Department of Environmental Quality
INL Oversight Program

ENVIRONMENTAL SURVEILLANCE PROGRAM QUARTERLY DATA REPORT

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Table of Contents

List of Tables

List of Figures

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 (Gonzales-Stoller Surveillance, LLC)
ESP - Environmental Surveillance Program
ESRPA - Eastern Snake River Plain Aquifer
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 $1/1000^{th}$ 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's (DEQ-INL OP) Environmental Surveillance Program (ESP) is conducted at locations on the INL, on 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 data and programs. This program is also used to provide the citizens of Idaho with information 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, 2011 (**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 2011 for TSP filters are presented in **Table 3**. The only reported gamma-emitting radionuclide was beryllium-7, a naturally occurring, cosmogenic radionuclide.

The elevated results for gross alpha, gross beta, and Be-7 for the Idaho Falls site are due to a malfunction in the mass flow meter in the TSP sampler that measures the total volume of air sampled. The reported volume of air was much lower than actually sampled which accounts for the increased gross alpha/beta and Be-7.

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) at the Experimental Field Station, and Craters of the Moon sampling sites during the fourth quarter of 2011. While results for this sampling site are above MDC they are still well below regulatory limits (150 pCi/m^3). Average atmospheric tritium concentrations are presented in **Table 4**.

Precipitation samples were collected at six monitoring locations during the fourth quarter of 2011. 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 2011. 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.

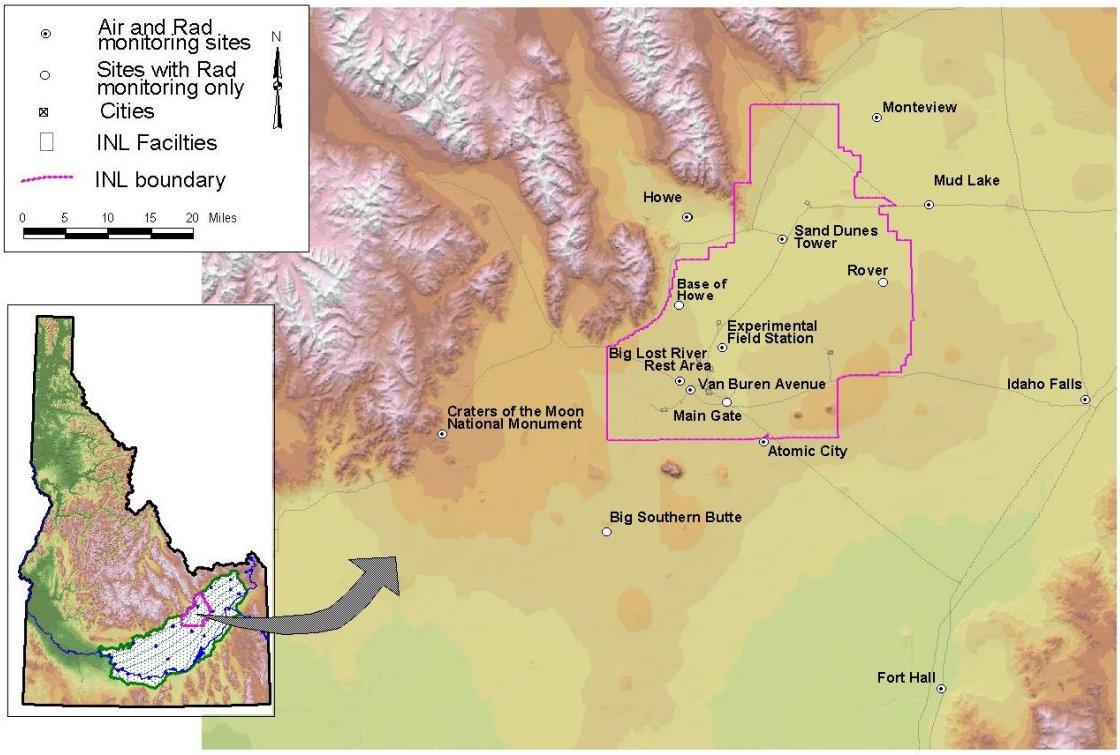

Figure 1. Air and radiation monitoring sites.

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, 2011.

Station Location	Concentration					
	Gross Alpha			Gross Beta		
On-Site Locations						
Big Lost River Rest Area	0.4	-	2.2	20.4	-	96.3
Experimental Field Station	0.3	-	2.3	16.3	-	86.8
Sand Dunes Tower	0.4	-	1.8	14.4	-	79.9
Van Buren Avenue	0.3	-	2.9	18.8	-	102.0
Boundary Locations						
Atomic City	0.3	-	2.1	17.8	-	93.6
Howe	0.3	-	2.0	15.5	-	77.9
Monteview	0.5	-	2.6	18.3	-	101.8
Mud Lake	0.8	-	2.7	21.7	-	100.8
Distant Locations						
Craters of the Moon	0.3	-	1.4	12.9	-	77.0
Fort Hall[1]	0.3	-	1.5	12.7	-	57.2
Idaho Falls	0.9 J[2]	-	5.6 J[2]	26.4 J[2]	-	238.5 J[2]

[1]Operated by Shoshone-Bannock Tribes.
[2]J = estimate value - mass flow meter malfunction in the TSP sampler resulted in an incorrect (high) concentration for gross alpha, gross beta, and Be-7.
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, 2011.

Station Location	Naturally Occurring Radionuclide Beryllium-7		Man-Made Gamma Emitting Radionuclides
	Concentration	± 2 SD	
On-site Locations			
Big Lost River Rest Area	54.0	2.9	<MDC[2]
Experimental Field Station	50.8	2.8	<MDC
Sand Dunes Tower	48.9	2.6	<MDC
Van Buren Avenue	52.2	2.8	<MDC
Boundary Locations			
Atomic City	48.6	2.6	<MDC
Howe	48.9	2.6	<MDC
Monteview	60.1	3.3	<MDC
Mud Lake	67.1	3.5	<MDC
Distant Locations			
Craters of the Moon	44.7	2.5	<MDC
Fort Hall[1]	41.5	2.3	<MDC
Idaho Falls	115.0 J[3]	6.2 J[3]	<MDC

[1]Operated by Shoshone-Bannock Tribes.
[2]MDC for Cs-137 typically (5-10)x10^{-5} pCi/m^3
[3]J = estimate value - mass flow meter malfunction in the TSP sampler resulted in an incorrect (high) concentration for gross alpha, gross beta, and Be-7.
Note: Concentrations are reported in 1 x 10^{-3} pCi/m^3 with associated uncertainty (± 2 SD), minimum detectable concentration (MDC), and correspond to filter composites collected during the calendar quarter.

Table 4. Tritium concentrations in air from atmospheric moisture, fourth quarter, 2011

Station Location	Tritium		
	Concentration	± 2 SD	MDC
On-site Locations			
Big Lost River Rest Area	0.38	0.24	0.40
Experimental Field Station	0.52	0.22	0.34
Sand Dunes Tower	0.18	0.24	0.39
Van Buren Avenue	0.35	0.22	0.35
Boundary Locations			
Atomic City	0.30	0.22	0.37
Howe	0.10	0.22	0.38
Mud Lake	0.21	0.24	0.40
Monteview	0.46	0.26	0.49
Distant Locations			
Craters of the Moon	0.83	0.22	0.36
Fort Hall[1]	0.22	0.29	0.47
Idaho Falls	0.17	0.24	0.39

[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, 2011.

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
On-site Locations						
Big Lost River Rest Area	20	70	120	0.5	2.2	3.7
Boundary Locations						
Atomic City	0	70	120	1.1	2.0	3.3
Howe	10	70	120	0.4	2.3	3.9
Monteview	10	70	120	0	2.6	4.4
Mud Lake	40	70	120	0	1.8	3.3
Distant Locations						
Idaho Falls	50	70	120	0	2.4	3.3

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 2011 (**Figure 1**). To detect gamma radiation, each station is instrumented with an electret ionization chamber (EIC), and 10 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 2011. **Table 8** lists the EIC monitoring results for fourth quarter 2011. 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, 2011, from HPIC network.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
Base of Howe	12.9	2.0
Big Lost River Rest Area	15.9	1.9
Main Gate[1]	NS	NS
Rover	15.0	1.0
Sand Dunes Tower	14.2	1.3
Boundary Locations		
Atomic City	13.5	1.3
Big Southern Butte	15.0	3.4
Howe Met Tower	13.1	2.1
Monteview	13.8	1.6
Mud Lake/Terreton	14.4	2.5
Distant Locations		
Fort Hall[2]	14.0	1.7
Idaho Falls	13.7	1.4

[1] Main Gate's new HPIC was experiencing equipment irregularity during the fourth quarter, 2011, and is reported as no sample (NS).
[2] Operated by Shoshone-Bannock Tribes.

Table 8. Electret ionization chamber (EIC) cumulative average exposure rates, fourth quarter, 2011.

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
On-site Locations		
Base of Howe	14.1	1.5
Big Lost River Rest Area	16.3	3.7
Experimental Field Station	21.8	0.8
Main Gate	13.7	1.7
Rover	12.4	1.2
Sand Dunes Tower	10.6	1.1
Van Buren Avenue	12.5	2.9
Boundary Locations		
Atomic City	12.5	3.4
Big Southern Butte	11.9	0.9
Howe Met Tower	11.6	3.5
Monteview	13.4	3.6
Mud Lake / Terreton	12.4	1.8
Distant Locations		
Craters of the Moon	9.7	3.0
Fort Hall[1]	12.5	2.4
Idaho Falls	8.3	2.9

[1] 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 Site 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 2011, 3 up-gradient, 14 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, americium, and neptunium; 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 2 up-gradient, 3 facility, 2 boundary, and 1 surface water 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 cesium-137 was not detected at any of the areas sampled. Results for gross alpha; gross beta; and man-made, gamma emitting radioactivity are shown in **Table 9**.

