

Department of Environmental Quality  
INL Oversight Program

**ENVIRONMENTAL SURVEILLANCE PROGRAM  
QUARTERLY DATA REPORT**

**October - December, 2010**



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# Table of Acronyms

aCi/L	-	attocuries per liter	RCRA	-	Resource Conservation and Recovery Act
BEA	-	Battelle Energy Alliance, LLC	RPD	-	relative percent difference
BLR	-	Big Lost River	RWMC	-	Radioactive Waste Management Complex
CERCLA	-	Comprehensive Environmental Response, Compensation and Liability Act	RTC	-	Reactor Technology Complex
CFA	-	Central Facilities Area	SD	-	standard deviation
CWI	-	CH2M-WG Idaho, LLC	SMCL	-	secondary maximum contaminant level
DEQ-INL OP	-	The State of Idaho, Department of Environmental Quality, Idaho National Laboratory Oversight Program	TAN	-	Test Area North
DOE	-	U.S. Department of Energy	TCE	-	trichloroethene
EIC	-	electret ionization chamber	TDS	-	total dissolved solids
EML	-	Environmental Monitoring Laboratory	TMI	-	Three Mile Island
EPA	-	Environmental Protection Agency	TSP	-	total suspended particulate
ESER	-	Environmental Surveillance, Education and Research Program (SM Stoller)	TSS	-	total suspended solids
ESP	-	Environmental Surveillance Program	USGS	-	U.S. Geological Survey
ESRPA	-	Eastern Snake River Plain Aquifer	VOC	-	volatile organic compound
HPIC	-	high-pressure ion chamber	WLAP	-	Wastewater Land Application Permit
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 <sup>th</sup> 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 <sup>3</sup>	-	picocuries per cubic meter			
PCE	-	perchloroethene			
QAPP	-	Quality Assurance Program Plan			
QA/QC	-	Quality Assurance/Quality Control			

## 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 provide the mechanism 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, 2010 (**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**.

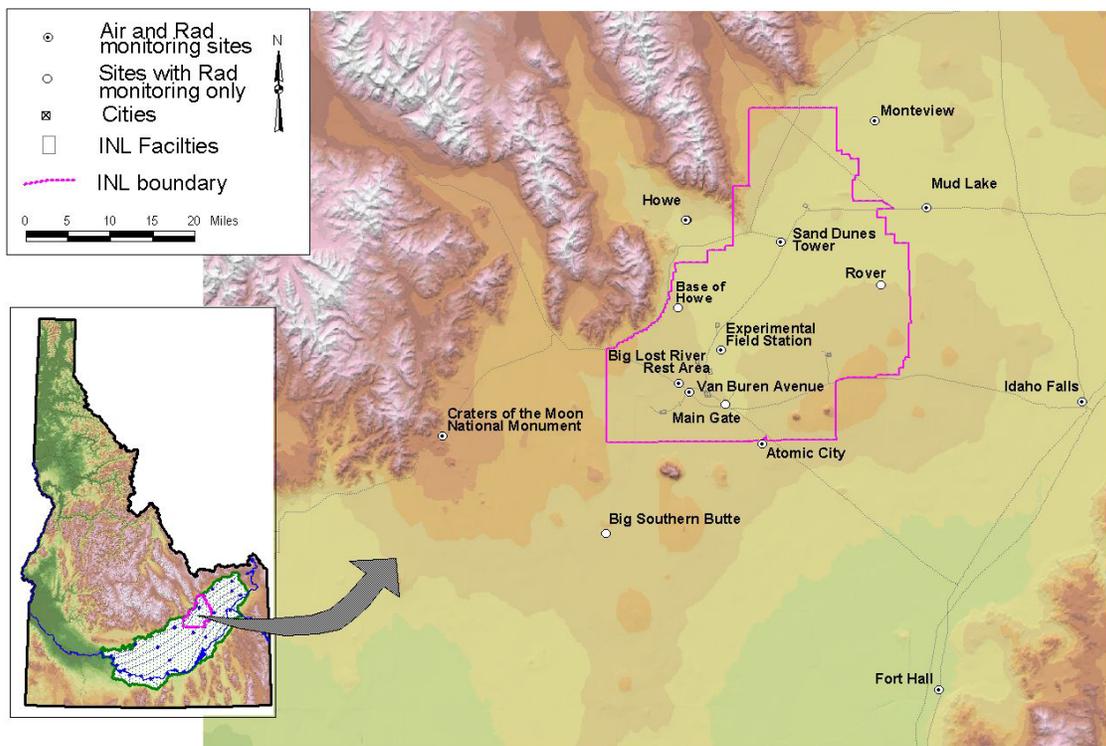
Composites of filters collected using TSP samplers during the course of a calendar quarter are analyzed using gamma spectroscopy. Typically, gamma spectroscopy results are only reported when exceeding a minimum detectable activity (MDA) or minimum detectable concentration (MDC). Gamma spectroscopy results for the fourth quarter of 2010 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 within its sponge-like pores. 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-

<sup>131</sup>I, 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 site during the fourth quarter of 2010. While results for this sampling site are above MDC they are still well below regulatory limits. Average atmospheric tritium concentrations are presented in **Table 4**.

Precipitation samples were collected at six monitoring locations during the fourth quarter of 2010. 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 2010. 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 <sup>1</sup>			
	TSP	Radioiodine	Water Vapor	Precipitation
<b>On-site Locations</b>				
Big Lost River Rest Area	☐	☐	■	■
Experimental Field Station	☐	☐	■	
Sand Dunes Tower	☐	☐	■	
Van Buren Avenue	☐	☐	■	
<b>Boundary Locations</b>				
Atomic City	☐	☐	■	■
Howe	☐	☐	■	■
Monteview	☐	☐	■	■
Mud Lake	☐	☐	■	■
<b>Distant Locations</b>				
Craters of the Moon	☐	☐	■	
Fort Hall <sup>2</sup>	☐	☐	■	
Idaho Falls	☐	☐	■	■

<sup>1</sup> ☐ Samples collected weekly; ■ Samples collected quarterly.

<sup>2</sup> TSP and radioiodine samples collected by Shoshone-Bannock Tribes.

**Table 2. Range of gross alpha and gross beta concentrations for TSP filters, fourth quarter, 2010.**

Station Location	Concentration					
	Gross Alpha			Gross Beta		
<b>On-Site Locations</b>						
Big Lost River Rest Area	0.4	-	2.4	28.8	-	78.4
Experimental Field Station	0.1	-	1.8	25.8	-	73.5
Sand Dunes Tower	0.2	-	1.8	24.6	-	70.5
Van Buren Avenue	0.4	-	2.4	24.6	-	77.3
<b>Boundary Locations</b>						
Atomic City	0.2	-	2.8	24.6	-	75.5
Howe	0.3	-	1.9	25.4	-	59.6
Monteview	0.5	-	3.3	29.1	-	81.2
Mud Lake	0.3	-	2.6	24.8	-	74.5
<b>Distant Locations</b>						
Craters of the Moon	0.1	-	1.3	15.5	-	61.7
Fort Hall <sup>1</sup>	0.3	-	2.1	16.0	-	53.2
Idaho Falls	0.3	-	2.6	23.6	-	75.6

<sup>1</sup> Operated by Shoshone-Bannock Tribes.

Note: Concentrations are expressed in  $1 \times 10^{-3}$  pCi/m<sup>3</sup>.

**Table 3. Gamma spectroscopy analysis data for TSP filters, composite samples, fourth quarter, 2010.**

Station Location	Naturally Occurring Radionuclide Beryllium-7		Man-Made Gamma Emitting Radionuclides
	Concentration	± 2 SD	
<b>On-site Locations</b>			
Big Lost River Rest Area	67.4	3.8	<MDC <sup>2</sup>
Experimental Field Station	68.8	3.8	<MDC
Sand Dunes Tower	60.6	3.4	<MDC
Van Buren Avenue	65.6	3.7	<MDC
<b>Boundary Locations</b>			
Atomic City	69.5	3.8	<MDC
Howe	74.5	4.1	<MDC
Monteview	72.9	4.2	<MDC
Mud Lake	58.9	3.4	<MDC
<b>Distant Locations</b>			
Craters of the Moon	63.0	3.7	<MDC
Fort Hall <sup>1</sup>	55.5	3.3	<MDC
Idaho Falls	73.3	4.1	<MDC

<sup>1</sup>Operated by Shoshone-Bannock Tribes.<sup>2</sup>MDC for Cs-137 typically (5-10)×10<sup>-5</sup> pCi/m<sup>3</sup>.Note: Concentrations are reported in 1 × 10<sup>-3</sup> pCi/m<sup>3</sup> 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, 2010.**

Station Location	Tritium		
	Concentration	± 2 SD	MDC
<b>On-site Locations</b>			
Big Lost River Rest Area	0.11	0.27	0.47
Experimental Field Station	0.69	0.30	0.51
Sand Dunes Tower	0.19	0.31	0.53
Van Buren Avenue	0.31	0.33	0.56
<b>Boundary Locations</b>			
Atomic City	0.09	0.33	0.54
Howe	0.05	0.31	0.53
Mud Lake	0.17	0.32	0.55
Monteview	0.14	0.28	0.49
<b>Distant Locations</b>			
Craters of the Moon	0.09	0.28	0.48
Fort Hall <sup>1</sup>	0.03	0.35	0.60
Idaho Falls	0.17	0.31	0.53

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

**Table 5. Tritium and Cesium-137 concentrations from precipitation, fourth quarter, 2010.**

Station Location	Tritium			Cesium-137		
	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
<b>On-site Locations</b>						
Big Lost River Rest Area	50	100	160	0.0	1.8	3.2
<b>Boundary Locations</b>						
Atomic City	60	100	160	0.0	2.0	3.6
Howe	40	100	160	0.0	2.8	5.1
Monteview	120	100	160	0.0	1.5	2.7
Mud Lake	20	100	160	0.0	1.4	2.5
<b>Distant Locations</b>						
Idaho Falls	110	100	160	0.3	1.7	3.0

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

## Environmental Radiation Monitoring Results

The ESP operated 14 environmental radiation stations during the fourth quarter of 2010 (**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/piconline.cfm](http://www.deq.idaho.gov/inl_oversight/monitoring/piconline.cfm)

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 2010. **Table 8** lists the EIC monitoring results for fourth quarter 2010. 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
<b>On-site Locations</b>		
Base of Howe	■	■
Big Lost River Rest Area <sup>1</sup>		■
Experimental Field Station		■
Main Gate	■	■
Rover	■	■
Sand Dunes Tower	■	■
Van Buren Avenue		■
<b>Boundary Locations</b>		
Atomic City	■	■
Big Southern Butte	■	■
Howe Met Tower	■	■
Monteview	■	■
Mud Lake	■	■
<b>Distant Locations</b>		
Craters of the Moon		■
Fort Hall <sup>2</sup>	■	■
Idaho Falls	■	■

<sup>1</sup> HPIC Sampling at Big Lost River Rest Area was suspended due to construction and has not been re-deployed.

