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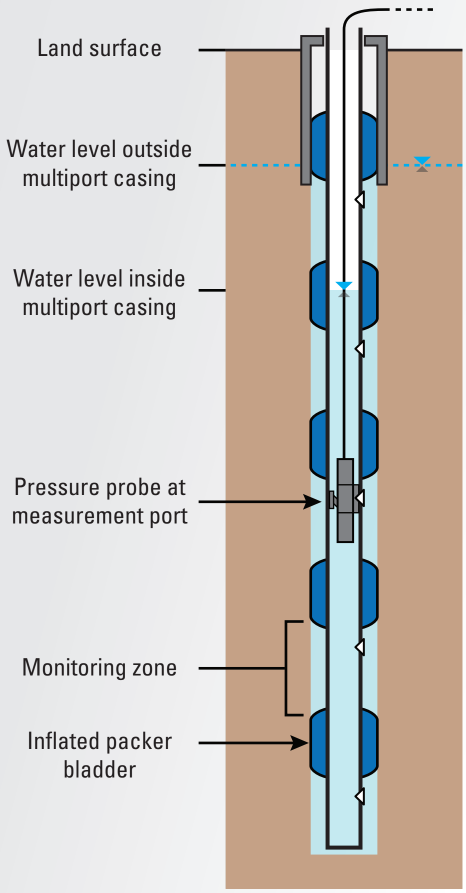
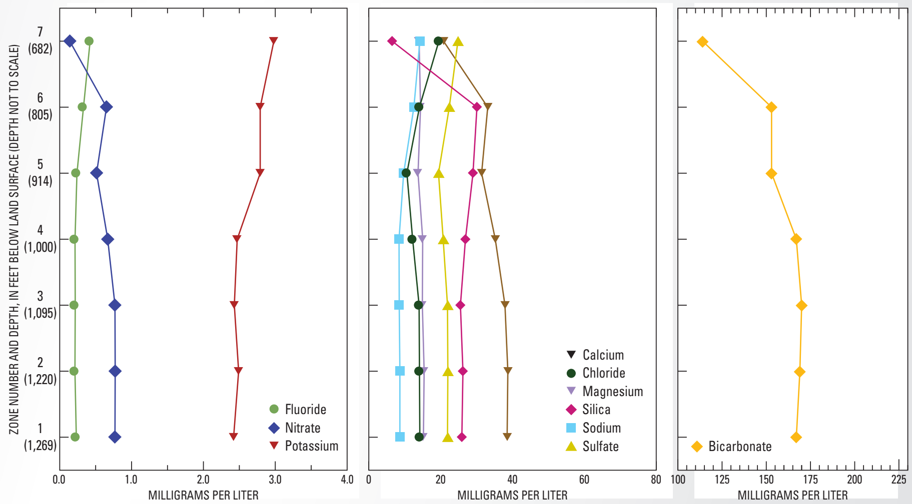
Chemical Constituents in Groundwater from Multiple Zones in the Eastern Snake River Plain Aquifer at the Idaho National Laboratory, Idaho, 2005–08





Scientific Investigations Report 2010–5116

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

Cover: Cross-section showing components of a multi-packer borehole completion, and average concentrations for selected chemical constituents from samples collected in 2007–08 from well USGS 103.

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By Roy C. Bartholomay and Brian V. Twining

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U.S. Geological Survey
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U.S. Geological Survey, Reston, Virginia: 2010

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Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	259.0	hectare (ha)
gallon (gal)	3.785	liter (L)
ounce, avoirdupois (oz avdp)	28.35	gram (g)
gallon (gal)	3.785	cubic decimeter (dm^3)
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year (m^3/yr)
foot squared per day (ft^2/d)	0.09290	meter squared per day (m^2/d)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
foot per second (ft/s)	0.3048	meter per second (m/s)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per day (ft^3/d)	0.02832	cubic meter per day (m^3/d)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
picocurie per liter (pCi/L)	0.037	Becquerel per liter (Bq/L)
attocurie per liter (aCi/L)	3.7×10^{-8}	Becquerel per liter (Bq/L)
foot per day (ft/d)	0.3048	meter per day (m/d)

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

$$°F=(1.8\times°C)+32.$$

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

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

Datums

Vertical coordinate information is referenced to National Geodetic Vertical Datum of 1929 (NGVD 29).

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

Altitude, as used in this report, refers to distance above the vertical datum.

Acronyms and Abbreviations

BLS	below land surface
C	carbon
DOE	Department of Energy
E	estimate
ESRP	Eastern Snake River Plain
H	hydrogen
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LRL	laboratory reporting levels
MDL	method detection limit
MP	Multiport
NRF	Naval Reactors Facility
NWQL	National Water Quality Laboratory
O	oxygen
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RESL	Radiological and Environmental Sciences Laboratory
RPD	relative percent difference
RTC	Reactor Technology Complex
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
TAN	Test Area North
USGS	U.S. Geological Survey

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Chemical Constituents in Groundwater from Multiple Zones in the Eastern Snake River Plain Aquifer at the Idaho National Laboratory, Idaho, 2005–08

By Roy C. Bartholomay and Brian V. Twining

Abstract

From 2005 to 2008, the U.S. Geological Survey's Idaho National Laboratory (INL) Project office, in cooperation with the U.S. Department of Energy, collected water-quality samples from multiple water-bearing zones in the eastern Snake River Plain aquifer. Water samples were collected from six monitoring wells completed in about 350–700 feet of the upper part of the aquifer, and the samples were analyzed for major ions, selected trace elements, nutrients, selected radiochemical constituents, and selected stable isotopes. Each well was equipped with a multilevel monitoring system containing four to seven sampling ports that were each isolated by permanent packer systems. The sampling ports were installed in aquifer zones that were highly transmissive and that represented the water chemistry of the top four to five model layers of a steady-state and transient groundwater-flow model. The model's water chemistry and particle-tracking simulations are being used to better define movement of wastewater constituents in the aquifer.

The results of the water chemistry analyses indicated that, in each of four separate wells, one zone of water differed markedly from the other zones in the well. In four wells, one zone to as many as five zones contained radiochemical constituents that originated from wastewater disposal at selected laboratory facilities. The multilevel sampling systems are defining the vertical distribution of wastewater constituents in the eastern Snake River Plain aquifer and the concentrations of wastewater constituents in deeper zones in wells Middle 2051, USGS 132, and USGS 103 support the concept of groundwater flow deepening in the southwestern part of the INL.

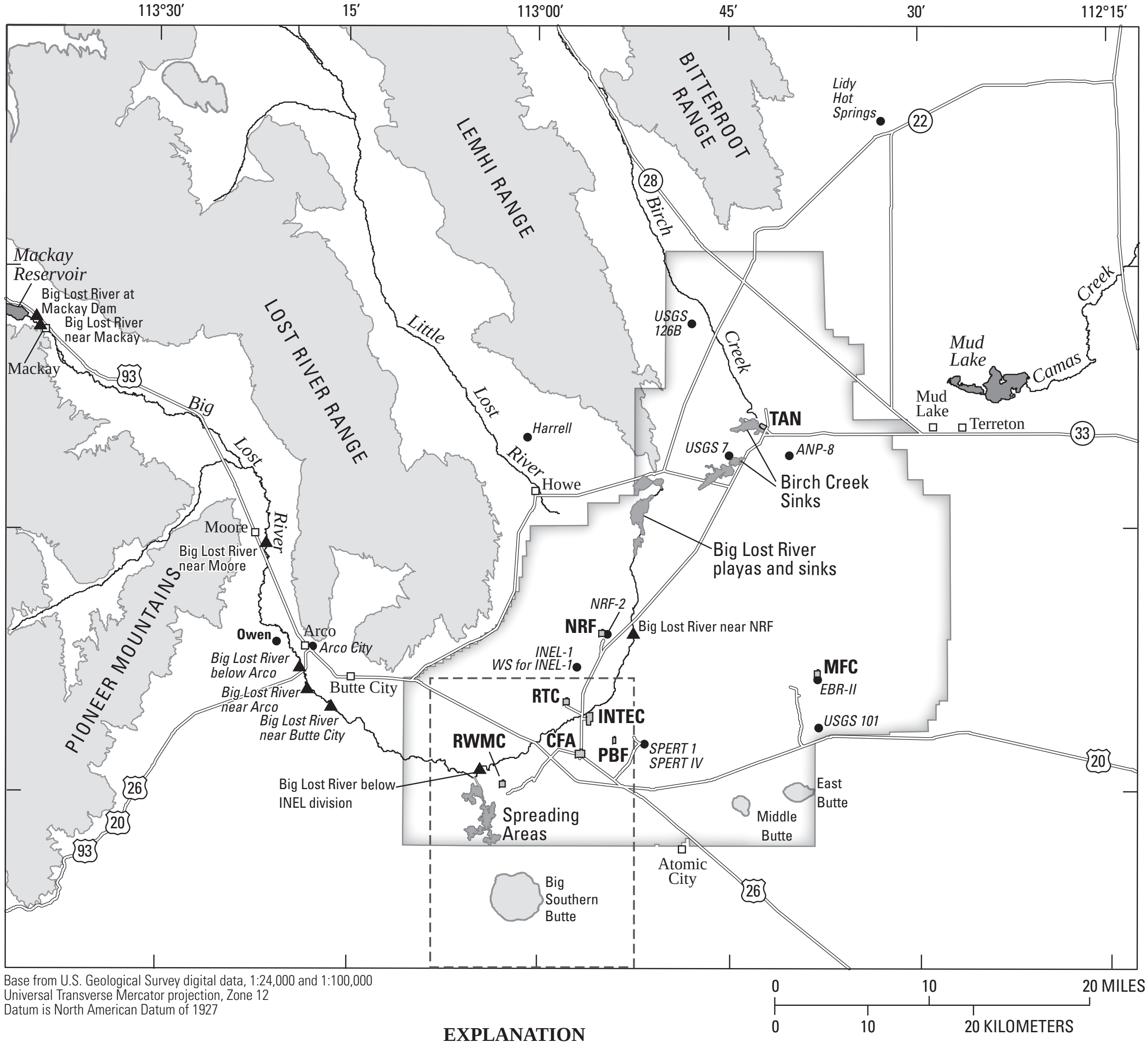
Introduction

The Idaho National Laboratory (INL), encompassing about 890 mi^2 of the eastern Snake River Plain (ESRP) in southeastern Idaho (fig. 1), is operated by the U.S. Department of Energy (DOE). The INL was established in 1949 for the development of peacetime atomic energy applications, nuclear safety research, defense programs, environmental research, and advanced energy concepts. Wastewater disposal sites at Test Area North (TAN), the Naval Reactors Facility (NRF), the Reactor Technology Complex (RTC), and the Idaho Nuclear Technology and Engineering Center (INTEC) (fig. 1) have been principal sources of radioactive- and chemical-waste contaminants in water from the ESRP aquifer. These wastewater disposal sites have included lined evaporation ponds, unlined infiltration ponds and ditches, drain fields, and injection wells. Waste materials buried in shallow pits and trenches within the Subsurface Disposal Area (SDA) at the Radioactive Waste Management Complex (RWMC) also have contributed contaminants to the groundwater.

Prior to 1984, most of the wastewater generated at the INTEC, which is located in the southwestern part of the INL, was injected directly to the ESRP aquifer through a 598-foot-deep disposal well. In February 1984, routine use of the disposal well was discontinued, and wastewater was then discharged to unlined infiltration ponds south of the INTEC until 2002 (when the ponds were relocated to about 2 mi southwest of INTEC). The infiltration ponds allowed the wastewater to percolate through about 450 ft of basalt and sediment to the aquifer.

Since 1952, wastewater generated at the RTC has been discharged mostly to ponds. Low-level radioactive wastewater was discharged to infiltration ponds until 1993; since then it has been discharged to evaporation ponds. Nonradioactive wastewater was discharged to the aquifer through a disposal well from 1964 to 1982, and has been discharged to infiltration ponds since 1982 (Davis, 2008).

The U.S. Geological Survey (USGS) has maintained a water-quality monitoring program at the INL since 1949 to define (1) the quality and availability of water for human consumption, (2) the usability of the water for supporting construction of facilities and for industrial purposes such as cooling systems and diluting concentrated waste streams, (3) the location and movement of contaminants in the ESRP aquifer, (4) the sources of recharge to the aquifer, (5) an early detection network for contaminants moving past the INL boundaries, and (6) the processes controlling the origin and distribution of contaminants and naturally occurring constituents in the aquifer (Ackerman and others, in press).



EXPLANATION

Big Lost River near NRF ▲ **Surface water site and identifier**

INEL-1 ● **Well or spring and identifier**

Selected facilities at the Idaho National Laboratory

CFA	Central Facilities Area
INTEC	Idaho Nuclear Technology and Engineering Center
MFC	Materials and Fuels Complex
NRF	Naval Reactors Facility
PBF	Power Burst Facility
RWMC	Radioactive Waste Management Complex
RTC	Reactor Technology Complex—also Known as Test Reactor Area
TAN	Test Area North

Boundary of Idaho National Labororatory

Area shown in figure 2

Figure 1. Location of the Idaho National Laboratory and selected sites, Idaho.

Since the inception of the monitoring program, a network that once numbered almost 200 wells has been sampled for various constituents including tritium, strontium-90, cesium-137, plutonium-238, plutonium-239, -240 (undivided), americium-241, gross alpha- and gross beta-radioactivity, iodine-129, chromium and other trace elements, sodium, chloride, sulfate, nitrate, fluoride, volatile organic compounds, and total organic carbon (Davis, 2008; Bartholomay, 2009). Most of the wells in this network were constructed as open-borehole wells, and many of the wells are open to the aquifer through their entire depth below the water table. This type of construction is good for maximum water-production rates, for identifying the time of arrival of contaminant plumes, and for delineating the horizontal extent of contaminants. However, it is not conducive to identifying either the vertical distribution of contaminants or pressure and temperature gradients (J.P. Rousseau, USGS, written commun., December 2006).

To acquire water-chemistry data that describe the vertical distribution of constituents in the ESRP aquifer, the USGS collaborated with an INL contractor in 2005 to develop a multilevel monitoring network. The multilevel network allows for sampling of discrete zones of water versus sampling an open, mixed zone. The multilevel monitoring network was expanded by the USGS in 2006 and 2007. In 2005, 2006, and 2007, wells Middle 2050A, Middle 2051, USGS 103, USGS 132, USGS 133, and USGS 134 (fig. 2) were instrumented with multilevel Westbay™ packer sampling systems to acquire water-quality samples and pressure and temperature measurements at isolated depths in each of the wells. These isolated depths coincide with the vertical location of groundwater model layers (table 1, fig. 3) in which particles are introduced to simulate groundwater flowpaths (Ackerman and others, in press).

Purpose and Scope

This report presents water-chemistry results from water samples collected between 2005 and 2008 from six wells equipped with multilevel monitoring systems completed in the upper 350–700 ft of the eastern Snake River Plain aquifer at the INL. Water chemistry is compared in different zones with water-source types throughout the INL. Two wells (Middle 2050A and Middle 2051), each with five sample ports, were instrumented in 2005; two wells (USGS 132 and USGS 134) with six and five sample ports, respectively, were instrumented in 2006; and two wells (USGS 103 and USGS 133) with seven and four sample ports, respectively, were instrumented in 2007. The sample ports were installed in zones of the aquifer that were highly transmissive of groundwater and that represented the water chemistry of the top four to five layers of the USGS INL groundwater model for steady-state and transient groundwater flow (Ackerman and others, in press).

Water samples that were collected from four wells in 2006 were analyzed for dissolved cations and anions; trace elements; nutrients; isotopes of oxygen, hydrogen, and carbon; dissolved gasses and chlorofluorocarbons; total organic carbon; uranium isotopes; tritium; strontium-90; plutonium and americium isotopes; and gross alpha, beta, and gamma radioactivity. Analyses of dissolved gas and chlorofluorocarbon samples indicated possible contamination from excess air in the system (Ed Busenberg, USGS oral commun., 2006) that probably was introduced during the drilling process. As a result, those sample results are not reported. A few samples collected in subsequent years still indicated probable contamination. Two wells (USGS 103 and USGS 133) were sampled for the first time in 2007 for all constituents sampled for in 2006, except for dissolved gases and chlorofluorocarbons. The list of constituents that were sampled for in 2007 and 2008 was revised based on results from the first round of sampling. For the entire period of sampling, eight replicate samples, two blank samples, and two samples of drilling water were collected as a measure of quality assurance. Iodine-129 was collected from all six wells in 2007, and the analysis results were reported in Bartholomay (2009). Tritium was sampled at two different detection levels in 2008 at all six wells.

Geohydrologic Setting

The INL is located on the west-central part of the ESRP. The ESRP is a northeast-trending structural basin about 200 mi long and 50–70 mi wide (fig. 1). The basin, bounded by faults on the northwest and by downwarping and faulting on the southeast, has been filled with basaltic-lava flows interbedded with terrestrial sediments. The basaltic rocks and sedimentary deposits combine to form the ESRP aquifer, which is the primary source of groundwater on the plain.

The ESRP aquifer is one of the most productive aquifers in the United States (U.S. Geological Survey, 1985, p. 193). Water in the aquifer generally moves from northeast to southwest, and eventually discharges to springs along the Snake River downstream of Twin Falls, ID, about 100 mi southwest of the INL. Water moves horizontally through basalt interflow zones and vertically through joints and interfingering edges of interflow zones. Infiltration of surface water, heavy pumpage, geologic conditions, and seasonal fluxes of recharge and discharge locally affect the movement of groundwater (Garabedian, 1986). The ESRP aquifer is recharged principally from infiltration of applied irrigation water, infiltration of streamflow, groundwater inflow from adjoining mountain drainage basins, and infiltration of precipitation.

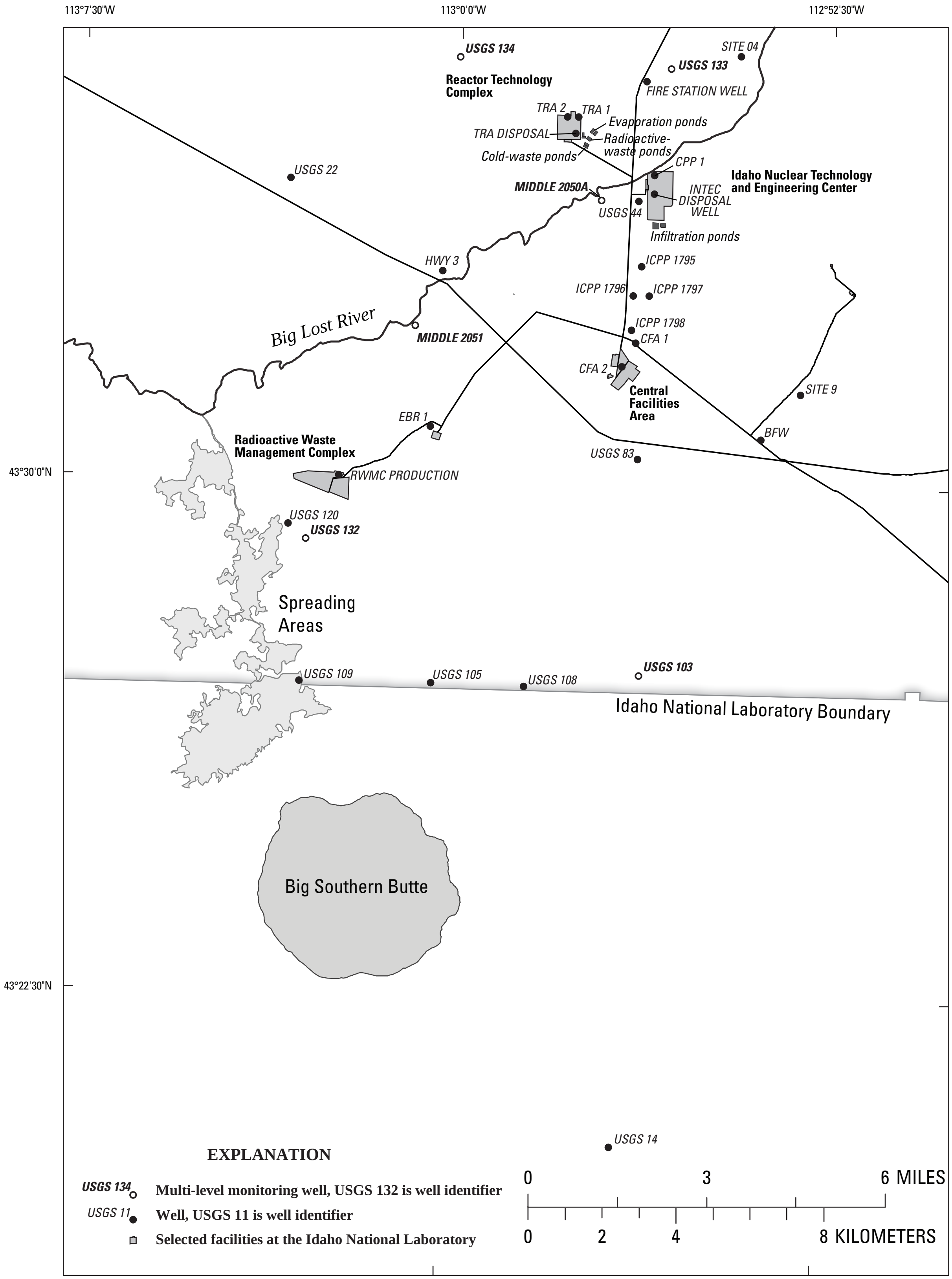


Figure 2. Location of wells at the Idaho National Laboratory, Idaho.

Table 1. Well identifier, port depth, interval sampled, and groundwater model layer information from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005-08.

[Well locations are shown in figure 2. Port depth and interval sampled in feet below land surface. **Model layer:** See Ackerman and others (in press) for more information. Layer 1 represents water from the upper 100 feet of the aquifer; layer 2 represents water from 100 to 200 feet below the top of the aquifer; layer 3 represents water from 200 to 300 feet below the top of the aquifer; layer 4 represents water from 300 to 500 feet below the top of the aquifer; layer 5 represents water from 500 to 800 feet below the top of the aquifer; and layer 6 represents water from greater than 800 feet below the top of the aquifer; none of the wells reach model layer 6]

Well name	Site identifier	Port depth	Interval sampled	Model layer
Middle 2050A				
Zone 5	433409112570515	515	464 – 536	1
Zone 4	433409112570512	642	642 – 700	2 and 3
Zone 3	433409112570509	790	787 – 804	4
Zone 2	433409112570506	998	998 – 1,038	5
Zone 1	433409112570503	1,179	1,179 – 1,224	5
Middle 2051				
Zone 5	433217113004912	604	564 – 610	1
Zone 4	433217113004909	750	745 – 771	2 and 3
Zone 3	433217113004906	828	828 – 876	3 and 4
Zone 2	433217113004903	1,092	1,092 – 1,128	5
Zone 1	433217113004901	1,142	1,142 – 1,178	5
USGS 103				
Zone 7	432714112560723	682	672 – 694	1 and 2
Zone 6	432714112560720	805	770 – 836	2 and 3
Zone 5	432714112560716	914	896 – 925	4
Zone 4	432714112560712	1,000	964 – 1,021	4
Zone 3	432714112560708	1,095	1,071 – 1,107	4 and 5
Zone 2	432714112560704	1,220	1,194 – 1,251	5
Zone 1	432714112560702	1,269	1,269 – 1,291	5
USGS 132				
Zone 6	432906113025022	636	623 – 657	1
Zone 5	432906113025018	764	726 – 785	2
Zone 4	432906113025014	826	810 – 861	3
Zone 3	432906113025010	917	910 – 933	4
Zone 2	432906113025006	1,010	984 – 1,041	4
Zone 1	432906113025001	1,172	1,152 – 1,213	5
USGS 133				
Zone 4	433605112554312	468	447 – 480	1
Zone 3	433605112554308	568	554 – 590	2
Zone 2	433605112554305	685	684 – 695	3
Zone 1	433605112554301	744	724 – 764	4
USGS 134				
Zone 5	433611112595819	578	554 – 588	1
Zone 4	433611112595815	644	638 – 650	2
Zone 3	433611112595811	706	690 – 718	2 and 3
Zone 2	433611112595807	806	782 – 816	3 and 4
Zone 1	433611112595804	[1]846	846 – 866	4
Zone 1	433611112595803	856	846 – 866	4

[1]The port at 856 feet below land surface was damaged in 2007, so samples were collected from the port at 846 feet below land surface in 2008.

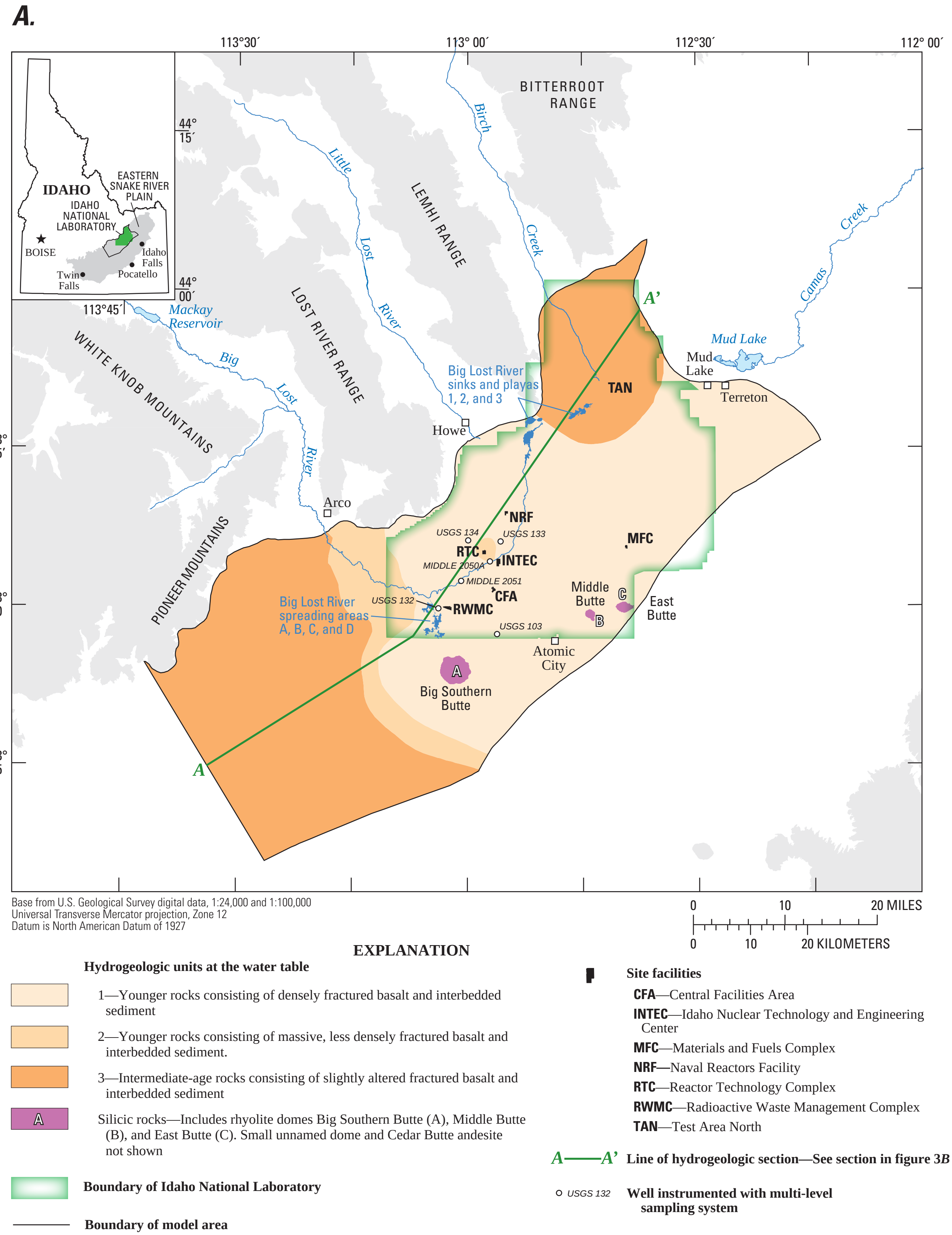


Figure 3. (*A*) Distribution of hydrogeologic units at the water table and cross section showing (*B*) borehole depth in relation to model layers and hydrogeologic units along section A-A’, Idaho National Laboratory and vicinity, Idaho.

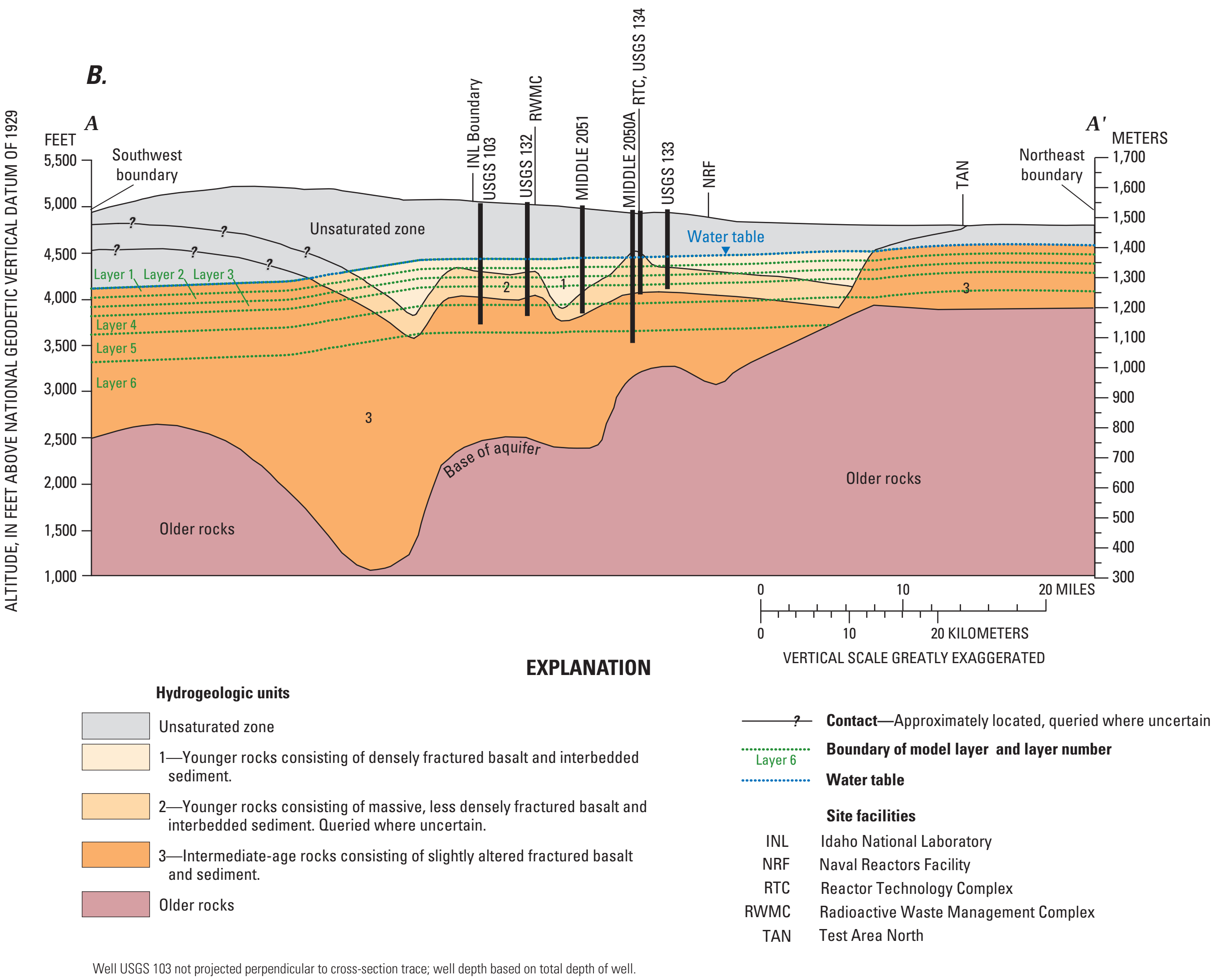


Figure 3.—Continued.

At the INL, depth to water in wells completed in the ESRP aquifer ranges from about 200 ft in the northern part of the site to more than 900 ft in its southeastern part. A significant proportion of the groundwater moves through the upper 200–800 ft of basaltic rocks (Mann, 1986, p. 21). Ackerman (1991, p. 30) and Bartholomay and others (1997, table 3) reported a range of transmissivity of basalt in the upper part of the aquifer of 1.1–760,000 ft^2/d. The hydraulic gradient at the INL ranges from 2 to 10 ft/mi, with an average of 4 ft/mi (Davis, 2008, fig. 11). Horizontal flow velocities of 2–20 ft/d have been calculated based on the movement of various constituents in different areas of the aquifer at the INL (Robertson and others, 1974; Mann and Beasley, 1994; Cecil and others, 2000; Busenberg and others, 2001). These flow rates equate to a travel time of about 70–700 years for water beneath the INL to travel to springs that discharge at the terminus of the ESRP aquifer. Localized tracer tests at the INL have revealed vertical- and horizontal-transport rates as high as 60–150 ft/d (Nimmo and others, 2002; Duke and others, 2007).

Previous Investigations

Many investigations have evaluated the geology and hydrology of the ESRP aquifer at the INL. A comprehensive listing of publications by the USGS is available at: http://id.water.usgs.gov/projects/INL/publication.html.

Some of the previous investigations of water chemistry at different depths in the ESRP aquifer at the INL were documented in Peckman (1959), Jones (1961), Olmsted (1962), Mann (1986), Mann and Cecil (1990), Fromm and others (1994), U.S. Department of Energy (2004, 2007, and 2008), and Bartholomay (2009).

Peckman (1959) discussed the hydrology and chemical quality of groundwater in the INTEC area. Nearly 1,000 samples were collected with a thief sampler from different depths in 13 wells, mostly looking at variations in chloride concentrations. Rates of movement of groundwater from the injection well to the monitoring wells were estimated from fluctuations in the chloride concentration of the water.

Jones (1961) defined five principal aquifers that occur locally from 460 to 660 ft below land surface (BLS) near the INTEC. Sodium concentrations were determined from selected depths from samples collected with a thief sampler. Comprehensive chemical analyses were conducted on samples collected from aquifers isolated during packer tests and by thief samples. These analyses included determinations of chromium, strontium, iodine, and other constituents. Dissolved–solids concentrations ranged from about 200 to 500 mg/L, and specific conductance ranged from about 350 to 880 µS/cm at 25°C. The flow zone (called aquifer D) was isolated by packers to test water quality and movement. Data indicated that flow from this zone moved primarily to the west, and that it did not seem to be influenced by regional flow.

Olmsted (1962) presented results of the chemical and physical properties of 148 groundwater samples collected at the INL, and defined four major water types for the aquifer at the INL. As part of the sample collection, thief samples were collected from USGS 7 (fig. 1) from depths of 380, 440, 720, 780, and 825 ft BLS (Olmsted, 1962, table 1). Concentrations of calcium, bicarbonate, and sulfate were much smaller in the sample from the 380-ft depth than in samples from the other zones. The sulfate concentration in the sample from the 825-ft zone was more than double the values from the other zones. Olmsted (1962) also evaluated specific conductance variations in several wells at the INL at different depths, and noted that, in most wells, the specific conductance was lower in the upper 50 ft of the aquifer than in the deeper zones. Olmsted (1962) interpreted the lower specific conductance water as being "fresher" water.

Mann (1986) presented results from water samples collected from four different intervals from well INEL-1 (fig. 1). Water samples were collected from intervals of 1,511–2,206; 3,559–3,713; 3,559–4,878; and 4,210–10,365 ft BLS, and the samples were analyzed for common ions and trace elements. An additional sample for comparison was collected from well Water Supply (WS) for INEL-1 (fig. 1) from the interval of 395–595 ft BLS. The dissolved solids and chemical composition of the water changed markedly with depth. Dissolved-solid concentrations changed from 381 mg/L in the 395–595 ft interval to 1,020 mg/L in the deepest interval. The water chemistry changed from a calcium-magnesium-bicarbonate water in the shallowest interval to a sodium-bicarbonate water in the deeper intervals. This change in chemistry coincides with the change from basaltic rocks in the upper interval to rhyolitic rocks in the deeper intervals.

Mann and Cecil (1990) presented tritium results collected with a thief sampler in 1983 from various depths in the aquifer from wells USGS 103, USGS 105, and USGS 108 along the southern boundary of the INL (fig. 2). The tritium concentration in one sample collected in July 1983 from USGS 103 was 800 ± 200 pCi/L. Tritium concentrations in 10 samples collected in October and November 1983 at depths from 588 to 750 ft BLS were less than the reporting level in all 10 samples. Tritium concentrations in nine water samples collected in October and November 1983 at depths from 670 to 795 ft BLS in USGS 105 ranged from less than the reporting level to 3,400 ± 200 pCi/L; concentrations in three of the nine samples exceeded the reporting level. Tritium concentrations in 11 water samples collected in October and November 1983 at depths from 610 to 755 ft BLS in USGS 108 were greater than the reporting level in all 11 samples; the concentrations ranged from 830 ± 90 to 3,400 ± 200 pCi/L.

Fromm and others (1994) presented results from water samples collected from six aquifer intervals isolated by a straddle packer system in USGS 44 (fig. 2). Water samples were analyzed for common ions, trace elements, nutrients, and selected radionuclides. Concentrations of tritium, iodine-129, nitrate, and chloride were highest in the deepest sample interval (580–600 ft) .

The U.S. Department of Energy (2004) summarized data collected from four wells south of the INTEC (ICPP 1795–1798, fig. 2). Samples were collected from several different zones using an inflatable packer sampling system in the aquifer to determine concentrations above, within, and beneath the H-I interbed to support results of iodine-129 contaminant transport modeling. Water samples were analyzed for tritium, strontium-90, iodine-129, technecium-99, and gross alpha and gross beta radiation. Concentrations of iodine-129 in the northernmost well, ICPP-1795 (fig. 2), increased from 0.34 ± 0.04 pCi/L at a depth of 560 ft BLS to 0.43 ± 0.07 pCi/L at a depth of 620 ft BLS. Concentrations of iodine-129 in three wells farther to the south decreased with depth—concentrations in the upper zone ranged from 0.58 ± 0.1 to 0.88 ± 0.08 pCi/L and concentrations in the lower zone ranged from not detected to 0.33 ± 0.05 pCi/L. The highest strontium-90 concentration was 8.86 ± 1.18 pCi/L from ICPP-1796 at a depth of 485 ft BLS. The highest tritium concentration was 11,100 ± 317 pCi/L from ICPP-1795 at a depth of 560 ft BLS. The highest technicium-99 concentration was 39.4 ± 2.91 pCi/L from ICPP-1797 at a depth of 472–503 ft BLS.

The U.S. Department of Energy (2007) presented results for INL contractor data collected in 2005 and 2006 from five zones each from two wells (Middle 2050A and Middle 2051) equipped with Westbay™ multilevel monitoring systems. Samples were analyzed for volatile organic compounds, metals, anions, and radionuclides. Water from the upper zone from Middle 2051 was similar in chemical composition to water from well Hwy 3. Water from deeper zones indicated some influence of waste disposal at the RTC. Concentrations of tritium, chloride, and sulfate in water samples from all five zones from Middle 2050A were less than detection limits or equal to background concentrations, which was interpreted by the authors that waste disposal at the INTEC and the RTC had not influenced water from any of the five zones.

The U.S. Department of Energy (2007) also presented results from two packer samples collected from well USGS 105 at intervals of 676–704 ft and 769–790 ft BLS and from well USGS 108 at intervals of 613–627 ft and 657–760 ft BLS (fig. 2). Samples were analyzed for common ions and nitrate. Concentrations of chloride and sulfate were larger in the shallow sample from USGS 105; the authors attributed this to migration of water from the RWMC area. Chloride and sulfate concentrations in the deeper zone in USGS 105 were similar to background concentrations reported by Robertson and others (1974). Chloride and sulfate concentrations in both samples from USGS 108 were similar to the pumped sample.