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

Six sites were sampled for isotopes of uranium. All six sample sites had detectable results for both uranium-234, and uranium-238 (**Table 11**). For all collected samples, the ratios of results observed cannot be distinguished from background concentrations, which means the uranium found in the samples is likely to be naturally occurring. There was one detectable result for americium-241 (**Table 12**). The reporting lab has been requested to re-analyze this sample following a report that an Am-243 carrier contaminated with Am-241 was used to analyze samples during 2010-2011.

Three of thirteen samples analyzed for strontium-90 had detectable results this quarter (**Table 13**). All three samples were from locations in areas of known contamination. All 12 locations sampled for technetium-99 had detectable results this quarter (**Table 14**). All results were within the expected ranges of concentrations.

Using the standard analytical method, tritium was detected in 10 of 14 facility samples (**Table 15**). Detections were consistent with historic concentrations for every site except TAN-10A and Middle-1823. TAN-10A tritium concentrations have risen from 50 pCi/L (4/4/07) to 280 pCi/L (10/13/09) and to 490 pCi/L (10/12/10). The most recent result collected 10/19/11 holds steady and was measured at 410 pCi/L. Tritium concentrations for Middle-1823 have gradually decreased since 2007 with a large jump from 1070 pCi/L (10/14/09) down to 450 pCi/L (10/12/10). The most recent Tritium concentration for Middle-1823 indicates a jump up to 970 pCi/L as measured in 10/19/11. 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. No samples were analyzed using the enrichment method for the current quarter; however samples from 16 sites collected during previous quarters were completed (**Table 16**). Ten of the sample sites had detectable results, six sites had undetectable results, while 15 of the sample site results were “J” flagged by either the reporting laboratory (14 samples flagged) or the INL Oversight Program (1 sample

flagged) due to failures with associated Quality Control procedures; however, all but one of the results (Shoshone Water Supply) are consistent with historic concentrations.

Samples were also analyzed for metals and the results shown in **Table 17**. All other 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 those locations.

Four locations were sampled for Volatile Organic Compounds (VOCs) this quarter, three locations had detectable concentrations. All locations with detectable results are in areas of known contamination at RWMC and TAN. 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 concentrations.

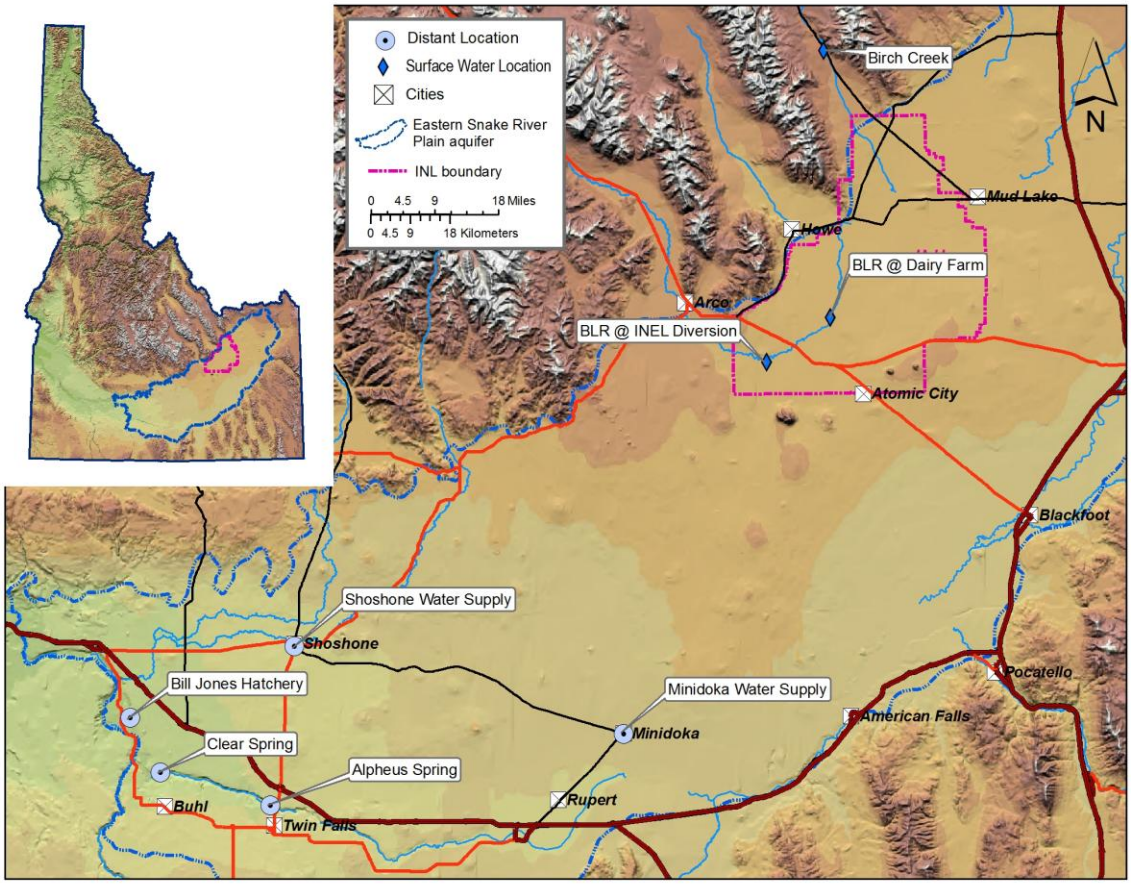

Figure 2. Distant and surface water sampling locations, fourth quarter, 2011.

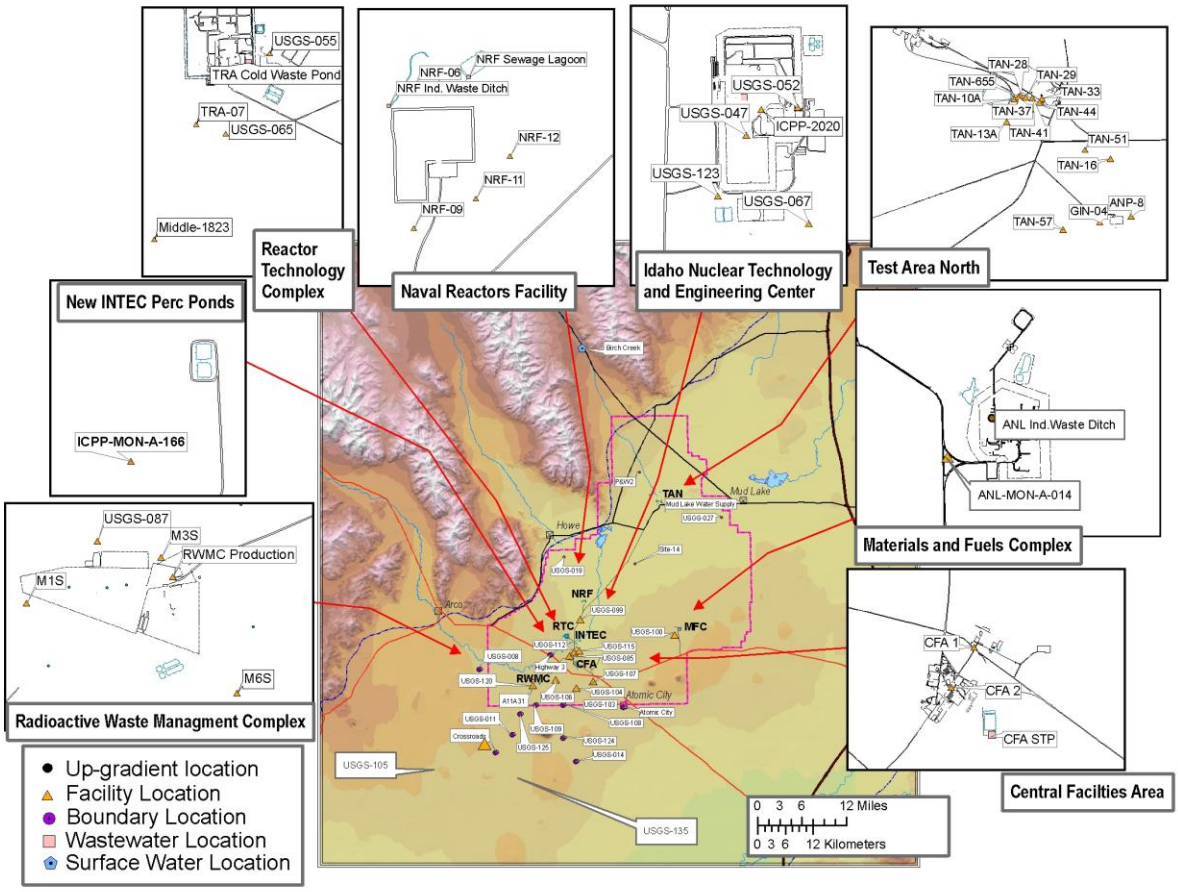

Figure 3. Up-gradient, facility, boundary and wastewater monitoring locations. fourth quarter, 2011.

Table 9. Alpha, beta, and gamma concentrations for water samples, fourth quarter, 2011.