<sup>2</sup> HPIC operated by Shoshone-Bannock Tribes with the EIC maintained by DEQ-INL OP.

**Table 7. Average gamma exposure rates, fourth quarter, 2010, from HPIC network.**

Station Location	Exposure Rate (µR/hr)	
	Quarterly Average	± 2 SD
<b>On-site Locations</b>		
Base of Howe	11.6	1.6
Big Lost River Rest Area <sup>1</sup>	NS	NS
Main Gate <sup>2</sup>	NS	NS
Rover <sup>3</sup>	NS	NS
Sand Dunes Tower	14.4	1.3
<b>Boundary Locations</b>		
Atomic City	13.1	5.8
Big Southern Butte	12.6	5.6
Howe Met Tower	13.0	1.7
Monteview	14.5	2.2
Mud Lake/Terreton	12.9	1.9
<b>Distant Locations</b>		
Fort Hall <sup>4</sup>	13.9	2.2
Idaho Falls	12.4	1.3

<sup>1</sup> Sampling at Big Lost River Rest Area was suspended due to construction and has not been re-deployed.

<sup>2</sup> Main Gate HPIC experienced equipment irregularity and then total failure near the end of the quarter which could not be repaired and therefore is reported as No Sample.

<sup>3</sup> The Rover HPIC was destroyed by a wildfire and is therefore reported as No Sample.

<sup>4</sup> Operated by Shoshone-Bannock Tribes.

**Table 8. Electret ionization chamber (EIC) cumulative average exposure rates, fourth quarter, 2010.**

Station Location	Exposure Rate ( $\mu\text{R/hr}$ )	
	Quarterly Average	$\pm 2 \text{ SD}$
<b>On-site Locations</b>		
Base of Howe <sup>1</sup>	NS	NS
Big Lost River Rest Area	11.8	0.8
Experimental Field Station	15.1	2.5
Main Gate	12.8	3.8
Rover <sup>1</sup>	NS	NS
Sand Dunes Tower	12.4	1.8
Van Buren Avenue	15.5	3.7
<b>Boundary Locations</b>		
Atomic City	11.0	0.5
Big Southern Butte <sup>1</sup>	NS	NS
Howe Met Tower	9.8	3.6
Monteview	7.4	0.7
Mud Lake / Terreton	13.0	2.9
<b>Distant Locations</b>		
Craters of the Moon	9.9	0.1
Fort Hall <sup>2</sup>	11.1	1.2
Idaho Falls	10.3	1.4

<sup>1</sup> Impassable roads prevented collection of EICs, therefore reported as NS.

<sup>2</sup> 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 2010, 2 up-gradient, 13 facilities, 2 boundary, 6 distant, 1 waste water 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 facility, 2 distant, 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 6 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 were no detectable results for americium-241 (**Table 12**). Neptunium-237 was not sampled for this quarter.

Two of thirteen samples analyzed for strontium-90 had detectable results this quarter (**Table 13**). Both samples were from locations in areas of known contamination. All 11 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 8 of 13 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 finally to 490 pCi/L as measured on 10/12/10. This result (490 pCi/L) is the largest measured tritium concentration by the Oversight Program (OP) at TAN-10A since OP began sampling in 2004. Other sites that showed differences from past results include the sample site Middle-1823. Tritium concentrations for Middle-1823 for this quarter were 450 pCi/L, which is less than half the previous concentration of 1070 pCi/L measured in 10/14/09. There were no detectable concentrations from other areas. 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 12 sites collected during previous quarters were completed (**Table 16**). Seven of the 12 sample sites had detectable results; however, all results are consistent with historic concentrations.

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 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

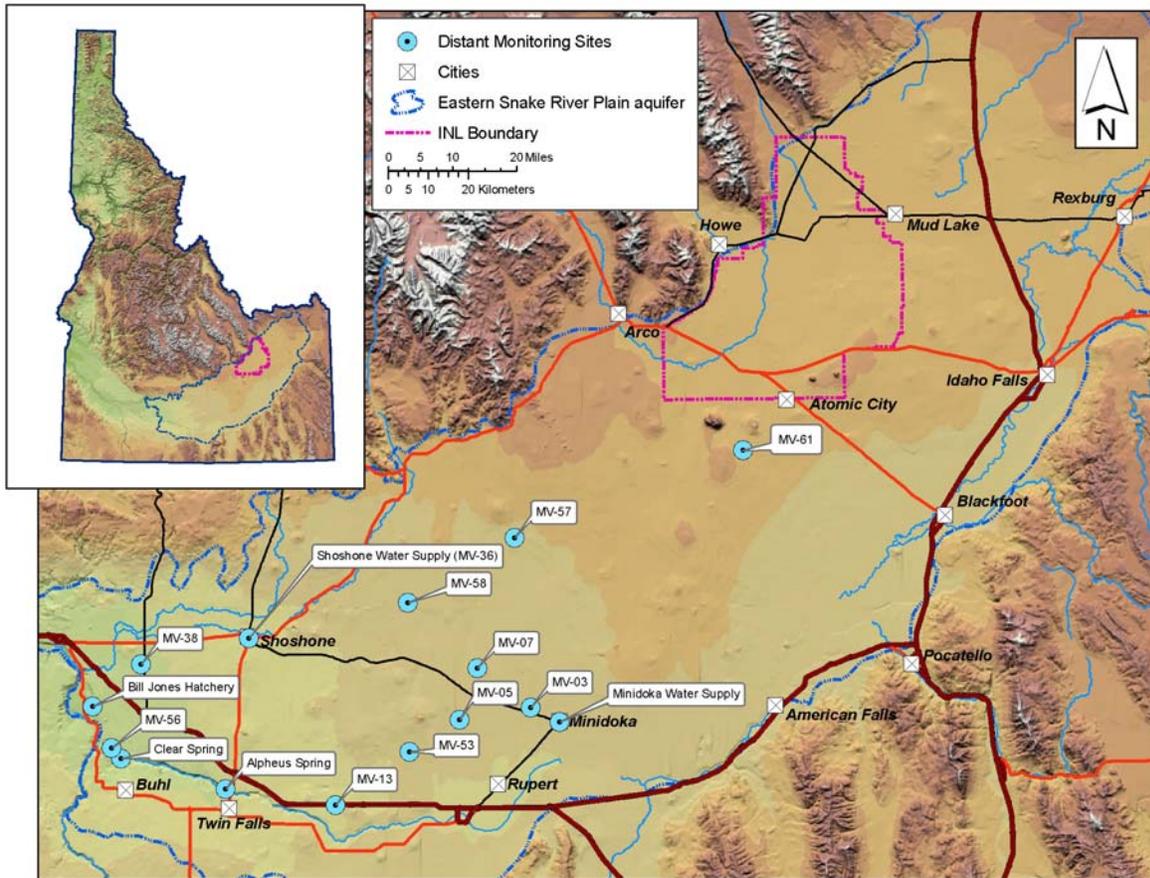


Figure 2. Distant sampling locations, fourth quarter, 2010.

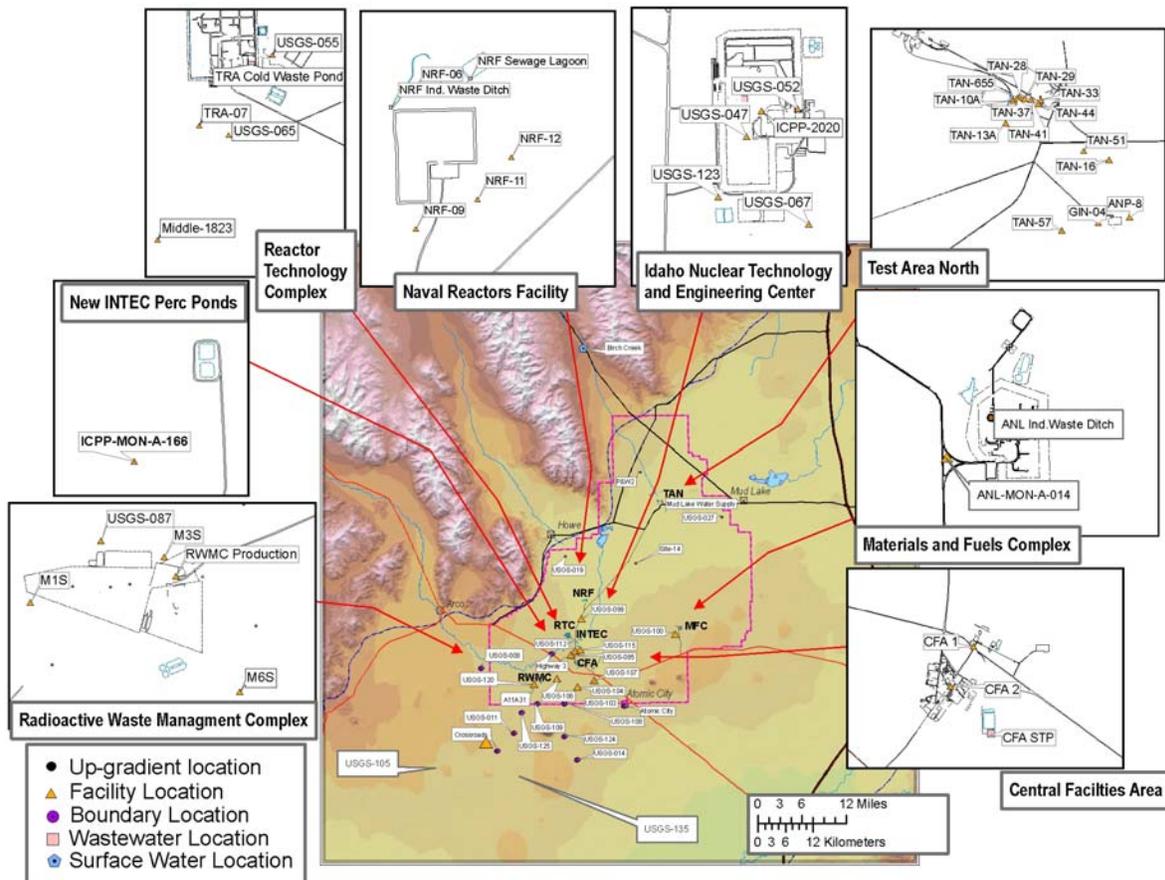


Figure 3. Up-gradient, facility, boundary, surface water, and wastewater monitoring locations, fourth quarter 2010.