The U.S. Department of Energy (2008) presented results for samples collected in 2007 by the INL contractor. A Westbay™ Mulitport System was used by the contractor to collect samples from three wells: Middle 2050A and Middle 2051 (five zones each), and USGS 132 (six zones). Samples were analyzed for volatile organic compounds, metals, anions, and radionuclides. Sulfate and chloride concentrations in water from the upper zone were much larger from USGS 132 than in the other five zones; these concentrations were similar to concentrations in samples from other wells south of the RWMC that generally indicate a high anion anomaly. Concentrations from the other five zones in USGS 132 were similar to two intervals sampled from Middle 2051.

Methods and Quality Assurance

Multilevel Monitoring System

The Westbay™ Multiport (MP) System was selected for multilevel groundwater monitoring at the INL. This system consists of a series of packers, measurement ports, magnetic collars, and variable length sections of casing (fig. 4). The multilevel monitoring system works to restore the initial pressure and chemical conditions in the borehole prior to drilling. The multilevel monitoring system is completely enclosed with a bore plug at the bottom and casing sections, sealed with o-rings, that run the entire length of the borehole. Each casing joint is leakproof tested during installation to form a continuous, rigid, sealed system that prohibits water from getting in or out. However, if a leak occurs at any joint, hydraulic isolation between the groundwater in the formation and any water inside the casing is maintained because the tubes connect only at the ports (Parker and others, 2006). The modular construction and varying lengths of polyvinyl chloride (PVC) sections allow ports and, therefore, monitoring intervals, to be placed at almost any desired depth within a hole, provided that the spacing between each interval is great enough to accommodate a sufficient seal.

Two specific MP systems were installed: the MP 38 and the MP 55. The MP-38 system is best suited for boreholes 3–4.5 in. in diameter, because the components are slightly smaller in diameter. The MP-38 system was purchased for well USGS 134 due to borehole diameter constraints that would not allow for the larger MP-55 system. The MP-55 system uses packers, ports, and casing segments similar to those of the MP 38, but they are larger in diameter and are thus better suited for 4.5–6 in. diameter boreholes. Another advantage of the MP-55 system is the ability to collect water samples of greater volume, approximately 2 L per run. MP-55 systems were installed in five of the six multiport boreholes (Middle 2050A, Middle 2051, USGS 103, USGS 132, and USGS 133).

Core material, borehole geophysics, and borehole video information were used to identify fractures, dense basalt, and sediment interbeds to determine the best locations for monitoring zones and packers. Core and lithologic information for Middle 2050A, Middle 2051, USGS 132, USGS 133, and USGS 134 are described in North Wind, Inc. (2006) and Twining and others (2008). The sample ports were installed in zones of the aquifer that appeared to have a large transmissivity of groundwater and that represented the water chemistry of the top four to five layers of the USGS INL groundwater model for steady-state and transient groundwater flow (Ackerman and others, in press). Multiport packers extend about 5 ft, so it was important to find areas of massive basalt for placement to prevent vertical flow in the borehole. A more detailed description of the installation for each of the six wells can be found in North Wind, Inc. (2006) and a draft USGS report (Jason Fisher, USGS, written commun., January 20, 2010).

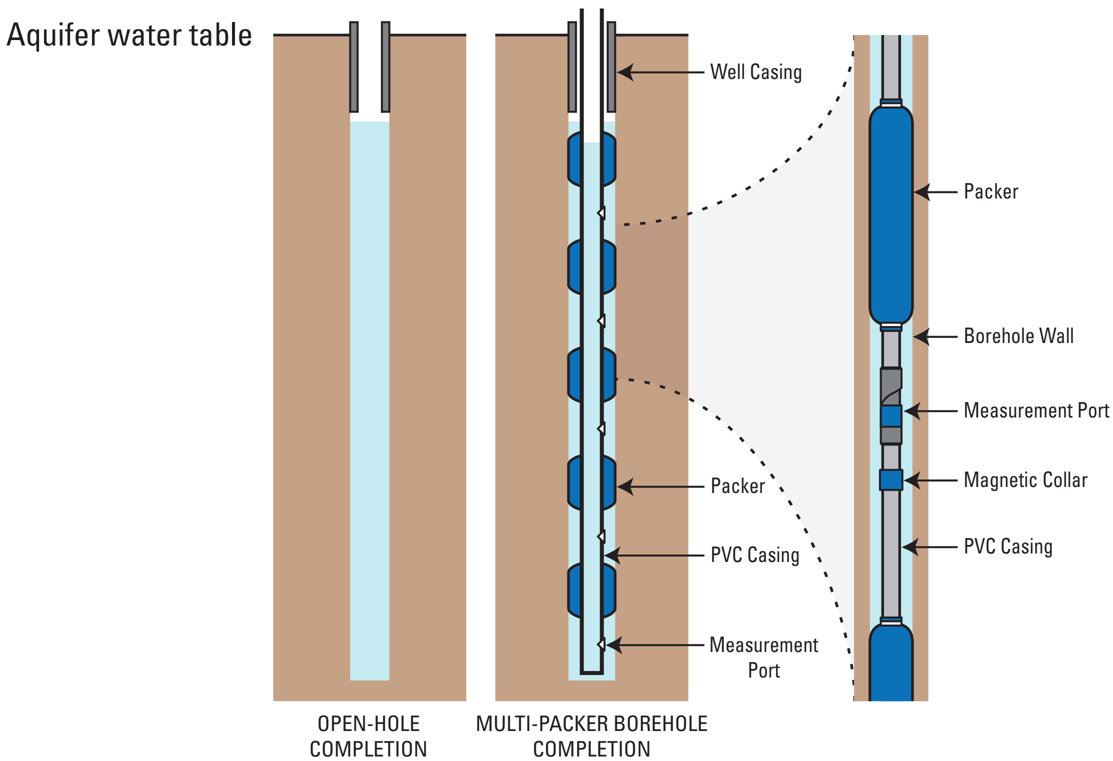


Figure 4. Components of the Westbay™ Multiport (MP) System for multilevel groundwater monitoring.

Sample Collection

Sample collection by the USGS at the INL generally followed guidelines established by the USGS that are documented in the USGS National Field Manual (U.S. Geological Survey, variously dated), Bartholomay and others (2003), and Knobel and others (2008). Water samples were collected from six wells each equipped with a dedicated Westbay™ Multiport (MP) System. A list of sample port depths from a total of 32 sampling zones from the aquifer are shown in tables 1–9.

Samples were collected using pre-cleaned, stainless-steel thief sampling bottles that were lowered to the zone to be sampled, connected to the sampling port, and filled with formation water. The stainless-steel bottles were then raised to the surface and emptied into a pre-cleaned container; the water was then processed to fill appropriate bottles for analyses. Field measurements also were taken from the pre-cleaned container for pH, specific conductance, water temperature, dissolved oxygen, alkalinity, and turbidity (table 2). Sample bottles were cleaned between uses in each sample zone by washing them in a liquinox solution and rinsing them with deionized water.

Field processing of samples differed depending on the constituents for which analyses were requested. Samples analyzed by the USGS National Water Quality Laboratory (NWQL) were placed in containers and preserved in accordance with laboratory requirements specified by Timme (1995) and Knobel and others (2008, app. A). Containers and preservatives used for this study were supplied by the NWQL and had undergone a rigorous quality-control procedure (Pritt, 1989, p. 75) to minimize sample contamination. Samples requiring filtration consisted of filtering the water through a disposable 0.45-µm filter cartridge that had been pre-rinsed with at least 1 L of deionized water. Samples analyzed by the Radiological and Environmental Sciences Laboratory (RESL) at the INL were placed in containers and preserved in accordance with laboratory requirements specified by Bodnar and Percival (1982) and Knobel and others (2008, app. A).

Analytical Methods

Analytical methods used by the USGS NWQL for selected organic, inorganic, and radionuclide constituents are described by Goerlitz and Brown (1972), Thatcher and others (1977), Wershaw and others (1987), Fishman and Friedman (1989), Faires (1993), Fishman (1993), Rose and Schroeder (1995), and McCurdy and others (2008). A discussion of procedures used by the DOE RESL for the analysis of radionuclides in water is provided by Bodnar and Percival (1982), Sill and Sill (1994), and U.S. Department of Energy (1995).

Table 2. Field measurements of pH, specific conductance, water temperature, dissolved oxygen, alkalinity, and turbidity, and calculations of dissolved solids in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.

[Well locations are shown in figure 2. Port depth in feet below land surface. **Units:** pH, negative base-10 logarithm of hydrogen ion activity in moles per liter; specific conductance, microsiemens per centimeter at 25 degrees Celsius; water temperature, degrees Celsius; dissolved oxygen, milligrams per liter; alkalinity, reported as calcium carbonate ($CaCO_3$), in milligrams per liter; turbidity, nephlometric turbidity units. NS, not sampled. E, estimated; NA, not analyzed. **Remarks:** QAW, quality assurance Westbay™ replicate sample. Values for replicates are the same measurement as the primary sample]

Well name	Port depth	Date	Time	pH	Specific conductance	Water temperature	Dissolved oxygen	Alkalinity	Turbidity	Dissolved solids, sum (as $CaCO_3$)	Remarks
Middle 2050A											
Zone 5	515	09-30-05	0924	7.62	432	11.3	9.84	NS	NS	NS	
		09-19-06	1430	7.87	335	11.7	6.88	150	NS	204	
		09-20-07	1348	7.87	426	13.0	7.19	168	NS	256	
		08-27-08	1200	7.69	421	11.1	7.60	164	0.5	253	
		08-27-08	1205	7.69	421	11.1	7.60	164	0.5	255	QAW-11
Zone 4	642	09-30-05	1252	7.47	421	12.3	10.1	NS	NS	NS	
		09-19-06	1047	7.94	348	11.2	5.69	146	NS	207	
		09-20-07	1208	7.79	352	12.8	7.42	144	NS	210	
		08-26-08	1615	7.70	351	11.6	7.42	149	0.52	211	
Zone 3	790	10-14-05	1125	7.41	404	12.9	10.5	NS	NS	NS	
		09-20-06	1315	7.85	396	11.5	9.04	168	NS	236	
		09-20-06	1320	7.85	396	11.5	9.04	168	NS	238	QAW-5
		09-20-07	1036	7.70	398	12.6	10.7	164	NS	238	
		08-26-08	1455	7.66	398	12.8	7.79	170	2.05	236	
Zone 2	998	10-07-05	1010	7.57	392	10.9	10.0	NS	NS	NS	
		09-18-06	1550	7.82	382	13.0	7.70	160	NS	227	
		09-19-07	1415	7.67	387	13.3	10.6	158	NS	225	
		08-26-08	1325	7.55	384	14.0	9.80	164	1.08	223	
Zone 1	1,179	10-21-05	1030	7.52	398	11.1	9.87	NS	NS	NS	
		09-18-06	1254	7.89	397	12.5	6.66	182	NS	226	
		09-19-07	1205	7.80	391	13.0	6.25	166	NS	224	
		08-26-08	1128	7.70	379	15.1	6.74	172	1.83	221	
Middle 2051											
Zone 5	604	09-27-05	1056	7.54	351	12.1	10.2	NS	NS	NS	
		09-11-06	1505	7.73	351	13.3	6.61	154	NS	215	
		09-12-07	1312	7.66	354	12.5	7.09	151	NS	215	
		08-25-08	1206	7.47	346	10.5	7.55	154	0.59	214	
Zone 4	750	09-27-05	1425	7.55	384	13.0	10.2	NS	NS	NS	
		09-13-06	1223	7.82	380	13.0	9.54	158	NS	230	
		09-13-06	1228	7.82	380	13.0	9.54	158	NS	229	QAW-4
		09-12-07	1120	7.89	383	13.2	9.90	152	NS	229	
		09-12-07	1125	7.89	383	13.2	9.90	152	NS	230	QAW-8
		08-25-08	1035	7.61	383	13.1	9.80	154	0.55	229	
Zone 3	828	09-28-05	1117	7.43	396	13.1	9.36	NS	NS	NS	
		09-12-06	1245	7.90	390	12.7	4.60	164	NS	230	
		09-12-06	1250	7.90	390	12.7	4.60	164	NS	232	QAW-3
		09-11-07	1525	7.89	386	13.8	8.84	162	NS	235	
		08-21-08	1514	7.73	390	13.4	10.3	158	0.48	229	

Table 2. Field measurements of pH, specific conductance, water temperature, dissolved oxygen, alkalinity, and turbidity, and calculations of dissolved solids in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. **Units:** pH, negative base-10 logarithm of hydrogen ion activity in moles per liter; specific conductance, microsiemens per centimeter at 25 degrees Celsius; water temperature, degrees Celsius; dissolved oxygen, milligrams per liter; alkalinity, reported as calcium carbonate ($CaCO_3$), in milligrams per liter; turbidity, nephlometric turbidity units. NS, not sampled. E, estimated; NA, not analyzed. **Remarks:** QAW, quality assurance Westbay™ replicate sample. Values for replicates are the same measurement as the primary sample]

Well name	Port depth	Date	Time	pH	Specific conductance	Water temperature	Dissolved oxygen	Alkalinity	Turbidity	Dissolved solids, sum (as $CaCO_3$)	Remarks
Zone 2	1,092	09-28-05	1520	7.56	361	13.9	10.8	NS	NS	NS	
		09-11-06	1139	7.89	362	13.2	8.99	144	NS	217	
		09-11-07	1346	7.78	363	13.8	9.99	142	NS	220	
		08-21-08	1330	7.64	366	15.0	9.31	146	0.39	217	
Middle 2051—Continued											
Zone 1	1,142	09-29-05	1144	7.28	422	13.3	9.80	NS	NS	NS	
		09-07-06	1226	7.68	363	13.3	7.50	146	NS	218	
		09-11-07	1108	7.62	360	13.5	9.45	146	NS	220	
		08-21-08	1126	7.55	366	15.1	10.7	144	0.75	220	
USGS 103											
Zone 7	682	10-02-07	1435	7.92	306	13.1	5.74	88	NS	156	
		08-20-08	1028	8.28	304	13.1	5.47	100	11.5	165 E	
Zone 6	805	10-02-07	1235	7.76	338	12.8	13.2	126	NS	211	
		08-19-08	1615	7.73	342	12.7	12.4	125	6.83	214 E	
Zone 5	914	10-01-07	1710	7.71	321	12.8	12.7	126	NS	200	
		08-19-08	1438	7.68	315	12.6	10.8	125	1.28	196	
Zone 4	1,000	10-01-07	1445	7.82	338	12.7	9.58	134	NS	205	
		08-18-08	1705	7.74	343	12.4	8.90	140	1.17	211 E	
Zone 3	1,095	10-01-07	1225	7.81	355	12.6	9.70	138	NS	216	
		08-18-08	1540	7.72	360	12.4	9.21	140	1.25	215	
Zone 2	1,220	09-25-07	1525	7.81	357	13.4	10.8	136	NS	215	
		08-18-08	1408	7.69	357	12.4	10.2	140	0.78	219	
		08-18-08	1414	7.69	357	12.4	10.2	140	0.78	220	QAW-10
Zone 1	1,269	09-25-07	1250	7.74	352	13.1	10.5	136	NS	216	
		08-19-08	1255	7.68	364	12.5	9.96	138	1.46	219	
USGS 132											
Zone 6	636	09-06-06	1315	8.00	434	13.7	6.59	150	NS	268	
		09-18-07	1652	7.99	433	12.6	7.00	144	NS	264	
		08-14-08	1306	7.91	478	11.6	6.94	140	0.47	275 E	
		08-14-08	1311	7.91	478	11.6	6.94	140	0.47	275 E	QAW-9
Zone 5	764	09-05-06	1428	7.95	364	13.9	8.05	146	NS	222	
		09-18-07	1410	7.85	365	12.9	8.25	142	NS	221	
		08-13-08	1348	7.88	364	12.3	8.38	144	0.9	220	
Zone 4	826	09-05-06	1054	7.99	353	12.6	8.05	140	NS	218	
		09-18-07	1224	7.98	352	12.8	9.03	138	NS	214	
		08-13-08	1210	7.80	358	12.4	9.28	140	2.59	214	

Table 2. Field measurements of pH, specific conductance, water temperature, dissolved oxygen, alkalinity, and turbidity, and calculations of dissolved solids in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. **Units:** pH, negative base-10 logarithm of hydrogen ion activity in moles per liter; specific conductance, microsiemens per centimeter at 25 degrees Celsius; water temperature, degrees Celsius; dissolved oxygen, milligrams per liter; alkalinity, reported as calcium carbonate ($CaCO_3$), in milligrams per liter; turbidity, nephlometric turbidity units. NS, not sampled. E, estimated; NA, not analyzed. **Remarks:** QAW, quality assurance Westbay^{TM} replicate sample. Values for replicates are the same measurement as the primary sample]

Well name	Port depth	Date	Time	pH	Specific conductance	Water temperature	Dissolved oxygen	Alkalinity	Turbidity	Dissolved solids, sum (as $CaCO_3$)	Remarks
Zone 3	917	08-31-06	1218	7.90	352	12.8	8.49	144	NS	216	
		09-18-07	1048	7.94	351	12.4	9.22	144	NS	215	
		08-13-08	0954	7.73	356	12.2	10.2	136	2.82	211	
USGS 132—Continued											
Zone 2	1,010	08-30-06	1242	7.94	357	13.4	7.98	172	NS	213	
		09-17-07	1425	7.95	355	14.0	8.58	144	NS	215	
		08-12-08	1452	7.91	353	11.8	8.89	136	5.15	213	
Zone 1	1,172	08-29-06	1030	7.88	368	13.7	8.70	146	NS	222	
		09-17-07	1225	7.95	367	13.0	9.38	144	NS	220	
		08-12-08	1322	7.90	366	10.6	9.49	146	4.6	220 E	
USGS 133											
Zone 4	468	09-24-07	1700	7.64	339	11.3	5.85	132	NS	202	
		09-02-08	1425	7.54	338	11.1	7.46	134	0.62	162E	
Zone 3	568	09-24-07	1500	7.77	346	11.6	10.9	132	NS	223	
		09-02-08	1303	7.56	349	11.4	11.1	138	0.45	212 E	
Zone 2	685	09-24-07	1255	7.69	407	11.9	11.4	138	NS	221	
		09-02-08	1139	7.55	367	11.9	11.4	145	0.69	NA	
Zone 1	744	09-24-07	1100	7.83	438	11.9	9.75	178	NS	269	
		09-02-08	1010	7.58	442	14.5	13.8	186	1.35	253 E	
USGS 134											
Zone 5	578	09-27-06	1614	7.22	337	15.3	8.65	134	NS	227	
		09-10-07	1232	7.76	317	15.9	9.23	128	NS	197	
		09-04-08	1038	7.93	313	12.9	10.0	128	10.5	188	
Zone 4	644	09-28-06	1652	7.32	381	14.7	6.75	162	NS	252	
		09-06-07	1428	7.79	405	16.3	8.52	168	NS	256	
		09-06-07	1433	7.79	405	16.3	8.52	168	NS	258	QAW-7
		09-04-08	1304	7.63	392	13.2	8.90	168	0.56	240 E	
Zone 3	706	09-27-06	1200	7.66	306	13.6	11.0	128	NS	152	
		09-05-07	1400	7.83	301	13.8	12.1	124	NS	190	
		09-03-08	1558	7.98	300	13.6	10.5	129	1.80	187	
Zone 2	806	09-26-06	1312	7.06	359	13.8	8.52	140	NS	254	
		09-05-07	1130	7.6	332	13.8	9.80	132	NS	203	
		09-03-08	1417	7.82	327	14.2	10.4	136	1.88		
Zone 1	856	09-25-06	1510	6.53	458	13.8	8.53	164	NS	420	
		09-04-07	1435	6.89	500	15.5	8.60	NS	NS	420	
	[1]846	09-03-08	1236	7.15	371	14.6	10.3	128	2.47	215 E	

[1]The port at 856 feet below land surface was damaged in 2007, so samples were collected from the port at 846 feet below land surface in 2008.

Guidelines for Interpretation of Analytical Results

Concentrations of radionuclides are reported with an estimated sample standard deviation, *s*, that is obtained by propagating sources of analytical uncertainty in measurements. McCurdy and others (2008) provide details on interpreting radiological data used by the USGS. The guidelines for interpreting analytical results are based on an extension of a method proposed by Currie (1984) and discussed in Davis (2008). In this report, radionuclide concentrations less than 3*s* are considered to be less than a “reporting level.” The reporting level should not be confused with the analytical method detection limit (MDL), which is based on laboratory procedures.

Concentrations of inorganic and organic constituents are reported with reference to laboratory reporting levels (LRLs). Childress and others (1999) provide details about the approach used by the USGS regarding detection levels and reporting levels. The MDL is the minimum concentration of a substance that can be measured and reported with 99-percent confidence that the concentration is greater than zero. The LRL is the concentration at which the false negative error rate is minimized to be no greater than 1 percent of the reported results. The LRL generally is equal to twice the yearly determined long-term MDL, which is a detection level derived by determining the standard deviation of a minimum of 24 MDL spike-sample measurements over an extended time. The long-term MDL controls false-positive error, and it is the concentration at which the false-positive risk is minimized to be no more than 1 percent of the reported values (Childress and others, 1999). These reporting levels may be described as preliminary for a developmental method if the levels have been based on a small number of analytical results. These levels also may vary from sample to sample for the same constituent and the same method if matrix effects or other factors arise that interfere with the analysis. Concentrations measured between the MDL and the LRL are described as estimated values. For most of the constituents in this report, reported concentrations generally are greater than the LRL, but some concentrations are reported as less than the LRL, and some concentrations are reported as estimated (E).

As a matter of convention, concentrations of stable isotopes are reported as relative isotopic ratios (Toran, 1982). Knobel and others (1999) describe stable-isotope data in more detail.

Quality Assurance/Quality Control

The overall quality-assurance (QA) and detailed descriptions of internal quality-control (QC) practices used by the NWQL are provided by Friedman and Erdmann (1982), Jones (1987), and Pritt and Raese (1995). The overall QA and detailed descriptions of internal QC practices used by the RESL are provided in Bodnar and Percival (1982) and U.S. Department of Energy (1995). Water samples were collected in accordance with a quality assurance plan for quality-of-water activities conducted by personnel assigned to the USGS INL project office; the plan was revised in 2008 (Knobel and others, 2008). Additional quality assurance was assessed with QA/QC replicates, blanks, and samples of water used in the drilling and Westbay™ installation process. Eight QA/QC replicate samples were collected during 2006–08; two QA/QC blanks (QAW-1 and QAW-6) were collected during 2006–08 and consisted of deionized water obtained from Culligan® that was used to fill the riser pipe used in the installation. One sample (QAW-2) was Central Facility Area water that was used to fill the riser pipe at USGS 132 and for drilling wells USGS 103, USGS 132, USGS 133, and USGS 134. One sample (QAW-12) was water from USGS 109 (fig. 2) that was used for drilling wells USGS 105 and USGS 108 (future Westbay™ installation sites). Concentrations in samples QAW-1 and QAW-6 were near or less than the reporting levels for all constituents that are typical for deionized water. The source of water for QAW-2 and QAW-12 is the Snake River aquifer, so both of those samples are representative of the locations at which the water-chemistry samples were collected.

The statistical equivalency of radiochemical-constituent concentrations in sample replicate pairs was determined following a method defined by Volk (1969) and described in more detail by Williams (1996). In this method, statistical equivalence is determined within a specified confidence level. A value for the standard deviate, Z, is calculated, and then the level of significance of the result is evaluated (evaluation of the level of significance assumes that the sample population is distributed normally). For this report, concentrations of individual constituents in sample pairs (constituent pairs) were considered to be equivalent when the results were within two standard deviations of each other. At this confidence level (95-percent), the level of significance, determined from a standard normal probability curve, was 0.05 for a two-tailed test, and it corresponded to a Z-value of 1.96.

The equation used to determine Z was adapted from Volk (1969):

$$Z = \frac{|x - y|}{\sqrt{(s_x)^2 + (s_y)^2}} , \quad (1)$$

where

x is the concentration of a constituent in the routine sample,

y is the concentration of the same constituent in the sequential replicate sample,

s_x is the standard deviation of x, and

s_y is the standard deviation of y.

When the population is not distributed normally, which is often the case with radiochemical results (L. DeWayne Cecil, USGS, written commun., January 4, 2009), or an approximation of the standard deviation is used, a Z-value less than 1.96 must be considered as a guide when testing for equivalence. Constituent concentrations in sample pairs were considered to be statistically equivalent when the calculated Z-value was less than or equal to 1.96.

The use of equation 1 is therefore considered to be a guide in determining if the results of radionuclide analyses of a replicate pair of samples were equivalent. The results and reported standard deviations for the analyses of replicate pairs and the Z-values are shown in tables 7–9 (at back of report). Z-values were less than 1.96 for 73 of the 76 replicate pairs (96 percent), and can be considered statistically equivalent. One replicate pair each for tritium (QAW-10, table 7), strontium-90 (QAW-11, table 7, both values below the reporting level) and carbon-13 (QAW-4, table 9) were not considered equivalent with this statistical test.

If the uncertainty of the result is not readily available, which is often the case for most of the inorganic and organic constituents, the relative percent difference (RPD) can be used to compare equivalency of replicate pairs. The RPD is calculated based on the formula:

$$RPD = ((ABS(X1 - X2)) / ((X1 + X2)) * 100, \qquad (2)$$

where

RPD is the relative percent difference,

ABS is the absolute value,

$X1$ is the result for primary environmental sample, and

$X2$ is the result for field-replicate sample.

A typical data-quality objective for field-replicate samples is a maximum RPD of 20 percent (Taylor, 1987). RPDs were less than 20 percent using equation 2 for 280 of the 295 samples (95 percent), and can be considered statistically equivalent using this statistical test. One replicate pair each for fluoride, cobalt, tungsten, and nitrite; two replicate pairs for aluminum and lead; three replicate pairs for total organic carbon; and four replicate pairs for copper were not in statistical agreement using this test (tables 4–6, at back of report). Results from the NWQL Blind Sample Program using double-blind, quality-control samples indicated that the laboratory had some bias and higher than expected variability for copper, total organic carbon, lead, and fluoride at some time during the sample periods for these analyses (USGS Inorganic Blind Sample Project, accessed July 27, 2009, at: http://bqs.usgs.gov/ibsp/qadata.shtml). Results of replicate samples generally indicated that the sample collection and laboratory procedures used were appropriate for the data obtained.

Water Chemistry of Recharge to the Eastern Snake River Plain Aquifer

Several sources recharge water to the ESRP aquifer at the INL, and an understanding of the chemical composition of these water sources is needed to help validate interpretations of groundwater flow based on groundwater model predictions. Ackerman and others (2006) characterized the ESRP aquifer at the INL as consisting of various amounts of inflow from sources including: precipitation recharge; streamflow infiltration from the Big Lost River; industrial wastewater return; irrigation infiltration; underflow from the Big Lost River, Little Lost River, and Birch Creek drainage basins; underflow from the ESRP aquifer northeast of the INL; and groundwater upwelling from below the base of the ESRP aquifer.

Several studies have described the water chemistry at the INL, and table 10 (at back of report) lists chemical concentrations from some of the studies for possible source waters that eventually recharge the ESRP aquifer following dissolution/precipitation reactions that may occur.

Busenberg and others (2001) analyzed the age and source of the young fraction of water in many of the wells that are routinely sampled at the INL. The young fraction of water is defined as water that was recharged to the aquifer since the 1940s.

Ackerman and others (2006) estimated that about 3 percent of the total recharge to the ESRP aquifer at the INL could be attributed to precipitation infiltration. Precipitation infiltration contributes to the old and young fractions of water, as defined by Busenberg and others (2001), in wells sampled for this study. Anion and cation concentrations in precipitation samples generally are very small; chemical concentrations at three different locations in the southwestern part of the INL are shown in table 10.

Ackerman and others (2006) estimated that 4 percent of the total recharge to the ESRP aquifer at the INL could be attributed to the infiltration of Big Lost River surface water. Surface-water infiltration contributes to the old and young fractions of water, as defined by Busenberg and others (2001), in wells sampled for this study. Chemical concentrations of the Big Lost River at and near the INL are shown in table 10. The concentrations indicate variable chemical input from the river depending on the time of year sampled and the location. Most flow at the INL probably comes from runoff events because flow does not occur on the site except during years of high discharge for the river (Davis, 2008, fig. 10), and the chemistry of the water probably is best represented by water from the Big Lost River downstream of the INEL diversion and near the NRF (table 10).

Ackerman and others (2006) estimated that less than 1 percent of the total recharge to the ESRP aquifer at the INL could be attributed to wastewater return. Of all the inflow sources to the system, industrial wastewater return is considered to consist completely of a young fraction of source water because wastewater disposal did not start at the INL until the 1950s. Wastewater chemistry consists of the chemistry of the water from the production wells to which the wastewater was discharged, along with the additive concentrations of sodium, chloride, sulfate, nitrate, purgeable organic compounds, tritium, strontium-90, and other radionuclides that were discharged during the history of wastewater disposal at the INL. The three primary facilities that discharged wastewater that probably is affecting the six multilevel monitoring wells sampled in this study are the NRF, the INTEC, and the RTC. The chemistry of some of the production wells at these three facilities is shown in table 10. Tritium concentrations in water from the ESRP aquifer that have resulted from cosmic-ray interactions and atmospheric testing probably are less than 200 pCi/L (Mann and Cecil, 1990, p. 11), so tritium concentrations greater than 200 pCi/L (detection limit used by the RESL lab) probably are a good indicator of wastewater disposal.

Ackerman and others (2006) estimated that 1 percent of the total recharge to the ESRP aquifer at the INL could be attributed to irrigation infiltration. Irrigation at the INL consists mostly of sprinkler irrigation of grassy areas at facilities, and the source of the irrigation water is from the pumpage of production wells at those facilities. The chemistry of some of the production wells is shown in table 10. An additional, larger amount of irrigation occurs on the agricultural land northeast of the INL near Mud Lake and to the northwest near Howe (fig. 1). The primary source of this additional irrigation infiltration probably is groundwater pumpage from regional northeast underflow, and the Little Lost River underflow in the northwest, respectively.

Ackerman and others (2006) estimated that 16 percent of the total recharge to the ESRP aquifer at the INL could be attributed to Big Lost River underflow. Big Lost River underflow contributes to the old and young fractions of water, as defined by Busenberg and others (2001), in wells sampled for this study. Carkeet and others (2001) determined that two wells farthest downgradient in the Big Lost River system could be chemically modeled from upgradient wells, and that the water chemistry of both wells could be used to represent shallower (Owen well) and deeper (Arco City well) underflow water from the Big Lost River system (table 10).

Ackerman and others (2006) estimated that 10 percent of the total recharge to the ESRP aquifer at the INL could be attributed to Little Lost River underflow. Little Lost River underflow contributes to the old and young fractions of water, as defined by Busenberg and others (2001), in wells sampled for this study. Swanson and others (2002) indicated that several wells in the Little Lost River system were highly influenced by agricultural practices. The farthest downgradient well that could be modeled from wells upgradient was the Harrell well (table 10). Although Swanson and others (2002) concluded that more wells were needed to fully characterize the natural geochemistry of the Little Lost River system, the Harrell well probably best represents the chemistry of the underflow from all the wells that have been sampled in the Little Lost River basin.

Ackerman and others (2006) estimated that 5 percent of the total recharge to the ESRP aquifer at the INL could be attributed to Birch Creek underflow. Birch Creek underflow contributes to the old and young fractions of water, as defined by Busenberg and others (2001), in wells sampled for this study. Swanson and others (2003) indicated that water chemistry from well USGS 126B (table 10) best represents the chemistry of water recharging the ESRP aquifer as underflow from the Birch Creek valley.

Ackerman and others (2006) estimated that 55 percent of the total recharge to the ESRP aquifer at the INL could be attributed to underflow from the northeastern part of the INL. Most of the underflow consists of old recharge water, with only a small fraction of young water in many of the wells. Busenberg and others (2001) used water from well USGS 101 as being indicative of the regional groundwater. Olmsted (1962) classified this underflow as type B water, and characterized it as having larger percentages of sodium and potassium and smaller percentages of calcium and magnesium than water recharged in the western part of the INL. Busenberg and others (2001) also noted that concentrations of lithium, chloride, boron, fluoride, and dissolved helium were larger in the area classified as type B water than most of the wells in the western part of the INL.

Ackerman and others (2006) estimated that 2 percent of the total recharge to the ESRP aquifer at the INL could be attributed to upwelling from below the aquifer. Mann (1986) calculated that the upward vertical movement of water into the ESRP aquifer from underlying rock units could be on the order of 15,000 acre-ft/yr at the INL. Most, if not all, of the upwelling water probably can be considered an old fraction of water. Mann (1986) evaluated the water quality of four zones of water from INEL-1, a 10,365-ft deep test hole at the INL, and noted that the chemical composition changed markedly with depth. Mann (1986) also noted that the chemical character of the water transitioned from calcium bicarbonate to sodium bicarbonate in the interval between 595 and 1,511 ft BLS. The sodium-type water at depths greater than 1,511 ft BLS (table 10) vertically moves upward in response to high hydraulic head (Mann, 1986), so the water chemistry from the interval of 1,511 to 2,206 ft BLS, characterized as a highly altered and mineralized basalt, may be used to characterize the water chemistry of deep upwelling recharge.

Geothermal water that is present throughout the ESRP also may be an indicator of the chemistry of upwelling water at the base of the aquifer. Robertson and others (1974) suggested that possible hot springs beneath the plain on buried basin and range faults may contribute thermal water to the groundwater. A large dissolved-solids concentration (particularly of sodium and chloride); large concentrations of constituents, such as fluoride, boron, lithium, and ammonia; and a high water temperature may denote a thermal contribution (Robertson and others, 1974). McLing and others (2002) characterized the deep thermal system as consisting of a sodium-potassium-bicarbonate water. The chemistry of Lidy and Condie Hot Springs (fig. 1) is variable depending on water-sample collection methods and location; and two examples of the chemical input from these two geothermal systems near the INL are shown in table 10.

Concentrations of Chemical Constituents in Groundwater

Cations, Anions, and Silica

Water samples were analyzed for concentrations of dissolved cations (calcium, magnesium, sodium, and potassium), dissolved silica, and dissolved anions (chloride, sulfate, and fluoride) by the USGS National Water Quality Laboratory (NWQL) (tables 3 and 4). Bicarbonate concentrations (table 3) were calculated from field alkalinity measurements (table 2) according to Hem (1989, p. 57).

Well Middle 2050A.—Cation and anion concentrations for Middle 2050A indicated a calcium plus magnesium-bicarbonate water chemistry for all five zones (fig. 5). A water type is considered calcium plus magnesium bicarbonate when calcium plus magnesium make up greater than 50 percent of the cations (calcium generally predominates over magnesium), and bicarbonate makes up greater than 50 percent of the anions (Knobel and others, 1998). Concentrations of all constituents in samples collected in 2006 in the zone of water in the upper part of the aquifer (port depth 515 ft BLS) were anomalously small, except for fluoride; the discrepancy could not be resolved. Samples collected from zone 5 during the other sample periods indicated that average concentrations of the constituents: calcium (54.2 mg/L), chloride (15.6 mg/L), and sulfate (25.8 mg/L) were much larger than the average concentrations in the other zones, except for a larger chloride concentration (14.9 mg/L) and a smaller sulfate concentration (11.1 mg/L) in the deepest zone (port depth 1,179 ft BLS) (fig. 6, tables 3 and 4). The large concentrations of chloride and sulfate in the upper zone may be related to wastewater disposal; the concentrations in the deepest zone probably are due to natural geochemical processes.

Well Middle 2051.—Cation and anion concentrations for Middle 2051 indicated a calcium plus magnesium bicarbonate water chemistry for all five zones (fig. 7). Calcium concentrations were larger and magnesium, sodium, and chloride were smaller in the zone of water in the upper part of the aquifer (port depth 604 ft BLS) than in the other four zones of water. The water chemistry in this zone is very similar to some samples of Big Lost River water (fig. 8), and it probably represents mostly local recharge from the Big Lost River. Calcium and bicarbonate concentrations were smaller and magnesium concentrations were larger in the two deepest zones of water (port depths 1,092 and 1,142 ft BLS) than in the upper three zones of water (fig. 9, tables 3 and 4).

Well USGS 103.—Cation and anion concentrations for USGS 103 indicated a calcium plus magnesium-bicarbonate water chemistry for all seven zones; however, zone 7 is enriched with sodium plus potassium, and is depleted in calcium when compared to the other zones (fig. 10). Concentrations of calcium, silica, and bicarbonate were smaller and sodium, chloride, sulfate, and fluoride were larger in the zone of water in the upper part of the aquifer (zone 7, port depth 678 ft BLS) than in the other six zones of water. Average chloride concentrations in zone 5 (port depth 907 ft BLS) were slightly smaller (10.6 mg/L) than in zones 1–4 and 6 (13.8 mg/L; fig. 11, tables 3 and 4).

Well USGS 132.—Cation and anion concentrations for USGS 132 indicated a calcium plus magnesium-bicarbonate water chemistry for all six zones, with the upper part of the aquifer (zone 6) enriched with sodium plus potassium and depleted in calcium as compared with the other five zones of water (fig. 12). Concentrations of magnesium, sodium, potassium, chloride, and sulfate were larger and calcium was smaller in the zone of water in the upper part of the aquifer (port depth 636 ft BLS) than the other five zones of water (fig. 13, tables 3 and 4).

Well USGS 133.—Cation and anion concentrations for USGS 133 indicated a calcium plus magnesium-bicarbonate water chemistry for all four zones (fig. 14). Concentrations of all cation constituents in samples collected in 2008 in the zone of water in the upper part of the aquifer (port depth 468 ft) were anomalously small; the discrepancy could not be resolved. Concentrations of calcium, magnesium, sodium, bicarbonate, chloride, and sulfate were larger and potassium and fluoride were smaller in the zone of water in the lower part of the aquifer (port depth 744 ft BLS) than in the other three zones of water (fig. 15, tables 3 and 4).

