Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM QUARTERLY DATA REPORT

October - December, 2012

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

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

Table of Contents

Table of Acronyms vi
Introduction 1
Air and Precipitation Monitoring Results 1
Environmental Radiation Monitoring Results 5
Water Monitoring 7
Terrestrial Monitoring Results 19
Quality Assurance 21

List of Tables

Table 1. Sampling locations and sample type. 3
Table 2. Range of gross alpha and gross beta concentrations for TSP filters, fourth quarter, 2012. 3
Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, fourth quarter, 2012 4
Table 4. Tritium concentrations in air from atmospheric moisture, fourth quarter, 2012 4
Table 5. Tritium and Cesium-137 concentrations from precipitation, fourth quarter, 2012. 5
Table 6. Summary of instrumentation at radiation monitoring stations. 6
Table 7. Average gamma exposure rates, fourth quarter, 2012, from HPIC network. 6
Table 8. Electret ionization chamber (EIC) cumulative average exposure rates, fourth quarter, 2012. 7
Table 9. Alpha, beta, and gamma concentrations for water samples, fourth quarter, 2012. 11
Table 10. Reported concentrations of plutonium isotopes in water samples, fourth quarter, 2012. 12
Table 11. Reported concentrations of uranium isotopes in water samples, fourth quarter, 2012. 12
Table 12. Reported concentrations of americium-241 in water samples, fourth quarter, 2012. 12
Table 13. Reported concentrations of strontium-90 in water samples, fourth quarter, 2012. 13
Table 14. Reported concentrations of technetium-99 in water samples, fourth quarter, 2012. 13
Table 15. Tritium concentrations for water samples, fourth quarter, 2012. 14
Table 16. Enriched Tritium concentrations for water samples from previous sampling quarters, 2012. 15
Table 17. Reported metals concentrations in water samples, fourth quarter, 2012. 16
Table 18. Reported common ion concentrations in water samples, fourth quarter, 2012. 17
Table 19. Reported nutrient concentrations in water samples, fourth quarter, 2012. 18
Table 20. Reported VOC concentrations in water samples, fourth quarter, 2012. 18
Table 21. Gamma spectroscopy analysis data for milk samples, fourth quarter, 2012. 19
Table 22. In-Situ gamma spectroscopic analysis results (^{137}Cs) for soil monitoring conducted during the fourth quarter, 2012. 20
Table 23. Summary of the analytical performance and usability of the analyses performed for the DEQ-INL OP ESP, fourth quarter, 2012. 25
Table 24. Blank analysis results for gross alpha and beta in particulate air (TSP), fourth quarter, 2012. 26
Table 25. Blank analysis results for gamma spectroscopy for TSP particulate air filters, fourth quarter, 2012. 26
Table 26. Blank analysis results for tritium in water vapor from air samples, fourth quarter, 2012. 26
Table 27. Radiological blank analysis in ground and surface water for samples for the fourth quarter, 2012. 27
Table 28. Blank analysis results (µg/L) for metals in ground and surface water for the fourth quarter, 2012. 28
Table 29. Blank analysis results (mg/L) for common ions and nutrients in ground and surface water for the fourth quarter, 2012 28
Table 30. Blank analysis results (µg/L) for VOCs in ground and surface water for the fourth quarter, 2012. 28
Table 31. Duplicate radiological analysis results in pCi/L for ground and surface water, fourth quarter, 2012. 29
Table 32. Duplicate results for metals (µg/L) in ground water and/or surface water for the fourth quarter, 2012. 30
Table 33. Duplicate results for common ions and nutrients (mg/L) in ground water and/or surface water for fourth quarter, 2012. 30
Table 34. Duplicate *in-situ* analyses of gamma emitting radionuclides in soil, fourth quarter, 2012 31
Table 35. De-ionized water spike results (in µg/L) for metals in ground and surface water for the fourth quarter, 2012 31

Table 36. De-ionized water spike results (in mg/L) for common ions and nutrients in ground and surface water for the fourth quarter, 2012. 32
Table 37. De-ionized water spike results (in µg/L) for VOCs in ground and surface water for the fourth quarter, 2012. 32
Table 38. Electret ionization chamber irradiation results (categorized as spiked samples) for fourth quarter, 2012. 33
Table 39. Air sampling field equipment service reliability (percent operational), fourth quarter, 2012. ... 33
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, 2012 34
Table B-1. Results for all electret locations, fourth quarter, 2012. 38
Table C-1. List of volatile organic compounds (VOCs) analyzed for water samples..... 40

List of Figures

Figure 1. Air and radiation monitoring sites. 2
Figure 2. Distant and Surface Water sampling locations, fourth quarter, 2012. 9
Figure 3. Up-gradient, facility, boundary and wastewater monitoring locations, fourth quarter, 2012. 10
Figure 4. Soil monitoring sites, fourth quarter, 2012. 21

Table of Acronyms

aCi/L	-	attocuries per liter
BEA	-	Battelle Energy Alliance, LLC
BLR		Big Lost River
CERCLA	-	Comprehensive Environmental Response, Compensation and Liability Act
CFA	-	Central Facilities Area
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
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
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
NRF	-	Naval Reactors Facility
pCi/g	-	picocuries per gram
pCi/L	-	picocuries per liter
pCi/m^3	-	picocuries per cubic meter
PCE	-	perchloroethene
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
TCE	-	trichloroethene
TDS	-	total dissolved solids
TMI	-	Three Mile Island
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, 2012 (**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. 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 2012 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 not measured above the minimum detectable concentration during the fourth quarter of 2012. Average atmospheric tritium concentrations are presented in **Table 4**.

Precipitation samples were collected at six monitoring locations during the fourth quarter of 2012. Precipitation samples were analyzed for tritium and gamma-emitting radionuclides. Tritium and gamma-emitting radionuclides were below minimum detectable concentration in precipitation collected during the fourth quarter of 2012. 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.

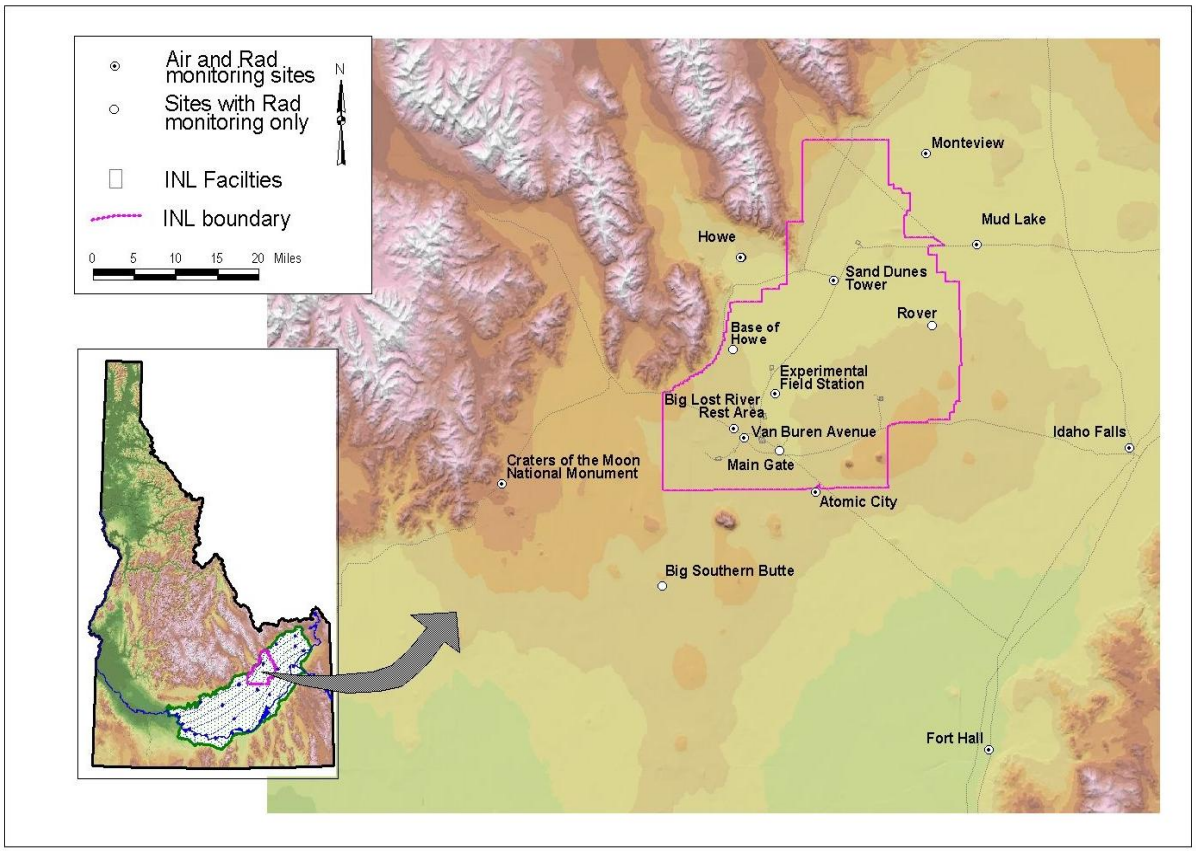

Figure 1. Air and radiation monitoring sites.

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, 2012.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.4	-	2.2	20.2	-	54.3
Experimental Field Station	0.2	-	8.5	13.6	-	41.6
Sand Dunes Tower	0.2	-	1.1	13.9	-	31.4
Van Buren Avenue	0.3	-	1.3	12.4	-	37.8
Boundary Locations						
Atomic City	0.5	-	1.5	13.4	-	39.6
Howe	0.3	-	1.4	12.9	-	32.9
Monteview	0.5	-	1.7	16.4	-	37.2
Mud Lake	0.7	-	1.9	23.3	-	50.0
Distant Locations						
Craters of the Moon	0.1	-	1.2	9.3	-	32.8
Fort Hall[1]	0.2	-	1.5	10.7	-	27.1
Idaho Falls	0.6	-	2.1	17.6	-	50.5

[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, 2012.

