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Prepared in cooperation with the U.S. Department of Energy

Evaluation of Quality-Control Data Collected by the U.S. Geological Survey for Routine Water-Quality Activities at the Idaho National Laboratory and Vicinity, Southeastern Idaho, 2002–08



Scientific Investigations Report 2014–5027

Cover: Photograph of U.S. Geological Survey (USGS) water-quality sampling camper and generator at Idaho National Laboratory (INL), with Big Southern Butte in background. Photograph taken on February 1, 2012.

Left Inset: Photograph of water being purged from USGS water-quality monitoring well at INL prior to collecting water-quality samples, with Big Southern Butte in background. Photograph taken on March 26, 1997.

Right Inset: Photograph of USGS water-quality monitoring well at INL, with Naval Reactors Facility and southern end of the Lost River Range in background. Photograph taken on March 26, 1997.

All photographs courtesy of the USGS INL Project Office.

Evaluation of Quality-Control Data Collected by the U.S. Geological Survey for Routine Water-Quality Activities at the Idaho National Laboratory and Vicinity, Southeastern Idaho, 2002–08

By Gordon W. Rattray

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**U.S. Department of the Interior
U.S. Geological Survey**

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U.S. Geological Survey
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Conversion Factors and Datum

Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
square mile (mi ²)	2.590	square kilometer (km ²)
gallon (gal)	3.785	liter (L)
picocurie per liter (pCi/L)	0.037	Becquerel per liter (Bq/L)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$$

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Datum

Horizontal coordinate information is referenced to North American Datum of 1927 (NAD 27).

Acronyms and Abbreviations

ATRC	Advanced Test Reactor Complex
CFA	Central Facilities Area
Cs-137	cesium-137
CSU	combined standard uncertainty
DIW	deionized water
DOE	U.S. Department of Energy
ESRP	Eastern Snake River Plain
IFFO	U.S. Geological Survey Idaho Water Science Center Idaho Falls field office
INL	Idaho National Laboratory
INLOP	Idaho National Laboratory Oversight Program
INLPO	USGS Idaho National Laboratory Project Office
INTEC	Idaho Nuclear Technology and Engineering Center
LRL	laboratory reporting level
LT-MDL	long-term method detection level
MDC	minimum detectable concentration
MDL	minimum detection limit
µg/L	micrograms per liter
mg/L	milligrams per liter
MFC	Materials and Fuels Complex
MRL	minimum reporting level
N	nitrogen
NAD	normalized absolute difference
NRF	Naval Reactors Facility
NWQL	U.S. Geological Survey National Water Quality Laboratory
P	phosphorus
pCi/L	picocuries per liter
Pu-238	plutonium-238
Pu-239	plutonium-239
Pu-239	plutonium-239 plus plutonium-240, undivided
QA	quality assurance
QC	quality control
RESL	DOE Radiological and Environmental Sciences Laboratory
RSD	relative standard deviation
RWMC	Radioactive Waste Management Complex
SiO ₂	silica dioxide
Sr-90	strontium-90
TAN	Test Area North
Th-230	thorium-230
TOC	total organic carbon
USGS	U.S. Geological Survey
VOC	volatile organic compounds
Y-90	yttrium-90

Evaluation of Quality-Control Data Collected by the U.S. Geological Survey for Routine Water-Quality Activities at the Idaho National Laboratory and Vicinity, Southeastern Idaho, 2002–08

By Gordon W. Rattray

Abstract

Quality-control (QC) samples were collected from 2002 through 2008 by the U.S. Geological Survey, in cooperation with the U.S. Department of Energy, to ensure data robustness by documenting the variability and bias of water-quality data collected at surface-water and groundwater sites at and near the Idaho National Laboratory. QC samples consisted of 139 replicates and 22 blanks (approximately 11 percent of the number of environmental samples collected). Measurements from replicates were used to estimate variability (from field and laboratory procedures and sample heterogeneity), as reproducibility and reliability, of water-quality measurements of radiochemical, inorganic, and organic constituents. Measurements from blanks were used to estimate the potential contamination bias of selected radiochemical and inorganic constituents in water-quality samples, with an emphasis on identifying any cross contamination of samples collected with portable sampling equipment.

The reproducibility of water-quality measurements was estimated with calculations of normalized absolute difference for radiochemical constituents and relative standard deviation (RSD) for inorganic and organic constituents. The reliability of water-quality measurements was estimated with pooled RSDs for all constituents. Reproducibility was acceptable for all constituents except dissolved aluminum and total organic carbon. Pooled RSDs were equal to or less than 14 percent for all constituents except for total organic carbon, which had pooled RSDs of 70 percent for the low concentration range and 4.4 percent for the high concentration range.

Source-solution and equipment blanks were measured for concentrations of tritium, strontium-90, cesium-137, sodium, chloride, sulfate, and dissolved chromium. Field blanks were measured for the concentration of iodide. No detectable concentrations were measured from the blanks except for strontium-90 in one source solution and one equipment blank collected in September and October 2004, respectively. The detectable concentrations of strontium-90 in the blanks probably were from a small source of strontium-90 contamination or large measurement variability, or both.

Order statistics and the binomial probability distribution were used to estimate the magnitude and extent of any potential contamination bias of tritium, strontium-90, cesium-137, sodium, chloride, sulfate, dissolved chromium, and iodide in water-quality samples. These statistical methods indicated that, with (1) 87 percent confidence, contamination bias of cesium-137 and sodium in 60 percent of water-quality samples was less than the minimum detectable concentration or reporting level; (2) 92–94 percent confidence, contamination bias of tritium, strontium-90, chloride, sulfate, and dissolved chromium in 70 percent of water-quality samples was less than the minimum detectable concentration or reporting level; and (3) 75 percent confidence, contamination bias of iodide in 50 percent of water-quality samples was less than the reporting level for iodide. These results support the conclusion that contamination bias of water-quality samples from sample processing, storage, shipping, and analysis was insignificant and that cross-contamination of perched groundwater samples collected with bailers during 2002–08 was insignificant.

Introduction

The Idaho National Laboratory (INL) was established by the U.S. Atomic Energy Commission—which later became the U.S. Department of Energy (DOE)—in 1949 for the development of atomic-energy applications, nuclear safety research, defense programs, and advanced energy concepts (Knobel and others, 2005, p. 1). The INL encompasses approximately 890 mi² of the north-central part of the eastern Snake River Plain (ESRP) in southeastern Idaho (fig. 1) and overlies about 8 percent of the ESRP aquifer, which is a fractured basalt sole-source aquifer of significant economic value to the State of Idaho. During its operations, the INL has produced and discharged radiochemical and chemical wastes from site facilities to the unsaturated zone and the underlying aquifer through infiltration ponds, evaporation ponds and ditches, drain fields, injection wells, and burial sites (Bartholomay and Twining, 2010, p. 1).

The U.S. Geological Survey (USGS) began studying the water quality of the ESRP aquifer in 1949 as part of a program to characterize the water resources at the INL (Nace and others, 1959; Olmstead, 1962; Robertson and others, 1974). Sampling for radiochemical and chemical constituents was sporadic until 1964 when a water-quality monitoring network was established and routine (quarterly, semiannual, or annual) sample collection and analysis began (Knobel and others, 2005, p. 11). The monitoring network has historically included three separate water-quality monitoring programs—a routine, site-wide, monitoring program at and near the INL (1964 to present [2014]; figs. 2–4); a local monitoring program at the Naval Reactors Facility (1989 to present [2014]); and off-site monitoring programs (1989–2003). The objectives of the water-quality monitoring network, which included the aquifer and perched groundwater zones, were to (1) monitor the concentrations and delineate the movement of facility-related radiochemical and chemical wastes, (2) understand the processes controlling the movement of the wastes, and (3) understand the processes controlling the geochemistry of groundwater at and near the INL (Mann, 1996, p. 2; Knobel and others, 2005, p. 1, 15, 20).

Quality-assurance (QA) plans (or programs) are essential for ensuring and documenting the quality of environmental data. (A glossary at the back of this report defines quality-assurance terms used throughout this report; terms are shown in bold underline at first occurrence.) A QA plan for water-quality activities by the USGS Idaho National Laboratory Project Office (INLPO) prepared in 1989 (L.J. Mann, U.S. Geological Survey, written commun., 1989) described the equipment and methods used to collect water-quality samples, the collection of **quality-control** (QC) samples, and data-quality objectives for laboratory analyses. Updated versions of the QA plan were published in 1996, 2003, and 2008 (Mann, 1996; Bartholomay and others, 2003; Knobel and others, 2008).

QC samples are collected to identify, quantify, and document **variability** and **bias**, two types of errors in water-quality data. This is important because the variability and bias “associated with environmental data must be known for the data

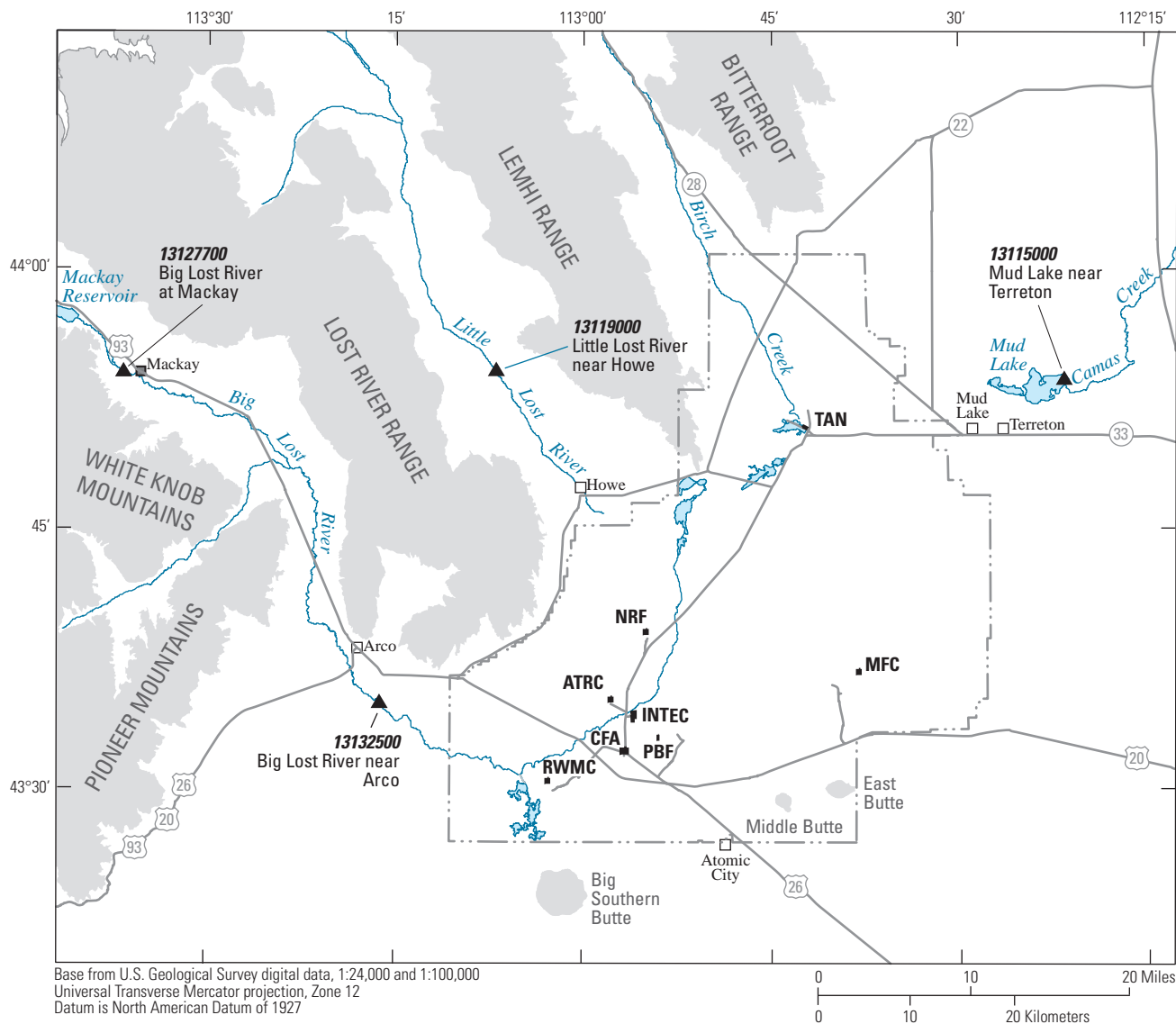
to be interpreted properly and be scientifically defensible” (U.S. Geological Survey, 2006). At the INLPO, routine collection of QC samples at groundwater and surface-water sites began in 1980. The types of QC samples routinely collected were **replicates** and **blanks**, with replicates used to estimate variability and blanks used to estimate bias from sample contamination.

Purpose and Scope

The purpose of this report is to estimate and document the variability and contamination bias of water-quality data collected by the INLPO for the routine, site-wide, water-quality monitoring program at and near the INL during 2002–08. Data collected during 2002–08 included radiochemical, inorganic, and organic constituents analyzed from approximately 1,460 water-quality samples and 161 QC samples (139 replicates and 22 blanks). Water-quality and QC samples were submitted to the DOE Radiological and Environmental Services Laboratory (RESL) for measurement of radiochemical constituents and the USGS National Water Quality Laboratory (NWQL) for measurement of inorganic and organic constituents. Constituents measured from QC samples during 2002–08 were:

- Radiochemical constituents (gross-alpha radioactivity, gross-beta radioactivity, gamma radioactivity, tritium, strontium-90, plutonium-238, plutonium-239+240, and americium-241).
- Inorganic constituents
 - major ions (sodium, chloride, sulfate, iodide, and fluoride),
 - nutrients (ammonia, nitrate plus nitrite, nitrite, orthophosphate),
 - dissolved metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, uranium, zinc, and chromium),
 - total metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver).
- Organic constituents (volatile organic compounds and total organic carbon).

Measurements of radiochemical, inorganic, and organic constituents from replicates were used to estimate the variability, as **reproducibility** and **reliability**, of water-quality measurements. The reproducibility of these measurements was estimated with calculations of normalized absolute difference (NAD) or relative standard deviation (RSD), and the reliability of these measurements was estimated with calculations of pooled RSD. Concentrations of constituents in blank samples were analyzed for evidence of contamination bias; the magnitude and extent of any bias affecting water-quality samples was estimated with order statistics and the binomial probability distribution.



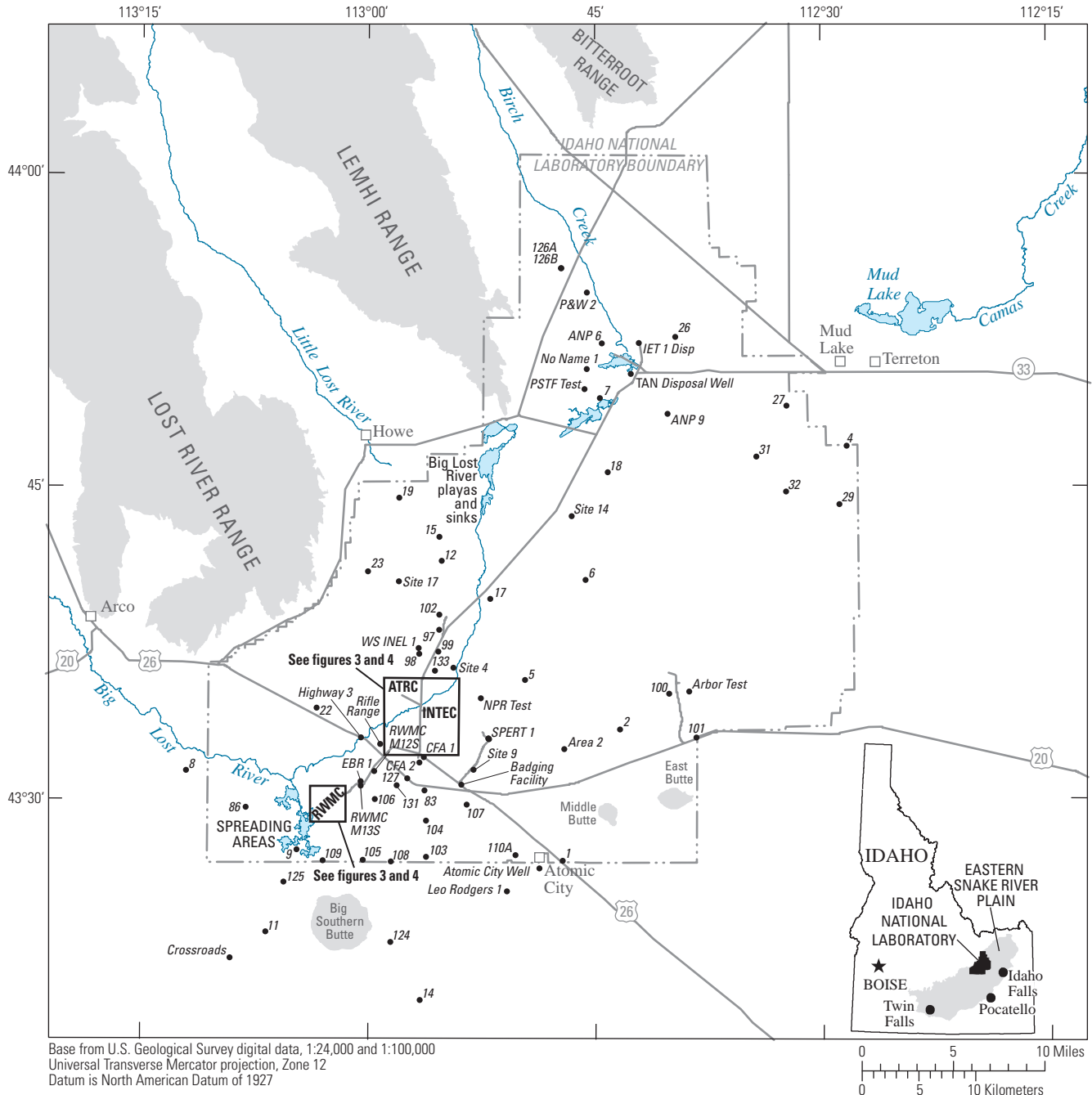
EXPLANATION

- **Selected facilities at the Idaho National Laboratory**
- MFC** Materials and Fuels Complex
- CFA** Central Facilities Area
- INTEC** Idaho Nuclear Technology and Engineering Center
- NRF** Naval Reactors Facility
- PBF** Power Burst Facility
- RWMC** Radioactive Waste Management Complex
- ATRC** Advanced Test Reactor Complex—formerly known as Reactor Technology Complex (RTC) and Test Reactor Area (TRA)
- TAN** Test Area North
- **Boundary of Idaho National Laboratory**
- ▲ **13132500** USGS streamgage and No.



Figure 1. Location of the Idaho National Laboratory (INL), selected facilities at the INL, and selected surface-water gaging stations, Idaho National Laboratory and vicinity, Idaho.

4 Quality-Control Data Collected for Routine Water-Quality Activities, Idaho National Laboratory and Vicinity, Idaho, 2002–08

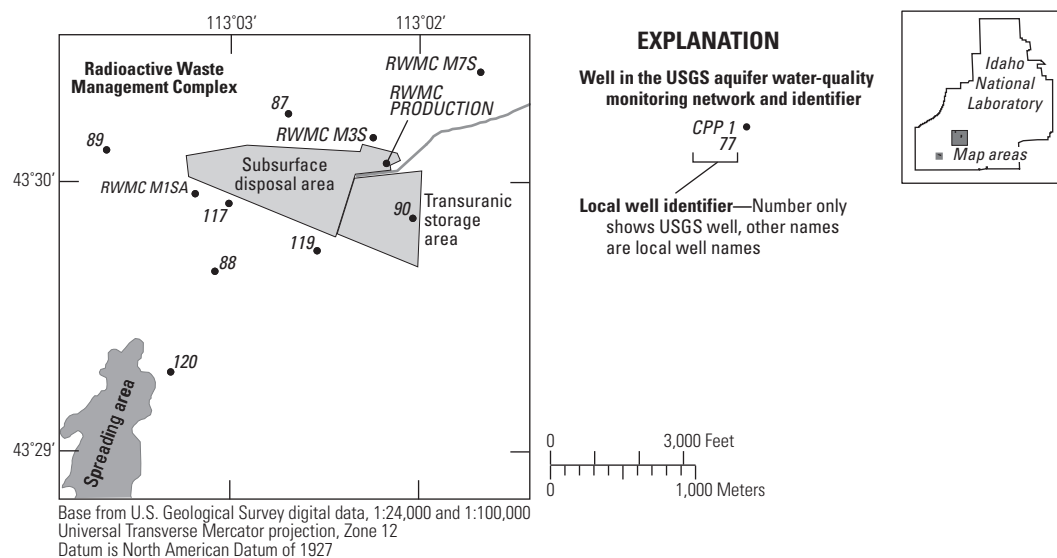
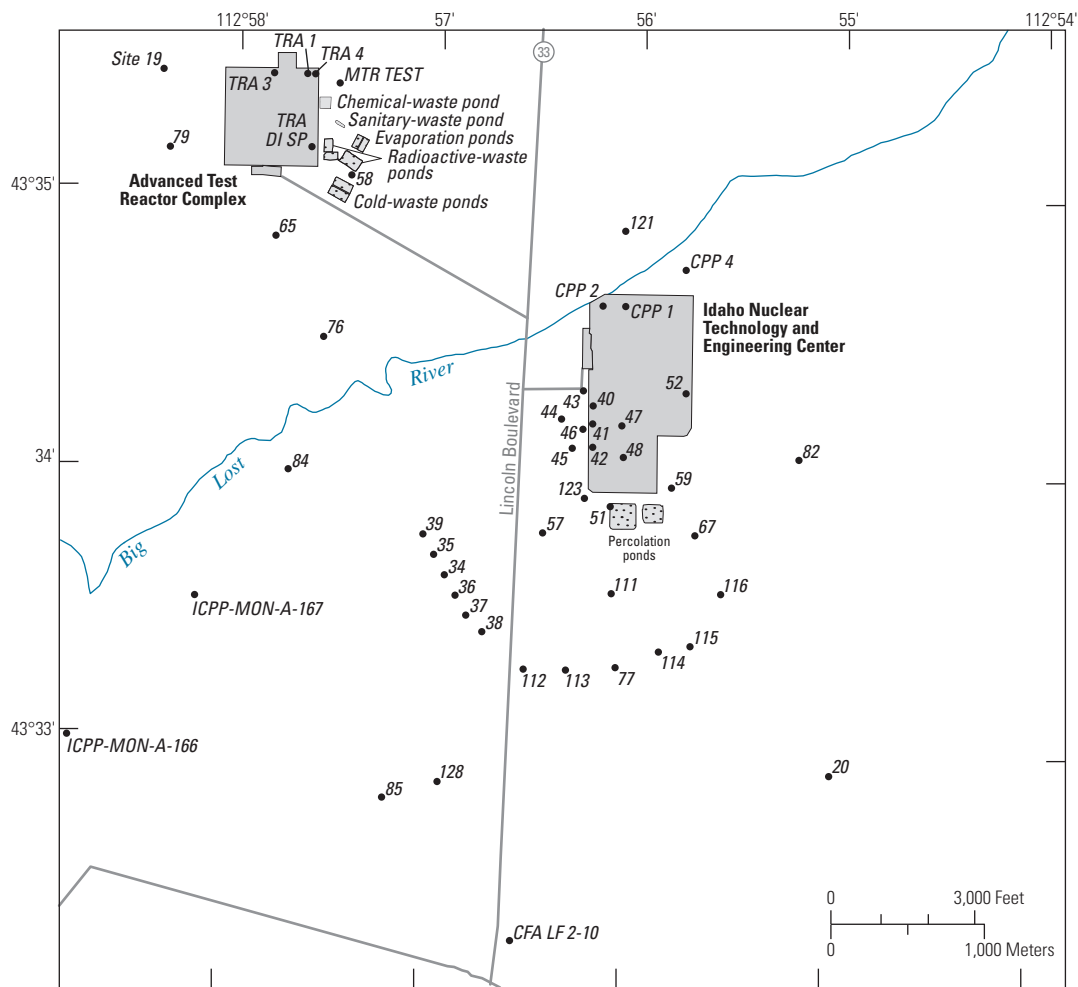


EXPLANATION

- Well in the USGS aquifer water-quality monitoring network and identifier

M14S
14
- Local well identifier—
Number only shows USGS well, other names are local well name
- Inset areas for selected facilities at the Idaho National Laboratory—See figures 3 and 4.
- RWMC** Radioactive Waste Management Complex
- ATRC** Advanced Test Reactor Complex
- INTEC** Idaho Nuclear Technology and Engineering Center
- TAN** Test Area North

Figure 2. Location of selected aquifer wells in the U.S. Geological Survey routine, site-wide, water-quality monitoring program, Idaho National Laboratory and vicinity, Idaho.



Base from U.S. Geological Survey digital data, 1:24,000 and 1:100,000
 Universal Transverse Mercator projection, Zone 12
 Datum is North American Datum of 1927

Figure 3. Location of selected aquifer wells in the U.S. Geological Survey routine, site-wide, water-quality monitoring program at the Advanced Test Reactor Complex, Idaho Nuclear Technology and Engineering Center, and Radioactive Waste Management Complex, Idaho National Laboratory, Idaho.