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	11/18/2011	0.6	U	0.5	3.8		0.7	1.0	U	2.2
P&W-2	10/20/2011	2.3		1.1	1.7	J	0.8	0.5	U	2.5
Site-14	10/13/2011	4.0		1.5	3.3		0.9	-1.0	U	1.7
Facility										
A11A31	11/9/2011	-0.8	U	1.3	3.9		0.9	-1.5	U	2.4
CFA 2	10/17/2011	0.6	U	2.6	4.2		2.0	-1.1	U	2.1
ICPP-MON-A-166	10/3/2011	0.5	U	1.3	2.5		0.8	0.6	U	1.8
M1S	11/8/2011	-0.9	U	0.9	2.9		0.8	-0.3	U	1.8
M3S	11/8/2011	0.6	U	1.2	3.0		0.8	-0.4	U	2.7
M6S	11/9/2011	0.6	U	1.3	3.5		0.8	-0.6	U	1.8
Middle-1823	10/12/2011	1.5	U	1.3	2.3		0.8	-1.5	U	2.8
RWMC Production	10/13/2011	0.7	U	1.3	3.4		0.9	0.3	U	1.6
TAN-10A	10/19/2011	2.6	U	3.0	172.7		4.9	0.2	U	2.5
TRA-07	10/12/2011	4.3		1.4	4.9		0.9	-0.3	U	2.1
USGS-104	10/19/2011	0.6	U	1.2	3.2		0.9	-0.5	U	1.8
USGS-112	10/11/2011	2.4		1.2	21.7	J	1.3	-0.8	U	1.8
USGS-115	10/11/2011	0.9	U	1.0	8.2	J	1.0	-0.7	U	2.9
USGS-120	10/18/2011	2.1		1.1	3.5	J	0.8	1.9	U	2.3
Boundary										
Highway 3	10/18/2011	2.3		1.4	2.6		0.8	-0.2	U	1.5
USGS-014	10/19/2011	2.2		1.0	3.4		0.8	-0.9	U	2.2
USGS-125	10/18/2011	0.9	U	1.2	2.2		0.8	0.4	U	2.0
Distant										
Alpheus Spring	11/14/2011	0.3	U	1.7	6.6		1.0	-0.7	U	2.4
Bill Jones Hatchery	11/14/2011	0.8	U	1.3	2.7		0.9	-0.3	U	1.9
Clear Spring	11/14/2011	-0.2	U	1.8	3.2		0.9	0.2	U	2.8
Minidoka Water Supply	11/14/2011	0.0	U	1.6	3.6		0.9	-2.4	U	2.4
Shoshone Water Supply	11/14/2011	-0.4	U	1.6	3.2		0.9	0.6	U	1.7
Surface water										
Birch Creek	10/17/2011	2.7		1.5	1.1	U	0.8	1.5	U	2.2

[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, 2011.

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	11/9/2011	0.002	U	0.021	0.004	U	0.021	NR	-	-
M1S	11/8/2011	-0.005	U	0.017	-0.001	U	0.017	NR	-	-
M3S	11/8/2011	-0.004	U	0.015	0.001	U	0.015	NR	-	-
M6S	11/9/2011	0.001	U	0.014	0.026	U	0.024	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, 2011.

Sample Location	Sample Date	Uranium-234			Uranium-235			Uranium-238		
		Concentration[1,2]		± 2SD	Concentration[1,2]		± 2SD	Concentration[1,2]		± 2SD
Facility										
A11A31	11/9/2011	1.32		0.39	0.017	U	0.079	0.38		0.19
M1S	11/8/2011	1.16		0.36	0.030	U	0.079	0.28		0.16
M3S	11/8/2011	1.36		0.34	0	U	0.066	0.48		0.18
M6S	11/9/2011	1.38		0.42	0.002	U	0.085	0.55		0.24
TRA-07	10/12/2011	2.21		0.55	0.014	U	0.074	1.23		0.37

[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, 2011.

Sample Location	Sample Date	Americium-241		
		Concentration[1,2]		± 2SD
Facility				
A11A31	11/9/2011	-0.001	U	0.016
M1S	11/8/2011	0.032		0.020
M3S	11/8/2011	0.008	U	0.013
M6S	11/9/2011	0.019	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, 2011.

Sample Location	Sample Date	Strontium-90		
		Concentration[1,2]		± 2SD
Facility				
A11A31	11/9/2011	-0.04	U	0.23
CFA 2	10/17/2011	0.25	U	0.34
M1S	11/8/2011	0.21	U	0.28
M3S	11/8/2011	0.15	U	0.28
M6S	11/9/2011	0.08	U	0.25
Middle-1823	10/12/2011	0.01	U	0.30
RWMC Production	10/13/2011	-0.15	U	0.30
TAN-10A	10/19/2011	74		17
TRA-07	10/12/2011	0.25	U	0.37
USGS-104	10/19/2011	0.84	J	0.38
USGS-112	10/11/2011	8.6		2.1
USGS-115	10/11/2011	0.44	U	0.31
USGS-120	10/18/2011	0.04	U	0.30

[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, 2011.

Sample Location	Sample Date	Technetium-99		
		Concentration[1,2]		± 2SD
Facility				
A11A31 (dissolved)	11/9/2011	0.9	J	0.2
CFA 2 (dissolved)	10/17/2011	3.6		0.2
M1S (dissolved)	11/8/2011	0.7	J	0.1
M3S (dissolved)	11/8/2011	1.5	J	0.2
M6S (dissolved)	11/9/2011	1.6	J	0.2
Middle-1823 (dissolved)	10/12/2011	0.7		0.2
RWMC Production (dissolved)	10/13/2011	1.3		0.2
TRA-07 (dissolved)	10/12/2011	2.0		0.2
USGS-104 (dissolved)	10/19/2011	1.6		0.2
USGS-112 (dissolved)	10/11/2011	4.3		0.2
USGS-115 (dissolved)	10/11/2011	10.0		0.3
USGS-120 (dissolved)	10/18/2011	1.4		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, 2011.

Sample Location	Sample Date	Tritium		
		Concentration[1,2]		± 2 SD
Up-gradient				
Mud Lake Water Supply	11/18/2011	-50	U	80
P&W-2	10/20/2011	10	U	90
Site-14	10/13/2011	120	U	100
Facility				
A11A31	11/9/2011	130	U	100
CFA 2	10/17/2011	4220		190
ICPP-MON-A-166	10/3/2011	150	U	100
M1S	11/8/2011	40	U	100
M3S	11/8/2011	930		110
M6S	11/9/2011	20	U	100
Middle-1823	10/12/2011	970		120
RWMC Production	10/13/2011	810		110
TAN-10A	10/19/2011	410		100
TRA-07	10/12/2011	810		110
USGS-104	10/19/2011	770		110
USGS-112	10/11/2011	1290		120
USGS-115	10/11/2011	1200		120
USGS-120	10/18/2011	200		100
Boundary				
Highway 3	10/18/2011	60	U	100
USGS-014	10/19/2011	50	U	90
USGS-125	10/18/2011	100	U	100
Distant				
Alpheus Spring	11/14/2011	90	U	100
Bill Jones Hatchery	11/14/2011	-20	U	100
Clear Spring	11/14/2011	20	U	100
Minidoka Water Supply	11/14/2011	-60	U	100
Shoshone Water Supply	11/14/2011	-20	U	80
Surface water				
Birch Creek	10/17/2011	-20	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, 2011.

Sample Location	Sample Date	Enriched Tritium Concentration[1,2]		± 2 SD
Up-gradient				
Mud Lake Water Supply	5/25/2011	-7	U	4
Distant				
Alpheus Spring	8/17/2011	18	J	7
Bill Jones Hatchery	8/17/2011	2	UJ	6
MV-01	6/23/2011	10	UJ	6
MV-08	6/23/2011	13	J	7
MV-11	6/23/2011	19	J	7
MV-18	6/23/2011	19	J	7
MV-21	6/23/2011	1	UJ	7
MV-24A	6/23/2011	15	J	7
MV-27	6/22/2011	9	UJ	6
MV-29	6/22/2011	0	UJ	6
MV-30	6/23/2011	14	J	7
MV-37	6/22/2011	21	J	7
MV-43	6/23/2011	20	J	7
MV-50	6/22/2011	28	J	7
Shoshone Water Supply	5/23/2011	77	J	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, 2011.

Sample Location	Sample Date	Concentration[1,2]																					
		Arsenic		Barium		Beryllium		Cadmium		Chromium		Iron		Lead		Manganese		Mercury		Selenium		Zinc	
Up-gradient																							
P&W-2 (dissolved)	10/20/2011	NR	-	47		NR	-	NR	-	<5	U	<10	U	<5	U	<2	U	NR	-	NR	-	<5	U
Site-14 (dissolved)	10/13/2011	NR	-	65		NR	-	NR	-	5.1		<10	U	<5	U	<2	U	NR	-	NR	-	<5	U
Facility																							
A11A31 (total)	11/9/2011	NR	-	34	J	NR	-	NR	-	12		31	J	<5	U	<2	U	NR	-	NR	-	160	
CFA 2 (dissolved)	10/17/2011	NR	-	110		NR	-	NR	-	7.9		88		<5	U	6.6		NR	-	NR	-	5.5	
ICPP-MON-A-166 (total)	10/3/2011	NR	-	50		NR	-	NR	-	5.9		84		<5	U	24		NR	-	NR	-	<5	U
M1S (total)	11/8/2011	NR	-	23	J	NR	-	NR	-	32		25	J	<5	U	<2	U	NR	-	NR	-	<5	U
M3S (total)	11/8/2011	NR	-	46	J	NR	-	NR	-	15		340	J	<5	U	4.1	J	NR	-	NR	-	<5	U
M6S (total)	11/9/2011	NR	-	32	J	NR	-	NR	-	20		1200	J	<5	U	5.2	J	NR	-	NR	-	<5	U
Middle-1823 (dissolved)	10/12/2011	NR	-	66		NR	-	NR	-	9.9		44		<5	U	3.6		NR	-	NR	-	<5	U
RWMC Production (dissolved)	10/13/2011	NR	-	40		NR	-	NR	-	12		<10	U	<5	U	<2	U	NR	-	NR	-	<5	U
TAN-10A (total)	10/19/2011	NR	-	240		NR	-	NR	-	<5	U	2300		<5	U	940		NR	-	NR	-	41	
TRA-07 (dissolved)	10/12/2011	NR	-	76		NR	-	NR	-	120		730		<5	U	11		NR	-	NR	-	170	
USGS-104 (dissolved)	10/19/2011	NR	-	32		NR	-	NR	-	7.5		<10	U	<5	U	<2	U	NR	-	NR	-	5.2	
USGS-112 (dissolved)	10/11/2011	NR	-	97		NR	-	NR	-	11		<10	U	<5	U	<2	U	NR	-	NR	-	<5	U
USGS-115 (dissolved)	10/11/2011	NR	-	57		NR	-	NR	-	<5	U	<10	U	<5	U	7.5		NR	-	NR	-	500	
USGS-120 (dissolved)	10/18/2011	NR	-	44		NR	-	NR	-	8.4		<10	U	<5	U	<2	U	NR	-	NR	-	<5	U
Boundary																							
Highway 3 (dissolved)	10/18/2011	NR	-	53		NR	-	NR	-	<5	U	<10	U	<5	U	<2	U	NR	-	NR	-	58	
USGS-014 (dissolved)	10/19/2011	NR	-	22		NR	-	NR	-	5.2		<10	U	<5	U	<2	U	NR	-	NR	-	<5	U
USGS-125 (dissolved)	10/18/2011	NR	-	35		NR	-	NR	-	<5	U	50		<5	U	18		NR	-	NR	-	<5	U
Surface water																							
Birch Creek (dissolved)	10/17/2011	NR	-	67		NR	-	NR	-	<5	U	<10	U	<5	U	<2	U	NR	-	NR	-	<5	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, 2011.