Station Location	Naturally Occurring Radionuclide Beryllium-7		Man-Made Gamma Emitting Radionuclides
	Concentration	± 2 SD	
On-site Locations			
Big Lost River Rest Area	65.7	3.5	<MDC[2]
Experimental Field Station	42.3	2.4	<MDC
Sand Dunes Tower	41.8	2.3	<MDC
Van Buren Avenue	46.6	2.5	<MDC
Boundary Locations			
Atomic City	47.0	2.5	<MDC
Howe	44.2	2.4	<MDC
Monteview	50.4	2.8	<MDC
Mud Lake	67.6	3.6	<MDC
Distant Locations			
Craters of the Moon	38.4	2.2	<MDC
Fort Hall[1]	35.4	2.0	<MDC
Idaho Falls	57.1	3.2	<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, 2012

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.12	0.32	0.54
Experimental Field Station	0.45	0.32	0.54
Sand Dunes Tower	0.14	0.29	0.50
Van Buren Avenue	0.15	0.30	0.51
Boundary Locations			
Atomic City	0.22	0.32	0.54
Howe	0.13	0.30	0.51
Mud Lake	0.15	0.35	0.59
Monteview	0.08	0.26	0.45
Distant Locations			
Craters of the Moon	0.04	0.21	0.36
Fort Hall[1]	0.21	0.37	0.63
Idaho Falls	0.22	0.37	0.63

[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, 2012.

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	0	100	170	0.0	1.7	2.9
Boundary Locations						
Atomic City	100	100	170	0.0	2.1	3.7
Howe	0	100	170	0.0	1.9	3.3
Monteview	0	90	160	0.9	1.5	2.4
Mud Lake	0	100	170	0.2	1.2	2.2
Distant Locations						
Idaho Falls	0	90	160	0.3	1.5	2.5

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

Environmental Radiation Monitoring Results

The ESP operated 14 environmental radiation stations during the fourth quarter of 2012 (**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 additional environmental radiation station at Fort Hall equipped with an EIC and HPIC, both of which belong to the DEQ-INL OP. The DEQ-INL OP reports these results.

HPICs are instruments capable of real-time measurements, and are sensitive enough to detect small changes in gamma radiation levels. The real-time gamma radiation measurements collected by the HPICs at each location are radioed to DEQ-INL OP and presented graphically via the worldwide web at http://www.deq.idaho.gov/inl-oversight/monitoring/gamma-radiation-measurements.aspx

EICs are a passive-integrating system that provides a cumulative measure of environmental gamma radiation exposure in the field. EICs are deployed, collected, and analyzed quarterly. EICs offer an inexpensive methodology to measure gamma radiation over a wide area, particularly in regions which do not have a power source. EICs can also provide valuable gamma radiation data in the event of an emergency. For this reason EICs are deployed at an additional 40 locations by DEQ-INL OP in a widespread network around the INL measuring external radiation. This information is tabulated in **Appendix B**.

These two systems are used by DEQ-INL OP to measure external gamma radiation for various radiological monitoring objectives. **Table 7** lists the average radiation exposure rates measured by the HPICs for fourth quarter 2012. **Table 8** lists the EIC monitoring results for fourth quarter 2012. 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, 2012, from HPIC network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
Base of Howe	15.3	3.7
Big Lost River Rest Area	15.4	1.3
Main Gate	15.8	1.4
Rover	14.6	1.0
Sand Dunes Tower	13.4	1.0
Boundary Locations		
Atomic City	12.8	2.9
Big Southern Butte	15.2	6.3
Howe Met Tower	13.2	1.0
Monteview	13.3	1.1
Mud Lake/Terreton	14.8	1.2
Distant Locations		
Fort Hall[1]	14.2	1.5
Idaho Falls	11.5	1.1

[1] Operated by Shoshone-Bannock Tribes.

Table 8. Electret ionization chamber (EIC) cumulative average exposure rates, fourth quarter, 2012.

Station Location	Exposure Rate (µR/hr)			
	Quarterly Average		± 2 SD	
On-site Locations				
Base of Howe	12.2		1.3	
Big Lost River Rest Area	13.7		3.5	
Experimental Field Station	19.2		2.0	
Main Gate	12.8		1.4	
Rover	11.8		1.9	
Sand Dunes Tower	14.5		2.1	
Van Buren Avenue	13.8		0.6	
Boundary Locations				
Atomic City[1]	13.3	(J)	4.0	(J)
Big Southern Butte	11.8		1.9	
Howe Met Tower	11.1		1.4	
Monteview	13.4		3.6	
Mud Lake / Terreton	11.5		1.3	
Distant Locations				
Craters of the Moon	12.3		3.3	
Fort Hall[2]	8.5		0.7	
Idaho Falls	11.6		2.6	

[1] Atomic City data did not conform to DEQ-INL OP acceptance criteria and therefore the result is reported as an estimate (J qualifier).
[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 2012, 2 up-gradient, 13 facility, 3 boundary, 5 distant, 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, uranium, and americium; and beta emitting radionuclides technetium-99 and strontium-90, 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 4 facility, and 1 boundary location. Concentrations observed at facility locations were in areas of known contamination and consistent with historical trends. All other locations with detectable results were 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 in 4 of the 5 areas (up-gradient, facility, boundary, and distant) sampled. Concentrations observed at facility locations were consistent with historical trends. Concentrations for up-gradient, boundary, and distant locations were within the range of concentrations observed for naturally-occurring radioactivity. The MCL for beta and gamma radioactivity is 4 mrem/year, equivalent to 8 pCi/l if the source is strontium-90; 900 pCi/L if technetium-99; 20,000 pCi/L if tritium; or 200 pCi/L if cesium-137. 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 cesium-137 are shown in **Table 9**.

Four sites were sampled for plutonium isotopes (**Table 10**). There were no detectable results for plutonium isotopes this quarter.

Five sites were sampled for isotopes of uranium. All five sample sites had detectable results for uranium-234, five detectable results for uranium-238, and one detectable result for uranium-235 (**Table 11**). The isotopic ratios of results observed at the five sample sites cannot be distinguished from background concentrations, which means the uranium found in the samples is likely to be naturally occurring. Four sites were sampled for americium-241 this quarter. There were no detections (**Table 12**).

Two of thirteen samples analyzed for strontium-90 had detectable results this quarter (**Table 13**). All samples were from locations in areas of known contamination. All twelve locations sampled for technetium-99 had detectable results this quarter (**Table 14**). All results are within the expected ranges of concentrations.

Using the standard analytical method, tritium was detected in nine of thirteen facility samples (**Table 15**). Detections are consistent with historic concentrations for these sites. These detections are consistent with historic INL waste disposal influences. 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. Thirteen samples collected during previous quarters were analyzed using the enrichment method, with results presented during this quarter (**Table 16**). A backlog of 60 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 were consistent with historical values at each location.

Four locations were sampled for Volatile Organic Compounds (VOCs) this quarter; all four locations had detectable concentrations for two analytes, including carbon tetrachloride and trichloroethylene. All

locations are in an area of known contamination at RWMC. VOCs with detectable concentrations are shown in **Table 20** and a complete list of analyses is shown in **Appendix C**. The background concentrations for VOCs should be zero. The results discussed in this section only refer to detectable VOC concentrations.

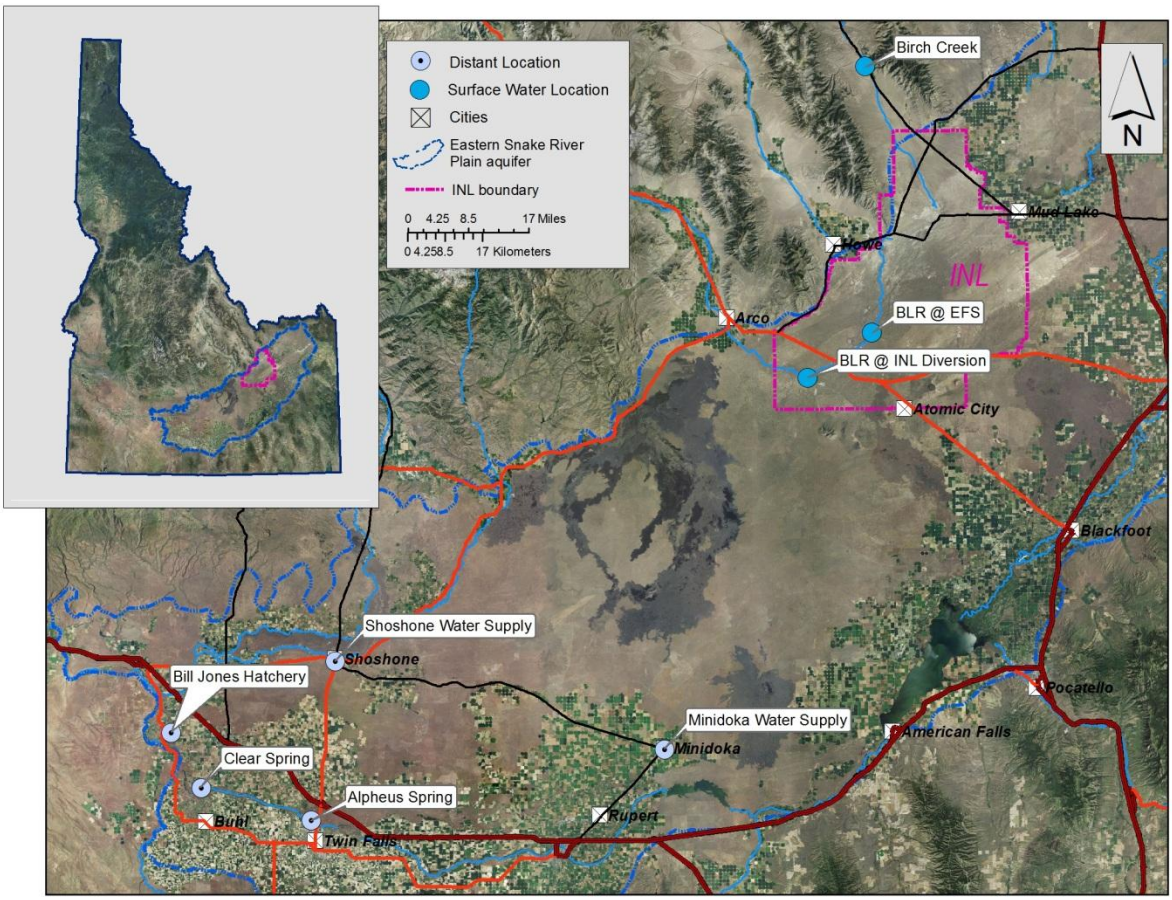

Figure 2. Distant and Surface Water sampling locations, fourth quarter, 2012.

