CHEMICAL AND ISOTOPIC COMPOSITION AND GAS CONCENTRATIONS OF GROUND WATER AND SURFACE WATER FROM SELECTED SITES AT AND NEAR THE IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY, IDAHO, 1994-97

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CONVERSION FACTORS AND ABREVIATED UNITS

Multiply	By	To obtain
Becquerel per liter (Bq/L)	0.027	Picocurie per liter
Tera becquerel (TBq)	27	Curie
Cubic centimeters (cm^3)	0.06102	Cubic inch
Gram (g)	0.03527	Ounce
Kilogram (kg)	2.205	Pound
Kilometer (km)	0.6214	Mile
Square kilometer (km^2)	0.3861	Square mile
Meter (m)	3.281	Foot
Centimeter (cm)	0.3937	Inch
Millimeter (mm)	0.03937	Inch
Meter per kilometer (m/km)	5.28	Foot per mile
Kilopascal (kPa)	0.009869	Atmosphere, standard
Tritium unit (TU)	3.2	Picocurie

For temperature, degrees Celsius (^oC) can be converted to degrees Fahrenheit (^oF) by using the formula $^oF = (1.8)(^oC) + 32$.

Isotopic enrichment or impoverishment factors are reported as $\pm\delta$ values computed from the formula

$$\delta_x = \frac{R_x - R_{STD}}{R_{STD}} \times 1,000$$

where R_x is the ratio of isotopes measured in the sample and R_{STD} is the same isotopes in the reference standard. The δ_x value is in parts per thousand (per mil).

Other abbreviated units used in report: L (liter), mL (milliliter), pg/kg (picogram per kilogram), ppt (parts per trillion), mol (mole), mmol/L (millimole per liter), ppm (parts per million), ppb (parts per billion), m^2/d (meter squared per day), mg/L (milligram per liter), µg/L (microgram per liter), STP (standard temperature and pressure, 0 degrees Celsius and 1 atmosphere pressure).

Chemical and Isotopic Composition and Gas Concentrations of Ground Water and Surface Water From Selected Sites at and Near the Idaho National Engineering and Environmental Laboratory, Idaho, 1994–97

By **Eurybiades Busenberg, L. Niel Plummer, Michael W. Doughten, Peggy K. Widman, and Roy C. Bartholomay**

Abstract

From May 1994 through May 1997, the U.S. Geological Survey, in cooperation with the U.S. Department of Energy, collected water samples from 86 wells completed in the Snake River Plain aquifer at and near the Idaho National Engineering and Environmental Laboratory. The samples were analyzed for a variety of chemical constituents including all major elements and 22 trace elements. Concentrations of scandium, yttrium, and the lanthanide series were measured in samples from 11 wells and 1 hot spring. The data will be used to determine the fraction of young water in the ground water. The fraction of young water must be known to calculate the ages of the ground water using chlorofluorocarbons. The concentrations of the isotopes deuterium, oxygen-18, carbon-13, carbon-14, and tritium were measured in many ground water, surface-water and spring samples. The isotopic composition will provide clues to the origin and sources of water in the Snake River Plain aquifer. Concentrations of helium-3, helium-4, total helium, and neon were measured in most ground-water samples, and the results will be used to determine the recharge temperature, and to date the ground waters.

INTRODUCTION

The Idaho National Engineering and Environmental Laboratory (INEEL), which encompasses about 2,300 km^2 of the eastern Snake River Plain in southeastern Idaho (fig. 1), was established in 1949 and is operated by the U.S. Department of Energy (DOE). INEEL facilities are used for the development of peacetime atomic-energy applications such as nuclear safety research, defense programs, advanced energy programs, and advanced energy concepts. In the past, liquid radiochemical and chemical wastes generated at these facilities have been discharged to onsite infiltration ponds and disposal wells. Liquid-waste disposal has resulted in detectable concentrations of several waste constituents in the Snake River Plain aquifer underlying the INEEL (Mann and Cecil, 1990; Busenberg and others, 1993; Bartholomay and others, 1997).

The DOE requires information about the mobility of dilute radiochemical- and chemical-waste constituents in the Snake River Plain aquifer. Waste-constituent mobility is, in part, determined by (1) the rate and direction of ground-water flow; (2) the locations, qualities, and methods of waste disposal; (3) waste-constituent chemistry, and (4) the geochemical processes taking place in the aquifer (Orr and Cecil, 1991, p. 2). The U.S. Geological Survey (USGS) in cooperation with the DOE's Idaho Operations Office, conducted a study to obtain the information needed to determine the mobility of waste constituents at INEEL.