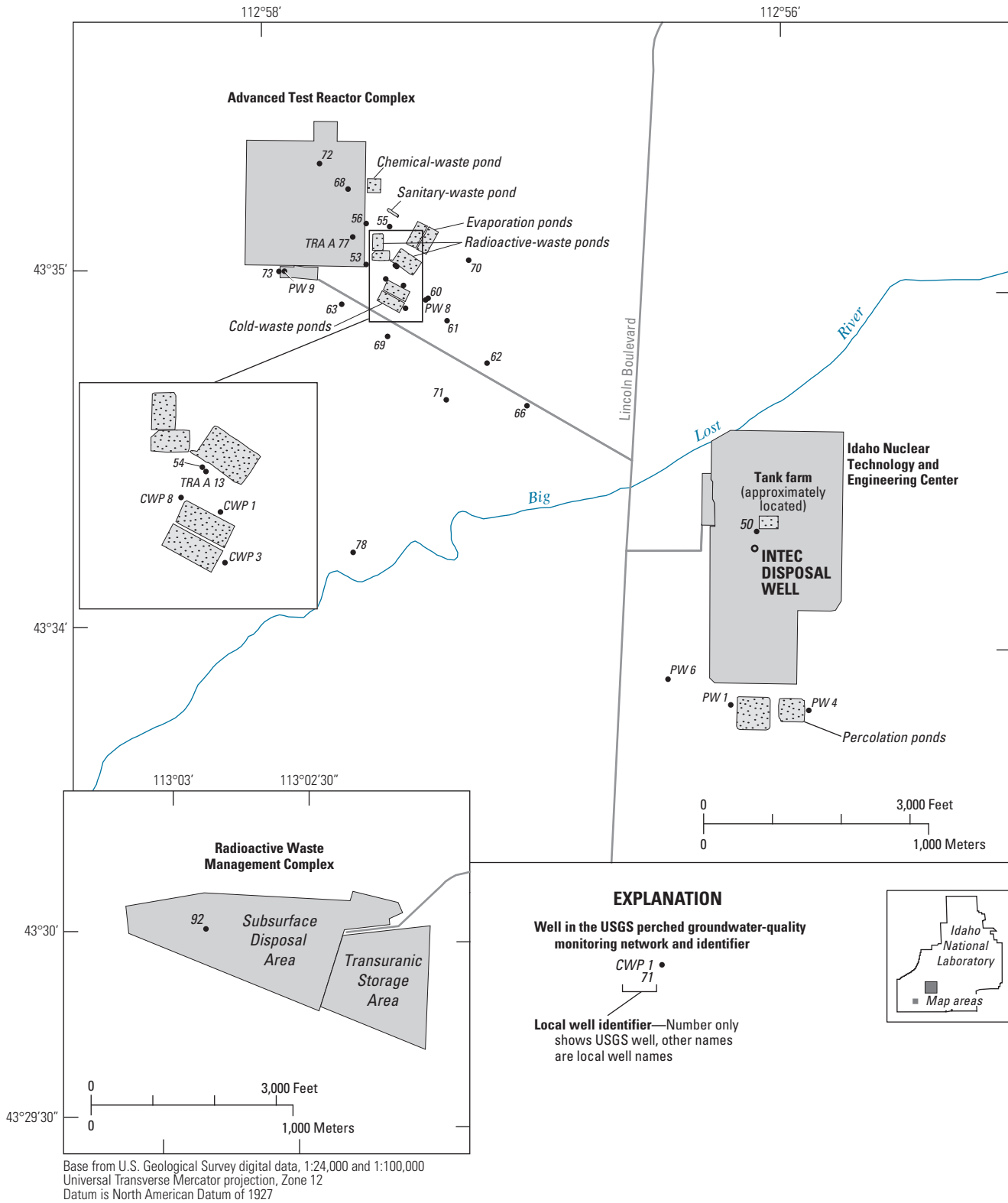


Figure 4. Location of selected perched groundwater wells in the U.S. Geological Survey routine, site-wide, water-quality monitoring program at the Advanced Test Reactor Complex, Idaho Nuclear Technology and Engineering Center, and Radioactive Waste Management Complex, Idaho National Laboratory, Idaho.

Previous Investigations

Comparative studies of **QC data** collected for the routine water-quality monitoring program were presented by Wegner (1989), Williams (1996, 1997), Rattray (2012), and Davis and others (2013); for the local monitoring program at the Naval Reactors Facility by Williams (1996, 1997) and Knobel and others (1999a); for off-site monitoring programs by Bartholomay and others (1997), Williams and others (1998), Rattray and Campbell (2003), and Rattray and others (2005); and for special on-site studies by Knobel and others (1999b) and Bartholomay and Twining (2010). Some of the QC data presented in these reports of comparative studies are not directly comparable to QC data presented in this report because laboratories other than the RESL or the NWQL were used for radiochemical or chemical analyses, respectively (Wegner, 1989; Williams, 1996; Williams and others, 1998; Knobel and others, 1999a, 1999b; Rattray and Campbell, 2003; Rattray and others, 2005).

Methods

Sample Collection Methods

Collection of Water-Quality Samples

During 2002–08, water-quality samples (water-quality, but not QC, data are available at the USGS National Information System; U.S. Geological Survey, 2013c) were collected from about 170 sample sites following methods presented in the USGS National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, 2006) and INLPO QA plans (Mann, 1996; Bartholomay and others, 2003; Knobel and others, 2008). Water-quality samples were collected from about 131 aquifer and 15 perched-groundwater wells equipped with permanently installed submersible pumps (from in line stainless-steel sampling pipes attached to the well head or spigots), 1 perched groundwater well with a portable Grundfos pump (and Tygon® tubing), 16 perched groundwater wells with portable 1,000-mL Teflon® or brass bailers, and 7 surface-water sites as **grab samples** collected near the streambank with a portable Teflon® churn splitter (Bartholomay and others, 2003, p. 26–34; Knobel and others, 2008, p. 22–27).

Water-quality samples were collected from aquifer wells equipped with submersible pumps after purging the well (through the stainless-steel sampling pipes) with three wellbore volumes of water (reduced to one wellbore volume of water beginning in 2004 [Knobel, 2006]) and measurements of field parameters (temperature, pH, and specific conductance) had stabilized. Purging of water and stable readings of field measurements were not required prior to collection of water-quality samples from perched groundwater wells without submersible pumps or from surface-water sites. All portable sampling equipment used to collect samples was

decontaminated by rinsing and cleaning the bailer or churn splitter with deionized water (DIW) and detergent before and after use or by passing a conditioning volume of DIW through the Tygon® tubing attached to the portable pump.

Water-quality samples were collected in polyethylene or glass bottles and filtered (if required) with a prerinsed (with DIW) 0.45- μm membrane filter capsule. Metals concentrations obtained from analysis of the 0.45- μm filtrate are referred to as “dissolved” metals in this report to distinguish these results from “total” metals, which indicates that the water sample was not filtered. Filtration occurred in line for aquifer and perched groundwater wells equipped with submersible pumps; for other sample collection methods filtration was accomplished by pouring water into a Teflon® pitcher and pumping the water through a prerinsed filter capsule with prerinsed (with DIW) Tygon® tubing attached to a peristaltic pump. Preservatives were added to sample bottles (if required); the bottles were capped, labeled, chilled (if required); and stored in the USGS laboratory at the INL until delivery to the analytical laboratory. Sample bottles with chain-of-custody forms were mailed twice a week to the NWQL in chilled, sealed coolers during each sample collection event and delivered by hand to the RESL at the end of each sample collection event.

Collection of Quality-Control Samples

Replicates

The INLPO generally collects a replicate water sample from a sampling site with the longest interval of time, relative to all other sampling sites, since a replicate was last collected. This approximates a rotational sequence for collecting replicates from sampling sites and ensures that, during a period of several years, replicates are collected from most sampling sites. From 2002 through 2008, replicates were collected from 137 unique sampling sites.

Replicates consisted of two water samples, a water-quality sample and a replicate sample (**blind replicates** were collected from 2002 to 2004). Water-quality and replicate samples were collected in an identical manner and replicate samples were collected as **sequential replicates**.

Blanks

The types of blanks collected included source-solution, field, and equipment blanks. Source-solution blanks were collected as DIW at the USGS Idaho Water Science Center field office in Idaho Falls (IFFO), and were collected after replacement of exchange tanks used to generate the DIW. Field blanks were collected at sample sites at and near the INL, and equipment blanks were collected at sample sites or the USGS laboratory at the INL.

Source-solution blanks were collected to confirm that the DIW used as a source solution for field and equipment blanks was free of the constituents of interest. Source-solution blanks also included any contamination from sample bottles, filter capsules and preservatives (if required), and sample

storage. Field blanks included all sources of contamination associated with source-solution blanks plus any contamination from ambient conditions at sample sites. Equipment blanks included all sources of contamination associated with field blanks (potential contamination during ambient conditions at sample sites was not a source of contamination if the blank was collected at the USGS laboratory at the INL) plus any contamination from portable sampling equipment. All blanks also included any contamination from shipping or delivering the blanks to the analytical laboratory and storing, processing, and analyzing the blanks at the laboratory.

Collection of source-solution and field blanks followed the procedures described for collection of water-quality samples, except that the DIW source solution was poured from a 5-gal plastic container into sample bottles for unfiltered samples and into a Teflon® pitcher for filtered samples. Collection of equipment blanks followed the procedures described for collection of water-quality samples except that for equipment blanks collected with (1) a bailer, DIW source solution was poured into the equipment, sloshed around, then poured into a Teflon® pitcher; (2) a portable Grundfos pump and Tygon® tubing, DIW source solution was pumped through the pump and Tygon® tubing into sample bottles for unfiltered samples or a Teflon® pitcher for filtered samples; and (3) a churn splitter, DIW source solution was poured into the churn splitter and sloshed around. The DIW in the Teflon® pitcher or churn splitter was then poured into sample bottles for unfiltered samples (if necessary) and pumped with a peristaltic pump through Tygon® tubing and a filter capsule into sample bottles for filtered samples.

Analytical Methods and Data Reporting Conventions

Analytical methods and QA/QC procedures used by the RESL are described by Bodnar and Percival (1982) and U.S. Department of Energy (1995). Radionuclide measurements carried out at the RESL are reported with **combined standard uncertainties** (CSU) at a confidence level of one standard deviation (s), where a lower CSU relative to the result indicates a smaller measurement uncertainty whereas a larger CSU relative to the result indicates a larger measurement uncertainty. These propagated random uncertainties were calculated by the laboratory using variables such as yields, appropriate half-lives, counting efficiencies, and count times (Williams, 1997, p. 10). Radionuclide concentrations less than $3s$ were considered to be less than the minimum detectable concentration (MDC) (Knobel and others, 2008, p. 30), and the MDC was used as a reporting level for radionuclide measurements. This reporting level should not be confused with the analytical method detection limit (MDL) (Knobel and others, 2008, p. 31), which is based on laboratory procedures. Interpretation of negative results from radionuclide measurements is discussed in McCurdy and others (2008).

Analytical methods used by the NWQL for measurement of inorganic and organic constituents are described by Goerlitz and Brown (1972), Thatcher and others (1977), Skougstad and others (1979), Wershaw and others (1987), Fishman and Friedman (1989), Faires (1993), Fishman (1993), and Rose and Schroeder (1995). QA/QC practices used by the NWQL are described by Friedman and Erdmann (1982) and Pritt and Raese (1995), and variability and bias of constituents analyzed by the NWQL is monitored and evaluated internally with laboratory QC data. Variability of constituents analyzed by the NWQL also is evaluated externally with the Organic Blind Sample Project and Inorganic Blind Sample Project managed by the USGS Branch of Quality Systems (U.S. Geological Survey, 2013a).

Reporting levels were used by the NWQL to determine when a constituent was detected with sufficient confidence to be reported uncensored or without remarks (Childress and others, 1999). The reporting levels were minimum reporting levels (MRL), long-term method detection levels (LT-MDL), and laboratory reporting levels (LRL) ([table A1](#) contains reporting levels for selected constituents). The MRL was the smallest measured constituent concentration that could be reliably reported using a specific analytical method (Timme, 1995). The LT-MDL was determined by calculating the standard deviation of a sample with at least 24 spike sample measurements over an extended period of time (Childress and others, 1999, p. 19). The LRL generally was equal to twice the yearly determined LT-MDL (Childress and others, 1999, p. 19). Results between the LT-MDL and the LRL, or between the LRL and the lowest calibration standard, were reported with the “E” remark code (Childress and others, p. 9), which means the result was estimated and had a greater uncertainty than data without the “E” remark. Non-detections were reported by the NWQL as censored values (reported with the “<” symbol) that were less than the MRL or LRL.

Statistical Methods

Statistical methods used to calculate variability were NAD and RSD and the statistical method used to calculate bias was the binomial probability distribution. These statistical methods were used to infer the variability or bias associated with water-quality samples from the calculated variability or bias of QC samples. Assumptions in this inference of variability and bias is that the water-quality and QC samples are from the same sample population with respect to potential sources of variability and bias and have the potential to experience the same degree/magnitude of variability and bias (Bender and others, 2011).

Statistical calculations were done using unrounded concentration data. However, concentrations in [tables 1–11](#) were rounded to the least significant figure, so the statistical results presented in [tables 1–13](#) may differ slightly from statistical calculations using the rounded concentration results in [tables 1–11](#).

Normalized Absolute Difference

Normalized absolute differences were calculated from radiochemical measurements and their CSUs. The NAD was then used to test the null hypothesis that a pair of radiochemical measurements did not differ significantly when compared to their CSUs (Williams, 1996, p. 11–15; Paar and Porterfield, 1997, p. 30; McCurdy and others, 2008, p. 15). The significance level, which indicates the weight of the evidence to accept or reject the null hypothesis of $x \pm \text{CSU}_x = y \pm \text{CSU}_y$, was determined using the NAD as the test statistic. At a NAD of 1.96, the significance level was 0.05 (assuming a normal distribution and a two-tailed test), the probability of error was 0.05, and the decision of whether or not concentrations were the same was determined at the 95-percent confidence level. Thus, for an NAD equal to or less than 1.96, the NAD was within the 95-percent confidence interval, the null hypothesis was accepted, and the concentrations did not differ significantly. Concentrations were considered significantly different when the NAD was greater than 1.96.

The equation for calculating the NAD is:

$$\text{NAD} = \frac{|x - y|}{\sqrt{\text{CSU}_x^2 + \text{CSU}_y^2}} \quad (1)$$

where

- x is the concentration of a radiochemical in the water-quality sample,
- y is the concentration of the same radiochemical in the replicate sample,
- CSU_x is the combined standard uncertainty of x at the 1 σ confidence level, and
- CSU_y is the combined standard uncertainty of y at the 1 σ confidence level.

Relative Standard Deviation

RSD is the percent coefficient of variation (CV), and CV “is a dimensionless quantity that measures the amount of variability relative to the value of the mean” (Devore, 1995, p. 39). RSD was calculated as (Taylor, 1987, p. 20):

$$\text{RSD} = \text{CV} \times 100 \quad (2)$$

The CV was calculated as:

$$\text{CV} = \frac{s}{\bar{x}} \quad (3)$$

where

- s is the standard deviation for a constituent from a replicate, and
- \bar{x} is the mean concentration for the same constituent from a replicate.

The standard deviations and mean concentrations for constituents from replicates were calculated as:

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}} \quad (4)$$

and

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n} \quad (5)$$

where

- x_i is a constituent concentration from the replicate, and
- n is 2, the number of measured concentrations for a constituent from the replicate.

The degrees of freedom are an important piece of information for estimates of standard deviation (Taylor, 1987, p. 21), and are included in equation 4 as $n-1$, or the number of independent values. The degree of freedom (or number of independent values) is always 1 in equation 4 because, for replicates in this report, n is always 2. For replicates containing more than 2 samples (none in this report), such as triplicates or higher number replicates, n is greater than 2 and the degrees of freedom are greater than 1.

Pooled RSDs were calculated for radiochemical, inorganic, and organic constituents, if the constituent had at least one replicate where both concentrations were detections. Because pooled RSDs should be calculated from samples with similar variability (Taylor, 1987, p. 22), and variability is a function of concentration (variability generally decreases as concentrations increase), pooled RSDs were calculated for discrete concentration ranges that had similar ranges of variability (Martin, 2002). The standard deviation and mean concentration used for calculating pooled RSDs were calculated as:

$$s_{pooled} = \sqrt{\frac{\sum_{i=1}^k v_i s_i^2}{\sum_{i=1}^k v_i}} \quad (6)$$

and

$$\bar{x}_{pooled} = \frac{\sum_{i=1}^{2k} x_i}{2k} \quad (7)$$

where

- k is the number of replicates with results for the constituent and concentration range of interest, and
- v is the degrees of freedom for s_{pooled} (equal to 1 for each replicate and to k for the sum of replicates).

Binomial Probability Distribution

The frequency and magnitude of contamination in blank samples was evaluated by determining an upper confidence limit for a specified percentile of contamination (Bender and others, 2011). Because the distribution of constituent concentrations from blank samples was highly skewed, a non-parametric statistical method was used to estimate the potential bias of constituents from blank sample measurements. For the statistical method, order statistics (with the ranking from low to high concentration) and the binomial probability distribution were used to determine an upper confidence limit, or confidence level (*cl*), that represented “the probability that *m* observed values from a total of *n* observations are equal to or less than the 100*p*th percentile of the sampled population” (Mueller, 1998, p. 5). The confidence level is calculated as:

$$cl = Prob(n, m, p) \quad (8)$$

At the 100*cl*, the concentration of the *m*+1 ranked observation represents the concentration that exceeded 100*p* percent of the values in the population. For example, for an *m*+1 ranked concentration and the *cl* and *p* for a specific constituent from blank samples, there is 100*cl* percent confidence that this concentration would be exceeded in no more than 1-*p* percent of all samples (including environmental samples) that were collected, processed, shipped, and analyzed in the same manner as the blank samples (Bender and others, 2011).

Evaluation of Quality Control Data

Variability

Variability was calculated by examining reproducibility (the closeness of agreement between individual measurements) and reliability (the error associated with a measurement). Variability was calculated from replicate water samples collected in the field, and includes variability from field procedures (sample collection, processing, preservation, storage, and shipping), laboratory procedures (sample storage, preparation, and analysis), and any inherent water-quality heterogeneity in the aqueous system being sampled.

The heterogeneity of groundwater quality depends on the location and type of aquifer being sampled and the method of sample collection. Water quality in the ESRP aquifer tends to vary little over relatively short distances; the same cannot be said for perched groundwater zones at the INL. Because there is often a limited amount of water in perched groundwater zones, these zones were not purged prior to collection of water-quality samples with bailers and partially or completely purged prior to collection of water-quality samples with portable pumps. Additionally, infiltration of waste discharge from site facilities to perched groundwater

zones may introduce variable concentrations of constituents. Consequently, water-quality in the perched groundwater zones may be more heterogeneous over shorter distances than in the ESRP aquifer; the resulting water quality in replicate samples collected from the perched zones would be expected to reflect this condition by exhibiting more variability than replicate samples collected from the ESRP aquifer

Reproducibility

Reproducibility was calculated from replicate measurements as NAD for radiochemical constituents (tables 1–3, at back of report; table A2 contains a cross reference of site names and types of blanks with USGS site numbers) and RSD for inorganic and organic constituents (tables 4–11, at back of report). RSD was used to calculate the reproducibility of inorganic and organic constituents because uncertainties, which are necessary for calculating NAD, were not provided with measurements of these constituents. The calculated NADs and RSDs, as well as measurements from replicates with censored or estimated concentrations for which RSDs were not calculated, were compared to criteria previously used by the INLPO (Rattray, 2012, p. 10) and (or) the State of Idaho INL Oversight Program to determine if measurements from replicates had acceptable reproducibility. The reproducibility was considered acceptable if:

1. The NAD was equal to or less than 1.96 (Williams, 1996, p. 14; Bartholomay and Twining, 2010, p. 14–15),
2. The RSD was less than 14 percent (this corresponds to the relative percent difference of less than 20 percent used by the State of Idaho INL Oversight Program [2002, p. 5–22] and Bartholomay and Twining [2010, p. 15]),
3. Both measurements were censored and (or) estimated because they were less than the reporting level for that analysis (Williams, 1996, p. 15), or
4. One measurement was censored or estimated and the other measurement was within one detection limit of the larger of the estimated value or the reporting level, or the measurements were within one detection limit of each other (State of Idaho INL Oversight Program, 2002, p. 5–22). For results reported using the LRL as the reporting level, the detection limit was the LT-MDL (one-half of the LRL). For results reported with the MRL as the reporting level, the detection limit was approximated as one-half of the MRL.

If the percentage of replicate measurements with acceptable reproducibility for a constituent was equal to or greater than 90 percent, then the reproducibility for that constituent was considered acceptable for 2002–08 (table 12, at back of report). If the percentage was less than 90 percent for a constituent, then the results for that constituent were investigated further (State of Idaho INL Oversight Program, 2002, p. 6-4).

Radiochemical Constituents

There were 49 replicates with measurements of gross-alpha and gross-beta radioactivity, 77 with measurements of gamma radioactivity (all gamma radionuclide results were less than their reporting levels, so only cesium-137 was reported by the RESL), 136 with measurements of tritium, 88 with measurements of strontium-90, and 16 with measurements of the plutonium and americium radionuclides (tables 1–3). All of these radiochemical constituents had acceptable reproducibility (that is, NAD was equal to or less than 1.96) between their replicate measurements with the exception of three results for gross-beta radioactivity, two results for cesium-137, four results for tritium, and eight results for strontium-90. The percentage of replicates with acceptable reproducibility for each radiochemical constituent was equal to or greater than 91 percent (table 12), so all radiochemical constituents met the criteria for the percentage of replicates with acceptable reproducibility (that is, ≥ 90 percent). All radiochemical measurements without acceptable reproducibility had small concentrations, as indicated by a nondetection for one or both of their replicate measurements, except for three results for tritium. Because relative variability generally increases as concentrations decrease, most of the results without acceptable reproducibility may be attributed to small concentrations for the constituents. Two of the tritium results without acceptable reproducibility were collected with dedicated pumps from aquifer wells (wells RWMC PROD and USGS 114) and had calculated NADs (1.98 and 2.12) that were only slightly larger than the criteria for acceptable reproducibility (table 2). These NADs probably represent variability from field procedures or laboratory processing and analysis, or both. The other tritium result without acceptable reproducibility was collected with a bailer from a perched groundwater well (well USGS 55), without purging water from the well, and had a calculated NAD of 4.04. In addition to variability from field procedures or laboratory processing and analysis, or both, this NAD also may represent variability from heterogeneity in groundwater quality.

Inorganic Constituents

There were 106 replicates with measurements of sodium, 135 with measurements of chloride, 68 with measurements of sulfate, 11 with measurements of iodide, and 4 with measurements of fluoride (tables 4–5). All replicate measurements for these ions had acceptable reproducibility (that is, RSD less than 14 percent) except for two results for chloride and one result for sodium and sulfate. The percentage of replicates with acceptable reproducibility for each ion was equal to or greater than 99 percent (table 12). Large RSDs (81 percent for sodium and 45 percent for chloride) were calculated from measurements of sodium and chloride from a replicate collected (on October 15, 2002) at well CPP 4 (table 4). These sodium and chloride measurements also were approximately two or more times larger than historical

(55 sodium and 52 chloride measurements between 1983 and 2012) concentrations of these constituents in water collected from well CPP 4. Consequently, these results were flagged as reviewed and rejected in the National Water Information System (NWIS). The RSDs calculated for chloride (17 percent) and sulfate (15 percent) from a replicate collected (on October 19, 2004) from a perched groundwater well (USGS 56; table 4) were slightly larger than the criteria for acceptable reproducibility of less than 14 percent. These replicates were collected with a bailer, without purging water from the well, so these RSDs represent variability from field procedures, laboratory processing and analysis, and (or) heterogeneity in groundwater quality.

There were 92 replicates with measurements of nutrients (table 6), and 100 percent of the replicates had acceptable reproducibility (table 12). The RSD (12 percent) calculated for nitrite plus nitrate (the aquifer is an oxidizing environment, so nitrite plus nitrate will hereafter be referred to as nitrate) for the replicate collected at well CPP 4 (on October 15, 2002) met the criteria for acceptable reproducibility. However, the measured concentrations of nitrate from the replicate were approximately four to five times larger than the historical concentrations of nitrate in water collected from well CPP 4. The nutrient results from the replicate collected at CPP 4 were flagged as reviewed and rejected in NWIS, because (1) measured nitrate concentrations relative to historical concentrations of nitrate in water from well CPP 4 were unusually large, (2) sodium and chloride results were already reviewed and rejected for this replicate, and (3) all nutrients were analyzed from water from the same sample bottle.

There were 10 replicates with measurements of dissolved aluminum, antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, silver, and uranium; 5 with measurements of dissolved selenium and thallium; and 75 with measurements of dissolved chromium (tables 7–8). All replicates had acceptable reproducibility except for two replicates each for aluminum and chromium and one replicate each for nickel and zinc. The percentage of replicates with acceptable reproducibility for each metal, except aluminum, was equal to or greater than 90 percent (table 12); the percentage of replicates with acceptable reproducibility was 80 percent for aluminum. The aluminum results without acceptable reproducibility may be attributed to small aluminum concentrations, because these two replicates had aluminum concentrations that were less than three times their reporting level. These two replicates were collected with permanently installed submersible pumps from aquifer wells (wells USGS 98 and USGS 131), and the results probably represent variability from field procedures or laboratory processing and analysis, or both. Chromium was measured from the replicate collected from well CPP 4 on October 15, 2002 (table 6). Both measurements from the replicate produced estimated results, so the criterion for acceptable reproducibility was met. However, because

chromium was analyzed from water from the same sample bottle as sodium, and because sodium results from this replicate were already reviewed and rejected, the chromium results from the replicate collected at well CPP 4 were flagged as reviewed and rejected in NWIS.

There were two replicates with measurements of total arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver ([table 9](#)). All (100 percent) of the replicates had acceptable reproducibility ([table 12](#)).

Organic Constituents

There were 27 replicates with measurements of volatile organic compounds (VOCs), and only 1,1-dichloroethene, tetrachloroethene, tetrachloromethane, toluene, 1,1,1-trichloroethane, trichloroethene, and trichloromethane had replicates with a concentration that exceeded the reporting level ([table A3](#) contains a list of all VOCs analyzed). For these seven VOCs, all replicates met the criteria for acceptable reproducibility except for one replicate for toluene ([table 10](#)). The percentage of paired measurements with acceptable reproducibility was 96 percent for toluene and 100 percent for all other VOCs ([table 12](#)).

There were 39 replicates with measurements of total organic carbon (TOC) ([table 11](#)), and 27 (69 percent) of the replicates had acceptable reproducibility. The RSDs were able to be calculated for 8 of the 12 results that did not meet the criteria for acceptable reproducibility, and these RSDs ranged from 29 to 106 percent with a mean RSD of 62 percent. The small percentage of TOC results with acceptable reproducibility and the large calculated RSDs indicates that TOC samples collected by the INLPO and analyzed by the NWQL have large variability. However, there were four RSDs calculated from replicates (ICPP-MON-A-167, USGS 5, USGS 1, and USGS 98) where both measured concentrations exceeded three times the reporting level for TOC ([tables 11](#) and [A1](#)). All four of these RSDs met the criteria for acceptable reproducibility, so the large variability observed for TOC occurs in samples with small TOC concentrations. All TOC results without acceptable reproducibility were from replicates collected with permanently installed submersible pumps from aquifer wells, so these results probably represent variability from field procedures and laboratory processing and analysis, or both.

