INL
OVERSIGHT PROGRAM
ANNUAL REPORT
2007

Department of Environmental Quality
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	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), 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 during 2007. 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 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 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 issues written quarterly and annual reports. Each quarterly report contains the detailed data and results of the DEQ-INL 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 environmental monitoring in and around the INL for 2007 are briefly summarized below.

Monitoring Results

In 2007, DEQ-INL 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 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 1% 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 in 2007 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 2007 monitoring showed measurements that were consistent with historic trends. Concentrations of radioactivity in air, soils, and milk

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 usedto 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

continued to be unchanged from 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 2007. 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 very good agreement between the environmental monitoring data reported by DEQ-INL and the DOE. This level of comparability between DEQ-INL 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'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 monitoring sites) are shown in **Figure 1** and a continuous air monitoring station is shown in **Figure 2**.

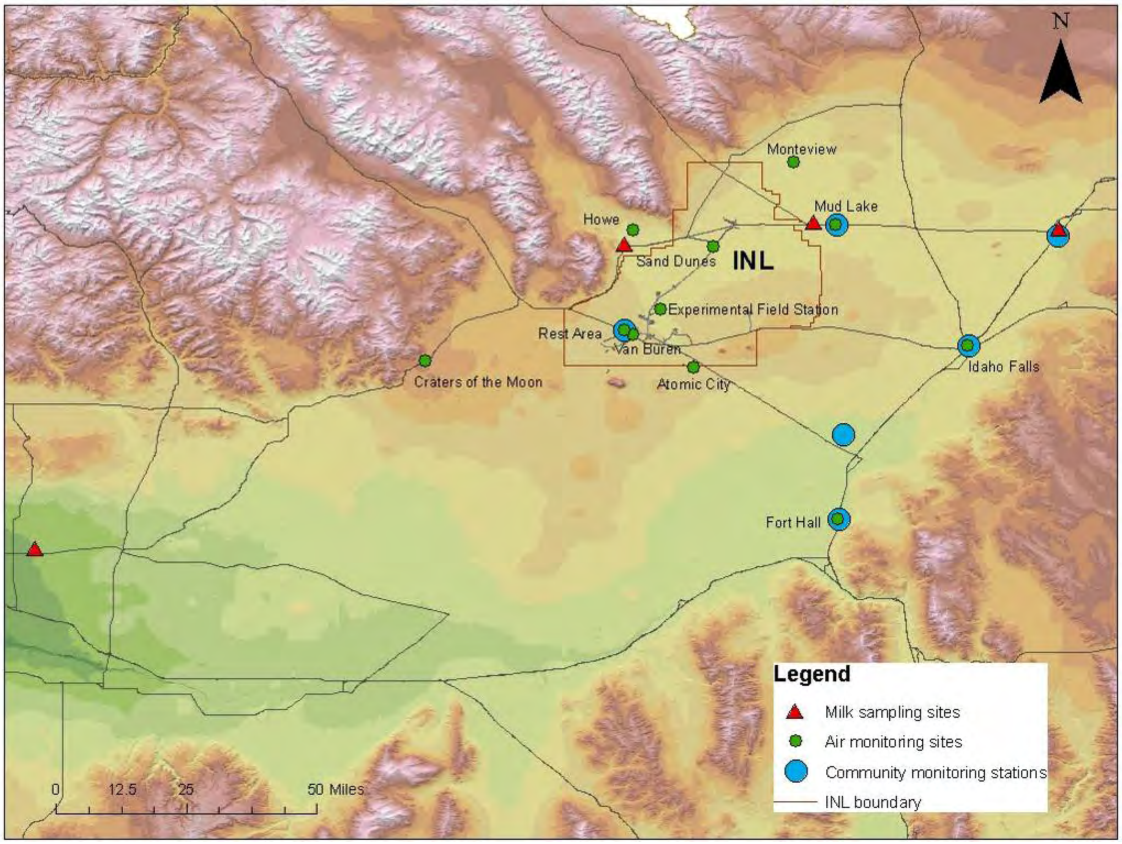

Figure 1. Locations of selected DEQ-INL monitoring sites.

Figure 2. A DEQ-INL Oversight 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.
- 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 Oversight air monitoring station with all four different types of sampling equipment is pictured in **Figure 3.**

Figure 3. DEQ-INL Oversight 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 Oversight 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 matter sampler (TSP). The filters are collected weekly and are analyzed for gross alpha and 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 radio-chemical 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 traps the radioiodine within its sponge-like pores. Each week, canisters are collected from all 11 air monitoring stations and analyzed together as a batch. 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 water. This water is then collected 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'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 533 filters from TSP samplers were collected during 2007. 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 2007 are summarized in **Table 1**. The annual TSP filter composite samples showed concentrations of strontium-90 from 3.26×10^{-5} to 6.41×10^{-5} picocuries per cubic meter (pCi/m^3) for 2007. These values are within the expected range due to global fallout from historic above-ground weapons testing. No transuranic radionuclides (plutonium-238, 239, 240 and americium-241) were detected in 2007.

Table 1. Gross alpha and beta screening ranges and averages observed by DEQ-INL Oversight Program for 2007.

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)
2007	0.1 to 5.6	1.12 ± 0.2	7.4 to 81.1	29.7 ± 0.6

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

Atmospheric Tritium

A total of 171 atmospheric moisture samples were collected in 2007 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 on the INL in 2007 were 1.10 ± 0.17 pCi/m^3 at the Experimental Field Station for the time period of August 9th through August 30th, 0.76 ± 0.19 pCi/m^3 at Van Buren Avenue for the time period of August 30th through September 27th, and 0.59 ± 0.12 pCi/m^3 at the Big Lost River Rest Area station for the time period of February 16th through March 22nd. Two off-site tritium detections were observed in 2007, one at the Atomic City sampling station for the time period of March 1st through March 29th with an airborne concentration of 1.23 ± 0.14 pCi/m^3 and one at the Idaho Falls sampling station for the time period of December 28th, 2006 through February 16th, 2007 with an airborne concentration of 0.45± 0.09 pCi/m^3.

All atmospheric tritium measurements for 2007 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 Iodine

No gaseous Iodine was detected by DEQ-INL Oversight in 2007.

Precipitation

No tritium or human-made gamma-emitting radionuclides have been detected by DEQ-INL Oversight 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 Oversight, the Environmental Surveillance, Education and Research Program (ESER), and Battelle Energy Alliance (BEA) for 2007 agreed within 20%, with the exception of the comparison of gross alpha results between DEQ-INL and ESER, which agreed within 25% 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 be investigated by DEQ-INL Oversight in 2008 to try to quantify the variations in sampling methods between the different organizations that perform air sampling at the INL.

Table 2. Comparison of DEQ-INL Oversight suspended particulate matter analysis results for paired samples with DOE contractor results in 2007.

(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	76.0%	95.2%
DEQ-INL Oversight Gross Beta Analysis	89.9%	90.3%

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 2007.

2007 annual averages for atmospheric tritium measurements were compared for each co-located sampling station among DEQ-INL, ESER, and BEA. Comparing tritium samples is difficult because although they are co-located, they are not paired or split samples. Each monitoring agency collects their 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. This results in differences and overlaps in sampling schedule throughout the year and makes a direct one to one comparison of results not possible. The Mann-Whitney non parametric statistical test was used to compare the means of the populations of laboratory results to account for these differences. The results between BEA and DEQ-INL OP agreed statistically for all sites at the 80% confidence level. The results between ESER Stoller and DEQ-INL OP were not in statistical agreement at the 80% confidence level. The results from all three monitoring agencies indicate no public health risk and are orders of magnitude below levels of regulatory concern.

No iodine-131 was detected in 2007 by DEQ-INL Oversight, ESER or BEA, using activated charcoal canisters.

Air Monitoring Impacts and Conclusions

Based upon 2007 air quality measurements, DEQ-INL 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 detections are well below federal regulatory limits and indicate no risk to public health.

Overall, DEQ-INL air monitoring results were in agreement with the results obtained by DOE and its contractors.

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. Penetrating radiation measurements are performed by DEQ-INL at each air monitoring station maintained by DEQ-INL, 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 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. Data are collected by DEQ-INL 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 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 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 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 2007, 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.