This report presents analytical results for 34 chemical constituents present in 103 ground-water samples, 10 surface-water samples, and 3 springs at the INEEL and vicinity. The concentrations of scandium, yttrium, and 14 rare-earth elements were measured in 11 ground-water samples and 1 hot spring. The oxygen-18/oxygen-16, deuterium/hydrogen, helium-3/helium-4, and carbon-13/carbon-12 isotopic ratios were determined in 141, 141, 52 and 83 samples, respectively. Concentrations of total helium, neon, tritium, and carbon-14 were measured in

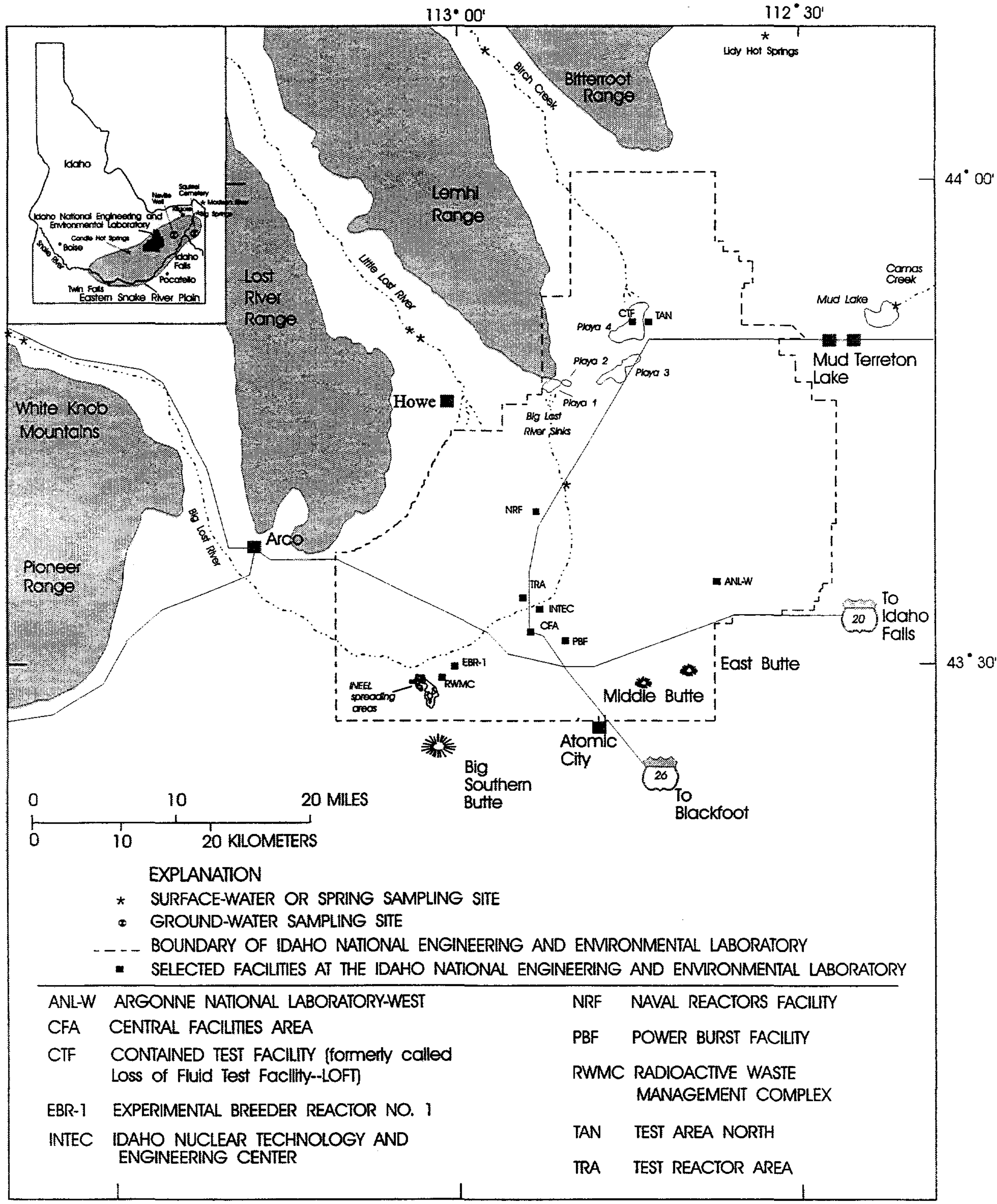

Figure 1. Location of the Idaho National Engineering and Environmental Laboratory, selected sampling sites, and selected facilities.