**Table 9. Alpha, beta, and gamma concentrations for water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Gross Alpha			Gross Beta			Man-made gamma-emitting radionuclide Cesium-137		
		Concentration <sup>1,2</sup>		± 2 SD	Concentration <sup>1,2</sup>		± 2 SD	Concentration <sup>1,2</sup>		± 2 SD
<b>Up-gradient</b>										
Mud Lake Water Supply	11/10/2010	0.6	U	0.6	4.0		0.8	0.8	U	1.9
Site-14	10/14/2010	1.4	U	1.1	3.5		0.8	-0.5	U	2.1
<b>Facility</b>										
A11A31	11/10/2010	0.8	U	1.1	5.2		0.9	-0.2	U	1.3
ICPP-MON-A-166	10/7/2010	1.0	U	1.2	2.8		0.8	0.5	U	1.7
M1S	11/8/2010	0.6	U	0.8	1.1	U	0.8	0.9	U	1.4
M3S	11/8/2010	1.2	U	1.2	2.4		0.8	-0.1	U	1.6
M6S	11/10/2010	0.7	U	1.1	4.3		0.9	0.1	U	1.3
Middle-1823 RWMC	10/12/2010	0.0	U	1.0	2.8		0.8	1.3	U	2.5
Production	10/14/2010	1.3	U	1.1	3.1		0.8	0.5	U	1.6
TAN-10A	10/12/2010	4.2		1.9	188.0		3.3	1.0	U	2.2
TRA-07	10/12/2010	2.3		1.4	4.4		0.9	0.0	U	1.5
USGS-104	10/18/2010	0.1	U	0.9	3.6		0.8	-0.2	U	1.4
USGS-112	10/7/2010	1.2	U	1.2	23.6		1.3	0.1	U	1.7
USGS-115	10/7/2010	0.1	U	1.0	6.0		0.9	0.1	U	2.0
USGS-120	10/13/2010	0.9	U	1.1	3.4		0.8	0.5	U	2.2
<b>Boundary</b>										
Highway 3	10/18/2010	0.3	U	1.1	2.5		0.8	-0.1	U	1.2
USGS-125	10/13/2010	0.7	U	1.0	3.3		0.8	0.5	U	1.8
<b>Distant</b>										
Alpheus Spring	11/9/2010	2.8		1.7	7.2		1.0	0.4	U	1.6
Bill Jones Hatchery	11/9/2010	1.3	U	1.2	2.4		0.8	-0.1	U	1.7
Clear Spring	11/9/2010	2.2		1.4	2.8		0.9	-0.6	U	1.8
Minidoka Water Supply	11/9/2010	0.4	U	1.2	1.5		0.9	0.4	U	1.6
MV-61	10/13/2010	1.2	U	1.0	2.6		0.8	2.0	U	2.5
Shoshone Water Supply (MV-36)	11/9/2010	1.4	U	1.1	3.1		0.8	-0.3	U	1.4
<b>Surface water</b>										
Birch Creek	10/26/2010	3.0		1.1	0.6	U	0.8	0.3	U	1.9
<b>Waste Water</b>										
NRF Ind. Waste Ditch	101W561	*Note		-	*Note		-	-0.2	U	1.5

<sup>1</sup> Data qualifiers: U = non-detection, J = estimate, R = rejected.

<sup>2</sup> Concentrations expressed in pCi/L.

\*Note: Analysis failed due to high TDS.

**Table 10. Reported concentrations of plutonium isotopes in water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Plutonium-238		Plutonium-239/240		Plutonium-241				
		Concentration <sup>1,2</sup>	± 2SD	Concentration <sup>1,2</sup>	± 2SD	Concentration <sup>1,2</sup>	± 2SD			
<b>Facility</b>										
A11A31	11/10/2010	0.004	U	0.021	-0.002	U	0.021	-	-	-
M1S	11/8/2010	-0.002	U	0.018	0	U	0.018	-	-	-
M3S	11/8/2010	0.008	U	0.024	-0.005	U	0.024	-	-	-
M6S	11/10/2010	0.003	U	0.019	0.003	U	0.019	-	-	-

<sup>1</sup> Data qualifiers: U = non-detection, J = estimate, R = rejected.

<sup>2</sup> Concentrations expressed in pCi/L.

**Table 11. Reported concentrations of uranium isotopes in water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Uranium-234		Uranium-235		Uranium-238		
		Concentration <sup>1,2</sup>	± 2SD	Concentration <sup>1,2</sup>	± 2SD	Concentration <sup>1,2</sup>	± 2SD	
<b>Facility</b>								
A11A31	11/10/2010	1.14	0.30	0.053*	U	0.054	0.62	0.20
M1S	11/8/2010	0.84	0.24	0.010	U	0.045	0.45	0.16
M3S	11/8/2010	1.23	0.30	0.021	U	0.043	0.38	0.14
M6S	11/10/2010	1.24	0.31	0.032	U	0.049	0.65	0.21
Middle-1823	10/12/2010	1.47	0.35	-0.003	U	0.046	0.49	0.17
TRA-07	10/12/2010	1.94	0.43	0.014	U	0.045	0.95	0.26

<sup>1</sup> Data qualifiers: U = non-detection, J = estimate, R = rejected

<sup>2</sup> Concentrations expressed in pCi/L.

\*Note: Result is greater than the MDC, but does not exceed 2SD. It is not considered a detection.

**Table 12. Reported concentrations of americium-241 in water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Americium-241		
		Concentration <sup>1,2</sup>	± 2SD	
<b>Facility</b>				
A11A31	11/10/2010	0.011	U	0.020
M1S	11/8/2010	0.016	U	0.021
M3S	11/8/2010	-0.004	U	0.022
M6S	11/10/2010	0.003	U	0.016

<sup>1</sup> Data qualifiers: U = non-detection, J = estimate, R = rejected.

<sup>2</sup> Concentrations expressed in pCi/L.

**Table 13. Reported concentrations of strontium-90 in water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Strontium-90		
		Concentration <sup>1,2</sup>		± 2SD
<b>Facility</b>				
A11A31	11/10/2010	0.03	U	0.16
M1S	11/8/2010	-0.19	U	0.16
M3S	11/8/2010	0.14	U	0.17
M6S	11/10/2010	0.02	U	0.16
Middle-1823	10/12/2010	0.11	U	0.17
RWMC Production	10/14/2010	0.17	U	0.17
TAN-10A	10/12/2010	84		20
TRA-07	10/12/2010	0.08	U	0.17
USGS-104	10/18/2010	0.03	U	0.16
USGS-112	10/7/2010	9.3		2.2
USGS-115	10/7/2010	0.05	U	0.15
USGS-120	10/13/2010	-0.03	U	0.15
<b>Waste Water</b>				
NRF Ind. Waste Ditch	12/7/2010	0.32	U	0.45

<sup>1</sup> Data qualifiers: U = non-detection, J = estimate, R = rejected.

<sup>2</sup> Concentrations expressed in pCi/L.

**Table 14. Reported concentrations of technetium-99 in water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Technetium-99	
		Concentration <sup>1,2</sup>	± 2SD
<b>Facility</b>			
A11A31 (dissolved)	11/10/2010	0.8	0.1
M1S (dissolved)	11/8/2010	0.9	0.2
M3S (dissolved)	11/8/2010	1.5	0.2
M6S (dissolved)	11/10/2010	0.5	0.1
Middle-1823 (dissolved)	10/12/2010	0.5	0.2
RWMC Production (dissolved)	10/14/2010	1.0	0.2
TRA-07 (dissolved)	10/12/2010	1.9	0.2
USGS-104 (dissolved)	10/18/2010	0.9	0.2
USGS-112 (dissolved)	10/7/2010	4.0	0.2
USGS-115 (dissolved)	10/7/2010	7.5	0.3
USGS-120 (dissolved)	10/13/2010	1.5	0.2

<sup>1</sup> Data qualifiers: U = non-detection, J = estimate, R = rejected

<sup>2</sup> Concentrations expressed in pCi/L.

**Table 15. Tritium concentrations for water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Tritium		
		Concentration <sup>1,2</sup>		± 2 SD
<b>Up-gradient</b>				
Mud Lake Water Supply	11/10/2010	30	U	80
Site-14	10/14/2010	-20	U	100
<b>Facility</b>				
A11A31	11/10/2010	100	U	80
ICPP-MON-A-166	10/7/2010	70	U	100
M1S	11/8/2010	-110	U	100
M3S	11/8/2010	860		110
M6S	11/10/2010	20	U	80
Middle-1823	10/12/2010	450		110
RWMC Production	10/14/2010	1000		120
TAN-10A	10/12/2010	490		70
TRA-07	10/12/2010	10580		290
USGS-104	10/18/2010	1080		120
USGS-112	10/7/2010	1400		130
USGS-115	10/7/2010	1560		130
USGS-120	10/13/2010	150	U	100
<b>Boundary</b>				
Highway 3	10/18/2010	120	U	100
USGS-125	10/13/2010	110	U	100
<b>Distant</b>				
Alpheus Spring	11/9/2010	40	U	100
Bill Jones Hatchery	11/9/2010	10	U	100
Clear Spring	11/9/2010	0	U	100
Minidoka Water Supply	11/9/2010	-40	U	100
MV-61	10/13/2010	-20	U	100
Shoshone Water Supply (MV-36)	11/9/2010	0	U	80
<b>Surface water</b>				
Birch Creek	10/26/2010	-10	U	80
<b>Waste Water</b>				
NRF Ind. Waste Ditch	12/7/2010	-30	U	80

<sup>1</sup> Data qualifiers: U = non-detection, J = estimate, R = rejected

<sup>2</sup> Concentrations expressed in pCi/L.

**Table 16. Enriched tritium concentrations for water samples from previous sampling quarters, 2010.**

Sample Location	Sample Date	Enriched Tritium		
		Concentration <sup>1,2</sup>		± 2 SD
<b>Up-gradient</b>				
P&W-2	4/27/2010	8	U	7
USGS-019	4/27/2010	8	U	7
USGS-027	4/27/2010	2	U	7
<b>Boundary</b>				
Crossroads	4/26/2010	11	U	7
USGS-008	4/26/2010	19		7
USGS-011	4/21/2010	18		8
USGS-103	6/24/2010	0	U	9
<b>Distant</b>				
MV-07	8/2/2010	24		10
MV-13	8/2/2010	29		10
Shoshone Water Supply (MV-36)	8/3/2010	27		9
<b>Surface Water</b>				
BLR @ Dairy Farm	6/10/2010	24		10
BLR @ INEL Diversion	6/10/2010	28		10

<sup>1</sup> Data qualifiers: U = non-detection, J = estimate, R = rejected

<sup>2</sup> Concentrations expressed in pCi/L.