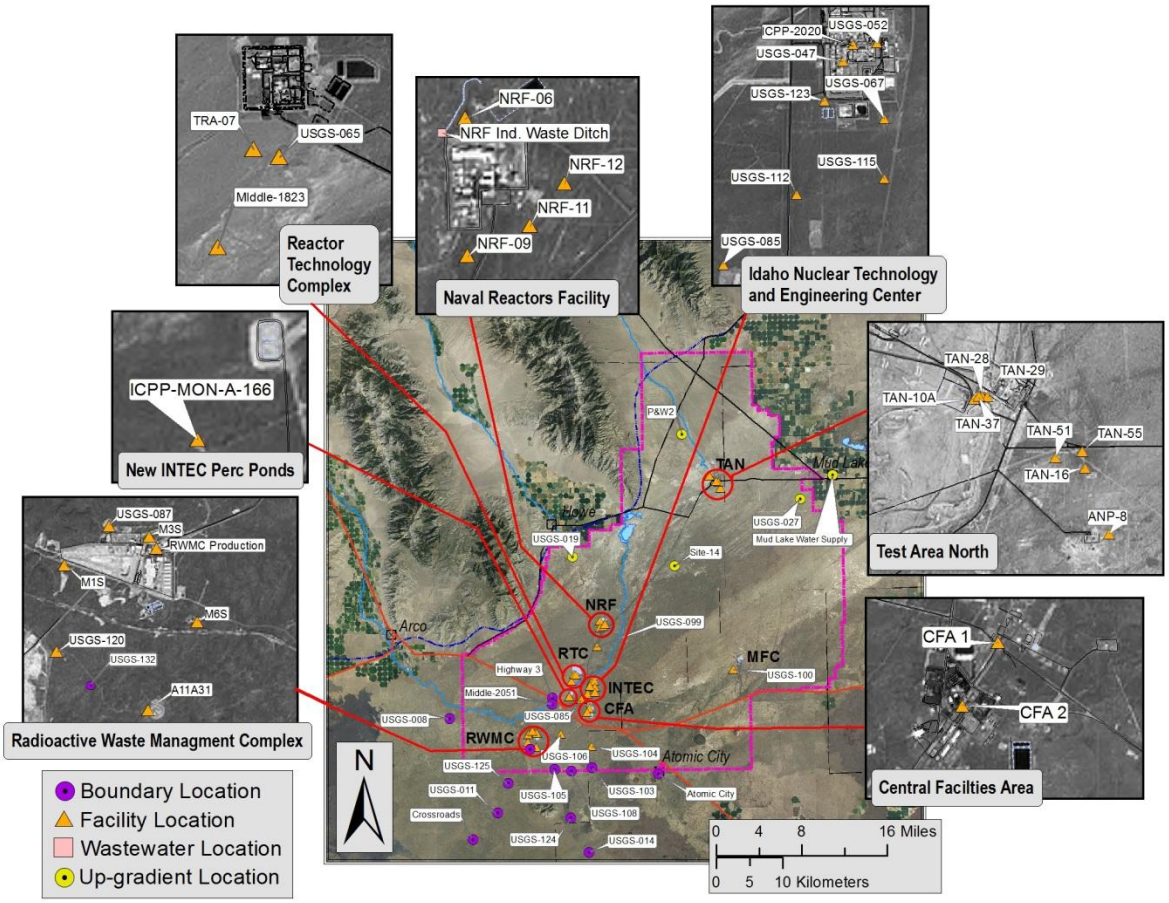

Figure 3. Up-gradient, facility, boundary and wastewater monitoring locations, fourth quarter, 2012.

Table 9. Alpha, beta, and gamma concentrations for water samples, fourth quarter, 2012.

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	11/14/2012	-0.5	U	0.3	3.9		0.7	-1.1	U	1.4
Site-14	10/16/2012	-0.5	U	1.2	3.5		0.9	-0.4	U	1.7
Facility										
A11A31	11/7/2012	-0.4	U	1.0	3.8		0.8	0.6	U	1.7
CFA 2	10/16/2012	-0.7	U	3.8	5.1		2.2	0.4	U	1.3
M1S	11/6/2012	-0.6	U	1.0	3.0		0.8	-0.2	U	1.8
M3S	11/6/2012	-0.3	U	1.2	7.3		1.0	-0.8	U	1.4
M6S	11/7/2012	0.0	U	1.3	5.7		1.0	0.0	U	1.5
Middle-1823	10/9/2012	1.6	U	1.0	2.1		0.9	0.2	U	1.4
RWMC Production	10/11/2012	1.1	U	1.0	6.3		1.0	-0.3	U	1.7
TAN-10A	10/9/2012	9.5		3.7	178.2		5.1	1.4	U	1.6
TRA-07	10/9/2012	3.9	J	1.5	5.7		1.1	-0.3	U	1.7
USGS-104	10/17/2012	-1.6	U	1.2	3.9		0.9	-1.1	U	1.6
USGS-112	10/3/2012	2.8		1.2	23.9		1.4	1.0	U	2.0
USGS-115	10/3/2012	1.2	U	1.0	8.0		1.0	-0.5	U	1.5
USGS-120	10/10/2012	0.5	U	0.4	2.6		0.7	-0.2	U	1.3
Boundary										
Highway 3	10/17/2012	0.3	U	1.3	2.6		0.9	-1.6	U	2.7
USGS-014	10/10/2012	1.4	U	0.9	6.2		1.0	-0.3	U	1.8
USGS-125	10/10/2012	3.1		1.1	3.1		0.9	-0.4	U	1.6
Distant										
Alpheus Spring	11/8/2012	-1.6	U	1.1	5.8		1.0	0.0	U	1.2
Bill Jones Hatchery	11/8/2012	-0.6	U	0.7	5.9		0.8	0.5	U	1.4
Clear Spring	11/8/2012	-1.3	U	1.5	5.0		1.0	0.5	U	2.0
Minidoka Water Supply	11/8/2012	0.3	U	1.5	3.4		1.0	0.8	U	1.5
Shoshone Water Supply	11/8/2012	-0.5	U	1.4	3.9		1.0	-0.3	U	1.8
Surface Water										
Birch Creek	10/11/2012	1.3	U	0.9	1.2	U	0.8	0.0	U	1.7

[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, 2012.

Sample Location	Sample Date	Plutonium-238			Plutonium-239/240			Plutonium-241		
		Concentration[1,2]		± 2SD	Concentration[1,2]		± 2SD	Concentration[1,2]		± 2SD
Facility										
A11A31	11/7/2012	0.004	U	0.017	0.003	U	0.017	NR	-	-
M1S	11/6/2012	-0.006	U	0.017	-0.002	U	0.016	NR	-	-
M3S	11/6/2012	-0.002	U	0.023	0	U	0.023	NR	-	-
M6S	11/7/2012	-0.002	U	0.021	0.009	U	0.021	NR	-	-

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

Table 11. Reported concentrations of uranium isotopes in water samples, fourth quarter, 2012.

Sample Location	Sample Date	Uranium-234			Uranium-235			Uranium-238		
		Concentration[1,2]		± 2SD	Concentration[1,2]		± 2SD	Concentration[1,2]		± 2SD
Facility										
A11A31	11/7/2012	1.48		0.36	0.050	U	0.056	0.54		0.19
M1S	11/6/2012	0.75		0.22	0.073		0.065	0.44		0.16
M3S	11/6/2012	1.53		0.34	-0.001	U	0.039	0.64		0.19
M6S	11/7/2012	1.14		0.28	0.049	U	0.053	0.55		0.17
TRA-07	10/9/2012	2.2		0.48	0.047	U	0.063	1.12		0.29

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

Table 12. Reported concentrations of americium-241 in water samples, fourth quarter, 2012.

Sample Location	Sample Date	Americium-241		
		Concentration[1,2]		± 2SD
Facility				
A11A31	11/7/2012	-0.019	U	0.015
M1S	11/6/2012	-0.003	U	0.020
M3S	11/6/2012	-0.021	U	0.017
M6S	11/7/2012	-0.014	U	0.015

[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, 2012.

Sample Location	Sample Date	Strontium-90		
		Concentration[1,2]		± 2SD
Facility				
A11A31	11/7/2012	-0.03	U	0.26
CFA 2	10/16/2012	0.22	U	0.30
M1S	11/6/2012	0.31	U	0.32
M3S	11/6/2012	-0.05	U	0.23
M6S	11/7/2012	0.22	U	0.29
Middle-1823	10/9/2012	0.45	U	0.37
RWMC Production	10/11/2012	0.38	U	0.33
TAN-10A	10/9/2012	72		17
TRA-07	10/9/2012	0.29	U	0.44
USGS-104	10/17/2012	0.03	U	0.28
USGS-112	10/3/2012	9.2		2.3
USGS-115	10/3/2012	0.37	U	0.31
USGS-120	10/10/2012	0.29	U	0.4

[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, 2012.

Sample Location	Sample Date	Technetium-99		
		Concentration[1,2]		± 2SD
Facility				
A11A31 (dissolved)	11/7/2012	0.8		0.1
CFA 2 (dissolved)	10/16/2012	3.1		0.2
M1S (dissolved)	11/6/2012	0.6		0.1
M3S (dissolved)	11/6/2012	1.2		0.2
M6S (dissolved)	11/7/2012	0.6		0.1
Middle-1823 (dissolved)	10/9/2012	0.5		0.1
RWMC Production (dissolved)	10/11/2012	1.4		0.2
TRA-07 (dissolved)	10/9/2012	2.0		0.2
USGS-104 (dissolved)	10/17/2012	1.3		0.2
USGS-112 (dissolved)	10/3/2012	3.4		0.2
USGS-115 (dissolved)	10/3/2012	7.3		0.3
USGS-120 (dissolved)	10/10/2012	1.0		0.2

[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, 2012.

Sample Location	Sample Date	Tritium		
		Concentration[1,2]		± 2SD
Up-gradient				
Mud Lake Water Supply	11/14/2012	-10	U	100
Site-14	10/16/2012	60	U	100
Facility				
A11A31	11/7/2012	90	U	110
CFA 2	10/16/2012	4000		170
M1S	11/6/2012	-50	U	100
M3S	11/6/2012	760		120
M6S	11/7/2012	-20	U	100
Middle-1823	10/9/2012	890		120
RWMC Production	10/11/2012	790		120
TAN-10A	10/9/2012	410		110
TRA-07	10/9/2012	7960		230
USGS-104	10/17/2012	610		110
USGS-112	10/3/2012	1110		120
USGS-115	10/3/2012	1290		130
USGS-120	10/10/2012	160	U	110
Boundary				
Highway 3	10/17/2012	140	U	100
USGS-014	10/10/2012	-60	U	100
USGS-125	10/10/2012	50	U	100
Distant				
Alpheus Spring	11/8/2012	-30	U	100
Bill Jones Hatchery	11/8/2012	10	U	100
Clear Spring	11/8/2012	-10	U	100
Minidoka Water Supply	11/8/2012	-70	U	100
Shoshone Water Supply	11/8/2012	10	U	100
Surface Water				
Birch Creek	10/11/2012	-30	U	100

[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, 2012.