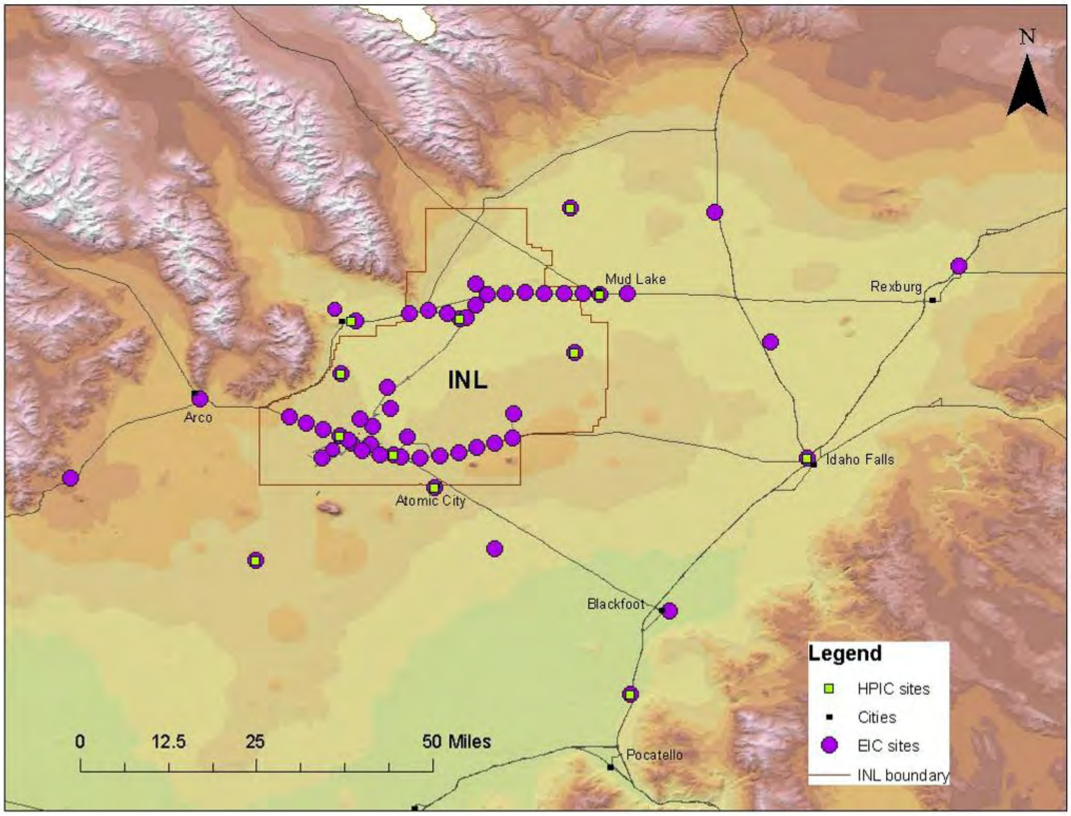

Figure 5. Locations of HPIC and EIC monitoring sites.

Radiation Monitoring Verification Results

DEQ-INL has placed several EICs at locations monitored by DOE contractors, using thermoluminescent dosimetry (TLD). Ambient penetrating radiation measurements during 2007 showed good agreement with DOE contractors, as 100% of BEA's TLD measurements and 100% of ESER Stoller's TLD measurements were within ± 20% of co-located DEQ-INL EIC measurements (**Table 3**).

Table 3. Comparison of DEQ-INL, ESER Stoller, and BEA radiation measurements at co-located sites in 2007. (Units in micro-Roentgen per hour or μR/h)

Statistical Measure	DEQ	ESER Stoller[a]	BEA[b]
Mean	13.52	14.08	14.50
Median	13.69	14.08	14.50
Standard Deviation	1.95	1.06	1.02
Minimum	9.41	11.90	12.27
Maximum	19.48	16.29	16.39
Average % difference		-2.43%	-3.88%

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 2007.

Radiation Monitoring Impacts and Conclusions

Based upon radiation measurements made by DEQ-INL, there are no discernable impacts from INL operations in 2007. 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 2007, 96 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 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.

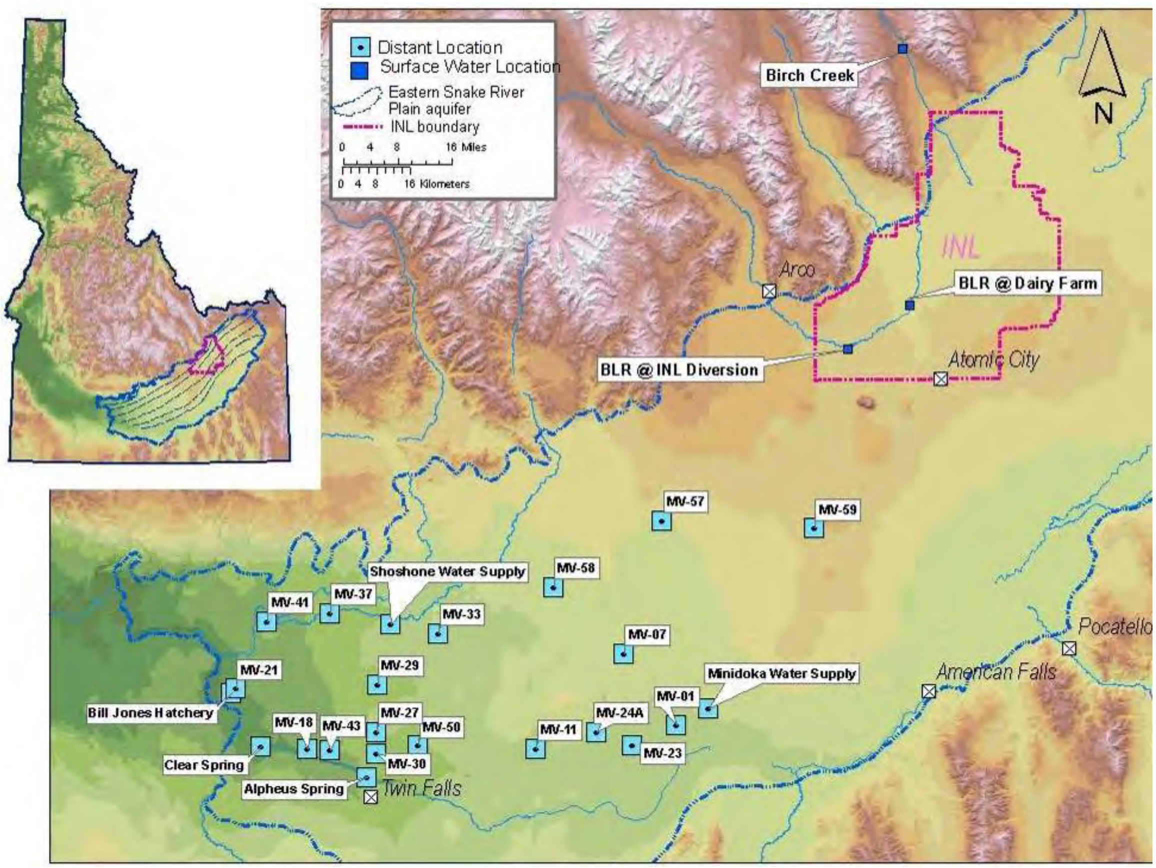

Figure 6. Water quality monitoring sites distant from the INL and surface water sites on Birch Creek and the Big Lost River (BLR).

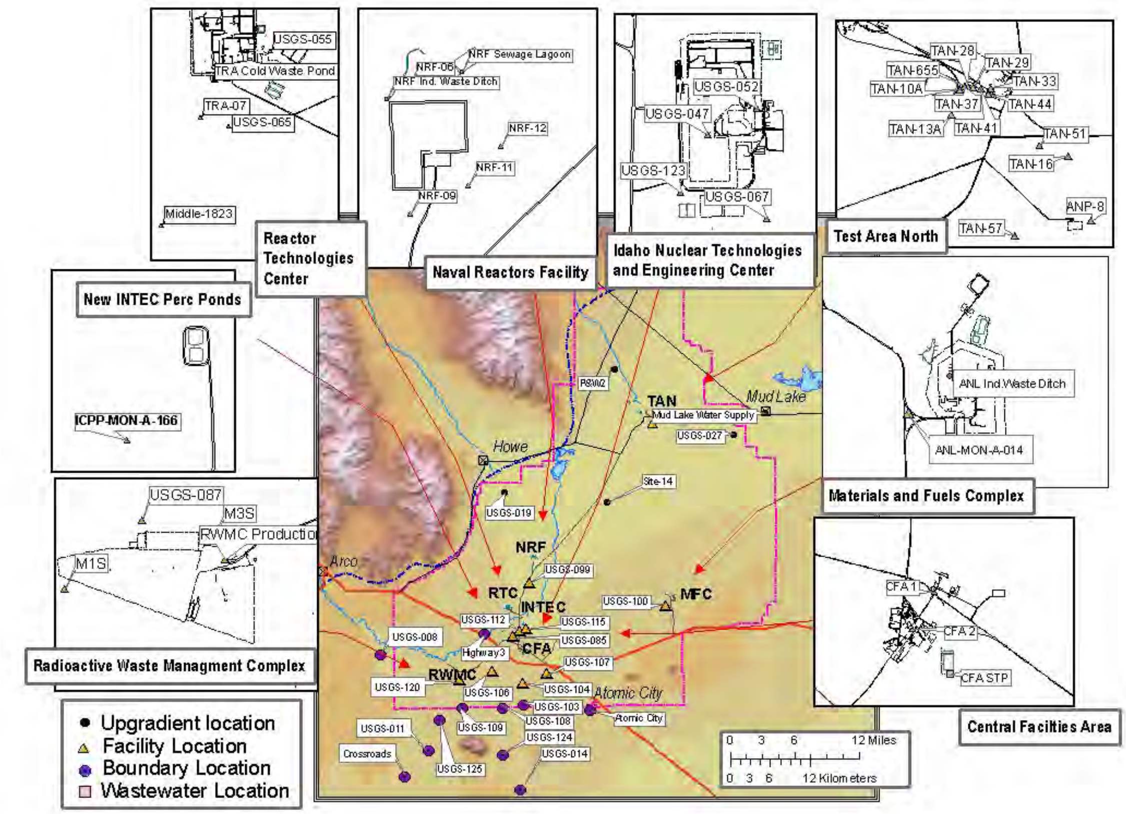

Figure 7. Water quality monitoring sites on and near the INL.