**Table 17. Reported metals concentrations in water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Concentration <sup>1,2</sup>																			
		Arsenic	Barium	Beryllium	Cadmium	Chromium	Iron	Lead	Manganese	Mercury	Selenium	Zinc									
<b>Up-gradient</b>																					
Site-14 (dissolved)	10/14/2010	-	-	63	-	-	-	-	5.0	-	-	<1.0	U	<1.0	U	-	-	-	-	<2.0	U
<b>Facility</b>																					
A11A31 (total)	11/10/2010	2.1		34	<1.0	U	<1.0	U	14	58		2.6		1.2		<0.5	U	<2.0	U	240	
ICPP-MON-A-166 (dissolved)	10/7/2010	-	-	52	-	-	-	-	4.6	-	-	<1.0	U	30	J	-	-	-	-	<2.0	U
M1S (total)	11/8/2010	2.9		22	<1.0	U	<1.0	U	32	50		<1.0	U	1.6		<0.5	U	2.5		2.5	
M3S (total)	11/8/2010	<2.0	U	44	<1.0	U	<1.0	U	13	17		<1.0	U	<1.0	U	<0.5	U	<2.0	U	<2.0	U
M6S (total)	11/10/2010	<2.0	U	32	<1.0	U	<1.0	U	30	3000		<1.0	U	5.9		<0.5	U	2.9		<2.0	U
Middle-1823 (dissolved)	10/12/2010	<2.0	U	69	-	-	<1.0	U	9.4	<10	U	<1.0	U	2.2	J	-	-	<2.0	U	<2.0	U
RWMC Production (dissolved)	10/14/2010	-	-	41	-	-	-	-	12	-	-	<1.0	U	<1.0	U	-	-	-	-	<2.0	U
TAN-10A (total)	10/12/2010	<2.0	U	280	<1.0	U	<1.0	U	<1.0	U	1800	<1.0	U	990	J	<0.5	U	<2.0	U	11	
TRA-07 (dissolved)	10/12/2010	<2.0	U	65	-	-	<1.0	U	93	<10	U	<1.0	U	1.2	J	-	-	<2.0	U	6.6	
USGS-104 (dissolved)	10/18/2010	-	-	32	-	-	-	-	7.8	-	-	<1.0	U	<1.0	U	-	-	-	-	2.3	
USGS-112 (dissolved)	10/7/2010	-	-	97	-	-	-	-	12	-	-	<1.0	U	<1.0	U	-	-	-	-	<2.0	U
USGS-115 (dissolved)	10/7/2010	-	-	60	-	-	-	-	5.8	-	-	<1.0	U	<1.0	U	-	-	-	-	580	
USGS-120 (dissolved)	10/13/2010	-	-	44	-	-	-	-	9.2	-	-	<1.0	U	<1.0	U	-	-	-	-	<2.0	U
<b>Boundary</b>																					
Highway 3 (dissolved)	10/18/2010	-	-	54	-	-	-	-	1.8	-	-	<1.0	U	<1.0	U	-	-	-	-	67	
USGS-125 (dissolved)	10/13/2010	-	-	37	-	-	-	-	2.0	-	-	<1.0	U	23	J	-	-	-	-	<2.0	U
<b>Distant</b>																					
MV-61 (dissolved)	10/13/2010	2.3		23	-	-	<1.0	U	3.9	<10	U	<1.0	U	<1.0	U	-	-	<2.0	U	3.1	
<b>Surface water</b>																					
Birch Creek (dissolved)	10/26/2010	-	-	67	-	-	-	-	<1.0	U	-	<1.0	U	<1.0	U	-	-	-	-	<2.0	U
<b>Waste Water</b>																					
NRF Ind. Waste Ditch (total) – (*Note)	12/7/2010	<200	U	1200	<25	U	<100	U	<120	U	700	<100	U	280		<0.5	U	<200	U	<200	U

<sup>1</sup> Data qualifiers: U = non-detection, J = estimate, R = rejected. A "<" indicates a result below the Minimum Detectable Concentration. NR= analysis not requested.

<sup>2</sup> Concentrations are expressed in µg/L. Samples are filtered unless otherwise indicated.

\*Note: The sample reporting limits were high due to high concentrations of sodium and probably other matrix interfering elements.

**Table 18. Reported common ion concentrations in water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Concentration <sup>1,2</sup>															
		Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Silica	Alkalinity <sup>3</sup>	TDS <sup>4</sup>	TSS <sup>5</sup>					
<b>Up-gradient</b>																	
Site-14*	10/14/2010	33	13	14	3.0	0.387	10.4	J	25.0	J	-	-	128	-	-	-	-
<b>Facility</b>																	
A11A31	11/10/2010	36	16	23	R	3.8	<0.20	U	25.0	42.3	-	-	133	-	-	-	-
ICPP-MON-A-166*	10/7/2010	34	12	9.2		2.6	<0.20	U	8.89	J	17.8	J	125	190	<5.0	U	
M1S	11/8/2010	27	12	11	R	2.7	0.233		16.0	23.4	-	-	96.0	-	-	-	-
M3S	11/8/2010	44	15	8.3	R	2.6	<0.20	U	16.7	28.1	-	-	141	-	-	-	-
M6S	11/10/2010	37	18	14	R	3.2	<0.20	U	31.3	63.5	-	-	101	-	-	-	-
Middle-1823*	10/12/2010	52	17	11		1.8	<0.20	U	12.2	J	34.4	J	173	-	-	-	-
RWMC Production*	10/14/2010	46	16	8.9		2.7	<0.20	U	22.5	J	28.8	J	137	-	-	-	-
TAN-10A	10/12/2010	88	25	50		3.9	<0.20	U	113	37.3	-	-	243	510	<5.0	U	
TRA-07*	10/12/2010	82	20	16		2.9	<0.20	U	20.7	J	157	-	134	-	-	-	-
USGS-104*	10/18/2010	34	14	9.1		2.5	0.204		15.2	22.0	-	-	120	-	-	-	-
USGS-112*	10/7/2010	50	13	16		2.7	0.212		24.1	J	30.8	J	153	-	-	-	-
USGS-115*	10/7/2010	41	12	14		3.4	0.225		38.2	22.9	J	-	216	-	-	-	-
USGS-120*	10/13/2010	37	17	15		3.1	0.200		15.6	J	31.1	J	142	-	-	-	-
<b>Boundary</b>																	
Highway 3*	10/18/2010	45	11	6.0		2.4	<0.20	U	6.89	21.6	-	-	146	-	-	-	-
USGS-125*	10/13/2010	37	15	11		2.7	0.217		13.2	J	24.8	J	138	-	-	-	-
<b>Distant</b>																	
MV-61*	10/13/2010	37	15	17		2.8	0.817		23.0	22.8	-	-	136	-	-	-	-
<b>Surface water</b>																	
Birch Creek*	10/26/2010	42	15	5.1		0.93	<0.20	U	4.99	25.6	-	-	145	-	-	-	-
<b>Waste Water</b>																	
NRF Ind. Waste Ditch	12/7/2010	230	71	16000		24	<4.0	U	31700	59.0	-	-	272	43000	<5.0	U	

<sup>1</sup> 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.

<sup>2</sup> Concentrations expressed in mg/L. Samples are filtered unless otherwise noted.

<sup>3</sup> As CaCO<sub>3</sub>.

<sup>4</sup> =Total Dissolved Solids.

<sup>5</sup> = Total Suspended Solids.

**Table 19. Reported nutrient concentrations in water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Concentration <sup>1,2</sup>					
		Nitrite + Nitrate	Phosphorus	Nitrite	Total Kjeldahl Nitrogen	Ammonia	
<b>Up-gradient</b>							
Site-14	10/14/2010	0.62	0.016	-	-	-	-
<b>Facility</b>							
A11A31	11/10/2010	0.92	0.020	-	-	-	-
ICPP-MON-A-166	10/7/2010	0.20	0.025	-	-	-	-
M1S	11/8/2010	0.97	0.023	-	-	-	-
M3S	11/8/2010	0.83	0.022	-	-	-	-
M6S	11/10/2010	1.5	0.036	-	-	-	-
Middle-1823	10/12/2010	1.1	0.027	-	-	-	-
RWMC Production	10/14/2010	0.98	0.069	-	-	-	-
TAN-10A	10/12/2010	<0.01	U	0.084	-	0.12	0.011
TRA-07	10/12/2010	1.2	0.022	-	-	-	-
USGS-104	10/18/2010	0.87	0.021	-	-	-	-
USGS-112	10/7/2010	1.4	0.030	-	-	-	-
USGS-115	10/7/2010	1.4	0.011	-	-	-	-
USGS-120	10/13/2010	0.89	0.021	-	-	-	-
<b>Boundary</b>							
Highway 3	10/18/2010	0.44	0.025	-	-	-	-
USGS-125	10/13/2010	0.61	0.013	-	-	-	-
<b>Distant</b>							
MV-61	10/13/2010	1.2	0.015	-	-	-	<0.010 U
<b>Surface water</b>							
Birch Creek	10/26/2010	0.25	<0.005	U	-	-	-
<b>Waste Water</b>							
NRF Ind. Waste Ditch	12/7/2010	1.2	2.0	-	-	0.56	-

<sup>1</sup> Data qualifiers: U = non-detection , J = estimate, R = rejected, NR = analysis not requested,

<sup>2</sup> Concentrations expressed in mg/L.

**Table 20. Reported VOC concentrations in water samples, fourth quarter, 2010.**

Sample Location	Sample Date	Concentrations <sup>1,2</sup>	
		Carbon tetrachloride	Trichloroethylene
<b>Boundary</b>			
A11A31	11/10/2010	2.6	1.2
M3S	11/8/2010	4.7	1.4
M6S	11/10/2010	3.0	0.98

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

<sup>2</sup> 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, 2010.**

Sample Location/Dairy	Sample Date	Naturally occurring gamma-emitting radionuclide Potassium-40		Man-made gamma-emitting radionuclide Iodine-131 <sup>1</sup>
		Concentration <sup>3</sup>	± 2 SD	
<b>Monitoring Samples</b>				
Howe/Nelson-Ricks Creamery	10/5/2010	1298	113	<MDC
	11/1/2010	1429	110	<MDC
	12/6/2010	1385	116	<MDC
Mud Lake/Nelson-Ricks Creamery	9/30/2010	1376	109	<MDC
	11/1/2010	1399	117	<MDC
	12/6/2010	1382	108	<MDC
Gooding/Glanbia	10/7/2010	1487	113	<MDC
	11/2/2010	1376	101	<MDC
	12/8/2010	1404	117	<MDC
Riverside	10/12/2010	1921	133	<MDC
	11/10/2010	2004	128	<MDC
	12/9/2010	2093	132	<MDC
Fort Hall	11/3/2010	1117	106	<MDC
	12/6/2010	1426	102	<MDC
<b>Verification Samples<sup>2</sup></b>				
Idaho Falls	10/5/2010	1423	110	<MDC
Dietrich	10/5/2010	1375	114	<MDC
Minidoka	11/2/2010	1430	110	<MDC
Howe	11/2/2010	1398	117	<MDC
Dietrich	12/7/2010	1470	105	<MDC
Terreton	12/7/2010	1399	109	<MDC

<sup>1</sup> <MDC – Less than Minimum Detectable Concentration (approximately 4 pCi/L for Iodine-131).