Sample Location	Sample Date	Enriched Tritium		
		Concentration[1,2]		± 2 SD
Upgradient				
USGS-019	4/17/2012	7	U	5
USGS-027	4/17/2012	3	U	6
Facility				
A11A31	5/9/2012	98		11
ICPP-MON-A-166	4/3/2012	99		9
M1S	5/8/2012	1	U	8
M6S	5/9/2012	0	U	6
USGS-067	3/19/2012	3063		37
Boundary				
USGS-008	4/10/2012	15		6
USGS-011	4/16/2012	17		5
Distant				
Alpheus Spring	5/7/2012	8	J	5
Bill Jones Hatchery	5/7/2012	11	U	7
Surface Water				
BLR @ Dairy Farm	5/3/2012	15		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, 2012.

Sample Location	Sample Date	Concentration[1,2]															
		Arsenic		Barium		Chromium		Iron		Lead		Manganese		Selenium		Zinc	
Up-gradient																	
Site-14 (dissolved)	10/16/2012	<5.0	U	62		5.0		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
Facility																	
A11A31 (total)	11/7/2012	<5.0	U	34		14		54		<5.0	U	<2.0	U	<10	U	220	
CFA 2 (dissolved)	10/16/2012	<5.0	U	110		7.1		52		<5.0	U	9.8		<10	U	<5.0	U
M1S (total)	11/6/2012	<5.0	U	22		34		19		<5.0	U	<2.0	U	<10	U	<5.0	U
M3S (total)	11/6/2012	<5.0	U	44		13		37		<5.0	U	<2.0	U	<10	U	<5.0	U
M6S (total)	11/7/2012	<5.0	U	28		28		3700		<5.0	U	5.7		<10	U	<5.0	U
Middle-1823 (dissolved)	10/9/2012	<5.0	U	67		9.7		10		<5.0	U	3.1		<10	U	<5.0	U
RWMC Production (dissolved)	10/11/2012	<5.0	U	38		12		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
TAN-10A (total)	10/9/2012	<5.0	U	260		<5.0	U	3000		<5.0	U	940		<10	U	49	
TRA-07 (dissolved)	10/9/2012	<5.0	U	64		89		<10	U	<5.0	U	<2.0	U	<10	U	5.5	
USGS-104 (dissolved)	10/17/2012	<5.0	U	32		8.2		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
USGS-112 (dissolved)	10/3/2012	<5.0	U	94		12		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
USGS-115 (dissolved)	10/3/2012	<5.0	U	61		5.9		<10	U	<5.0	U	<2.0	U	<10	U	670	
USGS-120 (dissolved)	10/10/2012	<5.0	U	45		9.8		<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
Boundary																	
Highway 3 (dissolved)	10/17/2012	<5.0	U	54		<5.0	U	<10	U	<5.0	U	<2.0	U	<10	U	180	
USGS-014 (dissolved)	10/10/2012	<5.0	U	23		<5.0	U	<10	U	<5.0	U	<2.0	U	<10	U	<5.0	U
USGS-125 (dissolved)	10/10/2012	<5.0	U	35		<5.0	U	31		<5.0	U	14		<10	U	<5.0	U
Surface water																	
Birch Creek (dissolved)	10/11/2012	<5.0	U	68		<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 "<" indicates a result below the Minimum Detectable Concentration. 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, 2012.

Sample Location	Sample Date	Concentration[1,2]																							
		Calcium		Magnesium		Sodium		Potassium		Fluoride		Chloride		Sulfate		Silica		Alkalinity[3]		TDS[4]		TSS[5]	
Up-gradient																									
Site-14*	10/16/2012	33		13		14		2.9		0.414		10.5		24.6		NR	-	145		NR	-	NR	-
Facility																									
A11A31	11/7/2012	36		16		23		3.8		0.201		25.0		42.1		NR	-	134		NR	-	NR	-
CFA 2*	10/16/2012	83		28		37		4.8		<0.20	U	147		53.2		NR	-	149		NR	-	NR	-
M1S	11/6/2012	26		12		11		2.6		0.25		14.5		21.0		NR	-	98		NR	-	NR	-
M3S	11/6/2012	43		15		8.4		2.6		0.211		16.5		25.8		NR	-	141		NR	-	NR	-
M6S	11/7/2012	36		19		15		3.5		0.224		29.1		60.5		NR	-	101		NR	-	NR	-
Middle-1823*	10/9/2012	53		17		11		1.8		<0.20	U	11.4		36.0		NR	-	170		NR	-	NR	-
RWMC Production*	10/11/2012	48		16		9.2		2.7		0.201		24.2		29.4		NR	-	138		NR	-	NR	-
TAN-10A	10/9/2012	86		24		44		3.8		<0.20	U	109		36.2		NR	-	226		NR	-	NR	-
TRA-07*	10/9/2012	85		20		18		3.1		<0.20	U	20.9		156		NR	-	134		NR	-	NR	-
USGS-104*	10/17/2012	35		14		8.7		2.5		<0.20	U	15.5		21.1		NR	-	130		NR	-	NR	-
USGS-112*	10/3/2012	50		13		15		2.7		0.244		22.6		30.2		NR	-	150		NR	-	NR	-
USGS-115*	10/3/2012	42		12		14		3.6		0.271		37.5		23.3		NR	-	113		NR	-	NR	-
USGS-120*	10/10/2012	37		17		14		3.1		0.244		15.6		31.4		NR	-	144		NR	-	NR	-
Boundary																									
Highway 3*	10/17/2012	45		11		6.0		2.4		<0.20	U	6.71		20.6		NR	-	122		NR	-	NR	-
USGS-014*	10/10/2012	37		15		17		2.8		0.902		22.0		22.5		NR	-	137		NR	-	NR	-
USGS-125*	10/10/2012	38		15		11		2.7		0.240		12.4		24.7		NR	-	140		NR	-	NR	-
Surface Water																									
Birch Creek*	10/11/2012	43		15		5.1		0.97		0.206		4.63		25.1		NR	-	146		NR	-	NR	-

[1] Data qualifiers: U = non-detection, J = estimate, R = rejected. * = samples are filtered for calcium, magnesium, sodium and potassium. A "<" indicates a result below the Minimum Detectable Concentration. NR= analysis not requested.

[2] Concentrations expressed in mg/L. Samples are filtered unless otherwise noted.

[3] As $CaCO_3$

[4] Total Dissolved Solids

[5] Total Suspended Solids

Table 19. Reported nutrient concentrations in water samples, fourth quarter, 2012.

Sample Location	Sample Date	Concentration [1,2]									
		Nitrite + Nitrate		Phosphorus		Nitrite		Total Kjeldahl Nitrogen		Ammonia	
Up-gradient											
Site-14	10/16/2012	0.62		0.020		NR	-	NR	-	NR	-
Facility											
A11A31	11/7/2012	0.92		0.022		NR	-	NR	-	<0.010	U
CFA 2	10/16/2012	3.9		0.021		NR	-	NR	-	NR	-
M1S	11/6/2012	1.0		0.025		NR	-	NR	-	<0.010	U
M3S	11/6/2012	0.86		0.025		NR	-	NR	-	<0.010	U
M6S	11/7/2012	1.5		0.038		NR	-	NR	-	<0.010	U
Middle-1823	10/9/2012	1.0		0.029		NR	-	NR	-	NR	-
RWMC Production	10/11/2012	1.0		0.18		NR	-	NR	-	NR	-
TAN-10A	10/9/2012	<0.01	U	0.076		NR	-	NR	-	0.018	
TRA-07	10/9/2012	1.2		0.025		NR	-	NR	-	NR	-
USGS-104	10/17/2012	0.86		0.024		NR	-	NR	-	NR	-
USGS-112	10/3/2012	1.4		0.032		NR	-	NR	-	NR	-
USGS-115	10/3/2012	1.4		0.012		NR	-	NR	-	NR	-
USGS-120	10/10/2012	0.88		0.022		NR	-	NR	-	NR	-
Boundary											
Highway 3	10/17/2012	0.45		0.027		NR	-	NR	-	NR	-
USGS-014	10/10/2012	1.3		0.017		NR	-	NR	-	NR	-
USGS-125	10/10/2012	0.63		0.017		NR	-	NR	-	NR	-
Surface Water											
Birch Creek	10/11/2012	0.26		<0.0050	U	NR	-	NR	-	NR	-

[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, 2012.

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	11/7/2012	<0.5 UJ	2.5 J	<0.5 UJ	<0.5 UJ	<0.5 UJ	0.93 J	<0.5 UJ
M3S	11/6/2012	<0.5 UJ	3.8 J	<0.5 UJ	<0.5 UJ	<0.5 UJ	1.1 J	<0.5 UJ
M6S	11/7/2012	<0.5 UJ	2.6 J	<0.5 UJ	<0.5 UJ	<0.5 UJ	0.76 J	<0.5 UJ
RWMC Production	10/11/2012	<0.5 U	3.7	<0.5 U	<0.5 U	<0.5 U	2.5	<0.5 U

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

[2] Concentrations expressed in µg/L

Terrestrial Monitoring Results

The ESP conducts terrestrial (soil and milk) monitoring and verification to provide an indication as to the long-term deposition and migration of contaminants in the environment, and to provide independent verification of DOE's analytical measurement of terrestrial variables.

Milk

DEQ-INL OP monitors milk for naturally occurring potassium-40 and man-made iodine-131. DEQ-INL OP collects milk samples on a monthly basis. Riverside is a small operation that needed to suspend sampling and Nelson Ricks Creamery went out of business during the quarter. Results for analyses of milk samples are presented in **Table 21**. Naturally occurring potassium-40 was detected in all samples within the expected range. Iodine-131 was not detected.

Table 21. Gamma spectroscopy analysis data for milk samples, fourth quarter, 2012.

