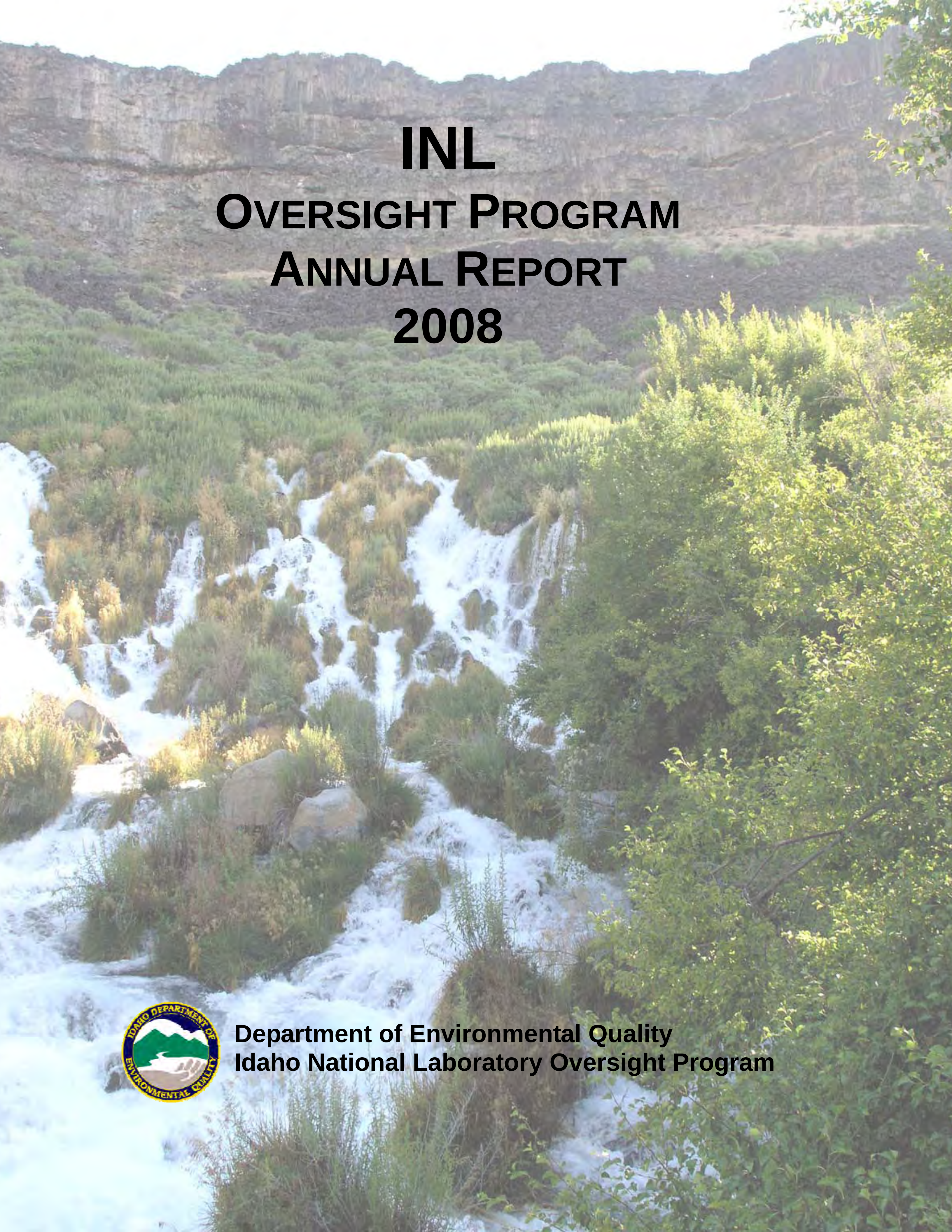

INL
OVERSIGHT PROGRAM ANNUAL REPORT 2008

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Idaho National Laboratory Oversight Program

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Table of Acronyms and Abbreviations

APGEMS	Air Pollutant Graphical Environmental Monitoring System
ARP	Accelerated Retrieval Project
AMWTP	Advanced Mixed Waste Treatment Project
ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance, LLC
BHS	Bureau of Homeland Security
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CWI	CH2M-WG Idaho, LLC
DEQ-INL OP	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 (SM Stoller)
ESP	Environmental Surveillance Program
ESRPA	Eastern Snake River Plain Aquifer
fCi/m^3	femtoCuries per cubic meter
HAD	hazard assessment document
HPIC	high-pressure ion chamber
IBL	Idaho Bureau of Laboratories
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISP	Idaho State Police
LLD	lower limit of detection
LSC	liquid scintillation counting
MFC	Materials and Fuels Complex
MCL	maximum contaminant level
µg/L	micrograms per liter
µR/hr	microRoentgen per hour
mg/L	milligrams per liter
mrem	millirem or $1/1000^{th}$ of a rem
mR/hr	milliRoentgen per hour
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
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pCi/m^3	picocuries per cubic meter
PCE	tetrachloroethylene
QAPP	Quality Assurance Program Plan
QA/QC	quality assurance/quality control
RAP	Radiological Assistance Program
RCRA	Resource Conservation and Recovery Act
RH-TRU	remote-handled transuranic
RPD	relative percent difference

RWMC	Radioactive Waste Management Complex
RTC	Reactor Technology Complex
SBW	sodium-bearing waste
SMCL	secondary maximum contaminant level
TAN	Test Area North
TCE	trichloroethylene
TDS	total dissolved solids
TLD	thermoluminescent dosimetry
TMI	Three Mile Island
TRU	transuranic
TSP	total suspended particulate
TSS	total suspended solids
USGS	U.S. Geological Survey
VOC	volatile organic compound
WGA	Western Governors Association
WIPP	Waste Isolation Pilot Plant
WLAP	wastewater land application permit

Idaho's INL Oversight Mission

For more than half a century, the Idaho National Laboratory (INL), operated by the Department of Energy (DOE) and its contractors, has been the site of development of peacetime uses of nuclear power, the birthplace of our nation's nuclear navy, and a storage location for spent nuclear fuel and various types of nuclear waste. Covering almost 900 square miles of the Snake River Plain and located 40 miles west of Idaho Falls, Idaho, this laboratory served as a testing ground for nuclear reactors. More recently, the major role of the laboratory has focused on environmental cleanup and restoration, as well as energy technology development.

In 1989, the Idaho Legislature established an INL oversight program to provide citizens with independent information and analysis related to the INL. In 2007, legislation was enacted to confirm DEQ as the agency responsible for the INL Oversight Program (DEQ-INL OP), which ensures INL activities are protective of public health and the environment. Our staff has expertise in radiation and health physics, hydrogeology, engineering, ecology, biology, computer science, education, and communications. We serve our fellow Idahoans by:

- Monitoring the environment on and around INL.
- Evaluating potential INL operational impacts to the public and the environment.
- Preparing for emergencies involving radioactive materials.
- Keeping the public informed about INL activities.
- Overseeing compliance with the 1995 Settlement Agreement between the State of Idaho and the DOE and U.S. Navy.

The purpose of this report is to provide a summary of the activities performed by DEQ-INL OP during 2008. The report is divided into sections covering the Environmental Surveillance Program (ESP), Assessment of INL Impacts, Radiological Emergency Response Planning and Preparedness, and Public Outreach.

Environmental Surveillance Program

DEQ-INL OP performs independent environmental monitoring of the INL for the citizens of Idaho through a multifaceted monitoring program. Measurements are collected at locations on the INL site, on public lands off the INL site, at population centers near the INL site, and at locations distant to the INL. Using their own data, DEQ-INL OP scientists also verify DOE monitoring results for air, radiation, water, soil, and milk.

In order to present independent sampling results to the public and interested agencies, DEQ-INL OP issues written quarterly and annual reports. Each quarterly report contains the detailed data and results of the DEQ-INL OP environmental monitoring program. The annual report is designed to summarize the quarterly data, look at general trends of major contaminants found in and around the INL, ascertain the impacts of DOE operations on the environment, and determine the validity of DOE monitoring 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. To this end, the results of DEQ-INL OP environmental monitoring in and around the INL for 2008 are briefly summarized below.

Monitoring Results

In 2008, DEQ-INL OP conducted off-site monitoring to measure environmental radiation levels and radioactivity in air, water, soil, and milk around the INL. Radioactivity levels found in air, soil, and milk samples were typical of background values. DEQ-INL OP also detected small quantities of tritium in the ground water near the southern boundary of the INL, which were attributed to historic INL operations. These concentrations, although greater than natural background levels, were less than 2% of the drinking water standard for tritium. No other contaminants attributable to INL operations were identified in ground water samples collected off-site of the INL.

On-site environmental measurements made by DEQ-INL OP in 2008 were consistent with past results. Water samples collected from locations near INL facilities identified concentrations of strontium-90, chromium, chloride, manganese, and volatile organic compounds (VOCs) greater than drinking water standards. These contaminants were found in locations of known INL contaminant plumes and at levels consistent with historic trends for these sites. These water sources are not used by the public or INL workers. Other contaminants from historic INL operations were identified in water, but at concentrations less than drinking water standards and within expected levels.

Tritium was occasionally detected in atmospheric moisture samples collected from both on-site and off-site monitoring locations. When detected these levels were less than 1% of EPA regulatory limits. Environmental measurements of radioactivity in air and direct radiation were typical of background levels at all sites, as were terrestrial radioactivity contributions calculated from soil estimates.

Trends

Results for 2008 monitoring showed measurements that were consistent with historic trends. Concentrations of radioactivity in air, soils, and milk continued to be unchanged from

Did You Know?

The amount of radioactivity in the environment is measured using terms that describe how often the material undergoes radioactive decay.

A **curie** is a unit of radioactivity, symbolized as Ci, equal to 3.7 x 10^{10} disintegrations or nuclear transformations per second. This is approximately the amount of radioactivity emitted by one gram (1g) of radium-226. The unit is named after Pierre Curie, a French physicist.

Fractions of curie are typically used to define small amounts of radioactivity. For example:

milli - millicurie is simply one one-thousandth of a curie

micro - microcurie is simply one one-millionth of a curie

nano - nanocurie is simply one one-billionth of a curie

pico - picocurie is simply one one-trillionth of a curie

femto - femtocurie is one-quadrillionth of a curie

Multiplication Factor	Prefix	Symbol
$0.001 = 10^{-3}$	milli	m
$0.000001 = 10^{-6}$	micro	μ
$0.000000001 = 10^{-9}$	nano	n
$0.000000000001 = 10^{-12}$	pico	p
$0.000000000000001 = 10^{-15}$	femto	f

previous years and were consistent with background levels. Radiation levels also were consistent with historic background measurements. Concentrations of strontium-90, chromium, chloride, manganese, and VOCs exceeded federal drinking water standards at sites on the INL in 2008. Trends for tritium continue to decline. Gross beta radioactivity followed trends for strontium-90. The concentrations of some contaminants, such as gross alpha radioactivity, technetium-99, and VOCs, showed trends that were not as clearly understood, possibly responding to changes in INL operations and cleanup efforts. Tritium concentrations in atmospheric moisture remained consistent with previous years.

Comparison with DOE Data

In general, there is a good agreement between the environmental monitoring data reported by DEQ-INL OP and the DOE. This level of comparability between DEQ-INL OP and DOE confirms that both programs present reasonable explanations of the state of the environment surrounding the INL. This should help to foster public confidence in both the State's and DOE's monitoring programs and conclusions drawn from their monitoring.

In the pages that follow, the results of DEQ-INL OP's monitoring for each type of media (air, radiation, water, soil, and milk) are discussed in greater detail.

Air Monitoring

Continuous air monitoring is conducted at 11 locations to monitor concentrations of radionuclides in the atmosphere. These 11 locations include one air monitoring station operated by the Shoshone-Bannock Tribes at Fort Hall, Idaho.

Air monitoring locations (and selected other DEQ-INL OP monitoring sites) are shown in **Figure 1** and a continuous air monitoring station is shown in **Figure 2**.

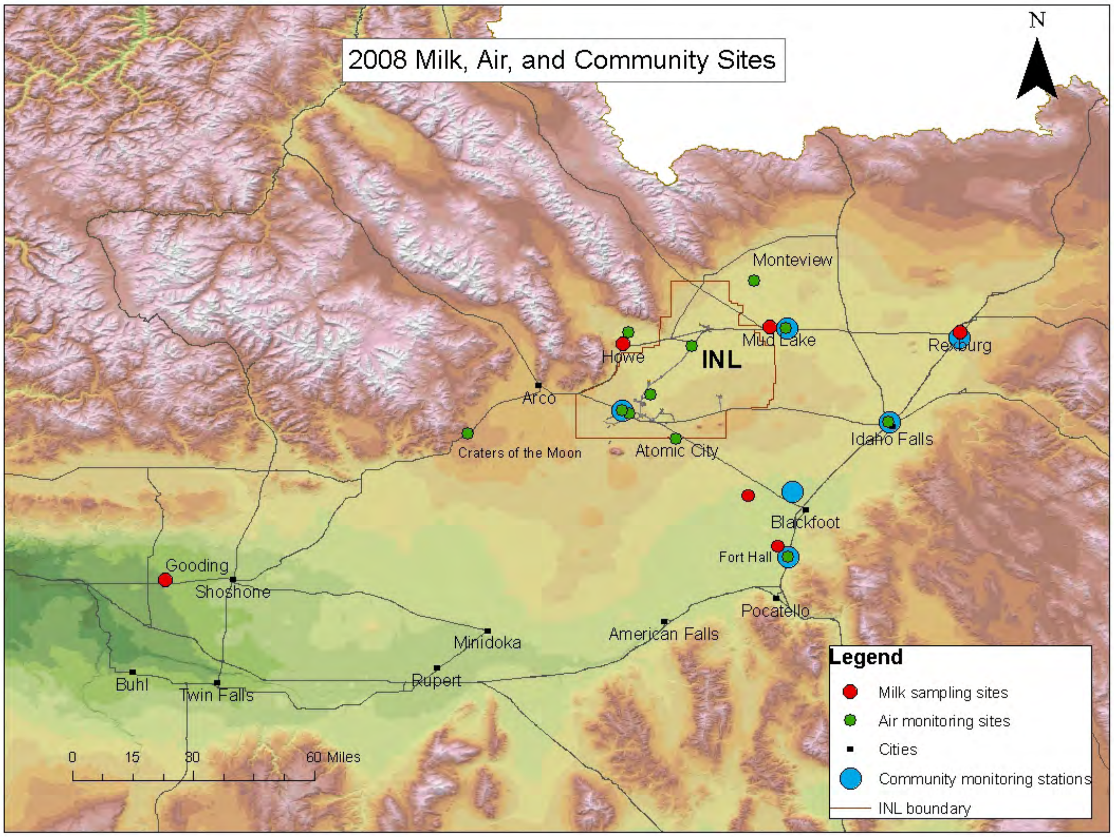


Figure 1. Locations of selected DEQ-INL OP monitoring sites.

Figure 2. A DEQ-INL OP continuous air monitoring station.