122, 122, 91, and 18 samples, respectively. A brief summary of the field and laboratory procedures used for collection and analysis of the samples is presented.

The data presented in this report will be used to determine the fraction of young water in the ground water. The fraction of young water must be known to calculate the date of recharge of the ground water using chlorofluorocarbons (CFCs). The dissolved gas and selected isotope data are needed to calculate the recharge temperature and date of recharge of the ground water using the tritium/helium-3 method.

Geohydrologic Setting

The eastern Snake River Plain is a northeast-trending structural basin about 320 km long and 80 to 110 km wide. (See small insert map on Figure 1.) The plain is underlain by a layered sequence of basaltic lava flows and cinder beds interbedded with eolian, fluvial, and lucustrine sedimentary deposits. The thickness of individual flows generally ranges from 3 to 15 m, and the mean thickness may be from 6 to 7.5 m (Mundorff and others, 1964, p. 143). The sedimentary deposits consist mainly of beds of sand, silt, clay, and lesser amounts of gravel. Locally, rhyolitic lava flows and tuffs are exposed at land surface or are present at depth. The basaltic lava flows and interbedded sedimentary deposits combine to form the framework for the eastern Snake River Plain aquifer, which is the main source of water on the plain.

Ground-water movement in the eastern Snake River Plain aquifer is from the northeast to the southwest. Recharge to the Snake River Plain aquifer is principally from inflow of water from the alluvium of adjoining mountain drainage basins, infiltration of applied irrigation water, and infiltration of streamflow (Goodell, 1988; Garabedian, 1992; Lindholm, 1996). Some recharge may be from direct precipitation, although the small annual precipitation on the plain (20 cm at INEEL), high evapotranspiration, and the great depth to water (in places, exceeding 275 m) probably minimize this source of recharge (Rightmire and Lewis, 1987; Bartholomay and others, 1997, p. 18).

The Big Lost River drains more than 3,600 km^2 of mountainous area that include parts of the Lost River Range and the Pioneer Range west of INEEL (fig. 1). Flow in the Big Lost River infiltrates to the Snake River Plain aquifer along its channel and at terminal sinks and playas. Since 1958, excess runoff has been diverted to spreading areas in the southwestern part of the INEEL, where most of the water rapidly infiltrates to the aquifer. Other surface drainages that provide recharge to the Snake River Plain aquifer at INEEL include Birch Creek, the Little Lost River, and Camas Creek (fig.1) (Harenberg and others, 1993; Brennan and others, 1996).

Water in the Snake River Plain aquifer moves principally through fractures and interflow zones in the basalt. A significant proportion of the ground water moves through the upper 60 to 245 m of basaltic rocks (Mann, 1986, p. 21). Ackerman (1991, p. 30) and Anderson and others (1999) reported a range of hydraulic conductivities from about 3.0×10^{-3} to 9.8×10^{3} m per day from single-well aquifer tests in 114 wells. The hydraulic conductivity of underlying rocks is smaller (Mann, 1986, p. 21) and the effective base of the Snake River Plain aquifer at the INEEL probably ranges from about 250 to 535 m below land surface (Anderson and others, 1986, p. 23).

At the INEEL, depth to water in wells completed in the Snake River Plain aquifer ranges from 60 m at the northern part to more than 275 m in the southeastern part. The direction of ground-water flow within the aquifer is mainly southward and southwestward at an average hydraulic gradient of about 0.7 m/km. Ground water moves southwestward from INEEL and eventually discharges to springs along the Snake River downstream from Twin Falls, about 160 km southwest of the INEEL (Robertson and others, 1974).

Sampling Locations and Sample Collection

Ground-water samples were collected from 86 locations—71 ground-water monitoring wells; 4 domestic or stock wells; 6 production wells; 3 public supply wells; and 2 irrigation wells. The wells sampled in this study and related studies are shown in figures 1–3 (Busenberg and others, 1993; 1998). The production wells, irrigation wells, and the Arco City well are equipped with turbine pumps. The ground-water monitoring wells, domestic wells, stock wells, and the Atomic City well are equipped with dedicated submersible pumps. Data on the pumping rate, hole diameter, well depth, depth of intake, intake diameter, material of intake, perforation or open-hole intervals, and the water level at the date of sampling, were reported by Busenberg and others (1998). Samples also were collected from three springs and from five streams (fig. 1).