<sup>2</sup> DEQ-INL OP samples collected by the off-site INL environmental surveillance contractor.

<sup>3</sup> Concentrations are expressed in pCi/L.

## Soil

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

In-Situ gamma spectroscopic measurements were performed at 34 locations (**Figure 4**) including onsite, boundary, and distant monitoring locations during the third calendar quarter of 2010. Data analysis was not completed in time for the third quarter report so results are included here. No man-made radionuclides other than  $^{137}\text{Cs}$  were identified. *In-situ* gamma spectroscopic analysis results for  $^{137}\text{Cs}$  concentrations are shown in **Table 22**.

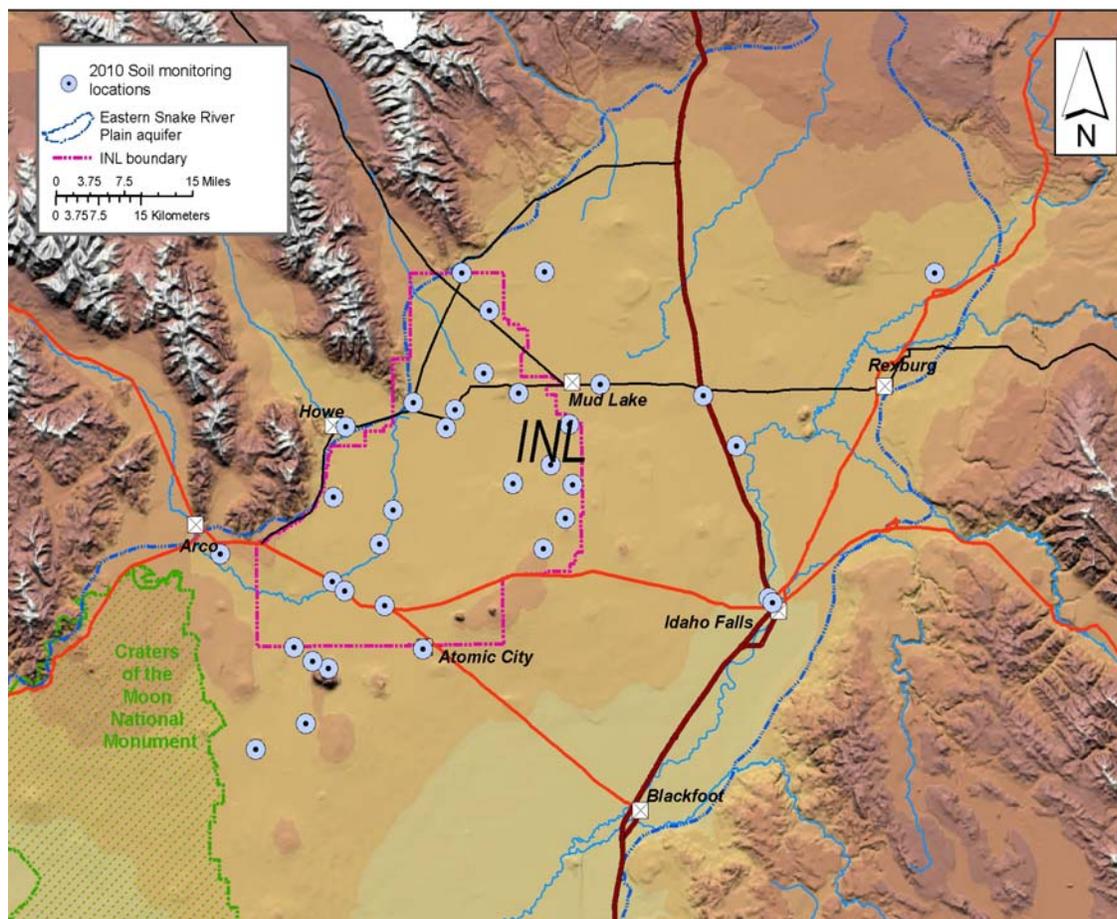


Figure 4. In-situ soil monitoring sites, third quarter 2010.

**Table 22. In-Situ gamma spectroscopy analysis results (<sup>137</sup>Cs) for soil monitoring conducted during the third quarter, 2010.**

Location	Date Acquired	Concentration <sup>1</sup>	± 2 SD	MDC
<b>Boundary Sampling Locations</b>				
Mud Lake/Terretton	8/16/2010	0.051	0.019	0.003
Montevieu	8/16/2010	0.106	0.010	0.003
Reno Ranch	8/16/2010	0.159	0.007	0.002
Mud Lake Soil Site	8/16/2010	0.066	0.006	0.002
Large Grid 12-4	8/20/2010	0.487	0.020	0.005
Large Grid 12-5	8/20/2010	0.396	0.020	0.005
Large Grid 18-4	8/20/2010	0.358	0.021	0.005
Big Southern HPIC	8/20/2010	0.178	0.022	0.004
Frenchman's Cabin	8/20/2010	0.312	0.016	0.004
Howe Met Tower	8/27/2010	0.096	0.013	0.004
Butte City	8/27/2010	0.228	0.013	0.003
Atomic City	9/2/2010	0.320 J <sup>4</sup>	0.009	0.002
<b>Distant Sampling Locations</b>				
Idaho Falls <sup>2</sup>	8/13/2010	0.187	0.013	0.003
St. Anthony	8/13/2010	0.155	0.020	0.004
Roberts	8/16/2010	0.137	0.016	0.003
Sage Junction	8/19/2010	0.348	0.013	0.003
Idaho Falls CMS <sup>3</sup>	9/2/2010	0.212 J	0.013	0.003
<b>On site Sampling Locations</b>				
Large Grid 18-1	8/19/2010	0.478	0.019	0.005
Large Grid 18-7	8/19/2010	0.369	0.021	0.005
Large Grid 24-8	8/19/2010	0.337	0.024	0.005
Large Grid 24-9	8/19/2010	0.344	0.012	0.003
Large Grid 30-1	8/19/2010	0.474	0.017	0.004
Large Grid 18-3	8/26/2010	0.355	0.018	0.005
Large Grid 18-8	8/26/2010	0.420	0.018	0.003
Large Grid 24-2	8/26/2010	0.326	0.026	0.006
Large Grid 24-7	8/26/2010	0.453	0.022	0.005
Rover	8/26/2010	0.399	0.024	0.005
Van Buren	8/27/2010	0.207	0.014	0.004
Sand Dunes	8/27/2010	0.294	0.014	0.003
Big Lost Rest Area	8/27/2010	0.153	0.012	0.003
Base of Howe	8/27/2010	0.226	0.018	0.004
Experimental Field Station	9/2/2010	0.474 J	0.015	0.004
Large Grid 6-3	9/2/2010	0.330 J	0.020	0.005
INL Main Gate	9/2/2010	0.115 J	0.012	0.003

<sup>1</sup>Concentrations, associated uncertainties (± 2 SD), and minimum detectable concentration (MDC) are reported in pCi/g.

<sup>2</sup>DEQ-INL OP HPIC air monitoring station near Idaho Falls, ID

<sup>3</sup>DEQ-INL OP HPIC Community Monitoring Station (CMS) near John's Hole Bridge, Idaho Falls, ID

<sup>4</sup>J = estimate value, see QA section.

The average Cesium-137 value for *in-situ* sampling was 0.274 picocuries per gram (pCi/g) with a minimum value of 0.051 pCi/g and a maximum of 0.487 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 discernable 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.

## Quality Assurance

The measurement of any physical quantity is subject to inaccuracy from errors that may be introduced during sample collection, measurement, calibration, and the reading and reporting of results. While all of these inaccuracies cannot be quantified with certainty for each analytical result, a quality assurance program can evaluate the overall quality of a data set and possibly identify and address errors or inaccuracies.

This section summarizes the results of the quality assurance (QA) assessment of the data collected for the fourth quarter of 2010 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 2010, the DEQ-INL OP submitted 56 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 2010 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**.

No anomalies were observed from the assessment of field blank samples for radiological analyses; however, there were anomalies for those associated with non-radiological analytes. The metal manganese was detected within the metal field blank sample analyzed on 10/27/10. All results for manganese analyzed on 10/27/10 with the metals field blank sample, and which exceeded the MDC were qualified as estimates with a "J"-flag. These include five sample locations shown in Table 17 of the water monitoring section. Also, the common ions chloride and sulfate were detected within the common ion field blank sample analyzed on 10/21/10. All results for both chloride and sulfate analyzed on 10/21/10 with the

common ion field blank sample, and which exceeded the MDC were qualified as estimates with a “J”-flag. These include eight sample locations shown in Table 18 of the water monitoring section.

## 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<sub>1</sub> = first sample result

R<sub>2</sub> = 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 “sigma”) to compare results for radiological analyses. Comparison tests that have an acceptable range of “3 sigma” allow for compared results to differ by as much as three times the pooled error for these measurements.

This is accomplished using the following equation:

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

Where:

R<sub>1</sub> = First sample value.

R<sub>2</sub> = Second sample value.

S<sub>1</sub> = Counting error associated with the laboratory measurement of the first sample.

S<sub>2</sub> = Counting error associated with the laboratory measurement of the second sample.

Duplicate results for ground and surface water are presented in **Table 30**, **Table 31**, and **Table 32** for radiological analyses and non-radiological analyses. Duplicate analyses for *in-situ* soil are presented in **Table 33**. Data analysis was not complete in time for the third quarter 2010 report so *in-situ* results are presented here.

Two field duplicate *in-situ* soil measurements failed to meet the criteria of either the RPD or the 3 sigma test for the <sup>137</sup>Cs energy peak which we report. However, both analyses were in agreement for the <sup>40</sup>K energy peak. Field measurements taken after a failed QA duplicate are considered estimates and the affected <sup>137</sup>Cs results have thus been flagged with a (J) in the *in-situ* soil results table found in the terrestrial section in this report.