Air monitoring stations are segregated into three categories:

- On-site stations are located within the INL boundary and include Experimental Field Station, Van Buren Avenue, Highway 20 Rest Area, and Sand Dunes/INL Gate 4.
- Off-site stations are located near the INL boundary and include Mud Lake, Monteview, Howe, and Atomic City.
- Distant or background locations are used for data comparisons and include the Craters of the Moon visitor center, Idaho Falls, and Fort Hall.

Particulate air samples (i.e., filters) and radioactive iodine gas samples (charcoal cartridges) are collected weekly to monitor short-term radiological conditions in the environment. Atmospheric moisture is also collected continuously to measure tritium concentrations present in the air. Finally, precipitation samples are collected at six locations to monitor for tritium and gamma-emitting radionuclides that may be present in the environment. A DEQ-INL OP air monitoring station with all four different types of sampling equipment is pictured in **Figure 3.**

Figure 3. DEQ-INL air monitoring station with a radioiodine sampler, an atmospheric moisture sampler, a precipitation sampler, and a total suspended particulate matter sampler (TSP).

In order to verify results, data collected by DEQ-INL OP at some air monitoring stations are directly compared to the air monitoring results obtained by the DOE and its contractors at co-located sample sites.

Air Monitoring Equipment and Procedures

Particulate matter is collected using a high-volume total suspended particulate (TSP) matter air sampler. The filters are collected weekly and are analyzed for gross alpha and gross beta radioactivity. Air concentrations are calculated based upon the amount of radioactivity on the filter divided by the quantity of air that has passed through the filter. Quarterly composite samples of all TSP filters collected from each location are analyzed for gamma-emitting radionuclides. Yearly composite samples of all TSP filters collected from each location are analyzed via radiochemical separation for strontium-90, americium-241, plutonium-238, and plutonium-239/240.

Radioactive iodine (radioiodine) 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 physically absorbs the radioiodine within its sponge-like pores. Each week, canisters are collected from all 11 air monitoring stations and analyzed together as a group. If radioiodine is detected in this grouping, the canisters are individually analyzed.

Atmospheric moisture is collected by drawing air through a column filled with molecular sieve beads (a desiccant or water-absorbing material). Upon saturation with moisture, the column is removed and the beads are heated up, causing them to release their stored moisture. This moisture is then condensed and collected as water in a sample container and subsequently analyzed for tritium.

Precipitation sampling involves the collection of precipitation using a collection tray that is heated during the winter months. At the end of each calendar quarter or once the 5-gallon sample container is full, whichever occurs first, the water sample is collected and analyzed for tritium and for gamma-emitting nuclides.

All samples collected from DEQ-INL OP’s air monitoring program are analyzed by the Idaho State University Environmental Monitoring Laboratory (ISU-EML) or its subcontractor(s). Analysis methods used are consistent with industry standards.

Air Monitoring Results and Trends

The following sections include monitoring results and trends for air monitoring.

Particulate Matter in Air

A total of 553 filters from TSP samplers were collected during 2008. The results from the analyses of off-site location samples were indistinguishable from those of on-site locations. Gross alpha and beta screening results for 2008 are well below federal regulatory limits (40 CFR 61) and are summarized in **Table 1**.

Table 1. Gross alpha and beta screening ranges and averages observed by DEQ-INL OP for 2008.

DEQ-INL Oversight Program	Gross Alpha Range (fCi/m^3)[a]	Gross Alpha Average (fCi/m^3)	Gross Beta Range (fCi/m^3)	Gross Beta Average (fCi/m^3)
2008	0.1 to 3.5	1.1 ± 0.2	3.8 to 66.6	28.9 ± 0.6

a. fCi/m^3 – femtocuries per cubic meter

The annual TSP filter composite samples showed concentrations of strontium-90 from 2.15×10^{-5} to 6.23×10^{-5} picocuries per cubic meter (pCi/m^3) for 2008. Of the transuranic radionuclides (plutonium-238, 239, 240 and americium-241) analyzed for, Pu-238 was detected at 0.18 pCi/m^3 (slightly above the MDC of 0.17 pCi/m^3) for the Rest Area composite, and Pu-239/240 was detected at the Van Buren location at a value of 0.06 pCi/m^3 (slightly above the MDC of 0.05 pCi/m^3). These values are within the expected range due to global fallout from historic above-ground weapons testing and well below federal regulatory limits (40 CFR 61).

Atmospheric Tritium

A total of 154 atmospheric moisture samples were collected in 2008 from 11 monitoring locations and analyzed for tritium. Detectable airborne tritium concentrations are occasionally observed in the environment. The highest airborne tritium concentrations observed by DEQ-INL OP on the INL in 2008 were 1.15 ± 0.45 pCi/m^3 at the Experimental Field Station for the time period of 6/22-7/10, 2008, 1.14 ± 0.34 pCi/m^3 for the period 7/10-7/31, 2008 and 0.64 ± 0.29 pCi/m^3 for the period 9/04-9/25, 2008; and 0.32 ± 0.12 pCi/m^3 at Van Buren Avenue for the time period of 12/27, 2007 through 3/27, 2008; and 0.66 ± 0.31 pCi/m^3 at the Big Lost River Rest Area station for the period of 9/04-9/25, 2008.

All atmospheric tritium measurements for 2008 were less than one percent of the concentration for compliance with federal regulations (40 CFR 61). Tritium levels were at or near background levels at all locations.

Gaseous Radioiodine

No gaseous Radioiodine was detected by DEQ-INL OP in 2008.

Precipitation

No tritium or human-made gamma-emitting radionuclides have been detected by DEQ-INL OP in precipitation samples since the inception of its air monitoring program in 1994.

Air Monitoring Verification Results

Comparisons of suspended particulate matter results from co-located monitoring stations used by DEQ-INL OP, the Environmental Surveillance, Education and Research Program (ESER), and Battelle Energy Alliance (BEA) for 2008 agreed within 20%, with the exception of the comparison of gross beta results between DEQ-INL OP and BEA, which agreed within ~34% and DEQ-INL OP and Stoller which agreed within ~ 40% as shown in **Table 2**. Slight variations in sampling methods and schedules and random uncertainty are the likely causes for the small differences observed. These differences have been an ongoing trend in recent years and will continue to be investigated by DEQ-INL OP in 2009 to try to quantify the variations in sampling methods between the different organizations that perform air sampling at the INL. However, all the results agree in that they are several orders of magnitude below minimum regulatory limits. The results from all three monitoring agencies indicate no public health risk.

Table 2. Comparison of DEQ-INL OP suspended particulate matter analysis results for paired samples with DOE contractor results in 2008.

(Results are presented as percentage of samples that agree within 20 percent or a 3-sigma test.)

Sampling Agency	ESER Stoller[a]	BEA[b]
DEQ-INL Oversight Gross Alpha Analysis	82.5 %	98.0 %
DEQ-INL Oversight Gross Beta Analysis	59.9 %	65.6 %

a. ESER – Environmental Surveillance, Education and Research [Program], conducted by INL contractor S. M. Stoller Corporation.

b. BEA – Battelle Energy Alliance, INL prime contractor during 2008.

Comparing tritium sample results among DEQ-INL OP, ESER, and BEA is problematic because although sampling sites are co-located, samples are not paired or split samples. Each monitoring agency collects its tritium sample when the desiccant material becomes saturated with moisture; therefore the sampling frequency is dependent on the volume of desiccant used and the sampler flow rate resulting in differences and overlaps in sampling schedules throughout the year. Also, most of the results are near or below the MDC, where statistical uncertainties are relatively high. These factors make a direct one-to-one comparison of results not possible. However, all the results agree in that they are several orders of magnitude below minimum regulatory limits. The results from all three monitoring agencies indicate no public health risk.

No iodine-131 was detected in 2008 by DEQ-INL OP, ESER or BEA, using activated charcoal canisters.

Air Monitoring Impacts and Conclusions

Based upon 2008 air quality measurements, DEQ-INL OP concludes that there are no discernable impacts to off-site locations as a result of INL operations. The results of screening analyses performed on particulate filters collected at boundary locations are consistent with the results obtained from background locations.

Atmospheric moisture sampling by all three agencies has occasionally shown detectable quantities of tritium in the environment; however, all detected quantities are well below federal regulatory limits and indicate no risk to public health.

Overall, DEQ-INL OP air monitoring results agreed with the results obtained by DOE and its contractors either (1) by direct comparison or, (2) where this is not possible, by the fact that all results are well below regulatory limits and pose no health concerns for the citizens of Idaho.

Radiation Monitoring

Penetrating radiation is naturally present in the environment, due to cosmic sources and naturally occurring radioactive materials in rock and soil. Human-made sources include the residual radioactivity present in soil from historic above-ground testing of nuclear weapons and nuclear reactor operations. Radiological conditions on the INL and throughout the eastern Snake River Plain are continuously monitored by DEQ-INL OP. Penetrating radiation measurements are performed by DEQ-INL OP at each air monitoring station maintained by DEQ-INL OP, at meteorological towers maintained by the National Oceanic and Atmospheric Administration (NOAA), at background locations distant to the INL, and along roadways that bound or cross the INL (**Figure 5**). Radiation monitoring results obtained by DEQ-INL OP are compared with radiation monitoring results reported by the DOE and its INL contractors for these same locations to determine whether the data are comparable.

Radiation Monitoring Equipment and Procedures

Radiological conditions are monitored continuously via a network of 12 high-pressure ion chambers (HPICs) that provide "real-time" radiation exposure rates. One of these HPIC stations is owned and operated by the Shoshone-Bannock Tribes at Fort Hall, Idaho, and uses equipment identical to that used by DEQ-INL OP. Data are collected by DEQ-INL OP via radio telemetry and are available to the public on the World Wide Web at http://www.deq.idaho.gov/inl_oversight/monitoring/piconline.cfm.

DEQ-INL OP also uses a network of passive electret ion chambers (EICs) on and around the INL to cumulatively measure radiation exposure. These measurements are then used to calculate an average exposure rate for the quarterly monitoring period. The objectives of the DEQ-INL OP EIC network are to identify baseline levels (background radiation) to use for comparison in the event of an upset condition (accidental release of radioactive material), to assess dose and verify the dispersion model, and to verify contractor environmental gamma radiation data. **Figure 4** shows a DEQ-INL OP staff member collecting an EIC for analysis and installing a new one.

Figure 4. Collecting an electret ionization chamber (EIC) and installing a new one.

Radiation Monitoring Results and Trends

During the course of 2008, EIC and HPIC measurements performed at locations on INL were similar to those at off-site monitoring locations and were consistent with expected background exposures associated with natural cosmic and terrestrial sources.

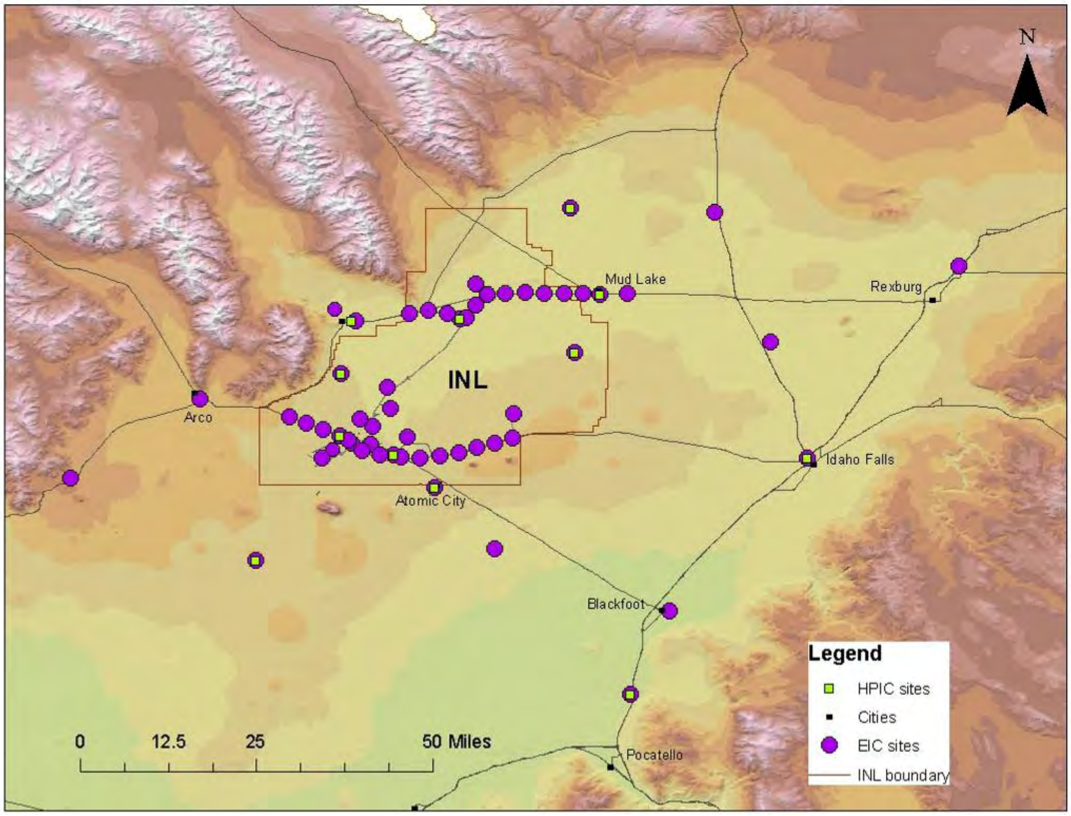


Figure 5. Locations of HPIC and EIC monitoring sites.

Radiation Monitoring Verification Results

DEQ-INL OP has placed several EICs at locations monitored by DOE contractors, using thermoluminescent dosimetry (TLD). Ambient penetrating radiation measurements during 2008 showed 100% of BEA's TLD measurements and 100% of ESER Stoller's TLD measurements satisfied the “3 sigma” test when compared with co-located DEQ-INL OP EIC measurements (**Table 3**).

Table 3. Comparison of DEQ-INL OP, ESER Stoller, and BEA radiation measurements at co-located sites in 2008. (Units in micro-Roentgen per hour or µR/h)

Statistical Measure	DEQ	ESER Stoller[a]	BEA[b]
Mean	13.26	13.25	14.26
Median	13.44	13.11	14.37
Standard Deviation	1.76	0.62	1.07
Minimum	9.79	12.39	12.11
Maximum	16.83	14.35	16.42
Average % difference		13.12%	11.15%

a. ESER – Environmental Surveillance, Education and Research [Program], conducted by INL contractor S. M. Stoller Corporation.

b. BEA – Battelle Energy Alliance, INL prime contractor during 2008.

Radiation Monitoring Impacts and Conclusions

Based upon radiation measurements made by DEQ-INL OP, there are no discernable impacts from INL operations in 2008. Measurements on the INL are comparable to those at background locations. Averaged real-time HPIC measurements are consistent with quarterly EIC dose rates.

