.2	1.5
	12/12/13	12/19/13	1.4	0.2	80.6	1.8
	12/19/13	12/26/13	0.5	0.2	37.1	1.2
	12/26/13	01/02/14	0.9	0.2	65.3	1.6

[1]R – Results rejected due to insufficient sample volume caused by a power outage at the station.

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, 2013.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Van Buren	09/26/13	10/03/13	0.5	0.2	16.9	0.9
	10/03/13	10/10/13	0.6	0.2	24.6	1.1
	10/10/13	10/17/13	0.9	0.2	31.6	1.2
	10/17/13	10/24/13	1.2	0.2	36.9	1.3
	10/24/13	10/31/13	1.0	0.2	41.4	1.3
	10/31/13	11/07/13	0.4	0.2	19.2	1.0
	11/07/13	11/14/13	0.8	0.2	34.4	1.2
	11/14/13	11/21/13	0.5	0.2	22.9	1.0
	11/21/13	11/27/13	0.8	0.2	50.4	1.6
	11/27/13	12/05/13	1.0	0.2	52.9	1.4
	12/05/13	12/12/13	1.4	0.3	62.1	1.6
	12/12/13	12/19/13	1.3	0.2	74.3	1.8
	12/19/13	12/26/13	0.8	0.2	31.6	1.2
	12/26/13	01/02/14	1.0	0.2	61.3	1.6
Boundary Locations						
Atomic City	09/26/13	10/03/13	0.8	0.2	19.6	1.0
	10/03/13	10/10/13	0.7	0.2	26.7	1.1
	10/10/13	10/17/13	1.2	0.2	34.6	1.2
	10/17/13	10/24/13	1.1	0.2	37.5	1.3
	10/24/13	10/31/13	1.3	0.2	46.1	1.4
	10/31/13	11/07/13	0.7	0.2	21.6	1.0
	11/07/13	11/14/13	1.2	0.2	43.3	1.4
	11/14/13	11/21/13	0.6	0.2	27.4	1.1
	11/21/13	11/27/13	0.8	0.2	56.4	1.6
	11/27/13	12/05/13	1.3	0.2	58.5	1.4
	12/05/13	12/12/13	1.3	0.3	63.6	1.6
	12/12/13	12/19/13	1.6	0.3	87.0	1.9
	12/19/13	12/26/13	0.7	0.2	33.2	1.2
	12/26/13	01/02/14	1.0	0.2	54.4	1.5
Howe	09/26/13	10/03/13	0.7	0.3	19.0	1.2
	10/03/13	10/10/13	0.6	0.2	23.7	1.1
	10/10/13	10/17/13	0.9	0.3	30.3	1.4
	10/17/13	10/24/13	0.9	0.2	30.8	1.2
	10/24/13	10/31/13	0.8	0.2	37.4	1.3
	10/31/13	11/07/13	0.9	0.2	21.4	1.1
	11/07/13	11/14/13	1.4	0.3	35.9	1.3
	11/14/13	11/21/13	0.7	0.2	23.4	1.1
	11/21/13	11/27/13	0.9	0.3	40.5	1.5
	11/27/13	12/05/13	1.6	0.3	45.0	1.3
	12/05/13	12/12/13	1.0	0.3	58.5	1.8
	12/12/13	12/19/13	1.5	0.3	72.3	1.8
	12/19/13	12/26/13	0.9	0.2	32.8	1.3
	12/26/13	01/02/14	1.1	0.2	50.1	1.5