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 staff members collecting a ground water sample.

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

Figure 9. DEQ-INL 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 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 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 2007, uranium isotope results were not differentiable from natural background ranges. Plutonium, neptunium-237, and americium-241 were not detected in 2007.

Table 4. Summary of selected radiological analytical results for DEQ-INL 2007 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	45.7 ± 4.6	<MDC	<MDC	7.2 ± 3.4	0-3	15
Gross Beta	<MDC	5.05 ± 1.2	1325.1 ± 14.3	<MDC	4.6 ± 1.1	9.6 ± 1.4	0-7	50
Cesium-137	<MDC	<MDC	4.7 ± 2.1	<MDC	<MDC	<MDC	0	200
Tritium	<MDC	940 ± 110	13830 ± 320	<MDC	<MDC	<MDC	0-40	20,000
Strontium-90	<MDC	<MDC	620 ± 150	NS[5]	NS	NS	0	8
Technetium-99	<MDC	0.9 ± 0.2	332 ± 1.2	NS	NS	NS	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 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 one sample in 2007, TAN-37. Although cesium-137 was not detected at this location in 2006, it is a known contaminant for the TAN 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 Technologies and Engineering Center (INTEC) and from reactor operations at the Reactor Technologies Center (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). The levels of tritium at the southern boundary wells are very low and less than 1% of the federal drinking water standard. **Figure 11** shows tritium concentrations measured in 2007.

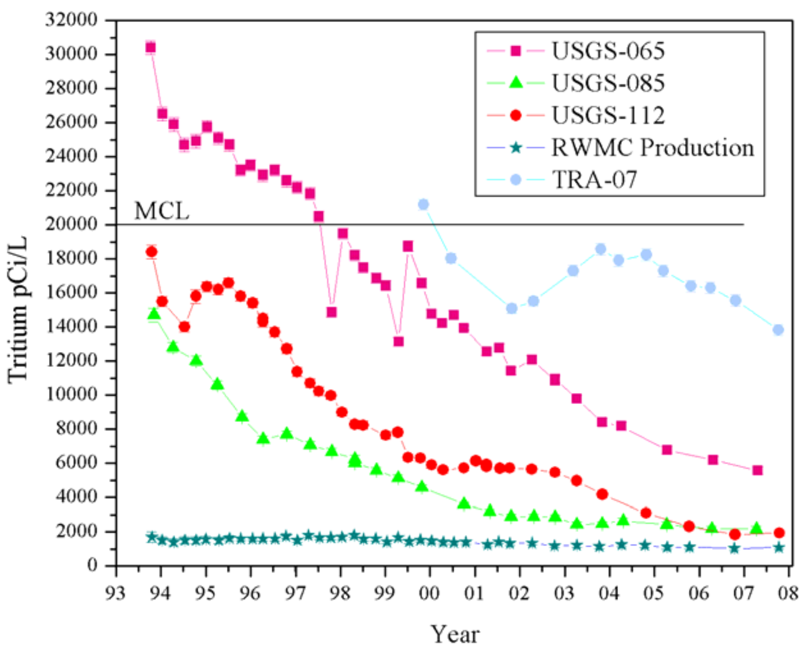

Figure 10. Tritium concentrations (pCi/L) over time for selected INL wells impacted by INL contamination.

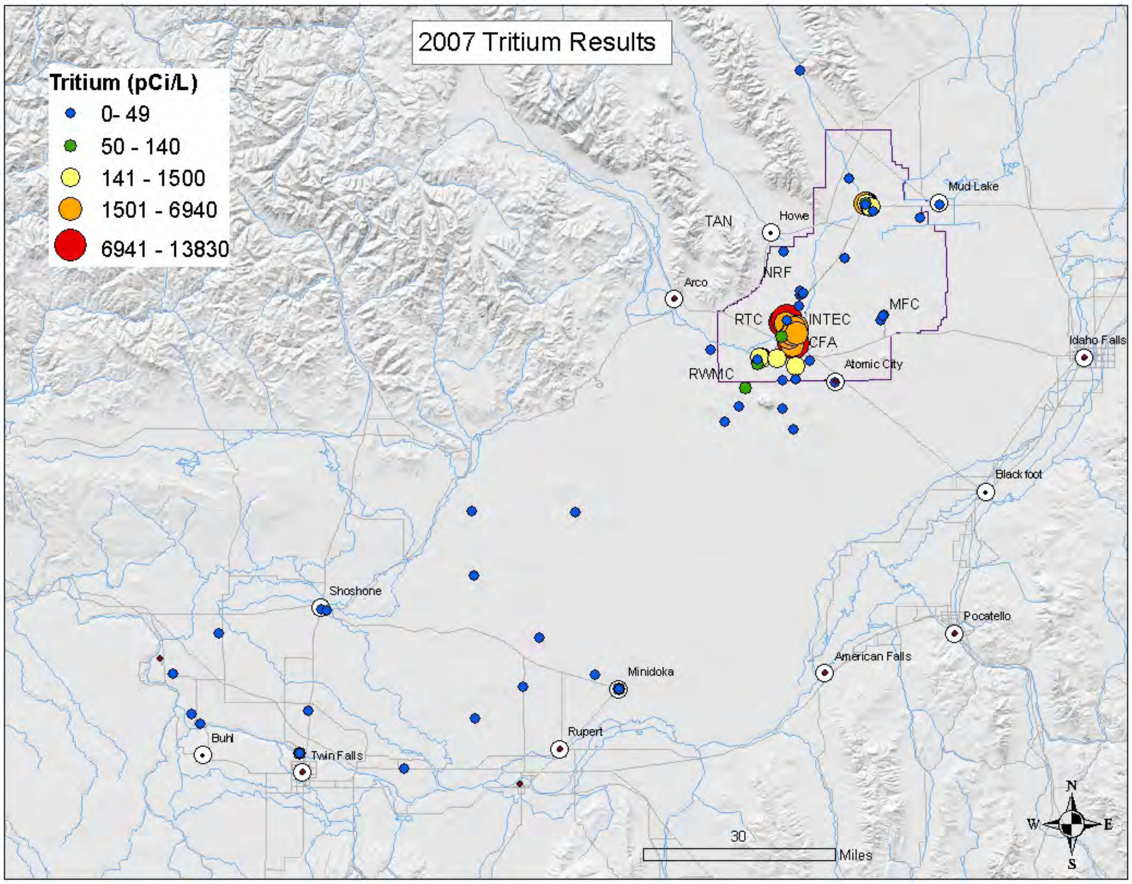

Figure 11. 2007 tritium concentrations (pCi/L) for DEQ-INL sample locations.

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 (620 ± 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 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. 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 sample locations.

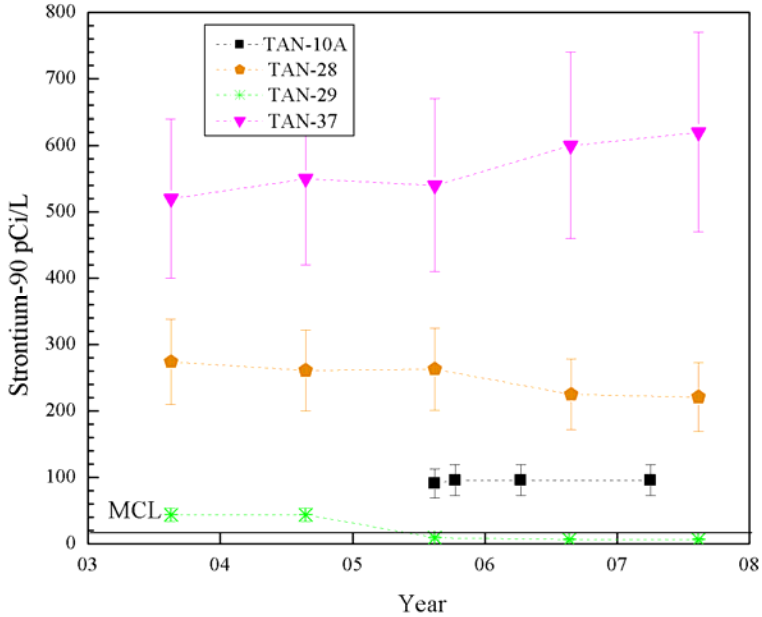

Figure 12. Strontium-90 concentrations over time for selected wells near Test Area North (TAN).