Water Monitoring

During 2008, 92 water monitoring sites were sampled to aid in identifying INL impacts on the Snake River Plain Aquifer. Data collected from these monitoring sites were further examined to determine trends of INL contaminants and other general ground water quality indicators. Some data were also used to determine whether the monitoring results obtained by the DOE and its contractors were consistent with the sampling results obtained by DEQ-INL OP for these same locations.

Samples collected from water monitoring sites are analyzed for radiological and non-radiological constituents. Measuring these constituents and parameters helps to identify INL impacts to the aquifer. Many of these analytes occur naturally in ground water and surface water. Elevated concentrations are also present in certain areas of the aquifer, due to historic and ongoing INL operations. Key non-radiological analytes include various common ions, trace metals, and organic compounds. Radiological analytes focus on specific human-made contaminants, such as gross alpha and gross beta radioactivity, cesium-137 and other gamma-emitting radionuclides, tritium, strontium-90, and technetium-99, although measurements of natural background radioactivity are also recorded.

The types of sites sampled include ground water locations (wells and springs), surface water locations (streams), and selected wastewater locations from INL facilities. Sample sites are also categorized as up-gradient, facility, boundary, distant, surface water, or wastewater. Up-gradient locations are not impacted by INL operations, so they are considered representative of background ground water quality conditions. Facility locations are sample sites within the INL that are near facilities, are in areas of known contamination, or have been selected to illustrate trends for specific INL contaminants or indicators of ground water quality. Boundary locations are on or near the southern boundary of the INL or 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. Surface water and wastewater are monitored because they are current sources of recharge to the aquifer or impacts to the aquifer. The water monitoring sites on and surrounding the INL are graphically depicted on **Figure 6** and **Figure 7**, providing a "big picture" of the coverage of the water monitoring program on the Snake River Plain.

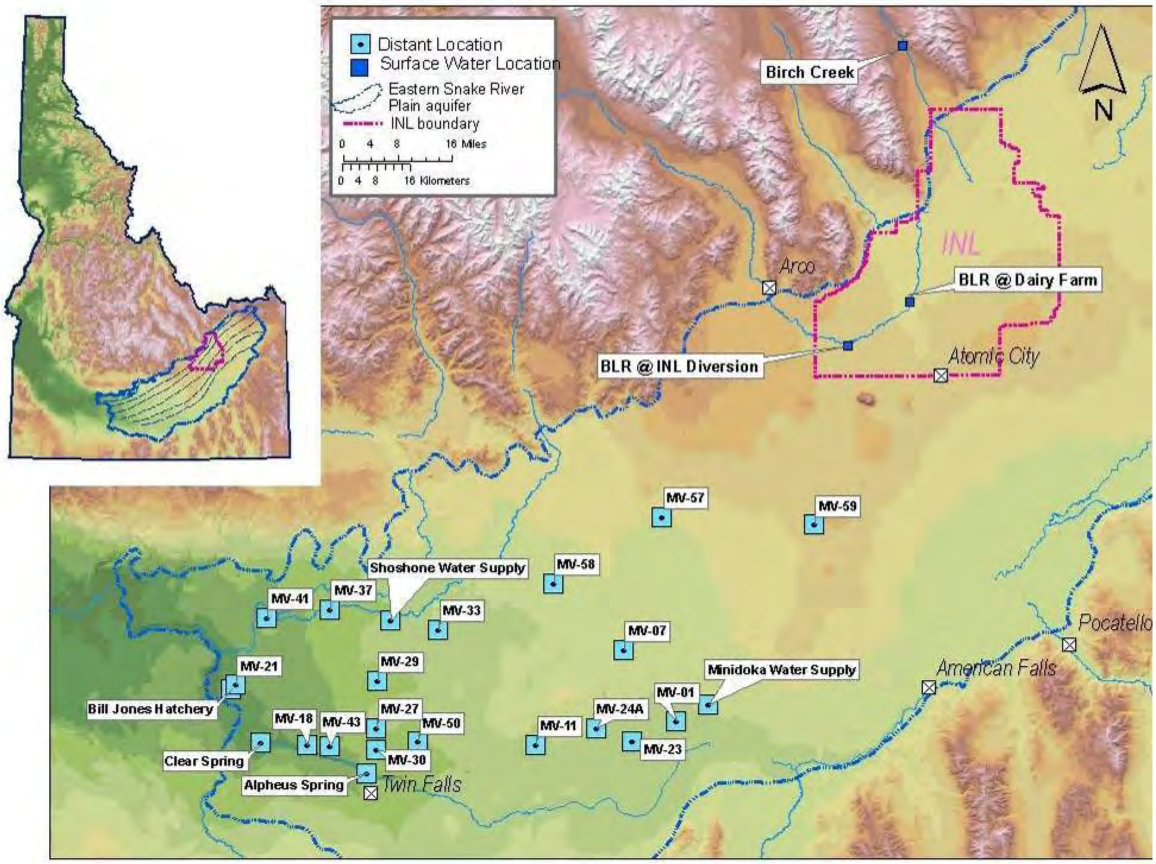


Figure 6. Water quality monitoring sites distant from the INL and surface water sites on Birch Creek and the Big Lost River (BLR).

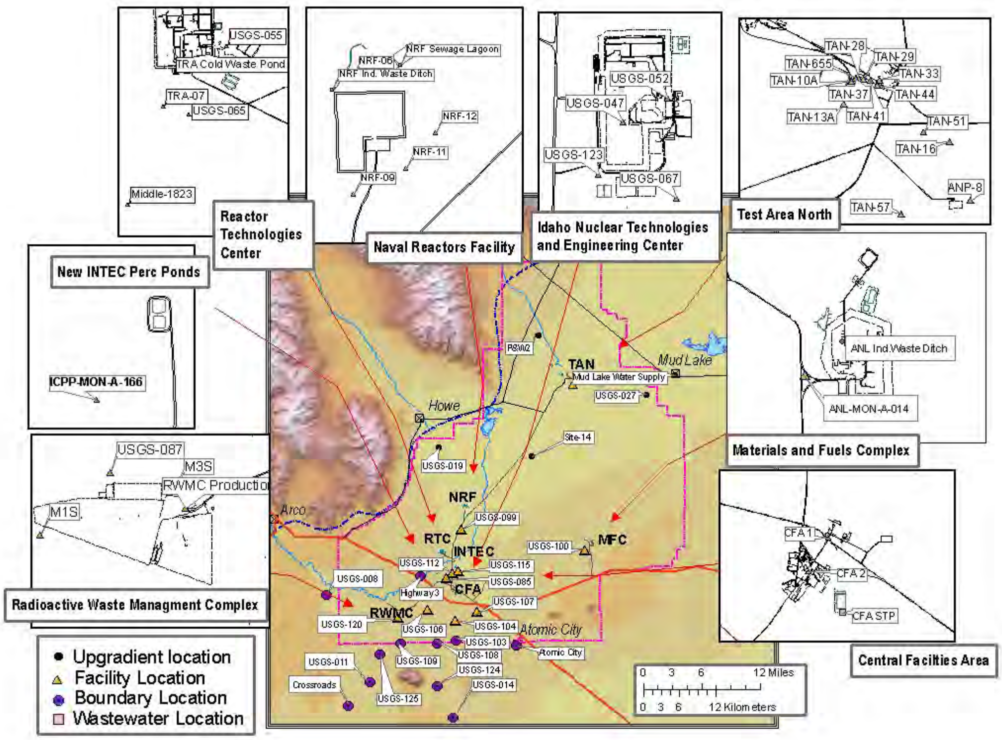


Figure 7. Water quality monitoring sites on and near the INL.

Water Monitoring Equipment and Procedures

Most ground water samples were collected from wells equipped with submersible pumps. Surface water samples were typically collected as grab samples from the water source. All water samples were handled and preserved using standard methods.

Sample analyses for non-radiological analytes were conducted by the Idaho Bureau of Laboratories in Boise or their subcontractor(s). Radiological analyses were performed by ISU-EML or its subcontractor(s). Analysis methods used were consistent with industry standards.

Samples from all monitoring locations were analyzed for gross alpha and gross beta radioactivity, for gamma-emitting radionuclides (by gamma spectroscopy), and for tritium. Selected sites with historic INL contamination were also sampled for strontium-90, technetium-99, and other site-specific analytes including uranium isotopes, plutonium isotopes (238, 239/240, and 241), neptunium-237, and americium-241. Samples were collected from monitoring sites for analysis of non-radiological parameters including the common ions (calcium, magnesium, sodium, potassium, chloride, fluoride, sulfate, and total alkalinity), nutrients (total nitrate plus nitrite and total phosphorus), and trace metals (barium, chromium, manganese, lead, and zinc).

The wellhead of a DEQ-INL monitoring well is pictured in **Figure 8**. **Figure 9** shows DEQ-INL OP staff members collecting a ground water sample.

Figure 8. Wellhead of a DEQ-INL OP monitoring well, surrounded by range cattle.

Figure 9. DEQ-INL OP staff members collect a sample from a monitoring well.

Water Monitoring Results and Trends

A summary of the ranges of analyte concentrations observed for up-gradient, facility, boundary, distant, and surface water monitoring sites is presented here. Also, analytical results from several sample locations are highlighted and examined more closely to identify current trends. Results for all DEQ-INL OP environmental surveillance are available in quarterly data reports on the DEQ Web site at http://www.deq.idaho.gov/inl_oversight/library.cfm.

Radiological Analytes

Gross alpha and gross beta analyses measure radioactivity contributed by alpha or beta particles in a sample, regardless of their radionuclide source. These analyses do not differentiate among the types of radionuclides present in a sample of water. Radionuclide contributors to both gross alpha and gross beta radioactivity can occur naturally, as well as due to historic INL operations. Therefore, the gross alpha and gross beta radioactivity analyses are especially useful to screen for the possible presence of specific radionuclides at levels above naturally occurring radioactive concentrations.

The primary natural sources of gross alpha radioactivity in ground water and surface water are naturally occurring uranium and thorium. The gross alpha radioactivity observed in most facility, boundary, distant, and surface water sites is due to natural sources. Some facility sites do show gross alpha radioactivity from INL sources. This is apparent not only because concentrations are above background, but other human-made contaminants are also detectable. The highest concentration for DEQ-INL OP sampled sites was from a facility site, TAN-37 (**Table 4**). A summary of this and other radiological results from water monitoring is shown in **Table 4**.

Select locations are sampled for uranium and plutonium isotopes. In 2008, uranium isotope results were not differentiable from natural background ranges. Plutonium, neptunium-237, and americium-241 were not detected in 2008.

Table 4. Summary of selected radiological analytical results for DEQ-INL OP 2008 water samples, wastewater excluded.

Analyte (pCi/L)[1]	Facility			Up-gradient, Boundary, Distant, and Surface Water			Back-ground[2]	Drinking Water Standard[3]
	Min	Median	Max	Min	Median	Max		
Gross Alpha	<MDC[4]	<MDC	29.4 ± 9.7	<MDC	<MDC	4.8 ± 2.8	0-3	15
Gross Beta	<MDC	4.3	1711 ± 17	<MDC	3.7	8.8 ± 1.3	0-7	50
Cesium-137	<MDC	<MDC	6.9 ± 2.4	<MDC	<MDC	<MDC	0	200
Tritium	<MDC	770	6390 ± 190	<MDC	<MDC	430 ± 100	0-40	20,000
Strontium-90	<MDC	<MDC	650 ± 150	NS[5]	NS	NS	0	8
Technetium-99	<MDC	2.1	314.9 ± 1.1	1.1 ± 0.2	1.45	1.8 ± 0.2	0	900

[1] pCi/L – picocuries per liter

[2] Background concentrations for the Snake River Plain Aquifer

[3] The federal drinking water standard is expressed as a cumulative annual dose of 4 millirem/year. This value was converted to a specific concentration for each analyte.

[4] MDC is the minimum detectable concentration

[5] NS – Not Sampled

Sources of naturally occurring gross beta radioactivity include radioactive potassium-40, as well as radioisotopes that have decayed from natural uranium and thorium. Several locations on the INL have gross beta levels that exceed those observed from natural sources in the Eastern Snake River Plain Aquifer (ESRPA). The highest concentration of gross beta radioactivity was measured at a facility site, TAN-37 (**Table 4**). The most likely source of gross beta radioactivity at this well is strontium-90, as seen in **Figure 12**. DEQ-INL OP has been tracking the levels of gross beta radioactivity present at INL monitoring sites for several years.

Cesium-137 was detected at very low levels in two samples in 2008, TAN-37 and USGS-47. Cesium-137 is a known contaminant for both the TAN area and INTEC area.

Monitoring samples were analyzed for additional human-made contaminants such as tritium, strontium-90, and technetium-99, and most results were consistent with concentrations measured in previous years. In the following sections, the results for tritium, strontium-90, and technetium-99 are discussed.

Tritium

Most of the radioactivity released to the aquifer was in the form of tritium from spent nuclear fuel reprocessing operations at the Idaho Nuclear Technology and Engineering Center (INTEC) and Reactor Technology Complex (RTC). At INTEC, tritium was disposed in the aquifer by injection well and later by percolation ponds. Waste pond operations that allowed tritium to infiltrate to the aquifer ceased in 1995 at INTEC and in 1993 at RTC. Tritium concentrations for selected wells with INL contamination near INTEC and RTC are presented in **Figure 10** (see **Figure 7** on page 13 for well locations). The tritium concentrations found in these wells have continued to decline because tritium is no longer disposed directly to the aquifer. Over time, the tritium contamination has undergone radioactive decay and has been diluted in the aquifer. Historic levels had previously exceeded the maximum contaminant level (MCL) of 20,000 picocuries per liter (pCi/L) for many of these sites.

Tritium concentrations found in wells near RWMC have also declined since about 1998, although they are much lower in concentration than those near INTEC and RTC. The source of tritium observed in wells at the RWMC is likely from wastes disposed at that facility, although up-gradient tritium sources at RTC may also contribute to the ground water contamination in these wells. Tritium concentrations greater than background have been measured in wells approximately 4 miles past the INL southern boundary using an enriched tritium analysis which has a lower MDC (10 to 14 pCi/L). **Figure 11** shows tritium concentrations measured in 2008.

Previously, tritium results from USGS-103 (near the southern boundary) have been less than the detection level using the standard tritium analysis method, and at or near the detection level for the enriched tritium analysis method, consistent with expected SRPA background levels. In 2007, the USGS deepened this well to approximately 1290 feet and equipped it with a Westbay™ packer sampling system, designed to allow samples to be taken from seven isolated vertical zones within the well. This enables scientists to determine the vertical distribution of contaminants at that location. Following Westbay ™ installation in 2007, DEQ-INL co-sampled with the USGS at the zone closest to the original pump-depth (615 ft below land surface). The resulting tritium concentration (42 pCi/L) was greater than previous concentrations, but still within the general background range. In 2008, the deepest zone was sampled, which is at 1269.4

ft bls (below land surface).The result (430 pCi/L) was an order of magnitude greater than the 2007 sample. These results indicate that at USGS-103, INL-related tritium contamination occurs at deeper levels within the aquifer. Results for gross alpha, beta and gamma emitting radioactivity at USGS-103 did not indicate the presence of other radionuclides. DEQ-INL OP will continue to co-sample this deepest zone on an annual basis. The USGS is planning to install three more Westbay ™ systems near the southern boundary this year, to approximately the same depth as USGS-103. DEQ-INL will sample these wells when they are completed.