No other anomalies were observed from the assessment of field duplicate samples as measured by the analytical laboratories used by DEQ-INL OP for the fourth quarter of 2010.

## 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 2010, no field matrices were spiked to assess the influence of the sample media on laboratory performance. However, several spiked samples were created using de-ionized water and submitted to analytical laboratories for analyses. These non-radiological constituents were used to assess ground water analyte recovery rates and the results are presented in **Table 34**, **Table 35**, and **Table 36**.

Spiked samples for common ion analysis submitted on 11/11/10 and analyzed on 11/24/10 exceeded recovery limits for sodium at 182%. All results for sodium analyzed on 11/24/10 with the common ion spiked sample, and which exceeded the MDC were qualified as “rejected (R)”. This included sample locations from four sites which are shown in Table 18 of the water monitoring section. Also, the VOC spiked sample submitted for analysis 11/11/10 and analyzed 11/12/10 exceeded recovery limits of 125% for vinyl chloride at 143%. All results for vinyl chloride analyzed on 11/12/10 with the spiked sample, and which exceeded the MDC would be qualified as estimates with a “J”-flag; however, there were no detections above the MDC for vinyl chloride in any fourth quarter VOC samples.

No irradiations of electret ionization chambers (EIC) to verify EIC response (categorized as spiked samples) were performed during the fourth quarter 2010.

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 2010.

### **Analytical QA/QC Assessment**

Aside from those 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 2010, 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 2010.

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 2010 met the minimum criteria of the DEQ-INL OP ESP and is summarized in **Table 23**. The analyses for both Gross Alpha and Gross Beta samples collected for NRF Industrial Waste Ditch (101W561) failed due to high TDS and were rejected. Also, the metals sample collected for NRF Industrial Waste Ditch (101W565) had a high sodium content that made up 1.6% of the solution as noted in lab comments. The high concentration of sodium and possibly other matrix interfering elements affected the sample reporting limits which are higher than normal. Other issues encountered during the fourth quarter included six samples that were partially frozen upon delivery to the lab. These included, M1S (101W432; metals, total), A11A31dup (101W475; common ions), A11A31dup (101W477; nutrients), A11A31 (101W580; common ions), A11A31 (101W581; metals, total), and M6S (101W584; common ions). Analysis results for these samples resemble historic concentrations indicating no negative effects from being partially frozen.

### **Preventative Maintenance and Equipment Reliability**

All equipment was calibrated and checked according to pre-described periodicity. Electrical power for the Van Buren sampling site was found to be off upon arrival, which resulted in an invalid sample for one week. Service reliability for air sampling equipment for the fourth quarter of 2010 is summarized in **Table 37**.

## **Conclusion**

All data collected for the fourth quarter of 2010, 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, 2010.**

Media Sampled	Collection Device	Analyte	Test Analyses	Blank Analyses	Duplicate Analyses	Spike Analyses	Data Rejected <sup>1</sup>	Analyzing Lab <sup>2</sup>
<b>AIR</b>								
<b>Particulate</b>	4 inch filter	Gross alpha	132	12	0	0	1	ISU-EML
		Gross beta	132	12	0	0	1	ISU-EML
		Gamma emitters	11	1	0	0	0	ISU-EML
		Radiochemical	0	0	0	0	0	ISU Sub
<b>Water Vapor</b>	Desiccant column	Tritium	38	3	0	0	0	ISU-EML
<b>Gaseous</b>	Charcoal filter	Iodine-131	12	0	0	0	0	ISU-EML
<b>Precipitation</b>	Poly bottle	Tritium	6	0	0	0	0	ISU-EML
		Gamma emitters	6	0	0	0	0	ISU-EML
<b>WATER</b>								
<b>Groundwater &amp; Surface Water</b>	Grab or composite	Gross alpha	25	1	2	0	1	ISU-EML
		Gross beta	25	1	2	0	1	ISU-EML
		Gamma emitters	25	1	2	0	0	ISU-EML
		Tritium	25	1	2	0	0	ISU-EML
		Enriched tritium	12	0	1	0	0	ISU-EML
		Technetium-99	11	0	1	0	0	ISU-EML
		Radiochemical	27	0	1	0	0	ISU Sub
		Metals	19	1	1	2	0	IBL
		Common Ions	19	1	1	2	4	IBL
		Nutrients	19	1	1	2	0	IBL
Volatile Organics	4	0	0	1	0	IBL		
<b>TERRESTRIAL</b>								
<b>Milk</b>	Grab or composite	Gamma emitters	20	0	0	0	0	ISU-EML
<b>Soil</b>	<i>in situ</i>	Gamma emitters	0	0	0	0	0	DEQ-INL OP
	Grab – “puck”	Gamma emitters	0	0	0	0	0	ISU-EML
<b>RADIATION</b>								
<b>Ambient</b>	EICs	Gamma Radiation	52	0	0	0	0	DEQ-INL OP
	HPICs	Gamma Radiation	9	NA	NA	NA	0	DEQ-INL OP
<b>Total Analyses</b>			<b>629</b>	<b>35</b>	<b>14</b>	<b>7</b>	<b>8</b>	
<b>Total of QC Analyses (blanks, duplicates, and spikes)</b>			<b>56</b>					
<b>Percentage of QC analyses of Total Test analyses<sup>3</sup></b>			<b>8.9</b>					
<b>Percentage of usable data<sup>4</sup></b>			<b>98.7%</b>					

<sup>1</sup> Combined Laboratory and DEQ-INL OP rejection criteria (data was rejected for any reason).

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> 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, 2010.**

Collection Period		Corrected volume (m <sup>3</sup> ) <sup>1</sup>	Gross alpha		Gross beta	
Start	Stop		Value	Uncertainty (± 2 SD)	Value	Uncertainty (± 2 SD)
09/30/10	10/07/10	1405	-0.1	0.2	-0.3	0.6
10/07/10	10/14/10	1405	-0.1	0.2	0.0	0.6
10/14/10	10/21/10	1405	0.0	0.1	-0.1	0.6
10/21/10	10/28/10	1405	0.0	0.2	-0.4	0.6
10/28/10	11/04/10	1405	-0.1	0.2	-0.6	0.6
11/04/10	11/11/10	1405	-0.1	0.1	-0.8	0.6
11/11/10	11/18/10	1405	0.0	0.2	-0.1	0.6
11/18/10	12/02/10	2811	-0.1	0.1	-0.1	0.3
12/02/10	12/10/10	1606	-0.2	0.1	-0.4	0.6
12/10/10	12/16/10	1205	-0.1	0.2	-0.5	0.7
12/16/10	12/23/10	1405	-0.1	0.1	0.0	0.6
12/23/10	12/30/10	1405	-0.1	0.1	-0.4	0.6

Note: Concentrations and associated uncertainties (±2 SD) are expressed in 1 x 10<sup>-3</sup> pCi/m<sup>3</sup>.

<sup>1</sup> 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, 2010.**

Analysis Date	Beryllium-7			Ruthenium-106/ Rhodium-106			Antimony-125		
	Concentration <sup>1</sup>	± 2 SD	MDC	Concentration	± 2 SD	MDC	Concentration	± 2 SD	MDC
01/29/11	-10	43	76	5	28	49	0	9	15
Analysis Date	Cesium-134			Cesium-137					
	Concentration <sup>1</sup>	± 2 SD	MDC	Concentration	± 2 SD	MDC			
01/29/11	1	4	7	-1	4	7			

Note: Concentrations are expressed in 1 x 10<sup>-5</sup> pCi/m<sup>3</sup> with associated uncertainty (± 2 SD) and minimum detectable concentration (MDC).

<sup>1</sup> 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, 2010.**

Sample Number	Start Date	Collect Date	Analysis Date	Tritium		
				Concentration	± 2 SD	MDC
OP104ZTR01	12/13/10	12/15/10	01/27/11	-0.03	0.10	0.17
OP104ZTR02	01/11/11	01/12/11	01/27/11	-0.06	0.10	0.17
OP104ZTR03	01/14/11	01/18/11	01/27/11	-0.03	0.10	0.17

Note: Concentrations are expressed in nCi/L 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, 2010.**

Sample Number	Sample Date	Concentration	± 2 SD	MDC	Within Blank Criteria?
<b>Gross Alpha</b>					
101W593	10/7/2010	-0.1	0.3	0.6	Yes
<b>Gross Beta</b>					
101W593	10/7/2010	-0.1	0.6	1.0	Yes
<b>Cesium-137</b>					
101W593	10/7/2010	0.7	1.8	3.0	Yes
<b>Tritium</b>					
101W594	10/7/2010	110	100	160	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, 2010.**

Sample Number	Sample Date	Arsenic	Barium	Beryllium	Cadmium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
101W596	10/7/2010	-	<1	-	-	<1	-	<1	1.9	-	<2

**Table 29. Blank analysis results (mg/L) for common ions and nutrients in ground and surface water for the fourth quarter, 2010.**

Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus
101W597,596,595	10/7/2010	<0.1	<0.1	<0.1	<0.1	<0.2	0.286	0.178	<1	<0.01	<0.005

**Table 30. Duplicate radiological analysis results in pCi/L for ground and surface water, fourth quarter, 2010.**

Analysis/ Sample Location	Original Sample Number	Concentration	±2 SD	Duplicate Sample Number	Concentration	±2 SD	R <sub>1</sub> -R <sub>2</sub>	$3(s_1^2+s_2^2)^{1/2}$	Within Criteria? <sup>1</sup>
<b>Gross Alpha</b>									
A11A31 Minidoka Water Supply	101W575	0.8	1.1	101W471	2.3	1.3	1.5	2.6	yes
	101W453	0.4	1.2	101W144	1.5	1.4	1.1	2.8	yes
<b>Gross Beta</b>									
A11A31 Minidoka Water Supply	101W575	5.2	0.9	101W471	3.9	0.8	1.3	1.8	yes
	101W453	1.5	0.9	101W144	2.6	0.9	1.1	1.9	yes
<b>Gamma Spectroscopy Cesium-137</b>									
A11A31 Minidoka Water Supply	101W575	-0.2	1.3	101W471	1.3	2.0	1.5	3.6	yes
	101W453	0.4	1.6	101W144	-0.8	1.8	1.2	3.6	yes
<b>Tritium</b>									
A11A31 Minidoka Water Supply	101W577	100	80	101W474	130	90	30	181	yes
	101W454	-40	100	101W145	50	100	90	212	yes
<b>Enriched Tritium</b>									
USGS-027	101W082	2.0	7.0	101W129	2.0	7.0	0	15	yes
<b>Strontium-90</b>									
A11A31	101W607	0.03	0.16	101W472	0.08	0.15	0.05	0.33	yes
<b>Technetium-99</b>									
A11A31 (dissolved)	101W576	0.8	0.1	101W473	0.8	0.1	0	0.21	yes

<sup>1</sup>  $|R_1-R_2| \leq 3(s_1^2+s_2^2)^{1/2}$

**Table 31. Duplicate results for metals (µg/L) in ground water and/or surface water for the fourth quarter, 2010.**

Sample Location	Sample Number	Sample Date	Arsenic	Barium	Cadmium	Chromium	Iron	Lead	Manganese	Selenium	Zinc
A11A31 (total)	101W581	11/10/2010	2.1	34	-1	14	58	2.6	1.2	-2	240
A11A31 (total)	101W476	11/10/2010	2.1	34	-1	14	53	2.6	1	-2	240
RPD			0	0	0	0	9	0	18	0	0

Relative Percent Difference =  $(R1-R2) / ((R1+ R2)/2)*100$ . NR= not requested.