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, 2013.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Monteview	09/26/13	10/03/13	0.8	0.2	20.5	1.0
	10/03/13	10/10/13	0.7	0.2	25.8	1.1
	10/10/13	10/17/13	1.3	0.3	37.5	1.3
	10/17/13	10/24/13	1.1	0.2	36.1	1.3
	10/24/13	10/31/13	1.2	0.2	49.3	1.5
	10/31/13	11/07/13	0.5	0.2	27.2	1.1
	11/07/13	11/14/13	1.1	0.2	38.1	1.3
	11/14/13	11/21/13	0.7	0.2	34.3	1.3
	11/21/13	11/27/13	0.8	0.2	48.3	1.6
	11/27/13	12/05/13	1.5	0.2	68.7	1.6
	12/05/13	12/12/13	1.8	0.3	65.9	1.7
	12/12/13	12/19/13	1.9	0.3	98.7	2.1
	12/19/13	12/26/13	0.7	0.2	33.5	1.2
	12/26/13	01/02/14	0.9	0.2	60.1	1.6
Mud Lake	09/26/13	10/03/13	1.4	0.3	28.6	1.2
	10/03/13	10/10/13	1.4	0.3	39.0	1.3
	10/10/13	10/17/13	2.1	0.3	51.5	1.5
	10/17/13	10/24/13	2.6	0.3	57.3	1.6
	10/24/13	10/31/13	1.7	0.3	60.3	1.6
	10/31/13	11/07/13	1.4	0.3	36.7	1.3
	11/07/13	11/14/13	2.0	0.3	66.9	1.7
	11/14/13	11/21/13	1.1	0.2	39.4	1.3
	11/21/13	11/27/13	1.7	0.3	76.7	1.9
	11/27/13	12/05/13	2.0	0.3	83.6	1.8
	12/05/13	12/12/13	1.6	0.3	85.3	1.9
	12/12/13	12/19/13	1.6	0.3	105.8	2.4
	12/19/13	12/26/13	0.9	0.2	50.0	1.5
	12/26/13	01/02/14	1.5	0.3	82.2	1.9
Distant Locations						
Craters of the Moon	09/26/13	10/03/13	0.3	0.2	15.4	0.9
	10/03/13	10/10/13	0.5	0.2	21.0	1.1
	10/10/13	10/17/13	0.6	0.2	31.4	1.2
	10/17/13	10/24/13	0.7	0.2	29.6	1.2
	10/24/13	10/31/13	0.8	0.2	36.4	1.3
	10/31/13	11/07/13	0.3	0.2	14.5	0.9
	11/07/13	11/14/13	0.4	0.2	28.4	1.2
	11/14/13	11/21/13	0.4	0.2	19.5	1.0
	11/21/13	11/27/13	0.8	0.3	40.6	1.5
	11/27/13	12/05/13	0.9	0.2	39.3	1.3
	12/05/13	12/12/13	1.1	0.2	52.3	1.6
	12/12/13	12/19/13	0.8	0.2	53.9	1.6
	12/19/13	12/26/13	0.7	0.2	21.2	1.1
	12/26/13	01/02/14	0.7	0.2	34.5	1.3

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, 2013.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	±2 SD	Concentration	±2 SD
Fort Hall[1]	09/26/13	10/03/13	0.5	0.2	13.1	0.8
	10/03/13	10/10/13	0.5	0.2	15.2	0.9
	10/10/13	10/17/13	0.6	0.2	21.0	1.0
	10/17/13	10/24/13	0.5	0.2	22.5	1.0
	10/24/13	10/31/13	0.9	0.2	29.6	1.2
	10/31/13	11/07/13	0.3	0.2	13.3	0.8
	11/07/13	11/14/13	0.8	0.2	23.1	1.1
	11/14/13	11/21/13	0.6	0.2	17.5	1.0
	11/21/13	11/27/13	0.6	0.2	30.1	1.3
	11/27/13	12/05/13	0.9	0.2	33.5	1.1
	12/05/13	12/12/13	1.1	0.2	36.7	1.3
	12/12/13	12/19/13	1.0	0.2	51.0	1.5
	12/19/13	12/26/13	0.4	0.2	16.5	0.9
	12/26/13	01/02/14	0.9	0.2	36.9	1.3
Idaho Falls - HVP 3804	09/26/13	10/03/13	1.0	0.3	22.0	1.5
	10/03/13	10/10/13	0.9	0.3	29.6	1.4
	10/10/13	10/17/13	1.3	0.3	41.2	1.4
	10/17/13	10/24/13	1.6	0.3	42.8	1.4
	10/24/13	10/31/13	1.6	0.3	58.7	1.6
	10/31/13	11/07/13	0.8	0.2	29.3	1.2
	11/07/13	11/14/13	1.3	0.3	49.3	1.5
	11/14/13	11/21/13	0.9	0.2	33.2	1.3
	11/21/13	11/27/13	1.2	0.3	61.0	1.8
	11/27/13	12/05/13	1.3	0.2	52.5	1.4
	12/05/13	12/12/13	1.7	0.3	67.0	1.7
	12/12/13	12/19/13	1.5	0.3	93.4	2.0
	12/19/13	12/26/13	0.7	0.2	35.0	1.3
	12/26/13	01/02/14	1.2	0.3	65.6	1.7
Idaho Falls - HVP 4304[2]	09/26/13	10/03/13	0.8	0.3	18.9	1.3
	10/03/13	10/10/13	0.9	0.2	26.6	1.3
	10/10/13	10/17/13	1.0	0.2	39.0	1.3
	10/17/13	10/24/13	1.2	0.2	36.2	1.3
	10/24/13	10/31/13	1.6	0.3	61.2	1.6
	10/31/13	11/07/13	0.5	0.2	25.4	1.1
	11/07/13	11/14/13	1.6	0.3	50.4	1.5
	11/14/13	11/21/13	0.8	0.2	30.5	1.2
	11/21/13	11/27/13	1.4	0.3	59.1	1.7
	11/27/13	12/05/13	1.3	0.2	54.3	1.4
	12/05/13	12/12/13	1.8	0.3	79.0	1.8
	12/12/13	12/19/13	1.6	0.3	100.0	2.0
	12/19/13	12/26/13	0.7	0.2	39.3	1.3
	12/26/13	01/02/14	1.1	0.2	67.1	1.7