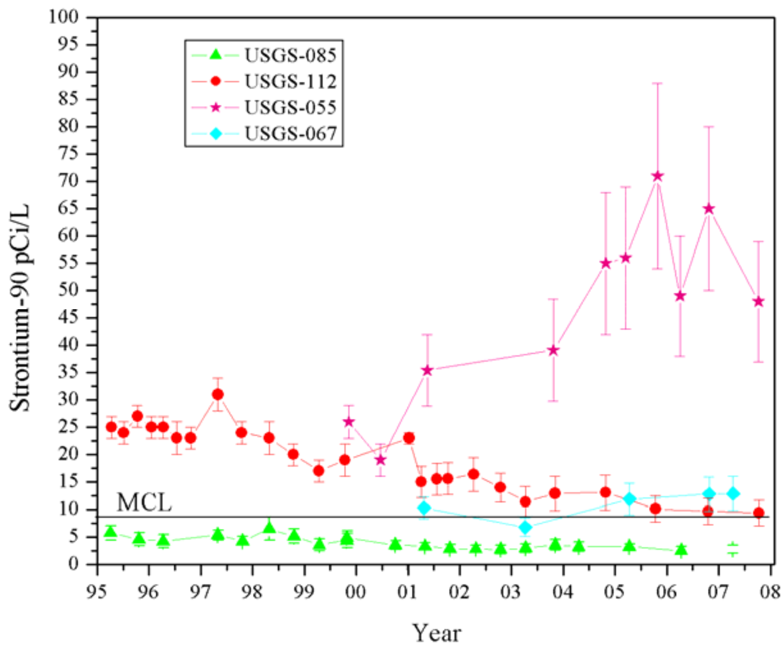

Figure 13. Strontium-90 concentrations over time for selected INL wells impacted by INL contamination.

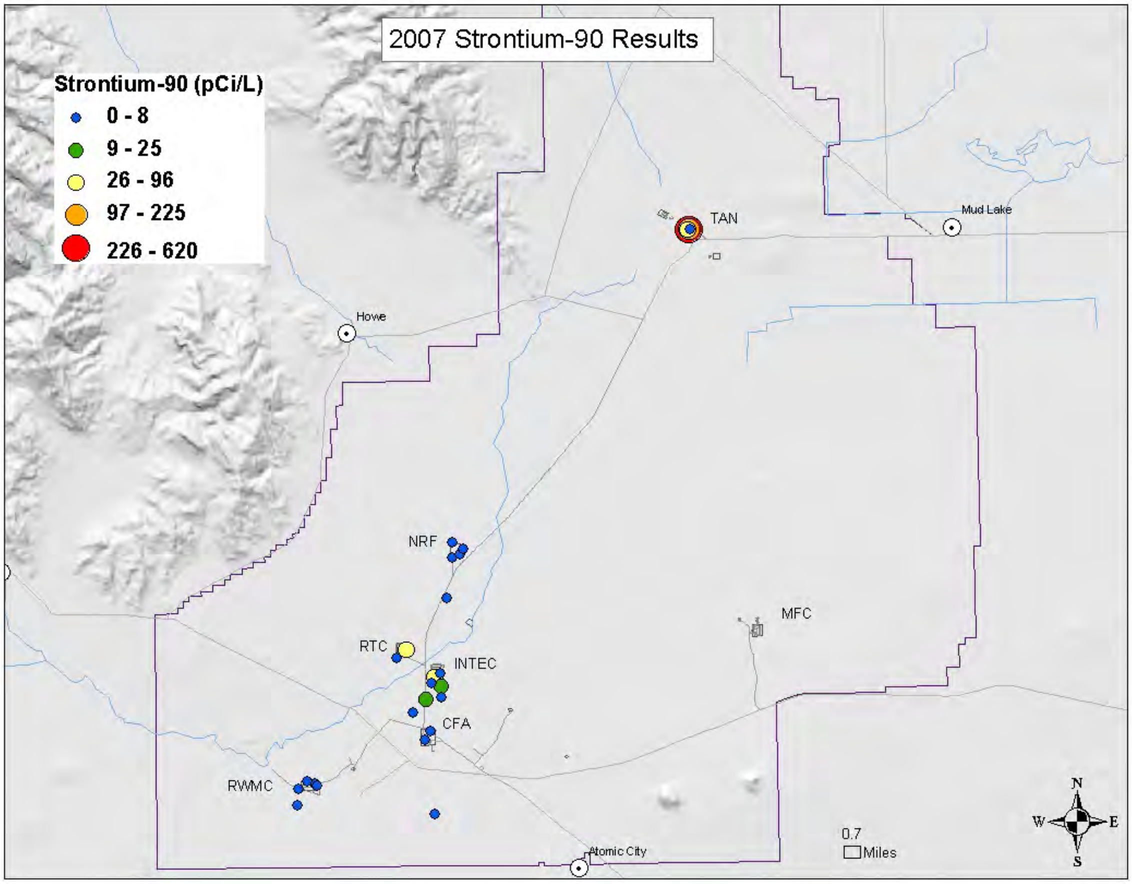

Figure 14. 2007 strontium-90 concentrations (pCi/L) for DEQ-INL sample locations.

Technetium-99

Concentrations of technetium-99 found in the aquifer from 3 selected wells near INTEC appeared to be constant over the past few years. However, results from wells USGS-052 and USGS-067 showed an increase in concentrations (**Figure 15**). All 2007 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 (332 ± 1.2 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 sample locations.

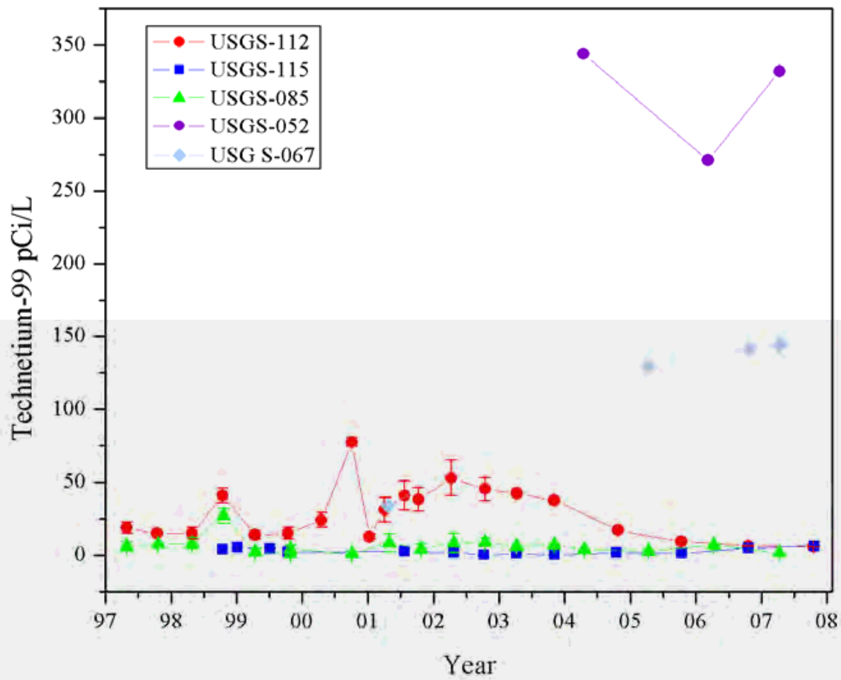

Figure 15. Technetium-99 concentrations over time for selected INL wells impacted by INL contamination.