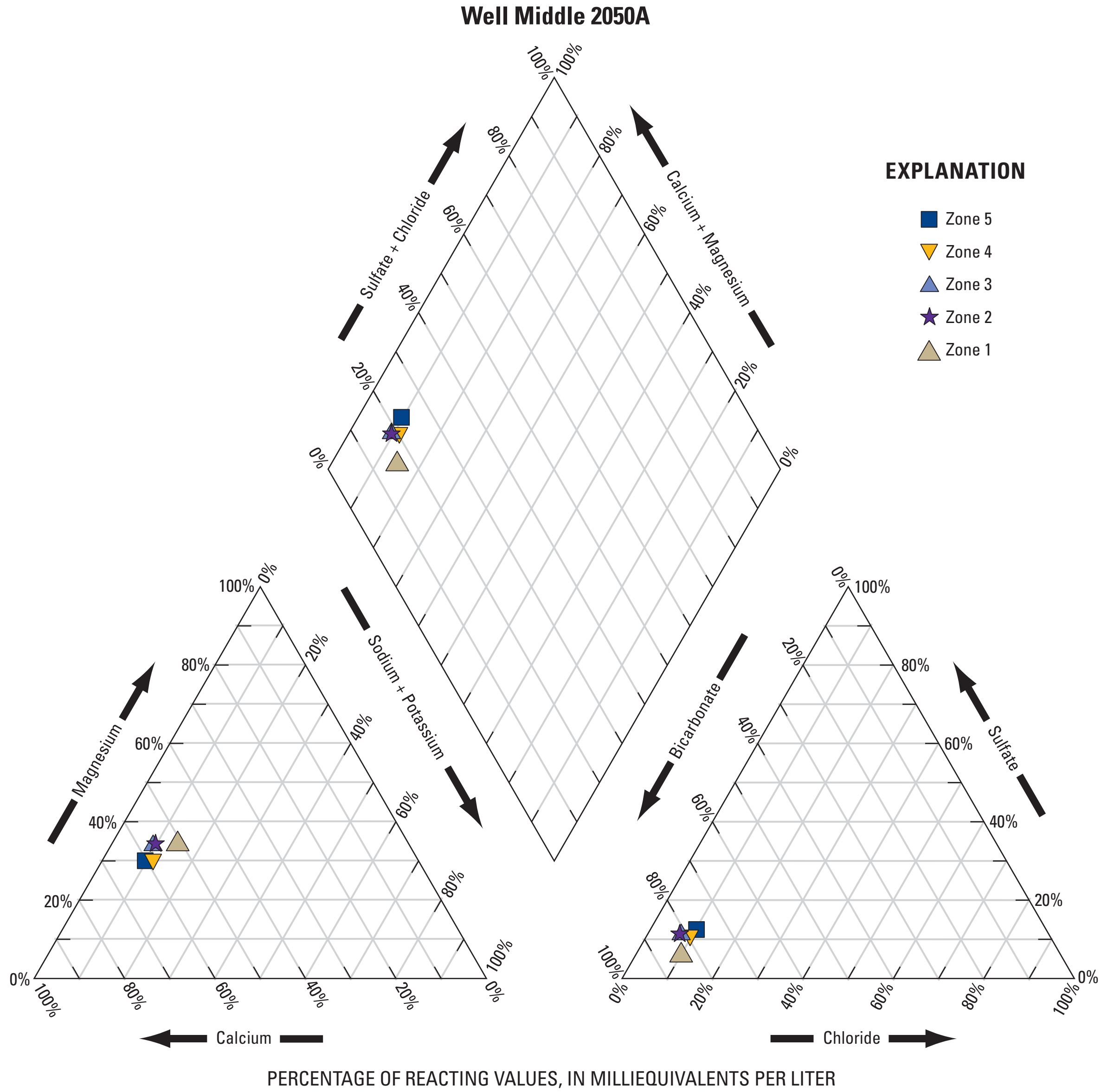


Figure 5. Major-ion composition of water from well Middle 2050A, Idaho National Laboratory, Idaho.

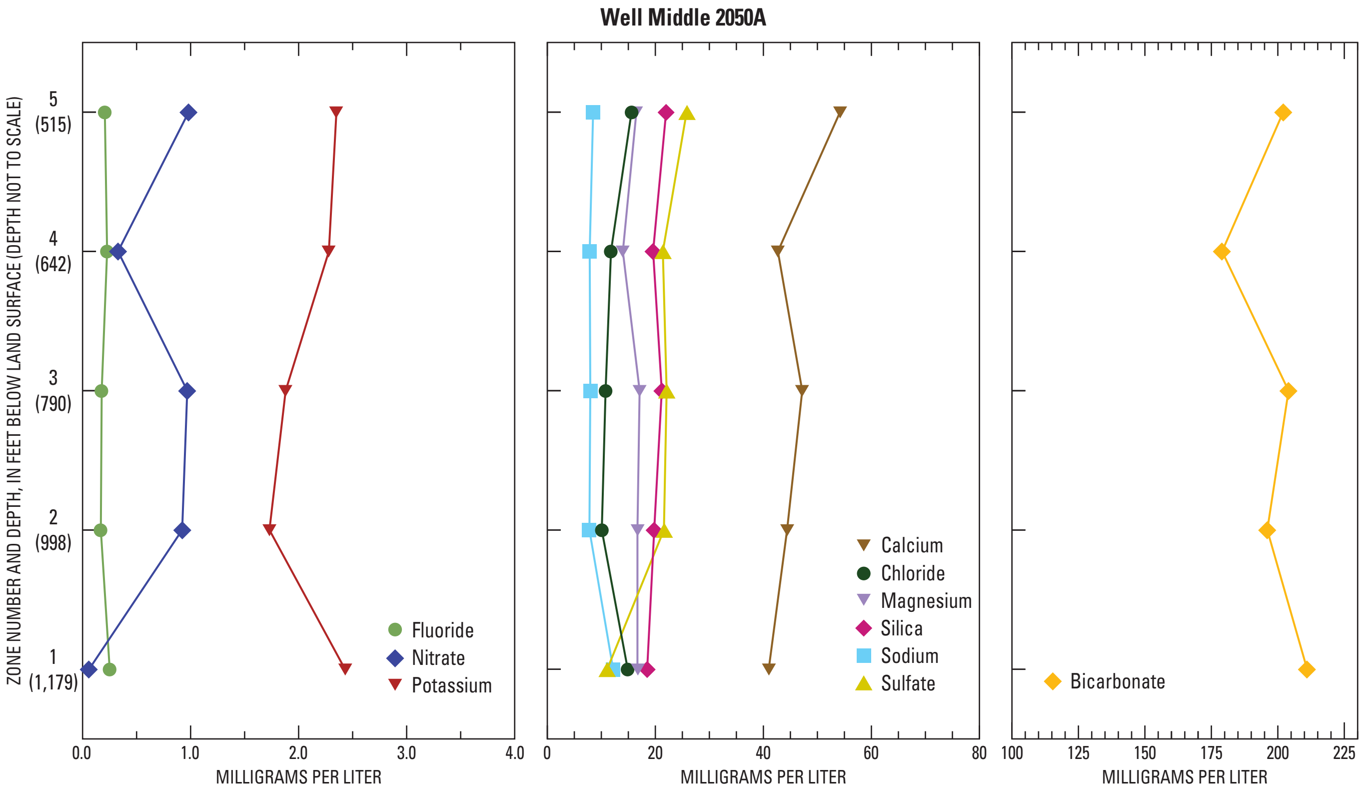


Figure 6. Concentrations of selected ions and silica in water from well Middle 2050A, Idaho National Laboratory, Idaho.

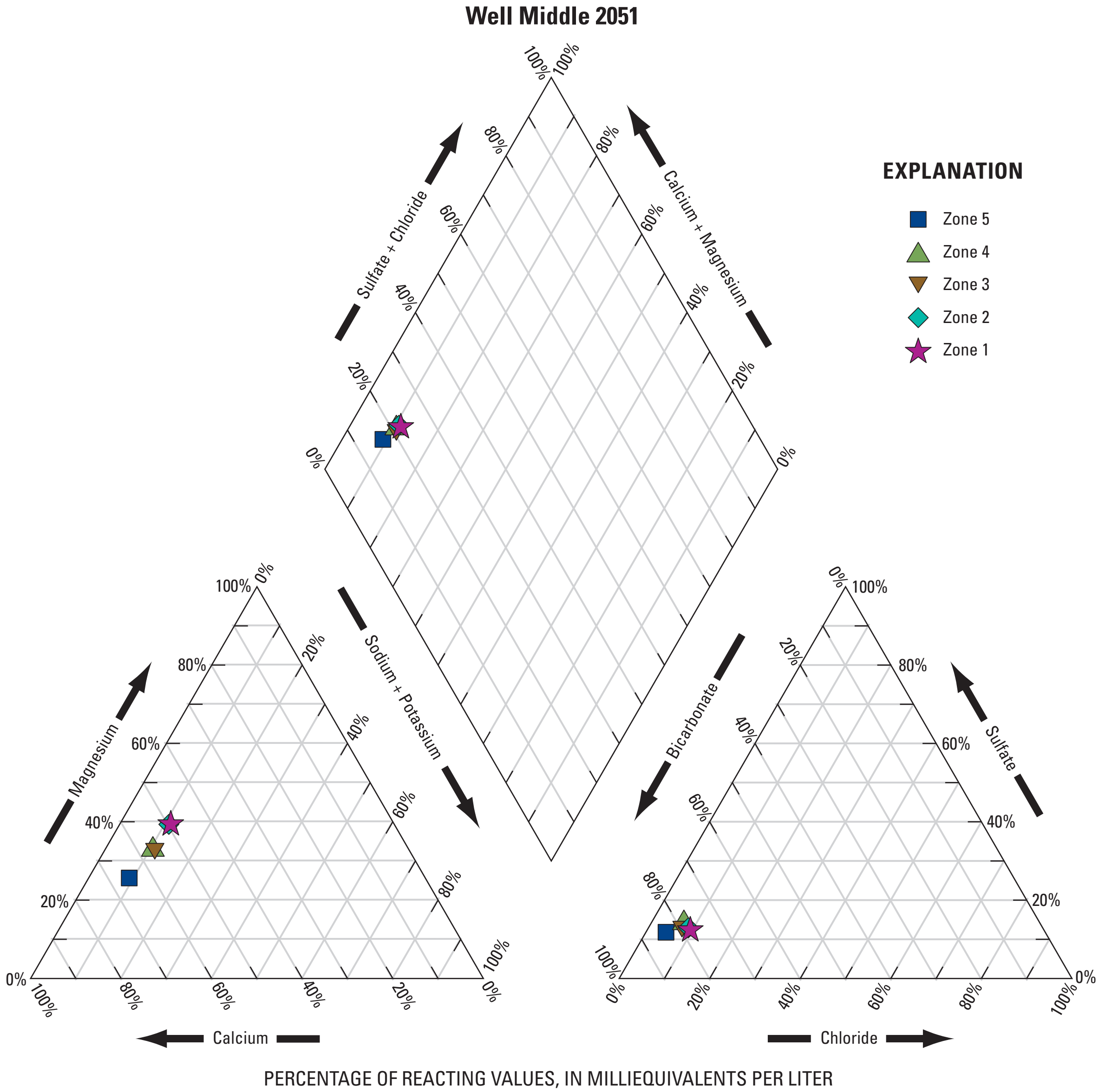


Figure 7. Major-ion composition of water from well Middle 2051, Idaho National Laboratory, Idaho.

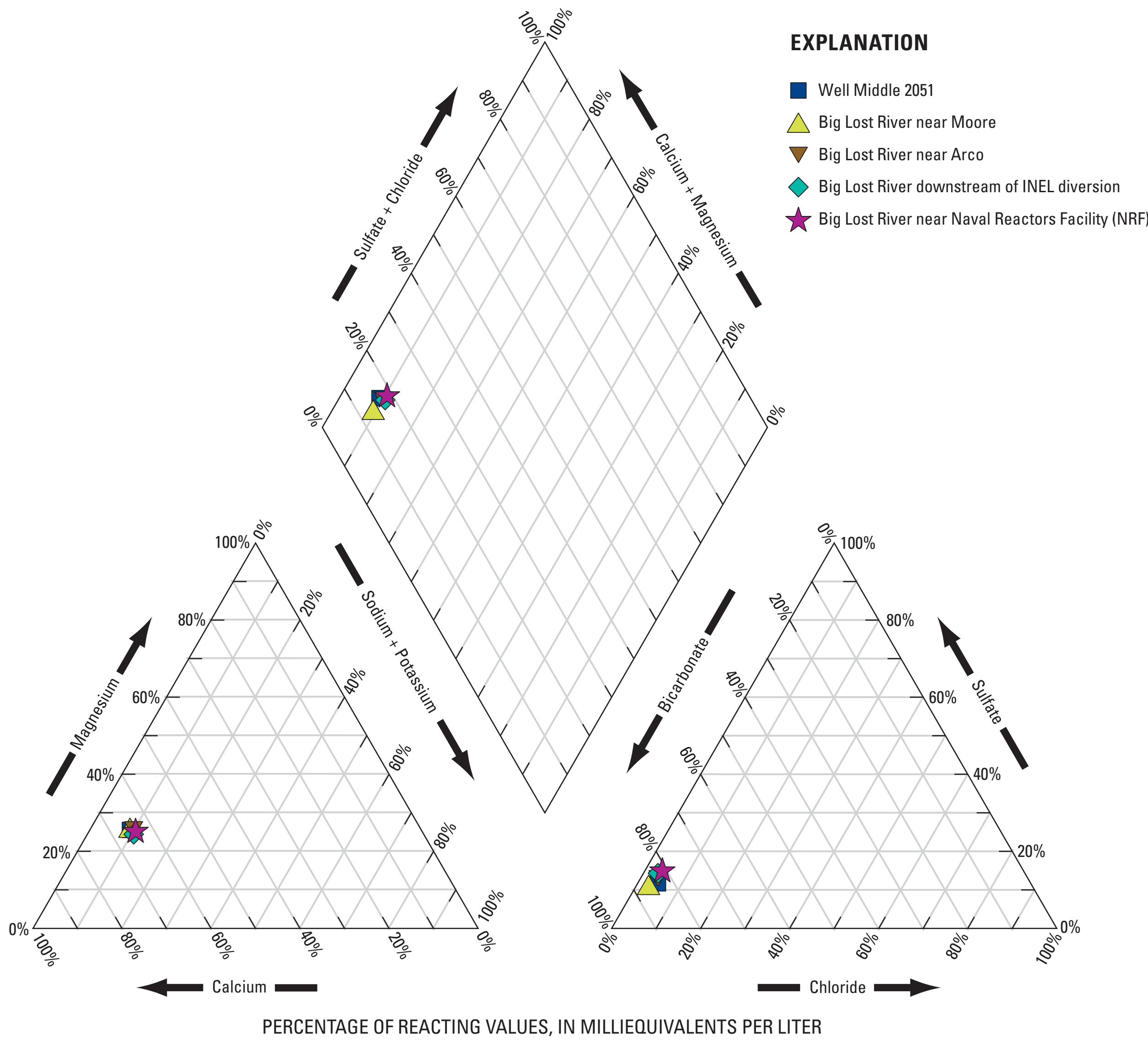


Figure 8. Major-ion composition of water from well Middle 2051 zone 5 and selected Big Lost River sites, Idaho National Laboratory, Idaho.

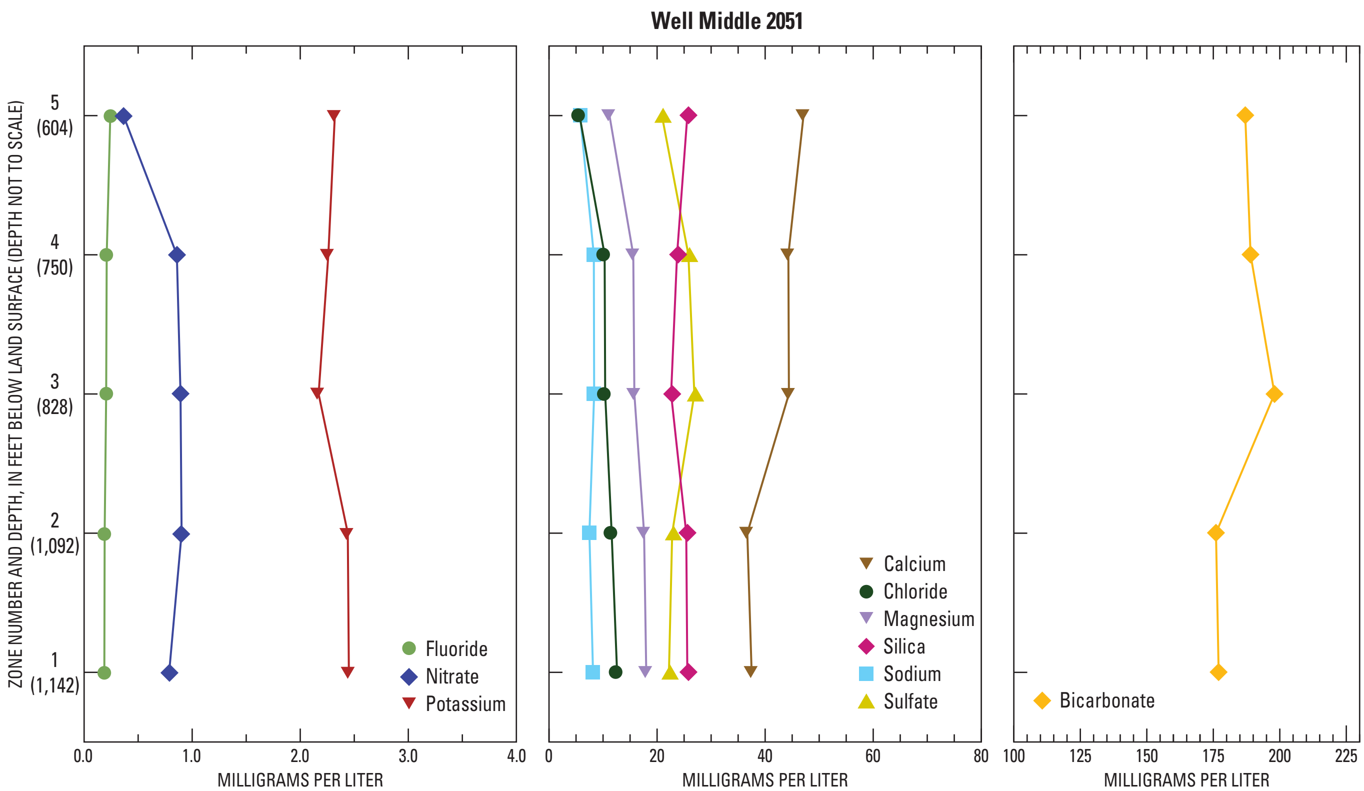


Figure 9. Concentrations of selected ions and silica in water from well Middle 2051, Idaho National Laboratory, Idaho.

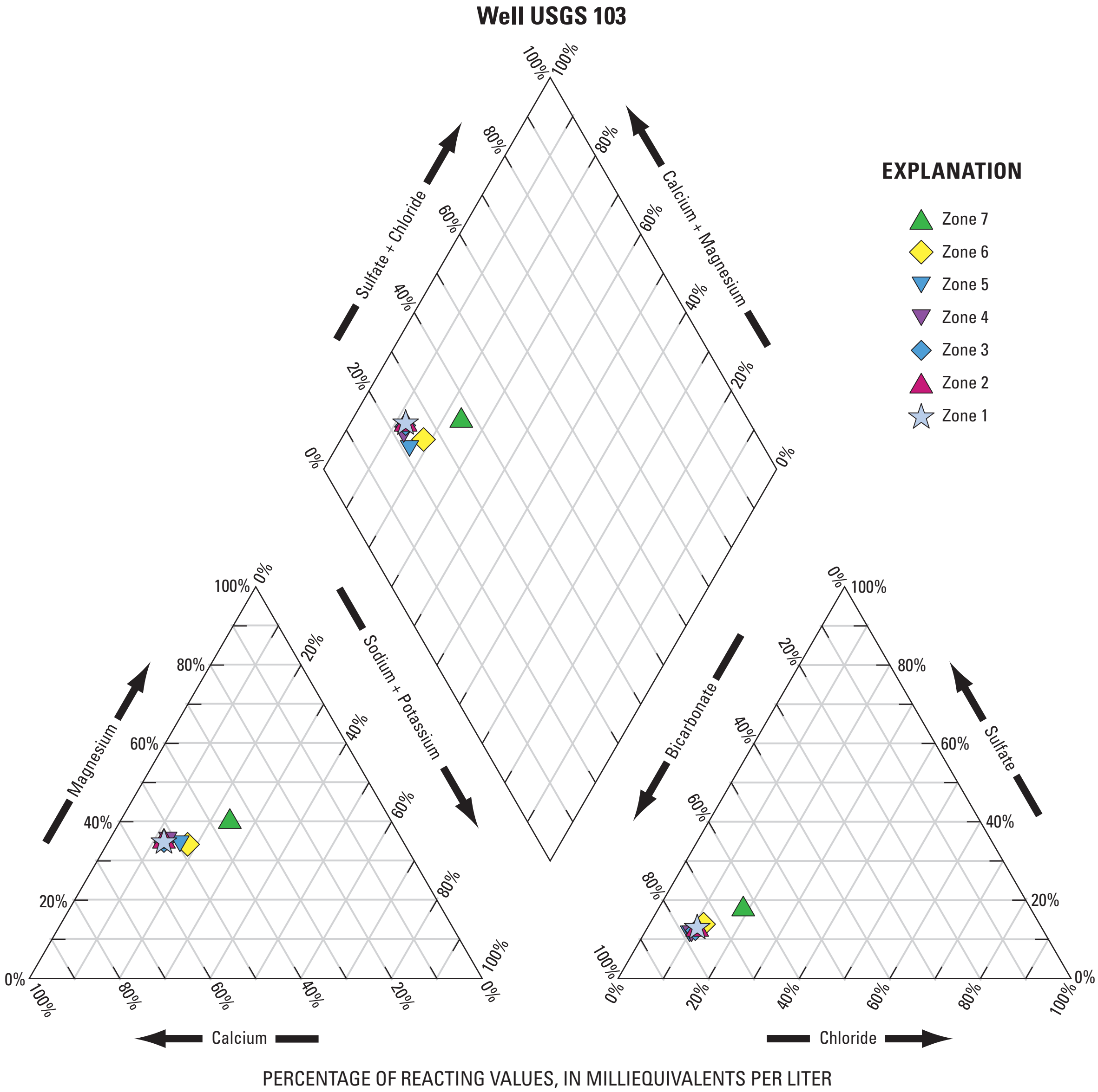


Figure 10. Major-ion composition of water from well USGS 103, Idaho National Laboratory, Idaho.

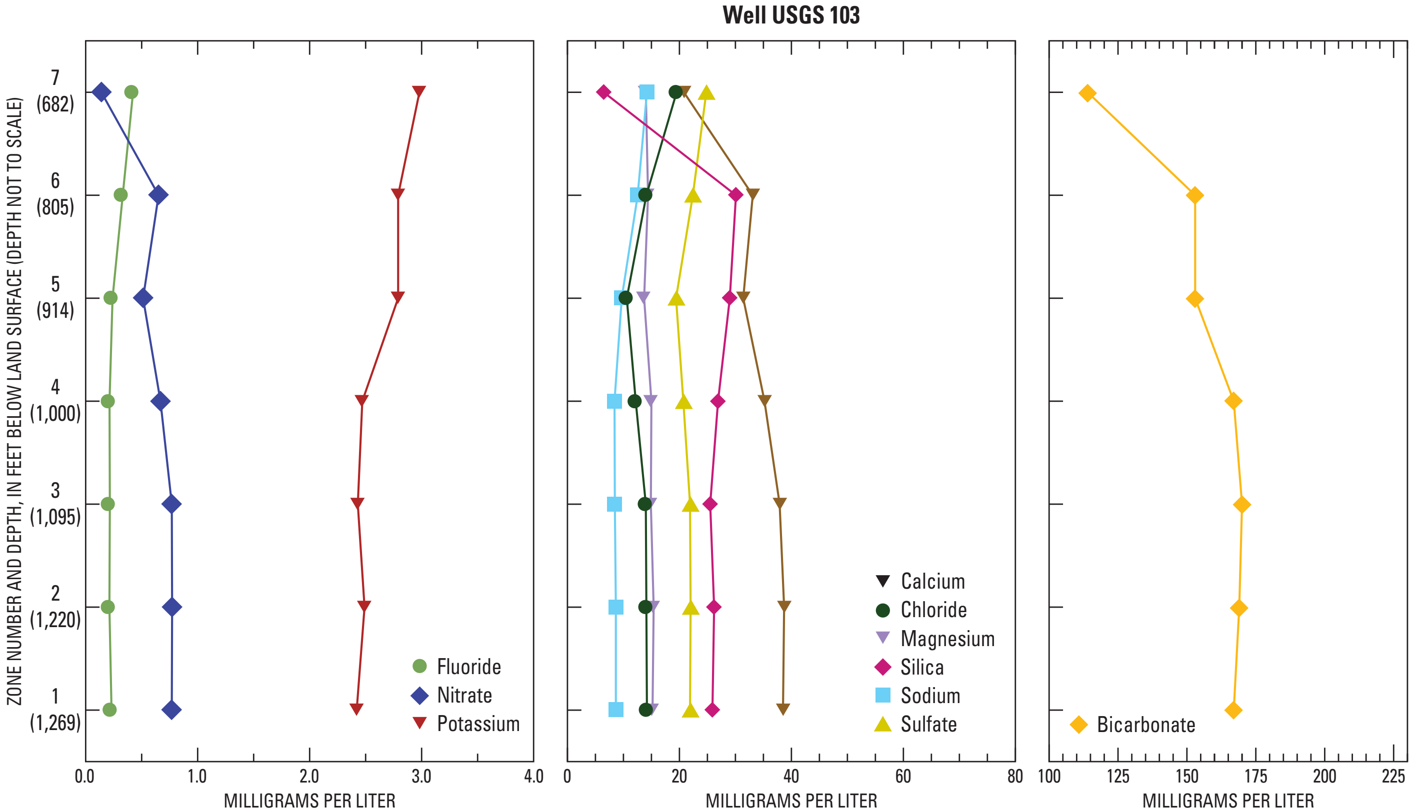


Figure 11. Concentrations of selected ions and silica in water from well USGS 103, Idaho National Laboratory, Idaho.

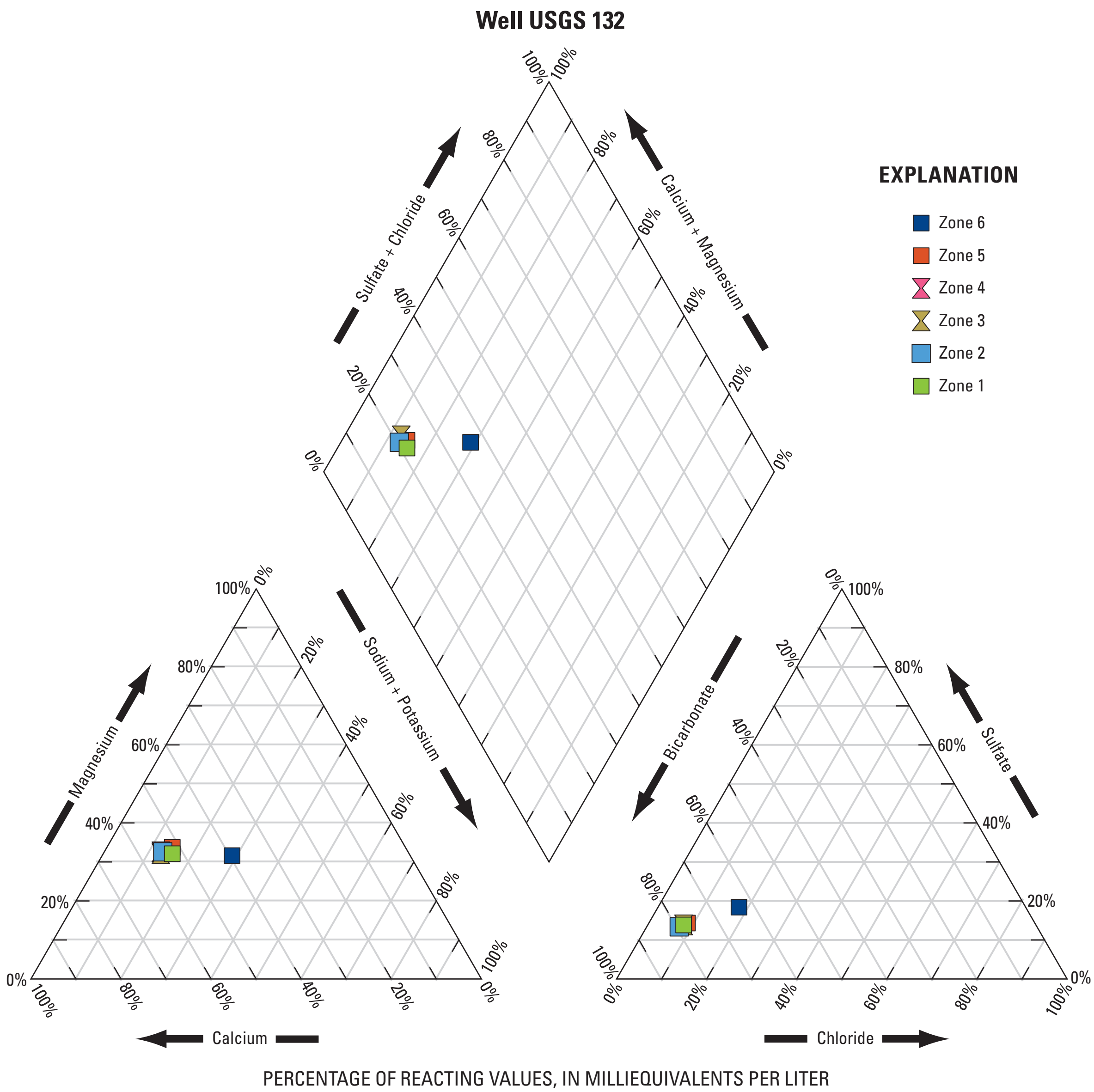


Figure 12. Major-ion composition of water from well USGS 132, Idaho National Laboratory, Idaho.

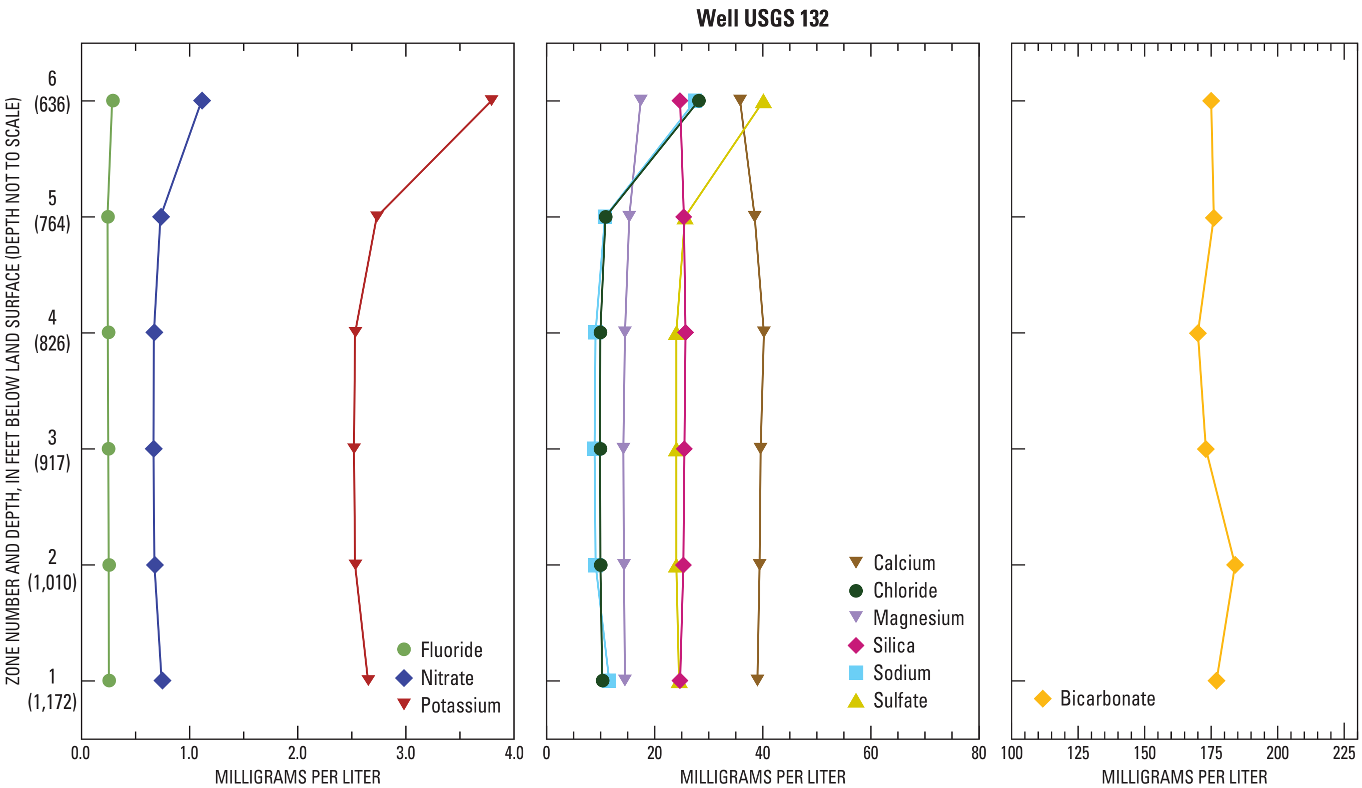


Figure 13. Concentrations of selected ions and silica in water from well USGS 132, Idaho National Laboratory, Idaho.

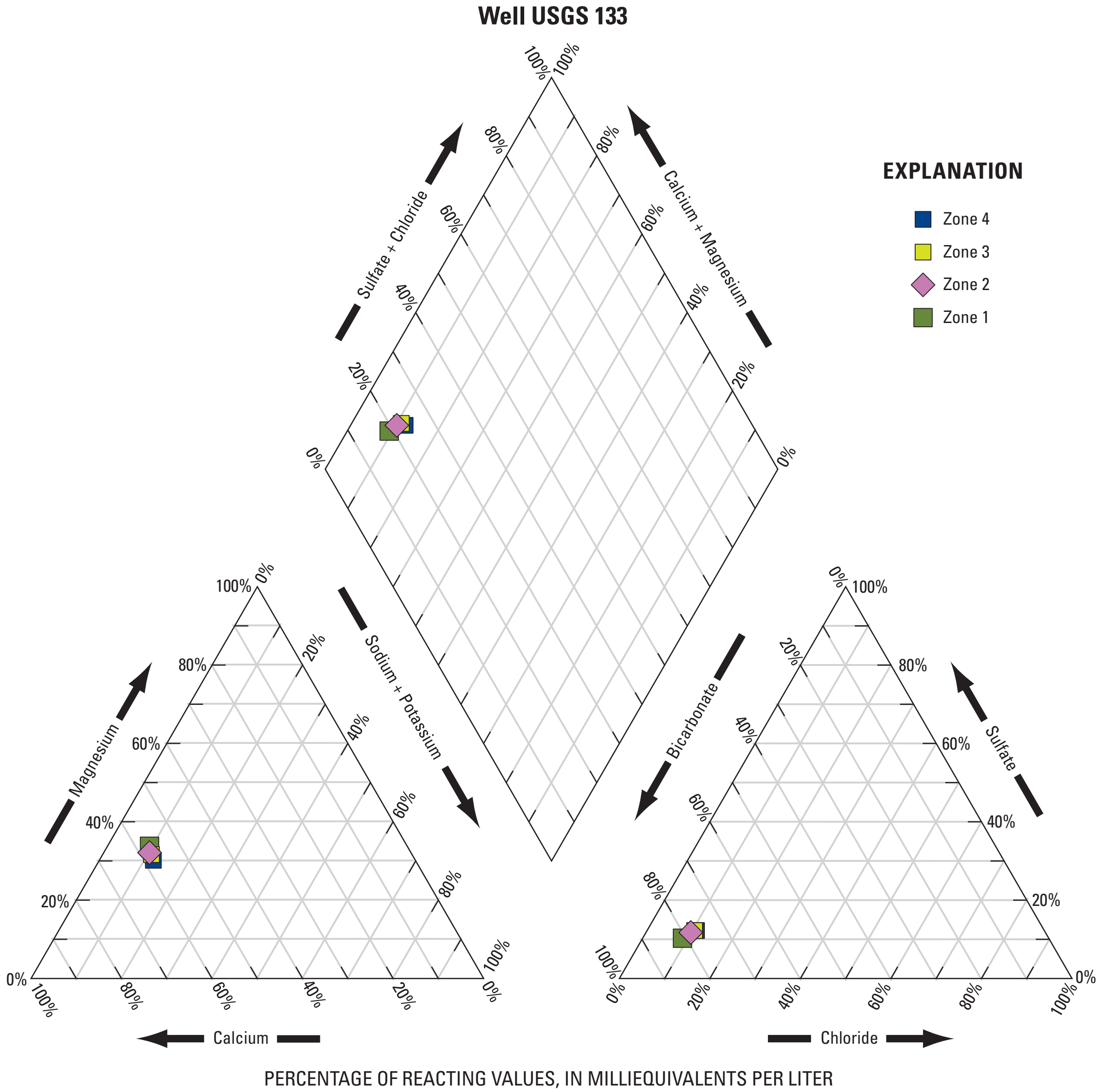


Figure 14. Major-ion composition of water from well USGS 133, Idaho National Laboratory, Idaho.

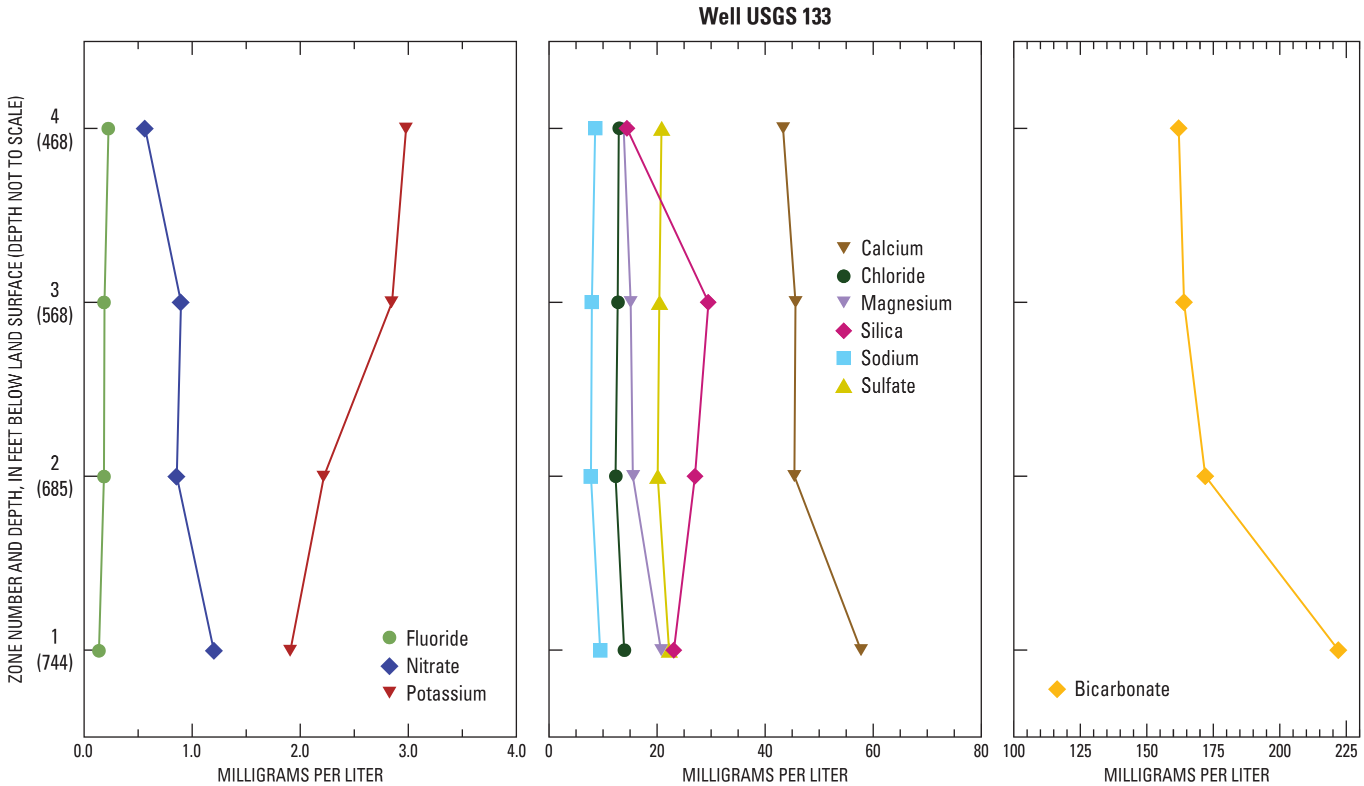


Figure 15. Concentrations of selected ions and silica in water from well USGS 133, Idaho National Laboratory, Idaho.