Sample Location/Dairy	Sample Date	Naturally occurring gamma-emitting radionuclide Potassium-40		Man-made gamma-emitting radionuclide Iodine-131[1]	
		Concentration[3]	± 2 SD	Concentration[3]	± 2 SD
Monitoring Samples					
Howe/Nelson-Ricks Creamery	10/2/2012	1423	115	<MDC	
Mud Lake/Nelson-Ricks Creamery	10/1/2012	1343	109	<MDC	
Gooding/Glanbia	10/6/2012	1564	120	<MDC	
	11/3/2012	1482	118	<MDC	
	12/4/2012	1403	112	<MDC	
Riverside	10/8/2012	2138	133	<MDC	
Verification Samples[2]					
Dietrich	10/2/2012	1338	108	<MDC	
Howe	10/2/2012	1459	115	<MDC	
Idaho Falls	11/6/2012	1592	110	<MDC	
Rupert	11/6/2012	1582	124	<MDC	
Terreton	12/4/2012	1426	117	<MDC	
Dietrich	12/4/2012	1584	109	<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 37 locations (**Figure 4**) during the fourth calendar quarter 2012. The *in-situ* measurements were performed onsite and at boundary and distant

monitoring locations. No man-made radionuclides other than ^{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 (^{137}Cs) for soil monitoring conducted during the fourth quarter, 2012.

Location	Date Acquired	Concentration[1]	2-sigma	MDA
Boundary Sampling Locations				
Large Grid 18-4	12/11/2012	0.192	0.025	0.008
Large Grid 12-5	12/11/2012	0.181	0.035	0.009
Large Grid 12-4	12/11/2012	0.208	0.032	0.009
Big Southern HPIC	12/11/2012	0.240	0.034	0.008
Frenchman's Cabin	12/11/2012	0.154	0.026	0.009
Reno Ranch	12/12/2012	0.256	0.026	0.007
Butte City	12/14/2012	0.195	0.029	0.010
Howe Met Tower	12/17/2012	0.089	0.022	0.008
Atomic City	12/17/2012	0.139	0.033	0.010
Mud Lake/Terreton Air Station	12/18/2012	0.029	0.021	0.010
Monteview Air Station	12/18/2012	0.064	0.024	0.008
Mud Lake Soil Site #2	12/18/2012	0.088	0.051	0.013
Monteview Soil Site	12/18/2012	0.175	0.035	0.007
Distant Sampling Locations				
Idaho Falls[2]	12/4/2012	0.059	0.023	0.008
Idaho Falls CMS[3]	12/4/2012	0.033	0.020	0.007
St. Anthony	12/4/2012	0.180	0.032	0.011
Sage Junction	12/12/2012	0.226	0.028	0.009
Carey	12/14/2012	0.051	0.025	0.009
Roberts	12/18/2012	0.153	0.026	0.009
Crystal Ice Caves	12/18/2012	0.172	0.026	0.008
On site Sampling Locations				
Large Grid 18-3	12/10/2012	0.167	0.032	0.010
Large Grid 18-8	12/10/2012	0.179	0.025	0.008
Large Grid 24-2	12/10/2012	0.197	0.027	0.009
Large Grid 24-7	12/10/2012	0.117	0.029	0.011
Rover	12/10/2012	0.176	0.026	0.009
Large Grid 18-1	12/12/2012	0.154	0.026	0.009
Large Grid 18-7	12/12/2012	0.176	0.029	0.008
Large Grid 30-1	12/12/2012	0.212	0.027	0.008
Large Grid 24-9	12/12/2012	0.204	0.029	0.009
Large Grid 24-8	12/12/2012	0.253	0.028	0.009
Van Buren	12/14/2012	0.273	0.034	0.010
Big Lost Rest Area	12/14/2012	0.074	0.024	0.008
Base of Howe	12/14/2012	0.143	0.025	0.009
Sand Dunes	12/17/2012	0.145	0.027	0.007
Experimental Field Station	12/17/2012	0.085	0.024	0.009
Large Grid 6-3	12/17/2012	0.144	0.027	0.009
INL Main Gate	12/17/2012	0.125	0.029	0.008

[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 0.154 picocuries per gram (pCi/g) with a minimum value of 0.029 pCi/g and a maximum of 0.273 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. 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.

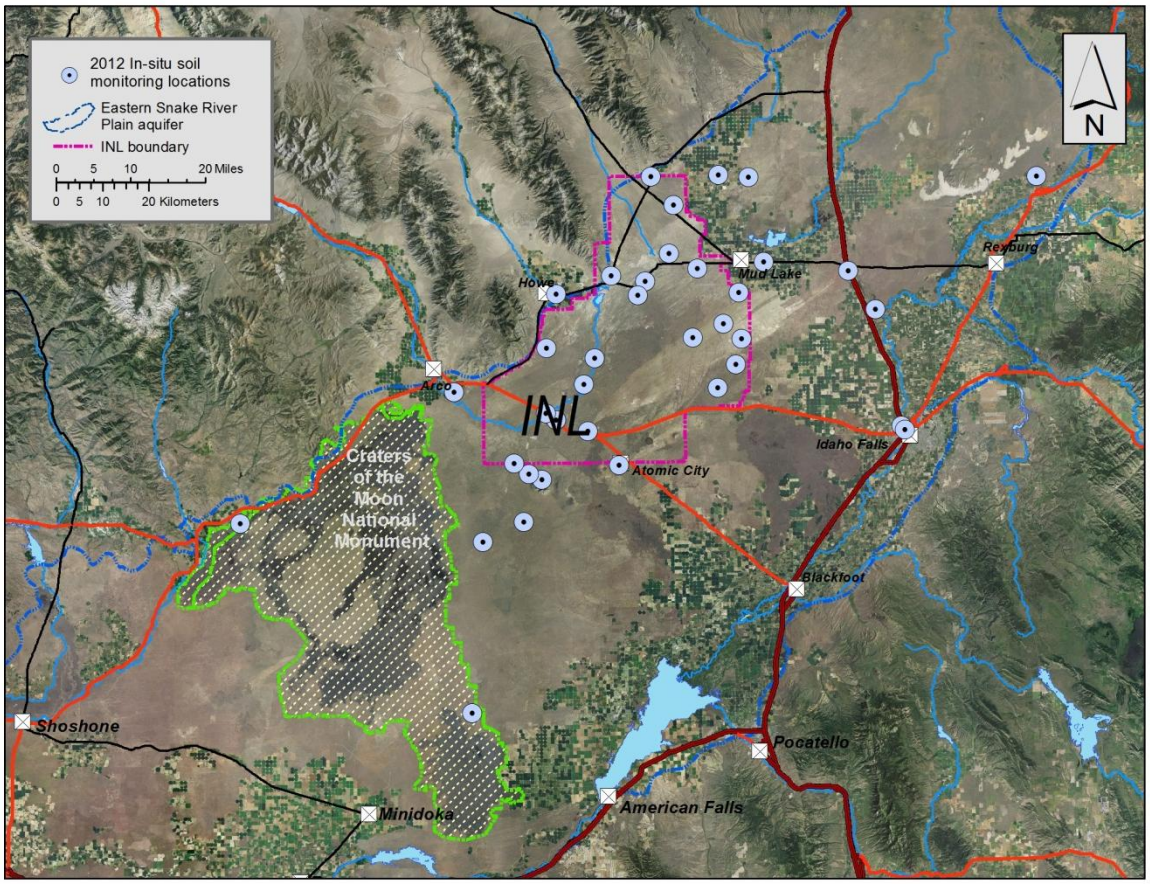

Figure 4. Soil monitoring sites, fourth quarter, 2012.

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 to ensure precise, accurate, representative, and reliable results, and to maximize data usability.

This section summarizes the results of the quality assurance (QA) assessment of the data collected for the fourth quarter of 2012 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 2012, the DEQ-INL OP submitted 104 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 analyses will provide a "zero" result when no contaminant is expected to be present or an acceptable measure of "background," and therefore monitor any bias that may have been 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 2012 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 observed from the assessment of field blank water samples as measured by the analytical laboratories used by DEQ-INL OP for the fourth quarter of 2012. The first includes a detection of Gross Alpha at 0.7 pCi/L. There were five samples analyzed on the same day as the blank sample (11/28/12) with one showing a detection of Gross Alpha. This sample will be flagged with a "J" and qualified as an estimate. The other anomaly is displayed in **Table 29**, which shows a Total Alkalinity result (1 mg/L) above the MDC. With sample results during this quarter for alkalinity ranging from 98 to 226 mg/L **(Table 18)** which is significantly above the blank value of 1 mg/L, no qualifiers or flags will be attached with alkalinity results analyzed on the same day as this blank sample.

Duplicate Samples

Duplicate samples are collected in a manner such that the samples are thought to be essentially identical in composition and are used to assess analytical precision. The difference between the original sample and the duplicate sample is expressed as a relative percent difference (RPD):

$RPD = (R_1-R_2)/((R_1+R_2)/2)*100$
R_1 = first sample result
R_2 = second sample result

and is used to measure a laboratory's ability to reproduce consistent results. A relative percent difference is acceptable at ± 20 percent.

DEQ-INL OP also uses standard radiological counting error (expressed as one standard deviation) to compare results for radiological analyses. Paired measurements that have an absolute difference between the two sample results of no more than three times the pooled error for these measurements are considered to be in 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 value.

R_2 = Second sample value.

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.

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

One gross-alpha analysis failed the duplicate criteria, however, the result was a non-detection and will not be qualified as an estimate; all other gross-alpha samples that were analyzed the same day were non-detections as well and will not be qualified as estimates.

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 2012, spiked samples were used to assess the influence of the sample media on laboratory performance. These non-radiological constituents were used to assess ground water analyte recovery rates and the results are presented in **Table 35**, **Table 36**, **Table 37**, and **Table 38**. The percent recoveries for all spiked samples were found within the acceptable range of 100 ± 25 percent.

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 (EIC) to verify EIC response. Irradiations of EICs are conducted in a repeatable geometry to a known exposure of 30 mR and two additional 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 percent of the known irradiated quantity. The irradiation results for fourth quarter 2012 are presented in **Table 39**. Real-time pressure correction is used to calculate the net exposure measured by these EIC control sets.

There were no anomalies observed from the assessment of spiked samples as measured by DEQ-INL OP or the analytical laboratories used by DEQ-INL OP for the fourth quarter of 2012.