Sample Location	Sample Date	Concentration[1,2]																					
		Calcium		Magnesium		Sodium		Potassium		Fluoride		Chloride		Sulfate		Silica		Alkalinity[3]		TDS[4]		TSS[5]	
Up-gradient																							
P&W-2*	10/20/2011	41		16		8.4		1.7		<0.2	U	8.91		29.3		NR	-	137		NR	-	NR	-
Site-14*	10/13/2011	34		13		14		3		0.46		10.4	J	24.9		NR	-	129		NR	-	NR	-
Facility																							
A11A31	11/9/2011	35		16		24		3.8		<0.2	U	23.8		40.7		NR	-	151		NR	-	NR	-
CFA 2*	10/17/2011	85		29		37		4.9		<0.2	U	148		69.9		NR	-	145		NR	-	NR	-
ICPP-MON-A-166	10/3/2011	34		12		9.6		2.6		0.249		8.8		18.2		NR	-	124		NR	-	NR	-
M1S	11/8/2011	26		12		11		2.7		0.207		13.7		21.3		NR	-	98		NR	-	NR	-
M3S	11/8/2011	43		15		8.4		2.6		<0.2	U	15.1		25.6		NR	-	140		NR	-	NR	-
M6S	11/9/2011	36		17		14		3.2		<0.2	U	24.3		50.4		NR	-	103		NR	-	NR	-
Middle-1823*	10/12/2011	54		19		11		1.9		<0.2	U	12.2	J	34.3		NR	-	169		NR	-	NR	-
RWMC Production*	10/13/2011	50		16		9.2		2.8		<0.2	U	24.6	J	29.1		NR	-	138		NR	-	NR	-
TAN-10A	10/19/2011	89		25		48		3.9		<0.2	U	110		35.6		NR	-	235		NR	-	NR	-
TRA-07*	10/12/2011	86		21		18		3.4		<0.2	U	21.5	J	154		NR	-	134		NR	-	NR	-
USGS-104*	10/19/2011	36		14		8.9		2.6		<0.2	U	14.7		21.1		NR	-	123		NR	-	NR	-
USGS-112*	10/11/2011	54		14		16		2.8		0.21		24.2	J	29.9		NR	-	153		NR	-	NR	-
USGS-115*	10/11/2011	42		13		14		3.4		0.215		59.9	J	22.7		NR	-	115		NR	-	NR	-
USGS-120*	10/18/2011	38		17		14		3.2		0.217		15		30.1		NR	-	140		NR	-	NR	-
Boundary																							
Highway 3*	10/18/2011	47		12		6.2		2.5		<0.2	U	6.71		21		NR	-	143		NR	-	NR	-
USGS-014*	10/19/2011	38		16		17		2.9		0.846		22.4		22.2		NR	-	136		NR	-	NR	-
USGS-125*	10/18/2011	38		15		11		2.8		0.237		12.9		24.3		NR	-	138		NR	-	NR	-
Surface water																							
Birch Creek*	10/17/2011	44		15		5.4		1		0.202		5.22		25.7		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, 2011.

Sample Location	Sample Date	Concentration [1,2]									
		Nitrite + Nitrate		Phosphorus		Nitrite		Total Kjeldahl Nitrogen		Ammonia	
Up-gradient											
P&W-2	10/20/2011	0.49		0.019		NR	-	NR	-	NR	-
Site-14	10/13/2011	0.62		0.021		NR	-	NR	-	NR	-
Facility											
A11A31	11/9/2011	0.82		0.02		NR	-	NR	-	<0.01	U
CFA 2	10/17/2011	3.9		0.022		NR	-	NR	-	NR	-
ICPP-MON-A-166	10/3/2011	0.24		0.032		NR	-	NR	-	NR	
M1S	11/8/2011	0.96		0.025		NR	-	NR	-	<0.01	U
M3S	11/8/2011	0.81		0.028		NR	-	NR	-	<0.01	U
M6S	11/9/2011	1.2		0.032		NR	-	NR	-	<0.01	U
Middle-1823	10/12/2011	1		0.031		NR	-	NR	-	NR	-
RWMC Production	10/13/2011	1		0.12		NR	-	NR	-	NR	-
TAN-10A	10/19/2011	<0.01	U	0.076		NR	-	NR	-	0.017	
TRA-07	10/12/2011	1.1		0.045		NR	-	NR	-	NR	-
USGS-104	10/19/2011	0.87		0.023		NR	-	NR	-	NR	-
USGS-112	10/11/2011	1.5		0.033		NR	-	NR	-	NR	-
USGS-115	10/11/2011	1.3		0.012		NR	-	NR	-	NR	-
USGS-120	10/18/2011	0.87		0.023		NR	-	NR	-	NR	-
Boundary											
Highway 3	10/18/2011	0.45		0.027		NR	-	NR	-	NR	-
USGS-014	10/19/2011	1.3		0.016		NR	-	NR	-	NR	-
USGS-125	10/18/2011	0.6		0.016		NR	-	NR	-	NR	-
Surface water											
Birch Creek	10/17/2011	0.27		<0.005	U	NR	-	NR	-	NR	-

[1] Data qualifiers: U = non-detection , J = estimate, R = rejected, NR = analysis not requested,

[2] Concentrations expressed in mg/L.

Table 20. Reported VOC concentrations in water samples, fourth quarter, 2011.

Sample Location	Sample Date	Concentrations [1,2]		
		Carbon tetrachloride	Trichloroethylene	Chloroform
Facility				
A11A31	11/9/2011	1.4 R	0.6 J	<0.5
M3S	11/8/2011	3.6 R	1.2 J	<0.5
M6S	11/9/2011	1.7 R	0.69 J	<0.5
RWMC Production	10/13/2011	6.1	3.2	1.6

[1] Data qualifiers: J= estimate, R= rejected. A "<" indicates a result below the Minimum Detectable Concentration.

[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. 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, 2011.

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	10/04/2011	1536	111	<MDC	
	10/31/2011	1519	122	<MDC	
	12/05/2011	1480	122	<MDC	
Mud Lake/Nelson-Ricks Creamery	10/03/2011	1481	123	<MDC	
	11/02/2011	1527	110	<MDC	
	12/05/2011	1516	109	<MDC	
Gooding/Glanbia	10/11/2011	1504	123	<MDC	
	11/01/2011	1550	126	<MDC	
	12/06/2011	1377	118	<MDC	
Fort Hall	11/01/2011	1423	119	<MDC	
	12/06/2011	1564	113	<MDC	
Riverside	10/12/2011	2103	135	<MDC	
	11/13/2011	1809	121	<MDC	
	12/11/2011	1600	129	<MDC	
Verification Samples[2]					
Dietrich	10/04/2011	1452	122	<MDC	
Howe	10/03/2011	1565	112	<MDC	
Rupert	11/01/2011	1552	109	<MDC	
Idaho Falls	11/01/2011	1593	112	<MDC	
Dietrich	12/06/2011	1346	117	<MDC	
Howe	12/06/2011	1590	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 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 30 locations (**Figure 3**) including onsite, boundary, and distant monitoring locations during the fourth calendar quarter of 2011. 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**. No physical soil samples were collected during the fourth quarter of 2011.

Table 22. In-Situ gamma spectroscopic analysis results for (^{137}Cs) soil monitoring, fourth quarter, 2011.