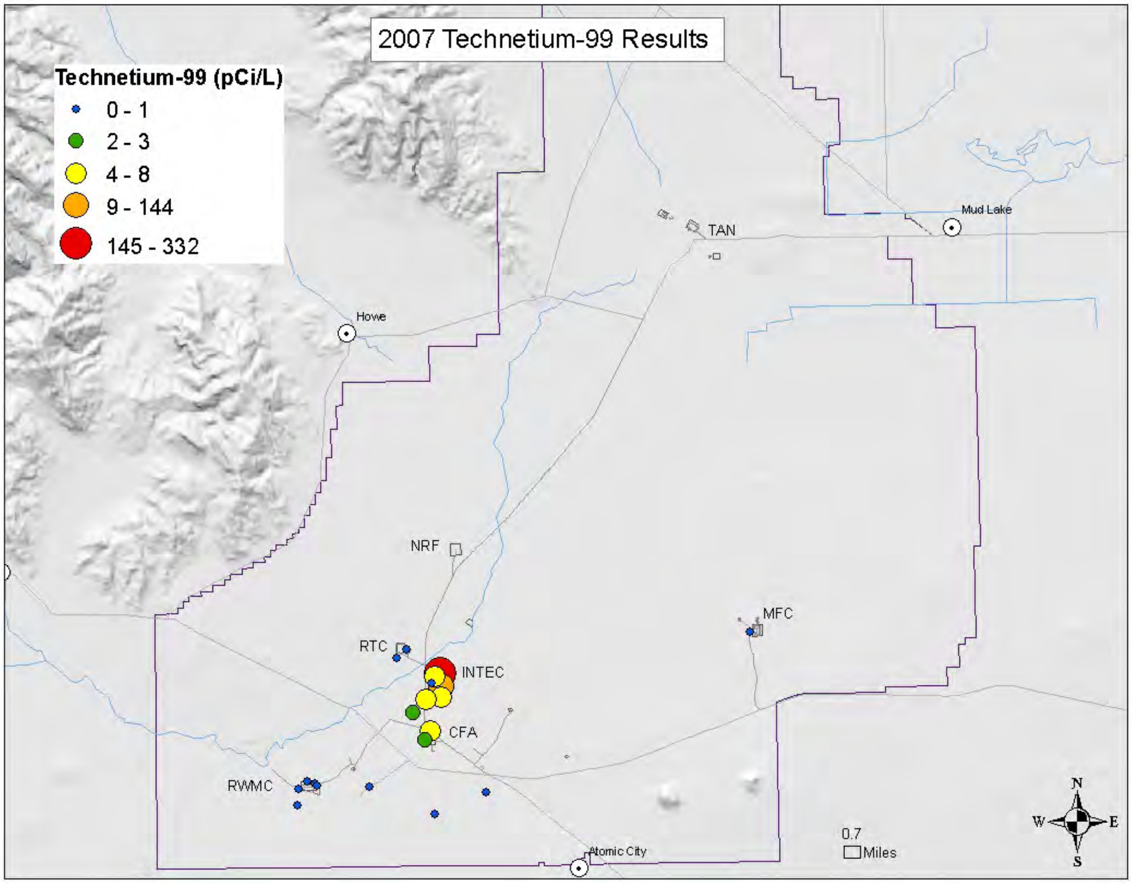

Figure 16. 2007 technetium-99 concentrations (pCi/L) for DEQ-INL sample locations.

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 2007 were relatively unchanged from previous years. Common ions, nutrients, and metals results found in samples collected by DEQ-INL in 2007 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 water samples for 2007.

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	8.8	41.5	50	26	50	163	34	37.5	45	23	42	61	5 - 43	none
Magnesium	2.8	15.5	17	10	15	40	13	14	15	11	16	27	1 – 15	none
Sodium	7.5	18.95	28	5.7	15	190	7	10.3	17	8	21	54	5 – 14	none
Potassium	1.3	3.1	6	1.9	2.9	6.6	1.8	2.55	3.2	2.1	3.6	6.9	1 – 3	none
Chloride	4.92	9.38	53.1	3.72	23.3	511	7.98	15.4	21.8	3.43	23.8	67.6	2 – 16	250*
Sulfate	8.24	24.1	41.1	14.8	28.6	161	19.3	22.3	24.1	11.7	37.1	75.7	2 – 24	250*
Total Nitrate plus Nitrite	0.5	0.745	2.5	0.29	1.2	5.6	0.58	0.785	1.4	0.42	1.6	4.4	1– 2	10
Total Phosphorus	0.0075	0.014	0.037	0.0075	0.024	0.33	0.013	0.016	0.02	0.01	0.024	0.048	<0.02	none
Metals (µg/L)														
Barium	18	62	77	22	65	299	19	36.5	76	5	33.5	90	50 – 70	2000
Chromium	5	5.5	6	5	11	106	6	6.5	7	<5	<5	<5	2 – 3	100
Lead	<5	<5	<5	6	14	15	<5	<5	<5	<5	<5	<5	<5	15
Manganese	4	12	34	2	3.5	920	3	5	28	<2	<2	2	<1– 4	50*
Zinc	<5	<5	51	6	15	597	29	132.5	236	7	28	496	<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 2007 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.

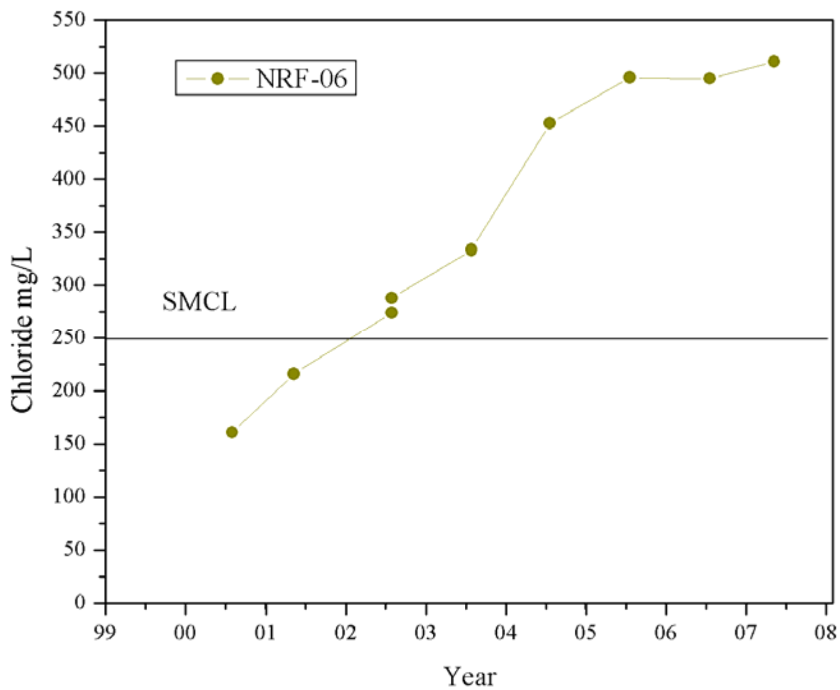

Figure 17. Chloride concentrations for sample location NRF-06 over time.

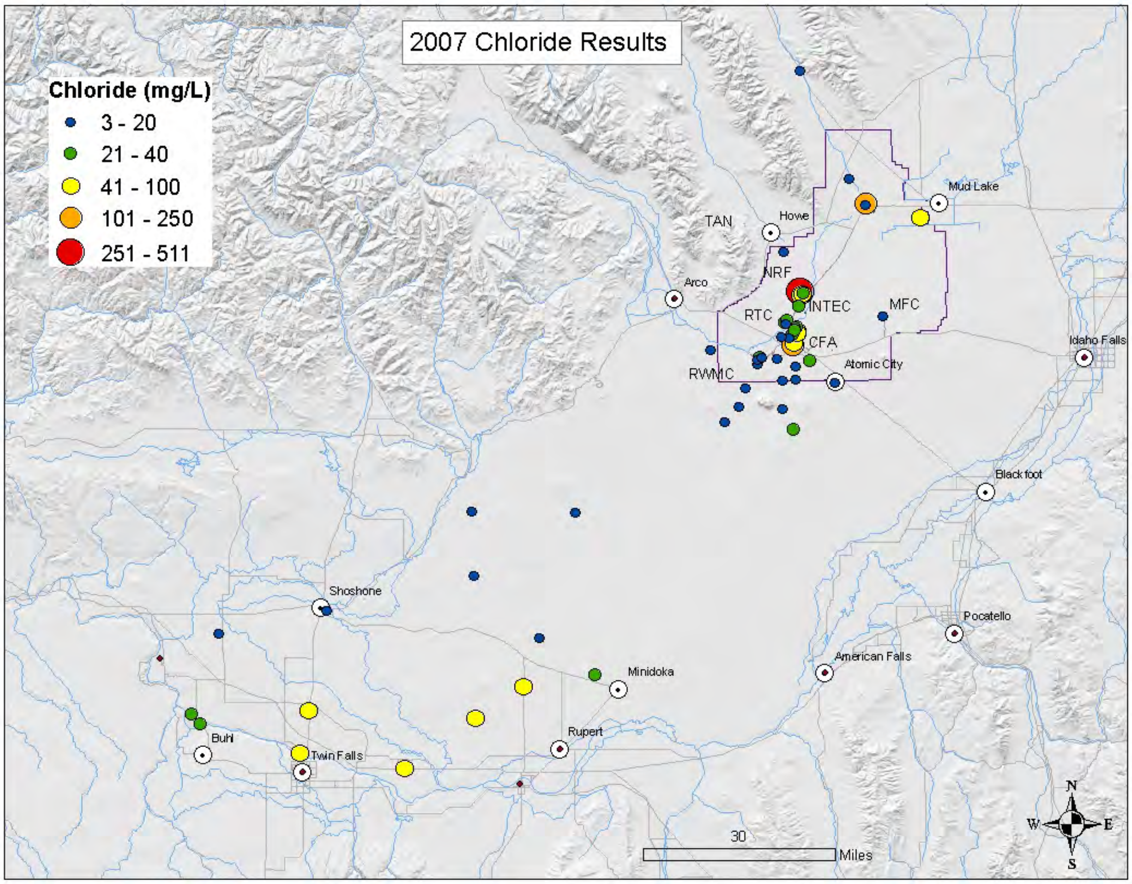

Figure 18. 2007 chloride concentrations for DEQ-INL sample locations.