**Table 32. Duplicate results for common ions and nutrients (mg/L) in ground water and/or surface water for fourth quarter, 2010.**

Sample Location	Sample Number	Sample Date	Calcium	Magnesium	Sodium	Potassium	Fluoride	Chloride	Sulfate	Total Alkalinity	Total Nitrogen	Total Phosphorus
A11A31	101W581,580,582	11/10/2010	36	16	23R	3.8	0.2	25	42.3	133	0.92	0.02
A11A31	101W476,475,477	11/10/2010	36	16	23R	3.8	0.2	23.8	43.4	133	0.89	0.021
RPD			0.0	0.0	0.0	0.0	0.0	4.9	-2.6	0.0	3.3	-4.9

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

**Table 33. Duplicate *in-situ* analyses of gamma emitting radionuclides in soil, third quarter, 2010.**

Sample Location	Sample Date	Original Result K-40 (pCi/g)	QA Result K-40 (pCi/g)	K-40 RPD (%)	K-40 Less than 3 sigma test	K-40 Meets either criterion?	Original Result Cs-137 (pCi/g)	QA Result Cs-137 (pCi/g)	Cs-137 RPD (%)	Cs-137 Less than 3 sigma test	Cs-137 Meets either criterion?
Idaho Falls	8/13/10	10.87	10.86	0.09	Pass	Yes	0.1866	0.1908	2.23	Pass	Yes
St. Anthony	8/13/10	16.32	16.24	0.49	Pass	Yes	0.1549	0.1362	12.9	Pass	Yes
Atomic City	9/2/10	11.38	11.36	0.18	Pass	Yes	0.3202	0.1996	46.4	Fail	No
EFS	9/2/10	11.94	12.04	0.83	Pass	Yes	0.4742	0.3542	29.0	Fail	No

Relative Percent Difference (RPD) =  $(R1-R2) / ((R1+ R2)/2)*100$ . 3-sigma test:  $|R1-R2| \leq 3(s_1^2 + s_2^2)^{1/2}$ .

**Table 34. De-ionized water spike results (in µg/L) for metals in ground and surface water for the 4th quarter, 2010.**

Spike Sample Number	Sample Date	Barium			Chromium			Lead			Manganese			Zinc		
		spike	result	%R <sup>1</sup>	spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R
101W601	10/27/2010	67.4	70	104	9.64	9.3	96	7.45	7.9	106	7.52	7.2	96	52.8	47	89
101W598	11/10/2010	112.0	110	98	16.1	16	99	5.43	5.60	103	5.48	5.5	100	88.1	79	90

<sup>1</sup> A percent recovery of 100 ± 25 is considered acceptable and is recorded as %R.

**Table 35. De-ionized water spike results (in mg/L) for common ions and nutrients in ground and surface water for the fourth quarter, 2010.**

Spike Sample Number	Sample Date	Calcium			Magnesium			Sodium			Potassium			Fluoride		
		spike	result	%R <sup>1</sup>	spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R
101W601,602	10/27/2010	12.2	12	<b>98</b>	4.82	4.7	<b>98</b>	10.8	11	<b>102</b>	1.65	1.7	<b>103</b>	3.84	3.63	<b>95</b>
101W598,599	11/10/2010	20.3	20	<b>99</b>	8.04	7.7	<b>96</b>	9.88	18	<b>182</b>	1.2	1.2	<b>100</b>	3.10	2.98	<b>96</b>

<sup>1</sup>A percent recovery (%R) of 100 ± 25 is considered acceptable.

**Table 35. continued. De-ionized water spike results (in mg/L) for common ions and nutrients in ground and surface water for the fourth quarter, 2010.**

Spike Sample Number	Sample Date	Chloride			Sulfate			Total Alkalinity as CaCO <sub>3</sub>			Total Nitrogen			Total Phosphorus		
		spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R
101W601,602,603	10/27/2010	101	106	<b>105</b>	19.40	19	<b>98</b>	42.3	42.0	<b>99</b>	1.5	1.5	<b>100</b>	0.0200	0.018	<b>90</b>
101W598,599,600	11/10/2010	61.1	66.5	<b>109</b>	12.3	12.6	<b>102</b>	70.8	68.0	<b>96</b>	2.8	2.7	<b>97</b>	0.01	0.0089	<b>89</b>

<sup>1</sup>A percent recovery (%R) of 100 ± 25 is considered acceptable.

**Table 36. De-ionized water spike results (in µg/L) for VOCs and nutrients in ground and surface water for the fourth quarter, 2010.**

Spike Sample Number	Sample Date	Carbon tetrachloride			Styrene			Tetrachloroethylene			Trichloroethylene			Vinyl Chloride		
		spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R	spike	result	%R
101W009	11/10/2010	7.6	9	<b>118</b>	11.1	11	<b>99</b>	15	15	<b>100</b>	13.4	16	<b>119</b>	9.12	13	<b>143</b>

<sup>1</sup>A percent recovery (%R) of 100 ± 25 is considered acceptable.

**Table 37. Air sampling field equipment service reliability (percent operational), fourth quarter, 2010.**

Station Locations	Sample Type			
	TSP	Radioiodine	Atmospheric Moisture	Precipitation
<b>Onsite Locations</b>				
Big Lost River Rest Area	100%	100 %	100 %	100 %
Experimental Field Station	100%	100 %	100 %	NC <sup>1</sup>
Sand Dunes Tower	100%	100 %	100 %	NC <sup>1</sup>
Van Buren Avenue	92%	100 %	100 %	NC <sup>1</sup>
<b>Boundary Locations</b>				
Atomic City	100%	100 %	100 %	100 %
Howe	100%	100 %	100 %	100 %
Monteview	100%	100 %	100 %	100 %
Mud Lake	100%	100 %	100 %	100 %
<b>Distant Locations</b>				
Craters of the Moon	100%	100 %	100 %	NC <sup>1</sup>
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.

<sup>1</sup>NC = sample not collected at this location.

## Appendix A

**Table A-1. Weekly concentrations (in  $1 \times 10^{-3}$  pCi/m<sup>3</sup>) for gross alpha and gross beta analyses for TSP filters for all locations, fourth quarter, 2010.**

Sample location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
<b>On-site Locations</b>						
<b>Rest Area</b>	9/30/10	10/07/10	2.1	0.4	64.3	2.0
	10/07/10	10/14/10	1.7	0.4	54.4	1.9
	10/14/10	10/21/10	2.4	0.4	78.4	2.2
	10/21/10	10/28/10	0.8	0.3	33.3	1.5
	10/28/10	11/04/10	0.8	0.3	39.0	1.6
	11/04/10	11/11/10	1.2	0.3	52.5	1.8
	11/11/10	11/18/10	0.6	0.3	28.8	1.4
	11/18/10	12/02/10 <sup>1</sup>	0.9	0.2	43.0	1.1
	12/02/10	12/10/10	0.5	0.2	39.6	1.5
	12/10/10	12/16/10	0.4	0.3	29.9	1.6
	12/16/10	12/23/10	0.5	0.2	36.1	1.5
	12/23/10	12/30/10	0.5	0.2	28.8	1.4
	<b>Experimental Field Station</b>	9/30/10	10/07/10	1.8	0.4	59.4
10/07/10		10/14/10	1.6	0.4	52.1	1.9
10/14/10		10/21/10	1.7	0.3	73.5	2.2
10/21/10		10/28/10	1.0	0.3	29.5	1.5
10/28/10		11/04/10	1.0	0.3	39.2	1.7
11/04/10		11/11/10	1.1	0.3	47.4	1.8
11/11/10		11/18/10	0.7	0.3	25.8	1.4
11/18/10		12/02/10 <sup>1</sup>	0.8	0.2	38.3	1.1
12/02/10		12/10/10	0.6	0.2	38.0	1.5
12/10/10		12/16/10	0.1	0.2	29.8	1.6
12/16/10		12/23/10	0.6	0.2	32.1	1.5
12/23/10		12/30/10	0.6	0.2	34.2	1.5

<sup>1</sup> Two week collection due to inclement weather

**Table A-1 continued.** Weekly concentrations (in  $1 \times 10^{-3}$  pCi/m<sup>3</sup>) for gross alpha and gross beta analyses for TSP filters for all locations, fourth quarter, 2010.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
<b>Sand Dunes</b>	9/30/10	10/07/10	1.4	0.3	49.5	1.7
	10/07/10	10/14/10	1.5	0.3	49.4	1.7
	10/14/10	10/21/10	1.8	0.3	70.5	2.0
	10/21/10	10/28/10	0.9	0.3	31.0	1.4
	10/28/10	11/04/10	0.5	0.2	35.3	1.5
	11/04/10	11/11/10	1.0	0.3	45.3	1.6
	11/11/10	11/18/10	0.4	0.2	26.7	1.3
	11/18/10	12/02/10 <sup>1</sup>	0.7	0.2	33.2	1.0
	12/02/10	12/10/10	0.6	0.2	38.0	1.4
	12/10/10	12/16/10	0.2	0.2	24.6	1.4
	12/16/10	12/23/10	0.5	0.2	29.5	1.4
12/23/10	12/30/10	0.7	0.2	38.2	1.5	
<b>Van Buren</b>	9/30/10	10/07/10	1.7	0.4	52.7	1.8
	10/07/10	10/14/10	1.8	0.4	51.6	1.8
	10/14/10	10/21/10	2.4	0.4	77.3	2.2
	10/21/10	10/28/10	0.7	0.3	31.2	1.4
	10/28/10	11/04/10	0.7	0.3	38.6	1.6
	11/04/10	11/11/10	R <sup>2</sup>	R <sup>2</sup>	R <sup>2</sup>	R <sup>2</sup>
	11/11/10	11/18/10	0.6	0.3	24.6	1.3
	11/18/10	12/02/10 <sup>1</sup>	0.9	0.2	32.8	1.0
	12/02/10	12/10/10	0.4	0.2	39.7	1.5
	12/10/10	12/16/10	0.4	0.3	28.2	1.5
	12/16/10	12/23/10	0.4	0.2	34.6	1.5
12/23/10	12/30/10	0.5	0.2	29.2	1.4	
<b>Boundary Locations</b>						
<b>Atomic City</b>	9/30/10	10/07/10	1.8	0.4	56.5	1.9
	10/07/10	10/14/10	1.4	0.3	46.5	1.7
	10/14/10	10/21/10	2.8	0.4	75.5	2.2
	10/21/10	10/28/10	0.9	0.3	31.1	1.4
	10/28/10	11/04/10	1.1	0.3	40.0	1.6
	11/04/10	11/11/10	0.9	0.3	50.1	1.8
	11/11/10	11/18/10	0.5	0.2	24.6	1.3
	11/18/10	12/02/10 <sup>1</sup>	0.8	0.2	36.6	1.1
	12/02/10	12/10/10	0.5	0.2	34.8	1.4
	12/10/10	12/16/10	0.2	0.2	25.6	1.4
	12/16/10	12/23/10	0.5	0.2	33.8	1.5
	12/23/10	12/30/10	0.3	0.2	27.3	1.3

<sup>1</sup> Two week collection due to inclement weather.