Location	Date Acquired	Concentration[1]	± 2 SD	MDA
Boundary Sampling Locations				
Mud Lake/Terreton	10/24/2011	0.194	0.063	0.015
Monteview	10/24/2011	0.196	0.057	0.013
Reno Ranch	10/21/2011	0.409	0.069	0.014
Large Grid 18-4	10/18/2011	0.372	0.092	0.017
Large Grid 12-5	10/18/2011	0.408	0.066	0.014
Large Grid 12-4	10/18/2011	0.292	0.064	0.014
Big Southern HPIC	10/18/2011	0.184	0.034	0.010
Howe Met Tower	10/25/2011	0.142	0.052	0.013
Atomic City	10/26/2011	0.286	0.059	0.014
Distant Sampling Locations				
Idaho Falls[2]	10/17/2011	0.123	0.031	0.008
Roberts	10/24/2011	0.265	0.056	0.014
Sage Junction	10/21/2011	0.443	0.087	0.018
Idaho Falls CMS[3]	10/17/2011	0.088	0.037	0.009
On site Sampling Locations				
Large Grid 18-1	10/21/2011	0.280	0.061	0.014
Large Grid 18-7	10/21/2011	0.309	0.067	0.015
Large Grid 30-1	10/21/2011	0.287	0.048	0.011
Large Grid 24-9	10/21/2011	0.309	0.046	0.012
Large Grid 24-8	10/21/2011	0.415	0.082	0.016
Large Grid 18-3	10/19/2011	0.288	0.070	0.016
Large Grid 18-8	10/19/2011	0.323	0.050	0.012
Large Grid 24-2	10/19/2011	0.448	0.088	0.017
Large Grid 24-7	10/19/2011	0.352	0.076	0.017
Rover	10/19/2011	0.248	0.074	0.016
Van Buren	10/25/2011	0.456	0.078	0.017
Sand Dunes	10/25/2011	0.271	0.073	0.016
Big Lost Rest Area	10/25/2011	0.273	0.056	0.014
Base of Howe	10/25/2011	0.328	0.070	0.014
Experimental Field Station	10/26/2011	0.552	0.073	0.016
Large Grid 6-3	10/26/2011	0.311	0.052	0.013
INL Main Gate	10/26/2011	0.398	0.089	0.018

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

The average Cesium-137 value was 0.308 picocuries per gram (pCi/g) with a minimum value of 0.088 pCi/g and a maximum of 0.552 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.

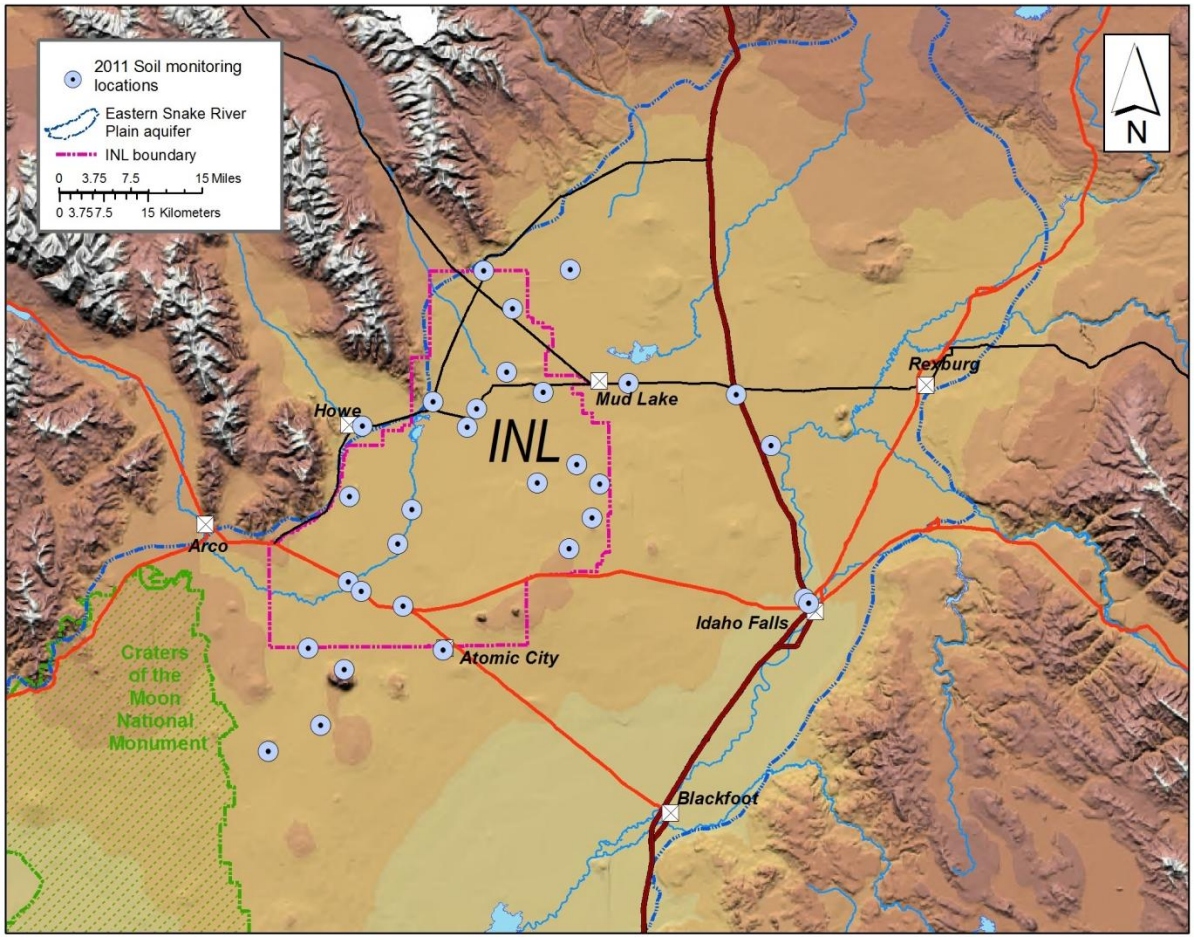

Figure 4. In-situ soil monitoring sites, fourth quarter 2011.

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 2011 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 2011, the DEQ-INL OP submitted 111 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 2011 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**, and **Table 29**.

There were a few anomalies observed from the assessment of field blank samples as measured by the analytical laboratories used by DEQ-INL OP for the fourth quarter of 2011. The first includes a detection of Barium at 7.9 ug/L. There were four samples analyzed on the same day as the blank sample (11/15/11). All of the samples detected Barium and will be flagged with a "J" and qualified as an estimate. The same blank sample also detected Manganese at 21 ug/L. There were four samples analyzed on the same day as the blank sample (11/15/11). Two of the four samples were non-detect for manganese and therefore will not be flagged; however, the two samples showing detection will be flagged with a "J" and qualified as an estimate. Other anomalies are displayed in Table 29, which shows exceedences of Calcium (0.13 mg/L) and Total Alkalinity (2 mg/L) above the MDC. With results during this quarter for calcium ranging from 26 to 89 mg/L and alkalinity ranging from 98 to 235 mg/L (**Table 18**) which is significantly above the blank values of 0.13 mg/L and 2.0 mg/L respectively, no qualifiers or flags will be attached with either calcium or alkalinity results analyzed on the same day as these blank samples. Lastly, one VOC blank was submitted during the fourth quarter. For this blank, IBL returned a detectable 1,3-Dichlorobenzene result of 0.60 µg/L. This result is currently under investigation. Because 1,3-Dichlorobenzene was not detectable in any samples this quarter, none of the data have been rejected or qualified.

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. Comparison tests that have an absolute difference in the two sample results of no more than three times the pooled error (or "3 sigma") for these measurements are considered acceptable. 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 30**, **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-beta analysis failed the duplicate criteria and will be flagged with a "J" and qualified as an estimate along with three other gross-beta samples that were analyzed the same day. One enriched tritium analysis failed the duplicate criteria and will be flagged with a "J" and qualified as an estimate; the other sample analyzed the same day was a non-detection and will not be qualified as an estimate. One strontium-90 analysis failed the duplicate criteria. While there was another duplicate for strontium-90 that was analyzed the same day that passed the criteria, the duplicate that failed will be flagged with a "J" and qualified as an estimate due to its abnormally high value when compared to historical concentrations at the site. Other strontium-90 samples analyzed the same day will not be flagged with a "J" due in part to the other duplicate comparison that passed criteria, as well as, a review of historic concentrations at each site. One Technetium-99 analysis failed the duplicate criteria and will be flagged with a "J" and qualified as an estimate along with three other technetium-99 samples that were analyzed the same day. One iron analysis failed the duplicate criteria and will be flagged with a "J" and qualified as an estimate along with three other iron samples that were analyzed the same day.

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 2011, 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**, and **Table 37**. Spiked samples for VOC analyses, specifically tetrachloroethylene, carbon tetrachloride, styrene, and trichloroethylene submitted for analysis 11/15/11 and analyzed 11/18/11 either exceeded or did not achieve recovery limits (**Table 38**). The sample results associated with these analytes will be qualified as either estimates (J) or

rejections (R). Vinyl chloride was not reported by the lab due to a calibration failure for samples submitted 11/15/11 with the spiked samples. Other constituents not reported due to the calibration failure include Dichlorodifluoromethane, Chloromethane, and Chloroethane. One chloride analyses failed the estimate (J) criteria, so all chloride results analyzed with the spiked sample on 10/14/11 will be flagged with a (J) and qualified as an estimate.

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 2011 are presented in **Table 38**. Real-time pressure correction is used to calculate the net exposure measured by these EIC control sets.

There were no other 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 2011.

Analytical QA/QC Assessment

Aside from the field blank, duplicate and spiked water samples discussed above, no other issues involving sample chain of custody, sample holding times, analysis of blank, duplicate, and spiked samples were observed during the fourth quarter of 2011, 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 2011.

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 2011 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. Service reliability for air sampling equipment for the fourth quarter of 2011 is summarized in **Table 39**.

Conclusion

All data collected for the fourth quarter of 2011, 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, 2011.