Well USGS 134.—Cation and anion concentrations for USGS 134 indicated a calcium plus magnesium-bicarbonate water chemistry for all five zones (fig. 16). Concentrations of all cation constituents in samples collected in 2006 in the zone of water in the middle part of the aquifer (zone 3, port depth 706 ft BLS) were anomalously small; the discrepancy could not be resolved. Concentrations of calcium, magnesium, sodium, potassium, and silica were larger in the zone of water in the lower part of the aquifer (port depth 856 ft BLS) than in the other four zones of water (fig. 17, tables 3 and 4). The chemistry varies greatly among the zones, and it does not seem to show a consistent pattern even within the same zone for some constituents for different sample periods. This well had bacterial buildup prior to the Westbay™ installation, and a phosphoric-acid solution was used to clean out the well. This residual solution probably had some effect on the chemical concentrations in this well; therefore, the data should be used with caution.

Selected Inorganic Constituents

Water samples were collected and analyzed for dissolved concentrations of aluminum, antimony, arsenic, barium, beryllium, bromide, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, tungsten, uranium, vanadium, and zinc at the NWQL (table 5).

Well Middle 2050A.—Most of the concentrations of minor inorganic constituents were similar in all five zones in Middle 2050A (table 5). Average concentrations of barium and strontium were larger in the upper part of the aquifer (zone 5, 71.9 and 265 µg/L, respectively) and in the lower part of the aquifer (zone 1, 66.7 and 284 µg/L, respectively) than in the other three zones (44.5 and 218 µg/L, respectively). Concentrations of chromium and vanadium were larger in zone 5 and smaller in zone 1 than in the other zones. Concentrations of cobalt, iron, lithium, manganese, molybdenum, and tungsten were all larger in zone 1 relative to the other four zones.

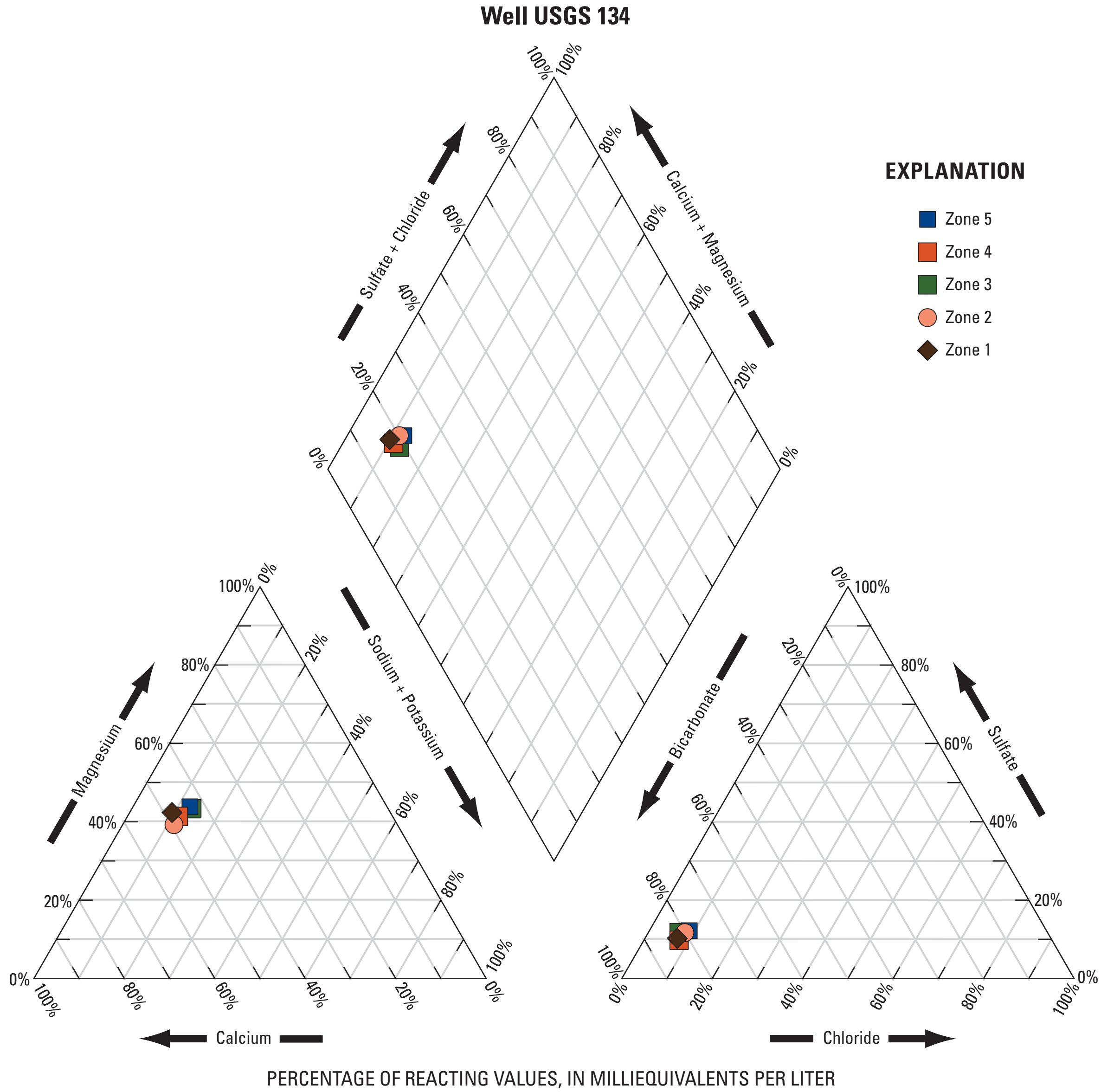


Figure 16. Major-ion composition of water from well USGS 134, Idaho National Laboratory, Idaho.

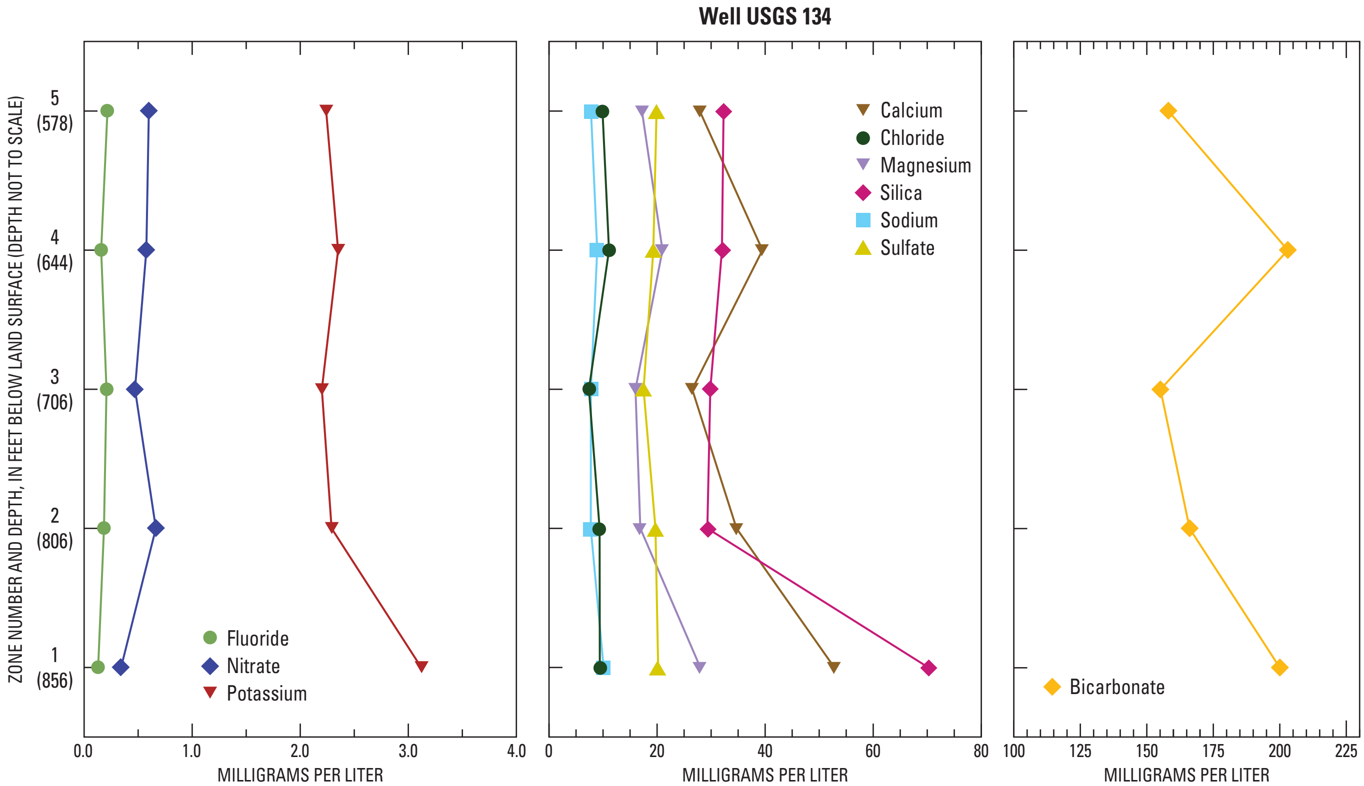


Figure 17. Concentrations of selected ions and silica in water from well USGS 134, Idaho National Laboratory, Idaho.

Well Middle 2051.—Most of the concentrations of minor inorganic constituents were similar in all five zones in Middle 2051 (table 5). Chromium concentrations were smaller in zone 5 than in the other zones. Barium concentrations were smaller in zones 1 and 2 relative to the other zones. Strontium concentrations were larger in zone 5 than in the other zones. Tungsten concentrations were larger in zone 1 than in the other zones (table 5).

Well USGS 103.—Most of the concentrations of minor inorganic constituents were similar in all seven zones in USGS 103 (table 5). Concentrations of antimony, arsenic, chromium, selenium, uranium, and vanadium were smaller and barium, iron, lithium, manganese, and molybdenum were larger in the upper zone in the aquifer (zone 7) than in the other zones (table 5).

Well USGS 132.—Almost all concentrations of minor inorganic constituents were similar in all six zones in USGS 132 (table 5). The concentration of barium in the upper part of the aquifer (zone 6) was slightly larger than in the other zones.

Well USGS 133.—Most of the concentrations of minor inorganic constituents were similar in all four zones in USGS 133 (table 5). Zinc concentrations were larger in zone 1 and the 2008 sample from zone 2 than in the other zones. Strontium and vanadium concentrations were larger in zone 3 than in the other zones. Concentrations of molybdenum were larger and concentrations of barium, chromium, and vanadium were smaller in zone 4 than in the other zones.

Well USGS 134.—Some of the minor inorganic constituents (arsenic, barium, chromium, manganese, molybdenum, nickel, strontium, tungsten, vanadium, and zinc; table 5) vary greatly among the zones in USGS 134. These constituents do not seem to show a consistent pattern even within the same zone for some constituents for different sample periods. This well had bacterial buildup prior to the installation, so a phosphoric-acid solution was used to clean out the well. This residual solution probably has some effect on the chemical concentrations in this well; therefore, the data should be used with caution.

Nutrients

Water samples were collected and analyzed at the NWQL for dissolved concentrations of ammonia as nitrogen, nitrite as nitrogen, nitrite plus nitrate as nitrogen, and orthophosphate as phosphorus (table 6).

Well Middle 2050A.—Concentrations of nitrite plus nitrate in the sample collected in 2006 in the zone of water in the upper part of the aquifer (port depth 515 ft BLS) were anomalously small; the discrepancy could not be resolved. Concentrations of ammonia as nitrogen were larger in samples collected from the deepest zone (port depth 1,179 ft BLS) than in the other zones (table 6). Average nitrite plus nitrate as nitrogen concentrations were smaller in zone 1 (<0.006 mg/L) and zone 4 (0.328 mg/L) than in the other three zones (average of 0.959 mg/L not including the 2006 sample for zone 5) (fig. 6).

Well Middle 2051.—Concentrations of most of the nutrients were similar in all five zones in Middle 2051. Average nitrite plus nitrate concentrations in the zone of water in the upper part of the aquifer (port depth 604 ft BLS) were smaller (0.364 mg/L) than in the other four zones (0.862 mg/L) (fig. 9; table 6).

Well USGS 103.—Concentrations of most of the nutrients were similar in the six deepest zones. Concentrations of ammonia were larger and nitrite plus nitrate (fig. 11) and orthophosphate were smaller in the zone of water in the upper part of the aquifer than in the other six zones (table 6).

Well USGS 132.—Concentrations of most of the nutrients were similar in all six zones in USGS 132 (fig. 13, table 6). Average concentrations of nitrite plus nitrate were larger (1.1 mg/L) in the zone of water in the upper part of the aquifer (port depth 636 ft BLS) than in the other five zones (0.696 mg/L) (fig. 13; table 6).

Well USGS 133.—Concentrations of most of the nutrients were similar in all four zones in USGS 133 (fig. 15, table 6). Orthophosphate concentrations were smaller in the zone of water in the upper part of the aquifer (port depth 468 ft BLS) than in the other three zones. Nitrite plus nitrate concentrations were larger in the deepest zone (port depth 744 ft BLS) than the other three zones (fig. 15; table 6).

Well USGS 134.—The nutrient concentrations were variable between some of the zones for ammonia and orthophosphate. In each zone, ammonia concentrations were greater in the 2006 samples than in samples collected during the other years. Orthophosphate concentrations were extremely large in most samples because a phosphoric-acid solution was used to clean bacterial buildup in the well; therefore, the data should be used with caution. Nitrite plus nitrate concentrations were smaller in the zone 1 (port depths 846 and 856 ft BLS (table 1)) and zone 3 (port depth 706 ft BLS) than in zones 2, 4, and 5 (fig. 17; table 6).

Total Organic Carbon

Water samples were collected and analyzed at the NWQL for concentrations of total organic carbon (table 6). Concentrations varied between each zone sampled and between each well. Well name and range-zone summary of total organic carbon, in milligrams per liter, follows:

Well	Range
Middle 2050A	0.234E in zone 2 to 1.96 in zone 1
Middle 2051	<0.4 in zones 4 and 5 to 1.42 in zone 4
USGS 103	<0.4 in zones 2 and 4 to 1.36 in zone 7
USGS 132	0.216E in zone 5 to 0.948 in zone 3
USGS 133	<0.4 mg/L in zones 1, 2, and 3 to 1.41 in zone 2
USGS 134	0.211E in zone 5 to 3.03 in zone 1

Gross Alpha- and Gross Beta-Particle Radioactivity

Water samples were collected and analyzed at the RESL for concentrations of gross alpha- and gross beta-particle radioactivity (table 7). Gross alpha- and beta-particle radioactivity is a measure of the total radioactivity given off as alpha and beta particles during the radioactive decay process. For convenience, laboratories report the radioactivity as if it were given off by one radionuclide. Radioactive decay of particles occurs from the decay of the natural elements in aquifer materials and the decay of radioactive particles in wastewater. In 2008, the RESL increased the sensitivity of the analyses for gross alpha- and gross-beta radioactivity, and they also switched the radionuclide reported from plutonium-239 to thorium-230 for gross alpha and from cesium-137 to strontium-90/yttrium-90 for gross beta (Guy Backstrom, U.S. Department of Energy, written commun., July 8, 2009). The minimum detectable activity went from about 1.6 to 1.5 pCi/L for gross alpha and from about 6.4 to 3.4 pCi/L for gross beta (Guy Backstrom, U.S. Department of Energy, written commun., July 7, 2009). The increased sensitivity allowed for increased detectable concentrations for the 2008 data.

Concentrations of gross alpha-particle radioactivity for all samples collected and analyzed during 2005–07 were less than the reporting level; concentrations in four samples collected in 2008 were greater than the reporting level. The positive results for the four samples may be due to statistical fluctuations because the data are close to background or they may be due to the increased sensitivity of the analyses. Concentrations were less than the reporting level for all but one sample collected and analyzed for gross beta-particle radioactivity during 2005–07; concentrations were greater than the reporting level for most of the samples collected in 2008 (table 7).

Strontium-90

Strontium-90 does not occur naturally, with the exception of natural reactors, such as Oklo, in which nuclear fission reactions have occurred in a uranium-enriched deposit (Kuroda, 1982, p. 48–49; Durrance, 1986, p. 90). This radionuclide is present in groundwater as a fission product of nuclear-weapons tests and as a result of disposal practices in the nuclear industry (Orr and others, 1991). Water samples were analyzed for concentrations of strontium-90 at the RESL. Concentrations were less than the reporting level for all but three samples (table 7). In 2005, concentrations were greater than the reporting level in samples from two wells in three zones, but the concentrations in all zones were less than the reporting level in 2006–08. The positive results for the three samples collected in 2005 may be due to statistical fluctuations because the counting data are fairly close to background (Guy Backstrom, U.S. Department of Energy, written commun., July 8, 2009).

Tritium

Tritium, a radioactive isotope of hydrogen, is formed in nature by interactions of cosmic rays with gases in the upper atmosphere. Tritium also is produced in thermonuclear detonations and is a waste product of the nuclear-power industry (Orr and others, 1991). Water samples were collected and analyzed for concentrations of tritium at the RESL; in 2008, samples also were analyzed at the NWQL using a lower MDL. The MDL for tritium analyzed at the RESL is about 200 pCi/L, and the MDL for tritium analyzed at the NWQL is 5.7 pCi/L.

Well Middle 2050A.—Tritium concentrations in samples collected in 2007–08 from the zone of water in the upper part of the aquifer (port depth 515 ft BLS) were greater than the reporting level of three times the sample standard deviation when analyzed at the RESL (table 7). Concentrations were less than the reporting level for all other samples and zones analyzed by the RESL. Tritium analyzed at the NWQL also indicated a larger concentration in the upper zone (fig. 18). This zone probably is influenced by wastewater disposal at the INL. Tritium analyzed by the NWQL from zone 2 (port depth 998 ft BLS) was less than the reporting level. Water from this zone is all old water that was recharged to the aquifer prior to thermonuclear explosions in the atmosphere during the 1960s.

Well Middle 2051.—Tritium concentrations in the upper zone of water (port depth 604 BLS) were less than the reporting level in samples analyzed at the RESL (table 7). Concentrations were greater than the reporting level for all samples from zones 1 through 4 (except for two collected in 2005); these zones are partially influenced by recharge from wastewater disposal. Concentrations were larger in water from zones 3 and 4 than in water from zones 1 and 2, and had much larger concentrations than in zone 5 (fig. 18, table 7). Iodine-129 results reported by Bartholomay (2009) were smaller in zones 3 and 4 than in zones 1 and 2. Given that the INTEC is considered to be the source of iodine-129 in the aquifer, this variability may indicate that zones 3 and 4 are influenced more from wastewater originating from the RTC, whereas zones 1 and 2 are more influenced by wastewater from the INTEC.

Well USGS 103.—Tritium concentrations were smaller in the three upper zones of the aquifer than the four deeper zones (fig. 18, table 7). Concentrations were greater than the reporting level for water in the four deeper zones; these zones are partially influenced by recharge from wastewater disposal. The greater concentrations in the deeper zones support the conceptual model interpretation that flow at the southern boundary of the INL moves downward in the aquifer (Ackerman and others, 2006, fig. 24).

Well USGS 132.—Tritium concentrations generally were smaller in the upper zone of the aquifer (port depth 636 ft BLS) than in the five deeper zones (fig. 18, table 7). Concentrations were greater than the reporting level for most of the water collected from the five deeper zones; these zones are partially influenced by recharge from wastewater disposal.

Well USGS 133.—Tritium concentrations were larger in the upper zone (port depth 468 ft BLS) than in the three deeper zones (fig. 18, table 7). The small tritium concentrations of the three deeper zones indicate that these zones probably are influenced mostly by old groundwater with only a small fraction of young water. The tritium concentration in the upper zone may indicate recharge from mostly young water, and the iodine-129 reported in Bartholomay (2009) did seem to indicate a wastewater source. However, iodine-129 in wastewater generally is attributed to disposal at INTEC, but this well is upgradient of the INTEC, so more research is needed to fully understand the sources of the water in the upper zone.

Well USGS 134.—Tritium concentrations in the three deepest zones in the well (zones 1–3) were less than the reporting level for RESL data. The NWQL tritium concentration in zone 2 water (3 ± 1.8 pCi/L) indicates all old water. The concentration in zone 3 indicates mostly all old water with a small fraction of young water. The concentrations in the upper two zones (zones 4 and 5) are variable among sample periods. For example, concentrations were greater than the reporting level in the 2006 sample in zone 5 and its replicate, which is indicative of wastewater disposal; however, subsequent samples indicated only a small amount of tritium in this zone (table 7). Tritium concentrations were greater than the reporting level in the 2008 sample in zone 4 (port depth of 644 ft BLS), which indicates there is some recharge from wastewater disposal in this zone; however, the rerun concentration from 2006 and the concentration in 2007 were less than the reporting level. Particle-tracking simulations by Ackerman and others (in press; figs. 38 and 45) indicate flow movement from RTC to the west, so RTC is the likely wastewater source.

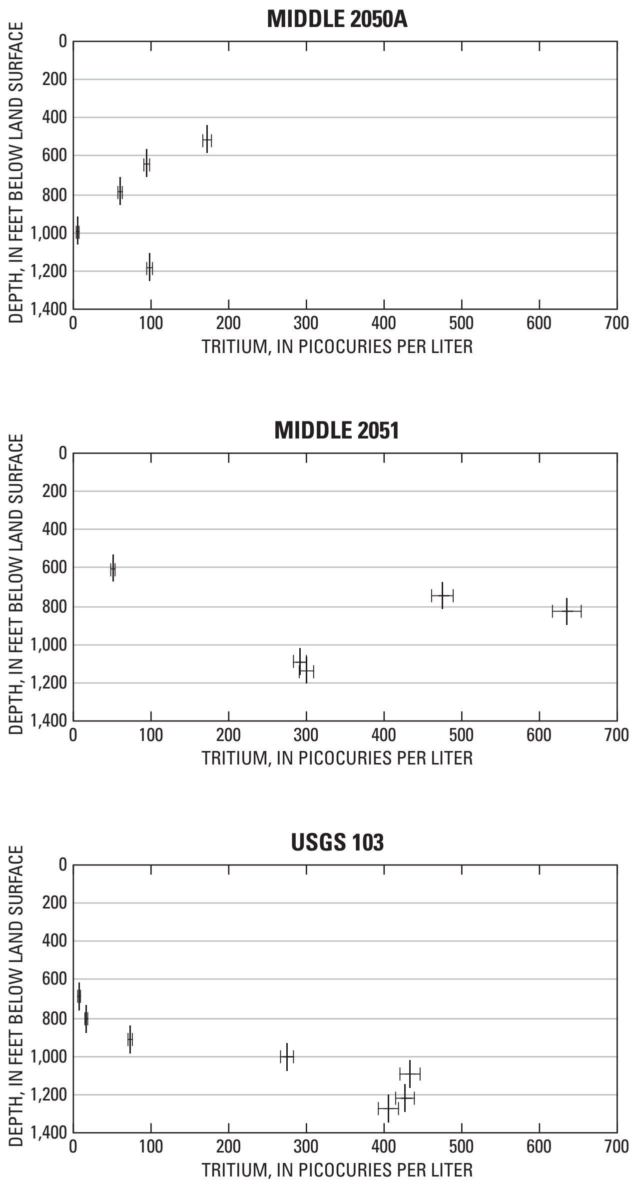


Figure 18. Concentrations of tritium in wells Middle 2050A, Middle 2051, USGS 103, USGS 132, USGS 133, and USGS 134, Idaho National Laboratory, Idaho.

Cesium-137

Cesium-137 is not naturally occurring; however, it can be present in groundwater as a fission product from nuclear facilities and weapons tests (Orr and others, 1991). Water samples were analyzed for concentrations of cesium-137 at the RESL using gamma spectrometry. Cesium-137 concentrations in all samples were less than the reporting level (table 7).

Uranium Isotopes

Uranium is a widely distributed element with three naturally occurring radioactive isotopes: uranium-234, uranium-235, and uranium-238. Uranium-238 (99.27 percent) is the most naturally abundant of the three isotopes. These isotopes undergo a complex series of radioactive decay that results in their ultimate conversion to stable isotopes of lead (Haglund, 1972). Water samples were analyzed from four wells (USGS 103, USGS 132, USGS 133, and USGS 134) for concentrations of uranium-233, -234 (undivided), uranium-235, and uranium-238 at the NWQL (table 8).

Concentrations of uranium-233, -234 (undivided) were greater than the reporting level in all but one sample (USGS 134, zone 1), and they ranged from 0.043 ± 0.018 pCi/L in USGS 134 (zone 1) to 1.83 ± 0.097 pCi/L in USGS 132 (zone 6) (table 8). Concentrations from four of the zones in USGS 134 and the concentration in the upper zone (zone 7) in USGS 103 were much less than concentrations in the other zones.

Uranium-235 concentrations were less than the reporting level in all sample zones from USGS 133 and USGS 134. Uranium-235 concentrations were greater than the reporting level (table 8) from zones 2 and 4 in USGS 103 and zones 1, 2, 4, and 6 in USGS 132.

Uranium-238 concentrations were greater than the reporting level in all but one sample (USGS 134, zone 1), and ranged from 0.021 ± 0.011 to 0.797 ± 0.058 pCi/L (table 8). Concentrations from all five zones in USGS 134 and from the upper zone (zone 7) in USGS 103 were much less than concentrations in the other zones.

Transuranic Elements

Some transuranic elements can be produced in nature because of the availability of neutrons that can be captured by uranium isotopes (Orr and others, 1991, p. 16), but concentrations are much less than the detection level used for analyses at the RESL. Some transuranic elements also are produced as by-products of the nuclear industry (Wampler, 1972, p. 6-7). Water samples were analyzed for concentrations of plutonium-238, plutonium-239, -240 (undivided), and americium-241 at the RESL. Concentrations in all samples were less than the reporting level (table 8).

Stable Isotopes

Water samples were analyzed for relative concentrations of stable isotopes of hydrogen (H), oxygen (O), and carbon (C). Because the absolute measurement of isotopic ratios is analytically difficult, relative isotopic ratios are measured instead (Toran, 1982). For example, $^{18}O/^{16}O$ of a sample is compared with $^{18}O/^{16}O$ of a standard:

$$\delta^{18}O = (R_{sample} / R_{standard} - 1) \times 1{,}000, \qquad (3)$$

where

$\delta^{18}O$ is the relative concentration, in units of parts per thousand (permil),

R_{sample} is the $^{18}O/^{16}O$ ratio in the sample, and

$R_{standard}$ is the $^{18}O/^{16}O$ ratio in the standard.

$\delta^{18}O$ is referred to as delta notation; it is the value reported by isotopic laboratories for stable isotope analysis. $^{2}H/^{1}H$, and $^{13}C/^{12}C$ are defined in a similar manner with the respective ratios replacing $^{18}O/^{16}O$ in R_{sample} and $R_{standard}$. The standard used for determining $\delta^{18}O$ and $\delta^{2}H$ in water is standard mean ocean water as defined by Craig (1961). The standard used for determining $\delta^{13}C$ in water is the PeeDee Belemnite reference standard (Timme, 1995, p. 71). Relative concentrations of stable isotopes are shown in table 9.

Well Middle 2050A.— Average concentrations of $\delta^{2}H$ and $\delta^{18}O$ isotopes were slightly heavier in the upper zone (-134.5 and -17.6) and lower zone (-135.4 and -17.8) than in the three middle zones (-136.4 and -18.0). $\delta^{13}C$ isotopes were quite variable among zones, ranging from -8.13 in zone 2 to -13.2 in zone 1.

Well Middle 2051.—Average concentrations of $\delta^{2}H$ and $\delta^{18}O$ isotopes were heavier in the upper zone (-133.6 and -17.3) than in the four lower zones (-136.6 and -18.0). Concentrations of $\delta^{13}C$ isotopes were lighter in the upper zone (-10.7) than in the four deeper zones. The heavier $\delta^{2}H$ and $\delta^{18}O$ isotopes, and the lighter $\delta^{13}C$ isotopes in the upper zone may indicate a greater fraction of young recharge water in this zone. The Big Lost River is the most likely source. Busenberg and others (2001) found that, as the fraction of young water in samples increased, the $\delta^{13}C$ isotopic composition became lighter, which implied that young water with slightly heavier $\delta^{18}O$ isotopic ratios recharged the aquifer, and that the young water dissolved soil CO_2 and then reacted with the aquifer minerals and rocks.

Well USGS 103.—Average concentrations of $\delta^{2}H$ and $\delta^{18}O$ isotopes were slightly heavier in the upper zone (-135.4 and -17.7) than in the other six zones (-137.1 and -17.9). $\delta^{13}C$ was relatively consistent among all seven zones (table 9).

Well USGS 132.—Concentrations of $\delta^{2}H$, $\delta^{18}O$, and $\delta^{13}C$ were relatively consistent among all six zones (table 9). $\delta^{2}H$ concentrations ranged from -137.5 to -133.5, but the variability in the range was not consistent with any particular zone. $\delta^{18}O$ ranged from -17.9 to -17.6. $\delta^{13}C$ ranged from -9.81 to -8.73.

Well USGS 133.—Concentrations of $\delta^{2}H$, $\delta^{18}O$, and $\delta^{13}C$ were relatively consistent among all four zones (table 9). $\delta^{2}H$ concentrations ranged from -139.1 to -135.8, but the variability in the range was not consistent with any particular zone. $\delta^{18}O$ ranged from -18.2 to -18.0; $\delta^{13}C$ ranged from -8.95 to -8.58.

Well USGS 134.—Concentrations of $\delta^{2}H$, $\delta^{18}O$, and $\delta^{13}C$ were relatively consistent among all five zones (table 9). $\delta^{2}H$ concentrations ranged from -138.6 to -136.2, but the variability in the range was not consistent with any particular zone. $\delta^{18}O$ ranged from -18.2 to -18.0; $\delta^{13}C$ ranged from -8.58 to -7.15.

Chemical Comparison of Groundwater from Multiple Zones

The hydrochemical facies or trilinear diagrams (figs. 5, 7, 8, 10, 12, 14, and 16) are based on a data visualization technique developed by Piper (1944) that is a useful tool for displaying the chemical character of water. Trilinear diagrams also can be used to test for simple mixing between two end-member solutions. A plot of the hydrochemical facies of all wells sampled for this report (fig. 19) indicates that four of the zones from four of the wells distinctly differ from the other zones of water. Percentages of sulfate compared with chloride and bicarbonate were smaller in the lower aquifer zone (zone 1) from well Middle 2050A than in all other samples. Percentages of calcium compared with magnesium, sodium, and potassium were larger and percentages of chloride compared with sulfate and bicarbonate were smaller in the upper aquifer zone from well Middle 2051 than in all other samples. The distribution of these facies compare similarly with Big Lost River water (fig. 8). The upper zone of water from USGS 103 and from USGS 132 both have much larger percentages of sulfate, chloride, and sodium plus potassium, and much smaller percentages of calcium and bicarbonate than do the other zones of water.

Other chemical, radiochemical, and isotope species also indicate chemical variability among different zones of water. In Middle 2050A, minor inorganic constituents vary in zones 1 and 5 compared with concentrations in the other three zones. Nitrite plus nitrate is not present in the deepest zone (zone 1), and the concentration in zone 4 is less than those in the other three zones (fig. 6). Tritium is present at a concentration that probably represents a wastewater source in the upper zone (zone 5). The tritium concentration in zone 2 indicates that all water in that zone was recharged prior to the 1960s. Deuterium and oxygen isotopes are heavier in zones 1 and 5 as compared with concentrations in the other three zones. Water in this well probably derives from a variable combination of wastewater disposal, recharge from the Big Lost River, and a mixture of water derived from precipitation and underflow from Big Lost River, Little Lost River, and Birch Creek.

In Middle 2051, some minor inorganic constituents (chromium, barium, strontium, and tungsten) are more variable in zones 1, 2, and 5 as compared with concentrations in the other zones. Nitrite plus nitrate had smaller average concentrations in the upper zone (zone 5) as compared with concentrations in the other four zones (fig. 9). Tritium concentrations were smaller in the upper zone as compared with concentrations in the other four zones (fig. 18). δ^2H and δ^{18}O isotopes are heavier in the upper zone, and δ^{13}C is lighter in the upper zone when compared with concentrations in the other four zones. Concentrations of calcium and magnesium and tritium differed among the upper zone (zone 5), zones 3 and 4, and zones 1 and 2 (figs. 7 and 18). Sedimentary interbeds and large changes in piezometric head (Bartholomay, 2009, fig. 8) separate zones 2 and 3 from zone 1 and zones 4 and 5 from zones 2 and 3 in this well, which indicates three different water types in this well. The upper zone of water in this well probably is influenced more by recent local recharge from the Big Lost River than are the other four zones of water in this well. The other four zones include a variable combination of wastewater disposal (from the INTEC and the RTC), recharge from the Big Lost River, and a mixture of water derived from precipitation and underflow from Big Lost River, Little Lost River, and Birch Creek.

Minor inorganic constituents were variable in the upper zone (zone 7) in USGS 103 as compared with the other six zones. Concentrations of ammonia were larger and nitrite plus nitrate and orthophosphate were smaller in the upper zone than in the other six zones. Tritium concentrations were smallest in the upper zone and were smaller in the upper three zones than in the deepest four zones (fig. 18). Uranium isotope concentrations were smaller in the upper zone than in the other zones. δ^2H and δ^{18}O isotopes were slightly heavier in the upper zone. Percentages of sodium and postassium concentrations in the upper zone of water were similar to regional underflow in that it has larger percentages of sodium and potassium and smaller percentages of calcium and magnesium than water from other zones. Fluoride and lithium concentrations also are slightly larger in this zone than in the other zones, but the lack of silica and the abundance of chloride do not support the concept of a regional-underflow source. The small tritium concentration in the upper zone indicates that the water is mostly old water. The deepest four zones include a variable combination of wastewater disposal and a mixture of water derived from precipitation and underflow from Big Lost River, Little Lost River, and Birch Creek.

In USGS 132, concentrations of barium and nitrate plus nitrite in the upper zone were slightly larger than in the other five zones. Tritium concentrations were smaller in the upper zone than in the other five zones (fig. 18). Water in the upper zone of USGS 132 is chemically similar to the upper zone of USGS 103 and USGS 120 (fig. 20), which is an open-borehole well near USGS 132 that is used to sample the upper 100 ft of the aquifer. The higher concentrations of magnesium, sodium, and chloride in this zone may be due to a magnesium chloride brine suppressant applied to roads in the RWMC area (Roddy, 2007). A tracer study conducted by Nimmo and others (2002) indicated that Big Lost River water from the spreading areas also recharges the upper part of the aquifer in the vicinity of this well. The other five zones include a variable combination of wastewater disposal, recharge from the Big Lost River, and a mixture of water derived from precipitation and underflow from Big Lost River, Little Lost River, and Birch Creek.

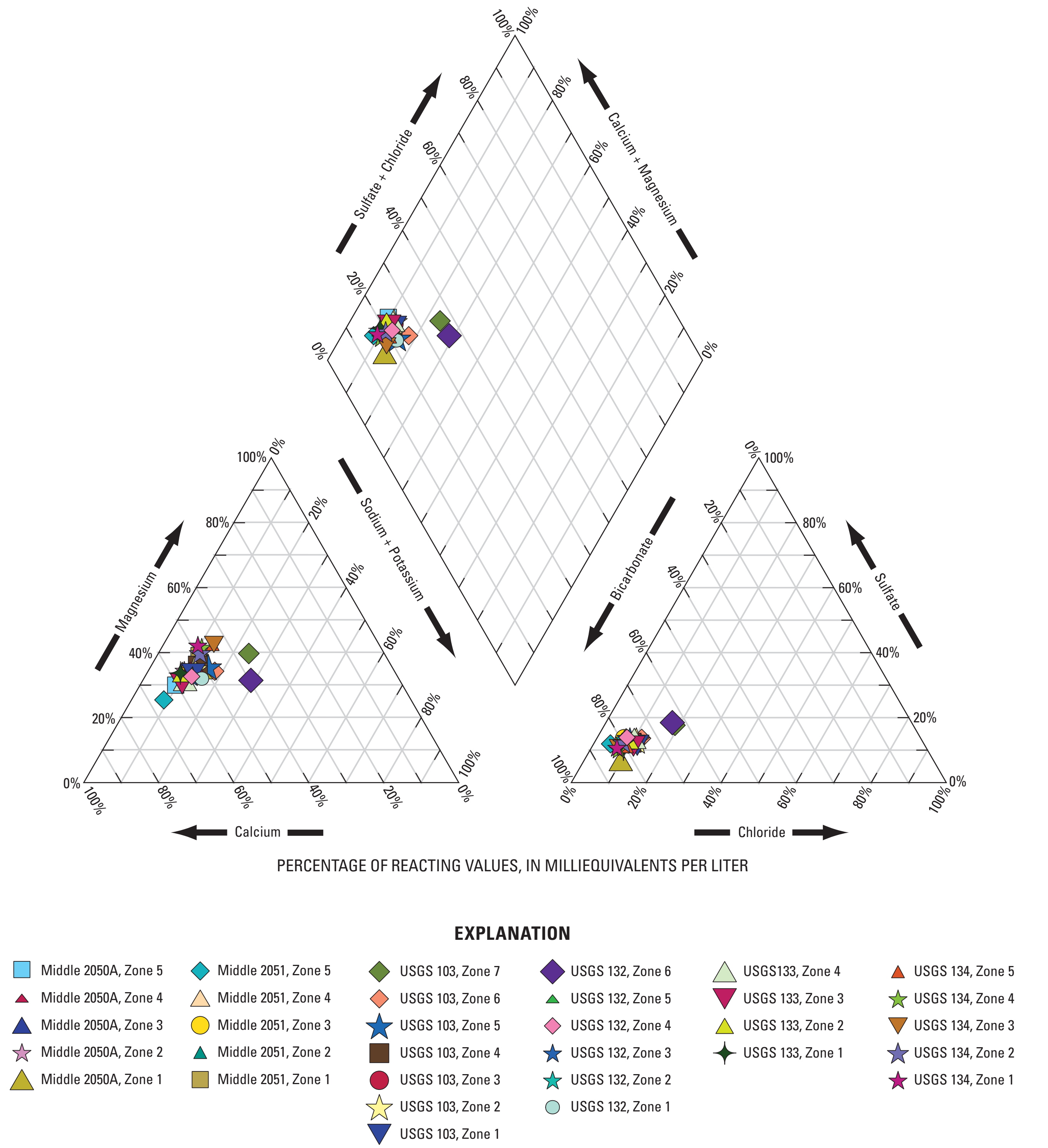


Figure 19. Major-ion composition of water from wells Middle 2050A, Middle 2051, USGS 103, USGS 132, USGS 133, and USGS 134, Idaho National Laboratory, Idaho.