Laboratory QC Issues

There was a failure of laboratory QC sample results to meet acceptance criteria that resulted in one enriched tritium sample to be identified as an estimate (**Table 16**). The lab split sample analysis and one of the two lab blank analyses associated with that particular batch of enriched tritium analyses failed. The entire batch, including field and QA samples, was recounted. Both blank analyses passed on the recount but the split sample analysis failed again resulting in the both the original and recounts of the field samples in the batch identified as estimates (J). Another problem faced this quarter included analyses for both plutonium isotopes and americium-241. Some of the samples were lost in shipment from ISU-EML to the vendor and replaced with the remaining fractions of the corresponding samples for

alpha/beta/gamma analyses. No samples were flagged and results are considered usable. The last problem encountered this quarter involved three of the four VOC samples exceeding their holding times due to instrument repair at the IBL laboratory. This resulted in all of the results for the affected samples identified as estimates (J), **Table 20**. It is important to note that there was a field blank and a spike sample included in this batch that passed criteria; results are displayed in **Table 30** and **38**.

Analytical QA/QC Assessment

Aside from the field blank, duplicate and laboratory QC issues discussed above, no other QC issues were observed during the fourth quarter of 2012, 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 2012.

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 2012 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 2012 the radioiodine pumps at Big Lost River Rest Area and Atomic City sampling sites were replaced. A TSP blower was also replaced during the fourth quarter at the Experimental Field Station sampling site. Service reliability for air sampling equipment for the fourth quarter of 2012 is summarized in **Table 40**.

During the fourth quarter the internal heat sensor of the TSP sampler at the Mud Lake sampling station caused the sampler to operate intermittently resulting in lower sample volumes and higher gross alpha/beta results. For this reason two gross alpha and two gross beta results were rejected from the Mud Lake site during the fourth quarter.

Conclusion

All data collected for the fourth quarter of 2012, 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, 2012.

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	142	13	0	0	4	ISU-EML
		Gross beta	142	13	0	0	4	ISU-EML
		Gamma emitters	11	1	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	26	2	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	3	3	0	0	ISU-EML
		Gross beta	24	3	3	0	0	ISU-EML
		Gamma emitters	24	3	3	0	0	ISU-EML
		Tritium	24	3	3	0	0	ISU-EML
		Enriched tritium	12	0	3	0	0	ISU-EML
		Technetium-99	12	0	1	0	0	ISU-EML
		Radiochemical	40	0	7	0	0	ISU Sub
		Metals	18	2	3	2	0	IBL
		Common Ions	18	2	3	2	0	IBL
		Nutrients	18	2	3	2	0	IBL
		Volatile Organics	4	1	0	1	0	IBL
TERRESTRIAL								
Milk	Grab or composite	Gamma emitters	12	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	37	0	8	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	NA	DEQ-INL OP
Total Analyses			**680**	**48**	**40**	**16**	**8**	
Total of QC Analyses (blanks, duplicates, and spikes)			**104**					
Percentage of QC analyses of Total Test analyses[3]			**15.3%**					
Percentage of usable data[4]			**98.8%**					

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 24. Blank analysis results for gross alpha and beta in particulate air (TSP), fourth quarter, 2012.

Collection Period		Corrected volume (m^3) [1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
09/27/2012	10/04/2012	2023	0.1	0.1	-0.5	0.4
10/04/2012	10/11/2012	2023	0.0	0.1	0.0	0.4
10/11/2012	10/18/2012	2023	0.1	0.2	0.1	0.5
10/18/2012	10/25/2012	2023	0.1	0.1	-0.2	0.4
10/25/2012	11/01/2012	2023	0.0	0.1	0.0	0.4
11/01/2012	11/08/2012	2023	-0.1	0.1	0.0	0.4
11/08/2012	11/15/2012	2023	0.1	0.1	-0.1	0.4
11/15/2012	11/21/2012	2023	0.1	0.1	0.3	0.4
11/21/2012	11/29/2012	2023	-0.1	0.1	0.1	0.5
11/29/2012	12/06/2012	2023	0.0	0.1	0.0	0.4
12/06/2012	12/13/2012	2023	0.0	0.1	0.0	0.4
12/13/2012	12/20/2012	2023	-0.1	0.1	-0.1	0.4
12/20/2012	12/27/2012	2023	-0.2	0.1	-0.2	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, 2012.

Analysis Date	Beryllium-7			Ruthenium-106/ Rhodium-106			Antimony-125		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
01/07/2013	-3	24	42	-7	29	50	-5	7	12

Analysis Date	Cesium-134			Cesium-137		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC
01/07/2013	1	2	4	-1	3	5

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 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, 2012.

Sample Number	Start Date	Collect Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP124ZTR01	12/19/2012	12/26/2012	01/18/2013	0.08	0.10	0.17
OP124ZTR02	01/14/2013	01/16/2013	01/18/2013	-0.03	0.10	0.17

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

Table 27. Radiological blank analysis in ground and surface water for samples for the fourth quarter, 2012.

Sample Number	Sample Date	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha					
121W617	10/3/2012	0.7	0.3	0.4	No
121W630	11/7/2012	0.1	0.4	0.7	Yes
121W622	11/8/2012	-0.8	0.3	0.7	Yes
Gross Beta					
121W617	10/3/2012	0.1	0.6	1.0	Yes
121W630	11/7/2012	0.3	0.6	0.9	Yes
121W622	11/8/2012	-0.1	0.6	1.0	Yes
Cesium-137					
121W617	10/3/2012	-0.5	1.3	2.4	Yes
121W630	11/7/2012	-0.5	1.7	2.9	Yes
121W622	11/8/2012	0.0	1.3	2.4	Yes
Tritium					
121W618	10/3/2012	-20	100	170	Yes
121W631	11/7/2012	-10	100	170	Yes
121W623	11/8/2012	-10	100	170	Yes

Note: 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 for the fourth quarter, 2012.

Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
121W620	10/3/2012	<5	<2	<5	<10	<5	<2	<10	<5
121W633	11/7/2012	<5	<2	<5	<10	<5	<2	<10	<5

Table 29. Blank analysis results (mg/L) for common ions and nutrients in ground and surface water for the fourth quarter, 2012.

Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus	Ammonia as N
121W621,620,619	10/3/2012	<0.1	<0.1	<0.1	<0.1	<0.2	<0.4	<0.8	<1	<0.01	<0.005	<0.01
121W634,633,632	11/7/2012	<0.1	<0.1	<0.1	<0.1	<0.2	<0.4	<0.8	1	<0.01	<0.005	<0.01

Table 30. Blank analysis results (µg/L) for VOCs in ground and surface water for the fourth quarter, 2012.

Sample Location	Sample Date	1,1-Dichloroethene	Carbon tetrachloride	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Tetrachloroethylene (PERC)	Trichloroethylene	Vinyl chloride
121W817	11/7/2012	<0.5 UJ	<0.5 UJ	<0.5 UJ	<0.5 UJ	<0.5 UJ	<0.5 UJ	<0.5 UJ

Table 31. Duplicate radiological analysis results in pCi/L for ground and surface water, fourth quarter, 2012.

Analysis/ Sample Location	Original Sample Number	Concentration	±2 SD	Duplicate Sample Number	Concentration	±2 SD	$/R_1-R_2/$	$3(s_1^2+s_2^2)^{1/2}$	Within Criteria?[1]
Gross Alpha									
Site-14	121W667	-0.5	1.2	121W724	2.5	1.1	3.0	2.4	**no**
M1S	121W754	-0.6	1.0	121W765	-0.3	1.0	0.3	2.1	yes
USGS-125	121W719	3.1	1.1	121W737	3.4	1.1	0.3	2.3	yes
Gross Beta									
Site-14	121W667	3.5	0.9	121W724	3.1	0.9	0.4	1.9	yes
M1S	121W754	3.0	0.8	121W765	3.9	0.8	0.9	1.7	yes
USGS-125	121W719	3.1	0.9	121W737	4.2	0.9	1.1	1.9	yes
Gamma Spectroscopy Cesium-137									
Site-14	121W667	-0.4	1.7	121W724	1.0	1.6	1.4	3.5	yes
M1S	121W754	-0.2	1.8	121W765	0.6	1.6	0.8	3.6	yes
USGS-125	121W719	-0.4	1.6	121W737	0.6	2.5	1.0	4.5	yes
Tritium									
Site-14	121W668	60	100	121W725	-20	100	80	212	yes
M1S	121W755	-50	100	121W766	-10	100	40	212	yes
USGS-125	121W720	50	100	121W738	10	100	40	212	yes
Enriched Tritium									
USGS-067	112W175	3063	37	112W185	3167	38	104	80	**yes***
Alpheus Spring	121W377	15	5	121W379	26	8	11	14	yes
A11A31	121W324	98	11	121W335	111	10	13	22	yes
Strontium-90									
M1S	121W757	0.31	0.32	121W768	0.19	0.29	0.12	0.65	yes
Technetium-99									
M1S (dissolved)	121W758	0.6	0.1	121W769	0.5	0.1	0.1	0.21	yes
Plutonium-238									
M1S	121W756	-0.006	0.017	121W767	-0.002	0.022	0.00	0.04	yes
Plutonium-239/240									
M1S	121W756	-0.002	0.016	121W767	0.004	0.022	0.01	0.04	yes
Uranium-234									
M1S	121W760	0.75	0.22	121W771	0.73	0.21	0.02	0.46	yes
Uranium-235									
M1S	121W760	0.073	0.065	121W771	0.023	0.042	0.05	0.12	yes
Uranium-238									
M1S	121W760	0.44	0.16	121W771	0.38	0.14	0.06	0.32	yes
Americium-241									
M1S	121W755	-0.003	0.02	121W766	-0.003	0.02	0.00	0.04	yes

[1] $/R_1-R_2/ \leq 3(s_1^2+s_2^2)^{1\backslash 2}$

[*] Compared using RPD criteria.

Table 32. Duplicate results for metals (µg/L) in ground water and/or surface water for the fourth quarter, 2012.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
Site-14 (dissolved)	121W670	10/16/2012	<5	62	5.0	<10	<5	<2	<10	<5
Site-14 (dissolved)	121W727	10/16/2012	<5	64	5.2	<10	<5	<2	<10	<5
RPD			**0**	**-3**	**-4**	**0**	**0**	**0**	**0**	**0**
M1S (total)	121W762	11/6/2012	<5	22	34	19	<5	<2	<10	<5
M1S (total)	121W773	11/6/2012	<5	22	33	21	<5	<2	<10	<5
RPD			**0**	**0**	**0**	**-10**	**0**	**0**	**0**	**0**
USGS-125 (dissolved)	121W722	10/10/2012	<5	35	<5	31	<5	14	<10	<5
USGS-125 (dissolved)	121W740	10/10/2012	<5	35	<5	35	<5	14	<10	<5
RPD			**0**	**0**	**0**	**-12**	**0**	**0**	**0**	**0**

Relative Percent Difference (RPD) = (R1-R2) / ((R1+ R2)/2)*100.