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	0	ISU-EML
		Gross beta	142	13	0	0	0	ISU-EML
		Gamma emitters	11	1	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
Water Vapor	Desiccant column	Tritium	30	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	26	3	4	0	0	ISU-EML
		Gross beta	26	3	4	0	0	ISU-EML
		Gamma emitters	26	3	4	0	0	ISU-EML
		Tritium	26	3	4	0	0	ISU-EML
		Enriched tritium	16	1	1	0	0	ISU-EML
		Technetium-99	12	0	3	0	0	ISU-EML
		Radiochemical	26	0	6	0	0	ISU Sub
		Metals	20	3	3	2	0	IBL
		Common Ions	20	3	3	2	0	IBL
		Nutrients	20	3	3	2	0	IBL
		Volatile Organics	4	1	1	1	3	IBL
TERRESTRIAL								
Milk	Grab or composite	Gamma emitters	20	0	0	0	0	ISU-EML
Soil	*in situ*	Gamma emitters	30	0	7	0	0	ISU-EML
	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	11	NA	NA	NA	NA	DEQ-INL OP
Total Analyses			**688**	**52**	**43**	**16**	**3**	
Total of QC Analyses (blanks, duplicates, and spikes)			**111**					
Percentage of QC analyses of Total Test analyses[3]			**16.1%**					
Percentage of usable data[4]			**99.6%**					

[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, 2011.

Collection Period		Corrected volume (m^3) [1]	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
09/29/2011	10/06/2011	2030	0.0	0.1	0.0	0.4
10/06/2011	10/13/2011	2030	-0.1	0.1	0.4	0.4
10/13/2011	10/20/2011	2030	0.0	0.1	0.1	0.4
10/20/2011	10/27/2011	2030	0.0	0.1	-0.1	0.4
10/27/2011	11/03/2011	2030	0.0	0.1	0.1	0.4
11/03/2011	11/10/2011	2030	0.0	0.1	-0.2	0.4
11/10/2011	11/17/2011	2030	0.0	0.1	0.0	0.4
11/17/2011	11/24/2011	2030	0.1	0.1	0.3	0.4
11/24/2011	12/01/2011	2030	0.0	0.1	-0.4	0.4
12/01/2011	12/08/2011	2030	0.0	0.1	-0.2	0.4
12/08/2011	12/15/2011	2030	0.0	0.1	0.1	0.4
12/15/2011	12/22/2011	2030	0.0	0.1	0.2	0.4
12/22/2011	12/29/2011	2030	0.0	0.1	0.4	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, 2011.

Analysis Date	Beryllium-7			Ruthenium-106/ Rhodium-106			Antimony-125		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
01/13/2012	6	26	44	5	20	34	-1	5	10

Analysis Date	Cesium-134			Cesium-137		
	Concentration[1]	± 2 SD	MDC	Concentration	± 2 SD	MDC
01/13/2012	-1	3	5	-1	2	4

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, 2011.

Sample Number	Start Date	Collect Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP114ZTR01	10/31/2011	11/02/2011	01/17/2012	0.02	0.07	0.12
OP114ZTR02	01/11/2012	01/12/2012	01/24/2012	0.00	0.10	0.16

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, fourth quarter, 2011.

Sample Number	Sample Date	Concentration	± 2 SD	MDC	Within Blank Criteria?
Gross Alpha					
111W513	10/13/2011	0.0	0.2	0.4	Yes
111W523	10/17/2011	0.0	0.2	0.4	Yes
111W518	11/9/2011	-0.5	0.3	0.7	Yes
Gross Beta					
111W513	10/13/2011	0.7	0.6	1.0	Yes
111W523	10/17/2011	0.7	0.6	1.0	Yes
111W518	11/9/2011	-0.2	0.6	1.0	Yes
Cesium-137					
111W513	10/13/2011	1.6	2.5	4.1	Yes
111W523	10/17/2011	-0.6	2.7	4.7	Yes
111W518	11/9/2011	-0.7	2.4	4.0	Yes
Tritium					
111W514	10/13/2011	0	100	160	Yes
111W524	10/17/2011	40	100	160	Yes
111W519	11/9/2011	150	100	170	Yes
Enriched Tritium					
111W387	8/17/2011	18	7	10	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, fourth quarter, 2011.

Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
111W516	10/13/2011	<5	<2	<5	<10	<5	<2	<10	<5
111W526	10/17/2011	<5	<2	<5	<10	<5	<2	<10	<5
111W521	11/9/2011	<5	7.9	<5	<10	<5	21	<10	<5

Table 29. Blank analysis results (mg/L) for common ions and nutrients in ground and surface water, fourth quarter, 2011.

Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus
111W517,516,515	10/13/2011	<0.1	<0.1	<0.1	<0.1	<0.2	<0.4	<0.8	2	<0.01	<0.005
111W527,526,525	10/17/2011	<0.1	<0.1	<0.1	<0.1	<0.2	<0.4	<0.8	<1	<0.01	<0.005
111W522,521,520	11/9/2011	0.13	<0.1	<0.1	<0.1	<0.2	<0.4	<0.8	2	<0.01	<0.005

Table 30. Duplicate radiological analysis results in pCi/L for ground and surface water, fourth quarter, 2011.

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									
M3S	111W666	0.6	1.2	111W678	0.5	1.3	0.1	2.7	yes
USGS-104	111W578	0.6	1.2	111W585	1.3	0.9	0.7	2.3	yes
USGS-112	111W592	2.4	1.2	111W599	1.0	0.9	1.4	2.3	yes
Minidoka Water Supply	111W707	0.0	1.6	111W709	0.6	1.3	0.6	3.1	yes
Gross Beta									
M3S	111W666	3.0	0.8	111W678	3.6	0.9	0.6	1.8	yes
USGS-104	111W578	3.2	0.9	111W585	2.4	0.8	0.8	1.8	yes
USGS-112	111W592	21.7	1.3	111W599	17.6	1.2	4.1	2.7	no
Minidoka Water Supply	111W707	3.6	0.9	111W709	3.2	0.9	0.4	1.9	yes
Gamma Spectroscopy Cesium-137									
M3S	111W666	-0.4	2.7	111W678	-0.6	1.6	0.2	4.7	yes
USGS-104	111W578	-0.5	1.8	111W585	-0.3	2.8	0.2	5.0	yes
USGS-112	111W592	-0.8	1.8	111W599	1.0	1.9	1.8	3.9	yes
Minidoka Water Supply	111W707	-2.4	2.4	111W709	-0.2	2.2	2.2	4.9	yes
Tritium									
M3S	111W671	930	110	111W683	880	110	50	233	yes
USGS-104	111W581	770	110	111W588	870	110	100	233	yes
USGS-112	111W595	1290	120	111W602	1130	120	160	255	yes
Minidoka Water Supply	111W708	-60	100	111W710	10	80	70	192	yes
Enriched Tritium									
Shoshone Water Supply	111W346	77	7	111W348	10	5	67	13	no
Strontium-90									
M3S	111W669	0.15	0.28	111W681	0.09	0.26	0.06	0.57	yes
USGS-104	111W579	0.84	0.38	111W586	-0.05	0.29	0.89	0.72	no
USGS-112	111W593	8.6	2.1	111W600	8.7	2.2	0.1	4.56	yes
Technetium-99									
M3S	111W670	1.5	0.2	111W682	1.1	0.1	0.4	0.34	no
USGS-104	111W580	1.6	0.2	111W587	1.4	0.2	0.2	0.42	yes
USGS-112	111W594	4.3	0.2	111W601	4.3	0.2	0.0	0.42	yes
Plutonium-238									
M3S	111W668	-0.004	0.015	111W680	0	0.016	0.004	0.03	yes
Plutonium-239/240									
M3S	111W668	0.001	0.015	111W680	0.002	0.016	0.001	0.03	yes
Uranium-234									
M3S	111W672	1.36	0.34	111W684	1.59	0.44	0.23	0.83	yes
Uranium-235									
M3S	111W672	0	0.066	111W684	0.043	0.078	0.04	0.15	yes
Uranium-238									
M3S	111W672	0.48	0.18	111W684	0.57	0.23	0.09	0.44	yes
Americium-241									
M3S	111W667	0.008	0.013	111W679	0.012	0.018	0.004	0.03	yes

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

Table 31. Duplicate results for metals (µg/L) in ground water and/or surface water, fourth quarter, 2011.

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
M3S (total)	111W674	11/8/2011	<5	46	15	340	<5	4.1	<10	<5
M3S (total)	111W686	11/8/2011	<5	46	14	420	<5	3.8	<10	<5
RPD			**0**	**0**	**7**	**-21**	**0**	**8**	**0**	**0**
USGS-104 (dissolved)	111W583	10/19/2011	<5	32	7.5	<10	<5	<2	<10	5.2
USGS-104 (dissolved)	111W590	10/19/2011	<5	32	8.4	<10	<5	<2	<10	5.1
RPD			**0**	**0**	**-11.3**	**0**	**0**	**0**	**0**	**2**
USGS-112 (dissolved)	111W597	10/11/2011	<5	97	11	<10	<5	<2	<10	<5
USGS-112 (dissolved)	111W604	10/11/2011	<5	94	11	<10	<5	<2	<10	<5
RPD			**0**	**3**	**0.0**	**0**	**0**	**0**	**0**	**0**

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

Table 32. Duplicate results for common ions and nutrients (mg/L) in ground water and/or surface water, fourth quarter, 2011.