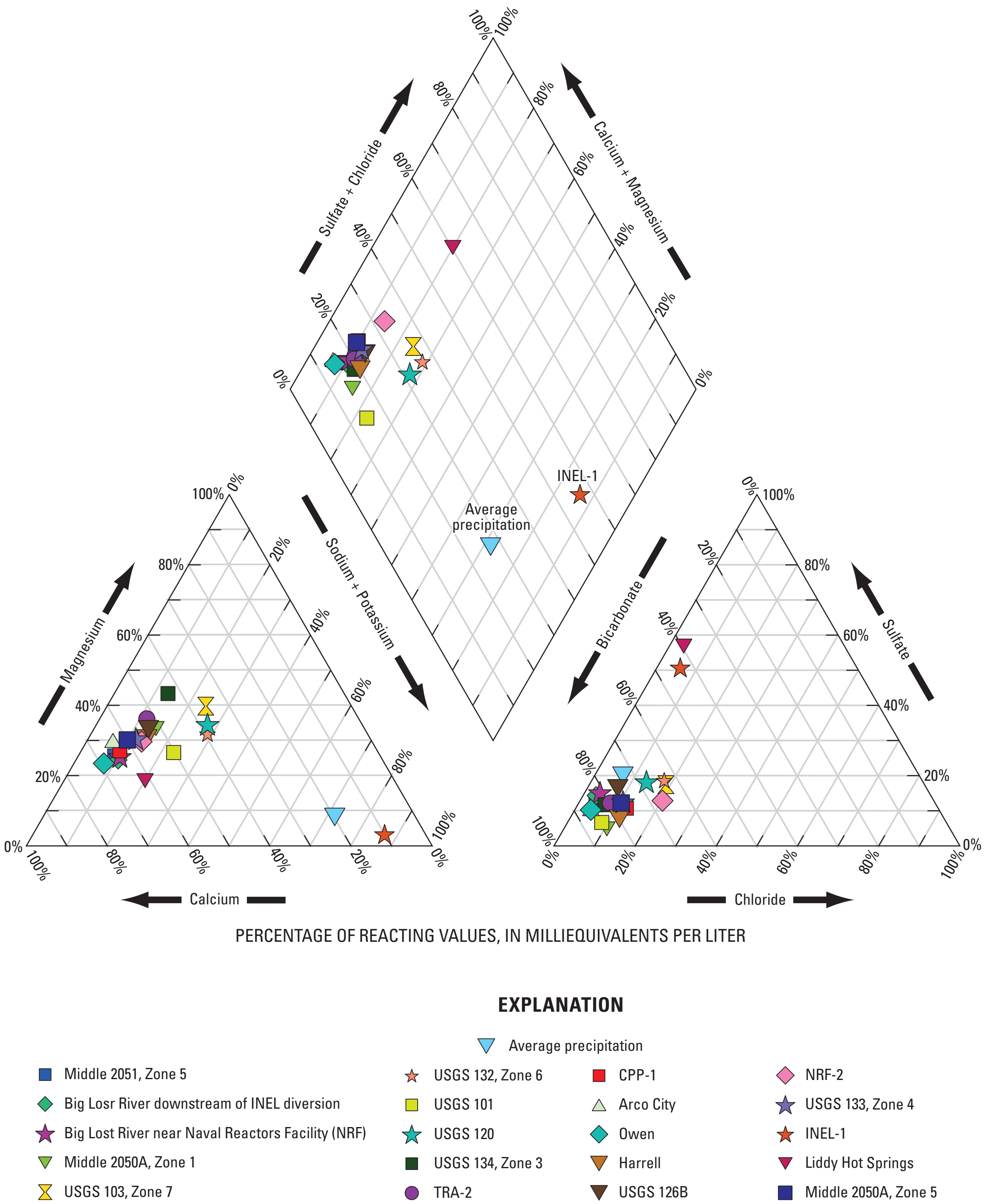


Figure 20. Major-ion composition from selected sites at and near the Idaho National Laboratory, Idaho.

Concentrations of minor inorganic constituents varied between the upper zone (zone 4) in USGS 133 and the other three zones. Concentrations of orthophosphate were smaller and tritium was larger in the upper zone (fig. 18) than in the other zones. Nitrite plus nitrate concentrations were larger in the deepest zone than in the other zones (fig. 15). Tritium concentrations in the deepest three zones were small, and the water in these zones probably is a mixture of old water derived from precipitation and underflow from Big Lost River, Little Lost River, and Birch Creek. The upper zone also probably is derived mostly from mixtures of precipitation and underflow from Big Lost River, Little Lost River, and Birch Creek; it also may be influenced by wastewater discharge at the NRF.

In USGS 134, the water chemistry is similar in all five zones, and the percentages of magnesium is greater in this well relative to the other wells sampled for this study. This may indicate a greater influence of underflow from Little Lost River and Birch Creek, and a lesser influence of underflow from Big Lost River than for the other wells sampled for this study. Uranium isotope concentrations are low in this well, which may indicate sluggish groundwater flow (Luo and others, 2000). Tritium concentrations vary in the upper two zones, but some of the concentrations may indicate influence of either recharge from wastewater disposal at the RTC or of contamination from drill water.

Tritium concentrations in the upper zone from well Middle 2050A, the four deepest zones from well Middle 2051, the four deepest zones from well USGS 103, the five deepest zones from well USGS 132, the upper zone from well USGS 133, and the upper two zones from USGS 134 indicate possible source water from wastewater disposal. The concentrations of wastewater constituents in deeper zones in wells Middle 2051, USGS 132, and USGS 103 support the concept of groundwater flow deepening in the southwestern corner of the INL (Ackerman and others, 2006, fig. 24).

Summary

Radiochemical and chemical wastewater discharged to infiltration ponds and disposal wells since the early 1950s at the INL has affected the water quality of the eastern Snake River Plain aquifer. In 1949, the USGS initiated an ongoing monitoring program to determine the horizontal movement of selected constituents within the aquifer. In 2005, the USGS, in cooperation with DOE, added a multilevel, well-monitoring program to begin describing the vertical distribution of these chemical constituents.

Between 2005 and 2008, water samples were collected from four to seven transmissive zones in the upper 350–700 ft of the aquifer from six wells: Middle 2050A, Middle 2051, USGS 103, USGS 132, USGS 133, and USGS 134. The samples were analyzed by the USGS NWQL and/or the RESL for the following chemical constituents: dissolved cations and anions; trace elements; nutrients; isotopes of oxygen, hydrogen, and carbon; total organic carbon; uranium isotopes; tritium; strontium-90; plutonium and americium isotopes; and gross alpha, beta, and gamma radioactivity. The water chemistry of these samples was compared with that of recharge sources throughout the INL, and the results will be used in the future to determine if model-simulated source areas and travel times are consistent with field evidence.

Eight replicate samples, two blank samples, and two samples of drilling water were collected as a measure of quality assurance for the entire period of sampling. About 96 percent of the replicate pairs for radionuclide and isotope results were statistically comparable, and about 95 percent of the replicate pairs for the inorganic and organic constituents were statistically comparable; these results indicate that the sample collection and laboratory procedures used were appropriate for the data collected.

The eastern Snake River Plain aquifer is recharged from several sources, including precipitation; streamflow infiltration from the Big Lost River; industrial wastewater return; irrigation infiltration; underflow from the Big Lost River, Little Lost River, and Birch Creek drainage basins; regional underflow from Snake River Plain aquifer northeast of the INL; and groundwater upwelling from below the base of the aquifer. The samples collected for this study represented variable mixtures of water sources consisting of underflow from the Big Lost River, Little Lost River, and Birch Creek; Big Lost River surface water; and minor contributions from precipitation recharge, wastewater return recharge, and irrigation return recharge. The water chemistry of one zone from one well compared with regional underflow water; however, other samples did not compare with regional underflow or with groundwater upwelling from below the base of the aquifer.

The water-chemistry composition of all sampled zones is calcium plus magnesium bicarbonate. Four of the zones of water from four of the wells distinctly differ from the rest of the zones. The lower aquifer zone in well Middle 2050A has smaller percentages of sulfate as compared with chloride and bicarbonate than do all of the other samples. The upper aquifer zone from Middle 2051 has larger percentages of calcium as compared to magnesium, sodium, and potassium; and it has smaller percentages of chloride as compared to sulfate and bicarbonate than do all of the other samples. The upper zone of water from USGS 103 and USGS 132 both have much larger percentages of sulfate, chloride, and sodium plus potassium, and much smaller percentages of calcium and bicarbonate than do the other zones of water. All five zones of water from USGS 134 have larger percentages of magnesium than in the other wells sampled for this study, which may indicate a greater influence of underflow from Little Lost River and Birch Creek, and less influence of underflow from Big Lost River.

Tritium concentrations in the upper zone from well Middle 2050A, the four deepest zones from well Middle 2051, the four deepest zones from well USGS 103, the five deepest zones from well USGS 132, the upper zone from well USGS 133, and the upper two zones from USGS 134 indicate possible source water from wastewater disposal. The concentrations of wastewater constituents in deeper zones in wells Middle 2051, USGS 132, and USGS 103 support the concept of groundwater flow deepening in the southwestern corner of the INL.

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Table 3. Concentrations of dissolved major cations and silica in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). NA, not applicable. NS, not sampled. **Remarks:** QAW, quality assurance Westbay™ sample. RPD, Relative percent difference in percent. <, less than]

Well name	Port depth	Date	Calcium		Magnesium		Sodium		Potassium		Silica		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
Middle 2050A													
Zone 5	515	09-30-05	NS	NA	NS	NA	8.44	NA	NS	NA	NS	NA	
		09-19-06	45.6	NA	11.3	NA	6.60	NA	1.90	NA	19.4	NA	
		09-20-07	54.7	NA	16.6	NA	8.55	NA	2.26	NA	22.9	NA	
		08-27-08	53.2	NA	16.5	NA	9.39	NA	2.36	NA	21.5	NA	
		08-27-08	54.5	2.2	16.6	1.2	9.48	0.95	2.43	2.90	21.7	0.93	QAW-11
Zone 4	642	09-30-05	NS	NA	NS	NA	8.06	NA	NS	NA	NS	NA	
		09-19-06	41.5	NA	13.6	NA	9.52	NA	2.32	NA	18.7	NA	
		09-20-07	43.8	NA	14.1	NA	6.70	NA	2.21	NA	20.4	NA	
		08-27-08	42.8	NA	14.2	NA	7.17	NA	2.32	NA	19.6	NA	
Zone 3	790	10-14-05	NS	NA	NS	NA	7.80	NA	NS	NA	NS	NA	
		09-20-06	47.3	NA	16.8	NA	7.73	NA	1.88	NA	21.4	NA	
		09-20-06	48.6	2.7	16.9	0.59	7.77	0.52	1.90	1.10	21.6	0.93	QAW-5
		09-20-07	47.5	NA	17.5	NA	7.93	NA	1.86	NA	21.6	NA	
		08-26-08	45.2	NA	17.2	NA	8.61	NA	1.90	NA	20.3	NA	
Zone 2	998	10-07-05	NS	NA	NS	NA	7.95	NA	NS	NA	NS	NA	
		09-18-06	43.8	NA	16.7	NA	7.65	NA	1.72	NA	20.7	NA	
		09-19-07	43.0	NA	16.9	NA	7.82	NA	1.74	NA	19.8	NA	
		08-26-08	41.4	NA	16.4	NA	7.81	NA	1.71	NA	19.0	NA	
Zone 1	1,179	10-21-05	NS	NA	NS	NA	11.6	NA	NS	NA	NS	NA	
		09-18-06	42.0	NA	15.8	NA	12.1	NA	2.40	NA	17.9	NA	
		09-19-07	41.0	NA	17.0	NA	12.5	NA	2.43	NA	18.8	NA	
		08-26-08	40.0	NA	17.4	NA	12.4	NA	2.45	NA	18.7	NA	
Middle 2051													
Zone 5	604	09-27-05	NS	NA	NS	NA	5.85	NA	NS	NA	NS	NA	
		09-11-06	47.4	NA	11.4	NA	5.69	NA	2.31	NA	26.4	NA	
		09-12-07	47.6	NA	11.1	NA	5.82	NA	2.29	NA	26.0	NA	
		08-25-08	46.3	NA	11.1	NA	5.68	NA	2.37	NA	24.3	NA	
Zone 4	750	09-27-05	NS	NA	NS	NA	8.40	NA	NS	NA	NS	NA	
		09-13-06	44.3	NA	15.8	NA	8.35	NA	2.27	NA	24.5	NA	
		09-13-06	44.1	0.45	15.8	0	8.22	1.6	2.27	0	24.2	1.2	QAW-4
		09-12-07	44.3	NA	15.4	NA	8.21	NA	2.22	NA	23.7	NA	
		09-12-07	44.9	1.3	15.6	1.3	8.33	1.5	2.26	2.20	23.9	0.8	QAW-8
		08-25-08	43.7	NA	15.6	NA	8.28	NA	2.28	NA	22.4	NA	
Zone 3	828	09-28-05	NS	NA	NS	NA	8.50	NA	NS	NA	NS	NA	
		09-12-06	43.8	NA	15.6	NA	8.08	NA	2.12	NA	23.1	NA	
		09-12-06	44.4	1.4	15.7	0.64	8.21	1.60	2.20	3.70	23.5	1.7	QAW-3
		09-11-07	46.4	NA	16.5	NA	8.65	NA	2.36	NA	22.2	NA	
		08-21-08	43.1	NA	15.3	NA	8.35	NA	2.18	NA	21.6	NA	
Zone 2	1,092	09-28-05	NS	NA	NS	NA	7.46	NA	NS	NA	NS	NA	
		09-11-06	36.4	NA	17.6	NA	7.27	NA	2.39	NA	26.8	NA	
		09-11-07	38.0	NA	18.0	NA	7.69	NA	2.51	NA	25.2	NA	
		08-21-08	35.7	NA	17.1	NA	7.49	NA	2.41	NA	24.2	NA	
Zone 1	1,142	09-29-05	NS	NA	NS	NA	9.25	NA	NS	NA	NS	NA	
		09-07-06	37.5	NA	18.4	NA	7.77	NA	2.48	NA	26.5	NA	
		09-11-07	38.2	NA	17.8	NA	7.81	NA	2.49	NA	25.3	NA	
		08-21-08	36.8	NA	17.8	NA	7.78	NA	2.52	NA	25.0	NA	

Table 3. Concentrations of dissolved major cations and silica in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). NA, not applicable. NS, not sampled. **Remarks:** QAW, quality assurance Westbay™ sample. RPD, Relative percent difference in percent. <, less than]

Well name	Port depth	Date	Calcium		Magnesium		Sodium		Potassium		Silica		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
USGS 103													
Zone 7	682	10-02-07	20.0	NA	13.3	NA	13.7	NA	2.84	NA	6.09	NA	
		08-20-08	21.6	NA	14.6	NA	14.7	NA	3.12	NA	6.89	NA	
Zone 6	805	10-02-07	33.2	NA	14.3	NA	12.2	NA	2.72	NA	29.6	NA	
		08-19-08	32.9	NA	14.5	NA	12.9	NA	2.86	NA	30.6	NA	
Zone 5	914	10-01-07	32.1	NA	13.7	NA	10.0	NA	2.75	NA	28.5	NA	
		08-19-08	30.7	NA	13.6	NA	9.3	NA	2.83	NA	29.5	NA	
Zone 4	1,000	10-01-07	34.7	NA	14.5	NA	8.1	NA	2.36	NA	26.4	NA	
		08-18-08	35.6	NA	15.4	NA	8.72	NA	2.58	NA	27.3	NA	
Zone 3	1,095	10-01-07	38.7	NA	14.9	NA	8.42	NA	2.40	NA	25.7	NA	
		08-18-08	37.1	NA	14.9	NA	8.52	NA	2.46	NA	25.2	NA	
Zone 2	1,220	09-25-07	38.2	NA	14.8	NA	8.15	NA	2.29	NA	25.8	NA	
		08-18-08	38.8	NA	15.5	NA	8.9	NA	2.57	NA	26.3	NA	
		08-18-08	39.1	0.77	15.8	1.9	8.9	0	2.60	1.2	26.6	1.1	QAW-10
Zone 1	1,269	09-25-07	38.6	NA	15.0	NA	8.48	NA	2.32	NA	25.3	NA	
		08-19-08	38.3	NA	15.4	NA	8.82	NA	2.51	NA	26.4	NA	
USGS 132													
Zone 6	636	09-06-06	36.6	NA	16.7	NA	29.7	NA	3.73	NA	25.4	NA	
		09-18-07	34.8	NA	16.7	NA	28.1	NA	3.84	NA	24.0	NA	
		08-14-08	35.8	NA	18.1	NA	26.1	NA	3.77	NA	24.8	NA	
		08-14-08	36.2	1.1	18.1	0	26.2	0.38	3.84	1.80	24.6	0.81	QAW-9
Zone 5	764	09-05-06	38.6	NA	15.4	NA	11.1	NA	2.72	NA	25.9	NA	
		09-18-07	38.6	NA	15.0	NA	10.8	NA	2.68	NA	24.6	NA	
		08-13-08	38.4	NA	15.4	NA	10.7	NA	2.81	NA	25.7	NA	
Zone 4	826	09-05-06	41.3	NA	14.9	NA	9.42	NA	2.57	NA	25.7	NA	
		09-18-07	39.7	NA	14.0	NA	8.87	NA	2.42	NA	25.5	NA	
		08-13-08	39.6	NA	14.5	NA	8.85	NA	2.60	NA	25.8	NA	
Zone 3	917	08-31-06	39.9	NA	14.3	NA	8.89	NA	2.51	NA	25.4	NA	
		09-18-07	39.6	NA	14.0	NA	8.90	NA	2.49	NA	25.3	NA	
		08-13-08	39.3	NA	14.4	NA	8.85	NA	2.56	NA	25.8	NA	
Zone 2	1,010	08-30-06	38.7	NA	14.4	NA	8.98	NA	2.49	NA	24.8	NA	
		09-17-07	39.7	NA	13.9	NA	9.08	NA	2.48	NA	25.3	NA	
		08-12-08	39.9	NA	14.6	NA	9.15	NA	2.63	NA	25.8	NA	
Zone 1	1,172	08-29-06	38.7	NA	14.8	NA	11.4	NA	2.60	NA	24.7	NA	
		09-17-07	39.5	NA	14.1	NA	11.8	NA	2.60	NA	24.6	NA	
		08-12-08	38.8	NA	14.7	NA	11.7	NA	2.75	NA	24.9	NA	

Table 3. Concentrations of dissolved major cations and silica in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). NA, not applicable. NS, not sampled. **Remarks:** QAW, quality assurance Westbay™ sample. RPD, Relative percent difference in percent. <, less than]

Well name	Port depth	Date	Calcium		Magnesium		Sodium		Potassium		Silica		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
USGS 133													
Zone 4	468	09-24-07	43.3	NA	13.8	NA	8.53	NA	2.98	NA	14.4	NA	
		09-02-08	20.0	NA	6.35	NA	4.65	NA	1.42	NA	10.0	NA	
Zone 3	568	09-24-07	45.6	NA	15.1	NA	7.92	NA	2.85	NA	29.5	NA	
		09-02-08	39.8	NA	13.2	NA	7.60	NA	2.70	NA	24.9	NA	
Zone 2	685	09-24-07	45.4	NA	15.5	NA	7.75	NA	2.22	NA	27.0	NA	
		09-09-08	40.2	NA	13.6	NA	7.09	NA	2.06	NA	23.6	NA	
Zone 1	744	09-24-07	57.7	NA	20.7	NA	9.45	NA	1.91	NA	23.1	NA	
		09-02-08	50.4	NA	17.8	NA	8.97	NA	1.75	NA	19.1	NA	
USGS 134													
Zone 5	578	09-27-06	31.0	NA	18.2	NA	8.18	NA	2.25	NA	40.3	NA	
		09-10-07	28.0	NA	17.5	NA	7.89	NA	2.32	NA	29.5	NA	
		09-04-08	24.8	NA	16	NA	7.23	NA	2.15	NA	27.0	NA	
Zone 4	644	09-28-06	39.6	NA	20.5	NA	8.61	NA	2.35	NA	36.4	NA	
		09-06-07	40.8	NA	21.6	NA	9.16	NA	2.41	NA	31.7	NA	
		09-06-07	41.2	0.98	21.7	0.46	9.20	0.44	2.37	1.7	31.7	0	QAW-7
		09-04-08	36.3	NA	20.1	NA	8.73	NA	2.26	NA	28.2	NA	
Zone 3	706	09-27-06	14.2	NA	8.21	NA	3.94	NA	1.13	NA	16.3	NA	
		09-05-07	27.5	NA	16.6	NA	7.77	NA	2.22	NA	31.1	NA	
		09-03-08	25.5	NA	15.5	NA	7.73	NA	2.19	NA	28.6	NA	
Zone 2	806	09-26-06	38.7	NA	17.6	NA	7.28	NA	2.28	NA	35.0	NA	
		09-05-07	33.6	NA	16.4	NA	7.74	NA	2.22	NA	26.9	NA	
		09-03-08	31.9	NA	16.6	NA	8.18	NA	2.38	NA	25.9	NA	
Zone 1	856	09-25-06	51.4	NA	25.7	NA	9.21	NA	2.89	NA	74.9	NA	
		09-04-07	54.1	NA	30.4	NA	11.0	NA	3.35	NA	65.6	NA	
	[1]846	09-03-08	25.2	NA	15.6	NA	7.79	NA	2.57	NA	39.1	NA	
QAW-1	NA	08-28-06	<0.02	NA	<0.008	NA	0.215	NA	<0.16	NA	1.01	NA	
QAW-2	NA	10-02-06	78.3	NA	24.8	NA	28.2	NA	4.26	NA	25.5	NA	
QAW-6	NA	10-12-07	<0.02	NA	<0.014	NA	0.415	NA	<0.04	NA	1.29	NA	
QAW-12	NA	09-08-08	38.3	NA	15.5	NA	11.8	NA	2.91	NA	24.6	NA	

[1]The port at 856 feet below land surface was damaged in 2007, so samples were collected from the port at 846 feet below land surface in 2008.

Table 4. Concentrations of dissolved major anions in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). Bicarbonate data were calculated from field measurements shown in table 2; alkalinity (as calcium carbonate) was divided by 0.8202 (Hem, 1989, p. 57). NS, not sampled. NA, not applicable. **Remarks:** QAW, quality assurance Westbay[TM] sample. RPD, Relative percent difference in percent. <, less than]

Well name	Port depth	Date	Chloride		Sulfate		Bicarbonate		Fluoride		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
Middle 2050A											
Zone 5	515	09-30-05	15.3	NA	NS	NA	NS	NA	NS	NA	
		09-19-06	5.64	NA	19.6	NA	183	NA	0.217	NA	
		09-20-07	16.1	NA	25.9	NA	205	NA	0.183	NA	
		08-27-08	15.5	NA	25.7	NA	200	NA	0.216	NA	
		08-27-08	15.6	0.64	25.7	0	200	0	0.209	3.30	QAW-11
Zone 4	642	09-30-05	14.7	NA	NS	NA	NS	NA	NS	NA	
		09-19-06	10.6	NA	18.4	NA	178	NA	0.237	NA	
		09-20-07	10.9	NA	19.7	NA	176	NA	0.210	NA	
		08-27-08	11.2	NA	21.4	NA	182	NA	0.235	NA	
Zone 3	790	10-14-05	11.7	NA	NS	NA	NS	NA	NS	NA	
		09-20-06	10.3	NA	21.1	NA	205	NA	0.167	NA	
		09-20-06	10.3	0	21.1	0	205	0	0.205	20.4	QAW-5
		09-20-07	10.7	NA	21.6	NA	200	NA	0.153	NA	
		08-26-08	10.9	NA	22.1	NA	207	NA	0.184	NA	
Zone 2	998	10-07-05	9.97	NA	NS	NA	NS	NA	NS	NA	
		09-18-06	9.76	NA	20.3	NA	195	NA	0.184	NA	
		09-19-07	10.2	NA	20.6	NA	193	NA	0.165	NA	
		08-26-08	10.3	NA	21.6	NA	200	NA	0.158	NA	
Zone 1	1,179	10-21-05	15.4	NA	NS	NA	NS	NA	NS	NA	
		09-18-06	14.6	NA	14.0	NA	222	NA	0.242	NA	
		09-19-07	14.9	NA	9.87	NA	202	NA	0.249	NA	
		08-26-08	14.6	NA	9.57	NA	210	NA	0.262	NA	
Middle 2051											
Zone 5	604	09-27-05	5.67	NA	NS	NA	NS	NA	NS	NA	
		09-11-06	5.63	NA	20.2	NA	188	NA	0.251	NA	
		09-12-07	5.68	NA	20.5	NA	184	NA	0.231	NA	
		08-25-08	5.68	NA	22.0	NA	188	NA	0.245	NA	
Zone 4	750	09-27-05	9.89	NA	NS	NA	NS	NA	NS	NA	
		09-13-06	9.95	NA	25.5	NA	193	NA	0.207	NA	
		09-13-06	9.94	0.10	25.6	0	193	0	0.212	2.4	QAW-4
		09-12-07	10.6	NA	25.6	NA	185	NA	0.209	NA	
		09-12-07	10.6	0	25.6	0	185	0	0.209	0	QAW-8
		08-25-08	10.7	NA	26.1	NA	188	NA	0.207	NA	
Zone 3	828	09-28-05	9.94	NA	NS	NA	NS	NA	NS	NA	
		09-12-06	10.2	NA	26.6	NA	200	NA	0.204	NA	
		09-12-06	10.2	0	26.6	0	200	0	0.207	1.50	QAW-3
		09-11-07	10.5	NA	27.3	NA	198	NA	0.207	NA	
		08-21-08	11.1	NA	27.1	NA	193	NA	0.197	NA	
Zone 2	1,092	09-28-05	11.4	NA	NS	NA	NS	NA	NS	NA	
		09-11-06	11.2	NA	21.9	NA	176	NA	0.191	NA	
		09-11-07	11.6	NA	23.1	NA	173	NA	0.185	NA	
		08-21-08	12.1	NA	23.3	NA	178	NA	0.193	NA	
Zone 1	1,142	09-29-05	15.7	NA	NS	NA	NS	NA	NS	NA	
		09-07-06	10.7	NA	20.6	NA	178	NA	0.161	NA	
		09-11-07	11.8	NA	22.4	NA	178	NA	0.193	NA	
		08-21-08	12.1	NA	23.5	NA	176	NA	0.207	NA	

Table 4. Concentrations of dissolved major anions in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). Bicarbonate data were calculated from field measurements shown in table 2; alkalinity (as calcium carbonate) was divided by 0.8202 (Hem, 1989, p. 57). NS, not sampled. NA, not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD, Relative percent difference in percent. <, less than]

Well name	Port depth	Date	Chloride		Sulfate		Bicarbonate		Fluoride		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
USGS 103											
Zone 7	682	10-02-07	20.6	NA	26.4	NA	107	NA	0.467	NA	
		08-20-08	18.4	NA	23.1	NA	122	NA	0.378	NA	
Zone 6	805	10-02-07	13.9	NA	21.8	NA	154	NA	0.341	NA	
		08-19-08	14.3	NA	22.9	NA	152	NA	0.320	NA	
Zone 5	914	10-01-07	11.0	NA	19.2	NA	154	NA	0.264	NA	
		08-19-08	10.2	NA	19.6	NA	152	NA	0.216	NA	
Zone 4	1,000	10-01-07	11.8	NA	20.0	NA	163	NA	0.209	NA	
		08-18-08	12.6	NA	21.4	NA	171	NA	0.216	NA	
Zone 3	1,095	10-01-07	13.7	NA	21.4	NA	168	NA	0.220	NA	
		08-18-08	14.2	NA	22.3	NA	171	NA	0.211	NA	
Zone 2	1,220	09-25-07	13.9	NA	20.9	NA	166	NA	0.221	NA	
		08-18-08	14.1	NA	22.4	NA	171	NA	0.211	NA	
		08-18-08	14.3	1.4	22.6	0.89	171	0	0.204	3.4	QAW-10
Zone 1	1,269	09-25-07	14.1	NA	21.3	NA	166	NA	0.247	NA	
		8-19-08	14.3	NA	22.5	NA	168	NA	0.214	NA	
USGS 132											
Zone 6	636	09-06-06	19.3	NA	40.2	NA	183	NA	0.287	NA	
		09-18-07	23.2	NA	38.6	NA	176	NA	0.284	NA	
		08-14-08	35.0	NA	40.8	NA	171	NA	0.279	NA	
		08-14-08	34.9	0.29	40.9	0.24	171	0	0.281	0.71	QAW-9
Zone 5	764	09-05-06	10.4	NA	25.1	NA	178	NA	0.217	NA	
		09-18-07	11.0	NA	25.8	NA	173	NA	0.241	NA	
		08-13-08	11.2	NA	25.9	NA	176	NA	0.262	NA	
Zone 4	826	09-05-06	9.50	NA	23.6	NA	171	NA	0.228	NA	
		09-18-07	10.0	NA	23.5	NA	168	NA	0.251	NA	
		08-13-08	10.3	NA	24.8	NA	171	NA	0.249	NA	
Zone 3	917	08-31-06	9.53	NA	23.9	NA	176	NA	0.249	NA	
		09-18-07	9.95	NA	23.4	NA	176	NA	0.255	NA	
		08-13-08	10.2	NA	24.7	NA	166	NA	0.238	NA	
Zone 2	1,010	08-30-06	9.52	NA	23.6	NA	210	NA	0.255	NA	
		09-17-07	10.1	NA	23.6	NA	176	NA	0.248	NA	
		08-12-08	10.3	NA	24.8	NA	166	NA	0.249	NA	
Zone 1	1,172	08-29-06	9.89	NA	24.1	NA	178	NA	0.249	NA	
		09-17-07	10.3	NA	24.1	NA	176	NA	0.262	NA	
		08-12-08	10.7	NA	25.4	NA	178	NA	0.247	NA	

Table 4. Concentrations of dissolved major anions in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). Bicarbonate data were calculated from field measurements shown in table 2; alkalinity (as calcium carbonate) was divided by 0.8202 (Hem, 1989, p. 57). NS, not sampled. NA, not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD, Relative percent difference in percent. <, less than]

Well name	Port depth	Date	Chloride		Sulfate		Bicarbonate		Fluoride		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
USGS 133											
Zone 4	468	09-24-07	12.5	NA	20.7	NA	161	NA	0.228	NA	
		09-02-08	13.2	NA	20.8	NA	163	NA	0.224	NA	
Zone 3	568	09-24-07	12.3	NA	19.7	NA	161	NA	0.183	NA	
		09-02-08	12.9	NA	21.0	NA	168	NA	0.195	NA	
Zone 2	685	09-24-07	12.1	NA	19.6	NA	168	NA	0.173	NA	
		09-02-08	12.5	NA	20.5	NA	177	NA	0.194	NA	
Zone 1	744	09-24-07	14.0	NA	22.3	NA	217	NA	0.143	NA	
		09-02-08	13.9	NA	22.1	NA	227	NA	0.132	NA	
USGS 134											
Zone 5	578	09-27-06	10.6	NA	19.3	NA	163	NA	0.237	NA	
		09-10-07	9.45	NA	19.6	NA	156	NA	0.207	NA	
		09-04-08	9.55	NA	20.7	NA	156	NA	0.205	NA	
Zone 4	644	09-28-06	11.6	NA	18.7	NA	198	NA	0.185	NA	
		09-06-07	11.2	NA	19.4	NA	205	NA	0.156	NA	
		09-06-07	11.2	0.89	19.5	0.51	205	0	0.156	0	QAW-7
		09-04-08	10.4	NA	19.7	NA	205	NA	0.136	NA	
Zone 3	706	09-27-06	7.16	NA	16.3	NA	156	NA	0.212	NA	
		09-05-07	7.34	NA	17.3	NA	151	NA	0.219	NA	
		09-03-08	7.69	NA	18.9	NA	157	NA	0.189	NA	
Zone 2	806	09-26-06	8.98	NA	18.5	NA	171	NA	0.162	NA	
		09-05-07	9.34	NA	19.8	NA	161	NA	0.215	NA	
		09-03-08	9.75	NA	20.8	NA	166	NA	0.176	NA	
Zone 1	856	09-25-06	9.56	NA	19.1	NA	200	NA	0.136	NA	
		09-04-07	9.25	NA	21.3	NA	NS	NA	0.125	NA	
	[1]846	09-03-08	7.51	NA	19.1	NA	156	NA	0.129	NA	
QAW-1	NA	08-28-06	0.16E	NA	<0.18	NA	11	NA	<0.1	NA	
QAW-2	NA	10-02-06	120	NA	46.2	NA	215	NA	0.165	NA	
QAW-6	NA	09-12-07	0.328	NA	<0.018	NA	NS	NA	<0.1	NA	
QAW-12	NA	09-08-08	13.5	NA	26.6	NA	173	NA	0.240	NA	

[1]The port at 856 feet below land surface was damaged in 2007, so samples were collected from the port at 846 feet below land surface in 2008.

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Aluminum		Antimony		Arsenic		Barium		Beryllium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
Middle 2050A												
Zone 5	515	09-19-06	3.54	NA	0.13 E	NA	1.39	NA	66.9	NA	<0.2	NA
		09-20-07	5.15	NA	0.104	NA	1.60	NA	72.6	NA	<0.2	NA
		08-27-08	4.18	NA	0.117 E	NA	1.61	NA	73.4	NA	<0.2	NA
		08-27-08	3.90	6.70	0.122 E	4	1.62	0.62	73.9	0.68	<0.2	0
Zone 4	642	09-19-06	4.78	NA	0.17 E	NA	0.800	NA	41.9	NA	<0.2	NA
		09-20-07	4.02	NA	0.089	NA	0.741	NA	40.7	NA	<0.2	NA
		08-26-08	3.82	NA	0.108 E	NA	0.886	NA	35.1	NA	<0.2	NA
Zone 3	790	09-20-06	4.34	NA	<0.2	NA	1.39	NA	51.1	NA	<0.2	NA
		09-20-06	4.33	0.23	<0.2	0	1.45	4.2	51.2	0.2	<0.2	0
		09-20-07	3.71	NA	0.074	NA	1.44	NA	49.8	NA	<0.2	NA
		08-26-08	3.79	NA	0.08 E	NA	1.47	NA	45.8	NA	<0.2	NA
Zone 2	998	09-18-06	4.12	NA	<0.2	NA	1.41	NA	45.8	NA	<0.2	NA
		09-19-07	6.20	NA	0.072	NA	1.42	NA	42.0	NA	<0.2	NA
		08-26-08	3.42	NA	0.071 E	NA	1.46	NA	41.9	NA	<0.2	NA
Zone 1	1,179	09-18-06	4.15	NA	<0.2	NA	1.15	NA	74.2	NA	<0.2	NA
		09-19-07	2.03	NA	<0.06	NA	1.25	NA	65.0	NA	<0.2	NA
		08-26-08	1.94	NA	<0.14	NA	1.32	NA	60.8	NA	<0.2	NA

Well name	Port depth	Date	Bromide		Cadmium		Chromium		Cobalt		Copper	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
Middle 2050A—Continued												
Zone 5	515	09-19-06	0.019 E	NA	<0.04	NA	1.59	NA	<0.04	NA	0.420	NA
		09-20-07	0.026	NA	<0.04	NA	7.11	NA	0.024 E	NA	2.00	NA
		08-27-08	0.034	NA	<0.04	NA	8.17	NA	0.028	NA	<1	NA
		08-27-08	0.035	2.90	<0.04	0	8.23	0.73	0.030	6.90	<1	0
Zone 4	642	09-19-06	0.023	NA	0.03 E	NA	1.63	NA	0.050	NA	0.710	NA
		09-20-07	0.026	NA	<0.04	NA	1.46	NA	<0.04	NA	0.45	NA
		08-27-08	0.027	NA	<0.04	NA	2.89	NA	0.026	NA	<1	NA
Zone 3	790	09-20-06	0.031	NA	<0.04	NA	4.04	NA	0.02 E	NA	0.21 E	NA
		09-20-06	0.030	3.3	<0.04	0	3.99	1.2	<0.04	NC	<0.4	NC
		09-20-07	0.025	NA	<0.04	NA	3.70	NA	0.022 E	NA	<0.4	NA
		08-26-08	0.029	NA	<0.04	NA	4.22	NA	0.029	NA	<1	NA
Zone 2	998	09-18-06	0.028	NA	0.080	NA	3.36	NA	0.02 E	NA	0.490	NA
		09-19-07	0.019 E	NA	<0.04	NA	3.50	NA	0.053	NA	4.27	NA
		08-26-08	0.031	NA	<0.04	NA	3.41	NA	0.032	NA	<1	NA
Zone 1	1,179	09-18-06	0.040	NA	0.110	NA	0.04	NA	2.36	NA	0.610	NA
		09-19-07	0.035	NA	0.054	NA	<0.12	NA	2.14	NA	<0.4	NA
		08-26-08	0.032	NA	0.047	NA	<0.12	NA	1.84	NA	<1	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay[TM] sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Iron		Lead		Lithium		Manganese		Mercury	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
Middle 2050A—Continued												
Zone 5	515	09-19-06	<6	NA	0.04 E	NA	1.62	NA	0.390	NA	NS	NA
		09-20-07	<6	NA	0.214	NA	1.32	NA	0.126 E	NA	NS	NA
		08-27-08	<8	NA	<0.08	NA	1.37	NA	0.131 E	NA	NS	NA
		08-27-08	<8	0	<0.08	0	1.34	2.20	0.125 E	4.70	NS	NC
Zone 4	642	09-19-06	20.9	NA	0.06 E	NA	2.04	NA	1.42	NA	NS	NA
		09-20-07	<6	NA	<0.12	NA	1.35	NA	0.891	NA	NS	NA
		08-27-08	<8	NA	<0.08	NA	1.47	NA	0.352	NA	NS	NA
Zone 3	790	09-20-06	3.38 E	NA	<0.08	NA	2.45	NA	0.730	NA	NS	NA
		09-20-06	3.38 E	0	0.210	NC	2.46	0.4	0.770	5.3	NS	NC
		09-20-07	<6	NA	<0.12	NA	1.90	NA	0.560	NA	NS	NA
		08-26-08	<8	NA	<0.08	NA	1.98	NA	0.426	NA	NS	NA
Zone 2	998	09-18-06	<6	NA	0.05 E	NA	3.08	NA	1.67	NA	NS	NA
		09-19-07	<6	NA	0.40	NA	3.00	NA	1.23	NA	NS	NA
		08-26-08	<8	NA	<0.08	NA	2.19	NA	0.614	NA	NS	NA
Zone 1	1,179	09-18-06	25.0	NA	0.100	NA	4.15	NA	476	NA	NS	NA
		09-19-07	20.3	NA	<0.12	NA	3.51	NA	460	NA	NS	NA
		08-26-08	16.7	NA	<0.08	NA	3.25	NA	365	NA	NS	NA