Reliability

The reliability of water-quality measurements was estimated with pooled RSDs. Pooled RSDs were calculated for radiochemical constituents if there were replicates where both radiochemical concentrations equaled or exceeded the MDL and the MDC. Pooled RSDs were calculated for inorganic and organic constituents from replicates where both measured concentrations for a constituent exceeded the reporting level (that is, replicates with calculated RSDs in [tables 4–11](#)). RSDs

calculated for sodium, chloride, nutrients, and chromium from the replicate collected from well CPP 4 (on October 15, 2002) were not included in calculations of pooled RSDs because these results were flagged as reviewed and rejected in NWIS.

Reliability was estimated and pooled RSDs were calculated for discrete concentration ranges for radiochemical, inorganic, and organic constituents ([table 13](#), at back of report). Reliability was estimated for discrete concentration ranges because pooled RSDs should be calculated from samples with similar variability (Taylor, 1987, p. 22) and variability and RSDs are a function of concentration (Martin, 2002, p. 35). Qualitatively, and using the criteria for RSDs previously specified, pooled RSDs less than 14 percent indicated that the measurements for that constituent and concentration range met a minimum objective for reliability. Pooled RSDs also provide a precise measure of reliability (which increases as pooled RSDs decrease) that can be used to calculate confidence limits for water-quality measurements (Martin, 2002, p. 50–51).

The RSDs calculated from replicate concentrations were used to identify appropriate concentration ranges for each constituent to evaluate reliability with pooled RSDs. Discrete concentration ranges were selected for each constituent by plotting the RSD and mean constituent concentration for each replicate and determining appropriate concentration ranges based on differences in the ranges of plotted RSDs. For example, [figure 5](#) shows a plot of RSDs and mean dissolved chromium concentrations from replicates. The range of RSDs was largest, 0–24 percent, for a concentration range of chromium of 1 to less than 5 µg/L. A smaller range of RSDs, 0–18 percent, was calculated for chromium concentrations ranging from 5 to 30 µg/L, and a still smaller range of RSDs, 0–3 percent, was calculated for chromium concentrations ranging from 100 to 150 µg/L.

Radiochemical Constituents

Pooled RSDs were calculated from 5 replicates for gross-beta radioactivity, 54 for tritium, and 25 for strontium-90. Pooled RSDs for gross-beta radioactivity were 13 percent for the concentration range 4.0–20 pCi/L (as Cs-137 or Sr-90/Y-90) ([table 13](#)). This small pooled RSD indicates small variability and large reliability for measurements of gross-beta radioactivity. Pooled RSDs for tritium were calculated for three concentration ranges: 600 to less than 1,400; 1,400 to less than 5,000; and 5,000–25,000 pCi/L. The pooled RSDs, 11, 5.1, and 4.9 percent, decreased as concentration increased and indicated a small variability and large reliability for measurements of tritium across all concentration ranges. Pooled RSDs for strontium-90 of 12, 3.3, and 0.7 percent were calculated for concentration ranges of 2.0 to less than 10; 10–50; and 100–110 pCi/L ([table 13](#)). These pooled RSDs decreased as concentration increased and indicated a small variability and large reliability for measurements of strontium-90 across all concentration ranges.

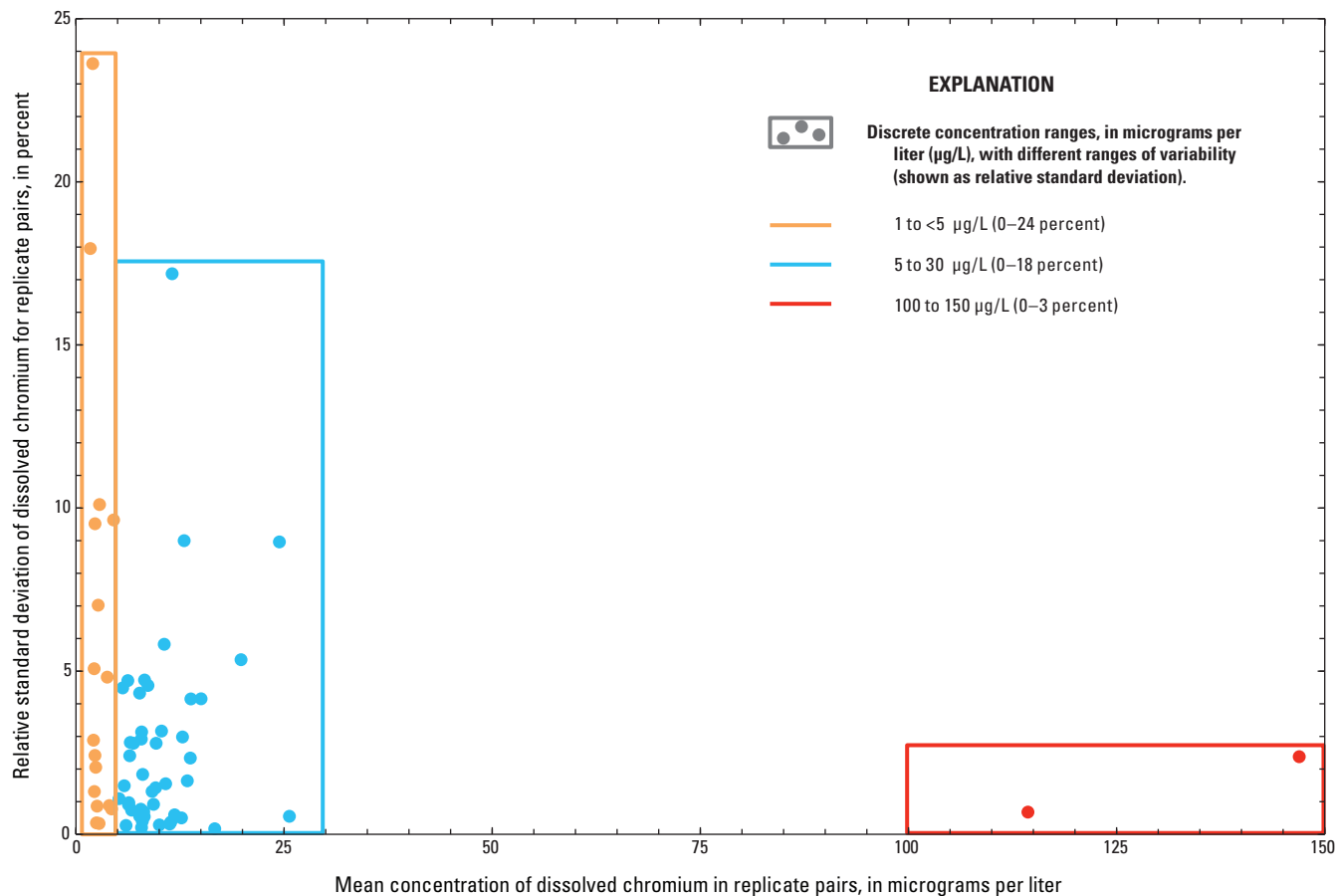


Figure 5. Variability of measurements of dissolved chromium as a function of chromium concentration.

Inorganic Constituents

Pooled RSDs were calculated from 105 replicates for sodium, 134 for chloride, 68 for sulfate, and 4 for fluoride. RSDs were not calculated for iodide because no detectable concentrations were measured for iodide. Pooled RSDs for major ions were 1.0–1.9 percent for sodium, 0.9–3.3 percent for chloride, 0.4–0.6 percent for sulfate, and 5.1 percent for fluoride (table 13). The pooled RSDs for the major ions indicate that these measurements had small variability and large reliability.

Pooled RSDs for nutrients were calculated from 2 replicates for ammonia, 91 for nitrate, 1 for nitrite, and 49 for orthophosphate. Pooled RSDs for the nutrients were 4.1–8.7 percent for ammonia, 0.2–1.4 percent for nitrate, 0.3 percent for nitrite, and 0.3–4.5 percent for orthophosphate (table 13). The pooled RSDs for nutrients indicate that measurements of nutrients had small variability and large reliability. One notable improvement in reliability was for the small concentration range of orthophosphate, where the pooled RSD decreased from 16 percent for results from 1996 to 2001 (Rattray, 2012, p. 68) to 4.5 percent for results from 2002 to 2008. A similar decrease in pooled RSD was observed for the small concentration range for orthophosphate from

replicates collected during 2009–11 (2.6 percent; Davis and others, 2013). This improved reliability is probably because of improved analytical performance.

Pooled RSDs for dissolved metals were calculated from 1 replicate for lead, 3 replicates for antimony and copper, 5 for selenium and zinc, 6 for manganese, 7 for aluminum, 9 for arsenic and cobalt, 10 for barium, molybdenum, nickel, and uranium, and 57 for chromium. RSDs were not calculated for dissolved beryllium, mercury, silver, thallium, and iron because there were no replicates where both concentrations of these constituents exceeded the reporting level. All pooled RSDs calculated for dissolved metals were equal to or less than 14 percent (table 13) indicating small variability and large reliability for measurements of these constituents.

Pooled RSDs for total metals were calculated from one replicate for arsenic, barium, cadmium, chromium, lead, and silver. RSDs were not calculated for total mercury and total selenium because there were no replicates where both concentrations of total mercury and total lead exceeded the reporting level. All pooled RSDs calculated for total metals were equal to or less than 11 percent (table 13) indicating small variability and large reliability for measurements of these constituents.

Organic Constituents

There were six VOCs (tetrachloroethene, tetrachloromethane, toluene, 1,1,1-trichloroethane, trichloroethene, and trichloromethane) that had replicates where both concentrations exceeded reporting levels. Pooled RSDs for these VOCs were calculated from two replicates for tetrachloroethene and toluene, four for trichloromethane, five for tetrachloromethane and trichloroethene, and seven for 1,1,1-trichloroethane. The pooled RSDs were all equal to or less than 14 percent ([table 13](#)) indicating small variability and large reliability for measurements of VOCs.

Pooled RSDs for TOC were calculated from TOC concentrations from 14 replicates. At the small concentration range, 0.5–5.0 mg/L, the pooled RSD was 70 percent, and at the large concentration range, 10–20 mg/L, the pooled RSD was 4.4 percent. The large pooled RSD for small concentrations of TOC is consistent with previous results for 1996–2001 (pooled RSD of 60 percent, Rattray, 2012, p. 67) and 2009–11 (pooled RSD of 27 percent, Davis and others, 2013, p. 31). The NWQL indicated that they had variable recovery of TOC during 1996–2001. The NWQL did not indicate that they had variable recovery of TOC during 2002–08, but RSDs of small concentration TOC spikes analyzed by the NWQL indicated that laboratory variability of small concentration TOC samples could be as large as 20 percent (U.S. Geological Survey, 2013b). The large pooled RSD for TOC from 2009 to 2011 was attributed to measured concentrations less than the LRL for TOC. Mostly small concentrations of TOC were measured from replicates collected from 2002 to 2008, and these small concentrations probably contributed to the large variability for TOC. Some replicates, however, had both small and large TOC concentrations. For example, four replicates (collected from wells RWMC M12S, USGS 109, USGS 107, and USGS 120) had small TOC concentrations ranging from an estimated value of 0.40 to 0.82 mg/L and large TOC concentrations ranging from 2.98 to 5.13 mg/L. These results indicate that variability calculated for TOC samples is not just because of small TOC concentrations. A study on the effects of sampling, shipping, and storage on TOC concentrations in water samples indicated that contamination of water samples with small concentrations of TOC may occur during sampling and storage (Otson and others, 1979). If this contamination is non-uniform it may add additional variability to TOC measurements. Collection of TOC samples was discontinued by the INLPO in 2012, but if collection of TOC samples is resumed in the future, a set of field blanks (field, ambient, storage, and source solution) should be collected to identify potential sources of TOC contamination in water samples collected by the INLPO.

Bias

Contamination bias of water-quality samples from field and laboratory procedures was evaluated with field and equipment blanks. Contamination bias in field and equipment blanks from the blank source solution was evaluated with

source solution blanks. Other sources of bias associated with water-quality samples, such as matrix interference and sample degradation, were not evaluated with field QC samples. However, the NWQL (Friedman and Erdmann, 1982; Pritt and Raese, 1995) and RESL (Bodnar and Percival, 1982; U.S. Department of Energy, 1995) evaluate laboratory bias, including sample contamination, sample degradation, and matrix interference, with analysis of laboratory QC samples (blank samples and [reference materials](#)).

Contamination bias was particularly important to evaluate for water-quality samples collected with portable sampling equipment from perched groundwater sites. This is because perched groundwater at the INL often has large concentrations of waste constituents, and cross-contamination of waste constituents between water-quality samples collected from perched groundwater sites may occur if the portable sampling equipment used to collect water-quality samples was not adequately cleaned. This source of contamination bias was eliminated from the routine, site-wide, water-quality monitoring program by installing (in 2003) a permanent submersible pump in the perched groundwater well (USGS 73; [fig. 4](#)) where the portable Grundfos pump was used to collect water-quality samples and by dedicating (in 2008) individual Teflon® bailers for use at specific perched-groundwater wells (use of brass bailers was discontinued in 2005).

Contamination bias, rather than instrument background uncertainty (sometimes referred to as “noise”), was considered present in a blank when a detectable concentration of a constituent was measured from the blank. This corresponded to a concentration exceeding the MDC of 3s (Bartholomay and others, 2003, p. 38; Knobel and others, 2008, p. 30) for radiochemical constituents and the reporting level for inorganic and organic constituents.

Source-Solution Blanks

Eleven source-solution blanks were collected from 2002 to 2008 ([table 14](#), at back of report). Tritium, strontium-90, and cesium-137 were analyzed from seven blanks, sodium and dissolved chromium were analyzed from six blanks, and chloride and sulfate were analyzed from five blanks ([table A4](#) contains concentrations of additional constituents measured from source blanks that were not measured from field or equipment blanks).

The only constituent with a detectable concentration was strontium-90, which had a measured concentration of 4.2 ± 0.8 pCi/L, from the source-solution blank collected on September 29, 2004 ([table 14](#)). There is no source of strontium-90 for DIW collected at the IFFO and used as source-solution, so the strontium-90 in the source-solution blank probably is from contamination acquired during the collection, processing, preservation, storage, shipping, preparation, and analysis of the sample, or is an artifact of large analytical variability. There were 59 measurements of strontium-90 from environmental water-quality samples collected in October 2004, and 32 of the measurements were

nondetections. These results indicate that some unknown, large source of strontium-90 did not uniformly contaminate the water-quality samples. Eight of the 27 measurements of strontium-90 that were detections ranged from 3 to 5 times the analytical uncertainty and were from wells that historically have not had detections of strontium-90 in water-quality samples. These few, small detectable concentrations could have occurred if a small source of strontium-90 contamination affected the water-quality samples in some random, nonuniform method. In addition, the variability of strontium-90 measurements of water-quality samples collected in October 2004 was large. This was determined by comparing the reproducibility of strontium-90 for replicates collected in October 2004 (71 percent, acceptable reproducibility for 5 of 7 replicates, [table 2](#)), with the reproducibility for replicates collected for 2002–08 (91 percent, [table 12](#)). Consequently, the detection of strontium-90 in the source-solution blank probably resulted from a small source of strontium-90 contamination or large measurement variability, or both.

Equipment Blanks

Nine equipment blanks were collected, one from the portable Grundfos pump and eight from bailers. Another equipment blank, of the stainless steel sampling pipes, was collected but did not accurately represent the method used to collect groundwater from the sampling pipes because the pipes were disconnected from the well when collecting the blank. This resulted in a much smaller volume of (source solution) rinse water being flushed through the pipes prior to collection of the blank, compared to the large amount of groundwater flushed through the pipes when collecting environmental water-quality samples from an aquifer well ([table A5](#) contains concentrations of constituents measured from the equipment blank of the stainless steel sampling pipes).

Equipment blanks were analyzed for known waste constituents in perched groundwater. Tritium, strontium-90, sodium, chloride, sulfate, and dissolved chromium were analyzed from the equipment blank of the portable Grundfos pump; tritium and strontium-90 were analyzed from seven of the equipment blanks of the bailers; cesium-137 and sodium were analyzed from four of the blanks of the bailers; and chloride, sulfate, and dissolved chromium were analyzed from eight of the blanks of the bailers ([table 14](#)). The only constituent with a detectable concentration in the equipment blanks was strontium-90, which had a measured concentration of 4.4 ± 0.8 pCi/L from an equipment blank of a bailer collected on October 26, 2004. This detectable concentration of strontium-90 is nearly the same concentration that was measured from the source-solution blank collected on September 29, 2004, and probably represents the same small source of strontium-90 contamination or large measurement variability, or both. Consequently, the detectable concentration of strontium-90 in the equipment blank probably is not from the bailer and probably does not represent cross-contamination between sample sites.

Field Blanks

Field blanks were collected to identify any potential contamination bias of iodide from select field (sample bottles, filter capsules, storage, and shipping) and all laboratory (storage, preparation, and analysis) sources of contamination. Iodide was analyzed from two field blanks collected in 2002, and iodide was not detected in either blank ([table 14](#)).

Analysis of Blank Results

No detectable concentrations of tritium, strontium-90, cesium-137, sodium, chloride, sulfate, dissolved chromium, and iodide were measured from blanks except for strontium-90 in one source solution and one equipment blank. Because the detectable concentration of strontium-90 in the equipment blank probably does not represent contamination from portable sampling equipment, the concentration of strontium-90 in the equipment blank was corrected, for statistical analysis, by subtracting the concentration of strontium-90 in the source-solution blank from the concentration of strontium-90 in the equipment blank (resulting in a corrected strontium-90 concentration in the equipment blank of 0.2 ± 0.8 pCi/L).

Order statistics and the binomial probability distribution were used to estimate the potential contamination bias of constituents in water-quality samples if more than one field or one equipment blank measurement was available for that constituent. For example, for the eight measurements of chloride from equipment blanks of bailers ($n = 8$), the potential contamination bias of chloride in associated water-quality samples was estimated, with a confidence level (100*c*l) of 94 percent, to be less than the $m+1$ ($m = 7$, $m+1 = 8 = n$) ranked chloride concentration of less than 0.20 mg/L for at least 70 percent of the samples ($p = 0.7$, where p is the probability of success in [table 15](#)). These methods indicated that: (1) with 87 percent confidence, contamination bias of cesium-137 and sodium in 60 percent of water-quality samples were less than the MDC or reporting level ([table 15](#), at back of report); (2) with 92–94 percent confidence, contamination bias of tritium, strontium-90, chloride, sulfate, and dissolved chromium in 70 percent of water-quality samples were less than the MDC or reporting level; and (3) with 75 percent confidence, contamination bias of iodide in 50 percent of water-quality samples was less than the reporting level for iodide.

Collection of more blank samples, providing more measurements of constituents from blanks, could provide a larger level of confidence that contamination bias did not affect water-quality samples. Nevertheless, these results support a conclusion that contamination bias of water-quality samples from sample processing, storage, shipping, and analysis was insignificant and that cross-contamination of perched-groundwater samples collected with bailers during 2002–08 was insignificant.

Summary

The U.S. Geological Survey (USGS), in cooperation with the U.S. Department of Energy, has been studying the water quality of the eastern Snake River Plain (ESRP) aquifer at and near the Idaho National Laboratory (INL) since 1949. The INL encompasses approximately 890 mi² of the ESRP in southeastern Idaho and overlies about 8 percent of the fractured basalt sole-source aquifer. The USGS began routine collection of water-quality samples in 1964 in order to monitor the concentrations and delineate the movement of radiochemical and chemical wastes discharged to the subsurface at the INL.

Beginning in 1980, quality control (QC) samples were routinely collected at groundwater and surface-water sites to ensure and to document the variability and bias of water-quality data. From 2002 to 2008, QC samples consisting of 139 replicates and 22 blanks (approximately 11 percent of the number of environmental samples collected) were collected at sampling sites, the USGS laboratory at the INL, or the USGS field office in Idaho Falls. Measurements from the replicates were used to estimate variability, as reproducibility and reliability, of water-quality measurements of radiochemical, inorganic, and organic constituents. Variability estimated from replicates collected in the field may include variability from field and laboratory procedures and groundwater quality heterogeneity. Measurements from blanks were used to estimate the potential contamination bias of selected radiochemical and inorganic constituents in water-quality samples, with an emphasis on identifying any cross contamination of samples collected with portable sampling equipment.

Reproducibility was estimated with calculations of normalized absolute difference (NAD) for radiochemical constituents and relative standard deviation (RSD) for inorganic and organic constituents. The NADs and RSDs, as well as replicate measurements with censored or estimated concentrations for which RSDs were not calculated, were compared to specified criteria to determine if the replicates had acceptable reproducibility. If the percentage of replicates with acceptable reproducibility for a constituent was equal to or greater than 90 percent, then the reproducibility for that constituent was considered acceptable for 2002–08. The percentage of replicates with acceptable reproducibility was equal to or greater than 90 percent for all constituents except dissolved aluminum (80 percent) and total organic carbon (TOC; 69 percent). The lower reproducibility for dissolved aluminum and TOC was attributed to calculation of reproducibility from replicates with small concentrations of these constituents.

The reliability of water-quality measurements was estimated with pooled RSDs, and pooled RSDs were calculated from measurements from replicates for discrete

concentration ranges for radiochemical, inorganic, and organic constituents. Pooled RSDs of 11 and 12 percent were calculated for the smallest concentration range for tritium and strontium-90, respectively, and pooled RSDs for larger concentration ranges were 4.9 and 5.1 percent for tritium, and 0.7 and 3.3 percent for strontium-90. The pooled RSD calculated for gross-beta radioactivity was 13 percent. Pooled RSDs for major ions and nutrients were equal to or less than 5.1 percent except for the smallest concentration range for ammonia, which had a pooled RSD of 8.7 percent. Pooled RSDs for dissolved metals were equal to or less than 8.2 percent except for aluminum and the smallest concentration range for dissolved nickel, which had pooled RSDs of 14 and 12 percent, respectively. Pooled RSDs for total arsenic, cadmium, and silver ranged from 8.6 to 11 percent, and pooled RSDs for total barium, chromium, and lead were equal to or less than 3.7 percent. Pooled RSDs for volatile organic compounds were equal to or less than 3.0 percent except for toluene, which had a pooled RSD of 14 percent. Pooled RSDs for TOC were 70 percent for the small concentration range and 4.4 percent for the large concentration range.

Source-solution and equipment blanks were measured for concentrations of tritium, strontium-90, cesium-137, sodium, chloride, sulfate, and dissolved chromium. Field blanks were measured for the concentration of iodide. No detectable concentrations were measured from the blanks except for strontium-90 in one source solution and one equipment blank collected in September and October of 2004, respectively. The detectable concentrations of strontium-90 in the blanks probably were from a small source of strontium-90 contamination and large measurement variability, or both.

Order statistics and the binomial probability distribution were used to estimate the magnitude and extent of any potential contamination bias of tritium, strontium-90, cesium-137, sodium, chloride, sulfate, dissolved chromium, and iodide in water-quality samples. These statistical methods indicated that, (1) with 87 percent confidence, contamination bias of cesium-137 and sodium in 60 percent of water-quality samples were less than the minimum detectable concentration or reporting level; (2) with 92–94 percent confidence, contamination bias of tritium, strontium-90, chloride, sulfate, and dissolved chromium in 70 percent of water-quality samples were less than the minimum detectable concentration or reporting level; and (3) with 75 percent confidence, contamination bias of iodide in 50 percent of water-quality samples was less than the reporting level for iodide. These results support a conclusion that contamination bias of water-quality samples from sample processing, storage, shipping, and analysis was insignificant and that cross-contamination of perched groundwater samples collected with bailers during 2002–08 was insignificant.