Samples were collected from a portable sampling apparatus from the monitoring wells and from sampling ports or spigots on other wells. All portable equipment was decontaminated after each sample was collected. Samples were collected at each site after three well-bore volumes of water were purged and measurements of pH, specific conductance, and water temperature were stable. Conditions at the sampling site during sample collection were recorded in a field logbook.

Acknowledgments

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COLLECTION AND ANALYSIS OF SAMPLES FOR CONCENTRATIONS OF MAJOR AND TRACE ELEMENTS

The procedures and guidelines established by the USGS were followed in the collection and preservation of the water samples (Wood, 1981; Claassen, 1982; Fishman and Friedman, 1989; Hardy and others, 1989; Faires, 1992; Fishman, 1993). Samples were collected in containers and preserved in accordance with the procedures specified by Pritt (1989). Samples for cations were filtered and collected in acid-rinsed 250-mL polyethylene bottles. The samples were acidified with 1 mL of Ultrex nitric acid. The samples for anions were filtered and collected in 500-mL polyethylene containers. The containers, filters, and acid were obtained from U.S. Geological Survey National Water Quality Laboratory.

Analytical Procedure for Major Cations

Major cations and silica were analyzed at the U.S. Geological Survey's Common-Use Laboratory in Reston, Virginia using the ARL SpectraSpan V, a multielement direct-current plasma spectrometer (DCP). The instrument is equipped with the Adam analytical manager and background corrector. Table 1 shows the recommended concentrations of five major and four trace elements on three standard reference water samples that were analyzed with the water samples from INEEL. Table 2 shows the recommended and measured concentrations and the standard deviations of the reference materials analyzed by the DCP. The detection limits for Ca, Mg, Sr, SiO_2, Na, K, Fe, Mn, and Al by DCP are less than 0.1, 0.01, 0.005, 0.1, 0.05, 0.1, 0.01, 0.005, and 0.005 ppm, respectively. Accuracies for measurement of Ca, Mg, Sr, SiO_2, Na, K, Fe, Mn, and Al by DCP are 3 to 5, 3 to 5, 3 to 5, 5, 3 to 5, 5 to 10, 5 to 10, 5, and 10 to 15 percent, respectively.

Analytical Procedure for Major Anions

A Dionex series 4000i ion chromatograph equipped with a Dionex AS14 column was used for the analysis of fluoride, chloride, nitrate, and sulfate. Bromide was measured with a Dionex DX-120 ion chromatograph. The eluent solution concentration was 3.5 mmol/L sodium carbonate with 1 mmol/L sodium bicarbonate. Standards were prepared using VHG Laboratory multi-ion standard solution #1 (ICM1-100) and solution #4 (ICM4-100), and Dionex standard multielement solutions. The accuracy of the system was checked with Simulated Rainwater 2 (table 3, High Purity Standards) and two standards