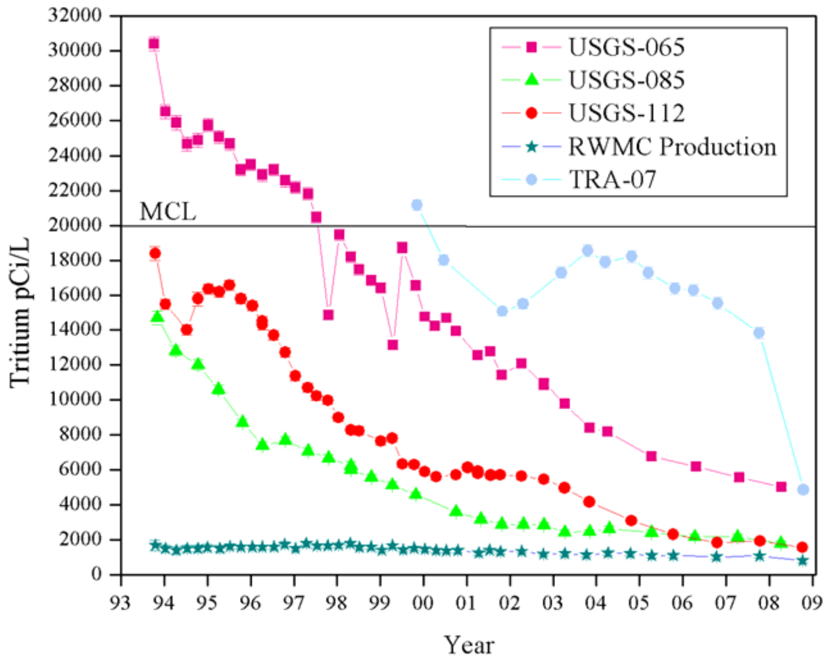


Figure 10. Tritium concentrations (pCi/L) over time for selected INL wells impacted by INL contamination.

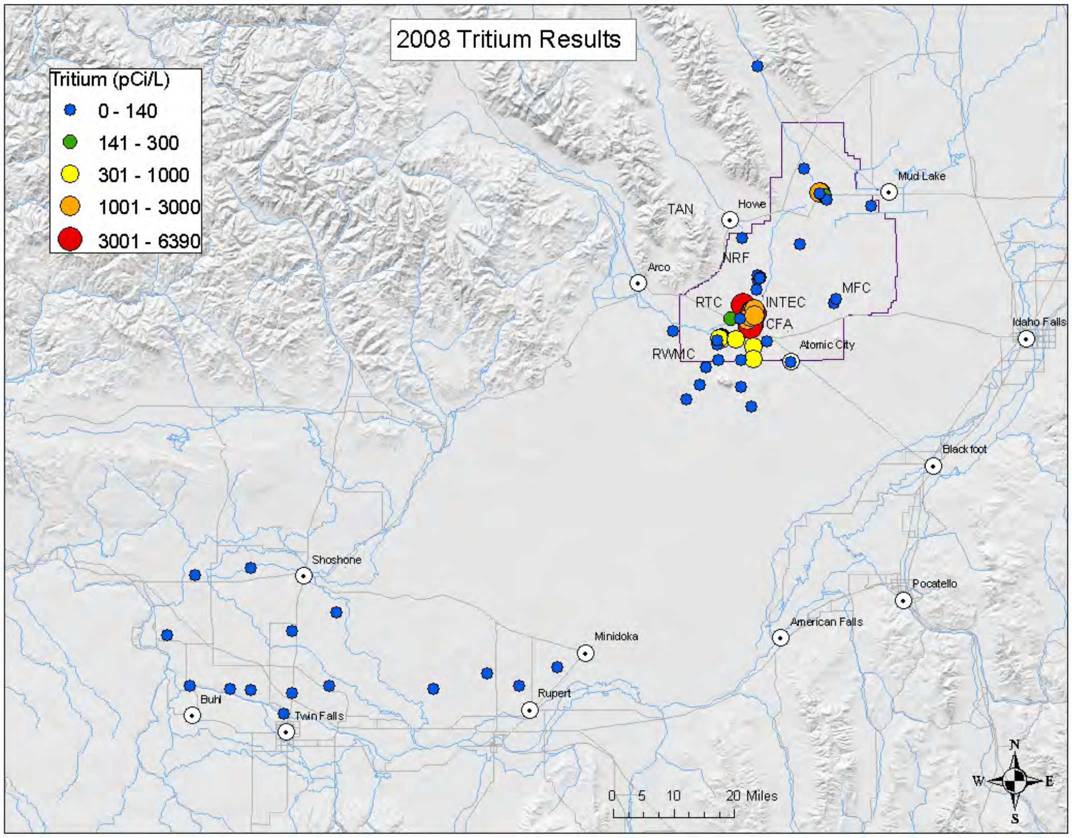


Figure 11. 2008 tritium concentrations (pCi/L) for DEQ-INL OP sample locations.

Strontium-90

Strontium-90 and technetium-99 are the primary sources of the elevated gross beta radioactivity observed in wells with INL contamination. Concentrations of strontium-90 found in the aquifer remain relatively constant for selected wells near the Test Area North (TAN). Selected wells down-gradient from INTEC generally have declining concentrations (**Figure 12 and Figure 13**). The highest strontium-90 concentration (650 ± 150 pCi/L) was from the TAN well TAN-37. This well is located near the TAN waste injection well (used from 1953-1972), and in the region of ongoing aquifer treatment for volatile organic compounds (VOCs) in the ground water. Concentrations of strontium-90 for this well have remained relatively consistent since DEQ-INL OP first sampled this site in 2003 (**Figure 12**). In well USGS-055, strontium-90 concentrations have been increasing, but may now be leveling off. This is a perched aquifer well near the historic warm waste ponds located adjacent to RTC. This well was dry in 2008 and could not be sampled. Another well in the same vicinity will be sampled in its place. Concentrations of strontium-90 near RTC are due to past disposal practices. **Figure 13** shows that while concentrations in two wells (USGS-085 and USGS-112) down-gradient from INTEC have been declining, concentrations in one well (USGS-067) closer to INTEC are slightly increasing. At INTEC, strontium-90 is thought to have been released due to historic waste injection at INTEC and more recently from leaks and spills associated with the INTEC Tank Farm Facility. **Figure 14** shows strontium-90 concentrations at DEQ-INL OP sample locations.

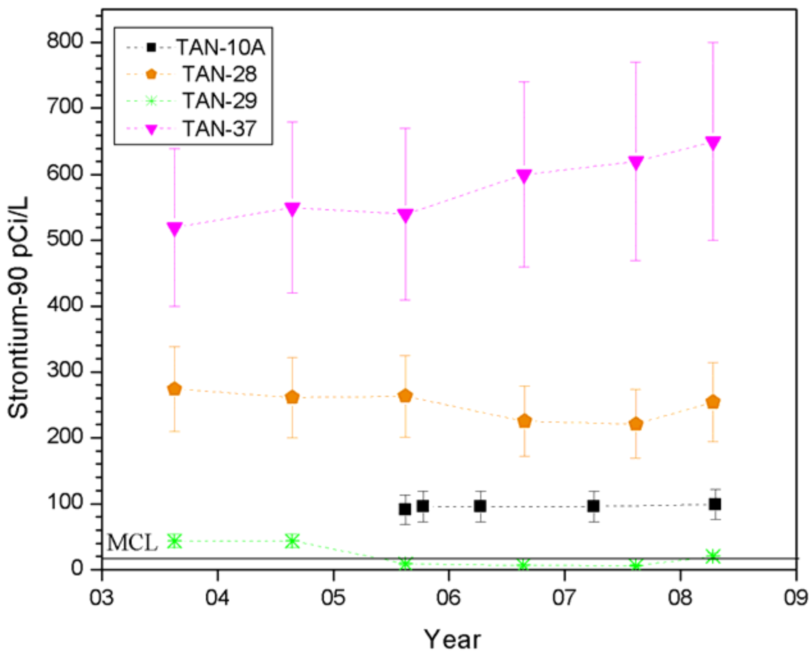


Figure 12. Strontium-90 concentrations over time for selected wells near Test Area North (TAN).

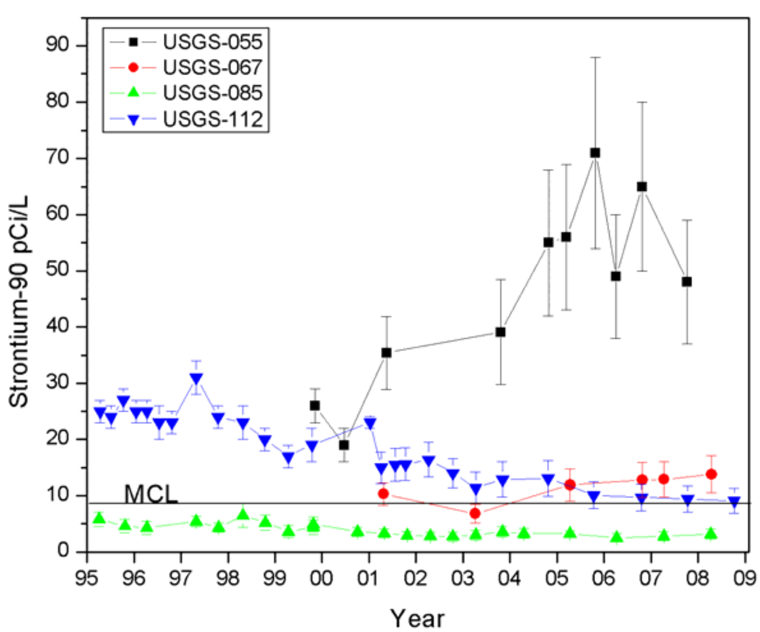


Figure 13. Strontium-90 concentrations over time for selected INL wells impacted by INL contamination.

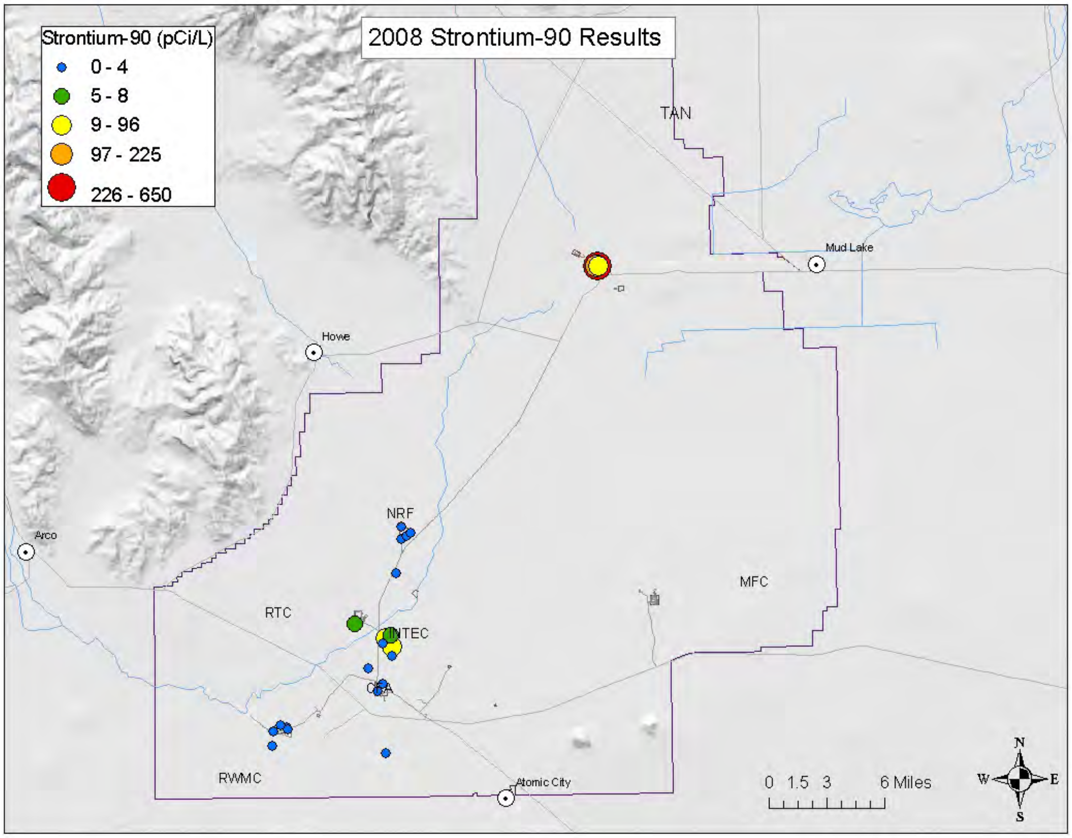


Figure 14. 2008 strontium-90 concentrations (pCi/L) for DEQ-INL OP sample locations.

Technetium-99

Concentrations of technetium-99 found in the aquifer from 3 selected wells (USGS-085, 112, and 115) near INTEC appeared to be constant over the past few years. Results from wells USGS-067 showed an increase in concentration, while a trend for USGS-052 results cannot be determined until more results become available (**Figure 15**). All 2008 results for technetium-99 were below the MCL of 900 pCi/L. Technetium-99 is thought to have been released due to historic waste injection at INTEC and more recently from leaks and spills associated with the INTEC Tank Farm Facility. The greatest concentration observed for DEQ-INL monitored sites was for well USGS-052 (314 ± 1.1 pCi/L), located at INTEC near the Tank Farm Facility. **Figure 15** shows technetium-99 concentrations over time for selected INL wells. **Figure 16** shows technetium-99 concentrations at DEQ-INL OP sample locations.