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus
M3S	111W675,674,673	11/8/2011	43	15	8.4	2.6	<0.2	15.1	25.6	140	0.81	0.028
M3S	111W687,686,685	11/8/2011	44	15	8.4	2.6	<0.2	15.1	25.6	139	0.80	0.029
RPD			**-2.3**	**0**	**0**	**0**	**0**	**0**	**0**	**0.7**	**1.2**	**-3.5**
USGS-104*	111W584,583,582	10/19/2011	36	14	8.9	2.6	<0.2	14.7	21.1	123	0.87	0.023
USGS-104*	111W591,590,589	10/19/2011	36	14	9	2.6	<0.2	14.7	21.1	122	0.86	0.023
RPD			**0**	**0**	**-1.1**	**0**	**0**	**0**	**0**	**0.8**	**1.2**	**0**
USGS-112*	111W598,597,596	10/11/2011	54	14	16	2.8	0.21	24.2	29.9	153	1.5	0.033
USGS-112*	111W605,604,603	10/11/2011	53	14	16	2.8	0.245	24.2	30.1	155	1.4	0.033
RPD			**2**	**0**	**0**	**0**	**-15.4**	**0**	**-0.7**	**-1.3**	**6.9**	**0**

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

Table 33. Duplicate results for VOCs in groundwater and/or surface water, fourth quarter, 2011.

Sample Location	Sample Date	Sample Number	Concentrations						
			1,1-Dichloroethene	Carbon tetrachloride	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Tetrachloroethylene (PERC)	Trichloroethylene	Vinyl chloride
M3S	11/8/2011	111W676	<0.5	3.6	<0.5	<0.5	<0.5	1.2	<0.5
M3S	11/8/2011	111W688	<0.5	3.7	<0.5	<0.5	<0.5	1.3	<0.5
RPD			**0**	**-2.7**	**0**	**0**	**0**	**-8.0**	**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, 2011.

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?
IF Community Monitoring Station	10/17/11	12.1 ± 0.7	11.2 ± 0.5	8.2	In Spec	Yes	0.088 ± 0.037	0.099 ± 0.040	12.0	In Spec	Yes
IF Air Station	10/17/11	14.0 ± 0.5	13.5 ± 0.5	3.8	In Spec	Yes	0.123 ± 0.031	0.163 ± 0.034	28.2	In Spec	Yes
Large Grid 18-4	10/18/11	15.4 ± 0.7	15.6 ± 0.8	1.0	In Spec	Yes	0.372 ± 0.092	0.316 ± 0.053	16.4	In Spec	Yes
Large Grid 12-4	10/18/11	14.9 ± 0.7	14.7 ± 0.7	1.6	In Spec	Yes	0.292 ± 0.064	0.315 ± 0.062	7.4	In Spec	Yes
Sand Dunes Air Station	10/25/11	20.1 ± 1.1	20.1 ± 1.0	0.1	In Spec	Yes	0.271 ± 0.073	0.277 ± 0.073	2.3	In Spec	Yes
EFS Air Station	10/26/11	19.5 ± 0.8	19.4 ± 0.8	0.2	In Spec	Yes	0.552 ± 0.073	0.511 ± 0.064	7.8	In Spec	Yes
Large Grid 6-3	10/26/11	19.9 ± 0.8	19.9 ± 0.8	0.4	In Spec	Yes	0.311 ± 0.052	0.290 ± 0.093	7.2	In Spec	Yes

[1]Result ± 2 SD

Table 35. De-ionized water spike results (in µg/L) for metals in ground and surface water, fourth quarter, 2011.

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
111W637	10/13/2011	111	110	**99.1**	15.9	16	**100.6**	6.21	6.4	**103.1**	6.26	7.1	**113.4**	87.1	85	**97.6**
111W640	11/9/2011	68.1	69	**101.3**	9.75	9.8	**100.5**	7.45	7.7	**103.4**	7.52	7.1	**94.4**	53.5	52	**97.2**

[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) for common ions and nutrients in ground and surface water, fourth quarter, 2011.

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
111W637,636	10/13/2011	20	20	**100.0**	7.94	7.8	**98.2**	17.9	18	**100.6**	1.37	1.4	**102.2**	3.18	2.95	**92.8**
111W640,639	11/9/2011	12.3	12	**97.6**	4.88	4.7	**96.3**	11	11	**100.0**	1.65	1.6	**97.0**	3.72	3.65	**98.1**

[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) for common ions and nutrients in ground and surface water, fourth quarter, 2011.

Spike Sample Number	Sample Date	Chloride			Sulfate			Total Alkalinity as CaCO3			Total Nitrogen			Total Phosphorus		
		spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R
111W637,636	10/13/2011	58.8	35.8	**60.9**	34.9	33.9	**97.1**	104	100	**96.2**	2.42	2.5	**103.3**	0.0245	0.022	**89.8**
111W640,639	11/9/2011	69	67.3	**97.5**	30.9	30.4	**98.4**	33.1	32	**96.7**	2.58	2.6	**100.8**	0.0148	0.013	**87.8**

[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) for VOCs in ground and surface water, fourth quarter, 2011.

Spike Sample Number	Sample Date	Carbon tetrachloride			Styrene			Tetrachloroethylene			Trichloroethylene		
		spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R
111W642	11/9/2011	7.62	1.2	**15.7**	11.1	14	**126.1**	15	11	**73.3**	13.4	7.3	**54.5**

[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, 2011.

Electret #	Exposure Received		Net Measured Exposure[1]		%R
	(mR)	Uncertainty (mR)	(mR)	Uncertainty (mR)	
Spike 1	29.4	1.5	31.1	1.3	105.7%
Spike 1	29.4	1.5	27.2	1.3	92.5%
Spike 1	29.4	1.5	30.1	1.4	102.4%
Spike 2	54.8	2.7	54.1	1.3	98.6%
Spike 2	54.8	2.7	54.9	1.3	100.2%
Spike 2	54.8	2.7	55.2	1.3	100.7%
Spike 3	22.2	1.1	23.2	1.3	104.5%
Spike 3	22.2	1.1	22.0	1.3	99.0%
Spike 3	22.2	1.1	22.6	1.3	101.7%

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, 2011.

Station Locations	Sample Type			
	TSP	Radioiodine	Atmospheric Moisture	Precipitation
Onsite Locations				
Big Lost River Rest Area	100 %	100 %	100 %	100 %
Experimental Field Station	100 %	100 %	100 %	NC[1]
Sand Dunes Tower	100 %	100 %	100 %	NC[1]
Van Buren Avenue	100 %	100 %	100 %	NC[1]
Boundary Locations				
Atomic City	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, 2011.

Sample location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
On-site Locations						
Rest Area	9/29/11	10/06/11	0.8	0.2	33.8	1.2
	10/06/11	10/13/11	0.4	0.2	20.4	1.0
	10/13/11	10/20/11	1.3	0.3	31.5	1.2
	10/20/11	10/27/11	1.0	0.2	32.4	1.3
	10/27/11	11/03/11	0.9	0.2	30.4	1.2
	11/03/11	11/10/11	1.1	0.2	32.4	1.2
	11/10/11	11/17/11	1.2	0.2	32.9	1.2
	11/17/11	11/24/11	0.5	0.2	22.3	1.1
	11/24/11	12/01/11	0.8	0.2	31.9	1.1
	12/01/11	12/08/11	1.5	0.3	30.4	1.2
	12/08/11	12/15/11	2.2	0.3	96.3	2.0
	12/15/11	12/22/11	2.0	0.3	89.2	2.1
	12/22/11	12/29/11	1.0	0.2	46.1	1.4
Experimental Field Station	9/29/11	10/06/11	0.9	0.2	28.4	1.2
	10/06/11	10/13/11	0.3	0.2	16.3	0.9
	10/13/11	10/20/11	0.9	0.2	28.1	1.2
	10/20/11	10/27/11	0.8	0.2	28.0	1.3
	10/27/11	11/03/11	0.7	0.2	25.9	1.1
	11/03/11	11/10/11	0.8	0.2	27.8	1.2
	11/10/11	11/17/11	0.8	0.2	28.8	1.2
	11/17/11	11/24/11	0.5	0.2	20.0	1.1
	11/24/11	12/01/11	0.5	0.2	31.8	1.1
	12/01/11	12/08/11	0.9	0.2	24.9	1.1
	12/08/11	12/15/11	1.5	0.3	86.8	2.0
	12/15/11	12/22/11	2.3	0.3	84.8	2.1
	12/22/11	12/29/11	0.8	0.2	48.5	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, 2011.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
Sand Dunes	9/29/11	10/06/11	1.0	0.2	27.3	1.1
	10/06/11	10/13/11	0.4	0.2	14.4	0.8
	10/13/11	10/20/11	1.1	0.2	28.5	1.1
	10/20/11	10/27/11	0.9	0.2	26.4	1.1
	10/27/11	11/03/11	0.7	0.2	28.2	1.0
	11/03/11	11/10/11	0.9	0.2	26.2	1.0
	11/10/11	11/17/11	0.9	0.2	27.7	1.0
	11/17/11	11/24/11	0.4	0.2	16.9	1.0
	11/24/11	12/01/11	0.7	0.2	29.1	1.0
	12/01/11	12/08/11	0.8	0.2	24.0	1.0
	12/08/11	12/15/11	1.7	0.3	79.9	1.8
	12/15/11	12/22/11	1.8	0.3	75.7	1.9
	12/22/11	12/29/11	0.9	0.2	49.6	1.4
Van Buren	9/29/11	10/06/11	0.9	0.2	28.2	1.1
	10/06/11	10/13/11	0.3	0.2	19.4	1.0
	10/13/11	10/20/11	1.1	0.2	31.5	1.2
	10/20/11	10/27/11	0.9	0.2	26.8	1.2
	10/27/11	11/03/11	0.7	0.2	27.9	1.1
	11/03/11	11/10/11	1.2	0.3	29.0	1.5
	11/10/11	11/17/11	0.7	0.2	31.8	1.2
	11/17/11	11/24/11	0.3	0.2	18.8	1.0
	11/24/11	12/01/11	1.1	0.2	32.2	1.1
	12/01/11	12/08/11	0.9	0.2	28.2	1.1
	12/08/11	12/15/11	2.9	0.4	102.0	2.0
	12/15/11	12/22/11	2.0	0.3	90.1	2.1
	12/22/11	12/29/11	1.1	0.2	44.8	1.4
Boundary Locations						
Atomic City	9/29/11	10/06/11	1.1	0.2	33.0	1.2
	10/06/11	10/13/11	0.3	0.2	17.8	0.9
	10/13/11	10/20/11	1.2	0.2	32.5	1.2
	10/20/11	10/27/11	0.9	0.2	28.7	1.2
	10/27/11	11/03/11	1.2	0.2	24.7	1.0
	11/03/11	11/10/11	0.8	0.2	30.1	1.1
	11/10/11	11/17/11	0.9	0.2	31.1	1.2
	11/17/11	11/24/11	0.5	0.2	21.0	1.1
	11/24/11	12/01/11	0.9	0.2	32.6	1.1
	12/01/11	12/08/11	1.0	0.2	28.4	1.1
	12/08/11	12/15/11	2.1	0.3	93.6	1.9
	12/15/11	12/22/11	1.6	0.3	75.7	1.9
	12/22/11	12/29/11	0.8	0.2	44.9	1.4