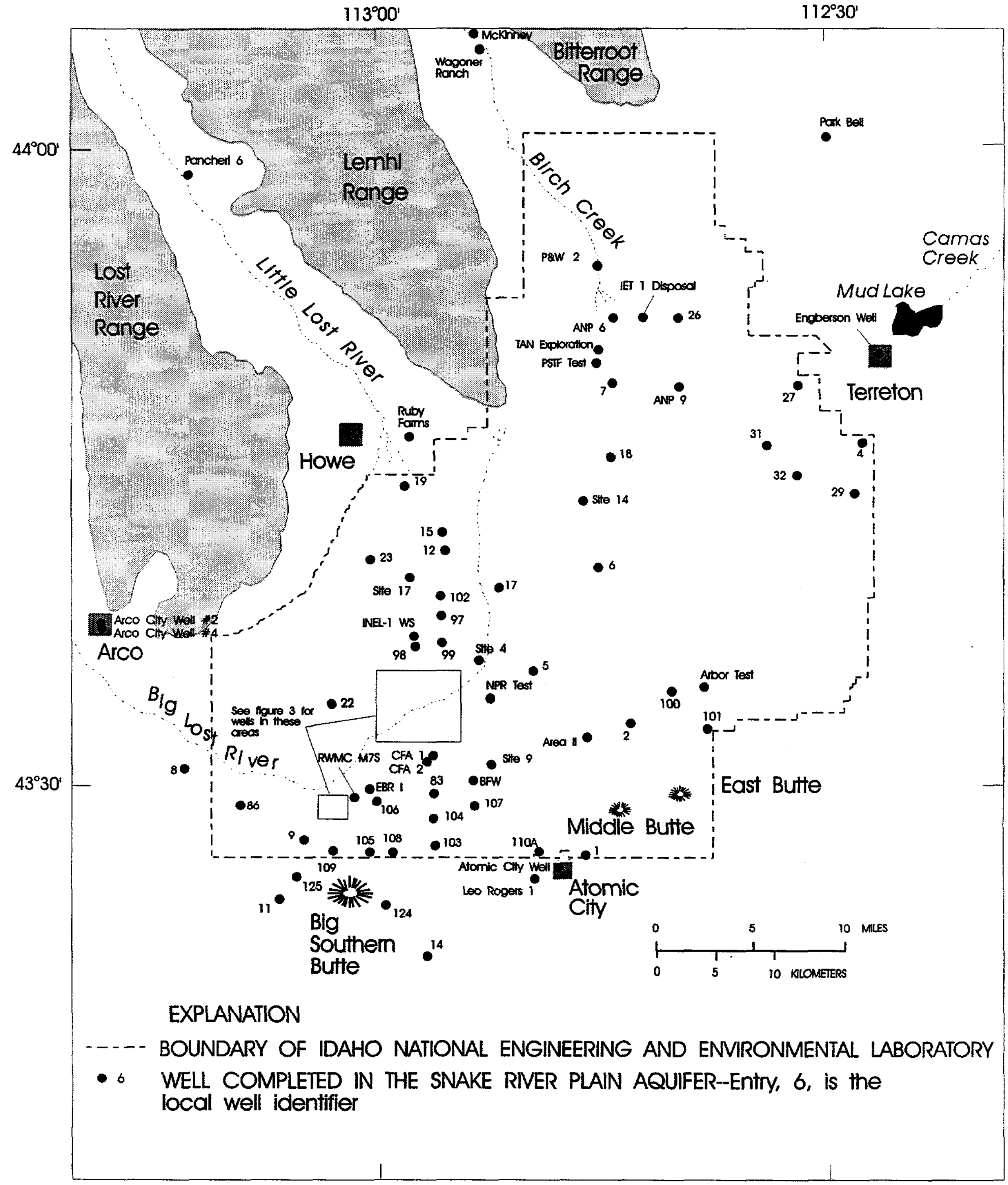

Figure 2. Location of wells sampled for chlorofluorocarbons and other selected constituents, Idaho National Engineering and Environmental Laboratory and vicinity.