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Table 1. Measured concentrations and normalized absolute differences for gross-alpha radioactivity, gross-beta radioactivity, and cesium-137 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. Normalized absolute difference values in **bold** indicate that the value exceeds the criteria for acceptable reproducibility. In 2008 gross-alpha and gross-beta radioactivity were reported using the thorium-230 and the strontium-90-yttrium-90 curves, respectively. **Symbols:** \pm , plus or minus the specified uncertainty; –, no data. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Gross-alpha radioactivity		Gross-beta radioactivity		Cesium-137	
		pCi/L as Pu-239	NAD	pCi/L as Cs-137	NAD	pCi/L	NAD
USGS 88	04-02-02	–	–	–	–	0 \pm 30	0.24
		–	–	–	–	-10 \pm 30	
USGS 60	04-02-02	–	–	–	–	30 \pm 20	0.45
		–	–	–	–	50 \pm 40	
USGS 89	04-02-02	–	–	–	–	20 \pm 20	1.41
		–	–	–	–	-20 \pm 20	
USGS 61	04-03-02	–	–	–	–	20 \pm 20	0.66
		–	–	–	–	-10 \pm 30	
USGS 65	04-09-02	0.3 \pm 0.6	0.00	4 \pm 2	0.35	-20 \pm 20	0.55
		0.3 \pm 0.6		5 \pm 2		0 \pm 30	
USGS 87	04-11-02	1.4 \pm 0.9	0.00	5 \pm 2	0.00	-10 \pm 20	0.13
		1.4 \pm 0.9		5 \pm 2		-20 \pm 30	
PW 1	05-20-02	–	–	–	–	-10 \pm 20	1.14
		–	–	–	–	30 \pm 30	
USGS 83	07-02-02	0.3 \pm 0.6	0.70	2 \pm 2	0.71	10 \pm 40	0.76
		1.0 \pm 0.8		4 \pm 2		-20 \pm 20	
USGS 19	07-09-02	1.7 \pm 0.9	0.88	8 \pm 2	1.77	30 \pm 20	0.22
		0.7 \pm 0.7		3 \pm 2		40 \pm 40	
USGS 8	07-11-02	0.0 \pm 0.6	0.35	2 \pm 2	0.00	20 \pm 40	0.11
		0.3 \pm 0.6		2 \pm 2		10 \pm 20	
EBR 1	07-16-02	1.0 \pm 0.8	0.33	6 \pm 2	1.41	50 \pm 40	0.80
		1.4 \pm 0.9		2 \pm 2		10 \pm 20	
USGS 4	07-24-02	1.0 \pm 0.8	1.00	8 \pm 2	0.35	0 \pm 20	1.11
		0.0 \pm 0.6		7 \pm 2		-40 \pm 30	
RWMC M11S	09-10-02	0.3 \pm 0.6	0.00	4 \pm 2	0.71	-10 \pm 30	1.18
		0.3 \pm 0.6		6 \pm 2		40 \pm 30	
USGS 113	10-02-02	–	–	–	–	0 \pm 30	0.20
		–	–	–	–	-10 \pm 40	
USGS 14	10-09-02	1.4 \pm 0.9	0.61	6 \pm 2	0.71	30 \pm 30	0.92
		0.7 \pm 0.7		4 \pm 2		-20 \pm 40	
TRA DISP	10-23-02	–	–	–	–	40 \pm 20	1.34
		–	–	–	–	-20 \pm 40	
USGS 72	11-07-02	0.3 \pm 0.6	0.00	2 \pm 2	0.71	0 \pm 20	0.67
		0.3 \pm 0.6		4 \pm 2		30 \pm 40	
USGS 55	04-03-03	–	–	–	–	30 \pm 20	0.29
		–	–	–	–	20 \pm 30	
USGS 68	04-07-03	0.3 \pm 0.6	0.00	3 \pm 2	0.71	50 \pm 40	1.12
		0.3 \pm 0.6		5 \pm 2		0 \pm 20	

Table 1. Measured concentrations and normalized absolute differences for gross-alpha radioactivity, gross-beta radioactivity, and cesium-137 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. Normalized absolute difference values in **bold** indicate that the value exceeds the criteria for acceptable reproducibility. In 2008 gross-alpha and gross-beta radioactivity were reported using the thorium-230 and the strontium-90-yttrium-90 curves, respectively. **Symbols:** \pm , plus or minus the specified uncertainty; –, no data. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Gross-alpha radioactivity		Gross-beta radioactivity		Cesium-137	
		pCi/L as Pu-239	NAD	pCi/L as Cs-137	NAD	pCi/L	NAD
USGS 117	04-09-03	–	–	–	–	0 \pm 30	0.55
		–	–	–	–	20 \pm 20	
PW 8	04-14-03	–	–	–	–	10 \pm 20	2.01
		–	–	–	–	-80 \pm 40	
USGS 63	04-16-03	–	–	–	–	-40 \pm 40	0.80
		–	–	–	–	0 \pm 30	
ANP 9	07-08-03	1.0 \pm 0.8	0.00	3 \pm 2	0.35	20 \pm 30	1.40
		1.0 \pm 0.8		2 \pm 2		-50 \pm 40	
RWMC M12S	08-04-03	1.0 \pm 0.8	0.28	1 \pm 2	0.29	10 \pm 20	0.64
		0.7 \pm 0.7		2 \pm 2		-10 \pm 30	
Big Lost River at Mackay, ID	10-01-03	0.3 \pm 0.6	0.89	2 \pm 2	0.18	30 \pm 40	0.35
		-0.3 \pm 0.3		1 \pm 2		10 \pm 40	
ICPP-MON-A-166	10-06-03	–	–	–	–	-30 \pm 20	0.55
		–	–	–	–	-10 \pm 30	
USGS 53	10-08-03	–	–	–	–	10 \pm 20	0.28
		–	–	–	–	20 \pm 30	
USGS 46	11-12-03	–	–	–	–	0 \pm 30	0.31
		–	–	–	–	-10 \pm 30	
USGS 47	11-17-03	–	–	–	–	10 \pm 20	0.55
		–	–	–	–	30 \pm 30	
USGS 126A	04-07-04	0.7 \pm 0.7	0.88	1 \pm 2	0.49	20 \pm 30	0.00
		1.7 \pm 0.9		0 \pm 2		20 \pm 30	
PAND W 2	04-07-04	0.3 \pm 0.6	0.70	1 \pm 2	0.20	10 \pm 20	0.07
		1.0 \pm 0.8		2 \pm 2		10 \pm 20	
USGS 40	04-15-04	–	–	–	–	40 \pm 30	0.45
		–	–	–	–	30 \pm 10	
USGS 76	04-19-04	–	–	–	–	-10 \pm 30	0.47
		–	–	–	–	10 \pm 40	
USGS 62	04-21-04	–	–	–	–	-10 \pm 30	0.08
		–	–	–	–	-10 \pm 20	
USGS 56	10-19-04	–	–	–	–	-30 \pm 40	1.00
		–	–	–	–	20 \pm 30	
ICPP-MON-A-167	10-19-04	–	–	–	–	-10 \pm 30	0.94
		–	–	–	–	30 \pm 30	
USGS 105	10-20-04	0.7 \pm 0.7	0.00	2 \pm 2	0.00	-10 \pm 30	0.14
		0.7 \pm 0.7		2 \pm 2		-20 \pm 30	
USGS 78	10-26-04	–	–	–	–	-10 \pm 30	1.25
		–	–	–	–	40 \pm 30	

Table 1. Measured concentrations and normalized absolute differences for gross-alpha radioactivity, gross-beta radioactivity, and cesium-137 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. Normalized absolute difference values in **bold** indicate that the value exceeds the criteria for acceptable reproducibility. In 2008 gross-alpha and gross-beta radioactivity were reported using the thorium-230 and the strontium-90-yttrium-90 curves, respectively. **Symbols:** \pm , plus or minus the specified uncertainty; –, no data. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Gross-alpha radioactivity		Gross-beta radioactivity		Cesium-137	
		pCi/L as Pu-239	NAD	pCi/L as Cs-137	NAD	pCi/L	NAD
USGS 5	04-11-05	1.0 \pm 0.8	0.28	4 \pm 2	0.00	0 \pm 30	0.28
		0.7 \pm 0.7		4 \pm 2		-10 \pm 20	
USGS 109	04-14-05	0.7 \pm 0.7	0.43	1 \pm 2	0.00	-10 \pm 40	0.67
		0.3 \pm 0.6		1 \pm 2		20 \pm 20	
USGS 7	04-21-05	0.3 \pm 0.6	0.43	2 \pm 2	0.18	-20 \pm 30	0.62
		0.7 \pm 0.7		1 \pm 2		10 \pm 30	
USGS 107	04-25-05	0.0 \pm 0.6	0.35	2 \pm 2	0.00	10 \pm 30	0.24
		0.3 \pm 0.6		2 \pm 2		20 \pm 30	
USGS 110A	10-03-05	0.3 \pm 0.6	0.43	4 \pm 2	0.35	30 \pm 40	1.59
		0.7 \pm 0.7		5 \pm 2		-60 \pm 40	
USGS 1	10-03-05	1.0 \pm 0.8	0.00	4 \pm 2	0.71	-30 \pm 40	1.34
		1.0 \pm 0.8		6 \pm 2		30 \pm 20	
USGS 131	04-26-06	0.7 \pm 0.7	0.00	2 \pm 2	0.35	-20 \pm 20	0.80
		0.7 \pm 0.7		3 \pm 2		0 \pm 20	
Big Lost River near Arco, ID	04-27-06	0.3 \pm 0.6	0.43	3 \pm 2	0.61	-10 \pm 40	0.19
		0.7 \pm 0.7		1 \pm 2		-20 \pm 20	
No Name 1	05-01-06	1.0 \pm 0.8	0.70	3 \pm 2	0.35	20 \pm 20	0.55
		0.3 \pm 0.6		4 \pm 2		0 \pm 30	
USGS 58	05-05-06	–	–	–	–	30 \pm 20	0.89
		–		–		-10 \pm 40	
USGS 12	05-10-06	0.3 \pm 0.6	0.70	2 \pm 2	0.50	30 \pm 40	0.40
		1.0 \pm 0.8		3 \pm 2		10 \pm 30	
USGS 86	10-24-06	0.7 \pm 0.7	0.43	1 \pm 2	0.96	-10 \pm 30	0.28
		0.3 \pm 0.6		4 \pm 2		0 \pm 30	
Highway 3	10-26-06	0.7 \pm 0.7	0.43	2 \pm 2	0.71	0 \pm 20	0.71
		0.3 \pm 0.6		4 \pm 2		20 \pm 20	
Leo Rogers 1	11-01-06	0.0 \pm 0.6	0.35	6 \pm 2	0.71	50 \pm 40	1.12
		0.3 \pm 0.6		4 \pm 2		0 \pm 20	
NPR Test	11-02-06	0.3 \pm 0.6	0.00	2 \pm 2	0.71	20 \pm 20	0.83
		0.3 \pm 0.6		4 \pm 2		50 \pm 30	
USGS 69	11-07-06	–	–	–	–	0 \pm 40	0.40
		–		–		20 \pm 30	
USGS 66	11-08-06	–	–	–	–	0 \pm 20	0.67
		–		–		-30 \pm 40	
USGS 50	04-10-07	–	–	–	–	-40 \pm 30	0.55
		–		–		-20 \pm 20	
USGS 44	04-12-07	–	–	–	–	-30 \pm 30	1.41
		–		–		30 \pm 30	
USGS 17	04-16-07	0.7 \pm 0.7	0.43	2 \pm 2	0.30	0 \pm 20	1.06
		0.3 \pm 0.6		1.2 \pm 1.7		30 \pm 20	

Table 1. Measured concentrations and normalized absolute differences for gross-alpha radioactivity, gross-beta radioactivity, and cesium-137 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. Normalized absolute difference values in **bold** indicate that the value exceeds the criteria for acceptable reproducibility. In 2008 gross-alpha and gross-beta radioactivity were reported using the thorium-230 and the strontium-90-yttrium-90 curves, respectively. **Symbols:** \pm , plus or minus the specified uncertainty; –, no data. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Gross-alpha radioactivity		Gross-beta radioactivity		Cesium-137	
		pCi/L as Pu-239	NAD	pCi/L as Cs-137	NAD	pCi/L	NAD
USGS 120	04-24-07	0.0 \pm 0.6	0.35	4 \pm 2	0.35	40 \pm 30	0.65
		0.3 \pm 0.6		3 \pm 2		10 \pm 30	
USGS 84	04-25-07	0.3 \pm 0.6	0.00	1.5 \pm 1.7	3.92	20 \pm 30	0.17
		0.3 \pm 0.6		15 \pm 3		10 \pm 20	
USGS 23	05-01-07	1.0 \pm 0.8	0.00	0.2 \pm 1.6	0.13	20 \pm 30	1.28
		1.0 \pm 0.8		0.5 \pm 1.6		-30 \pm 20	
USGS 101	10-10-07	0.3 \pm 0.6	0.00	1.8 \pm 1.6	0.36	10 \pm 30	0.71
		0.3 \pm 0.6		1.0 \pm 1.5		-20 \pm 30	
USGS 98	10-11-07	0.0 \pm 0.6	0.76	1.6 \pm 1.5	0.14	50 \pm 30	0.71
		0.7 \pm 0.7		1.9 \pm 1.6		20 \pm 30	
RWMC M14S	10-15-07	0.3 \pm 0.6	0.43	3.3 \pm 1.7	0.34	-10 \pm 30	0.47
		0.7 \pm 0.7		2.5 \pm 1.6		10 \pm 30	
USGS 126B	10-16-07	0.3 \pm 0.6	0.00	3.1 \pm 1.6	0.82	0 \pm 40	0.00
		0.3 \pm 0.6		1.3 \pm 1.5		0 \pm 40	
RWMC M13S	10-17-07	0.3 \pm 0.6	0.00	7 \pm 2	2.32	10 \pm 20	2.12
		0.3 \pm 0.6		1.2 \pm 1.5		-50 \pm 20	
USGS 77	10-18-07	0.7 \pm 0.7	0.00	12 \pm 2	0.71	0 \pm 20	0.00
		0.7 \pm 0.7		10 \pm 2		0 \pm 20	
USGS 127	04-07-08	0.6 \pm 0.8	1.09	2.2 \pm 0.9	0.31	0 \pm 40	0.71
		2.0 \pm 1.0		1.8 \pm 0.9		40 \pm 40	
USGS 26	04-15-08	2.5 \pm 1.1	1.06	1.9 \pm 0.9	1.26	10 \pm 30	0.55
		1.0 \pm 0.9		3.6 \pm 1.0		30 \pm 20	
CPP 1	04-16-08	1.8 \pm 1.0	0.74	15.6 \pm 1.5	1.32	-30 \pm 20	1.94
		0.8 \pm 0.9		18.6 \pm 1.7		40 \pm 30	
USGS 34	04-17-08	1.8 \pm 1.0	0.45	4.6 \pm 1.0	0.14	10 \pm 40	0.13
		1.2 \pm 0.9		4.4 \pm 1.0		20 \pm 40	
USGS 97	04-22-08	1.4 \pm 0.9	0.66	3.1 \pm 1.0	1.34	-20 \pm 40	1.00
		0.6 \pm 0.8		1.3 \pm 0.9		30 \pm 30	
USGS 27	04-24-08	1.6 \pm 1.0	0.59	5.9 \pm 1.1	0.34	-10 \pm 30	0.47
		0.8 \pm 0.9		5.4 \pm 1.0		10 \pm 30	
Highway 3	04-30-08	3.1 \pm 1.1	1.01	2.0 \pm 0.9	1.41	0 \pm 20	1.12
		1.6 \pm 1.0		3.9 \pm 1.0		-50 \pm 40	
Rifle Range	10-09-08	–	–	–	–	12 \pm 11	0.05
		–		–		13 \pm 17	
RWMC PROD	10-09-08	–	–	–	–	-7 \pm 8	1.09
		–		–		7 \pm 10	
PSTF Test	10-20-08	2.5 \pm 0.7	0.75	4.5 \pm 1.0	2.38	-11 \pm 6	1.05
		3.3 \pm 0.8		1.3 \pm 0.9		7 \pm 16	

24 Quality-Control Data Collected for Routine Water-Quality Activities, Idaho National Laboratory and Vicinity, Idaho, 2002–08

Table 2. Measured concentrations and normalized absolute differences for tritium and strontium-90 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. Normalized absolute difference values in **bold** indicate that the value exceeds the criteria for acceptable reproducibility. **Symbols:** \pm , plus or minus the specified uncertainty; –, no data. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Tritium		Strontium-90	
		pCi/L	NAD	pCi/L	NAD
USGS 88	04-02-02	-50 \pm 120	0.47	-2.1 \pm 0.7	2.42
		30 \pm 120		0.3 \pm 0.7	
USGS 60	04-02-02	90 \pm 120	0.43	3.1 \pm 0.7	0.28
		20 \pm 110		3.4 \pm 0.8	
USGS 89	04-02-02	-90 \pm 120	0.31	-0.4 \pm 0.7	0.10
		10 \pm 300		-0.5 \pm 0.7	
USGS 61	04-03-02	4,400 \pm 300	0.28	1.3 \pm 0.7	0.10
		4,500 \pm 200		1.2 \pm 0.7	
USGS 104	04-08-02	1,100 \pm 200	0.22	–	–
		1,200 \pm 400		–	
USGS 65	04-09-02	8,200 \pm 400	0.23	0.1 \pm 0.7	0.71
		8,300 \pm 160		0.8 \pm 0.7	
USGS 87	04-11-02	980 \pm 160	0.05	-2.0 \pm 0.7	3.13
		970 \pm 120		1.1 \pm 0.7	
Mud Lake near Terretton, ID	04-22-02	40 \pm 120	0.00	–	–
		40 \pm 130		–	
PW 1	05-20-02	260 \pm 140	0.33	1.2 \pm 0.7	0.09
		320 \pm 120		1.3 \pm 0.8	
USGS 83	07-02-02	-280 \pm 130	0.85	–	–
		-130 \pm 120		–	
USGS 102	07-02-02	-240 \pm 120	0.17	-0.1 \pm 0.5	0.62
		-270 \pm 130		-0.6 \pm 0.6	
USGS 19	07-09-02	-210 \pm 130	0.33	–	–
		-150 \pm 130		–	
USGS 8	07-11-02	-180 \pm 130	0.33	–	–
		-120 \pm 130		–	
EBR 1	07-16-02	-140 \pm 120	0.19	–	–
		-220 \pm 400		–	
CFA LF 3-9	07-17-02	8,400 \pm 400	0.24	0.7 \pm 0.5	0.75
		8,300 \pm 130		0.1 \pm 0.6	
USGS 4	07-24-02	-140 \pm 130	0.26	–	–
		-90 \pm 140		–	
RWMC M11S	09-10-02	-120 \pm 130	0.58	–	–
		-230 \pm 140		–	
USGS 79	10-01-02	190 \pm 140	0.30	–	–
		290 \pm 300		–	
USGS 113	10-02-02	4,700 \pm 300	0.60	–	–
		5,000 \pm 400		–	
USGS 67	10-03-02	7,700 \pm 400	0.48	8.8 \pm 0.6	0.59
		7,900 \pm 120		9.3 \pm 0.6	
USGS 14	10-09-02	-140 \pm 120	0.06	–	–
		-120 \pm 300		–	
USGS 70	10-09-02	3,700 \pm 300	0.31	41 \pm 1.3	0.94
		3,800 \pm 120		43 \pm 1.4	
CPP 4	10-15-02	-110 \pm 130	0.15	0.0 \pm 0.5	1.66
		-60 \pm 300		1.3 \pm 0.6	
USGS 59	10-16-02	6,200 \pm 300	0.17	16 \pm 0.8	0.35
		6,300 \pm 500		16 \pm 0.8	
TRA DISP	10-23-02	12,900 \pm 500	0.39	1.9 \pm 0.8	2.45
		13,100 \pm 130		-0.7 \pm 0.7	

Table 2. Measured concentrations and normalized absolute differences for tritium and strontium-90 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. Normalized absolute difference values in **bold** indicate that the value exceeds the criteria for acceptable reproducibility. **Symbols:** \pm , plus or minus the specified uncertainty; –, no data. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Tritium		Strontium-90	
		pCi/L	NAD	pCi/L	NAD
USGS 72	11-07-02	-20 \pm 130 -60 \pm 500	0.08	–	–
USGS 114	04-01-03	12,100 \pm 500 13,600 \pm 500	2.12	0.0 \pm 0.6 -0.9 \pm 0.6	1.06
USGS 55	04-03-03	11,800 \pm 500 13,900 \pm 140	4.04	45 \pm 1.5 46 \pm 1.5	0.33
USGS 68	04-07-03	160 \pm 140 190 \pm 300	0.09	1.1 \pm 0.9 1.1 \pm 0.9	0.00
USGS 37	04-08-03	3,500 \pm 300 3,600 \pm 130	0.31	6.3 \pm 0.7 7.6 \pm 0.7	1.31
USGS 108	04-08-03	-20 \pm 130 10 \pm 130	0.16	–	–
USGS 117	04-09-03	70 \pm 130 20 \pm 300	0.15	0.3 \pm 0.6 1.4 \pm 0.7	1.19
USGS 48	04-10-03	3,800 \pm 300 3,800 \pm 200	0.00	19 \pm 0.9 21 \pm 0.9	1.57
PW 8	04-14-03	1,900 \pm 200 1,700 \pm 200	0.71	2.5 \pm 0.7 3.6 \pm 0.7	1.11
Rifle Range	04-16-03	1,800 \pm 200 2,000 \pm 130	0.84	0.0 \pm 0.6 -0.2 \pm 0.6	0.18
USGS 63	04-16-03	80 \pm 140 120 \pm 100	0.23	2.7 \pm 0.7 1.0 \pm 0.6	1.84
WS INEL 1	07-07-03	20 \pm 100 20 \pm 100	0.02	–	–
ANP 9	07-08-03	10 \pm 100 130 \pm 100	0.85	0.6 \pm 0.8 1.0 \pm 0.8	0.35
SITE 19	07-08-03	-20 \pm 100 30 \pm 100	0.35	–	–
ANP 6	07-08-03	80 \pm 100 30 \pm 300	0.16	-0.2 \pm 0.6 0.6 \pm 0.6	0.90
CFA LF 3-9	07-24-03	7,600 \pm 300 7,600 \pm 150	0.00	0.8 \pm 0.6 -0.8 \pm 0.6	1.89
RWMC M12S	08-04-03	1,420 \pm 150 1,460 \pm 150	0.19	–	–
RWMC M7S	08-05-03	1,260 \pm 140 1,080 \pm 110	1.01	1.1 \pm 0.6 0.5 \pm 0.6	0.71
Big Lost River at Mackay, ID	10-01-03	40 \pm 100 -30 \pm 110	0.47	–	–
ICPP-MON-A-166	10-06-03	200 \pm 110 130 \pm 140	0.39	0.8 \pm 0.7 1.7 \pm 0.7	0.91
PW 4	10-08-03	870 \pm 140 830 \pm 200	0.16	3.7 \pm 0.8 3.5 \pm 0.8	0.18
USGS 53	10-08-03	3,100 \pm 200 3,600 \pm 200	1.77	49 \pm 1.4 48 \pm 1.5	0.58
USGS 85	11-04-03	2,500 \pm 200 2,700 \pm 200	0.71	4.1 \pm 0.6 5.1 \pm 0.6	1.18
USGS 112	11-04-03	4,500 \pm 200 4,600 \pm 200	0.35	15 \pm 0.8 15 \pm 0.8	0.53
USGS 128	11-05-03	2,600 \pm 200 2,900 \pm 200	1.06	6.0 \pm 0.6 5.7 \pm 0.6	0.35

Table 2. Measured concentrations and normalized absolute differences for tritium and strontium-90 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. Normalized absolute difference values in **bold** indicate that the value exceeds the criteria for acceptable reproducibility. **Symbols:** \pm , plus or minus the specified uncertainty; –, no data. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Tritium		Strontium-90	
		pCi/L	NAD	pCi/L	NAD
USGS 111	11-05-03	3,700 \pm 200	1.64	0.9 \pm 0.5	1.63
		4,100 \pm 140		2.3 \pm 0.7	
USGS 46	11-12-03	1,080 \pm 140	0.33	8.7 \pm 0.8	1.59
		1,010 \pm 160		11 \pm 0.8	
USGS 36	11-13-03	1,600 \pm 160	0.62	7.7 \pm 0.7	0.20
		1,760 \pm 200		7.9 \pm 0.7	
USGS 47	11-17-03	2,000 \pm 200	0.71	39 \pm 1.2	1.36
		2,200 \pm 200		37 \pm 1.2	
USGS 48	11-18-03	3,500 \pm 200	0.44	22 \pm 0.9	0.55
		3,600 \pm 110		22 \pm 0.9	
Site 9	04-05-04	-30 \pm 110	0.13	0.6 \pm 0.6	1.65
		-50 \pm 110		-0.8 \pm 0.6	
USGS 126A	04-07-04	-10 \pm 110	0.00	–	–
		-10 \pm 110		–	
P AND W 2	04-07-04	-10 \pm 110	0.27	–	–
		-120 \pm 400		–	
USGS 51	04-13-04	10,300 \pm 300	0.63	-0.3 \pm 0.6	0.71
		10,100 \pm 110		0.3 \pm 0.6	
TRA 4	04-14-04	0 \pm 110	0.13	–	–
		-20 \pm 110		–	
USGS 32	04-14-04	0 \pm 110	0.22	-0.2 \pm 0.6	0.71
		-50 \pm 200		0.4 \pm 0.6	
USGS 40	04-15-04	3,100 \pm 200	0.40	15 \pm 1.1	0.00
		3,000 \pm 150		15 \pm 1.1	
USGS 76	04-19-04	980 \pm 150	0.05	1.5 \pm 1.0	1.26
		970 \pm 120		-0.2 \pm 0.9	
USGS 62	04-21-04	60 \pm 120	0.47	2.7 \pm 1.0	1.84
		140 \pm 120		0.1 \pm 1.0	
USGS 6	10-12-04	-180 \pm 120	0.47	0.0 \pm 0.5	2.23
		-70 \pm 200		-2.1 \pm 0.8	
USGS 35	10-18-04	2,800 \pm 200	0.11	0.5 \pm 0.6	0.82
		2,900 \pm 900		-0.2 \pm 0.6	
USGS 56	10-19-04	23,300 \pm 900	0.44	19 \pm 1	0.78
		22,900 \pm 130		17 \pm 1	
IET 1 DISP	10-19-04	-40 \pm 130	0.55	0.4 \pm 0.7	0.81
		70 \pm 150		-0.4 \pm 0.7	
ICPP-MON-A-167	10-19-04	580 \pm 160	0.75	3.1 \pm 0.8	0.80
		740 \pm 140		4.0 \pm 0.8	
USGS 105	10-20-04	210 \pm 130	0.34	–	–
		150 \pm 120		–	
CPP 2	10-21-04	-70 \pm 130	0.49	0.9 \pm 0.6	3.30
		20 \pm 130		-1.9 \pm 0.6	
USGS 78	10-26-04	10 \pm 120	0.75	3.1 \pm 0.8	0.62
		-90 \pm 60		3.8 \pm 0.8	
USGS 5	04-11-05	80 \pm 60	0.38	–	–
		50 \pm 50		–	
USGS 18	04-11-05	-80 \pm 50	0.26	-0.1 \pm 0.5	0.41
		-100 \pm 60		0.2 \pm 0.5	
USGS 109	04-14-05	10 \pm 50	0.42	–	–
		-20 \pm 50		–	