Table 33. Duplicate results for common ions and nutrients (mg/L) in ground water and/or surface water for fourth quarter, 2012.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus
Site-14*	121W671,670,669	10/16/2012	33	13	14	2.9	0.414	10.5	24.6	145	0.62	0.02
Site-14*	121W728,727,726	10/16/2012	33	13	14	2.9	0.409	10.6	24.6	131	0.62	0.021
RPD			**0**	**0**	**0**	**0**	**1.2**	**-0.9**	**0**	**10.1**	**0**	**-4.9**
M1S	121W763,762,761	11/6/2012	26	12	11	2.6	0.250	14.5	21.0	98	1.0	0.025
M1S	121W774,773,772	11/6/2012	26	12	11	2.6	0.255	14.6	21.1	98	1.0	0.028
RPD			**0**	**0**	**0**	**0**	**-2.0**	**-0.7**	**-0.5**	**0**	**0**	**-11**
USGS-125*	121W723,722,721	10/10/2012	38	15	11	2.7	0.240	12.4	24.7	140	0.63	0.017
USGS-125*	121W741,740,739	10/10/2012	38	15	11	2.7	0.244	12.5	24.3	141	0.63	0.017
RPD			**0**	**0**	**0**	**0**	**-1.7**	**-0.8**	**1.6**	**-0.7**	**0**	**0**

Relative Percent Difference (RPD) = (R1-R2) / ((R1+ R2)/2)*100

Table 34. Duplicate *in-situ* analyses of gamma emitting radionuclides in soil, fourth quarter, 2012.

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 criteria?	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 criteria?
St. Anthony	12/4/12	21.2 ± 0.9	21.4 ± 0.9	1.0	In Spec	Yes	0.180 ± 0.032	0.186 ± 0.033	3.5	In Spec	Yes
Large Grid 12-5	12/11/12	10.8 ± 0.6	10.2 ± 0.6	5.1	In Spec	Yes	0.181 ± 0.035	0.219 ± 0.027	19.1	In Spec	Yes
Frenchman's Cabin	12/11/12	13.6 ± 0.7	13.8 ± 0.7	2.0	In Spec	Yes	0.154 ± 0.026	0.131 ± 0.029	16.1	In Spec	Yes
Large Grid 24-9	12/12/12	17.5 ± 0.8	17.2 ± 0.8	1.8	In Spec	Yes	0.204 ± 0.029	0.193 ± 0.026	5.4	In Spec	Yes
Large Grid 18-7	12/12/12	14.1 ± 0.7	14.3 ± 0.7	1.8	In Spec	Yes	0.176 ± 0.029	0.206 ± 0.028	15.4	In Spec	Yes
Butte City	12/14/12	16.6 ± 0.8	16.8 ± 0.8	1.6	In Spec	Yes	0.195 ± 0.029	0.224 ± 0.041	13.7	In Spec	Yes
EFS Air Station	12/17/12	15.4 ± 0.8	14.4 ± 0.7	6.6	In Spec	Yes	0.085 ± 0.024	0.102 ± 0.028	18.6	In Spec	Yes
Mud Lake Soil Site #2	12/18/12	20.5 ± 0.9	19.6 ± 0.8	4.5	In Spec	Yes	0.088 ± 0.051	0.099 ± 0.027	11.8	In Spec	Yes

[1]Result ± 2 SD

Table 35. De-ionized water spike results (in µg/L) for metals in ground and surface water for the fourth quarter, 2012

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
121W628	10/15/2012	126	130	**103.2**	18.0	18.0	**100.0**	5.50	5.6	**101.8**	5.54	5.8	**104.7**	98.6	95	**96.3**
121W814	11/7/2012	58.4	61	**104.5**	8.35	8.5	**101.8**	5.68	5.8	**102.1**	5.73	5.9	**103.0**	45.8	45	**98.3**

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

Table 36. De-ionized water spike results (in mg/L) for common ions and nutrients in ground and surface water for the fourth quarter, 2012.

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
121W628,627	10/15/2012	22.7	23	**101.3**	8.99	8.5	**94.5**	20.2	20	**99.0**	1.21	1.2	**99.2**	1.3	1.16	**89.2**
121W814,813	11/7/2012	10.5	10	**95.2**	4.18	4.0	**95.7**	9.4	9.5	**101.1**	1.26	1.2	**95.2**	2.0	1.76	**88.0**

[1]A percent recovery (%R) of 100 ± 25 is considered acceptable.

Table 36. continued. De-ionized water spike results (in mg/L) for common ions and nutrients in ground and surface water for the fourth quarter, 2012.

Spike Sample Number	Sample Date	Chloride			Sulfate			Total Alkalinity as CaCO3			Total Nitrogen			Total Phosphorus		
		spike	result	%R[1]	spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R
121W628,627	10/15/2012	85.3	87.0	**102.0**	30.3	29.2	**96.4**	71.5	71	**99.3**	2.0	2.0	**100.0**	0.0291	0.029	**99.7**
121W814,813	11/7/2012	75.2	76.6	**101.9**	39.1	37.5	**95.9**	69.4	69	**99.4**	1.83	1.8	**98.4**	0.0243	0.023	**94.7**

[1]A percent recovery (%R) of 100 ± 25 is considered acceptable.

Table 37. De-ionized water spike results (in µg/L) for VOCs in ground and surface water for the fourth quarter, 2012.

Spike Sample Number	Sample Date	Styrene			Tetrachloroethylene			Trichloroethylene			Carbon tetrachloride			Vinyl Chloride		
		spike	result	%R[1]	spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R
121W816	11/7/2012	9.34	8.1	**86.7**	8.44	6.4	**75.8**	8.72	8.2	**94.0**	12.5	14	**112.0**	10.8	13	**120.4**

[1]A percent recovery (%R) of 100 ± 25 is considered acceptable.

Table 38. Electret ionization chamber irradiation results (categorized as spiked samples) for fourth quarter, 2012.

Electret #	Exposure Received		Net Measured Exposure[1]		%R
	(mR)	Uncertainty (mR)	(mR)	Uncertainty (mR)	
Spike 1	48.0	2.4	44.9	1.3	93.6%
Spike 1	48.0	2.4	48.2	1.3	100.4%
Spike 1	48.0	2.4	47.4	1.2	98.7%
Spike 2	30.0	1.5	28.5	1.3	94.8%
Spike 2	30.0	1.5	30.1	1.3	100.1%
Spike 2	30.0	1.5	28.8	1.3	96.0%
Spike 3	17.0	0.9	16.3	1.2	95.5%
Spike 3	17.0	0.9	17.9	1.3	105.3%
Spike 3	17.0	0.9	17.4	1.3	102.2%

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, 2012.

Station Locations	Sample Type			
	TSP	Radioiodine	Atmospheric Moisture	Precipitation
Onsite Locations				
Big Lost River Rest Area	100 %	92 %	100 %	100 %
Experimental Field Station	92 %	100 %	100 %	NC[1]
Sand Dunes Tower	100 %	100 %	100 %	NC[1]
Van Buren Avenue	100 %	100 %	100 %	NC[1]
Boundary Locations				
Atomic City	100 %	92 %	100 %	100 %
Howe	100 %	100 %	100 %	100 %
Monteview	100 %	100 %	100 %	100 %
Mud Lake	85 %	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, 2012.

Sample location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
On-site Locations						
Rest Area	09/27/12	10/04/12	2.2	0.5	54.3	2.3
	10/04/12	10/11/12	NS[1]	NS[1]	NS[1]	NS[1]
	10/11/12	10/18/12	1.3	0.3	36.1	1.3
	10/18/12	10/25/12	0.8	0.2	27.0	1.1
	10/25/12	11/01/12	1.1	0.2	36.2	1.3
	11/01/12	11/08/12	0.8	0.2	40.6	1.4
	11/08/12	11/15/12	1.2	0.3	42.2	1.7
	11/15/12	11/21/12	0.8	0.2	38.0	1.4
	11/21/12	11/29/12	0.9	0.2	36.3	1.2
	11/29/12	12/06/12	0.6	0.2	20.8	1.0
	12/06/12	12/13/12	0.8	0.2	20.2	1.0
	12/13/12	12/20/12	0.4	0.2	26.0	1.1
	12/20/12	12/27/12	0.5	0.2	24.9	1.1
Experimental Field Station	09/27/12	10/04/12	1.3	0.3	36.1	1.3
	10/04/12	10/11/12	1.3	0.3	32.7	1.3
	10/11/12	10/18/12	1.1	0.3	26.4	1.2
	10/18/12	10/25/12	0.6	0.2	19.9	1.0
	10/25/12	11/01/12	1.3	0.3	27.1	1.2
	11/01/12	11/08/12	0.9	0.2	32.2	1.3
	11/08/12	11/15/12	0.7	0.2	30.2	1.2
	11/15/12	11/21/12	0.5	0.2	28.1	1.3
	11/21/12	11/29/12	0.7	0.2	27.4	1.1
	11/29/12	12/06/12	0.3	0.2	15.2	0.9
	12/06/12	12/13/12	0.5	0.2	13.6	0.9
	12/13/12	12/20/12	8.5	0.9	41.6	2.1
	12/20/12	12/27/12	0.2	0.4	14.3	1.6

[1]NS – No Sample due to no power at the station during this week.