[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.

Appendix B

Table B-1. Results for all EIC locations, fourth quarter, 2013.

Sample Location	Net Corrected Exposure Rate (µR/h)[2]	± 2 SD (µR/h)
Arco	11.4	3.1
Craters	11.2	2.4
Rest Area	15.4	2.5
Van Buren	15.2	2.6
EFS	19.2, 21.1	
Main Gate	15.1	1.9
Atomic City	14.0	2.5
Taber	13.0, 12.2	
Blackfoot	9.2, 10.1	
Fort Hall[1]	9.0	2.3
Idaho Falls	12.2	2.3
Mud Lake/Terreton	16.7, 15.8	
Monteview	16.0, 15.4	
Sand Dunes	14.5, 14.0	
Howe Met. Tower	14.3	3.0
MP276 -20	13.5	3.5
MP274 -20	11.3, 12.0	
MP272 -20	9.0	1.9
MP270 -20	11.7, 12.3	
MP268 -20	13.9	1.6
MP266 -20	13.8	3.5
MP264 -20	12.8, 14.5	
MP270 -20/26	18.6	1.9
MP268 -20/26	17.4, 17.7	
MP266 -20/26	12.9	2.0
MP263 -20/26	12.2	2.8
MP261 -20/26	11.6, 15.3	
MP259 -20/26	13.5	0.9
MFC (EBR II)	13.9	2.3
EBR I	13.5	1.7
RWMC	12.0, 15.0	
CFA	17.0	2.8
CITRC (PBF)	13.9, 15.0	

[1]Station operated by Shoshone-Bannock Tribes.
[2]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.

Table B-1 continued. Results for all EIC locations, fourth quarter, 2013.

Sample Location	Net Corrected Exposure Rate (µR/h)	± 2 SD (µR/h)
INTEC	16.3	2.4
ATR (TRA)	14.4	2.6
NRF	13.2	3.4
TAN	12.4, 13.8	
Mud Lake Bank of Commerce	15.5	2.5
MP43-33	21.3	0.9
MP41-33	19.5	2.9
MP39-33	15.8	2.1
MP37-33	9.7	3.6
MP35-33	11.0	2.0
MP33-33	15.5	1.7
MP31-33	14.8	2.4
MP29-33	14.2	3.0
MP27-33	10.6	1.3
MP25-33	13.4	3.0
MP23-33	13.2	0.5
Base of Howe	11.7	2.4
Rover	14.2	2.6
Hamer	13.0, 15.4	
Sugar City	15.9, 19.8	
Roberts	12.7	0.2
Big Southern Butte	14.4	2.9

Appendix C

Table C-1. List of volatile organic compounds (VOCs) analyzed for water samples. Minimum detectable concentrations (MDC) are expressed in µg/L.

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
Tetrachloroethylene (PERC)	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	0.5
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. Minimum detectable concentrations (MDC) are expressed in µg/L.

Analyte	Minimum detectable concentrations (MDC) (expressed in µg/L)
4-Chlorotoluene	0.5
1,2-Dibromo-3-chloropropane (DBCP)	1.0
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	0.5
Hexachlorobutadiene	0.5
Isopropylbenzene	0.5
p-Isopropyltoluene	0.5
Methyl Tert Butyl Ether (MTBE)	1.0
Naphthalene	1.0
n-Propylbenzene	0.5
1,1,1,2-Tetrachloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
1,2,3-Trichlorobenzene	1.25
Trichlorofluoromethane	0.5
1,2,3-Trichloropropane	0.5
1,2,4-Trimethylbenzene	0.5
1,3,5-Trimethylbenzene	0.5