Table 2. Measured concentrations and normalized absolute differences for tritium and strontium-90 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. Normalized absolute difference values in **bold** indicate that the value exceeds the criteria for acceptable reproducibility. **Symbols:** \pm , plus or minus the specified uncertainty; –, no data. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Tritium		Strontium-90	
		pCi/L	NAD	pCi/L	NAD
USGS 7	04-21-05	-60 \pm 50 -20 \pm 50	0.57	1.8 \pm 0.7 -0.8 \pm 0.7	2.63
USGS 107	04-25-05	-60 \pm 50 -80 \pm 50	0.28	– –	–
USGS 2	04-25-05	-70 \pm 50 -40 \pm 60	0.38	-1.2 \pm 0.8 -1.1 \pm 0.6	0.10
USGS 22	04-25-05	30 \pm 60 0 \pm 50	0.38	– –	–
USGS 31	04-26-05	-80 \pm 50 -20 \pm 110	0.50	-0.2 \pm 0.6 0.5 \pm 0.6	0.82
USGS 110A	10-03-05	60 \pm 100 -120 \pm 100	1.27	– –	–
USGS 99	10-03-05	-90 \pm 100 -90 \pm 100	0.00	– –	–
USGS 1	10-03-05	10 \pm 100 -100 \pm 100	0.78	– –	–
USGS 29	10-04-05	-110 \pm 100 -160 \pm 150	0.28	1.3 \pm 0.7 0.5 \pm 0.8	0.75
RWMC M7S	10-06-05	1,080 \pm 150 1,060 \pm 100	0.11	1.1 \pm 0.7 2.0 \pm 0.7	0.91
CWP 8	10-18-05	0 \pm 100 10 \pm 100	0.07	0.8 \pm 0.9 1.0 \pm 0.9	0.16
CWP 1	10-18-05	-100 \pm 100 10 \pm 100	0.78	1.0 \pm 0.9 1.6 \pm 0.9	0.47
USGS 15	10-18-05	-180 \pm 100 -80 \pm 170	0.51	2.3 \pm 0.7 -1.3 \pm 1.2	2.59
USGS 116	04-17-06	2,440 \pm 170 2,330 \pm 90	0.57	0.0 \pm 0.7 0.8 \pm 0.8	0.75
USGS 121	04-25-06	80 \pm 90 120 \pm 90	0.31	0.0 \pm 0.7 0.4 \pm 0.7	0.40
USGS 100	04-26-06	40 \pm 90 80 \pm 160	0.22	– –	–
USGS 131	04-26-06	2,120 \pm 160 2,020 \pm 90	0.54	0.2 \pm 0.7 -0.1 \pm 0.7	0.30
Big Lost River near Arco, ID	04-27-06	70 \pm 90 90 \pm 90	0.16	– –	–
No Name 1	05-01-06	100 \pm 90 50 \pm 140	0.30	1.1 \pm 0.7 -0.2 \pm 0.7	1.28
USGS 58	05-05-06	1,410 \pm 140 1,410 \pm 90	0.00	-0.9 \pm 0.7 -0.9 \pm 0.7	0.00
USGS 12	05-10-06	60 \pm 90 80 \pm 90	0.16	– –	–
Site 4	10-12-06	-60 \pm 50 30 \pm 50	1.27	– –	–
USGS 86	10-24-06	0 \pm 50 -40 \pm 50	0.57	– –	–
Highway 3	10-26-06	50 \pm 50 10 \pm 50	0.54	– –	–
Leo Rogers 1	11-01-06	0 \pm 50 -40 \pm 50	0.57	– –	–

Table 2. Measured concentrations and normalized absolute differences for tritium and strontium-90 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. Normalized absolute difference values in **bold** indicate that the value exceeds the criteria for acceptable reproducibility. **Symbols:** \pm , plus or minus the specified uncertainty; –, no data. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Tritium		Strontium-90	
		pCi/L	NAD	pCi/L	NAD
NPR Test	11-02-06	50 \pm 50 -10 \pm 50	0.85	–	–
USGS 69	11-07-06	-60 \pm 50 -50 \pm 80	0.11	-0.1 \pm 0.7 -1.8 \pm 0.7	1.72
RWMC M3S	11-07-06	1,030 \pm 80 1,050 \pm 70	0.19	0.2 \pm 0.7 0.3 \pm 0.7	0.10
USGS 66	11-08-06	790 \pm 80 830 \pm 300	0.13	0.8 \pm 0.7 -0.2 \pm 0.7	1.01
USGS 20	04-03-07	4,500 \pm 300 4,100 \pm 400	0.80	0.3 \pm 0.7 0.2 \pm 0.6	0.11
USGS 50	04-10-07	17,400 \pm 400 17,100 \pm 110	0.72	101 \pm 2 102 \pm 2	0.35
MTR Test	04-11-07	-60 \pm 110 10 \pm 110	0.45	–	–
USGS 44	04-12-07	140 \pm 110 40 \pm 110	0.64	2.3 \pm 0.7 2.2 \pm 0.7	0.10
USGS 17	04-16-07	0 \pm 110 -10 \pm 120	0.06	–	–
USGS 120	04-24-07	110 \pm 120 250 \pm 170	0.67	-0.5 \pm 0.7 -0.5 \pm 0.7	0.00
USGS 84	04-25-07	1,510 \pm 170 1,470 \pm 100	0.20	-0.9 \pm 0.7 -0.8 \pm 0.7	0.10
USGS 23	05-01-07	-50 \pm 110 0 \pm 70	0.38	–	–
USGS 101	10-10-07	-30 \pm 60 -60 \pm 70	0.33	–	–
USGS 98	10-11-07	30 \pm 70 0 \pm 70	0.30	0.8 \pm 0.7 -0.3 \pm 0.7	1.11
USGS 39	10-15-07	2,380 \pm 280 2,550 \pm 140	0.54	1.1 \pm 0.7 -0.4 \pm 0.7	1.52
RWMC M14S	10-15-07	1,100 \pm 140 1,510 \pm 180	1.80	–	–
USGS 126B	10-16-07	30 \pm 60 -100 \pm 60	1.53	–	–
RWMC M13S	10-17-07	-70 \pm 60 -200 \pm 60	1.53	–	–
USGS 77	10-18-07	6,690 \pm 700 6,650 \pm 700	0.04	1.1 \pm 0.7 0.5 \pm 0.7	0.61
Little Lost River near Howe, ID	10-30-07	-70 \pm 60 -10 \pm 70	0.65	–	–
USGS 127	04-07-08	200 \pm 70 90 \pm 60	1.19	0.2 \pm 0.7 1.4 \pm 0.7	1.21
USGS 26	04-15-08	20 \pm 60 -40 \pm 60	0.65	0.4 \pm 0.7 1.3 \pm 1.0	0.74
CPP 1	04-16-08	90 \pm 60 130 \pm 60	0.47	2.6 \pm 0.7 1.7 \pm 0.7	0.91
USGS 34	04-17-08	1,850 \pm 100 1,980 \pm 100	0.92	2.6 \pm 0.7 2.1 \pm 0.7	0.51
USGS 97	04-22-08	-70 \pm 60 -20 \pm 60	0.63	0.8 \pm 0.7 0.6 \pm 0.7	0.20

Table 2. Measured concentrations and normalized absolute differences for tritium and strontium-90 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. Normalized absolute difference values in **bold** indicate that the value exceeds the criteria for acceptable reproducibility. **Symbols:** \pm , plus or minus the specified uncertainty; –, no data. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Tritium		Strontium-90	
		pCi/L	NAD	pCi/L	NAD
USGS 27	04-24-08	0 \pm 60 70 \pm 60	0.82	–	–
SPERT 1	04-24-08	40 \pm 60 50 \pm 60	0.12	–	–
Highway 3	04-30-08	140 \pm 70 20 \pm 60	1.30	–	–
USGS 128	10-06-08	1,790 \pm 90	0.08	5.0 \pm 0.8	0.62
USGS 115	10-08-08	1,800 \pm 90 1,150 \pm 80 1,280 \pm 80	1.15	5.7 \pm 0.8 2.5 \pm 0.7 0.7 \pm 0.7	1.82
Rifle Range	10-09-08	810 \pm 70 680 \pm 70	1.31	1.7 \pm 0.7 0.9 \pm 0.7	0.81
RWMC PROD	10-09-08	940 \pm 70 1150 \pm 80	1.98	2.0 \pm 0.7 -1.1 \pm 0.7	3.13
CFA 2	10-09-08	5,330 \pm 150 5,510 \pm 150	0.85	0.6 \pm 0.7 2.2 \pm 0.7	1.62
CPP 4	10-09-08	50 \pm 50 50 \pm 50	0.00	0.3 \pm 0.7 -0.3 \pm 0.7	0.61
PSTF Test	10-20-08	240 \pm 60 70 \pm 50	2.18	1.9 \pm 0.7 0.9 \pm 0.7	1.01
USGS 106	10-21-08	730 \pm 70 660 \pm 70	0.71	– –	–

Table 3. Measured concentrations and normalized absolute differences for plutonium-238, plutonium-239+240, and americium-241 from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). Uncertainties are 1 σ combined standard uncertainties. **Symbols:** \pm , plus or minus the specified uncertainty. **Abbreviations:** pCi/L, picocuries per liter; NAD, normalized absolute difference]

Site name	Sample collection date	Plutonium-238		Plutonium-239+240		Americium-241	
		pCi/L	NAD	pCi/L	NAD	pCi/L	NAD
USGS 88	04-02-02	0.003 \pm 0.005	1.03	-0.003 \pm 0.007	0.70	0.003 \pm 0.01	0.00
		-0.003 \pm 0.003		-0.009 \pm 0.005		0.003 \pm 0.01	
USGS 89	04-02-02	0.006 \pm 0.006	0.38	0.003 \pm 0.008	0.90	0.003 \pm 0.01	0.67
		0.003 \pm 0.005		-0.006 \pm 0.006		-0.006 \pm 0.009	
USGS 65	04-09-02	-0.003 \pm 0.006	0.77	0.003 \pm 0.01	0.00	-0.003 \pm 0.01	0.81
		0.003 \pm 0.005		0.003 \pm 0.008		0.009 \pm 0.011	
USGS 87	04-11-02	-0.003 \pm 0.003	0.00	-0.003 \pm 0.007	0.56	0.003 \pm 0.011	0.00
		-0.003 \pm 0.003		0.003 \pm 0.008		0.003 \pm 0.009	
USGS 117	04-09-03	0.003 \pm 0.007	0.98	0.003 \pm 0.005	0.29	0.003 \pm 0.01	0.22
		-0.006 \pm 0.006		0.006 \pm 0.009		0.006 \pm 0.009	
USGS 47	11-17-03	0.003 \pm 0.007	0.61	0.003 \pm 0.005	0.00	0.003 \pm 0.008	0.53
		-0.003 \pm 0.007		0.003 \pm 0.005		-0.003 \pm 0.008	
USGS 40	04-15-04	0.006 \pm 0.006	0.30	0.006 \pm 0.006	0.38	0.012 \pm 0.01	1.17
		0.009 \pm 0.008		0.003 \pm 0.005		-0.003 \pm 0.008	
USGS 131	04-26-06	-0.003 \pm 0.003	1.03	-0.003 \pm 0.003	1.34	0.003 \pm 0.009	0.71
		0.003 \pm 0.005		0.006 \pm 0.006		0.012 \pm 0.009	
USGS 120	04-24-07	-0.003 \pm 0.003	1.41	0.003 \pm 0.005	0.38	0.005 \pm 0.009	0.07
		0.003 \pm 0.003		0.006 \pm 0.006		0.006 \pm 0.01	
USGS 84	04-25-07	0.003 \pm 0.003	1.41	0.006 \pm 0.006	1.41	0.003 \pm 0.009	0.00
		-0.003 \pm 0.003		-0.006 \pm 0.006		0.003 \pm 0.01	
USGS 98	10-11-07	0 \pm 0.004	0.60	0.003 \pm 0.005	0.42	-0.006 \pm 0.007	0.56
		-0.003 \pm 0.003		0 \pm 0.005		0 \pm 0.008	
USGS 77	10-18-07	0 \pm 0.006	0.38	0 \pm 0.006	0.38	0.006 \pm 0.009	0.00
		0.003 \pm 0.005		0.003 \pm 0.005		0.006 \pm 0.009	
CPP 1	04-16-08	-0.006 \pm 0.004	1.12	0.006 \pm 0.007	1.05	-0.009 \pm 0.011	0.74
		0.003 \pm 0.007		-0.003 \pm 0.005		0.003 \pm 0.012	
USGS 34	04-17-08	-0.003 \pm 0.005	0.77	-0.003 \pm 0.005	0.00	0.009 \pm 0.013	0.68
		0.003 \pm 0.006		-0.003 \pm 0.005		-0.003 \pm 0.012	
USGS 97	04-22-08	0.003 \pm 0.007	0.00	-0.003 \pm 0.005	0.70	0.003 \pm 0.012	0.38
		0.003 \pm 0.009		0.003 \pm 0.007		0.01 \pm 0.014	
RWMC PROD	10-09-08	-0.003 \pm 0.007	0.23	0.012 \pm 0.008	0.35	-0.003 \pm 0.013	0.35
		-0.005 \pm 0.005		0.008 \pm 0.008		0.003 \pm 0.011	

Table 4. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for sodium, chloride, and sulfate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** –, no data. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter]

Site name	Sample collection date	Sodium			Chloride			Sulfate		
		mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility
USGS 88	04-02-02	–	–	–	78.9	0	A	–	–	–
		–	–	–	78.6	–	–	–	–	–
USGS 60	04-02-02	–	–	–	17.5	2	A	–	–	–
		–	–	–	18.1	–	–	–	–	–
USGS 89	04-02-02	–	–	–	37.2	0	A	–	–	–
		–	–	–	37.1	–	–	–	–	–
USGS 61	04-03-02	–	–	–	17.1	0	A	–	–	–
		–	–	–	17.2	–	–	–	–	–
USGS 104	04-08-02	–	–	–	11.5	2	A	–	–	–
		–	–	–	11.8	–	–	–	–	–
USGS 65	04-09-02	13.6	1	A	18.7	2	A	156	1	A
		13.4	–	–	18.1	–	–	154	–	–
USGS 87	04-11-02	10.1	0	A	15.0	1	A	–	–	–
		10.0	–	–	14.9	–	–	–	–	–
Mud Lake near Terreton, ID	04-22-02	–	–	–	7.90	2	A	–	–	–
		–	–	–	7.69	–	–	–	–	–
PW 1	05-20-02	–	–	–	169	2	A	–	–	–
		–	–	–	173	–	–	–	–	–
USGS 83	07-02-02	9.36	0	A	11.5	1	A	–	–	–
		9.41	–	–	11.3	–	–	–	–	–
USGS 102	07-02-02	14.9	1	A	29.6	1	A	30.3	0	A
		15.0	–	–	29.4	–	–	30.3	–	–
USGS 19	07-09-02	10.4	2	A	10.6	2	A	–	–	–
		10.1	–	–	10.3	–	–	–	–	–
USGS 8	07-11-02	6.29	2	A	7.99	0	A	–	–	–
		6.48	–	–	8.32	–	–	–	–	–
EBR 1	07-16-02	8.06	2	A	7.01	1	A	–	–	–
		7.88	–	–	6.90	–	–	–	–	–
CFA LF 3-9	07-17-02	–	–	–	120	1	A	–	–	–
		–	–	–	119	–	–	–	–	–
USGS 4	07-24-02	46.1	1	A	31.6	0	A	–	–	–
		47.0	–	–	31.6	–	–	–	–	–
RWMC M11S	09-10-02	12.4	0	A	27.0	2	A	–	–	–
		12.4	–	–	27.5	–	–	–	–	–
USGS 79	10-01-02	8.52	2	A	11.4	2	A	26.2	1	A
		8.76	–	–	11.1	–	–	25.8	–	–
USGS 113	10-02-02	75.6	1	A	175	1	A	32.4	0	A
		76.7	–	–	173	–	–	32.4	–	–
USGS 67	10-03-02	53.0	1	A	162	0	A	30.7	0	A
		53.6	–	–	163	–	–	30.8	–	–
USGS 14	10-09-02	–	–	–	20.0	2	A	–	–	–
		–	–	–	20.6	–	–	–	–	–
USGS 70	10-09-02	16.4	0	A	17.5	1	A	192	0	A
		16.3	–	–	17.9	–	–	192	–	–
CPP 4	10-15-02	15.5	81	N	29.2	45	N	–	–	–
		56.6	–	–	56.8	–	–	–	–	–
USGS 59	10-16-02	59.9	1	A	170	0	A	31.3	0	A
		60.5	–	–	170	–	–	31.1	–	–
TRA DISP	10-23-02	10.5	1	A	10.1	1	A	39.2	0	A
		10.4	–	–	10.0	–	–	39.1	–	–

Table 4. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for sodium, chloride, and sulfate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** –, no data. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter]

Site name	Sample collection date	Sodium			Chloride			Sulfate		
		mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility
USGS 72	11-07-02	18.7	3	A	10.9	1	A	26.4	0	A
		18.0			11.0			26.4		
USGS 114	04-01-03	–	–	–	92.5	0	A	–	–	–
		–			92.6			–		
USGS 55	04-03-03	–	–	–	21.1	7	A	–	–	–
		–			19.1			–		
USGS 68	04-07-03	–	–	–	29.4	13	A	–	–	–
		–			24.5			–		
USGS 37	04-08-03	–	–	–	48.9	1	A	–	–	–
		–			48.5			–		
USGS 108	04-08-03	–	–	–	15.0	11	A	–	–	–
		–			12.9			–		
USGS 117	04-09-03	–	–	–	12.0	0	A	–	–	–
		–			12.0			–		
USGS 48	04-10-03	–	–	–	29.1	1	A	–	–	–
		–			28.5			–		
PW 8	04-14-03	–	–	–	21.3	6	A	–	–	–
		–			19.5			–		
Rifle Range	04-16-03	–	–	–	9.32	1	A	33.1	0	A
		–			9.49			33.1		
USGS 63	04-16-03	–	–	–	19.9	0	A	–	–	–
		–			19.9			–		
WS INEL 1	07-07-03	16.2	2	A	57.5	1	A	36.7	0	A
		16.7			57.1			36.6		
ANP 9	07-08-03	14.7	2	A	12.5	3	A	–	–	–
		14.3			13.1			–		
SITE 19	07-08-03	9.79	5	A	10.7	0	A	20.5	1	A
		10.4			10.8			20.8		
ANP 6	07-08-03	10.9	0	A	21.8	2	A	33.0	1	A
		10.9			21.2			32.7		
CFA LF 3-9	07-24-03	–	–	–	116	0	A	–	–	–
		–			115			–		
RWMC M12S	08-04-03	8.37	1	A	15.8	0	A	–	–	–
		8.49			15.9			–		
RWMC M7S	08-05-03	–	–	–	12.4	0	A	–	–	–
		–			12.5			–		
Big Lost River at Mackay, ID	10-01-03	–	–	–	3.12	2	A	–	–	–
		–			3.23			–		
ICPP-MON-A-166	10-06-03	9.76	0	A	7.96	1	A	14.3	0	A
		9.83			7.84			14.3		
PW 4	10-08-03	83.0	1	A	240	0	A	27.8	3	A
		84.3			239			29.0		
USGS 53	10-08-03	30.8	2	A	21.3	1	A	134	0	A
		31.9			21.5			133		
USGS 85	11-04-03	16.2	0	A	21.3	0	A	31.7	1	A
		16.3			21.3			32.0		
USGS 112	11-04-03	37.1	2	A	64.2	0	A	27.8	0	A
		36.1			63.8			27.9		

Table 4. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for sodium, chloride, and sulfate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** –, no data. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter]

Site name	Sample collection date	Sodium			Chloride			Sulfate		
		mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility
USGS 128	11-05-03	–	–	–	23.9	1	A	–	–	–
		–	–	–	23.4	–	–	–	–	–
USGS 111	11-05-03	25.0	1	A	97.6	0	A	28.9	1	A
		25.4	–	–	97.0	–	–	28.6	–	–
USGS 46	11-12-03	9.72	1	A	17.2	0	A	21.8	0	A
		9.87	–	–	17.1	–	–	21.9	–	–
USGS 36	11-13-03	11.7	1	A	15.2	0	A	29.4	0	A
		11.6	–	–	15.2	–	–	29.4	–	–
USGS 47	11-17-03	12.5	2	A	22.8	1	A	25.3	0	A
		12.1	–	–	22.6	–	–	25.2	–	–
USGS 48	11-18-03	15.4	0	A	27.5	0	A	25.9	0	A
		15.5	–	–	27.7	–	–	26.1	–	–
Site 9	04-05-04	13.4	2	A	13.9	1	A	22.5	1	A
		13.7	–	–	14.2	–	–	22.7	–	–
USGS 126A	04-07-04	9.66	1	A	7.82	2	A	–	–	–
		9.58	–	–	8.00	–	–	–	–	–
PAND W 2	04-07-04	8.28	0	A	8.78	2	A	–	–	–
		8.26	–	–	8.49	–	–	–	–	–
USGS 51	04-13-04	36.2	1	A	172	0	A	26.6	0	A
		36.8	–	–	173	–	–	26.5	–	–
TRA 4	04-14-04	8.55	0	A	10.3	0	A	18.2	0	A
		8.55	–	–	10.3	–	–	18.2	–	–
USGS 32	04-14-04	18.0	0	A	28.0	1	A	28.0	0	A
		17.9	–	–	28.3	–	–	27.8	–	–
USGS 40	04-15-04	14.7	0	A	24.5	2	A	23.6	1	A
		14.6	–	–	23.8	–	–	23.4	–	–
USGS 76	04-19-04	10.0	1	A	12.6	0	A	28.1	0	A
		10.1	–	–	12.5	–	–	28.2	–	–
USGS 62	04-21-04	15.9	3	A	17.0	1	A	141	1	A
		16.5	–	–	16.8	–	–	142	–	–
USGS 6	10-12-04	13.5	0	A	8.24	0	A	18.1	0	A
		13.6	–	–	8.25	–	–	18.1	–	–
USGS 35	10-18-04	8.77	3	A	11.5	0	A	43.5	0	A
		8.36	–	–	11.6	–	–	43.5	–	–
USGS 56	10-19-04	36.9	0	A	16.3	17	N	59.8	15	N
		37.0	–	–	12.9	–	–	48.1	–	–
IET 1 DISP	10-19-04	16.3	3	A	19.2	0	A	31.8	0	A
		15.6	–	–	19.1	–	–	31.8	–	–
ICPP-MON-A-167	10-19-04	12.0	3	A	8.63	1	A	31.8	0	A
		11.5	–	–	8.54	–	–	31.8	–	–
USGS 105	10-20-04	13.2	1	A	12.6	0	A	–	–	–
		13.4	–	–	12.6	–	–	–	–	–
CPP 2	10-21-04	8.02	1	A	13.8	0	A	–	–	–
		7.90	–	–	13.7	–	–	–	–	–
USGS 78	10-26-04	7.12	0	A	5.03	0	A	20.0	0	A
		7.16	–	–	5.01	–	–	20.0	–	–
USGS 5	04-11-05	8.12	0	A	9.29	0	A	–	–	–
		8.11	–	–	9.27	–	–	–	–	–

Table 4. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for sodium, chloride, and sulfate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** –, no data. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter]

Site name	Sample collection date	Sodium			Chloride			Sulfate		
		mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility
USGS 18	04-11-05	12.2	1	A	10.4	0	A	25.9	0	A
		12.4			10.4			25.8		
USGS 109	04-14-05	14.1	0	A	15.9	1	A	–	–	–
		14.1			15.6			–		
USGS 7	04-21-05	23.2	1	A	8.82	0	A	–	–	–
		22.9			8.80			–		
USGS 107	04-25-05	18.3	3	A	22.0	0	A	–	–	–
		17.5			22.1			–		
USGS 2	04-25-05	16.8	1	A	16.6	1	A	15.4	0	A
		17.0			16.8			15.4		
USGS 22	04-25-05	22.9	3	A	63.6	0	A	–	–	–
		23.9			64.1			–		
USGS 31	04-26-05	16.9	0	A	28.2	0	A	30.2	0	A
		16.8			28.3			30.3		
USGS 110A	10-03-05	18.1	4	A	19.6	1	A	–	–	–
		17.0			19.7			–		
USGS 99	10-03-05	14.4	3	A	24.6	0	A	28.5	0	A
		15.1			24.7			28.6		
USGS 1	10-03-05	16.2	4	A	13.2	0	A	–	–	–
		15.2			13.2			–		
USGS 29	10-04-05	18.5	0	A	25.7	0	A	15.0	0	A
		18.5			25.8			15.1		
RWMC M7S	10-06-05	–	–	–	12.2	1	A	–	–	–
		–			12.4			–		
CWP 8	10-18-05	–	–	–	16.5	1	A	148	0	A
		–			16.6			149		
CWP 1	10-18-05	–	–	–	31.6	0	A	396	0	A
		–			31.7			398		
USGS 15	10-18-05	13.8	0	A	15.5	1	A	23.9	0	A
		13.8			15.7			24.0		
USGS 116	04-17-06	32.8	0	A	106	0	A	33.0	0	A
		32.9			105			32.9		
USGS 121	04-25-06	7.48	2	A	12.7	0	A	22.6	0	A
		7.29			12.7			22.5		
USGS 100	04-26-06	16.4	0	A	16.2	1	A	17.6	2	A
		16.4			16.4			18.0		
USGS 131	04-26-06	7.68	1	A	20.1	1	A	24.7	0	A
		7.82			20.2			24.7		
Big Lost River near Arco, ID	04-27-06	–	–	–	3.32	1	A	–	–	–
		–			3.28			–		
No Name 1	05-01-06	10.2	1	A	20.1	0	A	–	–	–
		10.2			20.0			–		
USGS 58	05-05-06	9.76	2	A	11.7	0	A	34.1	0	A
		10.0			11.7			34.0		
USGS 12	05-10-06	15.4	2	A	–	–	–	–	–	–
		15.0			–			–		
Site 4	10-12-06	7.03	1	A	7.87	0	A	19.1	0	A
		6.94			7.84			19.0		

Table 4. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for sodium, chloride, and sulfate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** –, no data. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter]