Well name	Port depth	Date	Molybdenum		Nickel		Selenium		Silver		Strontium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
Middle 2050A—Continued												
Zone 5	515	09-19-06	2.47	NA	0.200	NA	1.05	NA	<0.20	NA	240	NA
		09-20-07	2.00	NA	0.239	NA	1.45	NA	<0.1	NA	276	NA
		08-27-08	2.01	NA	0.242	NA	1.40	NA	<0.1	NA	272	NA
		08-27-08	2.01	0	0.235	2.90	1.40	0	<0.1	0	272	0
Zone 4	642	09-19-06	8.21	NA	0.310	NA	0.610	NA	<0.20	NA	237	NA
		09-20-07	6.44	NA	0.357	NA	0.747	NA	<0.1	NA	219	NA
		08-27-08	6.03	NA	0.297	NA	0.757	NA	<0.1	NA	230	NA
Zone 3	790	09-20-06	1.18	NA	0.190	NA	1.09	NA	<0.20	NA	227	NA
		09-20-06	1.15	2.6	0.170	11.1	1.13	3.6	<0.20	0	227	0
		09-20-07	0.992	NA	0.254	NA	1.23	NA	<0.1	NA	211	NA
		08-26-08	0.983	NA	0.227	NA	1.15	NA	<0.1	NA	211	NA
Zone 2	998	09-18-06	1.50	NA	0.240	NA	0.990	NA	<0.20	NA	220	NA
		09-19-07	1.09	NA	0.459	NA	1.14	NA	<0.1	NA	201	NA
		08-26-08	0.994	NA	0.257	NA	1.11	NA	<0.1	NA	202	NA
Zone 1	1,179	09-18-06	17.7	NA	1.58	NA	<0.08	NA	<0.20	NA	306	NA
		09-19-07	23.9	NA	1.16	NA	<0.08	NA	<0.1	NA	273	NA
		08-26-08	26.3	NA	1.13	NA	<0.04	NA	<0.1	NA	273	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Thallium		Tungsten		Uranium		Vanadium		Zinc		Remarks
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	
Middle 2050A—Continued													
Zone 5	515	09-19-06	<0.04	NA	0.830	NA	1.94	NA	2.76	NA	5.34	NA	
		09-20-07	<0.04	NA	0.198	NA	1.93	NA	4.90	NA	6.79	NA	
		08-27-08	<0.04	NA	0.201	NA	1.79	NA	5.08	NA	2.97	NA	
		08-27-08	<0.04	0	0.209	3.90	1.79	0	5.10	0.39	2.66	11.0	QAW-11
Zone 4	642	09-19-06	<0.04	NA	27.5	NA	1.5	NA	2.32	NA	13.1	NA	
		09-20-07	<0.04	NA	23.6	NA	1.57	NA	2.34	NA	14.1	NA	
		08-27-08	<0.04	NA	23.2	NA	1.75	NA	2.76	NA	8.09	NA	
Zone 3	790	09-20-06	<0.04	NA	1.9	NA	1.44	NA	3.69	NA	20.2	NA	
		09-20-06	<0.04	0	1.83	3.8	1.44	0	3.61	2.2	20.8	2.9	QAW-5
		09-20-07	<0.04	NA	1.21	NA	1.41	NA	3.75	NA	13.2	NA	
		08-26-08	<0.04	NA	0.941	NA	1.39	NA	3.79	NA	5.29	NA	
Zone 2	998	09-18-06	<0.04	NA	7.23	NA	1.42	NA	3.43	NA	11.0	NA	
		09-19-07	<0.04	NA	5.65	NA	1.40	NA	3.50	NA	12.2	NA	
		08-26-08	<0.04	NA	5.37	NA	1.32	NA	3.33	NA	5.80	NA	
Zone 1	1,179	09-18-06	<0.04	NA	359	NA	0.450	NA	0.08 E	NA	11.8	NA	
		09-19-07	<0.04	NA	483	NA	0.480	NA	0.085	NA	19.3	NA	
		08-26-08	<0.04	NA	452	NA	0.628	NA	0.071	0.071	4.25	NA	

Well name	Port depth	Date	Aluminum		Antimony		Arsenic		Barium		Beryllium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
Middle 2051												
Zone 5	604	09-11-06	2.91	NA	0.11 E	NA	1.07	NA	48.4	NA	<0.2	NA
		09-12-07	2.33	NA	0.127	NA	1.04	NA	48.5	NA	<0.2	NA
		08-25-08	1.93	NA	0.123 E	NA	1.04	NA	45.4	NA	<0.2	NA
Zone 4	750	09-13-06	5.01	NA	<0.2	NA	1.59	NA	55.6	NA	<0.2	NA
		09-13-06	4.95	1.2	<0.2	0	1.49	6.5	55.2	0.72	<0.2	0
		09-12-07	6.09	NA	0.098	NA	1.40	NA	54.8	NA	<0.2	NA
		09-12-07	6.36	4.3	0.101	3.0	1.42	1.4	55.1	0.55	<0.2	0
		08-25-08	5.06	NA	0.094 E	NA	1.49	NA	54.3	NA	<0.2	NA
Zone 3	828	09-12-06	4.32	NA	<0.2	NA	1.41	NA	60.0	NA	<0.2	NA
		09-12-06	3.87	11.0	<0.2	0	1.52	7.5	60.4	0.66	<0.2	0
		09-11-07	4.05	NA	0.100	NA	1.49	NA	57.5	NA	<0.2	NA
		08-21-08	4.37	NA	0.094 E	NA	1.52	NA	57.6	NA	<0.2	NA
Zone 2	1,092	09-11-06	6.19	NA	<0.2	NA	1.39	NA	38.9	NA	<0.2	NA
		09-11-07	8.33	NA	0.073	NA	1.37	NA	33.9	NA	<0.2	NA
		08-21-08	4.97	NA	<0.14	NA	1.32	NA	34.2	NA	<0.2	NA
Zone 1	1,142	09-07-06	9.61	NA	0.11 E	NA	1.41	NA	32.1	NA	<0.2	NA
		09-11-07	6.90	NA	0.080	NA	1.34	NA	30.8	NA	<0.2	NA
		08-21-08	8.37	NA	<0.14	NA	1.29	NA	33.7	NA	<0.2	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (μg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Bromide		Cadmium		Chromium		Cobalt		Copper	
			μg/L	RPD	μg/L	RPD	μg/L	RPD	μg/L	RPD	μg/L	RPD
Middle 2051—Continued												
Zone 5	604	09-11-06	0.022	NA	0.02 E	NA	1.05	NA	<0.04	NA	1.58	NA
		09-12-07	0.021	NA	<0.04	NA	0.935	NA	0.031 E	NA	1.02	NA
		08-25-08	0.020 E	NA	<0.04	NA	1.02	NA	0.032	NA	<1	NA
Zone 4	750	09-13-06	0.031	NA	0.370	NA	7.68	NA	<0.04	NA	0.530	NA
		09-13-06	0.031	0	0.380	2.7	7.62	0.78	<0.04	0	0.430	20.8
		09-12-07	0.031	NA	<0.04	NA	6.65	NA	0.026 E	NA	4.30	NA
		09-12-07	0.030	3.3	<0.04	0	6.72	1.0	0.021 E	21.3	2.25	62.6
		08-25-08	0.030	NA	<0.04	NA	7.42	NA	0.032	NA	<1	NA
Zone 3	828	09-12-06	0.030	NA	0.370	NA	8.10	NA	<0.04	NA	0.670	NA
		09-12-06	0.034	12.5	0.390	5.3	8.18	0.98	<0.04	0	0.500	29.1
		09-11-07	0.029	NA	<0.04	NA	7.56	NA	<0.04	NA	0.256 E	NA
		08-21-08	0.032	NA	<0.04	NA	7.90	NA	0.018 E	NA	<1	NA
Zone 2	1,092	09-11-06	0.034	NA	0.360	NA	7.34	NA	<0.04	NA	5.25	NA
		09-11-07	0.030	NA	<0.04	NA	6.82	NA	<0.04	NA	0.258 E	NA
		08-21-08	0.030	NA	<0.04	NA	6.44	NA	0.014 E	NA	<1	NA
Zone 1	1,142	09-07-06	0.059	NA	0.02 E	NA	5.90	NA	0.230	NA	2.51	NA
		09-11-07	0.030	NA	<0.04	NA	6.13	NA	0.224	NA	4.20	NA
		08-21-08	0.031	NA	<0.04	NA	6.25	NA	0.154	NA	3.25	NA

Well name	Port depth	Date	Iron		Lead		Lithium		Manganese		Mercury	
			μg/L	RPD	μg/L	RPD	μg/L	RPD	μg/L	RPD	μg/L	RPD
Middle 2051—Continued												
Zone 5	604	09-11-06	<6	NA	0.140	NA	1.23	NA	0.560	NA	NS	NA
		09-12-07	<6	NA	0.092 E	NA	1.12	NA	0.229	NA	NS	NA
		08-25-08	<8	NA	<0.08	NA	1.59	NA	0.161 E	NA	NS	NA
Zone 4	750	09-13-06	<6	NA	<0.08	NA	2.16	NA	0.200	NA	NS	NA
		09-13-06	<6	0	<0.08	0	2.17	0.46	0.200	0	NS	NC
		09-12-07	<6	NA	0.387	NA	1.53	NA	0.488	NA	NS	NA
		09-12-07	<6	0	0.193	67.6	1.47	4.0	0.402	19.8	NS	NC
		08-25-08	<8	NA	<0.08	NA	1.88	NA	1.76	NA	NS	NA
Zone 3	828	09-12-06	<6	NA	<0.08	NA	2.14	NA	0.220	NA	NS	NA
		09-12-06	<6	0	<0.08	0	2.06	3.8	0.200	9.5	NS	NC
		09-11-07	3.08 E	NA	<0.12	NA	1.84	NA	0.895	NA	NS	NA
		08-21-08	<8	NA	<0.08	NA	1.90	NA	0.235	NA	NS	NA
Zone 2	1,092	09-11-06	<6	NA	<0.08	NA	2.74	NA	0.270	NA	NS	NA
		09-11-07	<6	NA	<0.12	NA	2.49	NA	0.192 E	NA	NS	NA
		08-21-08	<8	NA	<0.08	NA	2.06	NA	0.257	NA	NS	NA
Zone 1	1,142	09-07-06	<6	NA	0.150	NA	2.84	NA	1.09	NA	NS	NA
		09-11-07	3.70 E	NA	0.199	NA	2.60	NA	0.706	NA	NS	NA
		08-21-08	6.87 E	NA	<0.08	NA	2.18	NA	1.66	NA	NS	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Molybdenum		Nickel		Selenium		Silver		Strontium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
Middle 2051—Continued												
Zone 5	604	09-11-06	2.14	NA	0.380	NA	0.920	NA	<0.20	NA	262	NA
		09-12-07	2.07	NA	0.242	NA	1.00	NA	<0.1	NA	265	NA
		08-25-08	1.91	NA	0.242	NA	0.937	NA	<0.1	NA	255	NA
Zone 4	750	09-13-06	1.59	NA	0.340	NA	1.08	NA	<0.20	NA	254	NA
		09-13-06	1.54	3.2	0.290	15.9	1.09	0.92	<0.20	0	253	0.39
		09-12-07	1.42	NA	0.291	NA	1.14	NA	<0.01	NA	230	NA
		09-12-07	1.46	2.8	0.242	18.4	1.19	3.4	<0.1	NC	236	2.6
		08-25-08	1.45	NA	0.296	NA	1.17	NA	<0.1	NA	235	NA
Zone 3	828	09-12-06	1.49	NA	0.370	NA	1.06	NA	<0.20	NA	248	NA
		09-12-06	1.47	1.4	0.380	2.7	1.08	1.9	<0.20	0	250	0.80
		09-11-07	1.43	NA	0.270	NA	1.23	NA	<0.1	NA	237	NA
		08-21-08	1.25	NA	0.201	NA	1.15	NA	<0.1	NA	229	NA
Zone 2	1,092	09-11-06	1.34	NA	0.510	NA	1.09	NA	<0.20	NA	239	NA
		09-11-07	1.30	NA	0.178	NA	1.19	NA	<0.1	NA	230	NA
		08-21-08	1.07	NA	0.165 E	NA	1.06	NA	<0.1	NA	206	NA
Zone 1	1,142	09-07-06	1.34	NA	1.61	NA	1.19	NA	<0.20	NA	237	NA
		09-11-07	1.42	NA	1.35	NA	1.19	NA	0.088 E	NA	227	NA
		08-21-08	1.30	NA	1.13	NA	1.09	NA	0.058 E	NA	214	NA

Well name	Port depth	Date	Thallium		Tungsten		Uranium		Vanadium		Zinc		Remarks
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	
Middle 2051—Continued													
Zone 5	604	09-11-06	<0.04	NA	5.13	NA	1.84	NA	4.45	NA	7.36	NA	
		09-12-07	<0.04	NA	5.68	NA	1.74	NA	4.12	NA	6.13	NA	
		08-25-08	<0.04	NA	5.38	NA	1.69	NA	4.33	NA	2.65	NA	
Zone 4	750	09-13-06	<0.04	NA	1.78	NA	1.75	NA	4.76	NA	16.0	NA	
		09-13-06	<0.04	0	1.79	0.56	1.72	1.7	4.73	0.63	14.8	7.8	QAW-4
		09-12-07	<0.04	NA	0.951	NA	1.57	NA	4.21	NA	12.0	NA	
		09-12-07	<0.04	0	0.955	0.42	1.62	3.1	4.29	1.9	10.2	16	QAW-8
		08-25-08	<0.04	NA	0.653	NA	1.59	NA	4.63	NA	30.7	NA	
Zone 3	828	09-12-06	<0.04	NA	1.39	NA	1.70	NA	4.29	NA	7.30	NA	
		09-12-06	<0.04	0	1.39	0	1.72	1.2	4.35	1.4	6.68	8.9	QAW-3
		09-11-07	<0.04	NA	0.752	NA	1.62	NA	4.15	NA	19.3	NA	
		08-21-08	<0.04	NA	0.229	NA	1.56	NA	4.27	NA	4.32	NA	
Zone 2	1,092	09-11-06	<0.04	NA	0.880	NA	1.68	NA	5.73	NA	19.2	NA	
		09-11-07	<0.04	NA	0.572	NA	1.61	NA	5.44	NA	5.38	NA	
		08-21-08	<0.04	NA	0.414	NA	1.40	NA	4.98	NA	3.58	NA	
Zone 1	1,142	09-07-06	<0.04	NA	113	NA	1.53	NA	5.45	NA	13.3	NA	
		09-11-07	<0.04	NA	85.1	NA	1.56	NA	5.37	NA	13.3	NA	
		08-21-08	<0.04	NA	59.7	NA	1.44	NA	5.17	NA	19.9	NA	

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Aluminum		Antimony		Arsenic		Barium		Beryllium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 103												
Zone 7	682	10-02-07	1.31 E	NA	<0.14	NA	0.290	NA	89.6	NA	<0.2	NA
		08-20-08	1.74	NA	<0.14	NA	0.344	NA	49.9	NA	<0.2	NA
Zone 6	805	10-02-07	3.98	NA	0.133 E	NA	1.66	NA	27.5	NA	<0.2	NA
		08-19-08	3.90	NA	0.134 E	NA	1.85	NA	27.7	NA	<0.2	NA
Zone 5	914	10-01-07	2.97	NA	0.135 E	NA	1.34	NA	28.4	NA	<0.2	NA
		08-19-08	4.81	NA	0.121 E	NA	1.74	NA	27.6	NA	<0.2	NA
Zone 4	1,000	10-01-07	3.53	NA	0.097 E	NA	1.69	NA	37.3	NA	<0.2	NA
		08-18-08	4.27	NA	0.098 E	NA	1.72	NA	39.4	NA	<0.2	NA
Zone 3	1,095	10-01-07	4.36	NA	0.112 E	NA	1.60	NA	41.8	NA	<0.2	NA
		08-18-08	5.21	NA	0.097 E	NA	1.62	NA	40.6	NA	<0.2	NA
Zone 2	1,220	09-25-07	8.69	NA	0.096	NA	1.67	NA	41.0	NA	<0.2	NA
		08-18-08	4.48	NA	0.092 E	NA	1.64	NA	40.9	NA	<0.2	NA
		08-18-08	4.98	10.6	0.101 E	9.3	1.66	1.2	41.4	1.2	<0.2	0
Zone 1	1,269	09-25-07	5.47	NA	0.098	NA	1.53	NA	41.0	NA	<0.2	NA
		08-19-08	12.4	NA	0.125 E	NA	1.70	NA	41.3	NA	<0.2	NA

Well name	Port depth	Date	Bromide		Cadmium		Chromium		Cobalt		Copper	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 103—Continued												
Zone 7	682	10-02-07	0.050	NA	0.021 E	NA	0.242	NA	0.039	NA	<1	NA
		08-20-08	0.043	NA	<0.04	NA	0.542	NA	0.021	NA	<1	NA
Zone 6	805	10-02-07	0.033	NA	<0.04	NA	4.34	NA	0.026	NA	<1	NA
		08-19-08	0.038	NA	<0.04	NA	5.08	NA	0.030	NA	0.762 E	NA
Zone 5	914	10-01-07	0.026	NA	<0.04	NA	5.08	NA	0.060	NA	3.12	NA
		08-19-08	0.022	NA	<0.04	NA	5.66	NA	0.029	NA	<1	NA
Zone 4	1,000	10-01-07	0.024	NA	<0.04	NA	5.67	NA	0.017 E	NA	<1	NA
		08-18-08	0.029	NA	<0.04	NA	6.20	NA	0.026	NA	<1	NA
Zone 3	1,095	10-01-07	0.030	NA	<0.04	NA	5.43	NA	0.038	NA	<1	NA
		08-18-08	0.029	NA	<0.04	NA	5.62	NA	0.030	NA	<1	NA
Zone 2	1,220	09-25-07	0.033	NA	<0.04	NA	5.84	NA	0.032 E	NA	0.270 E	NA
		08-18-08	0.028	NA	<0.04	NA	5.74	NA	0.030	NA	<1	NA
		08-18-08	0.029	3.5	0.023 E	NC	5.86	2.1	0.030	0	<1	0
Zone 1	1,269	09-25-07	0.027	NA	<0.04	NA	5.41	NA	0.240	NA	1.45	NA
		08-19-08	0.029	NA	<0.04	NA	5.90	NA	0.078	NA	0.579 E	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Iron		Lead		Lithium		Manganese		Mercury	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 103—Continued												
Zone 7	682	10-02-07	45.7	NA	<0.08	NA	5.14	NA	97.4	NA	<0.01	NA
		08-20-08	15.3	NA	<0.08	NA	6.26	NA	56.6	NA	NS	NA
Zone 6	805	10-02-07	4.06 E	NA	<0.08	NA	3.11	NA	2.97	NA	<0.01	NA
		08-19-08	<8	NA	<0.08	NA	4.32	NA	1.29	NA	NS	NA
Zone 5	914	10-01-07	<8	NA	0.302	NA	2.23	NA	8.72	NA	<0.01	NA
		08-19-08	<8	NA	<0.08	NA	3.92	NA	1.74	NA	NS	NA
Zone 4	1,000	10-01-07	<8	NA	<0.08	NA	1.58	NA	0.171 E	NA	<0.01	NA
		08-18-08	<8	NA	<0.08	NA	2.32	NA	0.169 E	NA	NS	NA
Zone 3	1,095	10-01-07	<8	NA	<0.08	NA	1.51	NA	0.500	NA	<0.01	NA
		08-18-08	<8	NA	<0.08	NA	2.02	NA	0.252	NA	NS	NA
Zone 2	1,220	09-25-07	<6	NA	<0.12	NA	2.45	NA	0.272	NA	<0.01	NA
		08-18-08	<8	NA	<0.08	NA	2.03	NA	0.351	NA	NS	NA
		08-18-08	<8	0	<0.08	0	2.09	2.9	0.348	0.86	NS	NC
Zone 1	1,269	09-25-07	<6	NA	0.111 E	NA	1.76	NA	1.27	NA	<0.01	NA
		08-19-08	5.86 E	NA	<0.08	NA	2.12	NA	0.455	NA	NS	NA

Well name	Port depth	Date	Molybdenum		Nickel		Selenium		Silver		Strontium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 103—Continued												
Zone 7	682	10-02-07	10.9	NA	0.303	NA	0.378	NA	<0.1	NA	202	NA
		08-20-08	9.88	NA	0.368	NA	0.366	NA	<0.1	NA	148	NA
Zone 6	805	10-02-07	3.61	NA	0.371	NA	1.24	NA	<0.1	NA	180	NA
		08-19-08	3.15	NA	0.998	NA	1.26	NA	<0.1	NA	186	NA
Zone 5	914	10-01-07	3.93	NA	0.718	NA	1.09	NA	<0.1	NA	189	NA
		08-19-08	2.86	NA	0.403	NA	1.12	NA	<0.1	NA	172	NA
Zone 4	1,000	10-01-07	2.06	NA	0.170 E	NA	1.02	NA	<0.1	NA	180	NA
		08-18-08	2.07	NA	0.414	NA	1.16	NA	<0.1	NA	193	NA
Zone 3	1,095	10-01-07	2.16	NA	0.259	NA	1.10	NA	<0.1	NA	197	NA
		08-18-08	1.97	NA	0.337	NA	1.08	NA	<0.1	NA	191	NA
Zone 2	1,220	09-25-07	2.14	NA	0.238	NA	1.22	NA	<0.1	NA	195	NA
		08-18-08	2.12	NA	0.339	NA	1.17	NA	<0.1	NA	200	NA
		08-18-08	2.08	1.9	0.330	2.7	1.21	3.4	<0.1	0	203	1.5
Zone 1	1,269	09-25-07	1.94	NA	0.635	NA	1.19	NA	<0.1	NA	213	NA
		08-19-08	2.07	NA	0.657	NA	1.14	NA	<0.1	NA	203	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Thallium		Tungsten		Uranium		Vandium		Zinc		Remarks
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	
USGS 103—Continued													
Zone 7	682	10-02-07	<0.04	NA	0.276	NA	0.319	NA	0.691	NA	2.55	NA	
		08-20-08	<0.04	NA	0.159	NA	0.352	NA	0.872	NA	6.60	NA	
Zone 6	805	10-02-07	<0.04	NA	3.97	NA	1.72	NA	5.86	NA	3.98	NA	
		08-19-08	<0.04	NA	3.31	NA	1.84	NA	7.01	NA	7.77	NA	
Zone 5	914	10-01-07	<0.04	NA	4.56	NA	1.70	NA	5.91	NA	6.09	NA	
		08-19-08	<0.04	NA	1.54	NA	1.55	NA	8.89	NA	9.3	NA	
Zone 4	1,000	10-01-07	<0.04	NA	0.482	NA	1.36	NA	5.19	NA	2.81	NA	
		08-18-08	<0.04	NA	0.202	NA	1.44	NA	5.60	NA	12.2	NA	
Zone 3	1,095	10-01-07	<0.04	NA	1.59	NA	1.49	NA	4.82	NA	8.67	NA	
		08-18-08	<0.04	NA	0.372	NA	1.39	NA	4.97	NA	6.14	NA	
Zone 2	1,220	09-25-07	<0.04	NA	0.280	NA	1.47	NA	5.23	NA	7.35	NA	
		08-18-08	<0.04	NA	0.236	NA	1.47	NA	5.14	NA	24.4	NA	
		08-18-08	<0.04	0	0.232	1.7	1.49	0.68	5.24	1.9	24.4	0	QAW-10
Zone 1	1,269	09-25-07	<0.04	NA	2.46	NA	1.35	NA	4.69	NA	5.31	NA	
		08-19-08	<0.04	NA	1.27	NA	1.50	NA	5.21	NA	8.86	NA	

Well name	Port depth	Date	Aluminum		Antimony		Arsenic		Barium		Beryllium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 132												
Zone 6	636	09-06-06	4.65	NA	0.12 E	NA	2.32	NA	53.6	NA	<0.2	NA
		09-18-07	4.25	NA	0.116	NA	2.27	NA	49.8	NA	<0.2	NA
		08-14-08	4.98	NA	0.107 E	NA	2.27	NA	52.8	NA	<0.2	NA
		08-14-08	3.38	38.3	0.116 E	8.1	2.27	0	52.6	0.38	<0.2	0
Zone 5	764	09-05-06	6.19	NA	0.11 E	NA	1.76	NA	39.3	NA	<0.2	NA
		09-18-07	6.47	NA	0.098	NA	1.64	NA	38.5	NA	<0.2	NA
		08-13-08	5.28	NA	0.112 E	NA	1.76	NA	38.5	NA	<0.2	NA
Zone 4	826	09-05-06	6.53	NA	0.11 E	NA	1.51	NA	37.3	NA	<0.2	NA
		09-18-07	5.76	NA	0.102	NA	1.54	NA	38.9	NA	<0.2	NA
		08-13-08	5.53	NA	0.106 E	NA	1.48	NA	37.3	NA	<0.2	NA
Zone 3	917	08-31-06	5.23	NA	0.13 E	NA	1.33	NA	37.6	NA	<0.2	NA
		09-18-07	5.56	NA	0.103	NA	1.55	NA	37.7	NA	<0.2	NA
		08-13-08	5.32	NA	0.110 E	NA	1.50	NA	36.4	NA	<0.2	NA
Zone 2	1,010	08-30-06	4.91	NA	0.12 E	NA	1.59	NA	37.6	NA	<0.2	NA
		09-17-07	5.35	NA	0.114	NA	1.62	NA	39.1	NA	<0.2	NA
		08-12-08	4.71	NA	0.107 E	NA	1.52	NA	38.7	NA	<0.2	NA
Zone 1	1,172	08-29-06	4.60	NA	0.10 E	NA	1.88	NA	35.9	NA	<0.2	NA
		09-17-07	4.81	NA	0.105	NA	1.75	NA	36.1	NA	<0.2	NA
		08-12-08	4.40	NA	0.114 E	NA	1.76	NA	35.3	NA	<0.2	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Bromide		Cadmium		Chromium		Cobalt		Copper	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 132—Continued												
Zone 6	636	09-06-06	0.074	NA	<0.04	NA	9.56	NA	<0.04	NA	2.27	NA
		09-18-07	0.078	NA	<0.04	NA	10.6	NA	0.034 E	NA	0.224 E	NA
		08-14-08	0.109	NA	<0.04	NA	16.6	NA	0.033	NA	<1	NA
		08-14-08	0.114	4.5	<0.04	0	16.7	0.60	0.034	3.0	<1	0
Zone 5	764	09-05-06	0.032	NA	<0.04	NA	8.07	NA	<0.04	NA	1.03	NA
		09-18-07	0.024	NA	<0.04	NA	7.59	NA	0.032 E	NA	3.89	NA
		08-13-08	0.032	NA	<0.04	NA	8.36	NA	0.029	NA	<1	NA
Zone 4	826	09-05-06	0.031	NA	0.02 E	NA	7.95	NA	<0.04	NA	1.14	NA
		09-18-07	0.017 E	NA	<0.04	NA	8.02	NA	0.032 E	NA	2.50	NA
		08-13-08	0.030	NA	<0.04	NA	8.04	NA	0.023	NA	<1	NA
Zone 3	917	08-31-06	0.029	NA	<0.04	NA	7.63	NA	0.100	NA	3.48	NA
		09-18-07	0.032	NA	<0.04	NA	8.15	NA	0.046	NA	0.34 E	NA
		08-13-08	0.034	NA	<0.04	NA	8.10	NA	0.027	NA	<1	NA
Zone 2	1,010	08-30-06	0.030	NA	0.02 E	NA	7.57	NA	0.02 E	NA	1.71	NA
		09-17-07	0.023	NA	0.156	NA	8.45	NA	0.040	NA	3.15	NA
		08-12-08	0.030	NA	<0.04	NA	8.27	NA	0.024	NA	<1	NA
Zone 1	1,172	08-29-06	0.033	NA	0.02 E	NA	7.54	NA	<0.04	NA	1.74	NA
		09-17-07	0.025	NA	<0.04	NA	7.69	NA	0.037 E	NA	4.35	NA
		08-12-08	0.030	NA	<0.04	NA	7.88	NA	0.035	NA	<1	NA

Well name	Port depth	Date	Iron		Lead		Lithium		Manganese		Mercury	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 132—Continued												
Zone 6	636	09-06-06	<6	NA	0.310	NA	2.49	NA	0.31	NA	<0.01	NA
		09-18-07	<6	NA	<0.12	NA	2.54	NA	0.196 E	NA	NS	NA
		08-14-08	<8	NA	<0.08	NA	2.86	NA	0.113 E	NA	NS	NA
		08-14-08	<8	0	<0.08	0	2.90	1.4	0.108 E	4.5	NS	NC
Zone 5	764	09-05-06	13.2	NA	0.120	NA	2.16	NA	0.16 E	NA	<0.01	NA
		09-18-07	<6	NA	0.306	NA	2.12	NA	<0.2	NA	NS	NA
		08-13-08	<8	NA	<0.08	NA	2.16	NA	<0.2	NA	NS	NA
Zone 4	826	09-05-06	<6	NA	0.160	NA	1.95	NA	0.280	NA	<0.01	NA
		09-18-07	<6	NA	0.137	NA	2.28	NA	<0.2	NA	NS	NA
		08-13-08	<8	NA	<0.08	NA	1.78	NA	0.237	NA	NS	NA
Zone 3	917	08-31-06	<6	NA	0.320	NA	2.17	NA	6.34	NA	<0.01	NA
		09-18-07	<6	NA	<0.12	NA	2.28	NA	0.466	NA	NS	NA
		08-13-08	<8	NA	<0.08	NA	1.86	NA	0.278	NA	NS	NA
Zone 2	1,010	08-30-06	4.37 E	NA	0.100	NA	2.05	NA	1.53	NA	<0.01	NA
		09-17-07	<6	NA	0.166	NA	2.17	NA	0.170 E	NA	NS	NA
		08-12-08	<8	NA	<0.08	NA	1.73	NA	0.565	NA	NS	NA
Zone 1	1,172	08-29-06	<6	NA	0.110	NA	2.05	NA	0.360	NA	<0.01	NA
		09-17-07	3.73 E	NA	0.265	NA	2.32	NA	0.334	NA	NS	NA
		08-12-08	<8	NA	0.074E	NA	1.78	NA	0.637	NA	NS	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay[TM] sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Molybdenum		Nickel		Selenium		Silver		Strontium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 132—Continued												
Zone 6	636	09-06-06	3.23	NA	0.310	NA	1.49	NA	<0.2	NA	234	NA
		09-18-07	3.11	NA	0.294	NA	1.59	NA	<0.1	NA	224	NA
		08-14-08	2.83	NA	0.453	NA	1.94	NA	<0.1	NA	240	NA
		08-14-08	2.91	2.8	0.489	7.6	1.94	0	<0.1	0	243	1.2
Zone 5	764	09-05-06	2.03	NA	0.220	NA	1.13	NA	<0.2	NA	230	NA
		09-18-07	1.92	NA	0.318	NA	1.19	NA	<0.1	NA	216	NA
		08-13-08	2.04	NA	0.384	NA	1.18	NA	<0.1	NA	223	NA
Zone 4	826	09-05-06	2.06	NA	0.380	NA	1.06	NA	<0.2	NA	236	NA
		09-18-07	1.99	NA	0.298	NA	1.13	NA	<0.1	NA	220	NA
		08-13-08	1.99	NA	0.457	NA	1.10	NA	<0.1	NA	222	NA
Zone 3	917	08-31-06	2.25	NA	0.900	NA	1.07	NA	<0.2	NA	241	NA
		09-18-07	2.08	NA	0.404	NA	1.13	NA	<0.1	NA	223	NA
		08-13-08	2.10	NA	0.430	NA	1.12	NA	<0.1	NA	214	NA
Zone 2	1,010	08-30-06	2.34	NA	1.00	NA	1.12	NA	<0.2	NA	240	NA
		09-17-07	2.18	NA	0.518	NA	1.14	NA	<0.1	NA	224	NA
		08-12-08	2.09	NA	0.535	NA	1.14	NA	<0.1	NA	218	NA
Zone 1	1,172	08-29-06	2.35	NA	0.410	NA	1.24	NA	<0.2	NA	248	NA
		09-17-07	2.22	NA	0.369	NA	1.20	NA	<0.1	NA	228	NA
		08-12-08	2.34	NA	0.640	NA	1.28	NA	<0.1	NA	230	NA

Well name	Port depth	Date	Thallium		Tungsgen		Uranium		Vandium		Zinc		Remarks
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	
USGS 132—Continued													
Zone 6	636	09-06-06	<0.04	NA	0.280	NA	2.70	NA	7.33	NA	11.7	NA	
		09-18-07	<0.04	NA	0.381	NA	2.87	NA	7.29	NA	6.11	NA	
		08-14-08	<0.04	NA	0.305	NA	2.89	NA	7.62	NA	5.01	NA	
		08-14-08	<0.04	0	0.315	3.2	2.90	0.35	7.58	0.53	4.28	15.7	QAW-9
Zone 5	764	09-05-06	<0.04	NA	0.120	NA	1.91	NA	6.31	NA	6.50	NA	
		09-18-07	<0.04	NA	0.116	NA	1.85	NA	5.96	NA	8.28	NA	
		08-13-08	<0.04	NA	0.116	NA	2.07	NA	6.29	NA	3.87	NA	
Zone 4	826	09-05-06	<0.04	NA	0.310	NA	1.84	NA	5.64	NA	7.14	NA	
		09-18-07	<0.04	NA	0.307	NA	1.79	NA	5.60	NA	4.63	NA	
		08-13-08	<0.04	NA	0.266	NA	1.75	NA	5.53	NA	7.50	NA	
Zone 3	917	08-31-06	<0.04	NA	0.840	NA	1.83	NA	4.77	NA	16.3	NA	
		09-18-07	<0.04	NA	0.752	NA	1.82	NA	5.53	NA	7.75	NA	
		08-13-08	<0.04	NA	0.738	NA	1.78	NA	5.54	NA	6.06	NA	
Zone 2	1,010	08-30-06	<0.04	NA	3.78	NA	1.83	NA	5.15	NA	16.5	NA	
		09-17-07	<0.04	NA	0.716	NA	1.89	NA	5.85	NA	9.44	NA	
		08-12-08	<0.04	NA	0.616	NA	1.80	NA	5.71	NA	14.3	NA	
Zone 1	1,172	08-29-06	<0.04	NA	0.130	NA	2.24	NA	6.13	NA	6.12	NA	
		09-17-07	<0.04	NA	0.119	NA	2.20	NA	6.36	NA	11.6	NA	
		08-12-08	<0.04	NA	0.115	NA	2.31	NA	6.32	NA	8.17	NA	

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Aluminum		Antimony		Arsenic		Barium		Beryllium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 133												
Zone 4	468	09-24-07	1.59 E	NA	0.099	NA	0.110 E	NA	45.9	NA	<0.2	NA
		09-02-08	1.30 E	NA	0.089 E	NA	0.142	NA	26.2	NA	<0.2	NA
Zone 3	568	09-24-07	0.900 E	NA	0.11	NA	1.55	NA	69.3	NA	<0.2	NA
		09-02-08	<1.6	NA	0.123 E	NA	1.48	NA	60.8	NA	<0.2	NA
Zone 2	685	09-24-07	2.85	NA	0.104	NA	1.37	NA	53.6	NA	<0.2	NA
		09-09-08	3.41	NA	0.109 E	NA	1.6	NA	49.4	NA	<0.2	NA
Zone 1	744	09-24-07	1.89	NA	0.072	NA	1.56	NA	68.0	NA	<0.2	NA
		09-02-08	1.91	NA	0.076 E	NA	1.49	NA	58.5	NA	<0.2	NA

Well name	Port depth	Date	Bromide		Cadmium		Chromium		Cobalt		Copper	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 133—Continued												
Zone 4	468	09-24-07	0.028	NA	<0.04	NA	0.112 E	NA	0.045	NA	0.672	NA
		09-02-08	0.024	NA	<0.04	NA	0.942	NA	0.018 E	NA	<1	NA
Zone 3	568	09-24-07	0.036	NA	<0.04	NA	5.49	NA	0.021 E	NA	<0.4	NA
		09-02-08	0.031	NA	<0.04	NA	4.65	NA	0.02 E	NA	<1	NA
Zone 2	685	09-24-07	0.032	NA	<0.04	NA	5.09	NA	0.111	NA	0.423	NA
		09-09-08	0.029	NA	0.022 E	NA	5.11	NA	0.097	NA	<1	NA
Zone 1	744	09-24-07	0.026	NA	<0.04	NA	4.73	NA	0.031 E	NA	0.245 E	NA
		09-02-08	0.033	NA	<0.04	NA	4.20	NA	0.033	NA	0.841 E	NA

Well name	Port depth	Date	Iron		Lead		Lithium		Manganese		Mercury	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 133—Continued												
Zone 4	468	09-24-07	<6	NA	<0.12	NA	1.8	NA	<0.2	NA	<0.01	NA
		09-02-08	<8	NA	<0.08	NA	0.656 E	NA	0.111 E	NA	NS	NA
Zone 3	568	09-24-07	<6	NA	<0.12	NA	1.85	NA	0.119 E	NA	<0.01	NA
		09-02-08	<8	NA	<0.08	NA	0.846 E	NA	<0.2	NA	NS	NA
Zone 2	685	09-24-07	<6	NA	<0.12	NA	2.28	NA	0.548	NA	<0.01	NA
		09-09-08	6.83 E	NA	<0.08	NA	1.74	NA	0.406	NA	NS	NA
Zone 1	744	09-24-07	<6	NA	<0.12	NA	2.58	NA	0.383	NA	<0.01	NA
		09-02-08	16	NA	0.045 E	NA	1.37	NA	0.589	NA	NS	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Molybdenum		Nickel		Selenium		Silver		Strontium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 133—Continued												
Zone 4	468	09-24-07	8.17	NA	0.565	NA	0.77	NA	<0.1	NA	220	NA
		09-02-08	6.61	NA	0.194 E	NA	0.509	NA	<0.1	NA	116	NA
Zone 3	568	09-24-07	1.46	NA	0.175	NA	1.33	NA	<0.1	NA	243	NA
		09-02-08	1.47	NA	0.179 E	NA	1.28	NA	<0.1	NA	266	NA
Zone 2	685	09-24-07	1.66	NA	0.298	NA	1.25	NA	<0.1	NA	194	NA
		09-09-08	1.49	NA	0.315	NA	1.16	NA	<0.1	NA	184	NA
Zone 1	744	09-24-07	0.829	NA	0.288	NA	1.39	NA	<0.1	NA	216	NA
		09-02-08	0.804	NA	0.432	NA	1.30	NA	<0.1	NA	216	NA

Well name	Port depth	Date	Thallium		Tungsten		Uranium		Vandium		Zinc		Remarks
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	
USGS 133—Continued													
Zone 4	468	09-24-07	<0.04	NA	1.62	NA	1.32	NA	0.338	NA	1.63	NA	
		09-02-08	<0.04	NA	3.31	NA	0.876	NA	0.443	NA	2.84	NA	
Zone 3	568	09-24-07	<0.04	NA	0.171	NA	2.17	NA	7.64	NA	2.84	NA	
		09-02-08	<0.04	NA	0.171	NA	2.30	NA	6.82	NA	2.49	NA	
Zone 2	685	09-24-07	<0.04	NA	1.25	NA	1.92	NA	3.76	NA	2.13	NA	
		09-09-08	<0.04	NA	0.774	NA	1.74	NA	4.85	NA	9.11	NA	
Zone 1	744	09-24-07	<0.04	NA	0.096	NA	1.53	NA	3.28	NA	7.40	NA	
		09-02-08	<0.04	NA	0.074	NA	1.49	NA	3.12	NA	6.00	NA	

Well name	Port depth	Date	Aluminum		Antimony		Arsenic		Barium		Beryllium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 134												
Zone 5	578	09-27-06	2.52	NA	0.25	NA	3.70	NA	5.06	NA	<0.2	NA
		09-10-07	3.17	NA	0.097	NA	1.91	NA	8.20	NA	<0.2	NA
		09-04-08	2.54	NA	0.078 E	NA	1.71	NA	11.4	NA	<0.2	NA
Zone 4	644	09-28-06	1.72	NA	0.260	NA	8.11	NA	7.12	NA	<0.2	NA
		09-06-07	3.51	NA	0.212	NA	9.08	NA	11.0	NA	<0.2	NA
		09-06-07	2.76	23.9	0.224	5.5	9.09	0.11	10.8	1.8	<0.2	0
		09-04-08	1.68	NA	0.173	NA	7.39	NA	12.5	NA	<0.2	NA
Zone 3	706	09-27-06	5.01	NA	<0.2	NA	1.32	NA	7.24	NA	<0.2	NA
		09-05-07	8.56	NA	0.081	NA	1.97	NA	16.7	NA	<0.2	NA
		09-03-08	3.14	NA	0.076 E	NA	1.99	NA	16.2	NA	<0.2	NA
Zone 2	806	09-26-06	1.13 E	NA	0.15 E	NA	6.68	NA	4.89	NA	<0.2	NA
		09-05-07	2.24	NA	0.087	NA	2.29	NA	13.1	NA	<0.2	NA
		09-03-08	1.66	NA	0.076 E	NA	1.93	NA	17.2	NA	<0.2	NA
Zone 1	856	09-25-06	1.36 E	NA	0.310	NA	11.6	NA	4.30	NA	<0.2	NA
		09-04-07	1.12 E	NA	0.275	NA	10.6	NA	8.82	NA	<0.2	NA
	[1]846	09-03-08	1.19 E	NA	0.150	NA	2.5	NA	7.56	NA	<0.2	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Bromide		Cadmium		Chromium		Cobalt		Copper	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 134—Continued												
Zone 5	578	09-27-06	0.032	NA	0.06	NA	3.76	NA	0.420	NA	1.45	NA
		09-10-07	0.033	NA	<0.04	NA	6.09	NA	<0.04	NA	1.38	NA
		09-04-08	0.036	NA	<0.04	NA	5.92	NA	0.027	NA	<1	NA
Zone 4	644	09-28-06	0.032 E	NA	0.080	NA	1.43	NA	0.130	NA	1.39	NA
		09-06-07	0.026	NA	0.068	NA	2.53	NA	0.057	NA	3.45	NA
		09-06-07	0.026	0	0.069	1.5	2.56	1.2	0.059	3.4	2.78	21.5
		09-04-08	0.022	NA	0.047	NA	3.86	NA	0.035	NA	0.596 E	NA
Zone 3	706	09-27-06	0.022	NA	0.03 E	NA	3.01	NA	0.040	NA	4.93	NA
		09-05-07	0.026	NA	<0.04	NA	6.28	NA	0.029 E	NA	0.435	NA
		09-03-08	0.023	NA	<0.04	NA	5.96	NA	0.025	NA	<1	NA
Zone 2	806	09-26-06	0.028	NA	0.05	NA	5.12	NA	0.130	NA	2.09	NA
		09-05-07	0.027	NA	<0.04	NA	6.55	NA	0.030 E	NA	1.12	NA
		09-03-08	0.026	NA	<0.04	NA	6.11	NA	0.020 E	NA	<1	NA
Zone 1	856	09-25-06	0.029	NA	0.12	NA	0.34	NA	0.300	NA	6.98	NA
		09-04-07	0.027	NA	0.13	NA	1.23	NA	0.176	NA	1.89	NA
	[1]846	09-03-08	0.020	NA	0.027 E	NA	2.98	NA	0.074	NA	0.929 E	NA