Chromium

One result for a well (TRA-07) near the RTC was above the MCL (maximum contaminant level) 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 2007 sample locations are shown in **Figure 20**.

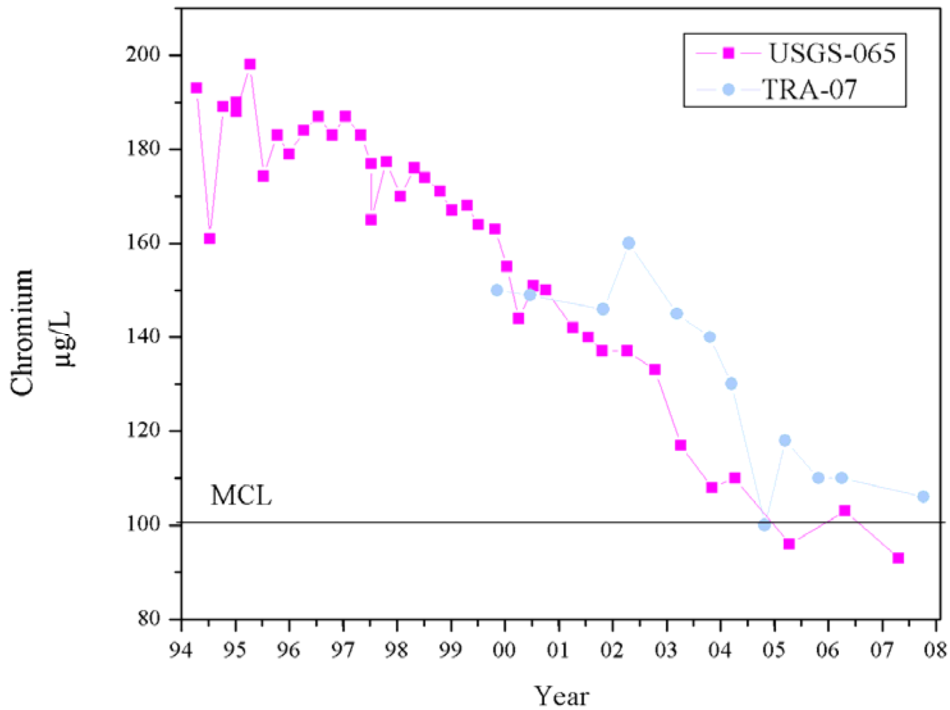

Figure 19. Chromium concentrations (µg/L) over time for selected INL wells impacted by INL contamination.

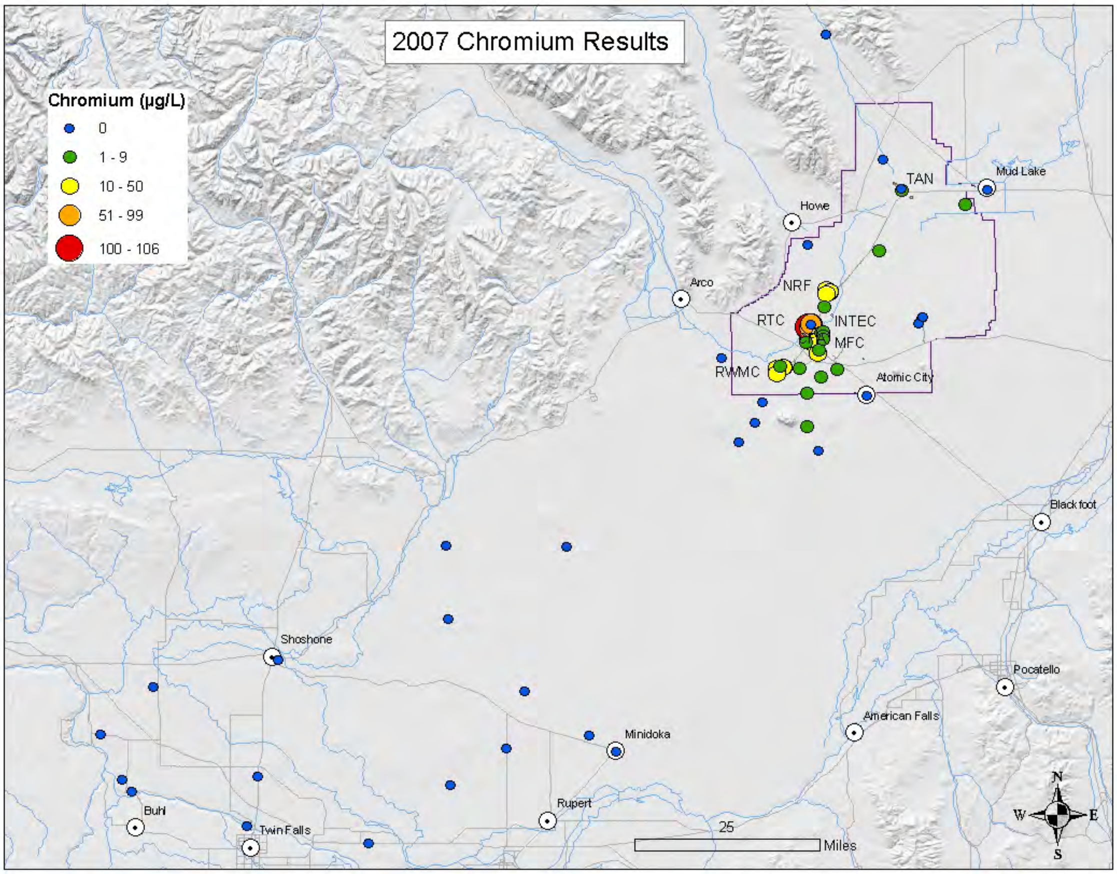

Figure 20. 2007 chromium concentrations (µg/L) for DEQ-INL sample locations.

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 2007 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 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 sample results and those of DOE, each sampling contractor's result is scrutinized individually to ascertain the cause of the difference. The DEQ-INL verification sampling program is designed to co-sample at approximately 10% of all DOE sample locations for selected analytes. Co-sampled DEQ-INL results for 2007 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 and DOE radiological results is presented in Table 6. Sample-by-sample comparisons showed that results were generally in good agreement, with the exception of technetium-99. The DEQ-INL results for technetium-99 appear to be biased high for samples near the lower limit of detection.

Table 6. Radiological results for co-samples collected by DOE and DEQ-INL in 2007.

Analyte	Number of Co-sampled pairs in 2007	Percent of Co-sampled pairs passing criteria in 2007
Americium-241	7	100
Gross Alpha	31	80
Gross Beta	31	90
Cesium-137	24	100
Neptunium-237	4	100
Plutonium-238	7	100
Plutonium-239/240	7	100
Plutonium-241	4	100
Strontium-90	24	92
Technetium-99	11	73
Tritium	55	90
Uranium-234	7	100
Uranium-235	10	100
Uranium-238	7	100

Non-Radiological

Figure 21 presents the overall comparisons of non-radiological results for sites co-sampled with DOE in 2007. In 2007, there was less than 20% difference between all the compared DEQ-INL water results and DOE water results. This means that DEQ-INL is getting the same results on average as the DOE for non-radiological parameters. The largest differences were in the analysis for maganese and VOCs; however, these differences were still within the 20% relative percent difference (RPD) criteria set by the DEQ-INL for comparisons.

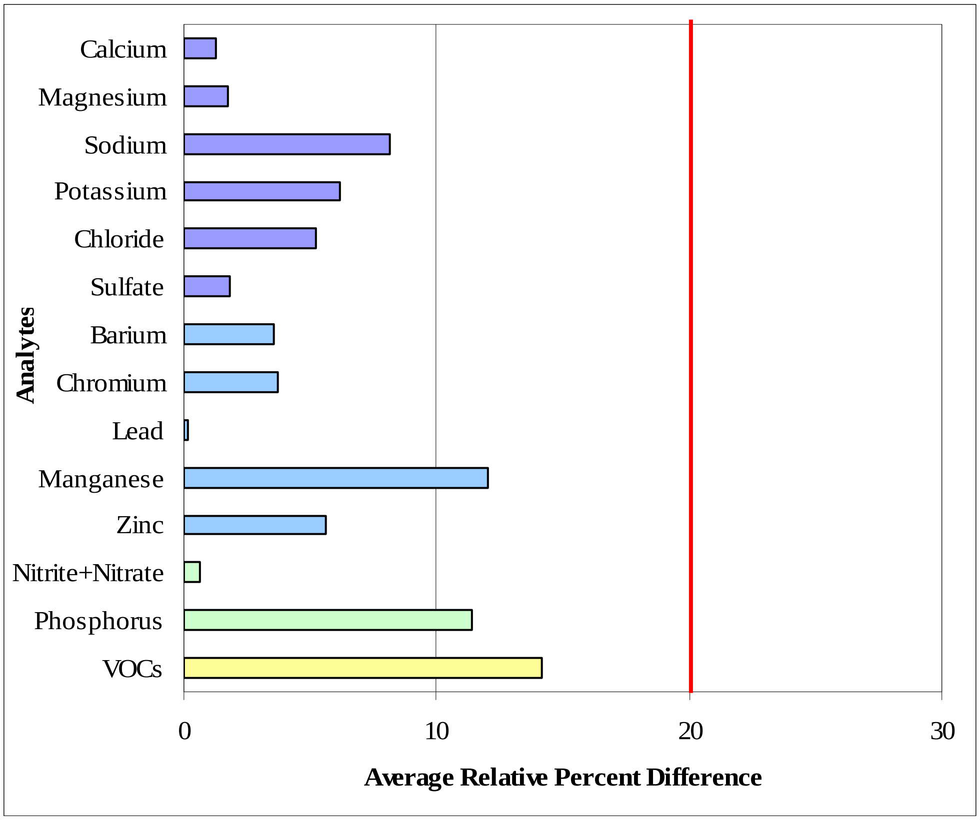

Figure 21. Summary of relative differences between results from DEQ-INL and those from DOE or its contractors in 2007.