<sup>2</sup>R – Results rejected due to insufficient sample volume.

**Table A-1 continued.** Weekly concentrations (in  $1 \times 10^{-3}$  pCi/m<sup>3</sup>) for gross alpha and gross beta analyses for TSP filters for all locations, fourth quarter, 2010.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
<b>Howe</b>	9/30/10	10/07/10	1.9	0.4	53.8	1.9
	10/07/10	10/14/10	1.1	0.3	48.5	1.8
	10/14/10	10/21/10	1.9	0.4	59.6	2.0
	10/21/10	10/28/10	1.0	0.3	31.6	1.5
	10/28/10	11/04/10	0.9	0.3	30.9	1.5
	11/04/10	11/11/10	1.0	0.3	40.8	1.7
	11/11/10	11/18/10	0.3	0.2	28.7	1.5
	11/18/10	12/02/10 <sup>1</sup>	0.9	0.2	33.3	1.0
	12/02/10	12/10/10	0.6	0.2	50.9	1.7
	12/10/10	12/16/10	0.3	0.2	25.6	1.5
	12/16/10	12/23/10	0.4	0.2	25.4	1.4
	12/23/10	12/30/10	0.6	0.2	31.5	1.5
<b>Montevieu</b>	9/30/10	10/07/10	2.3	0.4	63.0	2.0
	10/07/10	10/14/10	1.6	0.4	59.7	2.0
	10/14/10	10/21/10	3.3	0.4	81.2	2.2
	10/21/10	10/28/10	1.4	0.3	34.1	1.5
	10/28/10	11/04/10	1.1	0.3	42.5	1.7
	11/04/10	11/11/10	0.9	0.3	45.5	1.7
	11/11/10	11/18/10	1.0	0.3	33.9	1.5
	11/18/10	12/02/10 <sup>1</sup>	0.9	0.2	50.6	1.2
	12/02/10	12/10/10	0.7	0.2	49.9	1.7
	12/10/10	12/16/10	0.5	0.3	29.1	1.6
	12/16/10	12/23/10	0.5	0.2	31.0	1.5
	12/23/10	12/30/10	1.2	0.3	51.0	1.8
<b>Mud Lake</b>	9/30/10	10/07/10	2.5	0.4	53.4	1.9
	10/07/10	10/14/10	1.5	0.4	46.6	1.8
	10/14/10	10/21/10	2.6	0.4	74.5	2.2
	10/21/10	10/28/10	1.4	0.4	30.3	1.5
	10/28/10	11/04/10	1.1	0.3	41.4	1.7
	11/04/10	11/11/10	1.0	0.3	48.6	1.8
	11/11/10	11/18/10	0.6	0.3	24.8	1.4
	11/18/10	12/02/10 <sup>1</sup>	0.8	0.2	33.4	1.0
	12/02/10	12/10/10	0.5	0.2	39.9	1.6
	12/10/10	12/16/10	0.3	0.3	25.3	1.5
	12/16/10	12/23/10	0.5	0.2	31.0	1.5
	12/23/10	12/30/10	0.6	0.2	34.8	1.6

<sup>1</sup>Two week collection due to inclement weather.

**Table A-1 continued.** Weekly concentrations (in  $1 \times 10^{-3}$  pCi/m<sup>3</sup>) for gross alpha and gross beta analyses for TSP filters for all locations, fourth quarter, 2010.

Sample Location	Collection Date		Gross Alpha		Gross Beta	
	Start	Stop	Concentration	± 2 SD	Concentration	± 2 SD
<b>Distant Locations</b>						
<b>Craters</b>	9/30/10	10/07/10	1.2	0.3	49.8	1.9
	10/07/10	10/14/10	0.7	0.3	38.5	1.6
	10/14/10	10/21/10	1.3	0.3	61.7	2.1
	10/21/10	10/28/10	0.4	0.2	22.3	1.3
	10/28/10	11/04/10	0.4	0.2	31.2	1.5
	11/04/10	11/11/10	0.7	0.3	34.7	1.5
	11/11/10	11/18/10	0.4	0.3	24.5	1.4
	11/18/10	12/02/10 <sup>2</sup>	0.7	0.2	31.6	1.0
	12/02/10	12/10/10	0.3	0.2	24.1	1.3
	12/10/10	12/16/10	0.1	0.2	19.0	1.4
	12/16/10	12/23/10	0.6	0.2	26.1	1.4
	12/23/10	12/30/10	0.3	0.2	15.5	1.2
	<b>Fort Hall<sup>1</sup></b>	9/30/10	10/07/10	2.1	0.4	36.6
10/07/10		10/14/10	1.0	0.3	32.3	1.5
10/14/10		10/21/10	1.8	0.3	53.2	1.8
10/21/10		10/28/10	0.6	0.2	20.6	1.1
10/28/10		11/04/10	0.6	0.3	28.3	1.4
11/04/10		11/11/10	1.1	0.3	36.2	1.5
11/11/10		11/18/10	0.3	0.2	16.0	1.1
11/18/10		12/02/10 <sup>2</sup>	0.6	0.2	24.2	0.9
12/02/10		12/10/10	0.4	0.2	26.0	1.4
12/10/10		12/16/10	0.7	0.3	19.2	1.2
12/16/10		12/23/10	0.6	0.2	21.0	1.2
12/23/10		12/30/10	0.4	0.2	17.4	1.1
<b>Idaho Falls</b>		9/30/10	10/07/10	2.5	0.4	68.2
	10/07/10	10/14/10	1.5	0.3	48.9	1.8
	10/14/10	10/21/10	2.6	0.4	75.6	2.1
	10/21/10	10/28/10	1.3	0.3	39.7	1.6
	10/28/10	11/04/10	0.9	0.3	42.6	1.7
	11/04/10	11/11/10	1.2	0.3	48.3	1.8
	11/11/10	11/18/10	1.3	0.4	36.8	1.9
	11/18/10	12/02/10 <sup>2</sup>	0.9	0.2	34.9	1.1
	12/02/10	12/10/10	0.6	0.2	43.3	1.6
	12/10/10	12/16/10	0.3	0.2	24.9	1.5
	12/16/10	12/23/10	0.7	0.2	34.4	1.5
	12/23/10	12/30/10	0.5	0.2	23.6	1.3

<sup>1</sup> Operated by Shosone-Bannock Tribes.

<sup>2</sup> Two week collection due to inclement weather.

## Appendix B

**Table B-1. Results for all electret locations, fourth quarter, 2010.**

Sample Location	Net Corrected Exposure Rate ( $\mu\text{R/h}$ )	$\pm 2$ SD ( $\mu\text{R/h}$ )
Arco	12.1	0.3
Craters	9.9	0.1
Rest Area	11.8	0.8
Van Buren	15.5	3.7
EFS	15.1	2.5
Main Gate	12.8	3.8
Atomic City	11.0	0.5
Taber	11.6	0.8
Blackfoot	11.0	6.5
Ft. Hall <sup>1</sup>	11.1	1.2
Idaho Falls	10.3	1.4
Mud Lake/ Terretton	13.0	2.9
Monteview	7.4	0.7
Sand Dunes	12.4	1.8
Howe Met. Tower	9.8	3.6
MP276 -20	14.0	1.4
MP274 -20	14.4	3.5
MP272 -20	13.6	1.4
MP270 -20	14.9	3.3
MP268 -20	15.3	6.6
MP266 -20	13.6	2.9
MP264 -20	14.4	2.6
MP270 -20/26	15.7	1.6
MP268 -20/26	14.0	1.1
MP266 -20/26	16.9	2.6
MP263 -20/26	17.0	2.7
MP261 -20/26	13.6	1.9
MP259 -20/26	15.6	1.9
MFC (EBR II)	15.0	3.3
EBR I	14.9	1.4
RWMC	16.0	1.8
CFA	17.1	2.3
CITRC (PBF)	16.9	0.0

**Table B-1 continued. Results for all electret locations, fourth quarter, 2010.**

Sample Location	Net Corrected Exposure Rate ( $\mu\text{R/h}$ )	$\pm 2$ SD ( $\mu\text{R/h}$ )
INTEC (ICPPI)	17.3	2.6
ATR (TRA)	27.9	3.5
NRF	14.9	2.4
TAN	12.5	2.8
Mud Lake Bank of Commerce	17.8	2.8
MP43-33	13.2	2.9
MP41-33	16.0	3.6
MP39-33	18.1	5.5
MP37-33	23.9	1.3
MP35-33	13.9	0.5
MP33-33	19.3	2.5
MP31-33	19.1	1.6
MP29-33	14.6	1.3
MP27-33	18.5	3.9
MP25-33	15.1	0.4
MP23-33	11.5	1.5
Base of Howe	NS <sup>2</sup>	NS
Rover	NS <sup>2</sup>	NS
Hamer	15.5	3.5
Sugar City	17.4	1.1
Roberts	11.8	1.1
Big Southern Butte	NS <sup>2</sup>	NS

<sup>1</sup> Operated by Shosone-Bannock Tribes.

<sup>2</sup> Impassable roads prevented collection of EICS, therefore reported as no sample.

## 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