Well name	Port depth	Date	Iron		Lead		Lithium		Manganese		Mercury	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 134—Continued												
Zone 5	578	09-27-06	<6	NA	0.09	NA	2.95	NA	77.0	NA	<0.01	NA
		09-10-07	<6	NA	0.092 E	NA	2.56	NA	0.891	NA	NS	NA
		09-04-08	<8	NA	<0.08	NA	2.03	NA	0.596	NA	NS	NA
Zone 4	644	09-28-06	<6	NA	<0.08	NA	3.33	NA	45.4	NA	<0.01	NA
		09-06-07	<6	NA	0.135	NA	2.96	NA	11.3	NA	NS	NA
		09-06-07	<6	0	0.093 E	36.8	2.98	0.67	11.4	0.88	NS	NC
		09-04-08	<8	NA	<0.08	NA	2.90	NA	0.607	NA	NS	NA
Zone 3	706	09-27-06	<6	NA	0.69	NA	1.56	NA	8.26	NA	<0.01	NA
		09-05-07	3.22 E	NA	<0.12	NA	2.15	NA	1.72	NA	NS	NA
		09-03-08	<8	NA	<0.08	NA	2.32	NA	1.61	NA	NS	NA
Zone 2	806	09-26-06	<6	NA	0.21	NA	2.50	NA	60.8	NA	<0.01	NA
		09-05-07	<6	NA	0.060 E	NA	2.35	NA	0.755	NA	NS	NA
		09-03-08	<8	NA	<0.08	NA	1.86	NA	0.345	NA	NS	NA
Zone 1	856	09-25-06	<6	NA	0.06 E	NA	3.58	NA	122	NA	<0.01	NA
		09-04-07	4.63 E	NA	<0.12	NA	3.54	NA	85.5	NA	NS	NA
	[1]846	09-03-08	9.61	NA	<0.08	NA	2.71	NA	30.6	NA	NS	NA

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Molybdenum		Nickel		Selenium		Silver		Strontium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
USGS 134—Continued												
Zone 5	578	09-27-06	28.6	NA	6.56	NA	0.97	NA	<0.20	NA	119	NA
		09-10-07	3.33	NA	1.27	NA	1.16	NA	<0.1	NA	155	NA
		09-04-08	1.68	NA	0.725	NA	1.06	NA	<0.1	NA	145	NA
Zone 4	644	09-28-06	36.1	NA	2.6	NA	0.990	NA	<0.20	NA	171	NA
		09-06-07	30.1	NA	1.63	NA	0.935	NA	<0.1	NA	190	NA
		09-06-07	30.5	1.3	1.63	0	0.965	3.2	<0.1	0	191	0.52
		09-04-08	19.2	NA	0.69	NA	0.926	NA	<0.1	NA	174	NA
Zone 3	706	09-27-06	1.57	NA	1.02	NA	0.440	NA	<0.20	NA	80.7	NA
		09-05-07	1.50	NA	0.458	NA	0.984	NA	<0.1	NA	156	NA
		09-03-08	1.66	NA	0.39	NA	0.977	NA	<0.1	NA	153	NA
Zone 2	806	09-26-06	11.1	NA	2.4	NA	0.97	NA	<0.20	NA	156	NA
		09-05-07	2.7	NA	0.660	NA	1.11	NA	<0.1	NA	168	NA
		09-03-08	1.96	NA	0.368	NA	1.13	NA	<0.1	NA	182	NA
Zone 1	856	09-25-06	46.0	NA	9.99	NA	1.01	NA	<0.20	NA	166	NA
		09-04-07	50.8	NA	5.31	NA	1.09	NA	<0.1	NA	218	NA
	[1]846	09-03-08	7.87	NA	9.54	NA	0.88	NA	<0.1	NA	131	NA

Well name	Port depth	Date	Thallium		Tungsten		Uranium		Vandadium		Zinc		Remarks
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	
USGS 134—Continued													
Zone 5	578	09-27-06	<0.04	NA	383	NA	0.39	NA	14.0	NA	5.95	NA	
		09-10-07	<0.04	NA	44.4	NA	1.08	NA	10.3	NA	5.17	NA	
		09-04-08	<0.04	NA	9.74	NA	1.07	NA	9.22	NA	4.91	NA	
Zone 4	644	09-28-06	<0.04	NA	127	NA	0.310	NA	15.6	NA	12.9	NA	
		09-06-07	<0.04	NA	181	NA	0.387	NA	16.6	NA	8.00	NA	
		09-06-07	<0.04	0	168	53.7	0.389	0.52	16.9	1.8	7.22	10.1	
		09-04-08	<0.04	NA	87.1	NA	0.348	NA	14.6	NA	7.51	NA	
Zone 3	706	09-27-06	<0.04	NA	7.35	NA	0.51	NA	5.11	NA	18.8	NA	
		09-05-07	<0.04	NA	1.56	NA	1.10	NA	10.0	NA	5.21	NA	
		09-03-08	<0.04	NA	3.44	NA	1.17	NA	9.93	NA	6.14	NA	
Zone 2	806	09-26-06	<0.04	NA	2.47	NA	0.18	NA	11.9	NA	8.5	NA	
		09-05-07	<0.04	NA	0.655	NA	1.03	NA	8.30	NA	5.54	NA	
		09-03-08	<0.04	NA	0.454	NA	1.29	NA	7.14	NA	5.37	NA	
Zone 1	856	09-25-06	<0.04	NA	47.7	NA	0.03 E	NA	9.78	NA	10.5	NA	
		09-04-07	<0.04	NA	99.8	NA	0.024 E	NA	12.8	NA	11.0	NA	
	[1]846	09-03-08	<0.04	NA	19.9	NA	0.032	NA	8.12	NA	8.94	NA	

Table 5. Concentrations of selected minor dissolved inorganic constituents in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in micrograms per liter (µg/L). NS, not sampled; NC, not calculated. NA; not applicable. **Remarks:** QAW, quality assurance Westbay™ sample. RPD; Relative percent difference in percent; <, less than]

Well name	Port depth	Date	Aluminum		Antimony		Arsenic		Barium		Beryllium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
QAW-1	NA	08-28-06	<1.6	NA	<0.2	NA	<0.12	NA	<1.0	NA	<0.2	NA
QAW-2	NA	10-02-06	1.42 E	NA	0.120	NA	0.88	NA	87.9	NA	<0.2	NA
QAW-6	NA	09-12-07	<1.6	NA	<0.06	NA	<0.12	NA	<0.4	NA	<0.2	NA
QAW-12	NA	09-08-08	8.31	NA	0.102 E	NA	1.54	NA	29.4	NA	<0.2	NA

Well name	Port depth	Date	Bromide		Cadmium		Chromium		Cobalt		Copper	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
QAW-1	NA	08-28-06	<0.02	NA	<0.04	NA	0.05	NA	<0.04	NA	2.58	NA
QAW-2	NA	10-02-06	0.128	NA	<0.04	NA	8.63	NA	0.03 E	NA	62.9	NA
QAW-6	NA	09-12-07	<0.02	NA	<0.04	NA	<0.12	NA	<0.04	NA	1.39	NA
QAW-12	NA	09-08-08	0.041	NA	<0.04	NA	6.02	NA	0.04	NA	<1	NA

Well name	Port depth	Date	Iron		Lead		Lithium		Manganese		Mercury	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
QAW-1	NA	08-28-06	<6	NA	0.08	NA	<0.6	NA	<0.2	NA	<0.01	NA
QAW-2	NA	10-02-06	7.12	NA	0.910	NA	4.02	NA	1.69	NA	<0.01	NA
QAW-6	NA	09-12-07	<6	NA	0.088 E	NA	<6	NA	<0.2	NA	NS	NA
QAW-12	NA	09-08-08	20.7	NA	<0.08	NA	2.51	NA	3.77	NA	NS	NA

Well name	Port depth	Date	Molybdenum		Nickel		Selenium		Silver		Strontium	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
QAW-1	NA	08-28-06	<0.4	NA	0.04 E	NA	<0.08	NA	<0.20	NA	<0.4	NA
QAW-2	NA	10-02-06	1.68	NA	1.15	NA	2.54	NA	0.05 E	NA	479	NA
QAW-6	NA	09-12-07	<0.12	NA	<0.06	NA	<0.08	NA	<0.1	NA	<0.4	NA
QAW-12	NA	09-08-08	2.75	NA	0.326	NA	1.24	NA	<0.1	NA	234	NA

Well name	Port depth	Date	Thallium		Tungsten		Uranium		Vandadium		Zinc	
			µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD	µg/L	RPD
QAW-1	NA	08-28-06	<0.04	NA	NA	NA	<0.04	NA	<0.10	NA	1.94	NA
QAW-2	NA	10-02-06	<0.04	NA	0.084	NA	2.36	NA	3.54	NA	31.3	NA
QAW-6	NA	09-12-07	<0.04	NA	<0.06	NA	<0.04	NA	<0.04	NA	0.853	NA
QAW-12	NA	09-08-08	<0.04	NA	0.147	NA	1.99	NA	5.22	NA	2.68	NA

[1]The port at 856 feet below land surface was damaged in 2007, so samples were collected from the port at 846 feet below land surface in 2008.

Table 6. Concentrations of dissolved nutrients and total organic carbon in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). NA, not applicable. NS, not sampled. NC, Not calculated. Remarks: QAW, quality assurance Westbay(TM) sample. RPD, Relative percent difference. <, less than]

Sample identifier	Port depth	Date	Ammonia (as nitrogen)		Nitrite (as nitrogen)		Nitrite plus nitrate (as nitrogen)		Orthophosphate (as phosphorus)		Total organic carbon		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
Middle 2050A													
Zone 5	515	09-19-06	0.006 E	NA	<0.002	NA	0.513	NA	0.023	NA	NS	NA	
		09-20-07	<0.02	NA	<0.002	NA	1.02	NA	0.027	NA	0.475	NA	
		08-27-08	0.012 E	NA	<0.002	NA	0.965	NA	0.028	NA	0.350 E	NA	
		08-27-08	<0.02	NC	<0.002	0	0.960	0.5	0.027	3.60	0.807	79.0	QAW-11
Zone 4	642	09-19-06	0.008 E	NA	<0.002	NA	0.315	NA	0.013	NA	NS	NA	
		09-20-07	<0.02	NA	<0.002	NA	0.325	NA	0.015	NA	1.02	NA	
		08-26-08	<0.02	NA	<0.002	NA	0.345	NA	0.020	NA	0.342 E	NA	
Zone 3	790	09-20-06	<0.010	NA	<0.002	NA	1.00	NA	0.015	NA	NS	NA	
		09-20-06	<0.010	0	<0.002	0	0.998	0.2	0.018	18.2	NS	NC	QAW-5
		09-20-07	<0.02	NA	<0.002	NA	0.953	NA	0.017	NA	1.19	NA	
		08-26-08	<0.02	NA	<0.002	NA	0.926	NA	0.022	NA	1.02	NA	
Zone 2	998	09-18-06	0.008 E	NA	<0.002	NA	0.963	NA	0.017	NA	NS	NA	
		09-19-07	<0.02	NA	<0.002	NA	0.917	NA	0.016	NA	0.234 E	NA	
		08-26-08	<0.02	NA	<0.002	NA	0.885	NA	0.019	NA	0.382 E	NA	
Zone 1	1,179	09-18-06	0.112	NA	<0.002	NA	<0.06	NA	0.013	NA	NS	NA	
		09-19-07	0.115	NA	<0.002	NA	<0.06	NA	0.014	NA	1.96	NA	
		08-26-08	0.114	NA	<0.002	NA	<0.04	NA	0.016	NA	1.91	NA	

Table 6. Concentrations of dissolved nutrients and total organic carbon in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). NA, not applicable. NS, not sampled. NC, Not calculated. Remarks: QAW, quality assurance Westbay™ sample. RPD, Relative percent difference. <, less than]

Sample identifier	Port depth	Date	Ammonia (as nitrogen)		Nitrite (as nitrogen)		Nitrite plus nitrate (as nitrogen)		Orthophosphate (as phosphorus)		Total organic carbon		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
Middle 2051													
Zone 5	604	09-11-06	0.008 E	NA	<0.002	NA	0.375	NA	0.023	NA	NS	NA	
		09-12-07	<0.02	NA	0.002 E	NA	0.358	NA	0.024	NA	<0.4	NA	
		08-25-08	<0.02	NA	<0.002	NA	0.360	NA	0.031	NA	0.406	NA	
Zone 4	750	09-13-06	0.009 E	NA	<0.002	NA	0.879	NA	0.019	NA	NS	NA	
		09-13-06	0.010	10.5	<0.002	0	0.881	0.2	0.020	5.1	NS	NC	QAW-4
		09-12-07	<0.02	NA	0.002 E	NA	0.847	NA	0.023	NA	<0.4	NA	
		09-12-07	<0.02	0	0.001 E	66.7	0.849	0.2	0.023	0	<0.4	0	QAW-8
		08-25-08	<0.02	NA	<0.002	NA	0.832	NA	0.024	NA	1.42	NA	
Zone 3	828	09-12-06	0.011	NA	<0.002	NA	0.892	NA	0.020	NA	NS	NA	
		09-12-06	0.012	9	<0.002	0	0.901	1.0	0.019	5.10	NS	NC	QAW-3
		09-11-07	<0.02	NA	0.001 E	NA	0.873	NA	0.023	NA	0.283 E	NA	
		08-21-08	<0.02	NA	<0.002	NA	0.902	NA	0.024	NA	0.267 E	NA	
Zone 2	1,092	09-11-06	0.009 E	NA	<0.002	NA	0.922	NA	0.015	NA	NS	NA	
		09-11-07	<0.02	NA	0.002 E	NA	0.874	NA	0.018	NA	0.390 E	NA	
		08-21-08	<0.02	NA	<0.002	NA	0.910	NA	0.019	NA	0.809	NA	
Zone 1	1,142	09-07-06	0.006 E	NA	<0.002	NA	0.751	NA	0.013	NA	NS	NA	
		09-11-07	<0.02	NA	0.002	NA	0.782	NA	0.019	NA	0.243 E	NA	
		08-21-08	<0.02	NA	<0.002	NA	0.829	NA	0.018	NA	0.262 E	NA	

Table 6. Concentrations of dissolved nutrients and total organic carbon in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). NA, not applicable. NS, not sampled. NC, Not calculated. Remarks: QAW, quality assurance Westbay™ sample. RPD, Relative percent difference. <, less than]

Sample identifier	Port depth	Date	Ammonia (as nitrogen)		Nitrite (as nitrogen)		Nitrite plus nitrate (as nitrogen)		Orthophosphate (as phosphorus)		Total organic carbon		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
USGS 103													
Zone 7	682	10-02-07	0.107	NA	0.002	NA	0.137	NA	0.003 E	NA	0.6	NA	
		08-20-08	0.038	NA	0.001 E	NA	0.142	NA	0.005 E	NA	1.36	NA	
Zone 6	805	10-02-07	<0.02	NA	0.002	NA	0.652	NA	0.016	NA	0.808	NA	
		08-19-08	<0.02	NA	<0.002	NA	0.650	NA	0.020	NA	0.228 E	NA	
Zone 5	914	10-01-07	<0.02	NA	0.005	NA	0.538	NA	0.014	NA	0.473	NA	
		08-19-08	<0.02	NA	0.002	NA	0.488	NA	0.020	NA	0.25 E	NA	
Zone 4	1,000	10-01-07	<0.02	NA	<0.002	NA	0.661	NA	0.013	NA	<0.4	NA	
		08-18-08	<0.02	NA	<0.002	NA	0.675	NA	0.018	NA	1.2	NA	
Zone 3	1,095	10-01-07	<0.02	NA	<0.002	NA	0.768	NA	0.016	NA	0.444	NA	
		08-18-08	<0.02	NA	<0.002	NA	0.770	NA	0.019	NA	0.284 E	NA	
Zone 2	1,220	09-25-07	<0.02	NA	0.001 E	NA	0.775	NA	0.019	NA	0.495	NA	
		08-18-08	<0.02	NA	<0.002	NA	0.772	NA	0.019	NA	<0.4	NA	
		08-18-08	<0.02	0	<0.002	0	0.769	0.4	0.019	0	<0.4	0	QAW-10
Zone 1	1,269	09-25-07	<0.02	NA	0.002	NA	0.767	NA	0.021	NA	0.452	NA	
		08-19-08	<0.02	NA	<0.002	NA	0.770	NA	0.021	NA	0.883	NA	

Table 6. Concentrations of dissolved nutrients and total organic carbon in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). NA, not applicable. NS, not sampled. NC, Not calculated. Remarks: QAW, quality assurance Westbay[TM] sample. RPD, Relative percent difference. <, less than]

Sample identifier	Port depth	Date	Ammonia (as nitrogen)		Nitrite (as nitrogen)		Nitrite plus nitrate (as nitrogen)		Orthophosphate (as phosphorus)		Total organic carbon		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
USGS 132													
Zone 6	636	09-06-06	0.006 E	NA	<0.002	NA	0.915	NA	0.020	NA	0.336 E	NA	
		09-18-07	<0.02	NA	<0.002	NA	0.985	NA	0.018	NA	0.426	NA	
		08-14-08	<0.02	NA	<0.002	NA	1.26	NA	0.023	NA	0.307 E	NA	
		08-14-08	<0.02	0	<0.002	0	1.26	0	0.023	0	0.689	76.7	QAW-9
Zone 5	764	09-05-06	0.009 E	NA	<0.002	NA	0.731	NA	0.018	NA	0.424	NA	
		09-18-07	<0.02	NA	<0.002	NA	0.734	NA	0.019	NA	0.216 E	NA	
		08-13-08	<0.02	NA	<0.002	NA	0.725	NA	0.025	NA	0.419	NA	
Zone 4	826	09-05-06	0.009 E	NA	<0.002	NA	0.674	NA	0.016	NA	0.218 E	NA	
		09-18-07	<0.02	NA	<0.002	NA	0.662	NA	0.018	NA	0.414	NA	
		08-13-08	<0.02	NA	<0.002	NA	0.672	NA	0.023	NA	0.745	NA	
Zone 3	917	08-31-06	0.007 E	NA	<0.002	NA	0.663	NA	0.021	NA	0.948	NA	
		09-18-07	<0.02	NA	<0.002	NA	0.661	NA	0.019	NA	0.242 E	NA	
		08-13-08	<0.02	NA	<0.002	NA	0.671	NA	0.024	NA	0.550	NA	
Zone 2	1,010	08-30-06	0.009 E	NA	<0.002	NA	0.665	NA	0.018	NA	0.395 E	NA	
		09-17-07	<0.02	NA	<0.002	NA	0.676	NA	0.019	NA	0.257 E	NA	
		08-12-08	<0.02	NA	<0.002	NA	0.682	NA	0.023	NA	0.343 E	NA	
Zone 1	1,172	08-29-06	0.009 E	NA	<0.002	NA	0.743	NA	0.018	NA	0.372 E	NA	
		09-17-07	<0.02	NA	<0.002	NA	0.733	NA	0.019	NA	0.577	NA	
		08-12-08	<0.02	NA	<0.002	NA	0.747	NA	0.024	NA	0.224 E	NA	
USGS 133													
Zone 4	468	09-24-07	<0.02	NA	<0.002	NA	0.417	NA	0.006	NA	0.334 E	NA	
		09-02-08	<0.02	NA	<0.002	NA	0.712	NA	0.007	NA	0.389 E	NA	
Zone 3	568	09-24-07	<0.02	NA	<0.002	NA	0.876	NA	0.026	NA	0.966	NA	
		09-02-08	<0.02	NA	<0.002	NA	0.917	NA	0.023	NA	<0.4	NA	
Zone 2	685	09-24-07	<0.02	NA	0.001 E	NA	0.846	NA	0.021	NA	<0.40	NA	
		09-02-08	<0.02	NA	<0.002	NA	0.87	NA	0.018	NA	1.41	NA	
Zone 1	744	09-24-07	<0.02	NA	<0.002	NA	1.18	NA	0.021	NA	0.396 E	NA	
		09-02-08	<0.02	NA	<0.002	NA	1.21	NA	0.018	NA	0.376 E	NA	

Table 6. Concentrations of dissolved nutrients and total organic carbon in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in milligrams per liter (mg/L). NA, not applicable. NS, not sampled. NC, Not calculated. Remarks: QAW, quality assurance Westbay™ sample. RPD, Relative percent difference. <, less than]

Sample identifier	Port depth	Date	Ammonia (as nitrogen)		Nitrite (as nitrogen)		Nitrite plus nitrate (as nitrogen)		Orthophosphate (as phosphorus)		Total organic carbon		Remarks
			mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	mg/L	RPD	
USGS 134													
Zone 5	578	09-27-06	0.024	NA	0.001 E	NA	0.562	NA	4.04	NA	0.403	NA	
		09-10-07	<0.02	NA	0.002 E	NA	0.604	NA	0.684	NA	0.211 E	NA	
		09-04-08	<0.02	NA	<0.002	NA	0.632	NA	0.217	NA	0.472	NA	
Zone 4	644	09-28-06	0.020	NA	0.006	NA	0.484	NA	5.01	NA	1.60	NA	
		09-06-07	<0.02	NA	<0.002	NA	0.605	NA	3.43	NA	1.09	NA	
		09-06-07	<0.02	0	<0.002	0	0.602	0.5	3.41	5.8	1.79	48.6	QAW-7
		09-04-08	<0.02	NA	<0.002	NA	0.614	NA	2.36	NA	1.75	NA	
Zone 3	706	09-27-06	0.009 E	NA	<0.002	NA	0.473	NA	0.948	NA	1.14	NA	
		09-05-07	<0.02	NA	0.001 E	NA	0.462	NA	0.102	NA	1.31	NA	
		09-03-08	<0.02	NA	<0.002	NA	0.478	NA	0.143	NA	1.07	NA	
Zone 2	806	09-26-06	0.005 E	NA	<0.002	NA	0.660	NA	11.7	NA	0.365 E	NA	
		09-05-07	<0.02	NA	0.001 E	NA	0.659	NA	2.01	NA	0.481	NA	
		09-03-08	<0.02	NA	<0.002	NA	0.673	NA	0.920	NA	0.327 E	NA	
Zone 1	856	09-25-06	0.034	NA	<0.002	NA	0.332	NA	39.8	NA	1.93	NA	
		09-04-07	0.019 E	NA	0.001 E	NA	0.351	NA	31.2	NA	3.02	NA	
	[1]846	09-03-08	<0.02	NA	<0.002	NA	0.404	NA	5.77	NA	0.419	NA	
QAW-1	NA	08-28-06	0.012	NA	<0.002	NA	<0.06	NA	<0.006	NA	<0.40	NA	
QAW-2	NA	10-02-06	0.014 E	NA	<0.002	NA	3.64	NA	0.013	NA	0.663	NA	
QAW-6	NA	10-12-07	<0.02	NA	0.001 E	NA	<0.06	NA	0.003 E	NA	0.253 E	NA	
QAW-12	NA	09-08-08	<0.02	NA	<0.002	NA	0.671	NA	0.012	NA	0.396 E	NA	

[1]The port at 856 feet below land surface was damaged in 2007, so samples were collected from the port at 846 feet below land surface in 2008.

Table 7. Concentrations of gross alpha-particle radioactivity, gross-beta particle radioactivity, strontium-90, tritium, and cesium-137 in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.

[Well locations are shown in figure 2. Port depth in feet below land surface. Date: (m-d-y) indicates month-day-year. Analytical results and uncertainties in picocuries per liter (pCi/L). Analytical uncertainties are reported as 1 sample standard deviation (s). Concentrations that meet or exceed the reporting level of 3 times the 1s value are shown in **boldface** type. Z-values associated with QA replicates were calculated using equation 1. NA, not applicable. NS, not sampled. NR, not requested. Remarks: QAW, quality assurance Westbay™ sample. RESL, Radiological and Environmental Sciences Laboaratory. NWQL, National Water Quality Laboratory]

Sample identifier	Port depth	Date	Gross alpha-particle radioactivity		Gross beta-particle radioactivity		Strontium-90		Tritium (RESL)		Tritium (NWQL)		Cesium-137		Remarks
			pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	
Middle 2050A															
Zone 5	515	09-30-05	NS	NA	NS	NA	**2.9±0.7**	NA	30±100	NA	NS	NA	NS	NA	
		09-19-06	0.7±0.7	NA	1.4±2.1	NA	0±0.7	NA	90±50	NA	NS	NA	16.1±21.1	NA	
		09-20-07	0.3±0.6	NA	2.1±1.5	NA	-0.6±0.7	NA	**210±70**	NA	NS	NA	-13.5±26.7	NA	
		08-27-08	3.5±1.3	NA	**3.7±0.9**	NA	-2.6±0.7	NA	**220±70**	NA	**172±5.4**	NA	40±30	NA	
		08-27-08	1.2±1.1	1.4	2.4±0.9	1.0	1±0.7	3.64	**360±70**	1.41	**185±5.7**	1.66	20±30	0.47	QAW-11
Zone 4	642	09-30-05	NS	NA	NS	NA	1.8±0.7	NA	140±110	NA	NS	NA	NS	NA	
		09-19-06	0.7±0.7	NA	2±2	NA	-0.15±0.72	NA	140±50	NA	NS	NA	-40±40	NA	
		09-20-07	0.3±0.6	NA	2.5±1.6	NA	-0.5±0.7	NA	70±60	NA	NS	NA	-10±30	NA	
		08-26-08	2.5±1.2	NA	**2.9±0.9**	NA	-2±0.7	NA	140±70	NA	**93.8±3.5**	NA	20±20	NA	
Zone 3	790	10-14-05	NS	NA	NS	NA	1.8±0.7	NA	90±110	NA	NS	NA	NS	NA	
		09-20-06	0.7±0.7	NA	3±2	NA	0.12±0.72	NA	160±60	NA	NS	NA	-14.5±27	NA	
		09-20-06	0.7±0.7	0	0±2	1.06	0.6±0.7	0.48	70±50	1.15	NS	NC	-80±40	1.36	QAW-5
		09-20-07	0.7±0.7	NA	1.9±1.5	NA	0.3±0.7	NA	40±60	NA	NS	NA	-10.6±31.7	NA	
		08-26-08	2±1.2	NA	2.3±0.9	NA	-2.2±0.7	NA	90±70	NA	**60.9±2.9**	NA	-20±30	NA	
Zone 2	998	10-07-05	NS	NA	NS	NA	**2.4±0.7**	NA	-90±100	NA	NS	NA	NS	NA	
		09-18-06	0±0.6	NA	2±2	NA	0.8±0.7	NA	20±50	NA	NS	NA	0±30	NA	
		09-19-07	0.7±0.7	NA	2.2±1.6	NA	0.4±0.7	NA	-20±60	NA	NS	NA	13.6±21.6	NA	
		08-26-08	3.7±1.3	NA	**3.2±0.9**	NA	-0.125±0.743	NA	16.3±64	NA	5.4±1.9	NA	0±30	NA	
Zone 1	1,179	10-21-05	NS	NA	NS	NA	1.2±0.7	NA	210±110	NA	NS	NA	NS	NA	
		09-18-06	0.3±0.6	NA	2±2	NA	0.9±0.7	NA	170±60	NA	NS	NA	30±40	NA	
		09-19-07	0.7±0.7	NA	1.1±1.5	NA	1.0±0.7	NA	70±60	NA	NS	NA	30±40	NA	
		08-26-08	0±1	NA	**3.8±0.9**	NA	0.145±0.864	NA	130±70	NA	**97.6±3.5**	NA	17±13	NA	

Table 7. Concentrations of gross alpha-particle radioactivity, gross-beta particle radioactivity, strontium-90, tritium, and cesium-137 in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08. —Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Date: (m-d-y) indicates month-day-year. Analytical results and uncertainties in picocuries per liter (pCi/L). Analytical uncertainties are reported as 1 sample standard deviation (s). Concentrations that meet or exceed the reporting level of 3 times the 1s value are shown in **boldface** type. Z-values associated with QA replicates were calculated using equation 1. NA, not applicable. NS, not sampled. NR, not requested. Remarks: QAW, quality assurance Westbay™ sample. RESL, Radiological and Environmental Sciences Laboaratory. NWQL, National Water Quality Laboratory]

Sample identifier	Port depth	Date	Gross alpha-particle radioactivity		Gross beta-particle radioactivity		Strontium-90		Tritium (RESL)		Tritium (NWQL)		Cesium-137		Remarks
			pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	
Middle 2051															
Zone 5	604	09-27-05	NS	NA	NS	NA	1.4±0.7	NA	-60±100	NA	NS	NA	NS	NA	
		09-11-06	0.7±0.7	NA	3±2	NA	-0.1±0.7	NA	60±50	NA	NS	NA	0±30	NA	
		09-12-07	0.3±0.6	NA	1.7±1.5	NA	0.1±0.7	NA	-50±60	NA	NS	NA	-20±20	NA	
		08-25-08	1.2±1.1	NA	**3.7±0.9**	NA	0.7±0.7	NA	50±60	NA	**51.7±2.9**	NA	-14.6±21.5	NA	
Zone 4	750	09-27-05	NS	NA	NS	NA	**2.3±0.7**	NA	**680±130**	NA	NS	NA	NS	NA	
		09-13-06	0.3±0.6	NA	3±2	NA	0.6±0.7	NA	**700±100**	NA	NS	NA	-20±40	NA	
		09-13-06	0.7±0.7	0.45	3±2	0	0.3±0.7	0.43	**610±90**	0.67	NS	NC	0±20	0.45	QAW-4
		09-12-07	1±0.8	NA	2.5±1.6	NA	0±0.7	NA	**450±80**	NA	NS	NA	-20±40	NA	
		09-12-07	0.7±0.7	0.28	2.2±1.6	0.13	-0.15±0.66	0.16	**490±90**	0.33	NS	NC	0±40	0.35	QAW-8
		08-25-08	2.9±1.3	NA	**3.9±0.9**	NA	1.3±0.7	NA	**680±80**	NA	**475±13**	NA	30±50	NA	
Zone 3	828	09-28-05	NS	NA	NS	NA	1.9±0.7	NA	**670±130**	NA	NS	NA	NS	NA	
		09-12-06	0.7±0.7	NA	2±2	NA	-0.2±0.7	NA	**660±90**	NA	NS	NA	30±20	NA	
		09-12-06	0±0.6	0.76	3±2	0.35	0.2±0.7	0.40	**780±110**	0.84	NS	NC	-40±40	0.22	QAW-3
		09-11-07	0.7±0.7	NA	2.3±1.6	NA	0.12±0.68	NA	**610±100**	NA	NS	NA	-60±40	NA	
		08-21-08	4.1±1.4	NA	1.4±0.8	NA	0.4±0.7	NA	**630±80**	NA	**635±19**	NA	-40±40	NA	
Zone 2	1,092	09-28-05	NS	NA	NS	NA	0.8±0.7	NA	240±110	NA	NS	NA	NS	NA	
		09-11-06	0.3±0.6	NA	3±2	NA	0.7±0.7	NA	**360±70**	NA	NS	NA	0±30	NA	
		09-11-07	1±0.8	NA	2.3±1.6	NA	-1±0.7	NA	**230±70**	NA	NS	NA	-30±40	NA	
		08-21-08	3.5±1.3	NA	**3.5±0.9**	NA	0.7±0.7	NA	**470±80**	NA	**292±8.6**	NA	30±50	NA	
Zone 1	1,142	09-29-05	NS	NA	NS	NA	0.2±0.7	NA	-70±100	NA	NS	NA	NS	NA	
		09-07-06	0.3±0.6	NA	2±2	NA	0.8±0.7	NA	**320±70**	NA	NS	NA	-13.6±33.3	NA	
		09-11-07	0.3±0.6	NA	1.9±1.5	NA	-0.8±0.7	NA	**210±70**	NA	NS	NA	30±40	NA	
		08-21-08	1.8±1.2	NA	**4.5±0.9**	NA	-0.167±0.791	NA	**460±80**	NA	**300±8.9**	NA	-30±30	NA	

Table 7. Concentrations of gross alpha-particle radioactivity, gross-beta particle radioactivity, strontium-90, tritium, and cesium-137 in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08. —Continued

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Sample identifier	Port depth	Date	Gross alpha-particle radioactivity		Gross beta-particle radioactivity		Strontium-90		Tritium (RESL)		Tritium (NWQL)		Cesium-137		Remarks
			pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	
USGS 103															
Zone 7	682	10-02-07	0±0.6	NA	2.5±1.6	NA	-0.1±0.7	NA	-70±60	NA	NS	NA	40±40	NA	
		08-20-08	0±1	NA	2.6±0.9	NA	-0.4±0.8	NA	-10±60	NA	**8±1.9**	NA	20±30	NA	
Zone 6	805	10-02-07	0.7±0.7	NA	2.7±1.6	NA	-0.151±0.682	NA	-80±60	NA	NS	NA	-20±30	NA	
		08-19-08	**5.7±1.6**	NA	**3.3±0.9**	NA	0.8±0.7	NA	50±60	NA	**16.9±1.9**	NA	-20±30	NA	
Zone 5	914	10-01-07	0.3±0.6	NA	1.2±1.5	NA	0.2±0.7	NA	160±70	NA	NS	NA	-10±40	NA	
		08-19-08	3.9±1.4	NA	**4.5±1**	NA	1.1±0.8	NA	90±60	NA	**72.4±2.9**	NA	0±30	NA	
Zone 4	1,000	10-01-07	1±0.8	NA	0.6±1.4	NA	0±0.7	NA	**290±70**	NA	NS	NA	20±40	NA	
		10-01-07	NR	NA	NR	NA	NR	NA	200±70	NA	NR	NA	NR	NA	Rerun
		08-18-08	2±1.2	NA	**4.3±0.9**	NA	1.7±0.8	NA	**370±70**	NA	**275±8**	NA	50±30	NA	
Zone 3	1,095	10-01-07	0.7±0.7	NA	2.4±1.6	NA	-0.5±0.7	NA	**350±80**	NA	NS	NA	-10±20	NA	
		10-01-07	NR	NA	NR	NA	NR	NA	**460±70**	NA	NR	NA	NR	NA	Rerun
		08-18-08	2.9±1.3	NA	**2.9±0.9**	NA	0±0.7	NA	**440±70**	NA	**434±13**	NA	0±40	NA	
Zone 2	1,220	09-25-07	0.3±0.6	NA	2.5±1.6	NA	0.3±0.7	NA	**380±80**	NA	NS	NA	-10±30	NA	
		09-25-07	NR	NA	NR	NA	NR	NA	**530±70**	NA	NR	NA	NR	NA	Rerun
		08-18-08	1±1.1	NA	**3.2±0.9**	NA	0.5±0.8	NA	**320±70**	NA	**427±12**	NA	30±40	NA	
		08-18-08	1.8±1.2	0.49	5±1	1.34	1.4±0.8	0.8	**530±80**	1.98	**408±12**	1.12	0±30	0.60	QAW-10
		08-18-08	NR	NA	NR	NA	NR	NA	**320±70**	NA	NR	NA	NR	NA	Rerun
Zone 1	1,269	09-25-07	0.3±0.6	NA	2.0±1.5	NA	-0.8±0.7	NA	**400±80**	NA	NS	NA	-20±30	NA	
		09-25-07	NR	NA	NR	NA	NR	NA	**370±70**	NA	NR	NA	NR	NA	Rerun
		08-19-08	**4.3±1.4**	NA	**4.4±0.9**	NA	2±0.7	NA	**430±70**	NA	**405±13**	NA	0±20	NA	

Table 7. Concentrations of gross alpha-particle radioactivity, gross-beta particle radioactivity, strontium-90, tritium, and cesium-137 in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08. —Continued

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Sample identifier	Port depth	Date	Gross alpha-particle radioactivity		Gross beta-particle radioactivity		Strontium-90		Tritium (RESL)		Tritium (NWQL)		Cesium-137		Remarks
			pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	
USGS 132															
Zone 6	636	09-06-06	1.0±0.8	NA	4±2	NA	-0.5±0.7	NA	120±50	NA	NS	NA	11±17	NA	
		09-18-07	0.7±0.7	NA	3.9±1.7	NA	-0.1±0.7	NA		NA	NS	NA	12.4±35.1	NA	
									14.7±59.6						
		08-14-08	3.3±1.3	NA	**4±0.9**	NA	1.5±0.7	NA	190±70	NA	**122±4.1**	NA	-11.3±22.7	NA	
		08-14-08	2.5±1.2	0.45	**6.3±1**	1.71	1.5±0.8	0	**290±70**	1.01	**113±3.8**	1.61	-14.9±30.4	0.095	QAW-9
Zone 5	764	09-05-06	0±0.6	NA	4±2	NA	0.5±0.7	NA	**270±60**	NA	NS	NA	0±20	NA	
		09-18-07	0.3±0.6	NA	1.2±1.5	NA	-0.2±0.7	NA	**290±70**	NA	NS	NA	-50±40	NA	
		08-13-08	**4.5±1.4**	NA	**3.9±0.9**	NA	0.8±0.7	NA	**360±70**	NA	**252±7.7**	NA	10±20	NA	
Zone 4	826	09-05-06	0.7±0.7	NA	5±2	NA	-0.8±0.7	NA	**190±60**	NA	NS	NA	40±30	NA	
		09-18-07	0.7±0.7	NA	1.7±1.5	NA	-0.4±0.7	NA	140±60	NA	NS	NA	0±30	NA	
		08-13-08	2±1.2	NA	**5.3±1.0**	NA	1.2±0.7	NA	120±50	NA	**256±8**	NA	0±30	NA	
Zone 3	917	08-31-06	0.7±0.7	NA	4±2	NA	0.4±0.7	NA	**330±70**	NA	NS	NA	20±40	NA	
		09-18-07	0.7±0.7	NA	2.4±1.6	NA	-1.4±0.7	NA	150±60	NA	NS	NA	-20±20	NA	
		08-13-08	2.5±1.2	NA	2.5±0.9	NA	1.6±0.7	NA	**340±70**	NA	**269±8.6**	NA	16±14	NA	
Zone 2	1,010	08-30-06	0.7±0.7	NA	4±2	NA	0.2±0.7	NA	**300±60**	NA	NS	NA	30±30	NA	
		09-17-07	0.7±0.7	NA	1.4±1.5	NA	0.2±0.7	NA	**210±70**	NA	NS	NA	-12.4±24.1	NA	
		08-12-08	2.2±1.2	NA	**13.6±1.4**	NA	-0.1±0.9	NA	**310±70**	NA	**301±8.9**	NA	0±20	NA	
Zone 1	1,172	08-29-06	0±0.6	NA	3±2	NA	0.5±0.7	NA	**270±60**	NA	NS	NA	-30±30	NA	
		09-17-07	0.3±0.6	NA	3.9±1.7	NA	-0.1±0.7	NA	**310±70**	NA	NS	NA	-30±20	NA	
		08-12-08	2±1.2	NA	1.7±0.8	NA	1.1±0.8	NA	**300±70**	NA	**286±8.6**	NA	20±30	NA	
USGS 133															
Zone 4	468	09-24-07	0.7±0.7	NA	1.1±1.5	NA	0.118±0.66	NA	50±60	NA	NS	NA	0±20	NA	
		09-02-08	3.3±1.3	NA	**3.3±0.9**	NA	-0.1±0.8	NA	**210±70**	NA	**131±4.1**	NA	-30±0.30	NA	
Zone 3	568	09-24-07	1±0.8	NA	3.5±1.6	NA	1±0.7	NA	-50±60	NA	NS	NA	0±20	NA	
		09-02-08	**4.7±1.4**	NA	**4.9±1**	NA	0.5±0.8	NA	-10±60	NA	**6.9±1.8**	NA	-10±40	NA	
Zone 2	685	09-24-07	0.3±0.6	NA	2.4±1.6	NA	0.149±0.667	NA	-30±60	NA	NS	NA	50±40	NA	
		09-02-08	2±1.2	NA	**4.1±0.9**	NA	0.9±0.7	NA	40±60	NA	**7.9±1.7**	NA	0±20	NA	
Zone 1	744	09-24-07	0.7±0.7	NA	1.2±1.5	NA	-0.3±0.7	NA	-50±60	NA	NS	NA	15±38.5	NA	