Site name	Sample collection date	Sodium			Chloride			Sulfate		
		mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility
USGS 86	10-24-06	10.7	1	A	17.7	0	A	–	–	–
		10.8			17.7			–		
Highway 3	10-26-06	5.74	1	A	5.70	1	A	–	–	–
		5.84			5.75			–		
Leo Rogers 1	11-01-06	15.8	3	A	18.5	1	A	–	–	–
		16.5			18.7			–		
NPR Test	11-02-06	7.16	1	A	9.36	0	A	–	–	–
		7.07			9.38			–		
USGS 69	11-07-06	8.72	2	A	12.4	0	A	62.5	0	A
		8.95			12.5			62.3		
RWMC M3S	11-07-06	–	–	–	12.7	0	A	–	–	–
		–			12.8			–		
USGS 66	11-08-06	14.2	1	A	17.4	0	A	146	0	A
		14.4			17.4			146		
USGS 20	04-03-07	9.08	0	A	28.5	0	A	19.6	0	A
		9.10			28.4			19.6		
USGS 50	04-10-07	58.2	1	A	52.5	1	A	39.4	0	A
		57.2			53.3			39.4		
MTR Test	04-11-07	9.80	1	A	9.76	0	A	21.5	0	A
		9.65			9.79			21.6		
USGS 44	04-12-07	8.39	1	A	12.3	0	A	23.2	0	A
		8.33			12.3			23.2		
USGS 17	04-16-07	7.25	2	A	5.39	0	A	–	–	–
		7.01			5.39			–		
USGS 120	04-24-07	16.8	0	A	14.9	1	A	31.8	0	A
		16.8			14.8			31.7		
USGS 84	04-25-07	9.28	2	A	9.73	0	A	33.3	0	A
		9.04			9.76			33.3		
USGS 23	05-01-07	10.4	2	A	9.92	0	A	–	–	–
		10.7			9.90			–		
USGS 101	10-10-07	14.3	2	A	9.27	0	A	–	–	–
		14.0			9.22			–		
USGS 98	10-11-07	11.4	1	A	13.7	1	A	21.3	0	A
		11.3			13.9			21.3		
USGS 39	10-15-07	9.48	1	A	11.9	0	A	45.9	0	A
		9.28			11.8			45.6		
RWMC M14S	10-15-07	9.21	2	A	14.8	0	A	–	–	–
		9.42			14.8			–		
USGS 126B	10-16-07	9.4	1	A	8.0	0	A	–	–	–
		9.25			8.00			–		
RWMC M13S	10-17-07	12.0	1	A	5.80	0	A	–	–	–
		11.8			5.82			–		
USGS 77	10-18-07	40.4	0	A	95.4	0	A	29.2	0	A
		40.5			95.2			29.3		
Little Lost River Howe, ID	10-30-07	–	–	–	12.1	0	A	–	–	–
		–			12.2			–		
USGS 127	04-07-08	8.40	0	A	15.2	0	A	–	–	–
		8.39			15.2			–		

Table 4. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for sodium, chloride, and sulfate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** –, no data. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter]

Site name	Sample collection date	Sodium			Chloride			Sulfate		
		mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility	mg/L	RSD (percent)	Reproducibility
USGS 26	04-15-08	15.3	2	A	14.3	0	A	–	–	–
		15.7			14.3			–		
CPP 1	04-16-08	8.29	1	A	15.2	0	A	23.7	0	A
		8.23			15.2			23.7		
USGS 34	04-17-08	9.52	1	A	12.4	1	A	44.7	0	A
		9.42			12.3			44.6		
USGS 97	04-22-08	15.9	0	A	29.2	0	A	32.1	0	A
		15.9			29.2			32.2		
USGS 27	04-24-08	27.6	0	A	52.1	0	A	–	–	–
		27.6			51.9			–		
SPERT 1	04-24-08	21.2	1	A	42.2	1	A	–	–	–
		21.6			41.9			–		
Highway 3	04-30-08	5.83	1	A	6.02	0	A	–	–	–
		5.88			6.03			–		
USGS 128	10-06-08	–	–	–	15.2	0	A	–	–	–
		–			15.1			–		
USGS 115	10-08-08	19.4	0	A	48.2	0	A	26.0	0	A
		19.4			48.5			26.1		
Rifle Range	10-09-08	16.4	0	A	42.4	0	A	31.1	0	A
		16.3			42.5			31.1		
RWMC PROD	10-09-08	9.16	1	A	21.2	0	A	28.5	0	A
		9.34			21.2			28.5		
CFA 2	10-09-08	36.6	1	A	134	1	A	50.7	0	A
		37.0			136			50.6		
CPP 4	10-09-08	7.87	1	A	12.8	1	A	–	–	–
		7.80			13.0			–		
PSTF Test	10-20-08	7.05	2	A	6.60	1	A	–	–	–
		6.89			6.51			–		
USGS 106	10-21-08	8.16	2	A	15.2	0	A	–	–	–
		7.90			15.1			–		

Table 5. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for iodide and fluoride from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than; –, no data. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Iodide			Fluoride		
		mg/L	RSD (percent)	Repro-ducibility	mg/L	RSD (percent)	Repro-ducibility
USGS 114	04-01-03	0.001E	NC	A	–	–	–
		0.001E			–		
USGS 37	04-08-03	<0.002	NC	A	–	–	–
		0.001E			–		
USGS 121	04-09-03	<0.002	NC	A	–	–	–
		<0.002			–		
USGS 11	04-14-03	<0.002	NC	A	–	–	–
		<0.002			–		
USGS 14	04-14-03	0.001E	NC	A	–	–	–
		0.001E			–		
USGS 85	11-04-03	<0.002	NC	A	–	–	–
		<0.002			–		
USGS 112	11-04-03	<0.002	NC	A	–	–	–
		<0.002			–		
USGS 128	11-05-03	<0.002	NC	A	–	–	–
		<0.002			–		
USGS 111	11-05-03	<0.002	NC	A	–	–	–
		<0.002			–		
USGS 36	11-13-03	<0.002	NC	A	–	–	–
		<0.002			–		
USGS 47	11-17-03	<0.002	NC	A	–	–	–
		<0.002			–		
USGS 131	04-26-06	–	–	–	0.25	8	A
		–			0.23		
USGS 77	10-18-07	–	–	–	0.22	2	A
		–			0.23		
CPP 1	04-16-08	–	–	–	0.25	2	A
		–			0.25		
USGS 34	04-17-08	–	–	–	0.24	6	A
		–			0.22		

Table 6. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for ammonia, nitrate plus nitrite, nitrite, and orthophosphate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter; N, nitrogen; P, phosphorous; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Ammonia			Nitrate plus nitrite		
		mg/L as N	RSD (percent)	Reproducibility	mg/L as N	RSD (percent)	Reproducibility
USGS 65	04-09-02	<0.04	NC	A	1.62	0	A
		<0.04			1.62		
USGS 87	04-11-02	<0.04	NC	A	0.76	0	A
		<0.04			0.77		
USGS 83	07-02-02	<0.04	NC	A	0.63	0	A
		<0.04			0.62		
USGS 102	07-02-02	<0.04	NC	A	1.70	0	A
		0.03E			1.70		
USGS 19	07-09-02	<0.04	NC	A	0.89	1	A
		<0.04			0.90		
USGS 8	07-11-02	<0.04	NC	A	0.90	0	A
		<0.04			0.90		
EBR 1	07-16-02	<0.04	NC	A	0.36	0	A
		<0.04			0.36		
CFA LF 3-9	07-17-02	<0.04	NC	A	3.07	0	A
		<0.04			3.07		
USGS 4	07-24-02	<0.04	NC	A	4.46	2	A
		<0.04			4.61		
RWMC M11S	09-10-02	<0.04	NC	A	0.61	3	A
		<0.04			0.63		
USGS 113	10-02-02	<0.04	NC	A	2.19	1	A
		<0.04			2.16		
USGS 67	10-03-02	<0.04	NC	A	2.55	1	A
		<0.04			2.51		
CPP 4	10-15-02	<0.04	NC	A	5.29	12	A
		<0.04			4.49		
USGS 59	10-16-02	<0.04	NC	A	2.17	0	A
		<0.04			2.18		
TRA DISP	10-23-02	<0.04	NC	A	1.18	0	A
		<0.04			1.19		
ANP 9	07-08-03	<0.04	NC	A	0.76	1	A
		<0.04			0.77		
ANP 6	07-08-03	<0.04	NC	A	0.86	0	A
		<0.04			0.86		
CFA LF 3-9	07-24-03	<0.04	NC	A	3.16	1	A
		<0.04			3.19		
RWMC M12S	08-04-03	<0.04	NC	A	0.91	0	A
		<0.04			0.91		
RWMC M7S	08-05-03	<0.04	NC	A	0.73	0	A
		<0.04			0.73		
ICPP-MON-A-166	10-06-03	<0.04	NC	A	0.18	1	A
		<0.04			0.17		
USGS 85	11-04-03	<0.04	NC	A	1.26	1	A
		<0.04			1.24		
USGS 112	11-04-03	<0.04	NC	A	2.68	0	A
		<0.04			2.70		
USGS 128	11-05-03	<0.04	NC	A	1.33	0	A
		<0.04			1.32		

Table 6. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for ammonia, nitrate plus nitrite, nitrite, and orthophosphate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter; N, nitrogen; P, phosphorous; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Ammonia			Nitrate plus nitrite		
		mg/L as N	RSD (percent)	Reproducibility	mg/L as N	RSD (percent)	Reproducibility
USGS 111	11-05-03	<0.04	NC	A	2.36	1	A
		<0.04			2.38		
USGS 46	11-12-03	<0.04	NC	A	1.89	1	A
		<0.04			1.87		
USGS 36	11-13-03	<0.04	NC	A	1.07	0	A
		<0.04			1.07		
USGS 47	11-17-03	<0.04	NC	A	3.18	2	A
		<0.04			3.27		
USGS 48	11-18-03	<0.04	NC	A	3.48	0	A
		<0.04			3.49		
SITE 9	04-05-04	<0.04	NC	A	0.70	0	A
		<0.04			0.70		
USGS 126A	04-07-04	<0.04	NC	A	0.53	0	A
		<0.04			0.54		
P AND W 2	04-07-04	<0.04	NC	A	0.50	1	A
		<0.04			0.49		
USGS 51	04-13-04	<0.04	NC	A	2.84	0	A
		<0.04			2.84		
USGS 32	04-14-04	<0.04	NC	A	1.02	0	A
		<0.04			1.02		
USGS 40	04-15-04	<0.04	NC	A	6.48	2	A
		<0.04			6.32		
USGS 76	04-19-04	<0.04	NC	A	1.11	2	A
		<0.04			1.15		
USGS 6	10-12-04	<0.04	NC	A	0.52	0	A
		<0.04			0.52		
USGS 35	10-18-04	<0.04	NC	A	1.02	0	A
		<0.04			1.02		
IET 1 DISP	10-19-04	0.50	4	A	0.37	1	A
		0.47			0.36		
ICPP-MON-A-167	10-19-04	<0.04	NC	A	0.53	1	A
		<0.04			0.54		
USGS 105	10-20-04	<0.04	NC	A	0.70	0	A
		<0.04			0.70		
CPP 2	10-21-04	<0.04	NC	A	0.82	1	A
		<0.04			0.81		
USGS 5	04-11-05	0.05	9	A	0.13	1	A
		0.05			0.13		
USGS 18	04-11-05	<0.04	NC	A	0.59	0	A
		<0.04			0.59		
USGS 109	04-14-05	<0.04	NC	A	0.66	1	A
		<0.04			0.67		
USGS 7	04-21-05	<0.04	NC	A	0.38	0	A
		<0.04			0.38		
USGS 107	04-25-05	<0.04	NC	A	1.15	1	A
		<0.04			1.16		
USGS 2	04-25-05	<0.04	NC	A	1.63	0	A
		<0.04			1.63		

Table 6. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for ammonia, nitrate plus nitrite, nitrite, and orthophosphate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter; N, nitrogen; P, phosphorous; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Ammonia			Nitrate plus nitrite		
		mg/L as N	RSD (percent)	Reproducibility	mg/L as N	RSD (percent)	Reproducibility
USGS 31	04-26-05	<0.04	NC	A	1.03	0	A
		<0.04			1.04		
USGS 110A	10-03-05	0.02E	NC	A	1.28	1	A
		0.02E			1.26		
USGS 1	10-03-05	<0.04	NC	A	0.99	5	A
		<0.04			1.06		
USGS 29	10-04-05	<0.04	NC	A	1.93	1	A
		<0.04			1.91		
RWMC M7S	10-06-05	<0.04	NC	A	0.76	1	A
		<0.04			0.75		
USGS 15	10-18-05	<0.04	NC	A	1.09	0	A
		<0.04			1.09		
USGS 116	04-17-06	<0.04	NC	A	2.31	1	A
		<0.04			2.29		
USGS 121	04-25-06	<0.04	NC	A	0.78	0	A
		<0.04			0.78		
USGS 131	04-26-06	<0.04	NC	A	1.09	0	A
		<0.04			1.09		
NO NAME 1	05-01-06	<0.04	NC	A	0.61	0	A
		<0.04			0.61		
USGS 12	05-10-06	<0.04	NC	A	1.81	1	A
		<0.04			1.80		
USGS 86	10-24-06	<0.02	NC	A	1.39	1	A
		<0.02			1.37		
HIGHWAY 3	10-26-06	<0.02	NC	A	0.38	0	A
		<0.02			0.38		
NPR TEST	11-02-06	0.01E	NC	A	0.55	0	A
		<0.02			0.55		
RWMC M3S	11-07-06	<0.02	NC	A	0.80	2	A
		<0.02			0.82		
USGS 20	04-03-07	<0.02	NC	A	1.04	1	A
		<0.02			1.07		
USGS 50	04-10-07	<0.02	NC	A	22.5	0	A
		<0.02			22.6		
MTR TEST	04-11-07	<0.02	NC	A	0.99	0	A
		<0.02			0.99		
USGS 44	04-12-07	<0.02	NC	A	0.83	1	A
		<0.02			0.82		
USGS 17	04-16-07	<0.02	NC	A	0.38	0	A
		<0.02			0.38		
USGS 120	04-24-07	<0.02	NC	A	0.86	0	A
		<0.02			0.86		
USGS 84	04-25-07	<0.02	NC	A	1.00	1	A
		<0.02			0.99		
USGS 23	05-01-07	<0.02	NC	A	0.52	1	A
		<0.02			0.52		
USGS 101	10-10-07	<0.02	NC	A	1.11	0	A
		<0.02			1.11		

Table 6. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for ammonia, nitrate plus nitrite, nitrite, and orthophosphate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter; N, nitrogen; P, phosphorous; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Ammonia			Nitrate plus nitrite		
		mg/L as N	RSD (percent)	Reproducibility	mg/L as N	RSD (percent)	Reproducibility
USGS 98	10-11-07	<0.02	NC	A	1.04	0	A
		<0.02			1.03		
USGS 39	10-15-07	0.01E	NC	A	1.01	0	A
		0.01E			1.01		
RWMC M14S	10-15-07	0.01E	NC	A	0.89	0	A
		<0.02			0.89		
USGS 126B	10-16-07	<0.02	NC	A	0.52	1	A
		<0.02			0.52		
RWMC M13S	10-17-07	<0.02	NC	A	0.36	0	A
		0.01E			0.36		
USGS 77	10-18-07	0.01E	NC	A	2.80	0	A
		0.01E			2.81		
USGS 127	04-07-08	<0.02	NC	A	0.56	1	A
		<0.02			0.56		
USGS 26	04-15-08	<0.02	NC	A	0.84	0	A
		<0.02			0.84		
CPP 1	04-16-08	<0.02	NC	A	0.95	1	A
		<0.02			0.96		
USGS 34	04-17-08	<0.02	NC	A	1.00	1	A
		<0.02			1.01		
USGS 97	04-22-08	<0.02	NC	A	2.03	0	A
		<0.02			2.02		
USGS 27	04-24-08	<0.02	NC	A	2.47	1	A
		<0.02			2.45		
SPERT 1	04-24-08	<0.02	NC	A	1.45	2	A
		<0.02			1.41		
HIGHWAY 3	04-30-08	<0.02	NC	A	0.42	0	A
		<0.02			0.41		
USGS 128	10-06-08	<0.02	NC	A	1.17	0	A
		<0.02			1.17		
USGS 115	10-08-08	<0.02	NC	A	1.55	1	A
		<0.02			1.52		
RWMC PROD	10-09-08	<0.02	NC	A	0.94	0	A
		<0.02			0.94		
CFA 2	10-09-08	0.01E	NC	A	3.93	0	A
		<0.02			3.92		
CPP 4	10-09-08	0.01E	NC	A	0.73	0	A
		0.01E			0.73		
PSTF TEST	10-20-08	<0.02	NC	A	0.59	0	A
		<0.02			0.59		

Table 6. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for ammonia, nitrate plus nitrite, nitrite, and orthophosphate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter; N, nitrogen; P, phosphorous; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Nitrite			Orthophosphate		
		mg/L as N	RSD (percent)	Reproducibility	mg/L as P	RSD (percent)	Reproducibility
USGS 65	04-09-02	<0.008	NC	A	0.012E	NC	A
		<0.008			0.012E		
USGS 87	04-11-02	<0.008	NC	A	0.010E	NC	A
		<0.008			0.010E		
USGS 83	07-02-02	<0.008	NC	A	0.011E	NC	A
		<0.008			0.010E		
USGS 102	07-02-02	<0.008	NC	A	0.025	5	A
		<0.008			0.027		
USGS 19	07-09-02	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
USGS 8	07-11-02	<0.008	NC	A	0.012E	NC	A
		<0.008			0.014E		
EBR 1	07-16-02	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
CFA LF 3-9	07-17-02	<0.008	NC	A	0.019	4	A
		<0.008			0.018		
USGS 4	07-24-02	<0.008	NC	A	0.018	0	A
		<0.008			0.018		
RWMC M11S	09-10-02	<0.008	NC	A	0.015E	NC	A
		<0.008			0.014E		
USGS 113	10-02-02	<0.008	NC	A	0.018	4	A
		<0.008			0.019		
USGS 67	10-03-02	<0.008	NC	A	0.014E	NC	A
		<0.008			0.016E		
CPP 4	10-15-02	<0.008	NC	A	0.029	10	A
		<0.008			0.025		
USGS 59	10-16-02	<0.008	NC	A	0.017E	NC	A
		<0.008			0.018		
TRA DISP	10-23-02	<0.008	NC	A	0.045	6	A
		<0.008			0.049		
ANP 9	07-08-03	<0.008	NC	A	0.010E	NC	A
		<0.008			0.009E		
ANP 6	07-08-03	<0.008	NC	A	0.022	3	A
		<0.008			0.021		
CFA LF 3-9	07-24-03	<0.008	NC	A	0.010E	NC	A
		<0.008			0.009E		
RWMC M12S	08-04-03	<0.008	NC	A	0.015E	NC	A
		<0.008			0.017E		
RWMC M7S	08-05-03	<0.008	NC	A	0.015E	NC	A
		<0.008			0.014E		
ICPP-MON-A-166	10-06-03	<0.008	NC	A	0.019	NC	A
		<0.008			0.014E		
USGS 85	11-04-03	<0.008	NC	A	0.020	10	A
		<0.008			0.023		
USGS 112	11-04-03	<0.008	NC	A	0.021	3	A
		<0.008			0.022		
USGS 128	11-05-03	<0.008	NC	A	0.016E	NC	A
	11-05-03	<0.008			0.016E		

Table 6. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for ammonia, nitrate plus nitrite, nitrite, and orthophosphate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter; N, nitrogen; P, phosphorous; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Nitrite			Orthophosphate		
		mg/L as N	RSD (percent)	Reproducibility	mg/L as P	RSD (percent)	Reproducibility
USGS 111	11-05-03	<0.008	NC	A	0.010E	NC	A
		<0.008			<0.018		
USGS 46	11-12-03	<0.008	NC	A	0.022	3	A
		<0.008			0.023		
USGS 36	11-13-03	<0.008	NC	A	0.022	3	A
		<0.008			0.021		
USGS 47	11-17-03	<0.008	NC	A	0.026	0	A
		<0.008			0.026		
USGS 48	11-18-03	<0.008	NC	A	0.026	3	A
		<0.008			0.027		
SITE 9	04-05-04	0.005E	NC	A	0.012E	NC	A
		0.005E			0.013E		
USGS 126A	04-07-04	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
P AND W 2	04-07-04	<0.008	NC	A	0.012E	NC	A
		<0.008			0.014E		
USGS 51	04-13-04	<0.008	NC	A	0.010E	NC	A
		<0.008			0.009E		
USGS 32	04-14-04	<0.008	NC	A	0.021	NC	A
		<0.008			0.010E		
USGS 40	04-15-04	<0.008	NC	A	0.018	7	A
		<0.008			0.020		
USGS 76	04-19-04	<0.008	NC	A	0.023	6	A
		<0.008			0.021		
USGS 6	10-12-04	<0.008	NC	A	0.011E	NC	A
		<0.008			0.011E		
USGS 35	10-18-04	<0.008	NC	A	0.016E	NC	A
		<0.008			0.016E		
IET 1 DISP	10-19-04	0.006E	NC	A	0.138	1	A
		0.005E			0.137		
ICPP-MON-A-167	10-19-04	<0.008	NC	A	0.009E	NC	A
		<0.008			<0.018		
USGS 105	10-20-04	<0.008	NC	A	0.013E	NC	A
		<0.008			0.014E		
CPP 2	10-21-04	<0.008	NC	A	0.020	0	A
		<0.008			0.020		
USGS 5	04-11-05	0.007E	NC	A	<0.018	NC	A
		<0.008			<0.018		
USGS 18	04-11-05	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
USGS 109	04-14-05	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
USGS 7	04-21-05	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
USGS 107	04-25-05	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
USGS 2	04-25-05	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		

Table 6. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for ammonia, nitrate plus nitrite, nitrite, and orthophosphate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter; N, nitrogen; P, phosphorous; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Nitrite			Orthophosphate		
		mg/L as N	RSD (percent)	Reproducibility	mg/L as P	RSD (percent)	Reproducibility
USGS 31	04-26-05	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
USGS 110A	10-03-05	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
USGS 1	10-03-05	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
USGS 29	10-04-05	<0.008	NC	A	0.009E	NC	A
		<0.008			0.009E		
RWMC M7S	10-06-05	<0.008	NC	A	0.013E	NC	A
		<0.008			0.013E		
USGS 15	10-18-05	<0.008	NC	A	0.014E	NC	A
		<0.008			0.013E		
USGS 116	04-17-06	<0.008	NC	A	<0.018	NC	A
		<0.008			<0.018		
USGS 121	04-25-06	<0.008	NC	A	0.018	7	A
		<0.008			0.020		
USGS 131	04-26-06	<0.008	NC	A	0.015E	NC	A
		<0.008			0.016E		
NO NAME 1	05-01-06	<0.008	NC	A	0.015E	NC	A
		<0.008			0.014E		
USGS 12	05-10-06	<0.008	NC	A	¹ <0.090	NC	A
		<0.008			0.018		
USGS 86	10-24-06	<0.002	NC	A	0.024	3	A
		<0.002			0.025		
HIGHWAY 3	10-26-06	<0.002	NC	A	0.011	1	A
		<0.002			0.011		
NPR TEST	11-02-06	<0.002	NC	A	0.022	1	A
		<0.002			0.022		
RWMC M3S	11-07-06	<0.002	NC	A	0.016	6	A
		<0.002			0.018		
USGS 20	04-03-07	<0.002	NC	A	0.013	0	A
		<0.002			0.013		
USGS 50	04-10-07	0.004	0	A	0.038	1	A
		0.004			0.037		
MTR TEST	04-11-07	<0.002	NC	A	0.020	2	A
		<0.002			0.021		
USGS 44	04-12-07	<0.002	NC	A	0.023	11	A
		<0.002			0.027		
USGS 17	04-16-07	<0.002	NC	A	0.018	1	A
		<0.002			0.017		
USGS 120	04-24-07	<0.002	NC	A	0.018	1	A
		<0.002			0.019		
USGS 84	04-25-07	<0.002	NC	A	0.025	1	A
		<0.002			0.025		
USGS 23	05-01-07	<0.002	NC	A	0.013	2	A
		<0.002			0.013		
USGS 101	10-10-07	<0.002	NC	A	0.013	0	A
		<0.002			0.013		

Table 6. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for ammonia, nitrate plus nitrite, nitrite, and orthophosphate from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter; N, nitrogen; P, phosphorous; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Nitrite			Orthophosphate		
		mg/L as N	RSD (percent)	Reproducibility	mg/L as P	RSD (percent)	Reproducibility
USGS 98	10-11-07	<0.002	NC	A	0.020	0	A
		<0.002			0.020		
USGS 39	10-15-07	<0.002	NC	A	0.025	1	A
		<0.002			0.025		
RWMC M14S	10-15-07	<0.002	NC	A	0.019	3	A
		<0.002			0.018		
USGS 126B	10-16-07	<0.002	NC	A	0.009	2	A
		0.001E			0.009		
RWMC M13S	10-17-07	<0.002	NC	A	0.018	1	A
		<0.002			0.019		
USGS 77	10-18-07	0.001E	NC	A	0.022	1	A
		0.001E			0.023		
USGS 127	04-07-08	<0.002	NC	A	0.017	7	A
		<0.002			0.018		
USGS 26	04-15-08	<0.002	NC	A	0.012	1	A
		<0.002			0.013		
CPP 1	04-16-08	<0.002	NC	A	0.024	0	A
		<0.002			0.024		
USGS 34	04-17-08	<0.002	NC	A	0.024	1	A
		<0.002			0.024		
USGS 97	04-22-08	<0.002	NC	A	0.028	1	A
		<0.002			0.027		
USGS 27	04-24-08	<0.002	NC	A	0.011	3	A
		<0.002			0.011		
SPERT 1	04-24-08	<0.002	NC	A	0.020	4	A
		<0.002			0.019		
HIGHWAY 3	04-30-08	<0.002	NC	A	0.022	0	A
		<0.002			0.022		
USGS 128	10-06-08	0.001E	NC	A	0.023	0	A
		0.001E			0.023		
USGS 115	10-08-08	<0.002	NC	A	0.008E	NC	A
		<0.002			0.010		
RWMC PROD	10-09-08	<0.002	NC	A	0.052	0	A
		<0.002			0.052		
CFA 2	10-09-08	0.002E	NC	A	0.020	2	A
		<0.002			0.019		
CPP 4	10-09-08	<0.002	NC	A	0.024	9	A
		<0.002			0.021		
PSTF TEST	10-20-08	<0.002	NC	A	0.027	7	A
		<0.002			0.030		

¹The orthophosphate value <0.090 mg/L as P represents a 5x diluted sample with an undiluted reporting level of 0.018 mg/L as P.