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, 2011.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
Howe	9/29/11	10/06/11	1.1	0.2	26.5	1.1
	10/06/11	10/13/11	0.4	0.2	15.8	0.9
	10/13/11	10/20/11	0.9	0.2	27.8	1.2
	10/20/11	10/27/11	1.0	0.2	24.3	1.2
	10/27/11	11/03/11	0.8	0.2	25.4	1.1
	11/03/11	11/10/11	0.8	0.2	26.2	1.2
	11/10/11	11/17/11	0.9	0.2	25.0	1.1
	11/17/11	11/24/11	0.3	0.2	15.5	1.0
	11/24/11	12/01/11	0.7	0.2	25.7	1.0
	12/01/11	12/08/11	1.0	0.2	24.1	1.1
	12/08/11	12/15/11	2.0	0.3	77.9	1.9
	12/15/11	12/22/11	1.6	0.3	64.2	1.8
	12/22/11	12/29/11	0.9	0.2	43.6	1.4
Monteview	9/29/11	10/06/11	1.1	0.2	30.5	1.2
	10/06/11	10/13/11	0.6	0.2	20.2	1.0
	10/13/11	10/20/11	1.5	0.3	33.0	1.2
	10/20/11	10/27/11	1.3	0.3	33.7	1.4
	10/27/11	11/03/11	1.4	0.3	35.8	1.6
	11/03/11	11/10/11	1.6	0.3	36.4	1.3
	11/10/11	11/17/11	1.3	0.2	32.8	1.2
	11/17/11	11/24/11	0.5	0.2	18.3	1.1
	11/24/11	12/01/11	1.0	0.2	33.8	1.2
	12/01/11	12/08/11	1.3	0.3	29.7	1.2
	12/08/11	12/15/11	2.6	0.4	100.3	2.1
	12/15/11	12/22/11	2.6	0.3	101.8	2.3
	12/22/11	12/29/11	1.4	0.3	55.8	1.6
Mud Lake	9/29/11	10/06/11	2.3	0.6	57.9	3.2
	10/06/11	10/13/11	0.8	0.2	21.7	1.0
	10/13/11	10/20/11	1.4	0.3	45.8	1.4
	10/20/11	10/27/11	1.7	0.3	50.1	1.9
	10/27/11	11/03/11	1.6	0.3	47.0	1.4
	11/03/11	11/10/11	1.4	0.3	37.2	1.3
	11/10/11	11/17/11	1.5	0.3	32.3	1.2
	11/17/11	11/24/11	0.8	0.2	26.6	1.2
	11/24/11	12/01/11	1.6	0.3	37.7	1.2
	12/01/11	12/08/11	1.8	0.3	32.6	1.2
	12/08/11	12/15/11	2.3	0.3	94.8	2.0
	12/15/11	12/22/11	2.7	0.4	100.8	2.2
	12/22/11	12/29/11	1.8	0.3	71.5	1.7

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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, 2011.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
Distant Locations						
Craters	9/29/11	10/06/11	0.7	0.2	23.5	1.1
	10/06/11	10/13/11	0.3	0.2	14.5	0.9
	10/13/11	10/20/11	0.7	0.2	21.8	1.1
	10/20/11	10/27/11	0.7	0.2	19.4	1.1
	10/27/11	11/03/11	0.5	0.2	25.0	1.1
	11/03/11	11/10/11	0.3	0.2	23.7	1.1
	11/10/11	11/17/11	0.5	0.2	23.2	1.1
	11/17/11	11/24/11	0.3	0.2	12.9	1.0
	11/24/11	12/01/11	0.5	0.2	22.2	1.0
	12/01/11	12/08/11	0.5	0.2	21.5	1.1
	12/08/11	12/15/11	1.2	0.3	77.0	1.9
	12/15/11	12/22/11	1.4	0.3	56.2	1.8
	12/22/11	12/29/11	0.5	0.2	29.6	1.2
Fort Hall[1]	9/29/11	10/06/11	1.2	0.2	23.7	1.1
	10/06/11	10/13/11	0.3	0.2	12.7	0.8
	10/13/11	10/20/11	0.7	0.2	22.2	1.0
	10/20/11	10/27/11	0.7	0.2	18.5	1.1
	10/27/11	11/03/11	1.0	0.2	19.6	1.0
	11/03/11	11/10/11	0.6	0.2	18.8	1.0
	11/10/11	11/17/11	0.8	0.2	22.7	1.0
	11/17/11	11/24/11	0.5	0.2	15.8	1.0
	11/24/11	12/01/11	1.0	0.2	19.1	0.9
	12/01/11	12/08/11	0.9	0.2	17.0	0.9
	12/08/11	12/15/11	1.5	0.3	57.2	1.6
	12/15/11	12/22/11	1.5	0.3	44.1	1.5
	12/22/11	12/29/11	NS[2]	NS[2]	NS[2]	NS[2]
Idaho Falls	9/29/11	10/06/11	1.3	0.6	31.3	2.8
	10/06/11	10/13/11	0.9	0.3	26.4	1.4
	10/13/11	10/20/11	1.9	0.4	58.2	2.0
	10/20/11	10/27/11	1.0	0.3	35.8	1.7
	10/27/11	11/03/11	2.3	0.4	59.8	2.0
	11/03/11	11/10/11	2.0	0.4	64.3	2.1
	11/10/11	11/17/11	1.6	0.3	46.9	1.5
	11/17/11	11/24/11	1.1	0.3	39.1	1.6
	11/24/11	12/01/11	1.9	0.3	64.2	1.8
	12/01/11	12/08/11	2.5	0.4	67.6	2.2
	12/08/11	12/15/11	5.6 J[3]	0.7 J[3]	238.5 J[3]	4.4 J[3]
	12/15/11	12/22/11	4.5 J[3]	0.5 J[3]	157.4 J[3]	3.3 J[3]
	12/22/11	12/29/11	2.3 J[3]	0.5 J[3]	113.7 J[3]	3.0 J[3]

[1] Operated by Shosone-Bannock Tribes
[2] NS – Sampler not started from previous week.
[3] J = estimate value - mass flow meter malfunction in the TSP sampler resulting in an incorrect (high) concentration for gross alpha, gross beta, and Be-7.

Appendix B

Table B-1. Results for all electret locations, fourth quarter, 2011.

Sample Location	Net Corrected Exposure Rate (µR/h)	± 2 SD (µR/h)
Arco	14.3	0.8
Craters	9.7	3.0
Rest Area	16.3	3.7
Van Buren	12.5	2.9
EFS	21.8	0.8
Main Gate	13.7	1.7
Atomic City	12.5	3.4
Taber	11.2	3.0
Blackfoot	9.7	1.4
Ft. Hall[1]	12.5	2.4
Idaho Falls	8.3	2.9
Mud Lake/Terreton	12.4	1.8
Monteview	13.4	3.6
Sand Dunes	10.6	1.1
Howe Met. Tower	11.6	3.5
MP276 -20	11.2	1.5
MP274 -20	10.4	1.1
MP272 -20	9.8	2.0
MP270 -20	11.4	3.7
MP268 -20	12.2	2.6
MP266 -20	14.9	1.8
MP264 -20	15.4	2.3
MP270 -20/26	15.6	2.8
MP268 -20/26	16.5	1.0
MP266 -20/26	12.7	3.5
MP263 -20/26	16.1	2.3
MP261 -20/26	11.7	3.2
MP259 -20/26	12.1	3.1
MFC (EBR II)	10.3	1.5
EBR I	12.8	3.2
RWMC	12.5	2.8
CFA	17.3	0.4
CITRC (PBF)	14.8	2.8

[1]Station operated by Shoshone-Bannock Tribes.

Table B-1 continued. Results for all electret locations, fourth quarter, 2011.

Sample Location	Net Corrected Exposure Rate (µR/h)	± 2 SD (µR/h)
INTEC (ICPPI)	15.9	0.4
ATR (TRA)	13.2	2.3
NRF	14.7	2.6
TAN	12.8	1.2
Mud Lake Bank of Commerce	13.9	2.9
MP43-33	16.2	3.2
MP41-33	12.4	2.3
MP39-33	16.0	0.8
MP37-33	9.9	1.2
MP35-33	14.5	3.9
MP33-33	16.6	2.3
MP31-33	16.8	3.4
MP29-33	15.8	3.7
MP27-33	14.8	2.0
MP25-33	12.1	2.5
MP23-33	9.1	1.5
Base of Howe	14.1	1.5
Rover	12.4	1.2
Hamer	10.8	0.8
Sugar City	17.7	3.1
Roberts	14.8	0.6
Big Southern Butte	11.9	0.9

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