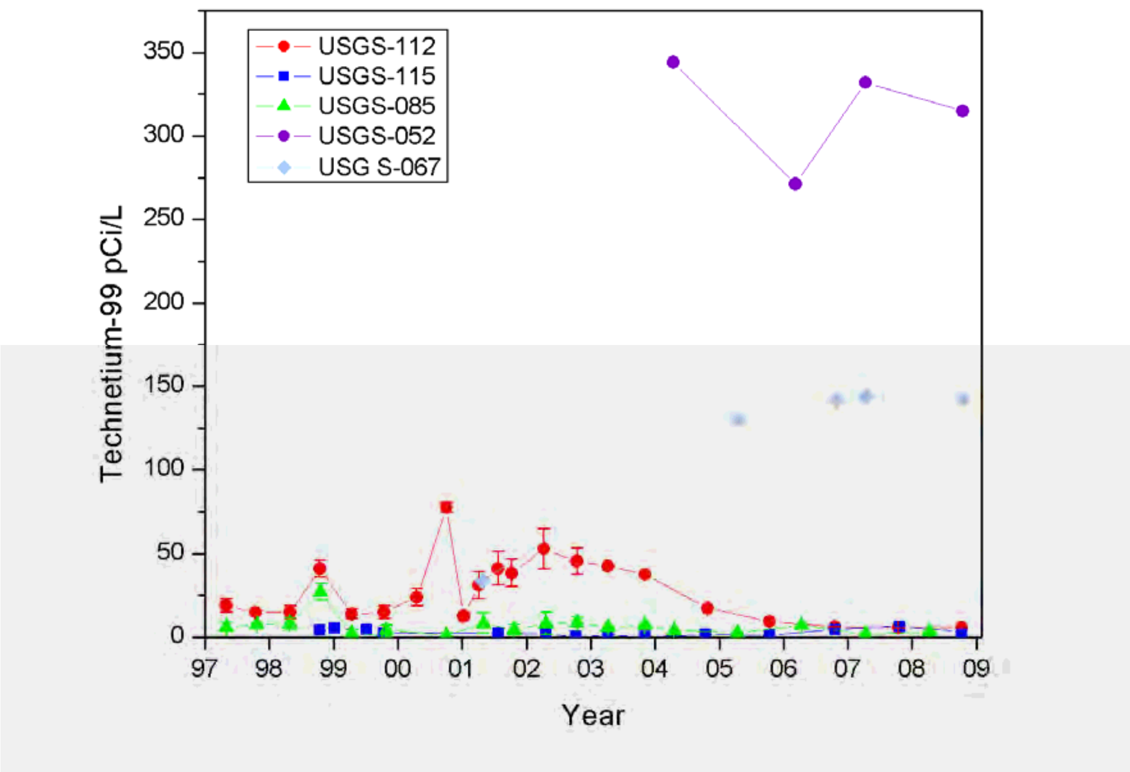


Figure 15. Technetium-99 concentrations over time for selected INL wells impacted by INL contamination.

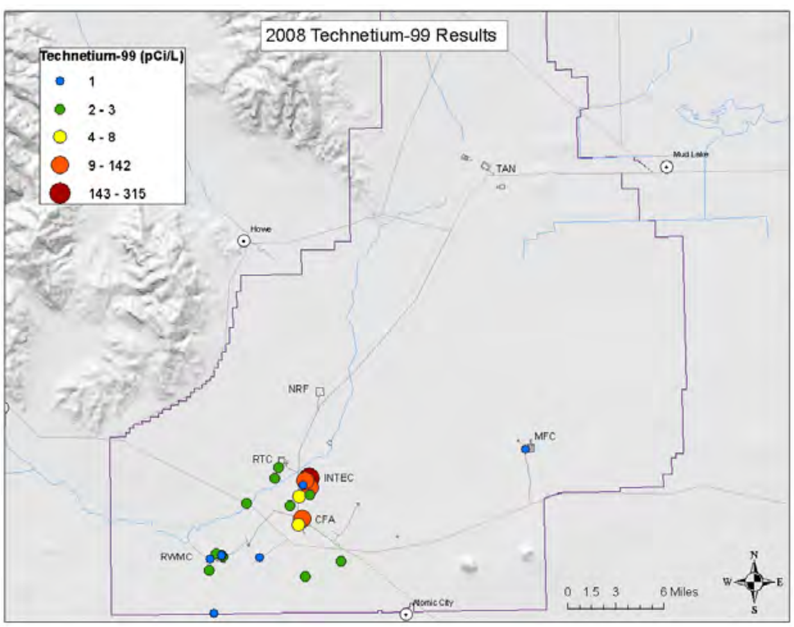


Figure 16. 2008 technetium-99 concentrations (pCi/L) for DEQ-INL OP sample locations.

Non-radiological Analytes

Common ions, nutrients, and metals comprise all the dissolved constituents in natural ground water. These constituents also comprise nearly all the chemical wastes disposed to surface water or ground water as a result of past INL waste disposal practices. Concentrations for most analytes measured in 2008 were relatively unchanged from previous years. Common ions, nutrients, and metals results found in samples collected by DEQ-INL OP in 2008 are summarized in **Table 5**. Following the table is a discussion of analytical results for chloride, chromium, manganese and VOCs, which have each exceeded their respective drinking water standards.

Table 5. Summary of selected non-radiological analytical results for DEQ-INL OP water samples for 2008.

Analyte	Up-gradient			Facility			Boundary			Distant			Back-ground[1]	Drinking water standard[2]
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max		
Common Ions/Nutrients (mg/L)														
Calcium	8.7	37.5	50	26	49	169	36	39.5	44	29	48	125	5 - 43	none
Magnesium	2.7	15	18	10	16	43	11	15	16	14	18	46	1 – 15	none
Sodium	7.4	21.5	32	5.6	15	228	6	9.4	17	15	30	69	5 – 14	none
Potassium	1.3	4.0	6.0	1.8	2.7	6.7	1.8	2.4	2.8	3.0	4.4	7.4	1 – 3	none
Chloride	4.8	9.3	51.9	3.3	22.5	545	6.2	13.8	22.2	6.5	34	74	2 – 16	250*
Sulfate	8.5	23.1	40.7	15	28	159	21	22.5	27	17	47	93	2 – 24	250*
Total Nitrate plus Nitrite	<0.01	0.78	2.0	<0.01	1.35	5.6	0.45	0.85	1.2	0.45	1	30	1– 2	10
Total Phosphorus	0.01	0.015	0.04	0.01	0.023	0.14	0.01	0.016	0.02	0.01	0.018	0.070	<0.02	none
Metals (µg/L)														
Barium	19	61	78	22	70	310	22	40	74	17	49	166	50 – 70	2000
Chromium	<2	<5	5.4	<5	11	110	<5	<5	7	<5	<5	7	2 – 3	100
Lead	<5	<5	<5	<5	<5	14	<5	<5	<5	<5	<5	<5	<5	15
Manganese	<2	31	50	<2	4	1040	4	14	24	<2	<2	<2	<1– 4	50*
Zinc	<5	<5	57	<5	31	830	8.6	93.5	159	<5	57	275	<10	5000*

[1] Background concentrations for the snake river plain aquifer. Depending on local geology, concentrations for sites not impacted by INL may be higher than the given background ranges.

[2] Primary standard unless otherwise noted. National Primary Drinking Water Regulations are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. Maximum Contaminant Levels (MCL's) are the highest level of a contaminant that is allowed in drinking water. * = Secondary Drinking Water Regulations are non-enforceable guidelines regulating contaminants that may cause cosmetic effects or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply.

Chloride

Sodium chloride (salt) is commonly used to regenerate water softeners. Large quantities of chloride have been discharged in the wastewater at the INL. Chloride concentrations at one well (NRF-06) exceed the secondary maximum contaminant level (SMCL) of 250 mg/L (**Figure 17**). This well is near the NRF industrial waste ditch in which wastewater from water softeners is discharged. Chloride concentrations for DEQ-INL OP 2008 sample locations are shown in **Figure 18**. Chloride concentrations in ground water are often elevated in regions impacted by agriculture, due to the evaporation of infiltrating irrigation water.

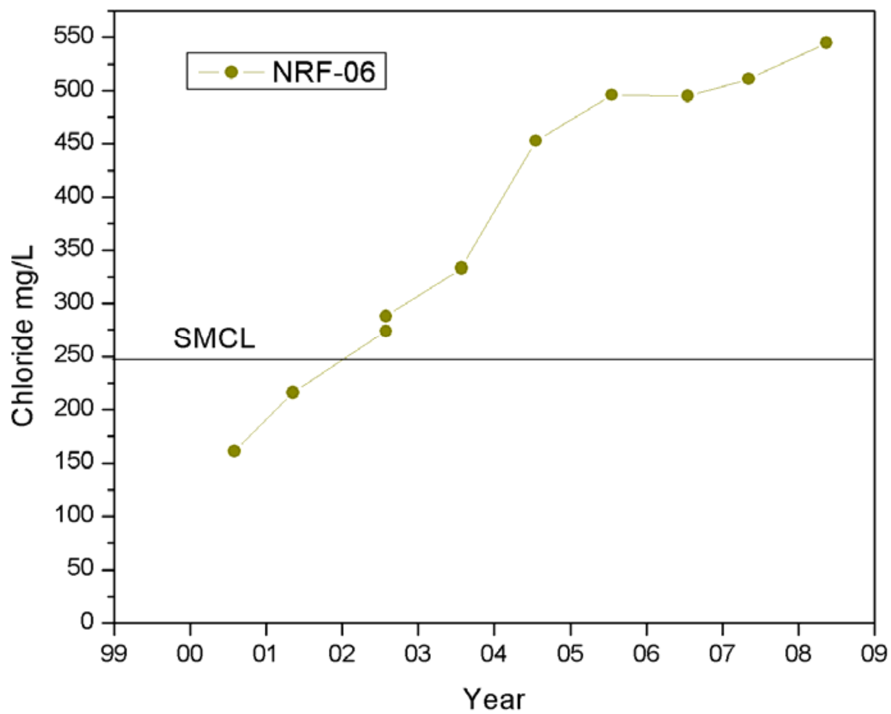


Figure 17. Chloride concentrations for sample location NRF-06 over time.

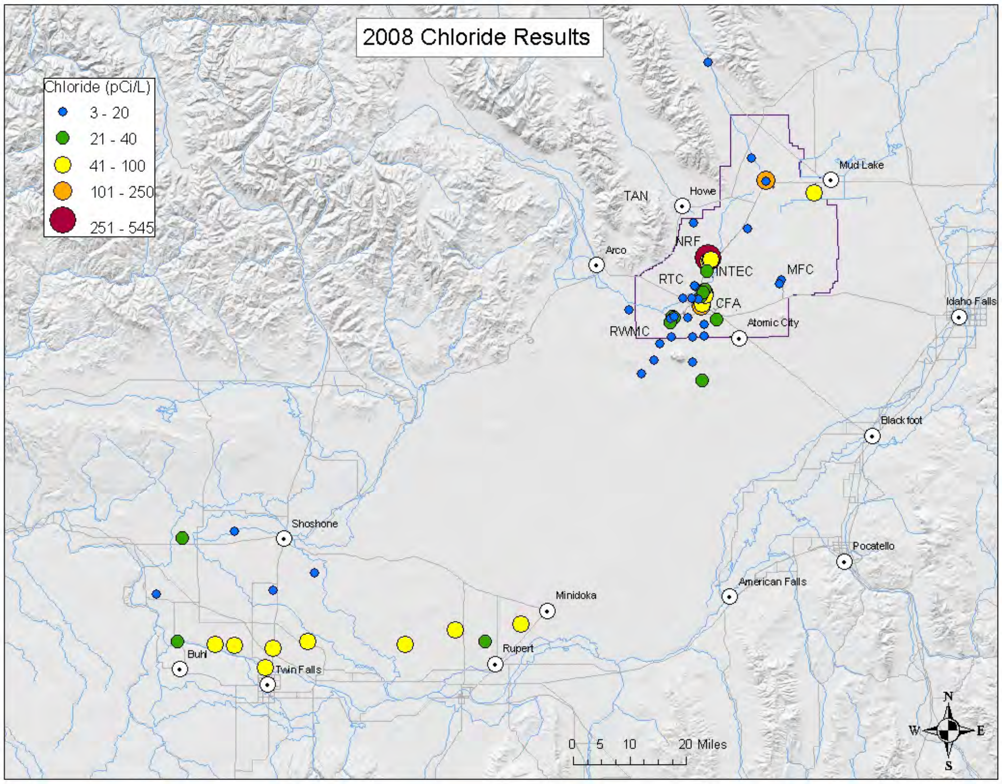


Figure 18. 2008 chloride concentrations for DEQ-INL OP sample locations.

Chromium

One result for a well (TRA-07) near the RTC was above the maximum contaminant level (MCL) of 100 µg/L (**Figure 19**). Chromium was used at the INL to prevent corrosion in industrial water systems until the early 1970s. Disposal practices at that time allowed chromium-contaminated water to percolate down to ground water from injection wells, open disposal ponds, and ditches. For this reason, chromium is observed at some INL ground water sampling sites. Generally, chromium concentrations have been declining. Concentrations for DEQ-INL OP 2008 sample locations are shown in **Figure 20**.

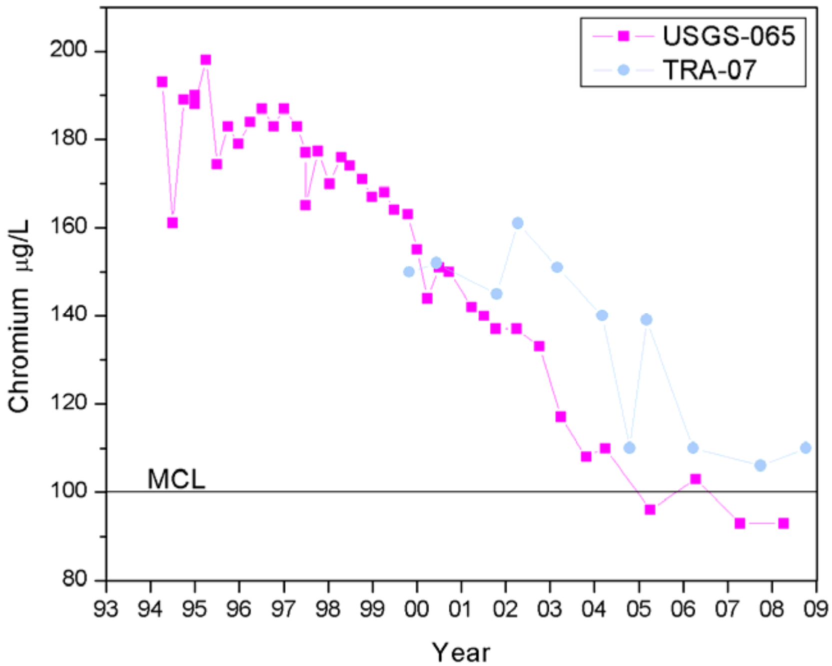


Figure 19. Chromium concentrations (µg/L) over time for selected INL wells impacted by INL contamination.