Water Monitoring and Verification Impacts and Conclusions

DEQ-INL sample results are generally in agreement with those reported by DOE and its contractors. Results of DEQ-INL 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 2007. 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, but at levels very near background concentrations.
- 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 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 for these same locations.

Terrestrial Monitoring Equipment and Procedures

Where possible, DEQ-INL used *in-situ* gamma spectrometry to monitor concentrations of gamma-emitting radionuclides in soil at DEQ-INL air monitoring stations (locations shown in **Figure 1** on page 4) and selected soil sampling sites (all the 2007 soil sampling sites are shown in **Figure 22** below). Using *in-situ* gamma spectroscopy minimizes impact to the environment by not requiring collection of a physical sample. A portable gamma radiation detector was used in the field to collect surface radiation measurements. These measurements were then used to identify radionuclides present and to estimate soil radioactivity concentrations. No physical soil samples were taken in 2007. ESER Stoller collects soil samples every other year and they did not sample in 2007, therefore no off-site verification data is available for 2007.

DEQ-INL collected milk samples from distribution centers where milk was received from individual dairies in southern and southeastern Idaho. Milk sampling locations are shown in **Figure 1** on page 4. 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.

In recent years, DEQ-INL has lost three milk sampling locations due to the closure of local distribution centers in Blackfoot, Pocatello and Rupert. This is the result of small dairies going out of business or selling out to large corporate milking operations. To compensate for these lost samples, DEQ-INL began sampling goat milk from Blackfoot, Tetonia, Twin Falls and Arco. Goats concentrate about ten times more iodine in their milk than cows do and most of the goats rely on grazing for their daily food (in contrast to large milking operations that feed stored, baled hay). These two factors make goat milk an excellent indicator of iodine deposition in the environment.

Two DEQ milk samples were 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 for analysis. DEQ-INL used the analysis results from these samples to verify DOE's analysis results from the same (split) samples.

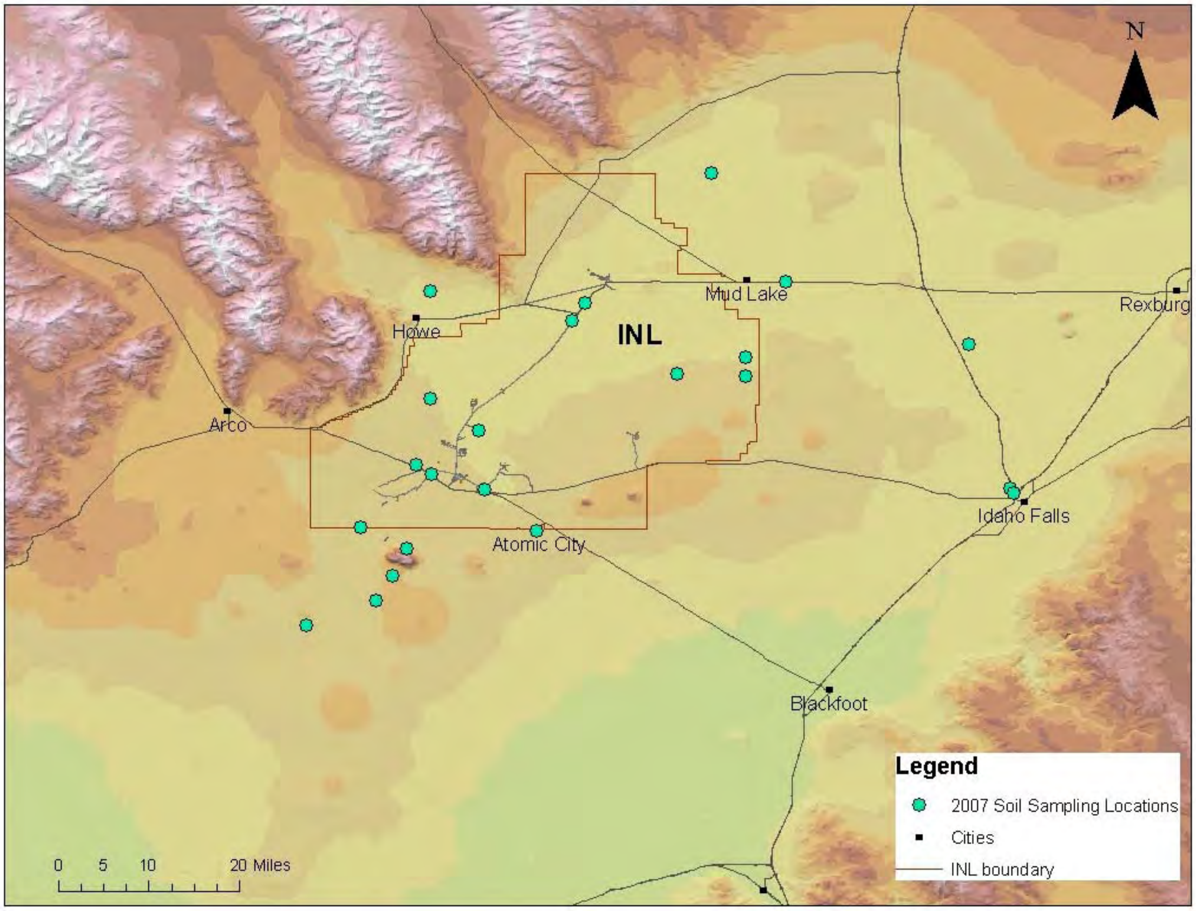

Figure 22. DEQ-INL soil sampling locations for 2007.

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 2007, DEQ-INL made *in-situ* gamma spectrometry measurements to estimate accumulations of gamma-emitting radionuclides in surface soil at 22 locations. Of the 22 measurements, no human-made radionuclides were detected, with the exception of cesium-137.

Milk sampling is conducted by DEQ-INL 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 the ground and eventually absorbed by plants or animals. 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 2007, DEQ-INL analyzed 81 milk samples. Radioactive iodine was not detected in any milk sample. In fact, since DEQ-INL began monitoring milk in 1996, no radioactive iodine (specifically iodine-131) has ever been detected in excess of the DEQ-INL 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.

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 and DOE sample results include this isotope, especially since the target radionuclide (such as iodine-131) is seldom detected.

Gamma spectroscopic analysis results of milk split samples collected by the DOE contractor and submitted to DEQ-INL for analysis were compared with DOE results. Analytical Potassium-40 results obtained by DEQ-INL showed 95% agreement with DOE results. All results for iodine-131 for both agencies were below the minimum detectable activity.

To verify DOE soil sampling results, DEQ-INL conducted *in-situ* gamma spectrometry measurements at eight locations where DOE conducted *in-situ* gamma spectrometry measurements. Results of the soil verification measurements did not meet the agreement criteria as defined by a 3 sigma test. This is probably due to a DEQ-INL systematic operational error which caused an energy shift in the spectrum during collection. The resulting spectra did not have clearly defined energy peaks needed to yield a good comparison. This issue has been resolved and repeat measurements will be made at all 2007 soil locations in 2008. A more detailed discussion of this issue follows in the quality assurance (QA) section.

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. Analytical results of DEQ-INL milk samples are consistent with those obtained by DOE contractors.

Quality Assurance for the ESP

This section summarizes the results of the quality assurance (QA) assessment of the data collected for calendar year 2007 for the DEQ-INL's Environmental Surveillance Program. All analyses and quality control (QC) measures at the analytical laboratories used by the DEQ-INL 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. Analytical results for blanks, duplicates, and spikes were used to assess the precision, accuracy, and representativeness of results from analyzing laboratories. During calendar year 2007, the DEQ-INL submitted 318 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.

Issues and Problems

Two significant QC issues were identified during calendar year 2007:

The Big Lost River Rest Area was demolished and a new facility built in 2007. During this construction, the NOAA meteorological tower and the DEQ-INL air sampling station were moved a few hundred yards from their previous location. The construction began in the first quarter and finished up in the fourth quarter. There is no data for this time period as there was no power at the site and construction dust would have impacted air sampling. DEQ-INL resumed air sampling in December 2007 and will be reporting data for 2008.