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Sample identifier	Port depth	Date	Gross alpha-particle radioactivity		Gross beta-particle radioactivity		Strontium-90		Tritium (RESL)		Tritium (NWQL)		Cesium-137		Remarks
			pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	
		09-02-08	2.2±1.2	NA	2.2±0.9	NA	0.9±0.7	NA	20±60	NA	**12.4±2.2**	NA	10.4±22.3	NA	
USGS 134															
Zone 5	578	09-27-06	0±0.6	NA	3±2	NA	0.4±0.7	NA	**390±70**	NA	NS	NA	0±30	NA	
		09-27-06	NR	NA	NR	NA	NR	NA	**340±60**	NA	NR	NA	NR	NA	Rerun
		09-10-07	0.7±0.7	NA	1.1±1.5	NA	0.2±0.7	NA	-20±60	NA	NS	NA	-30±20	NA	
		09-04-08	1.6±1.1	NA	**4.5±1**	NA	-0.4±0.8	NA	10±60	NA	**17±1.9**	NA	-20±20	NA	
Zone 4	644	09-28-06	NS	NA	NS	NA	0.9±0.7	NA	**6,250±670**	NA	NS	NA	10±30	NA	
		09-28-06	NR	NA	NR	NA	NR	NA	110±60	NA	NR	NA	NR	NA	Rerun
		09-06-07	0.3±0.6	NA	1.7±1.5	NA	0.4±0.7	NA	180±70	NA	NS	NA	10±30	NA	
		09-06-07	0.3±0.6	0	3.7±1.7	0.88	0.121±0.683	0.29	**230±70**	0.51	NS	NC	30±20	0.55	QAW-7
		09-04-08	-0.2±0.9	NA	**6.7±1**	NA	-2±0.7	NA	**390±70**	NA	**261±7.3**	NA	0±20	NA	
Zone 3	706	09-27-06	0.7±0.7	NA	2±2	NA	0.2±0.7	NA	40±50	NA	NS	NA	-60±40	NA	
		09-05-07	0.3±0.6	NA	2.5±1.6	NA	0.4±0.7	NA	-110±60	NA	NS	NA	16.7±27.6	NA	
		09-03-08	1.2±1.1	NA	**3.7±0.9**	NA	-0.3±0.8	NA	40±60	NA	**9.1±1.7**	NA	-40±40	NA	
Zone 2	806	09-26-06	0.3±0.6	NA	1.62±2.13	NA	0.6±0.7	NA	30±50	NA	NS	NA	10±20	NA	
		09-05-07	0.3±0.6	NA	2.8±1.6	NA	0.9±0.7	NA	-130±60	NA	NS	NA	-10±30	NA	
		09-03-08	2±1.2	NA	**3.1±0.9**	NA	-1±0.8	NA	16.3±64	NA	3±1.8	NA	-30±40	NA	
Zone 1	856	09-25-06	0.3±0.6	NA	**7±2**	NA	0.8±0.7	NA	80±50	NA	NS	NA	-12.4±25	NA	
		09-04-07	0.7±0.7	NA	4.1±1.7	NA	1.2±0.7	NA	50±60	NA	NS	NA	14.9±46	NA	
	[1]846	09-03-08	-1.6±0.8	NA	**3.8±0.9**	NA	0.164±0.796	NA	90±70	NA	**88.7±3.2**	NA	-10±20	NA	
QAW-1	NA	08-28-06	0.3±0.6	NA	1±2	NA	-0.4±0.7	NA	50±50	NA	NS	NA	-40±40	NA	
QAW-2	NA	10-02-06	0.3±0.6	NA	5±2	NA	0.3±0.7	NA	**350±70**	NA	NS	NA	15±21.7	NA	
QAW-6	NA	09-12-07	0.3±0.6	NA	-0.7±1.3	NA	0.2±0.7	NA	0±60	NA	NS	NA	30±30	NA	
QAW-12	NA	09-08-08	1±1.1	NA	**3.4±0.9**	NA	1.5±0.7	NA	**220±70**	NA	**84.5±3.2**	NA	10±30	NA	

[1]The port at 856 feet below land surface was damaged in 2007, so samples were collected from the port at 846 feet below land surface in 2008.

Table 8. Concentrations of uranium, plutonium, and americium isotopes in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results and uncertainties in picocuries per liter (pCi/L). Analytical uncertainties are reported as 1 sample standard deviation (s). Concentrations that meet or exceed the reporting level of 3 times the 1s value are shown in **boldface** type. Z-values associated with QA replicates were calculated using equation 1. NA, not applicable. NC, not calculated. NS, not sampled. NR, not requested. LS, Sample lost. Remarks: QAW, quality assurance Westbay™ sample]

Sample identifier	Port depth	Date	Uranium-233,234 (undivided)		Uranium-235		Uranium-238		Plutonium-238		Plutonium-239,240 (undivided)		Americium-241		Remarks
			pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	
Middle 2050A															
Zone 5	515	09-19-06	NS	NA	NS	NA	NS	NA	0.003±0.005	NA	0.006±0.006	NA	0.007±0.011	NA	
		09-20-07	NS	NA	NS	NA	NS	NA	0.003±0.005	NA	0±0.004	NA	0.006±0.01	NA	
Zone 4	642	09-19-06	NS	NA	NS	NA	NS	NA	0.003±0.003	NA	0.003±0.003	NA	0.006±0.01	NA	
		09-20-07	NS	NA	NS	NA	NS	NA	-0.003±0.003	NA	0.003±0.005	NA	0±0.009	NA	
Zone 3	790	09-20-06	NS	NA	NS	NA	NS	NA	0.006±0.006	NA	0.003±0.005	NA	0.007±0.009	NA	
		09-20-06	NS	NA	NS	NA	NS	NA	0.003±0.003	0.45	0.003±0.005	0	0.006±0.009	0.11	QAW-5
		09-20-07	NS	NA	NS	NA	NS	NA	-0.003±0.003	NA	-0.003±0.003	NA	-0.006±0.007	NA	
Zone 2	998	09-18-06	NS	NA	NS	NA	NS	NA	-0.003±0.003	NA	0.006±0.006	NA	0.009±0.009	NA	
		09-19-07	NS	NA	NS	NA	NS	NA	0±0.004	NA	0.005±0.005	NA	0.006±0.009	NA	
Zone 1	1,179	09-18-06	NS	NA	NS	NA	NS	NA	0.003±0.003	NA	0.003±0.003	NA	0.007±0.009	NA	
		09-19-07	NS	NA	NS	NA	NS	NA	-0.003±0.003	NA	0.003±0.003	NA	-0.003±0.009	NA	
Middle 2051															
Zone 5	604	09-11-06	NS	NA	NS	NA	NS	NA	0.003±0.003	NA	0.003±0.006	NA	0.007±0.011	NA	
		09-12-07	NS	NA	NS	NA	NS	NA	-0.003±0.010	NA	0.003±0.007	NA	0±0.008	NA	
Zone 4	750	09-13-06	NS	NA	NS	NA	NS	NA	0.003±0.005	NA	0.003±0.005	NA	0.003±0.008	NA	
		09-13-06	NS	NA	NS	NA	NS	NA	0.007±0.007	0.46	0.003±0.006	0	0.006±0.008	0.27	QAW-4
		09-12-07	NS	NA	NS	NA	NS	NA	-0.006±0.009	NA	0.003±0.006	NA	0.003±0.008	NA	
		09-12-07	NS	NA	NS	NA	NS	NA	0.009±0.011	1.06	0±0.006	0.35	0.006±0.009	0.25	QAW-8
Zone 3	828	09-12-06	NS	NA	NS	NA	NS	NA	0.003±0.005	NA	0.003±0.003	NA	0.006±0.008	NA	
		09-12-06	NS	NA	NS	NA	NS	NA	LS	NC	LS	NC	LS	NC	QAW-3
		09-11-07	NS	NA	NS	NA	NS	NA	0.009±0.011	NA	-0.003±0.005	NA	0.003±0.010	NA	
Zone 2	1,092	09-11-06	NS	NA	NS	NA	NS	NA	0.003±0.005	NA	0.006±0.006	NA	0.006±0.010	NA	
		09-11-07	NS	NA	NS	NA	NS	NA	-0.003±0.010	NA	-0.003±0.005	NA	0.006±0.010	NA	
Zone 1	1,142	09-07-06	NS	NA	NS	NA	NS	NA	0.003±0.003	NA	0.003±0.003	NA	0.006±0.008	NA	
		09-11-07	NS	NA	NS	NA	NS	NA	0±0.010	NA	-0.006±0.004	NA	0±0.008	NA	

Table 8. Concentrations of uranium, plutonium, and americium isotopes in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results and uncertainties in picocuries per liter (pCi/L). Analytical uncertainties are reported as 1 sample standard deviation (s). Concentrations that meet or exceed the reporting level of 3 times the 1s value are shown in **boldface** type. Z-values associated with QA replicates were calculated using equation 1. NA, not applicable. NC, not calculated. NS, not sampled. NR, not requested. LS, Sample lost. Remarks: QAW, quality assurance Westbay[TM] sample]

Sample identifier	Port depth	Date	Uranium-233,234 (undivided)		Uranium-235		Uranium-238		Plutonium-238		Plutonium-239,240 (undivided)		Americium-241		Remarks
			pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	
USGS 103															
Zone 7	682	10-02-07	**0.327±0.032**	NA	0±0.006	NA	**0.157±0.021**	NA	-0.003±0.003	NA	-0.003±0.003	NA	-0.003±0.007	NA	
		08-20-08	NS	NA	NS	NA	NS	NA	-0.003±0.005	NA	0.006±0.008	NA	0.006±0.012	NA	
Zone 6	805	10-02-07	**1.52±0.084**	NA	0.016±0.012	NA	**0.594±0.046**	NA	0.006±0.006	NA	0±0.004	NA	0.006±0.010	NA	
		08-19-08	NS	NA	NS	NA	NS	NA	0.006±0.007	NA	0.003±0.007	NA	-0.006±0.011	NA	
Zone 5	914	10-01-07	**1.32±0.077**	NA	0.034±0.013	NA	**0.477±0.044**	NA	-0.006±0.009	NA	0±0.006	NA	0.006±0.009	NA	
		08-19-08	NS	NA	NS	NA	NS	NA	0.009±0.008	NA	0.003±0.007	NA	0.003±0.011	NA	
Zone 4	1,000	10-01-07	**1.18±0.062**	NA	**0.034±0.010**	NA	**0.489±0.039**	NA	-0.003±0.003	NA	0±0.004	NA	0.003±0.009	NA	
		08-18-08	NS	NA	NS	NA	NS	NA	0.003±0.007	NA	0.003±0.005	NA	0.003±0.012	NA	
Zone 3	1,095	10-01-07	**1.19±0.076**	NA	0.032±0.014	NA	**0.431±0.043**	NA	-0.003±0.003	NA	0±0.004	NA	0.003±0.009	NA	
		08-18-08	NS	NA	NS	NA	NS	NA	-0.003±0.005	NA	-0.003±0.005	NA	0.003±0.013	NA	
Zone 2	1,220	09-25-07	**1.26±0.072**	NA	**0.045±0.015**	NA	**0.554±0.043**	NA	0.003±0.006	NA	0±0.005	NA	0.003±0.009	NA	
		08-18-08	NS	NA	NS	NA	NS	NA	0.007±0.008	NA	-0.003±0.006	NA	0.006±0.012	NA	
		08-18-08	NS	NA	NS	NA	NS	NA	-0.003±0.006	1.0	0.003±0.007	0.65	0.009±0.013	0.17	QAW-10
Zone 1	1,269	09-25-07	**1.36±0.069**	NA	0.025±0.010	NA	**0.479±0.039**	NA	0±0.005	NA	0±0.005	NA	0.003±0.009	NA	
		08-19-08	NS	NA	NS	NA	NS	NA	-0.003±0.005	NA	-0.003±0.005	NA	0.003±0.012	NA	
USGS 132															
Zone 6	636	09-06-06	**1.83±0.097**	NA	**0.066±0.017**	NA	**0.797±0.058**	NA	0.003±0.003	NA	0.006±0.006	NA	0.009±0.010	NA	
		09-18-07	NS	NA	NS	NA	NS	NA	0.003±0.005	NA	0.003±0.005	NA	0.006±0.010	NA	
Zone 5	764	09-05-06	**1.40±0.078**	NA	0.008±0.008	NA	**0.577±0.048**	NA	-0.003±0.003	NA	0.003±0.005	NA	0.006±0.009	NA	
		09-18-07	NS	NA	NS	NA	NS	NA	0±0.004	NA	0.008±0.006	NA	0.003±0.009	NA	
Zone 4	826	09-05-06	**1.32±0.077**	NA	**0.042±0.012**	NA	**0.571±0.047**	NA	0.004±0.007	NA	0.004±0.004	NA	0.007±0.010	NA	
		09-18-07	NS	NA	NS	NA	NS	NA	0.008±0.011	NA	0.003±0.006	NA	0±0.008	NA	
Zone 3	917	08-31-06	**1.40±0.078**	NA	0.015±0.008	NA	**0.582±0.047**	NA	-0.003±0.003	NA	0.006±0.006	NA	0.003±0.009	NA	
		09-18-07	NS	NA	NS	NA	NS	NA	0±0.011	NA	0.003±0.007	NA	0.003±0.009	NA	
Zone 2	1,010	08-30-06	**1.33±0.053**	NA	**0.051±0.009**	NA	**0.660±0.033**	NA	0.006±0.006	NA	0.003±0.006	NA	0.010±0.010	NA	
		09-17-07	NS	NA	NS	NA	NS	NA	0.006±0.011	NA	0±0.006	NA	0.006±0.009	NA	
Zone 1	1,172	08-29-06	**1.53±0.063**	NA	**0.035±0.010**	NA	**0.772±0.041**	NA	-0.003±0.003	NA	0.006±0.006	NA	0.009±0.009	NA	
		09-17-07	NS	NA	NS	NA	NS	NA	0.006±0.011	NA	0±0.006	NA	0±0.008	NA	

Table 8. Concentrations of uranium, plutonium, and americium isotopes in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005–08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results and uncertainties in picocuries per liter (pCi/L). Analytical uncertainties are reported as 1 sample standard deviation (s). Concentrations that meet or exceed the reporting level of 3 times the 1s value are shown in **boldface** type. Z-values associated with QA replicates were calculated using equation 1. NA, not applicable. NC, not calculated. NS, not sampled. NR, not requested. LS, Sample lost. Remarks: QAW, quality assurance Westbay™ sample]

Sample identifier	Port depth	Date	Uranium-233,234 (undivided)		Uranium-235		Uranium-238		Plutonium-238		Plutonium-239,240 (undivided)		Americium-241		Remarks
			pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	pCi/L	Z-value	
USGS 133															
Zone 4	468	09-24-07	**0.836±0.054**	NA	0.02±0.01	NA	**0.394±0.034**	NA	0.003±0.005	NA	0.006±0.006	NA	0±0.008	NA	
		09-02-08	NS	NA	NS	NA	NS	NA	0.003±0.007	NA	0.003±0.007	NA	-0.009±0.01	NA	
Zone 3	568	09-24-07	**1.41±0.074**	NA	0.037±0.014	NA	**0.719±0.048**	NA	-0.003±0.003	NA	0.003±0.006	NA	0±0.01	NA	
		09-02-08	NS	NA	NS	NA	NS	NA	0.003±0.005	NA	-0.006±0.004	NA	-0.003±0.012	NA	
Zone 2	685	09-24-07	**1.52±0.08**	NA	0.013±0.01	NA	**0.657±0.047**	NA	-0.003±0.003	NA	0.003±0.005	NA	0.006±0.009	NA	
		09-02-08	NS	NA	NS	NA	NS	NA	-0.006±0.004	NA	-0.003±0.005	NA	0.006±0.013	NA	
Zone 1	744	09-24-07	**1.53±0.08**	NA	0.033±0.014	NA	**0.543±0.042**	NA	0.006±0.006	NA	0±0.004	NA	0.003±0.009	NA	
		09-02-08	NS	NA	NS	NA	NS	NA	-0.006±0.006	NA	0.003±0.007	NA	-0.003±0.012	NA	
USGS 134															
Zone 5	578	09-27-06	**0.450±0.043**	NA	0±0.009	NA	**0.145±0.023**	NA	0.003±0.003	NA	0.007±0.007	NA	0.003±0.008	NA	
		09-10-07	NS	NA	NS	NA	NS	NA	-0.006±0.009	NA	0.003±0.007	NA	0.003±0.009	NA	
Zone 4	644	09-28-06	NS	NA	NS	NA	NS	NA	NS	NA	NS	NA	NS	NA	
		09-06-07	**0.320±0.031**	NA	0.006±0.006	NA	**0.151±0.022**	NA	0.003±0.005	NA	0.006±0.006	NA	-0.003±0.007	NA	
		09-06-07	NS	NA	NS	NA	NS	NA	-0.003±0.003	1.03	0.003±0.005	0.38	-0.003±0.008	0	QAW-7
Zone 3	706	09-27-06	**0.872±0.064**	NA	0.024±0.010	NA	**0.242±0.033**	NA	0.003±0.005	NA	0.003±0.005	NA	0.006±0.010	NA	
		09-05-07	NS	NA	NS	NA	NS	NA	-0.003±0.003	NA	0.003±0.005	NA	0.003±0.008	NA	
Zone 2	806	09-26-06	**0.225±0.028**	NA	0.004±0.004	NA	**0.070±0.015**	NA	-0.003±0.003	NA	-0.003±0.003	NA	0.006±0.009	NA	
		09-05-07	NS	NA	NS	NA	NS	NA	0.003±0.005	NA	0.003±0.005	NA	0.003±0.009	NA	
Zone 1	856	09-25-06	**0.043±0.018**	NA	0±0.008	NA	0.021±0.011	NA	0.003±0.005	NA	0.003±0.005	NA	0.009±0.010	NA	
		09-04-07	NS	NA	NS	NA	NS	NA	-0.003±0.003	NA	-0.003±0.003	NA	0.006±0.009	NA	
QAW-1	NA	08-28-06	0.017±0.008	NA	0.004±0.006	NA	0.016±0.006	NA	-0.003±0.003	NA	0.003±0.005	NA	0.009±0.009	NA	
QAW-2	NA	10-02-06	**0.150±0.079**	NA	**0.048±0.014**	NA	**0.766±0.053**	NA	-0.003±0.003	NA	0.003±0.006	NA	0.009±0.010	NA	
QAW-6	NA	09-12-07	NS	NA	NS	NA	NS	NA	0.020±0.030	NA	0.010±0.018	NA	0.003±0.010	NA	
QAW-12	NA	09-08-08	NS	NA	NS	NA	NS	NA	-0.006±0.004	NA	0.003±0.005	NA	-0.009±0.011	NA	

Table 9. Concentrations of isotopes of oxygen, hydrogen, and carbon in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005-08.

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in per mil (parts per thousand relative to a standard). Uncertainty of delta ^{2}H and delta ^{18}O is ±1.5 per mil. Uncertainty of delta ^{13}C is ±0.3 per mil. NS, not sampled. Z-values associated with QA replicates were calculated using equation 1. NA, not applicable. NC, not calculated. Remarks: QAW, quality assurance Westbay™ sample]

Sample identifier	Port depth	Date	Delta ^{2}H		Delta ^{18}O		Delta ^{13}C		Remarks
			per mil	Z-value	per mil	Z-value	per mil	Z-value	
Middle 2050A									
Zone 5	515	09-19-06	-132.5	NA	-17.4	NA	-10.3	NA	
		09-20-07	-135.2	NA	-17.8	NA	NS	NA	
		08-27-08	-134.3	NA	-17.7	NA	NS	NA	
		08-27-08	-136.0	0.80	-17.7	0	NS	NC	QAW-11
Zone 4	642	09-19-06	-136.3	NA	-18.0	NA	-11.0	NA	
		09-20-07	-137.0	NA	-17.9	NA	NS	NA	
		08-26-08	-137.9	NA	-18.0	NA	NS	NA	
Zone 3	790	09-20-06	-136.0	NA	-18.0	NA	-8.80	NA	
		09-20-06	-136.5	0.24	-18.0	0	-8.46	0.80	QAW-5
		09-20-07	-136.3	NA	-18.0	NA	NS	NA	
		08-26-08	-135.0	NA	-18.0	NA	NS	NA	
Zone 2	998	09-18-06	-136.6	NA	-18.1	NA	-8.13	NA	
		09-19-07	-136.9	NA	-18.0	NA	NS	NA	
		08-26-08	-135.7	NA	-18.1	NA	NS	NA	
Zone 1	1,179	09-18-06	-135.7	NA	-17.8	NA	-13.2	NA	
		09-19-07	-135.9	NA	-17.8	NA	NS	NA	
		08-26-08	-134.7	NA	-17.8	NA	NS	NA	
Middle 2051									
Zone 5	604	09-11-06	-133.2	NA	-17.3	NA	-10.7	NA	
		09-12-07	-133.6	NA	-17.3	NA	NS	NA	
		08-25-08	-134.1	NA	-17.3	NA	NS	NA	
Zone 4	750	09-13-06	-136.5	NA	-17.9	NA	-7.45	NA	
		09-13-06	-136.3	0.09	-17.9	0	-8.60	2.7	QAW-4
		09-12-07	-136.9	NA	-18.0	NA	NS	NA	
		09-12-07	-136.8	0.05	-18.0	0	NS	NC	QAW-8
		08-25-08	-135.9	NA	-17.9	NA	NS	NA	
Zone 3	828	09-12-06	-136.5	NA	-18.0	NA	-8.13	NA	
		09-12-06	-135.4	0.52	-18.0	0	-8.43	0.71	QAW-3
		09-11-07	-137.1	NA	-18.0	NA	NS	NA	
		08-21-08	-136.0	NA	-18.0	NA	NS	NA	
Zone 2	1,092	09-11-06	-137.3	NA	-18.0	NA	-8.26	NA	
		09-11-07	-137.3	NA	-18.1	NA	NS	NA	
		08-21-08	-137.0	NA	-18.0	NA	NS	NA	
Zone 1	1,142	09-07-06	-136.8	NA	-18.0	NA	-7.76	NA	
		09-11-07	-136.8	NA	-18.1	NA	NS	NA	
		08-21-08	-135.7	NA	-18.0	NA	NS	NA	

Table 9. Concentrations of isotopes of oxygen, hydrogen, and carbon in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005-08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in per mil (parts per thousand relative to a standard). Uncertainty of delta ^{2}H and delta ^{18}O is ±1.5 per mil. Uncertainty of delta ^{13}C is ±0.3 per mil. NS, not sampled. Z-values associated with QA replicates were calculated using equation 1. NA, not applicable. NC, not calculated. Remarks: QAW, quality assurance Westbay™ sample]

Sample identifier	Port depth	Date	Delta ^{2}H		Delta ^{18}O		Delta ^{13}C		Remarks
			per mil	Z-value	per mil	Z-value	per mil	Z-value	
USGS 103									
Zone 7	682	10-02-07	-135.6	NA	-17.7	NA	-8.79	NA	
		08-20-08	-135.1	NA	-17.7	NA	NS	NA	
Zone 6	805	10-02-07	-136.5	NA	-17.8	NA	-9.06	NA	
		08-19-08	-136.2	NA	-17.8	NA	NS	NA	
Zone 5	914	10-01-07	-137.7	NA	-18.0	NA	-9.25	NA	
		08-19-08	-137.7	NA	-18.0	NA	NS	NA	
Zone 4	1,000	10-01-07	-136.7	NA	-18.0	NA	-8.90	NA	
		08-18-08	-137.8	NA	-18.0	NA	NS	NA	
Zone 3	1,095	10-01-07	-136.7	NA	-18.0	NA	-8.92	NA	
		08-18-08	-138.1	NA	-18.0	NA	NS	NA	
Zone 2	1,220	09-25-07	-136.7	NA	-17.9	NA	-8.86	NA	
		08-18-08	-139.2	NA	-17.9	NA	NS	NA	
		08-18-08	-137.2	0.94	-17.9	0	NS	NC	QAW-10
Zone 1	1,269	09-25-07	-137.0	NA	-18.0	NA	-8.93	NA	
		08-19-08	-135.0	NA	-18.0	NA	NS	NA	
USGS 132									
Zone 6	636	09-06-06	-135.2	NA	-17.6	NA	-9.81	NA	
		09-18-07	-134.6	NA	-17.7	NA	NS	NA	
		08-14-08	-137.5	NA	-17.7	NA	NS	NA	
		08-14-08	-136.0	0.71	-17.7	0	NS	NC	QAW-9
Zone 5	764	09-05-06	-135.8	NA	-17.9	NA	-8.73	NA	
		09-18-07	-136.2	NA	-17.8	NA	NS	NA	
		08-13-08	-134.4	NA	-17.9	NA	NS	NA	
Zone 4	826	09-05-06	-135.4	NA	-17.8	NA	-9.20	NA	
		09-18-07	-135.8	NA	-17.9	NA	NS	NA	
		08-13-08	-135.7	NA	-17.8	NA	NS	NA	
Zone 3	917	08-31-06	-135.0	NA	-17.8	NA	-9.14	NA	
		09-18-07	-136.1	NA	-17.9	NA	NS	NA	
		08-13-08	-136.1	NA	-17.8	NA	NS	NA	
Zone 2	1,010	08-30-06	-135.7	NA	-17.8	NA	-9.17	NA	
		09-17-07	-136.4	NA	-17.9	NA	NS	NA	
		08-12-08	-137.0	NA	-17.9	NA	NS	NA	
Zone 1	1,172	08-29-06	-133.5	NA	-17.7	NA	-9.53	NA	
		09-17-07	-135.4	NA	-17.8	NA	NS	NA	
		08-12-08	-135.9	NA	-17.8	NA	NS	NA	

Table 9. Concentrations of isotopes of oxygen, hydrogen, and carbon in water from multiple zones in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2005-08.—Continued

[Well locations are shown in figure 2. Port depth in feet below land surface. Analytical results in per mil (parts per thousand relative to a standard). Uncertainty of delta ^2H and delta ^{18}O is ±1.5 per mil. Uncertainty of delta ^{13}C is ±0.3 per mil. NS, not sampled. Z-values associated with QA replicates were calculated using equation 1. NA, not applicable. NC, not calculated. Remarks: QAW, quality assurance Westbay™ sample]

Sample identifier	Port depth	Date	Delta ^2H		Delta ^{18}O		Delta ^{13}C		Remarks
			per mil	Z-value	per mil	Z-value	per mil	Z-value	
USGS 133									
Zone 4	468	09-24-07	-137.6	NA	-18.1	NA	-8.58	NA	
		09-02-08	-139.1	NA	-18.1	NA	NS	NA	
Zone 3	568	09-24-07	-137.3	NA	-18.1	NA	-8.95	NA	
		09-02-08	-136.5	NA	-18.1	NA	NS	NA	
Zone 2	685	09-24-07	-137.9	NA	-18.1	NA	-8.83	NA	
		09-02-08	-137.8	NA	-18.2	NA	NS	NA	
Zone 1	744	09-24-07	-136.7	NA	-18.0	NA	-8.87	NA	
		09-02-08	-135.8	NA	-18.0	NA	NS	NA	
USGS 134									
Zone 5	578	09-27-06	-137.3	NA	-18.1	NA	-8.48	NA	
		09-10-07	-137.8	NA	-18.2	NA	NS	NA	
		09-04-08	-137.0	NA	-18.1	NA	NS	NA	
Zone 4	644	09-28-06	-137.1	NA	-18.0	NA	-8.58	NA	
		09-06-07	-138.0	NA	-18.1	NA	NS	NA	
		09-06-07	-137.3	0.33	-18.0	0.047	NS	NC	QAW-7
		09-04-08	-137.8	NA	-18.1	NA	NS	NA	
Zone 3	706	09-27-06	-137.9	NA	-18.1	NA	-8.03	NA	
		09-05-07	-138.6	NA	-18.1	NA	NS	NA	
		09-03-08	-136.6	NA	-18.2	NA	NS	NA	
Zone 2	806	09-26-06	-138.1	NA	-18.1	NA	-7.15	NA	
		09-05-07	-137.6	NA	-18.1	NA	NS	NA	
		09-03-08	-136.7	NA	-18.1	NA	NS	NA	
Zone 1	856	09-25-06	-137.5	NA	-18.2	NA	-8.52	NA	
		09-04-07	-138.0	NA	-18.1	NA	NS	NA	
	[1]846	09-03-08	-136.2	NA	-18.2	NA	NS	NA	
QAW-1	NA	08-28-06	-124.2	NA	-16.3	NA	-16.7	NA	
QAW-2	NA	10-02-06	-133.0	NA	-17.0	NA	-12.7	NA	
QAW-6	NA	09-12-07	-124.1	NA	-16.3	NA	NS	NA	
QAW-12	NA	09-08-08	-135.2	NA	-17.9	NA	NS	NA	

[1]The port at 856 feet below land surface was damaged in 2007, so samples were collected from the port at 846 feet below land surface in 2008.

Table 10. Chemical concentrations of selected source water that provide recharge to the Snake River Plain aquifer, Idaho National Laboratory, Idaho.

[Concentrations are in milligrams per liter (mg/L). Date sampled: month-day -year. Ca, calcium; Mg, magnesium; K, potassium; Na, sodium; SiO_2, silica; HCO_3, bicarbonate; Cl, chloride; F, fluoride; SO_4, sulfate; NO_3, nitrate; ^2H, delta hydrogen-2; ^{18}O, delta oxygen-18. Big Lost River below INEL diverson data are from National Water Information System. Wells TRA-1 and TRA-2 called MTR 1 and MTR 2 in Olmstead (1962). NC, not collected]

Water source	Date sampled	Ca	Mg	K	Na	SiO_2	HCO_3	Cl	F	SO_4	NO_3	Tritium	^2H	^{18}O
Snowpack near USGS 22[1]	02-02-78	0.8	0.1	0.8	0.1	1.1	2	0.3	0.1	2.3	NC	NC	NC	NC
Snowpack near USGS 83[1]	02-02-78	0.1	0.2	2.2	0.2	1.5	5	0.8	0.1	3.1	NC	NC	NC	NC
Snowpack near Site 9[1]	02-02-78	1.7	0.5	0.4	9.1	0.3	29	0.7	0.1	2.8	NC	NC	NC	NC
Big Lost River at Mackay Dam[2]	06-28-95	26	6.3	1.3	3.8	8.7	108	2.3	0.19	13.1	NC	NC	-134.4	-17.57
Big Lost River near Mackay[3]	03-28-89	44	11	1.4	6.1	11	165	4.3	0.2	21	NC	NC	NC	NC
Big Lost River near Mackay[2]	06-17-95	26	6.3	1.4	3.8	9.1	105	2.3	0.18	13	0.4	NC	-134.9	-17.6
Big Lost River near Moore[4]	08-27-63	48	11	1.4	6.9	12	192	3.5	1.9	18	0.5	NC	NC	NC
Big Lost River near Butte City[1]	12-07-77	61	18	1.7	11	15	260	8.2	0.3	23	NC	NC	NC	NC
Big Lost River below Arco[3]	03-28-89	67	15	1.5	12	14	266	7.6	0.3	25	NC	NC	-132.2	-17.17
Big Lost River nr Arco[5]	06-05-81	48	12	1.6	7.1	13	200	4.8	0.2	27	NC	NC	-135.0	-17.4
Big Lost River below INEL div	06-02-95	35	8	1.4	5.4	12	132	3	0.2	18	<0.05	52±3.2	NC	NC
Big Lost River below INEL div	07-05-95	33	7.1	1.6	4.1	11	133	2.4	0.3	15	0.12	47±3.2	NC	NC
Big Lost River near NRF[2]	06-19-95	31	7.4	1.7	4.8	11	123	3.1	0.21	18	0.8	NC	NC	NC
ANP-8[6]	12-13-89	45	14	3.2	8.8	27	155	10	0.2	30	0.86	38±13	NC	NC
BFW[2]	07-16-96	38	14	2.3	9.7	24	162	17	0.22	21	0.68	7.10±0.40	-139.2	-17.9
CFA-1[7]	06-19-91	66	21	4.3	30	26	152	100	0.2	33	4.3	19,500±160	-137.0	-17.55
CFA-1[2]	07-16-96	62	19	3.2	14	21	160	74	0.25	28	3.5	18,800±600	-137.4	-17.71
CFA-2[2]	07-16-96	72	26	4.3	21	24	149	115	0.39	45	3.8	14,100±700	-136.6	-17.23
CPP-1[7]	06-06-91	54	14	2.5	7.9	23	194	18	0.1	22	1	355±16	-137.0	-17.85
EBR-1[7]	06-19-91	24	16	3.4	9.0	34	141	7.4	0.2	13	0.39	-3.2±13	-139.0	-18.35
EBR-1[2]	10-16-96	23	15	3.1	8.0	34	144	7	0.19	16	0.36	-300±200	-139.4	-18.13
EBR-II[8]	10-03-58	32	9.7	3.0	14	33	149	12	0.7	13	3	NC	NC	NC
Fire Station 2[7]	06-19-91	53	17	2.4	8.7	24	207	15	0.2	21	1.1	32±13	-139.0	-18.15
Fire Station 2[2]	10-16-96	55	18	2.4	8.1	23	204	18	0.19	24	1.2	11.4±0.5	-138.7	-17.94
NRF-2[6]	05-23-89	70	22	1.8	18	22	260	46	0.3	39	1.7	-40±160	NC	NC
RWMC Production[6]	03-23-89	45	15	2.8	9.0	28	180	13	0.2	27	0.67	1,700±200	NC	NC
Site 4[2]	10-16-96	45	14	1.8	7.8	22	192	10	0.2	19	0.57	16.1±0.6	-137.9	-17.74
SPERT 1[8]	02-27-56	39	14	2.7	8.8	26	158	16	0.1	19	1.2	NC	NC	NC
SPERT IV[8]	04-14-60	35	13	2.6	13	29	160	10	0.4	23	2	NC	NC	NC
TRA-1[8]	07-24-57	55	16	1.4	8.3	18	211	12	0.1	23	4.3	NC	NC	NC
TRA-2[8]	09-14-55	40	17	2.3	8.6	25	183	10	0.1	22	2.3	NC	NC	NC
Big Lost River deep underflow-Arco City[9]	02-17-99	54	15	1.1	5.7	15	222	6.4	0.16	20	0.71	35.2±25.6	-135.0	-17.73
Big Lost River shallow underflow-Owen[9]	06-23-99	68	14	1.2	7.4	16	243	6.3	0.19	23	2.1	0±25.6	-132.0	-17.32
Little Lost River underflow-Harrell[10]	07-31-00	62	22	1.4	17	18	259	22	0.16	34	1.9	35.2±25.6	-135.2	-17.93
Birch Creek underflow-USGS 126B[11]	11-08-00	38	15	2.5	9.0	19	162	8.2	0.23	29	0.53	6.4±19.2	-140.9	-18.44
USGS 101[2]	04-21-95	28	9.1	2.7	14	29	145	8.5	0.77	8.8	0.86	4.16±0.064	-135	-17.89
USGS 101[2]	10-10-96	29	9.2	2.8	13	34	148	8.5	0.78	9	0.86	2.88±0.96	-135.3	-17.84

Table 10. Chemical concentrations of selected source water that provide recharge to the Snake River Plain aquifer, Idaho National Laboratory, Idaho.—Continued

[Concentrations are in milligrams per liter (mg/L). Date sampled: month-day -year. Ca, calcium; Mg, magnesium; K, potassium; Na, sodium; SiO_2, silica; HCO_3, bicarbonate; Cl, chloride; F, fluoride; SO_4, sulfate; NO_3, nitrate; ^2H, delta hydrogen-2; ^{18}O, delta oxygen-18. Big Lost River below INEL diverson data are from National Water Information System. Wells TRA-1 and TRA-2 called MTR 1 and MTR 2 in Olmstead (1962). NC, not collected]

Water source	Date sampled	Ca	Mg	K	Na	SiO_2	HCO_3	Cl	F	SO_4	NO_3	Tritium	^2H	^{18}O
Groundwater upwelling-INEL-1[12]	07-19-79	10	2	10	92	60	220	17	1.1	32	NC	NC	NC	NC
Geothermal-Lidy Hot Springs[7]	11-05-90	88	16	15	27	33	193	6.7	4.8	200	<0.10	0.42±0.29	-135.0	-18.1
Geothermal-Lidy Hot Springs-resample[7]	08-20-92	88	15	15	26	31	172	8.4	4.2	190	NC	NC	NC	NC
Geothermal-Lidy Hot Springs[2]	07-20-96	59	15	12	21	35	179	7.2	4.2	94	0.05	NC	NC	NC
Geothermal-Lidy Hot Springs[2]	05-14-97	89	17	14	24	34	168	7.6	4.1	196	0.14	NC	NC	NC
Geothermal-Lidy Hot Springs[2]	07-20-97	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.5±0.30	-134.2	-17.91
Geothermal-Condie Hot Springs[2]	06-21-95	61	12	18	58	25	361	14	1.2	27	NC	NC	-144.4	-18.81
Geothermal-Condie Hot Springs[2]	05-22-97	58	12	19	52	29	342	13	1.3	24	<0.05	NC	-146.1	-18.74

[1]From Rightmire and Lewis (1987).

[2]From Busenberg and others (2000).

[3]From Bartholomay (1990).

[4]From Robertson and others (1974).

[5]From Wood and Low (1988).

[6]From Knobel and others (1992).

[7]From Knobel and others (1999).

[8]From Olmstead (1962).

[9]From Carkeet and others (2001).

[10]From Swanson and others (2002).

[11]From Swanson and others (2003).

[12]From Mann (1986); interval sampled was from 1,511 to 2,206 below land surface.

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