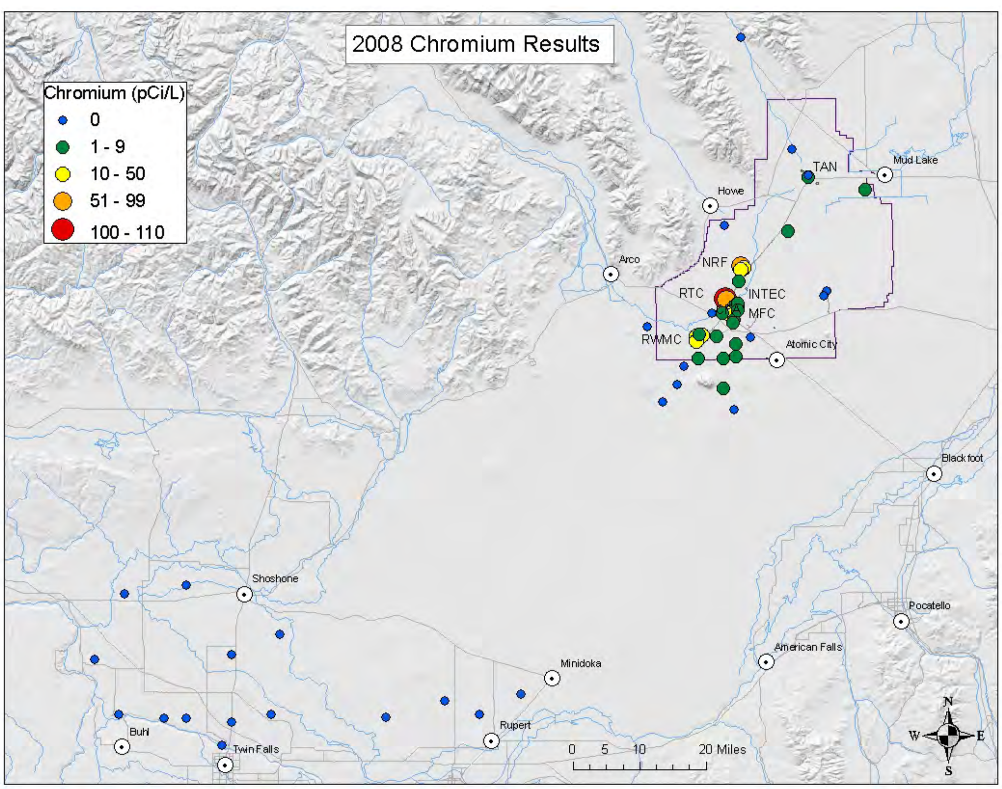


Figure 20. 2008 chromium concentrations (µg/L) for DEQ-INL OP sample locations.

Manganese

One well (TAN-10A) in the TAN area has exceeded the SMCL since 2004. This exceedance is most likely a byproduct of the clean-up action for VOCs at TAN, which are being remediated through natural attenuation and bioremediation.

Volatile Organic Compounds

Concentrations of three VOCs continue to exceed MCL's in a few wells at TAN: Tetrachloroethylene, trichloroethylene, and cis-1,2-dichloroethene. A clean-up action is currently being implemented for the ground water at TAN, which is being remediated through natural attenuation and bioremediation. This clean-up action is in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The 2008 sample results for specific wells can be found in the quarterly reports published on our Web site: http://www.deq.idaho.gov/inl_oversight/library.cfm.

Water Monitoring Verification Results

DEQ-INL OP collects water samples at the same time and location (co-sampled) with DOE or its contractors and verifies that its monitoring results are consistent with those obtained by DOE. In the event that a significant difference is found between DEQ-INL OP sample results and those of DOE, each sampling contractor's result is scrutinized individually to ascertain the cause of the difference. The DEQ-INL OP verification sampling program is designed to co-sample at approximately 10% of all DOE sample locations for selected analytes. Co-sampled DEQ-INL OP results for 2008 were compared to the results obtained by DOE, both on an individual sample-by-sample basis, and on an overall sample average basis.

Radiological

A summary of the sample-by-sample comparison of DEQ-INL OP and DOE radiological results is presented in **Table 6**. Sample-by-sample comparisons showed that results were generally in good agreement.

Table 6. Radiological results for co-samples collected by DOE and DEQ-INL OP in 2008.

Analyte	Number of Co-sampled pairs in 2008	Percent of Co-sampled pairs passing criteria in 2008
Americium-241	5	100
Gross Alpha	30	90
Gross Beta	28	93
Cesium-137	35	100
Neptunium-237	1	100
Plutonium-238	5	100
Plutonium-239/240	5	100
Plutonium-241	0	NA
Strontium-90	22	86
Technetium-99	6	100
Tritium	54	91
Uranium-234	5	100
Uranium-235	7	100
Uranium-238	5	100

Non-Radiological

Figure 21 presents the overall comparisons of non-radiological results for sites co-sampled with DOE in 2008. In 2008, there was less than 20% difference between all the compared DEQ-INL OP water results and DOE water results. This means that DEQ-INL OP is getting the same results on average as the DOE for non-radiological parameters. The largest differences were in the analysis for manganese and zinc; however, these differences were still within the 20% relative percent difference (RPD) criteria set by the DEQ-INL OP for comparisons.

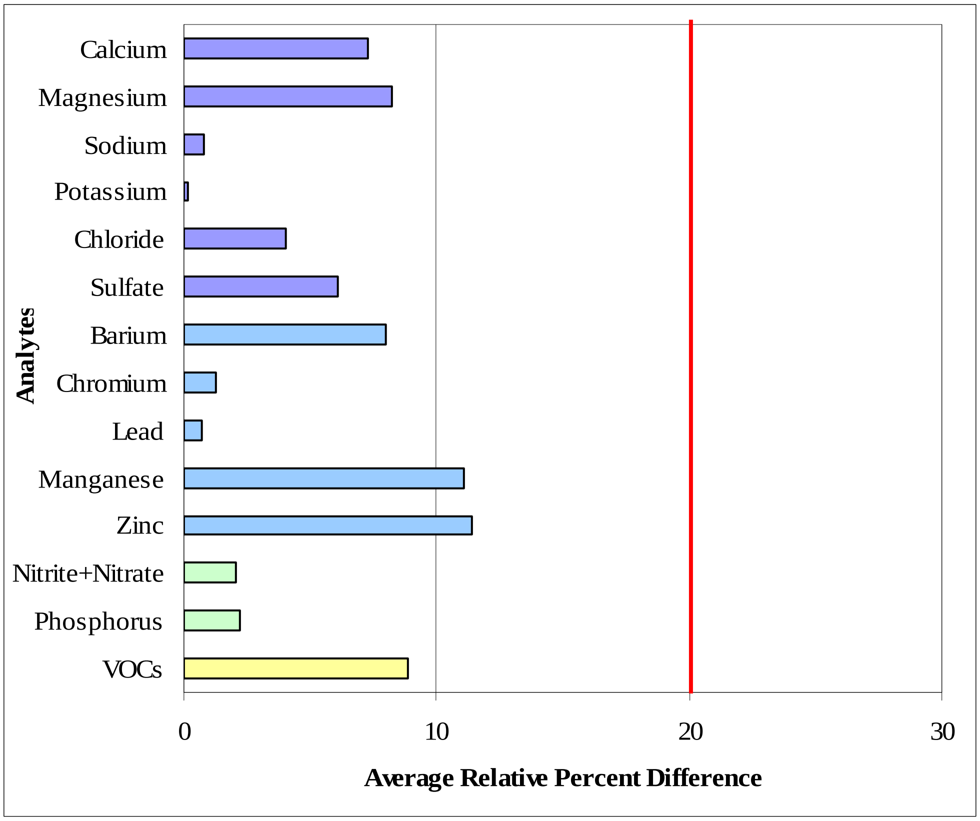


Figure 21. Summary of relative differences between results from DEQ-INL OP and those from DOE or its contractors in 2008.

Water Monitoring and Verification Impacts and Conclusions

DEQ-INL OP sample results are generally in agreement with those reported by DOE and its contractors. Results of DEQ-INL OP water monitoring have identified contamination in the Eastern Snake River Plain Aquifer as a result of historic waste disposal practices at the INL. Specifically:

- Concentrations for strontium-90, chromium, chloride, manganese and VOCs exceeded federal drinking water standards (MCLs or SMCLs) at some sites on the INL in 2008. These sites, however, are not used for drinking water.

- Concentration trends for tritium continue to decline. No sites monitored exceed federal drinking water standards for tritium. This INL contaminant is detectable at monitoring sites beyond the INL boundary. Results obtained from a Westbay™ packer sampling system well indicate that the tritium concentration is an order of magnitude greater at deeper levels within the aquifer at this location near the southern boundary.
- Concentrations for other INL contaminants in water continue to decline at most locations as a result of changes in waste disposal practices.
- INL impacts to the aquifer are not identifiable in water samples collected from sites distant from the INL.

Terrestrial Monitoring

Terrestrial monitoring is performed by measuring radionuclide accumulations in soil to help assess long-term trends of radiological conditions in the environment on and around the INL. Monitoring of milk samples is performed to indirectly verify the presence or absence of atmospheric radioiodine deposited in the terrestrial environment on and near the INL. Some of these data are also used to determine whether the monitoring results obtained by the DOE and its contractors were consistent with the soil and milk sampling results obtained by DEQ-INL OP for these same locations.

Terrestrial Monitoring Equipment and Procedures

DEQ-INL OP uses a combination of *in-situ* gamma spectrometry and physical soil samples to monitor concentrations of gamma-emitting radionuclides in soil at DEQ-INL OP air monitoring stations and selected soil sampling sites on and around the INL (2008 soil sampling sites are shown in **Figure 22**). A portable gamma radiation detector was used in the field to collect surface gamma radiation measurements. In addition to the *in-situ* sampling, physical soil samples were collected and prepared in the field at four locations during the third calendar quarter of 2008. Both types of measurements were then used to identify radionuclides present and to estimate soil radioactivity concentrations.

DEQ-INL OP collected milk samples from distribution centers where milk was received and from individual dairies in southern and southeastern Idaho. Milk sampling locations are shown in **Figure 1**. Raw milk samples were collected from trucks arriving at the distribution centers from each region of interest. For example, milk samples from Mud Lake were collected from a truck servicing that area once it returned to the Nelson-Ricks Creamery distribution center in Rexburg, Idaho. For the independent cow and goat dairies, DEQ-INL OP personnel drop off empty sample containers that are filled by the owner/operator of the dairy. The samples are picked up within 1-2 days of collection.

Two DEQ-INL OP milk samples were collected and split by a DOE contractor each month. One half of the split samples were analyzed by DOE and the other half were submitted to DEQ-INL OP for analysis. DEQ-INL OP used the analysis results from these split samples to verify the DOE contractor’s milk sampling results and conclusions.

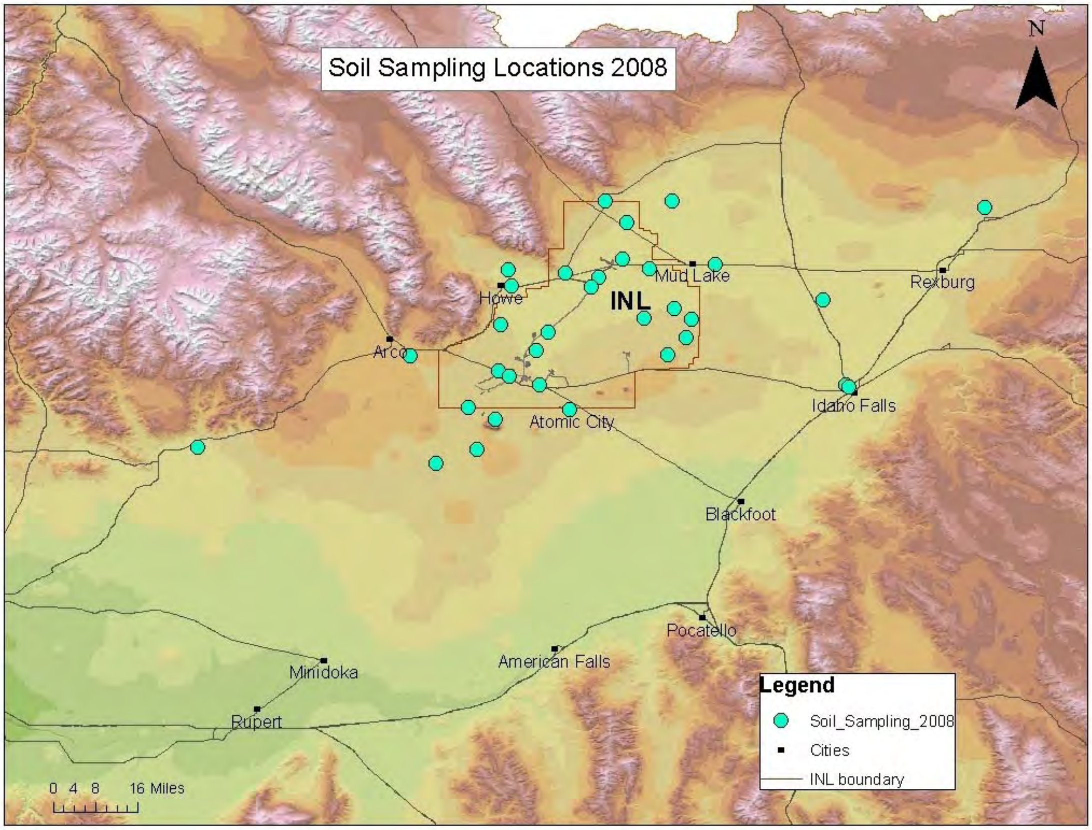


Figure 22. DEQ-INL OP soil sampling locations for 2008.

Terrestrial Monitoring Results and Trends

Monitoring concentrations of gamma-emitting radionuclides in surface soil provides insight to the transport, deposition, and accumulation of radioactive material in the environment as a result of INL operations and historic atmospheric testing of nuclear weapons. During 2008, DEQ-INL OP made *in-situ* gamma spectrometry measurements to estimate accumulations of gamma-emitting radionuclides in surface soil at 33 locations. DEQ-INL OP also collected 8 physical samples of surface soil at four locations. Of the 41 measurements, Cesium-137 was the only man-made radionuclide that was detected. The average Cesium-137 value, including *in-situ* and physical samples, was 0.18 picocuries per gram (pCi/g) with a minimum value of 0.02 pCi/g and a maximum of 0.59 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.

Milk sampling is conducted by DEQ-INL OP to determine whether radioactive iodine is present or absent in the food supply. Radioactive iodine is produced in relatively large quantities during fission reactions (e.g., in nuclear reactors). The chemical nature of iodine makes it mobile under normal conditions. Gaseous radioactive iodine can be dispersed through the atmosphere and carried along with the wind until it is deposited on plants. Dairy cows and goats that graze on radioiodine-contaminated pasture or feed will accumulate iodine in the milk they produce. Drinking this milk could lead to an accumulation of radioactive iodine in the thyroid gland and a greater risk of thyroid cancer.

During 2008, DEQ-INL OP analyzed 77 milk samples. Radioactive iodine was not detected in any milk sample. Since DEQ-INL OP began monitoring milk in 1996 no radioactive iodine (specifically Iodine-131) has ever been detected in excess of the DEQ-INL OP action level of 4.4 pCi/L. This action level is based upon the radioiodine concentration in milk necessary for an infant to receive an annual thyroid radiation dose of 5 millirem. The Food and Drug Administration (FDA) recommended maximum concentration of I-131 for food, including milk, is 4600 pCi/kg.

Terrestrial Monitoring Verification Results

Naturally occurring Potassium-40 is present in milk and soil and is ideal as a quality control measurement and indicator of measurement sensitivity. Therefore, many of the comparisons conducted between DEQ-INL OP and DOE sample results include this isotope, especially since the target radionuclide (such as Iodine-131) is seldom detected in milk samples.

Gamma spectroscopic analysis results of the 24 milk split samples collected by the DOE contractor and submitted to DEQ-INL OP for analysis were compared with DOE results. Potassium-40 results obtained by DEQ-INL OP showed 96% agreement with DOE contractor results. All Iodine-131 results were below the minimum detectable activity for both agencies.