Table 7. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for dissolved metals from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** –, not analyzed; <, less than. **Abbreviations:** RSD, relative standard deviation; µg/L, micrograms per liter; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Aluminum			Antimony			Arsenic		
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility
USGS 65	04-09-02	1.96	5	A	0.19	2	A	1.48E	NC	A
		2.11			0.19			1.03E		
ANP 9	07-08-03	1.17E	NC	A	<0.30	NC	A	2.28	9	A
		1.22E			<0.30			2.01		
USGS 7	04-21-05	1.68	11	A	0.11E	NC	A	3.11	11	A
		1.98			0.11E			3.63		
USGS 131	04-26-06	3.08	22	N	0.14E	NC	A	1.50	1	A
		4.22			0.17E			1.53		
No Name 1	05-01-06	1.67	NC	A	0.14E	NC	A	1.74	4	A
		1.53E			0.14E			1.83		
USGS 84	04-25-07	3.96	1	A	0.10	0	A	1.77	1	A
		4.00			0.10			1.75		
USGS 98	10-11-07	2.43	23	N	0.10E	NC	A	1.84	1	A
		1.74			0.10E			1.82		
USGS 26	04-15-08	3.16	14	A	0.09E	NC	A	2.49	0	A
		2.60			0.09E			2.51		
USGS 97	04-22-08	2.95	5	A	0.13E	NC	A	1.69	1	A
		3.16			0.13E			1.72		
PSTF Test	10-20-08	<4	NC	A	0.11	11	A	1.94	0	A
		<4			0.13			1.92		

Site name	Sample collection date	Barium			Beryllium			Cadmium		
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility
USGS 65	04-09-02	49.0	0	A	<0.06	NC	A	0.03E	NC	A
		49.2			<0.06			0.03E		
ANP 9	07-08-03	76.8	1	A	<0.06	NC	A	<0.04	NC	A
		77.4			<0.06			<0.04		
USGS 7	04-21-05	15.5	0	A	<0.06	NC	A	<0.04	NC	A
		15.4			<0.06			<0.04		
USGS 131	04-26-06	49.1	0	A	<0.06	NC	A	<0.04	NC	A
		49.1			<0.06			<0.04		
No Name 1	05-01-06	70.1	0	A	<0.06	NC	A	<0.04	NC	A
		70.5			<0.06			<0.04		
USGS 84	04-25-07	88.4	1	A	<0.06	NC	A	<0.04	NC	A
		87.7			<0.06			<0.04		
USGS 98	10-11-07	38.8	1	A	<0.008	NC	A	<0.04	NC	A
		38.3			<0.008			<0.04		
USGS 26	04-15-08	34.7	0	A	<0.008	NC	A	<0.04	NC	A
		34.7			<0.008			<0.04		
USGS 97	04-22-08	129	0	A	<0.008	NC	A	<0.04	NC	A
		130			<0.008			<0.04		
PSTF Test	10-20-08	65.7	0	A	<0.02	NC	A	<0.02	NC	A
		65.3			<0.02			<0.02		

Table 7. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for dissolved metals from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** –, not analyzed; <, less than. **Abbreviations:** RSD, relative standard deviation; µg/L, micrograms per liter; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Cobalt			Copper			Lead		
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility
USGS 65	04-09-02	0.17	3	A	1.27	1	A	1.69	1	A
		0.16			1.24			1.66		
ANP 9	07-08-03	0.10	9	A	0.24	9	A	<0.08	NC	A
		0.09			0.27			<0.08		
USGS 7	04-21-05	0.04	4	A	<0.4	NC	A	<0.08	NC	A
		0.04			<0.4			<0.08		
USGS 131	04-26-06	0.14	2	A	0.50	4	A	<0.08	NC	A
		0.14			0.47			<0.08		
No Name 1	05-01-06	0.11	0	A	0.26E	NC	A	<0.08	NC	A
		0.11			0.26E			<0.08		
USGS 84	04-25-07	<0.04	NC	A	<0.4	NC	A	<0.12	NC	A
		<0.04			<0.4			<0.12		
USGS 98	10-11-07	0.03	2	A	<1	NC	A	<0.08	NC	A
		0.03			<1			<0.08		
USGS 26	04-15-08	0.02	0	A	<1	NC	A	<0.08	NC	A
		0.02			<1			<0.08		
USGS 97	04-22-08	0.04	1	A	<1	NC	A	0.06E	NC	A
		0.04			<1			0.08		
PSTF Test	10-20-08	0.02	0	A	<1	NC	A	<0.06	NC	A
		0.02			<1			<0.06		

Site name	Sample collection date	Manganese			Mercury			Molybdenum		
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility
USGS 65	04-09-02	0.06E	NC	A	<0.011	NC	A	2.58	1	A
		0.08E			<0.011			2.63		
ANP 9	07-08-03	1.13	1	A	<0.018	NC	A	2.93	0	A
		1.15			<0.018			2.93		
USGS 7	04-21-05	2.60	1	A	<0.010	NC	A	3.90	1	A
		2.63			<0.010			3.85		
USGS 131	04-26-06	1.28	3	A	<0.010	NC	A	2.28	1	A
		1.22			<0.010			2.24		
No Name 1	05-01-06	1.60	2	A	<0.010	NC	A	6.10	2	A
		1.56			<0.010			6.29		
USGS 84	04-25-07	<0.2	NC	A	<0.010	NC	A	1.38	1	A
		<0.2			<0.010			1.40		
USGS 98	10-11-07	0.34	4	A	<0.010	NC	A	2.01	1	A
		0.32			<0.010			1.99		
USGS 26	04-15-08	0.71	1	A	<0.010	NC	A	2.83	0	A
		0.72			<0.010			2.84		
USGS 97	04-22-08	<0.2	NC	A	<0.010	NC	A	1.39	1	A
		<0.2			<0.010			1.38		
PSTF Test	10-20-08	0.13E	NC	A	<0.01	NC	A	1.77	0	A
		0.13E			<0.01			1.76		

Table 7. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for dissolved metals from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** –, not analyzed; <, less than. **Abbreviations:** RSD, relative standard deviation; µg/L, micrograms per liter; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Nickel			Selenium			Silver		
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility
USGS 65	04-09-02	1.00	10	A	2.46	8	A	<1	NC	A
		1.14			2.20			<1		
ANP 9	07-08-03	0.93	1	A	–	–	–	<0.20	NC	A
		0.94			<0.20					
USGS 7	04-21-05	0.27	10	A	–	–	–	<0.20	NC	A
		0.23			<0.20					
USGS 131	04-26-06	2.28	2	A	1.14	1	A	<0.20	NC	A
		2.35			<0.20					
No Name 1	05-01-06	2.31	2	A	–	–	–	<0.20	NC	A
		2.26			<0.20					
USGS 84	04-25-07	0.18	0	A	1.33	1	A	<0.1	NC	A
		0.18			1.32			<0.1		
USGS 98	10-11-07	0.48	5	A	1.50	4	A	<0.1	NC	A
		0.52			1.41			<0.1		
USGS 26	04-15-08	0.39	6	A	–	–	–	<0.1	NC	A
		0.43			<0.1					
USGS 97	04-22-08	0.46	24	N	1.99	1	A	<0.1	NC	A
		0.65			2.02			<0.1		
PSTF Test	10-20-08	0.27	1	A	–	–	–	<0.008	NC	A
		0.26			<0.008					

Site name	Sample collection date	Thallium			Uranium			Zinc		
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility
USGS 65	04-09-02	–	–	–	1.91	0	A	343	0	A
		–			1.90			345		
ANP 9	07-08-03	<0.04	NC	A	2.29	1	A	4.65	5	A
		<0.04			2.31			4.33		
USGS 7	04-21-05	<0.04	NC	A	2.12	1	A	<0.6	NC	A
		<0.04			2.14			0.33E		
USGS 131	04-26-06	–	–	–	1.85	0	A	0.85	22	N
		–			1.84			1.17		
No Name 1	05-01-06	<0.04	NC	A	1.47	0	A	<0.6	NC	A
		<0.04			1.47			<0.6		
USGS 84	04-25-07	–	–	–	1.68	0	A	1.11	11	A
		–			1.68			1.29		
USGS 98	10-11-07	–	–	–	1.86	1	A	3.00	0	A
		–			1.83			3.01		
USGS 26	04-15-08	<0.04	NC	A	2.14	1	A	1.18E	NC	A
		<0.04			2.11			<1.8		
USGS 97	04-22-08	–	–	–	2.07	1	A	<1.8	NC	A
		–			2.11			<1.8		
PSTF Test	10-20-08	<0.04	NC	A	1.55	0	A	2.01	NC	A
		<0.04			1.55			1.72E		

Table 8. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for dissolved chromium from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; µg/L, micrograms per liter; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Chromium			Site name	Sample collection date	Chromium		
		µg/L	RSD (percent)	Reproducibility			µg/L	RSD (percent)	Reproducibility
USGS 60	04-02-02	6.2E 5.3E	NC	A	ICPP-MON-A-166	10-06-03	7.7 7.8	1	A
USGS 61	04-03-02	13.8 12.2	9	A	USGS 53	10-08-03	6.3 6.4	1	A
USGS 65	04-09-02	144 149	2	A	USGS 126A	04-07-04	4.0E 3.3E	NC	A
USGS 87	04-11-02	11.0 10.2	6	A	P AND W 2	04-07-04	3.0E 2.7E	NC	A
USGS 83	07-02-02	10.9 10.7	2	A	TRA 4	04-14-04	5.2 5.1	1	A
USGS 19	07-09-02	<10 <10	NC	A	USGS 76	04-19-04	11.8 11.9	1	A
USGS 8	07-11-02	<10 <10	NC	A	USGS 62	04-21-04	9.4 9.8	3	A
EBR 1	07-16-02	6.5E 5.3E	NC	A	USGS 56	10-19-04	114 115	1	A
USGS 4	07-24-02	10.0 10.0	0	A	ICPP-MON-A-167	10-19-04	8.4 8.9	5	A
RWMC M11S	09-10-02	13.0 10.1	17	N	USGS 105	10-20-04	10.1 10.5	3	A
USGS 79	10-01-02	7.7E 6.6E	NC	A	CPP 2	10-21-04	8.0 8.0	0	A
USGS 70	10-09-02	13.5 14.0	2	A	USGS 78	10-26-04	2.2 2.3	2	A
CPP 4	10-15-02	7.7E 9.1E	NC	A	USGS 5	04-11-05	<2 1.2E	NC	A
TRA DISP	10-23-02	20.6 19.1	5	A	USGS 109	04-14-05	7.1 6.8	3	A
USGS 72	11-07-02	<10 <10	NC	A	USGS 7	04-21-05	2.3 2.1	5	A
USGS 55	04-03-03	22.9 26.0	9	A	USGS 107	04-25-05	7.7 8.1	3	A
PW 8	04-14-03	<10 <10	NC	A	USGS 110A	10-03-05	2.8 2.5	7	A
Rifle Range	04-16-03	15.5 14.6	4	A	USGS 99	10-03-05	6.0 6.4	5	A
USGS 63	04-16-03	7.4E 6.2E	NC	A	USGS 1	10-03-05	2.6 3.0	10	A
WS INEL 1	07-07-03	8.0 7.7	3	A	CWP 8	10-18-05	<2 <2	NC	A
ANP 9	07-08-03	2.5 2.5	0	A	CWP 1	10-18-05	2.2 1.9E	NC	A
Site 19	07-08-03	3.9E 3.8E	NC	A	USGS 100	04-26-06	2.2 2.1	3	A
RWMC M12S	08-04-03	13.5 13.2	2	A	USGS 131	04-26-06	11.4 11.4	0	A

Table 8. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for dissolved chromium from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; µg/L, micrograms per liter; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Chromium			Site name	Sample collection date	Chromium		
		µg/L	RSD (percent)	Reproducibility			µg/L	RSD (percent)	Reproducibility
No Name 1	05-01-06	6.6	2	A	USGS 98	10-11-07	6.0	0	A
		6.4					6.0		
USGS 58	05-05-06	13.1	3	A	RWMC M14S	10-15-07	13.4	4	A
		12.5					14.2		
USGS 12	05-10-06	7.4	4	A	RWMC M13S	10-17-07	9.2	1	A
		7.9					9.1		
Site 4	10-12-06	8.0	5	A	USGS 77	10-18-07	8.1	2	A
		8.5					7.9		
USGS 86	10-24-06	11.2	0	A	USGS 127	04-07-08	9.4	1	A
		11.3					9.3		
Highway 3	10-26-06	1.6E	NC	A	USGS 26	04-15-08	2.3	2	A
		1.7E					2.4		
NPR Test	11-02-06	6.4	3	A	CPP 1	04-16-08	5.8	4	A
		6.7					5.4		
USGS 69	11-07-06	1.7E	NC	A	USGS 34	04-17-08	25.5	1	A
		1.4E					25.7		
USGS 66	11-08-06	1.3E	NC	A	USGS 97	04-22-08	6.4	1	A
		<2					6.3		
MTR Test	04-11-07	3.6	5	A	USGS 27	04-24-08	4.2	10	A
		3.9					4.8		
USGS 17	04-16-07	<2	NC	A	Highway 3	04-30-08	1.5	18	N
		1.1E					1.9		
USGS 120	04-24-07	9.7	1	A	Rifle Range	10-09-08	7.9	0	A
		9.5					7.9		
USGS 84	04-25-07	12.7	1	A	CPP 4	10-09-08	4.3	1	A
		12.6					4.3		
USGS 23	05-01-07	2.2	1	A	PSTF Test	10-20-08	2.8	0	A
		2.2					2.8		
USGS 101	10-10-07	2.1	10	A					
		2.4							

Table 9. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for selected total metals from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Abbreviations:** RSD, relative standard deviation, µg/L, micrograms per liter; <, less than; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Arsenic			Barium			Cadmium		
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility
USGS 72	11-07-02	<2	NC	A	113	3	A	4.31	11	A
		<2			109			3.69		
USGS 68	04-07-03	2.4	9	A	14.2	3	A	<0.22	NC	A
		2.7			13.7			<0.22		
		Chromium			Lead			Mercury		
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility
USGS 72	11-07-02	1.7	3	A	11.5	4	A	0.011E	NC	A
		1.7			10.9			<0.018		
USGS 68	04-07-03	86.6	4	A	<1	NC	A	<0.018	NC	A
		82.2			<1			<0.018		
		Selenium			Silver					
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility			
USGS 72	11-07-02	<2.6	NC	A	0.51	10	A			
		<2.6			0.44					
USGS 68	04-07-03	2.3E	NC	A	<0.26	NC	A			
		1.7E			<0.26					

Table 10. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for selected volatile organic compounds from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; µg/L, micrograms per liter; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	1,1-dichloroethene			Tetrachloroethene			Tetrachloromethane			Toluene		
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility
USGS 88	04-02-02	<0.2	NC	A	<0.2	NC	A	1.49	4	A	<0.2	NC	A
		<0.2			<0.2			1.57			<0.2		
USGS 89	04-02-02	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		<0.2			<0.2			<0.2			<0.2		
USGS 65	04-09-02	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		0.13			<0.2			<0.2			<0.2		
USGS 87	04-11-02	<0.2	NC	A	<0.2	NC	A	2.65	0	A	<0.2	NC	A
		<0.2			<0.2			2.66			<0.2		
USGS 83	07-02-02	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		<0.2			<0.2			<0.2			<0.2		
EBR 1	07-16-02	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		<0.2			<0.2			<0.2			<0.2		
USGS 117	04-09-03	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		<0.2			<0.2			<0.2			<0.2		
ANP 9	07-08-03	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		<0.2			<0.2			<0.2			<0.2		
USGS 5	04-11-05	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
USGS 7	04-21-05	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		

Site name	Sample collection date	1,1,1-trichloroethane			Trichloroethene			Trichloromethane		
		µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility	µg/L	RSD (percent)	Repro-ducibility
USGS 88	04-02-02	0.14	2	A	0.60	1	A	0.44	1	A
		0.14			0.60			0.45		
USGS 89	04-02-02	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		<0.2			<0.2			<0.2		
USGS 65	04-09-02	0.22	0	A	<0.2	NC	A	<0.2	NC	A
		0.22			<0.2			<0.2		
USGS 87	04-11-02	0.19	0	A	0.61	0	A	0.12	3	A
		0.19			0.61			0.13		
USGS 83	07-02-02	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		<0.2			<0.2			<0.2		
EBR 1	07-16-02	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		<0.2			<0.2			<0.2		
USGS 117	04-09-03	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		<0.2			<0.2			<0.2		
ANP 9	07-08-03	<0.2	NC	A	<0.2	NC	A	<0.2	NC	A
		<0.2			<0.2			<0.2		
USGS 5	04-11-05	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
USGS 7	04-21-05	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		

Table 10. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for selected volatile organic compounds from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; µg/L, micrograms per liter; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	1,1-dichloroethene			Tetrachloroethene			Tetrachloromethane			Toluene		
		µg/L	RSD (percent)	Reproducibility	µg/L	RSD (percent)	Reproducibility	µg/L	RSD (percent)	Reproducibility	µg/L	RSD (percent)	Reproducibility
USGS 107	04-25-05	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
USGS 131	04-26-06	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
NO NAME 1	05-01-06	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
USGS 12	05-10-06	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
HIGHWAY 3	10-26-06	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
NPR TEST	11-02-06	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
USGS 120	04-24-07	<0.1	NC	A	<0.1	NC	A	1.06	0	A	0.45	5	A
		<0.1			<0.1			1.07			0.42		
USGS 84	04-25-07	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
USGS 98	10-11-07	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
USGS 77	10-18-07	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		

Site name	Sample collection date	1,1,1-trichloroethane			Trichloroethene			Trichloromethane		
		µg/L	RSD (percent)	Reproducibility	µg/L	RSD (percent)	Reproducibility	µg/L	RSD (percent)	Reproducibility
USGS 107	04-25-05	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
USGS 131	04-26-06	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
NO NAME 1	05-01-06	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
USGS 12	05-10-06	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
HIGHWAY 3	10-26-06	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
NPR TEST	11-02-06	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
USGS 120	04-24-07	0.12	12	A	0.13	3	A	<0.1	NC	A
		0.10			0.13			0.10		
USGS 84	04-25-07	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		0.11			<0.1			<0.1		
USGS 98	10-11-07	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
USGS 77	10-18-07	0.11	2	A	<0.1	NC	A	<0.1	NC	A
		0.11			<0.1			<0.1		

Table 10. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for selected volatile organic compounds from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.—Continued

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Symbols:** <, less than. **Abbreviations:** RSD, relative standard deviation; µg/L, micrograms per liter; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	1,1-dichloroethene			Tetrachloroethene			Tetrachloromethane			Toluene		
		µg/L	RSD (percent)	Reproducibility	µg/L	RSD (percent)	Reproducibility	µg/L	RSD (percent)	Reproducibility	µg/L	RSD (percent)	Reproducibility
USGS 26	04-15-08	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
CPP 1	04-16-08	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
USGS 34	04-17-08	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
HIGHWAY 3	04-30-08	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	0.18	28	N
		<0.1			<0.1			<0.2			0.27		
RWMC PROD	10-09-08	<0.1	NC	A	0.31	1	A	6.29	1	A	<0.1	NC	A
		<0.1			0.31			6.20			<0.1		
PSTF TEST	10-20-08	<0.1	NC	A	<0.1	NC	A	<0.2	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.2			<0.1		
RWMC PROD	12-11-08	<0.1	NC	A	0.32	4	A	8.55	1	A	<0.1	NC	A
		<0.1			0.30			8.41			<0.1		

Site name	Sample collection date	1,1,1-trichloroethane			Trichloroethene			Trichloromethane		
		µg/L	RSD (percent)	Reproducibility	µg/L	RSD (percent)	Reproducibility	µg/L	RSD (percent)	Reproducibility
USGS 26	04-15-08	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
CPP 1	04-16-08	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
USGS 34	04-17-08	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
HIGHWAY 3	04-30-08	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
RWMC PROD	10-09-08	0.47	1	A	3.21	1	A	1.49	0	A
		0.46			3.17			1.49		
PSTF TEST	10-20-08	<0.1	NC	A	<0.1	NC	A	<0.1	NC	A
		<0.1			<0.1			<0.1		
RWMC PROD	12-11-08	0.54	0	A	3.11	1	A	1.57	1	A
		0.54			3.07			1.56		

Table 11. Measured concentrations, relative standard deviations, and acceptable or not acceptable reproducibility for total organic carbon from replicate water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Location of sites are shown in [figures 1–4](#). **Reproducibility:** A, acceptable; N, not acceptable. **Abbreviations:** RSD, relative standard deviation; mg/L, milligrams per liter; <, less than; E, estimated; NC, not calculated because one or both concentrations were estimated or below the reporting level or both]

Site name	Sample collection date	Total organic carbon (mg/L)	RSD (percent)	Reproducibility	Site name	Sample collection date	Total organic carbon (mg/L)	RSD (percent)	Reproducibility
USGS 83	07-02-02	<0.60	NC	A	Highway 3	10-26-06	0.91	29	N
EBR 1	07-16-02	<0.60	NC	A	NPR Test	11-02-06	0.20E	NC	A
RWMC M11S	09-10-02	0.33E	NC	N	USGS 17	04-16-07	<0.40	NC	A
ANP 9	07-08-03	<0.40	NC	A	USGS 120	04-24-07	2.98	80	N
RWMC M12S	08-04-03	0.75	87	N	USGS 84	04-25-07	0.36E	NC	A
ICPP-MON-A-166	10-06-03	0.87	51	N	USGS 23	05-01-07	<0.40	NC	A
USGS 126A	04-07-04	0.62	75	N	USGS 101	10-10-07	0.38E	NC	A
PAND W 2	04-07-04	0.22E	NC	N	USGS 98	10-11-07	1.80	11	A
ICPP-MON-A-167	10-19-04	4.47	12	A	RWMC M14S	10-15-07	0.30E	NC	A
USGS 105	10-20-04	0.60	NC	A	RWMC M13S	10-17-07	0.33E	NC	A
USGS 5	04-11-05	12.65	4	A	USGS 77	10-18-07	<0.40	NC	A
USGS 109	04-14-05	0.75	106	N	USGS 127	04-07-08	0.33	NC	A
USGS 7	04-21-05	0.51E	NC	A	USGS 26	04-15-08	0.75	36	N
USGS 107	04-25-05	0.40E	NC	N	CPP 1	04-16-08	0.25E	NC	A
USGS 110A	10-03-05	0.34E	NC	A	USGS 34	04-17-08	0.57	NC	A
USGS 1	10-03-05	2.03	6	A	USGS 97	04-22-08	0.48	11	A
USGS 131	04-26-06	<0.40	NC	A	USGS 27	04-24-08	0.73	8	A
No Name 1	05-01-06	0.82	31	N	HJ 3	04-30-08	0.28E	NC	A
USGS 12	05-10-06	1.67	NC	N	PSTF Test	10-20-08	<0.60	NC	A
USGS 86	10-24-06	0.25E	NC	A			0.90		

Table 12. Percentage of replicates with acceptable reproducibility for radiochemical, inorganic, and organic constituents in water samples collected from selected sites at the Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Values in **bold** indicate that the percentage of replicate pairs with acceptable reproducibility was less than 90 percent. **Abbreviations:** MDC, minimum detectable concentration; VOC, volatile organic compound]

Constituent	Number of replicate pairs	Replicate pairs with acceptable reproducibility		Constituent	Number of replicate pairs	Replicate pairs with acceptable reproducibility	
		Number	Percent			Number	Percent
Gross alpha radioactivity	49	49	100	Manganese	10	10	100
Gross beta radioactivity	49	46	94	Mercury	10	10	100
Cesium-137	77	75	97	Molybdenum	10	10	100
Tritium	136	132	97	Nickel	10	9	90
Strontium-90	88	80	91	Selenium	5	5	100
Plutonium-238	16	16	100	Silver	10	10	100
Plutonium-239 + plutonium-240	16	16	100	Thallium	5	5	100
Americium-241	16	16	100	Uranium	10	10	100
Sodium	106	105	99	Zinc	10	9	90
Chloride	135	133	99	Chromium	75	73	97
Sulfate	68	67	99	Total arsenic	2	2	100
Iodide	11	11	100	Total barium	2	2	100
Fluoride	4	4	100	Total cadmium	2	2	100
Ammonia	92	92	100	Total chromium	2	2	100
Nitrate	92	92	100	Total lead	2	2	100
Nitrite	92	92	100	Total mercury	2	2	100
Orthophosphate	92	92	100	Total selenium	2	2	100
Aluminum	10	8	80	Total silver	2	2	100
Antimony	10	10	100	Volatile organic compounds ¹	27/26/1	27/26/1	100
Arsenic	10	10	100	1,1-dichloroethene	27	27	100
Barium	10	10	100	Tetrachloroethene	27	27	100
Beryllium	10	10	100	Tetrachloromethane	27	27	100
Cadmium	10	10	100	Toluene	27	26	96
Cobalt	10	10	100	1,1,1-trichloroethane	27	27	100
Copper	10	10	100	Trichloroethene	27	27	100
Lead	10	10	100	Trichloromethane	27	27	100
				Total organic carbon	39	27	69

¹Includes all VOCs except for the seven VOCs listed in this table. Number of replicate pairs for each VOC is indicated in table A3.

Table 13. Ranges of concentrations, number of replicates with calculated relative standard deviations, and pooled relative standard deviations for radiochemical, inorganic, and organic constituents, Idaho National Laboratory and vicinity, Idaho, 2002–08.