Terrestrial in-situ soil sampling results using High Purity Germanium (HPGE) technology underestimated radionuclide concentrations in the soil due to a systematic operational error. Specifically, the digital interface equipment used to collect soil spectra experienced a gain shift during collection. This resulted in energy counts being distributed over several collection channels instead of concentrating them into a few channels. The system software equates these counts to exposure from discrete radionuclides in the soil. These spectra were able to distinguish which nuclides were present in the soil however the concentrations were under estimated. The gain shift was not recognized until the spectra were analyzed on the computer. Once the problem was understood, the digital interface equipment was re-programmed to prevent this issue from happening in the future. Due to weather constraints, repeat samples were not possible until 2008. All 2007 soil sampling locations will be repeated in 2008.

Comparing Data

In addition to reporting independent monitoring results, DEQ-INL also determines whether the information collected by DOE matches the information and/or conclusions reached by DEQ-INL. One basic tool used by DEQ-INL to conduct these comparisons for all sampling is to perform a measure of Relative Percent Difference between DEQ-INL and DOE measurements. Although the methodology is slightly different for radiological and non-radiological sample results, the comparison methodology is basically the same. In general, for each sample collected by both DEQ-INL and DOE and/or its contractors, the DEQ-INL result is subtracted from the DOE result to determine the difference between the two measurements. This difference is divided by the DEQ-INL result or 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 equations:

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

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

Typically, the RPD calculated using the above equation is considered acceptable if it is within ±20. Media specific RPD acceptability tests are listed in **Table 7**. DEQ-INL may also calculate an average of all the RPDs found for a specific test or analyte.

Table 7. Specific RPD criteria for individual sampling media.

Media Type	Specific Criteria
Total Suspended Particulate (TSP) air	20% relative percent difference with respect to mean
Impregnated Charcoal Canister (I-131)	20% relative percent difference with respect to mean (if detected)
Environmental Radiation (EIC & HPIC)	20% relative percent difference with respect to mean
Terrestrial Milk Sampling	20% relative percent difference with respect to mean (for K-40)
Terrestrial Soil Sampling	20% relative percent difference with respect to mean (for Cs-137)
Tritium in Precipitation (H-3)	20% relative percent difference with respect to mean (if above MDC)
Non-radiological Ground Water	20% relative percent difference
Radiological Ground Water	$/ R_1 - R_2 / \leq 3(S_1^2 + S_2^2)^{1/2}$

In addition, DEQ-INL 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 Oversight evaluates public health and environmental impacts from INL activities and proposed projects. DEQ scrutinizes INL's management of radiological materials and wastes, including inventories, storage, treatment, transportation, and disposal. DEQ 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 also reviews INL safety concerns and incidents to determine whether INL operates within appropriate safety parameters.

DEQ-INL Oversight assesses impacts of activities not covered by DEQ's Waste/Remediation and Air Quality Divisions—who have regulatory authority over INL air emissions, CERCLA site remediation, and RCRA hazardous waste management. A summary of DEQ'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 Settlement Agreement. Most of the SNF at INL is currently in dry storage. INL is only one of two DOE sites that have active SNF wet storage pools. According to the Settlement Agreement, DOE must complete the transfer of all INL SNF from wet storage to dry storage by the end of 2023.

During 2007:

- 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 eight shipments of SNF at the Naval Reactors Facility (NRF).

Some of the activities DEQ-INL Oversight 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 continued toward the completion of a major Settlement Agreement milestone completing the 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. Three of the four 30,000 gallon tanks were grouted in the late fall of 2006 before winter weather suspended grouting operations. In 2007, the fourth 30,000 gallon tank was grouted as were seven of the eleven 300,000 gallon tanks. 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 Oversight 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 grouting operations including review of grout batch sheets, observation of batch quality assurance activities, and observation of grout filling the tanks via remote camera.

Integrated Waste Treatment Unit Construction

During 2007, DOE began construction of a facility – the Integrated Waste Treatment Unit (IWTU) – to treat approximately 900,000 gallons of sodium-bearing waste (SBW) currently at the INTEC Tank Farms. Treatment will consist of solidification and preparation of this waste for off-site disposal. Solidification is a required activity to meet the 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 has selected a steam-reforming technology to treat and stabilize the waste for final disposition at the Waste Isolation Pilot Plant (WIPP) in New Mexico or at the planned Yucca Mountain repository in Nevada. Steam reforming is designed to convert SBW into a solid granular product that can be packaged into containers for safe storage and disposal.

Prior to the beginning of construction, DEQ-INL Oversight personnel attended meetings and reviewed documents pertaining to surrogate testing, and construction design for the IWTU. After construction began DEQ-INL Oversight personnel observed 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. 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. Through the end of 2007, 99 shipments of RH-TRU waste had been shipped to WIPP. DOE expects to complete the remaining 126 shipments for this campaign in 2008.

DEQ-INL Oversight 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) excavates, identifies, and repackages targeted waste for characterization and shipment to WIPP in New Mexico and for other treatment/disposal as appropriate. The current project addresses waste contained in 2.8 acres of the Subsurface Disposal Area. Targeted CERCLA wastes being retrieved consist of filters, graphite, and 741 series sludges containing transuranic radionuclides (i.e., americium-241 and plutonium-239/240), absorbed solvents contained in series 743 sludges, and depleted uranium contained in roaster oxides.

During 2007, more than 5000 cubic yards of material were excavated and sorted during ARP I and ARP II activities.

DEQ-INL Oversight 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 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. During 2007 AMWTP continued this accelerated rate of shipping, sending almost 6,000 cubic meters of contact handled TRU waste from AMWTP to WIPP.

Some of the activities DEQ-INL 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 may be 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 2007, there were about 500 EM owned SNM items awaiting disposition. During 2007, over 300 of these SNM items were dispositioned.

Some of the activities DEQ-INL Oversight 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 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 in the site.

Radiological Emergency Response Planning and Preparedness

The Idaho Bureau of Homeland Security (BHS) coordinates state emergency response actions in Idaho. For incidents involving radiological materials at the INL or elsewhere in Idaho, DEQ-INL 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's review of INL hazard assessment documents (HADs). These documents explain different potential incidents that could result in the release of certain radionuclides that some INL facilities house. This information allows DEQ-INL 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 uses the source inventory and accident scenarios for dose assessment modeling, using Air Pollutant Graphical Environmental Monitoring System (APGEMS) software. This allows DEQ-INL 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.

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 works with the ISP and the BHS to manage WIPP shipment safety activities on the US Route 26 / Interstate 15 and Interstate 84 / 86 corridors in Idaho.

During 2007, DEQ-INL:

- 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, and the Shoshone-Bannock Tribes.
- Provided public information support.

Support and Training of Idaho Radiological Emergency Responders

In 2007, DEQ-INL continued to provide Idaho emergency responders with fundamental knowledge and skills required to respond with confidence to incidents involving radioactive material. **Figure 23** shows trainees engaged in a class activity. DEQ-INL 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 23. Trainees in a DEQ-INL class for first responders.

During 2007, DEQ-INL performed the following activities with the assistance of DOE, ISP, and BHS:

- Trained 248 first responders on basic radiological awareness, shipping radiological material, and hands-on use of radiological instrumentation.
- Continued working with other states and DOE toward developing a Radiation Specialist course for first responders that could be used nationwide.
- Participated in the 2007 Radiological Assistance Program (RAP) Roundup. This DOE-sponsored event hosts first responders from several states and is held annually.
- Participated in two Northwest Regional Response Team meetings.
- Attended the Health Resources and Services Administration (HRSA) meeting put on by the State of Idaho Health District 7.

Public Outreach

A fundamental aspect of DEQ-INL's work is sharing our findings with the public and factoring public input into our activities and policy recommendations. DEQ-INL 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, a Web site, and our community monitoring network.

Publications

DEQ-INL regularly issues technical and non-technical publications to communicate the findings and activities of our program. In 2007, we issued:

- Quarterly environmental surveillance data reports.
- Annual INL issue updates (presented to Idaho's Senate Committee on Resources and the Environment).

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

Presentations and Events

DEQ-INL also communicates with the public about INL-related issues through schools, fairs, special interest groups, and public events. In 2007, we gave public presentations on radiation, the aquifer, and INL issues to a range of school and college classes, civic groups, and special interest groups. We also participated in events such as the Twin Falls County Fair, Buhl Trout Days, Science Expositions in Twin Falls and Idaho Falls, Earth Day, Household Hazardous Waste Day, and Water Festival. A water festival activity is pictured in **Figure 24** and **Figure 25**.

Figure 24. Students making rain sticks as part of water festival activities.

Figure 25. A DEQ-INL staff member explaining rain stick construction.

Community Monitoring Network

DEQ-INL 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 26** shows one community monitoring station.

Figure 26. Community monitoring station at the greenbelt in Idaho Falls.

Big Southern Butte near the Idaho National Laboratory through changing seasons.

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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