In-situ gamma spectrometry results from soil at thirteen co-located sample sites were compared with the DOE contractor's results. DEQ-INL OP's Potassium-40 results showed 77% agreement with DOE contractor results. DEQ-INL OP and DOE contractor Cesium-137 results showed a relative bias, with a DEQ-INL OP average of 0.23 pCi/g and a contractor average of 0.15 pCi/g. Differences in seasonal sampling schedules and detector placement may have contributed to this bias. These results were well below the DEQ-INL OP action level and the recommended screening limit for surface soil.

Gamma spectrometry results from physical soil samples taken at four co-located sample sites were compared with the DOE contractor's results. Cesium-137 results did not agree within the DEQ-INL OP criteria for any of the four samples, although all results were well below the DEQ-INL OP action level and the Federal limit. Known differences in sampling protocol may have contributed to this disagreement that will be investigated further.

Terrestrial Monitoring Impacts and Conclusions

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 for the ESP

This section summarizes the results of the quality assurance (QA) assessment of the data collected for calendar year 2008 for the DEQ-INL OP's Environmental Surveillance Program. All analyses and quality control (QC) measures at the analytical laboratories used by the DEQ-INL OP were performed in accordance with approved written procedures maintained by each analytical laboratory. Sample collection was performed in accordance with written procedures maintained by the DEQ-INL OP. Analytical results for blanks, duplicates, and spikes were used to assess the precision, accuracy, and representativeness of results from analyzing laboratories. During calendar year 2008, the DEQ-INL OP submitted 317 QC samples for various radiological and non-radiological analyses. All data collected were assigned the applicable qualifiers to designate the appropriate use of the data, validated, and deemed complete, meeting the requirements and data quality objectives established by DEQ-INL OP.

Issues and Problems

There were no significant QC issues identified during calendar year 2008.

Comparing Data

In addition to reporting independent monitoring results, DEQ-INL OP also determines whether the information collected by DOE matches the information and/or conclusions reached by DEQ-INL OP. One basic tool used by DEQ-INL OP to conduct these comparisons for all split sampling and some co-sampling, is to perform a measure of Relative Percent Difference (RPD) between DEQ-INL OP and DOE measurements. In general, for each sample collected by both DEQ-INL OP and DOE and/or its contractors, the DEQ-INL OP result is subtracted from the DOE result to determine the difference between the two measurements. This difference is divided by the mean of the results for that data pair. Dividing by this number serves to create an RPD, which can then be compared to other RPDs, regardless of the type of analyte or original measured result. This is best explained through the use of the following equation:

RPD = (((DOE result) – (DEQ result)) / ((DEQ result+DOE result)/2)) x 100

The RPD calculated using the above equation is considered acceptable if it is within ±20. DEQ-INL OP may also calculate an average of all the absolute values of RPDs found for a specific test or analyte.

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_1 = First sample value.

R_2 = Second sample value.

S_1 = Counting error associated with the laboratory measurement of the first sample.

S_2 = Counting error associated with the laboratory measurement of the second sample.

Combined sample comparisons are considered satisfactory if at least 80% of the paired results agree to within the above criteria.

Assessing INL Impacts

DEQ-INL OP evaluates public health and environmental impacts from INL activities and proposed projects. DEQ-INL OP scrutinizes INL's management of radiological materials and wastes, including inventories, storage, treatment, transportation, and disposal. DEQ-INL OP determines whether DOE and the Navy are in compliance with their 1995 court Settlement Agreement with Idaho, which outlines milestones for safe storage, treatment, and removal from Idaho of spent fuel, high-level waste, and transuranic waste. DEQ-INL OP also reviews INL safety concerns and incidents to determine whether INL operates within appropriate safety parameters.

DEQ-INL OP assesses impacts of activities not covered by DEQ's Waste Management/Remediation and Air Quality Divisions—who have regulatory authority over CERCLA site remediation, RCRA hazardous waste management, and INL air emissions. A summary of DEQ-INL OP's key priorities is presented in the following sections.

Spent Nuclear Fuel - Receipt and Movement from Wet to Dry Storage

INL continues to receive spent nuclear fuel (SNF) shipments from DOE and the Navy under parameters specified in the 1995 Settlement Agreement. Most of the SNF at INL is currently in dry storage. According to the 1995 Settlement Agreement, DOE must complete the transfer of all INL SNF from wet storage to dry storage by the end of 2023.

During 2008:

- DOE made significant progress in movement of SNF from wet storage in Building CPP-666 to dry storage in Building CPP-603.
- The Navy received three rail shipments containing eight containers of SNF at the Naval Reactors Facility (NRF).

Some of the activities DEQ-INL OP performed that were related to the safe management of SNF included:

- Continued to track shipments of SNF into Idaho from government, research, and naval nuclear reactors.
- Maintained awareness of fuel sources, characteristics, and storage locations as the inventory of SNF changed at the INL.
- Monitored operations that transferred SNF from wet storage to dry storage.
- Monitored mission need activities associated with decisions regarding the Idaho Spent Nuclear Fuel Dry Storage Project (formerly the proposed Foster Wheeler fuel storage facility project).
- Observed SNF operations at the CPP-666 storage pool.
- Reviewed NRF SNF shipment quarterly reports.

INTEC Tank Farm High-Level Waste Tank Grouting

DOE completed a significant 1995 Settlement Agreement milestone with grouting of the last 700 feet of piping associated with grouting of tanks that formerly stored high-level radioactive waste at the INTEC Tank Farm. The INTEC Tank Farm consists of fifteen large stainless steel tanks – four 30,000 gallon tanks and eleven 300,000 gallon tanks. These tanks have been used to store liquid radioactive waste generated during SNF reprocessing and decontamination activities. To date all four of the 30,000 gallon tanks and seven of the eleven 300,000 gallon tanks along with all their associated vaults and piping have been grouted. The four remaining 300,000 gallon tanks still store liquid radioactive waste that needs treatment in the Integrated Waste Treatment Unit that is under construction (see next section).

Some of the activities DEQ-INL OP performed that were related to the safe management of the INTEC Tank Farm included:

- Interfaced with the Nuclear Regulatory Commission (NRC) to review DOE's ongoing activities to assure they meet low-level waste standards and comply with federal laws and regulations.
- Observed tank/pipe grouting operations including review of grout batch sheets and observation of batch quality assurance activities.

Integrated Waste Treatment Unit Construction

During 2008, DOE continued construction of a facility – the Integrated Waste Treatment Unit (IWTU) – to treat approximately 900,000 gallons of sodium-bearing waste (SBW) currently in four 300,000 gallon tanks (one nearly empty) at the INTEC Tank Farm. Treatment will consist of solidification and preparation of this waste for off-site disposal. Solidification is a required activity to meet the 1995 Settlement Agreement milestone that states, "DOE shall complete calcination of sodium-bearing liquid high-level waste by December 31, 2012." A process called steam-reforming will be used to solidify this waste in place of calcination. SBW contains radioactive and hazardous constituents from previous SNF reprocessing and decontamination activities. DOE selected steam-reforming to treat and stabilize the waste for final disposition at the Waste Isolation Pilot Plant (WIPP) in New Mexico or at a geologic repository for high-level waste. Steam-reforming is designed to convert SBW into a solid granular product that can be packaged into containers for safe storage and disposal.

DEQ-INL OP personnel attended meetings where IWTU progress was detailed and observed IWTU construction progress during INL Site visits.

Remote-handled Transuranic Waste Shipment

In early 2007, DOE made INL's first (and DOE's first) shipment of remote-handled transuranic (RH-TRU) waste to WIPP. Throughout 2008 DOE continued to ship RH-TRU waste to WIPP. TRU waste generally consists of protective clothing, tools, glassware, equipment, soils, and sludge contaminated with radioactive elements with atomic mass greater than uranium such as plutonium, neptunium, americium, curium, and/or californium. Transuranic waste is divided into two categories based on the surface radiation levels of unshielded containers packaged with the waste. Containers filled with TRU waste that have surface radiation dose rates over 200 millirems per hour are RH-TRU waste, containers below this level are contact-handled transuranic (CH-TRU) waste. RH-TRU waste must be handled more cautiously than CH-TRU waste and transported in shielded casks. The majority of RH-TRU waste on the INL site originated at Argonne National Laboratory (near Chicago), with smaller contributions from the NRF, INTEC, Materials and Fuels Complex, and RTC. The waste generated from defense missions at Argonne National Laboratory was placed in interim storage at the Intermediate-Level Transuranic Storage Facility (ILTSF) at the RWMC in the 1970s. This waste (650 drums) was retrieved from the ILTSF vaults and sent to INTEC for venting, real-time radiography, and dose measurement to prepare the drums for loading in approved shipping containers (72B canisters) for placement in a 72B cask (shielded cask) for shipment to WIPP. During 2008 DOE sent about 85 shipments of RH-TRU waste to WIPP.

DEQ-INL OP personnel toured packaging facilities, attended meetings, and reviewed documents pertaining to the ongoing process of shipping RH-TRU waste to WIPP.

Accelerated Retrieval Project Activities

The Accelerated Retrieval Project (ARP) is a CERCLA activity to remove targeted waste buried prior to 1970 in the Subsurface Disposal Area (SDA) in the RWMC at the INL Site. Excavated targeted waste is identified, repackaged, characterized, and shipped off-site for disposal. Targeted waste that characterizes as transuranic is shipped to the Waste Isolation Pilot Plant (WIPP) in New Mexico. Non-transuranic targeted waste is shipped to other off-site locations for treatment/disposal as appropriate. Targeted wastes consist of filters, graphite, and 741 series sludges containing transuranic radionuclides (i.e., americium-241 and plutonium-239/240), series 743 sludges containing absorbed solvents, and depleted uranium contained in roaster oxides.

The ARP is being implemented in numerous phases. ARP I was the fist phase and was completed in April 2008. During this activity 0.50 acres were exhumed with the targeted waste removed and packaged for disposal at WIPP. ARP II began excavation in 2007. At the end of 2008, about 0.23 acres of the 0.35 acres in ARP II had been exhumed.

DEQ-INL OP personnel participated in several site visits to observe activities at ARP facilities.

Transuranic Waste Shipments to the Waste Isolation Pilot Plant

The Advanced Mixed Waste Treatment Plant (AMWTP) at the RWMC packages transuranic (TRU) waste for shipment to the Waste Isolation Pilot Plant (WIPP) in New Mexico. According to the 1995 Settlement Agreement, INL must ship to WIPP at least 2,000 cubic meters of TRU waste per year over a three year running average. After a slow start prior to 2006, AMWTP far surpassed the yearly goal of shipping 2,000 cubic meters by shipping more than 6,000 cubic meters in 2006 and almost 6,000 cubic meters in 2007. During 2008 AMWTP continued this accelerated rate of shipping, sending about 5,000 cubic meters of contact handled TRU waste from AMWTP to WIPP.

Some of the activities DEQ-INL OP performed to ensure safe management of transuranic waste included:

- Tracked WIPP shipments and coordinated WIPP shipment safety with the Idaho State Police (ISP) (who inspect every outgoing truckload) and with other states through the Western Governors Association (WGA).
- Reviewed DOE weekly reports detailing AMWTP progress on shipping TRU waste out of Idaho.
- Reviewed real-time radiography (RTR) screen shot paperwork for AMWTP box dumping operations to assure proper disposal volume credit was received for TRU waste processed though the AMWTP super compactor.
- Conducted visits to AMWTP to observe waste management activities.
- Joined EPA on their inspection at the AMWTP to review and observe the implementation of key procedures used to build WIPP contact-handled payloads.

DOE Environmental Management Special Nuclear Material Disposition

Special nuclear material (SNM) is defined as plutonium, uranium-233, or uranium enriched in the isotopes uranium-233 or uranium-235. DOE Environmental Management (EM) owned SNM disposition (reuse, recycle, or disposal) is being coordinated by CWI under the Idaho Clean-up Project (ICP) contract. This SNM includes unirradiated reactor fuel, radioactive sources used to calibrate laboratory equipment, material remaining from the fabrication of experimental reactor fuel, and other materials used by the INL to develop nuclear power science and technology. The ICP contract requires disposition of all ICP-assigned SNM by October 2009. In order to determine a disposition path, SNM items are characterized to determine their radiological classification, chemical content, and regulatory (RCRA hazardous waste) status. Based on the characterization and potential reuse/recycle, one of the following disposition paths was selected:

1) Transfer to another program for reuse.
2) Recycle at a DOE or commercial facility.
3) Disposal at an approved facility.

At the beginning of 2008, there were about 200 EM owned SNM items awaiting disposition. During 2008, all except one of these SNM items were dispositioned.

Some of the activities DEQ-INL OP performed that were related to the State's priority for safe disposition of SNM included:

- Maintained awareness of SNM storage locations and quantities as the inventory of SNM changed at the INL.
- Received periodic updates from DOE on SNM inventory disposition decisions and activities.

Occurrence Reporting and Processing System Reviews

The Occurrence Reporting and Processing System (ORPS) is an integral part of the Department of Energy's Occurrence Reporting Program. This program provides timely notification to DOE of events that could adversely affect: public or DOE worker health and safety, the environment, national security, DOE's safeguards and security interests, or functioning of DOE facilities. DOE ORPS reports provide an important resource for obtaining information on: numbers and types of these events, common or related causes for these events, effectiveness of corrective actions, and lessons learned.

Some of the activities DEQ-INL OP performed to monitor the ORPS were:

- Reviewed OPRS reports for events that occurred on the INL site.
- Performed follow-up on selected ORPS reports to assess how DOE addressed some safety and environmental incidents which occurred on the site.

National Environmental Policy Act Monitoring and Reviews

The National Environmental Policy Act (NEPA) establishes a national framework for protecting the environment. NEPA requires that Federal agencies consider the environmental impacts of their proposed actions and reasonable alternatives to those actions. The NEPA process is intended to help public officials make decisions that are based on understanding environmental consequences and take actions that protect, restore, and enhance the environment. The three basic levels of NEPA environmental review and documentation are: (1) Environmental Impact Statement (EIS); (2) Environmental Assessment (EA); and (3) Categorical Exclusion (CATEX). The type of proposed action and the degree of environmental effects determine the appropriate level of environmental review.