[**Abbreviations:** RSD, relative standard deviation; pCi/L, picocuries per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; Cs-137, cesium-137; Sr-90/Y-90, strontium-90/yttrium-90; N, nitrogen; P, phosphorus]

Constituent	Concentration range	Number of replicate pairs with calculated RSDs	Pooled RSD (percent)	Constituent	Concentration range	Number of replicate pairs with calculated RSDs	Pooled RSD (percent)
Gross-beta radioactivity (pCi/L as Cs-137 or Sr-90/Y-90)	4.0–20	5	13	Molybdenum (µg/L)	1.0–7.0	10	1.8
Tritium (pCi/L)	600–<1,400	15	11	Nickel (µg/L)	0.1–<1.0	7	12
	1,400–<5,000	26	5.1		1.0–3.0	3	3.6
	5,000–25,000	13	4.9	Selenium (µg/L)	1.0–3.0	5	5.3
Strontium-90 (pCi/L)	2.0–<10	14	12	Uranium (µg/L)	1.0–3.0	10	0.8
	10–50	10	3.3	Zinc (µg/L)	1.0–5.0	4	7.1
	100–110	1	0.7		300–400	1	0.4
Sodium (mg/L)	5–<25	90	1.9	Chromium (µg/L)	1.0–<5.0	15	8.2
	25–<40	8	1.3		5.0–30	40	5.6
	40–80	7	1.0		100–150	2	1.9
Chloride (mg/L)	3–<30	108	3.3	Total arsenic (µg/L)	2.0–3.0	1	8.6
	30–240	26	0.9	Total barium (µg/L)	10–20	1	2.8
Sulfate (mg/L)	10–70	61	0.6		100–200	1	2.6
	100–400	7	0.4	Total cadmium (µg/L)	3.0–5.0	1	11
Fluoride (mg/L)	0.2–0.3	4	5.1	Total chromium (µg/L)	1.0–2.0	1	3.1
Ammonia (mg/L as N)	0.04–0.05	1	8.7		80–90	1	3.7
	0.4–0.5	1	4.1	Total lead (µg/L)	10–12	1	3.7
Nitrate (mg/L as N)	0.1–<1.0	45	0.7	Total silver (µg/L)	0.4–0.6	1	10
	1.0–7.0	45	1.4	Tetrachloroethene (µg/L)	0.3–0.4	2	3.0
	20–30	1	0.2	Tetrachloromethane (µg/L)	1.0–10	5	1.5
Nitrite (mg/L as N)	0.004–0.005	1	0.3	Toluene (µg/L)	0.2–0.5	2	14
Orthophosphate (mg/L as P)	0.009–0.06	48	4.5	1,1,1-trichloroethane (µg/L)	0.1–0.6	7	2.4
	3.0–4.0	1	0.3	Trichloroethene (µg/L)	0.1–0.7	3	0.6
Aluminum (µg/L)	1.0–4.0	7	14		3.0–4.0	2	0.9
Antimony (µg/L)	0.1–0.2	3	5.6	Trichloromethane (µg/L)	0.1–0.5	2	1.9
Arsenic (µg/L)	1.0–4.0	9	6.8		1.0–2.0	2	0.5
Barium (µg/L)	15–150	10	0.5	Total organic carbon (mg/L)	0.5–5.0	13	70
Cobalt (µg/L)	0.02–0.2	9	4.7		10–20	1	4.4
Copper (µg/L)	0.2–2.0	3	3.0				
Lead (µg/L)	1.0–2.0	1	1.2				
Manganese (µg/L)	0.3–3.0	6	1.9				

Table 14. Measured concentrations of tritium, strontium-90, cesium-137, sodium, chloride, sulfate, iodide, and dissolved chromium from source-solution, field, and equipment blanks, Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Uncertainties for radionuclides are 1σ combined standard uncertainties. Values in **bold** indicate contamination bias was considered present in the blank for that constituent. **Symbols:** <, less than; –, no data. **Abbreviations:** IFFO, U.S. Geological Survey Idaho Water Science Center Idaho Falls field office; CFA, Central Facilities Area; pump, Grundfos portable sampling pump; bailer, brass or Teflon sample bailer; DIW, deionized water from IFFO; pCi/L, picocuries per liter; mg/L, milligrams per liter; µg/L, micrograms per liter]

Blank collection date	Processing location	Blank type	Source water	Tritium (pCi/L)	Strontium-90 (pCi/L)	Cesium-137 (pCi/L)	Sodium (mg/L)
03-21-02	IFFO	Source solution	DIW	-30±120	1.1±0.7	15±30	<0.09
07-15-02	IFFO	Source solution	DIW	–	–	–	<0.09
05-01-03	IFFO	Source solution	DIW	–	–	–	<0.09
06-25-03	IFFO	Source solution	DIW	10±100	-0.7±0.8	-20±20	–
09-29-04	IFFO	Source solution	DIW	-220±120	4.2±0.8	-50±40	<0.10
06-23-06	IFFO	Source solution	DIW	–	–	–	<0.20
08-24-06	IFFO	Source solution	DIW	-50±50	-0.1±0.7	16±24	–
05-17-07	IFFO	Source solution	DIW	90±110	-0.2±0.7	-10±20	–
10-19-07	IFFO	Source solution	DIW	-60±60	-0.6±0.7	-30±40	–
08-18-08	IFFO	Source solution	DIW	–	–	–	<0.12
08-22-08	IFFO	Source solution	DIW	110±70	-2.6±0.7	40±20	–
02-14-02	CFA lab	Field	DIW	–	–	–	–
02-14-02	CFA lab	Field	DIW	–	–	–	–
10-17-02	USGS 73	Equipment, pump	DIW	-90±120	0.3±0.6	–	<0.09
10-26-04	USGS 71	Equipment, bailer	DIW	80±130	4.4±0.8	-10±30	<0.20
04-27-05	CWP 3	Equipment, bailer	DIW	-10±60	-1.5±0.6	–	–
10-18-05	USGS 71	Equipment, bailer	DIW	-90±100	0.8±0.8	40±20	<0.20
05-15-06	USGS 53	Equipment, bailer	DIW	–	–	–	–
11-09-06	CFA lab	Equipment, bailer	DIW	-15±53	0.6±0.7	-60±30	<0.20
04-30-07	CWP 3	Equipment, bailer	DIW	80±120	-0.2±0.7	–	–
10-23-07	CWP 1	Equipment, bailer	DIW	-130±60	0±0.7	–	–
05-27-08	CFA lab	Equipment, bailer	DIW	-140±70	1.4±0.7	14±36	0.06E

Blank collection date	Processing location	Blank type	Source water	Chloride (mg/L)	Sulfate (mg/L)	Iodide (mg/L)	Chromium (µg/L)
03-21-02	IFFO	Source solution	DIW	<0.3	<0.1	–	<0.8
07-15-02	IFFO	Source solution	DIW	–	–	–	<0.8
05-01-03	IFFO	Source solution	DIW	<0.01	<0.01	–	<0.8
06-25-03	IFFO	Source solution	DIW	–	–	–	–
09-29-04	IFFO	Source solution	DIW	<0.01	<0.01	–	<0.8
06-23-06	IFFO	Source solution	DIW	<0.01	<0.01	–	0.02E
08-24-06	IFFO	Source solution	DIW	–	–	–	–
05-17-07	IFFO	Source solution	DIW	–	–	–	–
10-19-07	IFFO	Source solution	DIW	–	–	–	–
08-18-08	IFFO	Source solution	DIW	<0.01	<0.01	–	<0.12
08-22-08	IFFO	Source solution	DIW	–	–	–	–
02-14-02	CFA lab	Field	DIW	–	–	<0.002	–
02-14-02	CFA lab	Field	DIW	–	–	<0.002	–
10-17-02	USGS 73	Equipment, pump	DIW	<0.20	<0.18	–	<10
10-26-04	USGS 71	Equipment, bailer	DIW	<0.20	<0.18	–	<2
04-27-05	CWP 3	Equipment, bailer	DIW	<0.20	<0.18	–	<2
10-18-05	USGS 71	Equipment, bailer	DIW	<0.20	<0.18	–	<2
05-15-06	USGS 53	Equipment, bailer	DIW	<0.20	<0.18	–	<2
11-09-06	CFA lab	Equipment, bailer	DIW	0.08E	<0.18	–	<2
04-30-07	CWP 3	Equipment, bailer	DIW	<0.12	<0.18	–	<2
10-23-07	CWP 1	Equipment, bailer	DIW	<0.12	<0.18	–	<2
05-27-08	CFA lab	Equipment, bailer	DIW	<0.12	<0.18	–	<1.2

Table 15. Probability of success, confidence level, and maximum concentration in blank samples, Idaho National Laboratory, Idaho, 2002–08.

[**Probability of Success:** Probability that each blank (or environmental) sample is less than the $m+1$ sample concentration. **Abbreviations:** pCi/L, picocuries per liter; mg/L, milligrams per liter]

Constituent	Blank type	Number of blank results (n)	Probability of success (p)	Confidence level (c) (percentage)	Maximum concentration in equipment blanks of bailers ($m+1$)
Iodide (mg/L)	Field	2	0.5	75	<0.002
Tritium (pCi/L)	Equipment, bailer	7	0.7	92	80±130
Strontium-90 (pCi/L)	Equipment, bailer	7	0.7	92	¹ 1.4±0.7
Cesium-137 (pCi/L)	Equipment, bailer	4	0.6	87	40±20
Sodium (mg/L)	Equipment, bailer	4	0.6	87	<0.20
Chloride (mg/L)	Equipment, bailer	8	0.7	94	<0.20
Sulfate (mg/L)	Equipment, bailer	8	0.7	94	<0.18
Dissolved chromium (µg/L)	Equipment, bailer	8	0.7	94	<2

¹The strontium-90 measurement of 4.4±0.8 from the equipment blank collected on 10-26-04 was recalculated as 0.2±0.8 by subtracting the strontium-90 measurement of 4.2±0.8 from the source solution blank collected on 09-29-04. See text for further explanation.

Glossary

bias A persistent positive or negative deviation of the mean value, obtained by using a specific method or procedure, from the true value.

blank Used to identify potential sources of sample contamination and assess the magnitude of contamination with respect to target analytes (USGS, 2006). Blanks discussed in this report include source-solution, equipment, and field blanks.

blind replicate Replicates submitted to an analytical laboratory with different sample identification numbers.

combined standard uncertainty Standard uncertainty estimate reported at the 1σ confidence level by combining the standard uncertainties of the analysis (McCurdy and others, 2008, p. 18). For analyses performed at the U.S. Department of Energy Radiological and Environmental Services Laboratory, uncertainties may include yields, half-lives, counting efficiencies, and counting times (Williams, 1997, p. 10).

grab sample A discrete (in contrast to a composite) water-quality sample collected at a single time and location.

quality assurance A term used to describe programs and the sets of procedures, including (but not limited to) quality control procedures, which are necessary to assure data reliability (Friedman and Erdmann, 1982).

quality control A term used to describe the routine procedures used to regulate measurements and produce data of satisfactory quality (Friedman and Erdmann, 1982).

quality-control (QC) data Data from blank, replicate, reference, or spike samples. The data are used “to identify, quantify, and document bias and variability in data that result from the collection, processing, shipping, and handling of samples,” (U.S. Geological Survey, 2006, chap. A4, p. 133).

quality-control (QC) samples Blank, replicate, reference, or spike samples.

reference materials A material or substance with one or more properties sufficiently well established to be used for the assessment of a measurement method.

reliability “A statement of the error or precision of an estimate,” (Spiegel, 1998, p. 194).

replicate Environmental samples collected in duplicate, triplicate, or larger multiples, considered identical in composition and analyzed for the same chemical properties (U.S. Geological Survey, 2006).

reproducibility “The closeness of agreement between individual results,” (Kateman and Buydens, 1993, p. 11).

sequential replicate “Samples of environmental water—commonly ground water—that are collected consecutively,” (U.S. Geological Survey, 2006, chap. A4, p. 144).

variability “The degree of random error in independent measurements of the same quantity,” (Mueller, 1998, p. vii).

Appendix A. Supplementary Information

The supplementary information in the appendix may be of interest to the reader but is not essential for understanding the report. [Table A1](#) shows U.S. Geological Survey National Water Quality Laboratory reporting levels for selected constituents for 2002–08. [Table A2](#) is a cross reference of report site names and blank types with U.S. Geological Survey site numbers. [Table A3](#) lists the volatile organic compounds analyzed from water-quality samples collected by the U.S. Geological Survey Idaho National Laboratory Project Office as part of the routine water-quality monitoring program at

the Idaho National Laboratory. [Table A4](#) shows the measured concentrations of inorganic constituents from source-solution blanks for inorganic constituents that were not analyzed from field or equipment blanks. [Table A5](#) shows the measured concentrations of radiochemical and inorganic constituents from an equipment blank of stainless steel sampling pipes. This equipment blank was not applicable to the U.S. Geological Survey Idaho National Laboratory Project Office routine water-quality monitoring program because sampling procedures included purging of three- or one-borehole volume of groundwater from sampling wells through the sampling pipes. The equipment blank does not include this significant field rinse of the sampling pipes.

Table A1. Reporting and detection levels and reporting level codes for selected constituents analyzed by the U.S. Geological Survey National Water Quality Laboratory, 2002–08.

[Symbols: ~, approximately. Abbreviations: mg/L, milligrams per liter; µg/L, micrograms per liter; P, phosphorus; LRL, laboratory reporting level; MRL, minimum reporting level]

Constituent	Dates	Reporting level	Detection level	Reporting level code
Orthophosphate (mg/L as P)	01-01-02–12-31-08	0.018	0.009	LRL
Aluminum, dissolved (µg/L)	01-01-02–09-30-02	1	~0.5	MRL
	10-01-02–09-30-08	1.6	0.8	LRL
	10-01-08–12-31-08	4	2	LRL
Chromium, dissolved (µg/L)	01-01-02–04-30-03	10	5	LRL
	05-01-03–09-30-03	5	2.4	LRL
	10-01-03–09-30-04	4.2	2.1	LRL
	10-01-04–09-30-07	2	1	LRL
	10-01-07–12-31-08	1.2	0.6	LRL
Copper, dissolved (µg/L)	01-01-02–09-30-03	0.23	0.12	LRL
	10-01-03–09-30-07	0.4	0.2	LRL
	10-01-07–12-31-08	1	0.5	LRL
Lead, dissolved (µg/L)	01-01-02–09-30-06	0.08	0.04	LRL
	10-01-06–09-30-07	0.12	0.06	LRL
	10-01-07–09-30-08	0.08	0.04	LRL
	10-01-08–12-31-08	0.06	0.03	LRL
Zinc, dissolved (µg/L)	01-01-02–09-30-02	1	~0.5	MRL
	10-01-02–09-30-03	1	0.5	LRL
	10-01-03–09-30-07	0.6	0.3	LRL
	10-01-07–09-30-08	1.8	0.9	LRL
	10-01-08–12-31-08	2	1	LRL
Toluene (µg/L)	01-01-02–09-30-02	0.2	~0.1	MRL
	10-01-02–12-31-08	0.1	~0.05	MRL
Total organic carbon (mg/L)	01-01-02–09-30-02	0.6	0.3	LRL
	10-01-02–09-30-08	0.4	0.2	LRL
	10-01-08–12-31-08	0.6	0.3	LRL

Table A2. Cross reference of site names or type of blank with U.S. Geological Survey site numbers, Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Abbreviations: USGS, U.S. Geological Survey; No., number]

Site name	USGS site No.	Site name	USGS site No.	Site name	USGS site No.
Big Lost River at Mackay, ID	13127700	USGS 1	432700112470801	USGS 68	433516112573901
Big Lost River near Arco, ID	13132500	USGS 2	433320112432301	USGS 69	433450112573001
Little Lost River near Howe, ID	13119000	USGS 4	434657112282201	USGS 70	433504112571001
Mud Lake near Terreton, ID	13115000	USGS 5	433543112493801	USGS 72	433519112574601
ANP 6	435152112443101	USGS 6	434031112453701	USGS 76	433425112573201
ANP 9	434856112400001	USGS 7	434915112443901	USGS 77	433315112560301
CFA 2	433144112563501	USGS 8	433121113115801	USGS 78	433413112573501
CFA LF 3-9	433216112571001	USGS 11	432336113064201	USGS 79	433505112581901
CPP 1	433433112560201	USGS 12	434126112550701	USGS 83	433023112561501
CPP 2	433432112560801	USGS 14	432019112563201	USGS 84	433356112574201
CPP 4	433440112554401	USGS 15	434234112551701	USGS 85	433246112571201
CWP 1	433459112572601	USGS 17	433937112515401	USGS 86	432935113080001
CWP 8	433500112573001	USGS 18	434540112440901	USGS 87	433013113024201
EBR 1	433051113002601	USGS 19	434426112575701	USGS 88	432940113030201
Highway 3	433256113002501	USGS 20	433253112545901	USGS 89	433005113032801
ICPP-MON-A-166	433300112583301	USGS 22	433422113031701	USGS 97	433807112551501
ICPP-MON-A-167	433331112580701	USGS 23	434055112595901	USGS 98	433657112563601
IET 1 DISP	435153112420501	USGS 26	435212112394001	USGS 99	433705112552101
Leo Rogers 1	432533112504901	USGS 27	434851112321801	USGS 100	433503112400701
MTR Test	433520112572601	USGS 29	434407112285101	USGS 101	433255112381801
No Name 1	435038112453401	USGS 31	434625112342101	USGS 102	433853112551601
NPR Test	433449112523101	USGS 32	434444112322101	USGS 104	432856112560801
P AND W 2	435419112453101	USGS 34	433334112565501	USGS 105	432703113001801
PSTF Test	434941112454201	USGS 35	433339112565801	USGS 106	432959112593101
PW 1	433349112560701	USGS 36	433330112565201	USGS 107	432942112532801
PW 4	433348112554901	USGS 37	433326112564801	USGS 108	432659112582601
PW 8	433456112572001	USGS 39	433343112570001	USGS 109	432701113025601
Rifle Range	433243112591101	USGS 40	433411112561101	USGS 110A	432717112501502
RWMC M11S	433058113010401	USGS 44	433409112562101	USGS 111	433331112560501
RWMC M12S	433118112593401	USGS 46	433407112561501	USGS 112	433314112563001
RWMC M13S	433037113002701	USGS 47	433407112560301	USGS 113	433314112561801
RWMC M14S	433052113025001	USGS 48	433401112560301	USGS 114	433318112555001
RWMC M3S	433008113021801	USGS 50	433419112560201	USGS 115	433320112554101
RWMC M7S	433023113014801	USGS 51	433350112560601	USGS 116	433331112553201
RWMC PROD	433002113021701	USGS 53	433503112573401	USGS 117	432955113025901
Site 19	433522112582101	USGS 55	433508112573001	USGS 120	432919113031501
Site 4	433617112542001	USGS 56	433509112573501	USGS 121	433450112560301
Site 9	433123112530101	USGS 58	433500112572502	USGS 126A	435529112471301
SPERT 1	433252112520301	USGS 59	433354112554701	USGS 126B	435529112471401
TRA 4	433521112574201	USGS 60	433456112571901	USGS 127	433058112572201
TRA DISP	433506112572301	USGS 61	433453112571601	USGS 128	433250112565601
WS INEL 1	433716112563601	USGS 62	433446112570701	USGS 131	433036112581601
		USGS 63	433455112574001	Source solution blank	432942112021800
		USGS 65	433447112574501	Field blank	433000113000001
		USGS 66	433436112564801	Equipment blank	433000113000001
		USGS 67	433344112554101		

Table A3. Volatile organic compounds analyzed as part of the routine water-quality monitoring program.

[Volatile organic compounds in **bold** were only analyzed from the water sample collected from the RWMC production well on 12-11-08. Xylene was analyzed from all water samples except the water sample collected from the RWMC production well on December 11, 2008]

Compound	Compound
Acetone	Isopropylbenzene
Acrylonitrile	4-Isopropyltoluene
Benzene	Methyl tert-pentyl ether
Bromobenzene	Methyl acrylate
Bromochloromethane	Methyl acrylonitrile
Bromodichloromethane	Methyl methacrylate
Bromoethene	Methyl tert-butyl ether
Bromomethane	m-Xylene plus p-xylene
Carbon disulfide	Naphthalene
Chlorobenzene	n-Butyl methyl ketone
Chloroethane	n-Butylbenzene
Chloromethane	n-Propylbenzene
3-Chloropropene	o-Xylene
2-Chlorotoluene	sec-Butylbenzene
4-Chlorotoluene	Styrene
cis-1 2-Dichloroethene	tert-Butyl ethyl ether
cis-1 3-Dichloropropene	tert-Butylbenzene
Dibromochloromethane	1 1 1 2-Tetrachloroethane
1 2-Dibromo-3-chloropropane	1 1 2 2-Tetrachloroethane
Dibromomethane	Tetrachloroethene
1 2-Dibromoethane	Tetrachloromethane
1 2-Dichlorobenzene	Tetrahydrofuran
1 3-Dichlorobenzene	1 2 3 4-Tetramethylbenzene
1 4-Dichlorobenzene	1 2 3 5-Tetramethylbenzene
Dichlorodifluoromethane	Toluene
1 1-Dichloroethane	trans-1 2-Dichloroethene
1 2-Dichloroethane	trans-1 3-Dichloropropene
1 1-Dichloroethene	trans-1 4-Dichloro-2-butene
Dichloromethane	Tribromomethane
1 2-Dichloropropane	1 2 3-Trichlorobenzene
1 3-Dichloropropane	1 2 4-Trichlorobenzene
2 2-Dichloropropane	1 1 1-Trichloroethane
1 1-Dichloropropene	1 1 2-Trichloroethane
Diethyl ether	Trichloroethene
Diisopropyl ether	Trichlorofluoromethane
Ethylbenzene	Trichloromethane
Ethyl methacrylate	1 2 3-Trichloropropane
Ethyl methyl ketone	1 1 2-Trichloro-1 2 2-trifluoroethane
2-Ethyltoluene	1 2 3-Trimethylbenzene
Hexachlorobutadiene	1 2 4-Trimethylbenzene
Hexachloroethane	1 3 5-Trimethylbenzene
Iodomethane	Vinyl chloride
Isobutyl methyl ketone	Xylene (all isomers)

Table A4. Measured concentrations of selected cations, anions, silica, nutrients, and trace metals from source-solution blanks, Idaho National Laboratory and vicinity, Idaho, 2002–08.

[Source water for blanks was deionized water from the U.S. Geological Survey Idaho Water Science Center Idaho Falls field office. Values in **bold** indicate that contamination bias was considered present in the blank for that constituent. Symbols: <, less than; –, no data. **Abbreviations:** mg/L, milligrams per liter; µg/L, micrograms per liter; SiO₂, silica dioxide; N, nitrogen; P, phosphorus; E, estimated]

Date collected	Calcium (mg/L)	Magnesium (mg/L)	Bromide (mg/L)	Fluoride (mg/L)	Silica (mg/L as SiO ₂)	Ammonia (mg/L as N)	Nitrate plus nitrite (mg/L as N)	Nitrite (mg/L as N)
03-21-02	0.026	0.004E	–	<0.1	<0.13	0.016	<0.013	<0.002
07-15-02	0.099	0.026	–	–	<0.13	–	–	–
05-01-03	<0.012	<0.008	<0.01	<0.01	<0.13	<0.015	<0.022	<0.002
09-29-04	0.009E	<0.008	<0.01	<0.01	0.02E	<0.010	<0.016	<0.002
06-23-06	<0.02	<0.008	<0.01	<0.01	0.02E	0.008E	<0.016	<0.002
08-18-08	0.029E	<0.02	<0.01	<0.01	0.01E	0.017E	<0.016	<0.002
Date collected	Ortho-phosphate (mg/L as P)	Aluminum (µg/L)	Antimony (µg/L)	Arsenic (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Boron (µg/L)	Cadmium (µg/L)
03-21-02	<0.007	1.2	0.17	<0.18	<1.0	<0.06	<7	<0.037
07-15-02	–	<1.0	<0.05	<0.18	<1.0	<0.06	<7	<0.037
05-01-03	<0.007	<1.6	<0.3	<0.26	<0.05	<0.06	<7	<0.037
09-29-04	<0.006	<1.6	<0.2	<0.2	<0.2	<0.06	<8	<0.04
06-23-06	<0.006	<1.6	<0.2	<0.12	<0.2	<0.06	<8	<0.04
08-18-08	<0.006	<1.6	<0.14	<0.06	<0.4	<0.008	<6	<0.04
Date collected	Cobalt (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Lithium (µg/L)	Manganese (µg/L)	Molybdenum (µg/L)	Nickel (µg/L)
03-21-02	<0.015	0.27	<10	0.08E	<0.3	<0.1	<0.2	0.09
07-15-02	<0.015	<0.23	<10	<0.08	<0.3	0.1	0.2E	<0.06
05-01-03	<0.015	<0.23	<10	<0.08	<0.5	<0.2	<0.3	<0.06
09-29-04	<0.014	<0.4	<6	<0.08	<0.6	<0.2	<0.4	<0.06
06-23-06	<0.04	<0.4	<6	0.06E	<0.6	<0.2	<0.4	<0.06
08-18-08	<0.02	2.4	<8	0.12	<1	<0.2	<0.2	<0.2
Date collected	Selenium (µg/L)	Silver (µg/L)	Strontium (µg/L)	Thallium (µg/L)	Uranium (µg/L)	Vanadium (µg/L)	Zinc (µg/L)	
03-21-02	<0.33	<1.00	0.1	<0.04	<0.02	<0.21	1.0	
07-15-02	<0.33	<1.00	0.3	<0.04	<0.02	<0.21	2.5	
05-01-03	<0.5	<0.20	<0.2	<0.04	<0.02	<0.13	<1	
09-29-04	<0.4	<0.20	<0.4	<0.04	<0.04	<0.14	<0.6	
06-23-06	<0.08	<0.20	<0.4	<0.04	<0.04	<0.10	<0.6	
08-18-08	<0.04	<0.1	<0.8	<0.04	<0.02	<0.04	2.2	

Table A5. Measured concentrations of cesium-137, tritium, strontium-90, sodium, chloride, sulfate, ammonia, nitrite plus nitrate, nitrite, orthophosphate, and dissolved chromium from an equipment blank of the stainless steel sampling pipes, Idaho National Laboratory (INL) and vicinity, Idaho, 2002–08.

[Blank was prepared on October 29, 2008 at the U.S. Geological Survey (USGS) laboratory at the INL with deionized water from the USGS Idaho Water Science Center Idaho Falls field office as the source water. Uncertainties for radionuclides are 1σ combined standard uncertainties. Values in **bold** indicate a sample detection. **Symbols:** \pm , plus or minus the specified uncertainty; $<$, less than. **Abbreviations:** pCi/L, picocuries per liter; mg/L, milligrams per liter; μ g/L, micrograms per liter; N, nitrogen; P, phosphorus; E, estimated]

Cesium-137 (pCi/L)	Tritium (pCi/L)	Strontium-90 (pCi/L)	Sodium (mg/L)
27 \pm 11	14 \pm 52	2.7\pm0.7	0.07E
Chloride (mg/L)	Sulfate (mg/L)	Ammonia (mg/L as N)	Nitrate plus nitrite (mg/L as N)
<0.12	<0.18	<0.02	<0.04
Nitrite (mg/L as N)	Orthophosphate (mg/L as P)	Chromium (μ g/L)	
<0.002	<0.008	7.0	

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