Table A-1 continued. Weekly concentrations (in 1 x 10^{-3} pCi/m^3) for gross alpha and gross beta analyses for TSP filters for all locations, fourth quarter, 2012.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
Sand Dunes	09/27/12	10/04/12	R[1]	R[1]	R[1]	R[1]
	10/04/12	10/11/12	1.1	0.2	31.4	1.2
	10/11/12	10/18/12	0.6	0.2	22.8	1.0
	10/18/12	10/25/12	0.6	0.2	18.3	0.9
	10/25/12	11/01/12	0.7	0.2	25.7	1.1
	11/01/12	11/08/12	0.6	0.2	28.0	1.1
	11/08/12	11/15/12	0.6	0.2	25.1	1.0
	11/15/12	11/21/12	0.9	0.2	28.7	1.2
	11/21/12	11/29/12	0.4	0.2	25.8	1.0
	11/29/12	12/06/12	0.3	0.2	14.8	0.8
	12/06/12	12/13/12	0.5	0.2	13.9	0.8
	12/13/12	12/20/12	0.2	0.1	18.1	0.9
	12/20/12	12/27/12	0.3	0.2	18.9	0.9
Van Buren	09/27/12	10/04/12	1.3	0.2	37.8	1.3
	10/04/12	10/11/12	1.2	0.3	36.7	1.3
	10/11/12	10/18/12	0.9	0.2	25.6	1.1
	10/18/12	10/25/12	0.6	0.2	20.1	1.0
	10/25/12	11/01/12	0.6	0.2	23.3	1.1
	11/01/12	11/08/12	0.9	0.2	30.7	1.2
	11/08/12	11/15/12	0.7	0.2	28.7	1.1
	11/15/12	11/21/12	0.6	0.2	28.4	1.2
	11/21/12	11/29/12	0.5	0.2	26.4	1.0
	11/29/12	12/06/12	0.4	0.2	13.7	0.9
	12/06/12	12/13/12	0.3	0.2	12.4	0.8
	12/13/12	12/20/12	0.3	0.2	18.4	1.0
	12/20/12	12/27/12	0.3	0.2	17.5	0.9
Boundary Locations						
Atomic City	09/27/12	10/04/12	1.5	0.3	35.3	1.3
	10/04/12	10/11/12	1.4	0.3	39.6	1.3
	10/11/12	10/18/12	1.1	0.2	25.2	1.1
	10/18/12	10/25/12	0.7	0.2	21.2	1.0
	10/25/12	11/01/12	0.6	0.2	24.2	1.1
	11/01/12	11/08/12	0.9	0.2	33.0	1.2
	11/08/12	11/15/12	0.8	0.2	31.2	1.2
	11/15/12	11/21/12	0.6	0.2	30.3	1.3
	11/21/12	11/29/12	0.5	0.2	25.7	1.0
	11/29/12	12/06/12	0.5	0.2	17.1	1.1
	12/06/12	12/13/12	0.5	0.2	13.4	0.8
	12/13/12	12/20/12	0.5	0.2	21.5	1.0
	12/20/12	12/27/12	0.8	0.2	20.4	1.0

[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, 2012.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
Howe	09/27/12	10/04/12	1.3	0.3	28.4	1.2
	10/04/12	10/11/12	1.4	0.3	32.9	1.3
	10/11/12	10/18/12	1.1	0.3	21.3	1.1
	10/18/12	10/25/12	0.6	0.2	17.9	1.0
	10/25/12	11/01/12	0.7	0.2	23.0	1.1
	11/01/12	11/08/12	0.6	0.2	26.6	1.2
	11/08/12	11/15/12	0.7	0.2	26.4	1.1
	11/15/12	11/21/12	0.7	0.2	27.4	1.3
	11/21/12	11/29/12	0.6	0.2	21.6	1.0
	11/29/12	12/06/12	0.3	0.2	13.2	0.9
	12/06/12	12/13/12	0.3	0.2	12.9	0.9
	12/13/12	12/20/12	0.3	0.2	17.3	1.0
	12/20/12	12/27/12	0.3	0.2	17.6	1.0
Monteview	09/27/12	10/04/12	1.6	0.3	36.5	1.3
	10/04/12	10/11/12	1.7	0.3	36.2	1.3
	10/11/12	10/18/12	1.2	0.3	30.1	1.2
	10/18/12	10/25/12	0.8	0.2	20.4	1.0
	10/25/12	11/01/12	1.2	0.3	32.8	1.2
	11/01/12	11/08/12	0.9	0.2	34.8	1.3
	11/08/12	11/15/12	0.6	0.2	31.7	1.2
	11/15/12	11/21/12	0.8	0.2	31.5	1.3
	11/21/12	11/29/12	0.9	0.2	37.2	1.2
	11/29/12	12/06/12	0.5	0.2	19.8	1.0
	12/06/12	12/13/12	0.5	0.2	16.4	0.9
	12/13/12	12/20/12	0.5	0.2	23.1	1.1
	12/20/12	12/27/12	0.5	0.2	23.8	1.1
Mud Lake	09/27/12	10/04/12	R[1]	R[1]	R[1]	R[1]
	10/04/12	10/11/12	R[1]	R[1]	R[1]	R[1]
	10/11/12	10/18/12	1.9	0.3	37.6	1.3
	10/18/12	10/25/12	1.3	0.3	31.2	1.2
	10/25/12	11/01/12	1.4	0.3	42.8	1.4
	11/01/12	11/08/12	1.6	0.3	49.5	1.5
	11/08/12	11/15/12	1.5	0.3	49.5	1.5
	11/15/12	11/21/12	1.2	0.3	50.0	1.6
	11/21/12	11/29/12	1.6	0.3	49.4	1.4
	11/29/12	12/06/12	0.8	0.2	24.7	1.1
	12/06/12	12/13/12	0.9	0.3	23.3	1.3
	12/13/12	12/20/12	0.8	0.2	34.4	1.3
	12/20/12	12/27/12	0.7	0.2	31.4	1.2

[1]R – Results rejected due to insufficient sample volume – internal heat sensor would shut down the sampler when overheated which affected operation.

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, 2012.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
Distant Locations						
Craters	09/27/12	10/04/12	1.2	0.3	32.8	1.3
	10/04/12	10/11/12	1.0	0.2	29.8	1.2
	10/11/12	10/18/12	0.6	0.2	19.6	1.0
	10/18/12	10/25/12	0.3	0.2	13.4	0.9
	10/25/12	11/01/12	0.4	0.2	15.0	0.9
	11/01/12	11/08/12	0.4	0.2	19.7	1.0
	11/08/12	11/15/12	0.5	0.2	23.8	1.1
	11/15/12	11/21/12	0.9	0.3	23.8	1.2
	11/21/12	11/29/12	0.4	0.2	19.0	0.9
	11/29/12	12/06/12	0.2	0.2	9.3	0.8
	12/06/12	12/13/12	0.4	0.2	11.0	0.8
	12/13/12	12/20/12	0.1	0.1	13.5	0.9
	12/20/12	12/27/12	0.4	0.2	13.6	0.9
Fort Hall[1]	09/27/12	10/04/12	1.5	0.3	27.1	1.1
	10/04/12	10/11/12	1.2	0.3	26.6	1.1
	10/11/12	10/18/12	1.1	0.2	17.2	0.9
	10/18/12	10/25/12	0.4	0.2	13.0	0.8
	10/25/12	11/01/12	0.5	0.2	15.4	0.9
	11/01/12	11/08/12	0.7	0.2	19.5	1.0
	11/08/12	11/15/12	0.6	0.2	17.5	0.9
	11/15/12	11/21/12	0.6	0.2	20.2	1.1
	11/21/12	11/29/12	0.6	0.2	17.3	0.9
	11/29/12	12/06/12	0.3	0.2	14.0	0.9
	12/06/12	12/13/12	0.3	0.2	10.7	0.8
	12/13/12	12/20/12	0.2	0.2	12.3	0.8
	12/20/12	12/27/12	0.4	0.2	15.2	0.9
Idaho Falls	09/27/12	10/04/12	2.1	0.3	50.5	1.7
	10/04/12	10/11/12	1.9	0.3	44.5	1.5
	10/11/12	10/18/12	1.6	0.3	28.8	1.2
	10/18/12	10/25/12	0.8	0.2	25.0	1.1
	10/25/12	11/01/12	0.9	0.2	32.0	1.2
	11/01/12	11/08/12	1.3	0.3	41.3	1.4
	11/08/12	11/15/12	1.3	0.3	41.0	1.4
	11/15/12	11/21/12	0.9	0.2	33.0	1.4
	11/21/12	11/29/12	0.7	0.2	33.8	1.2
	11/29/12	12/06/12	0.6	0.2	19.1	1.0
	12/06/12	12/13/12	0.7	0.2	17.6	1.0
	12/13/12	12/20/12	0.6	0.2	23.6	1.1
	12/20/12	12/27/12	R^2	R^2	R^2	R^2

[1] Operated by Shoshone Bannock-Tribes
[2] R – Results rejected due to insufficient sample volume caused by a power outage at the station.

Appendix B

Table B-1. Results for all electret locations, fourth quarter, 2012.

Sample Location	Net Corrected Exposure Rate (µR/h)		± 2 SD (µR/h)
Arco	12.3		1.8
Craters	12.3		3.3
Rest Area	13.7		3.5
Van Buren	13.8		0.6
EFS	19.2		2.0
Main Gate	12.8		1.4
Atomic City[1]	13.3	(J)	4.0
Taber	13.5		1.7
Blackfoot	11.4		1.6
Ft. Hall[2]	8.5		0.7
Idaho Falls	11.6		2.6
Mud Lake/Terreton	11.5		1.3
Monteview	13.4		3.6
Sand Dunes	14.5		2.1
Howe Met. Tower	11.1		1.4
MP276 -20	11.1		1.0
MP274 -20	11.0		2.8
MP272 -20	12.9		2.2
MP270 -20	13.6		3.8
MP268 -20	15.0		3.7
MP266 -20	12.2		2.0
MP264 -20	14.5		2.5
MP270 -20/26	13.5		2.3
MP268 -20/26	16.0		1.8
MP266 -20/26	14.1		0.4
MP263 -20/26	13.6		1.2
MP261 -20/26	11.2		0.6
MP259 -20/26	11.7		0.4
MFC (EBR II)	13.1		2.5
EBR I	10.6		3.2
RWMC	11.6		2.9
CFA	12.9		2.5
CITRC (PBF)	12.5		2.2

[1] The reported result is the mean of the results from three individual electrets placed at each location. The "J" qualifier (estimate) indicates that the individual results did not meet DEQ-INL OP agreement criteria.
[2]Station operated by Shoshone-Bannock Tribes

Table B-1 continued. Results for all electret locations, fourth quarter, 2012.

Sample Location	Net Corrected Exposure Rate (µR/h)	± 2 SD (µR/h)
INTEC (ICPPI)	14.4	3.2
ATR (TRA)	14.6	3.0
NRF	14.2	4.0
TAN	13.4	0.4
Mud Lake Bank of Commerce	13.2	3.5
MP43-33	14.4	3.0
MP41-33	18.0	1.6
MP39-33	15.2	2.1
MP37-33	10.7	2.8
MP35-33	13.0	2.6
MP33-33	15.4	2.4
MP31-33	13.1	2.7
MP29-33	11.8	0.5
MP27-33	17.2	3.8
MP25-33	12.7	1.3
MP23-33	12.4	3.3
Base of Howe	12.2	1.3
Rover	11.8	1.9
Hamer	15.4	3.0
Sugar City	14.9	2.1
Roberts	11.0	1.2
Big Southern Butte	11.8	1.9

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