The DEQ-INL OP monitored and kept informed on the following EAs and EISs pertinent to INL:

1) Reviewed, summarized, and attended public meeting on DOE/EIS-0396, *Draft Global Nuclear Energy Partnership Programmatic Environmental Impact Statement,* October 2008. This EIS is not moving forward at this time.
2) Reviewed and made comments on the *Draft Environmental Assessment on the Remote-handled Waste Disposition Project* (DOE/EA-01386). This activity is moving ahead in 2009.
3) Monitored ongoing activities associated with the *Idaho High-Level Waste and Facilities Disposition* (DOE/EIS-0287). An additional (3^{rd}) Record of Decision (ROD) is expected in 2009.
4) Monitored ongoing activities associated with the *Disposal of Greater-Than-Class-C Low-Level Radioactive Waste* (DOE/EIS-0375). This EIS is delayed while its scope is reassessed.
5) Monitored ongoing activities associated with the *Proposed Consolidation of Nuclear Operations Related to the Production of Radioisotope Power Systems* (DOE/EIS-0373). This EIS is on hold until further notice.
6) Reviewed the *Supplement Analysis for the Treatment of Transuranic Waste at the Idaho*

National Laboratory (DOE/EIS-0200-SA-03*).* This supplemental analysis (SA) was performed to determine whether the proposed treatment and characterization of waste received at INL from other sites prior to disposal at WIPP is a substantial change to the proposed action analyzed in DOE's *Waste Management Programmatic Environmental Impact Statement* (DOE/EIS-0200) (WM-PEIS). DOE determined that a supplement to the WM-PEIS or a new EIS was not needed.

Radiological Emergency Response Planning and Preparedness

The Idaho Bureau of Homeland Security (IBHS) coordinates state emergency response actions in Idaho. For incidents involving radiological materials at the INL or elsewhere in Idaho, DEQ-INL OP provides technical information, assistance, and training to local and state authorities.

INL Radiological Incidents

A key element of preparing for INL radiological emergencies is DEQ-INL OP's annual review of INL hazard assessment documents (HADs). These documents explain various potential incidents that could result in the release of certain radionuclides that some INL facilities house. This information allows DEQ-INL OP to identify the scenarios that could potentially result in off-site radiological impacts and plan for those accordingly. In addition to reviewing the HADs, DEQ-INL OP uses the source inventory and accident scenarios for dose assessment modeling, using Air Pollutant Graphical Environmental Monitoring System (APGEMS) software. This allows DEQ-INL OP to run independent radiological plume projections and dose assessment using real time NOAA weather data to make timely technical and protective action recommendations to state emergency authorities. DEQ-INL OP also revised and issued the INL Fixed Facility Plan for the State in 2008. This document describes actions, roles and responsibilities of state agencies in the event of an accidental release from an INL facility which results in an off site impact to the public or the environment.

Drills and Exercises

DEQ-INL OP co-sponsored a full scale exercise in conjunction with Idaho Bureau of Homeland Security (IBHS), the Shoshone Bannock Tribes Emergency Management and Response (EMR), and Technical Resources Group, Inc. (TRG). RadReck, as it was named, was a cross jurisdictional multiple vehicle traffic accident scenario where a van, loaded with radioactive pharmaceutical products left the interstate (I-15) and spilled its contents onto Fort Hall Indian Reservation territory. RadReck also practiced safe parking procedures for WIPP truck shipments. This exercise followed guidance set forth in the Federal Emergency Management Agency (FEMA) Homeland Security Exercise and Evaluation Program (HSEEP). Participation included DEQ-INL OP, DOE Transportation Emergency Preparedness Program (TEPP), DOE Waste Isolation Pilot Plant (WIPP), NOAA, Regional Response Team 6 (RRT 6), Regional Response Team 7 (RRT 7), Idaho Transportation Department (ITD), Idaho State Police (ISP), TRG, State District Health Department (SDHD), IBHS, Bingham County Emergency Management, Bingham Memorial Hospital, Fort Hall Emergency Management, Fort Hall Police, and Fort Hall

Fire & HazMat. Preparation for the RadReck exercise included several training sessions with first responders and hospital emergency room staff, a series of practice drills, and a table top exercise. Practice drills were held in February 2008 and focused on patient handling, personnel decontamination, and instrument surveys and mapping. **Figures 23-25** show first responders participating in practice drills.

Figure 23. Patient handling drill emphasizing the double blanket technique to minimize the spread of contamination in preparation for the RadReck exercise, February 2008.

Figure 24. Personnel decontamination drill in preparation for the RadReck exercise, February 2008.

Figure 25. First responders practicing instrument survey and mapping techniques in preparation for the RadReck exercise, February 2008.

The RadReck table top exercise was held in March 2008 and focused on the initial notification process, the incident command structure including transition to a unified command, resource allocation, and the public information process. The full scale exercise followed on May 14th 2008 in Fort Hall, Idaho. In addition to aspects practiced in the drills, potentially contaminated injured patients were transported, received and treated at Bingham Memorial Hospital (**Figure 26**), and WIPP shipment safe parking procedures with ISP were part of the event (**Figure 27**).

Figure 26. Potentially contaminated patient being transported to the local hospital for treatment during RadReck exercise, May 14th, 2008.

Figure 27. WIPP truck transuranic waste shipment awaiting safe parking instructions during RadReck exercise, May 14th, 2008.

DEQ-INL OP also participated in the 2008 INL annual exercise which consisted of a simulated accidental on-site release of radioactive material that became airborne and was transported off-site. This exercise was conducted in multiple phases to practice different areas of the response including transport and receiving of contaminated patients to the local hospital, environmental modeling of plume projections, and deployment of State environmental monitoring teams.

Waste Isolation Pilot Plant Shipment Safety

DOE contracts with the WGA to coordinate activities related to the safe shipment of transuranic waste to WIPP through western states. DEQ-INL OP works with the Idaho State Police (ISP) and the IBHS to manage WIPP shipment safety activities on the US Route 20/26, Interstate 15, and Interstate 84/86 corridors in Idaho.

During 2008, DEQ-INL OP:

- Reviewed the WIPP Transportation Safety Program Implementation Guide.
- Co-chaired the WIPP Technical Advisory Group meetings for western states.
- Provided emergency responder training.
- Oversaw radiological equipment procurement and calibrations for ISP, all seven Idaho regional response teams, the Shoshone-Bannock Tribes, and three area hospitals.

- Practiced ISP & WIPP safe parking procedures during RadReck exercise.
- Provided public information support.

Support and Training of Idaho Radiological Emergency Responders

In 2008, DEQ-INL OP continued to provide Idaho emergency responders with fundamental knowledge and skills required to respond with confidence to incidents involving radioactive material. **Figure 28** shows first responders in a training exercise. DEQ-INL OP health physicists taught courses ranging from an overview of radioactive materials to more complex topics of radiological instrumentation, incident response measures, decontamination procedures, receiving and handling of potentially contaminated patients, and internal contamination.

Figure 28. First responders participating in a radiation transportation accident during RadReck exercise, May 14th, 2008.

During 2008, DEQ-INL OP performed the following activities with the assistance of DOE, ISP, and IBHS:

- Trained 179 first responders on basic radiological awareness, shipping radiological material, and hands-on use of radiological instrumentation.

  Included in these numbers are:

  a) All 7 Idaho Regional Response Teams (RRTs)

  b) Fire departments and EMT groups on the I-15 WIPP corridor

  c) Fire departments, EMT groups, Sheriff Departments and ISP on the I-84/86 corridor

- Trained 17 hospital emergency room personnel on radiological basics, biological effects, contamination control, radiation detection instrument usage and contaminated patient handling.
- Provided radiation awareness training for 24 Idaho Transportation Department (ITD) employees as guest instructors at the ITD Hazardous Material HAZMAT conference.
- Three Oversight staff members attended IBHS Hazardous Material Duty Officer training.
- Attended the Region 6, 2008 Radiological Assistance Program (RAP) Roundup. This DOE-sponsored event hosts first responders from several states and is held annually.
- Assisted Region 6 RAP Team in training and evaluating local responders at Tamarack in preparation for hosting events of the Special Olympics World Winter Games in February of 2009.
- Participated in two Northwest Regional Response Team meetings.
- Attended the Northwest area Emergency Management Working Group meeting.

Public Outreach

A fundamental aspect of DEQ-INL OP's work is sharing our findings with the public and factoring public input into our activities and policy recommendations. DEQ-INL OP uses several tools to provide Idahoans with independent, accurate, and timely information about activities relating to the INL and other DOE activities in Idaho – publications, events, our Web site, and our community monitoring network.

Publications

DEQ-INL OP regularly issues technical and non-technical publications to communicate the findings and activities of our program. In 2008, we issued:

- Quarterly environmental surveillance data reports.
- The INL Oversight Program Publication: **Monitoring and Surveillance of the Idaho National Laboratory – Fall 2008**. This publication covered the following topics:
    - Environmental Pathway Monitoring
    - Air Monitoring
    - External Radiation Monitoring
    - Water Monitoring
    - Terrestrial Radiation Monitoring
    - Community Monitoring

DEQ-INL OP publications are available at http://www.deq.idaho.gov/inl_oversight/library.cfm.

Presentations and Events

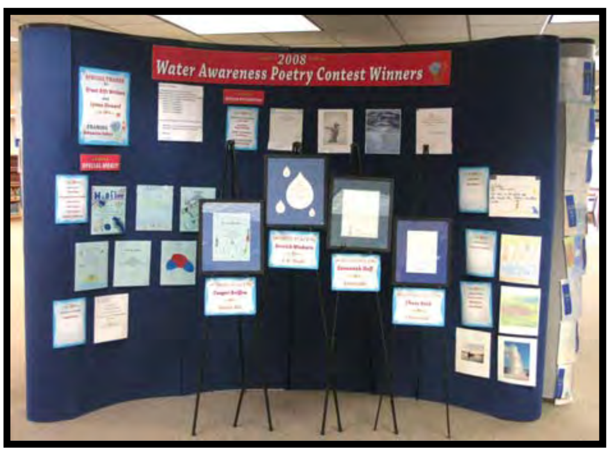
DEQ-INL OP also communicates with the public about INL-related issues through schools, fairs, special interest groups, and public events. In 2008, we gave public presentations on radiation, the aquifer, and INL issues to a range of schools, civic groups, and special interest groups. We also participated in events such as the Twin Falls County Fair, Buhl Trout Days, Science Expositions in Idaho Falls, Earth Day, Household Hazardous Waste Event, and Water Festival.

Several Edible Aquifer presentations were given at these events as well as conducted in school classrooms. This illustration allows the children to learn the geologic formation of an aquifer, how pollution can get into ground water, and how this pollution can end up in drinking water wells. Students come to understand how our actions can affect ground water and drinking water through building an edible aquifer that they can eat after the presentation is complete. It is a very effective way to help them understand that ground water supplies 95% of the drinking water in Idaho and they need to do their part to protect it. Below are examples of various events held in 2008.

Water Festival Activities

Students building an Edible Aquifer

Students playing Conservation Jeopardy



Poetry Contest Winners Display at Idaho Falls Library

Students playing Hold the Load

Twin Falls Fair

Children building an Edible Aquifer

Twin Falls Fair display

Household Hazardous Waste Event (HHW)

Volunteers collecting HHW

HHW collection

Earth Day 2008

Idaho Falls Power Demonstration

Earth Day Kids Crafts

DEQ Edible Aquifer Presentation

INL Glovebox activities

Community Monitoring Network

DEQ-INL OP also participates in a community monitoring network in Eastern Idaho in cooperation with the Shoshone-Bannock Tribes, the U.S. Department of Energy, and NOAA. Strategically located community monitoring stations provide real-time atmospheric and radiological data to the public at each station location and also transmit data to the World Wide Web at http://www.idahoop.org/. **Figure 29** shows one community monitoring station.

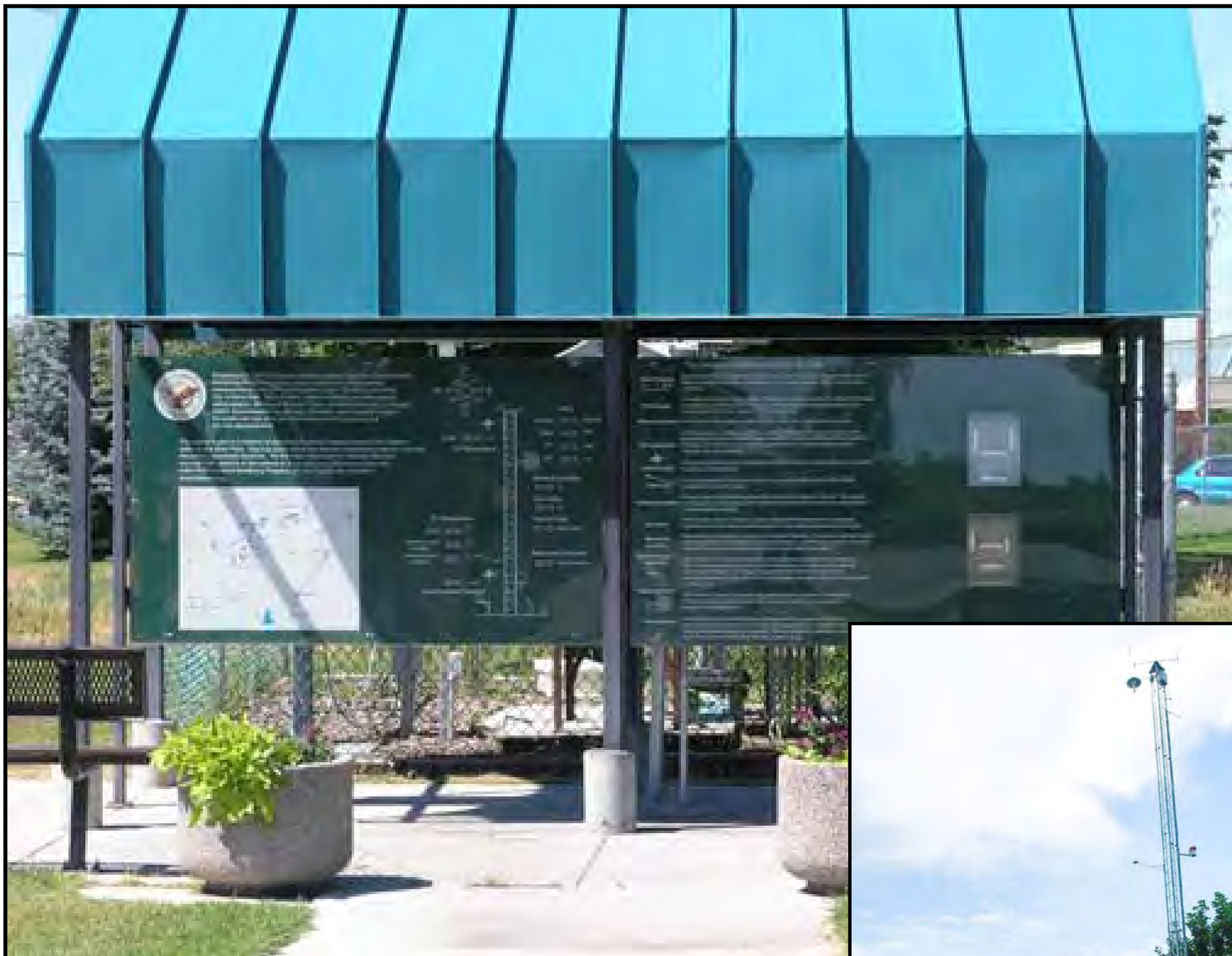


Figure 29. Community monitoring station at the greenbelt in Idaho Falls.

Costs associated with this publication are available from the State of Idaho, Department of Environmental Quality in accordance with Section 60-202, Idaho Code.

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