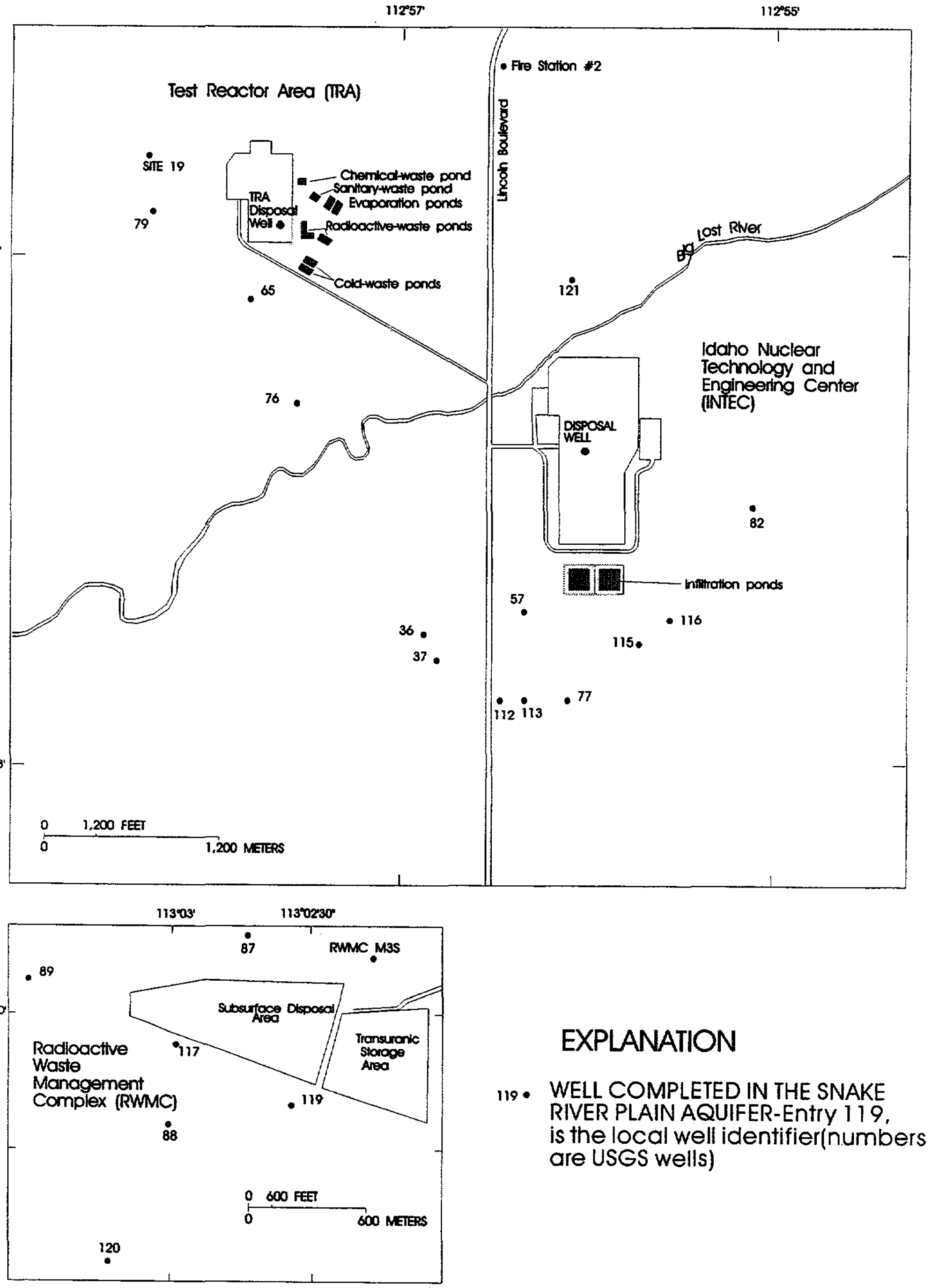

Figure 3. Location of wells sampled for chlorofluorocarbons and other selected constituents, Test Reactor Area, Idaho Nuclear Technology and Engineering Center, and Radioactive Waste Management Complex.

obtained from Environmental Resources Associates. Bromide standard solutions were prepared from Dionex standard solutions and measured separately. Detection limits for chloride, sulfate, nitrate, and fluoride are less than 1, 2, 0.1, and 0.05 ppm, respectively. The bromide detection limit was determined by the volume of the sampling loop injected into the ion chromatograph and ranged from less than 0.005 to less than 0.02 ppm. The precisions for measurement of chloride, sulfate, nitrate, fluoride, and bromide are 3, 3 to 5, 3 to 5, 3, and 10 percent, respectively.

Analytical Procedure for Trace Elements

Trace elements were measured with a Perkin Elmer Elan 6000 inductively coupled plasma instrument with a mass spectrometer detector (ICP-MS). The detector has a high degree of specificity, there are few interferences, isotopic overlaps are predictable and correctable by evaluating other isotopes of the same element or of the interfering element. The background mass-spectral features of the argon plasma were characterized by Tan and Horlick (1986). All corrections are performed by the software package of the ICP-MS.

The water used to prepare the standards and blanks was prepared by passing deionized water through a Millipore Milli-Q system to obtain ultra-pure, 18-megaohm reagent water. Blanks were prepared in the acid-washed, 250-mL polypropylene bottles that were used to collect the ground-water samples. The samples were acidified in the field with the same lot of nitric acid. Working standard solutions were prepared from Claritas PPT grade 10 ppm multi element solutions purchased from Spex CertiPrep. The acidified blanks were compared to reagent water and results are given in table 5. Blanks containing 100 ppm calcium and chloride also were used to determine the possible presence of interfering molecular ions that can form in the argon plasma (Tan and Horlick, 1986). The analytical procedures were described by Faires (1992) and the results are given in table 5.

Scandium, yttrium, and the lanthanide elements from 11 ground-water sites and from Lidy Hot Springs were analyzed by the procedures described by de Boer and others (1996). The detection limits, concentrations measured for the 20 and 102 ppt standards, the acidified blank, and the spike recovery data are given in table 6.

Standards

Standard solutions for trace-element analyses were purchased from the National Institute of Science and Technology (NIST), the National Research Council of Canada (NRCC), and a variety of commercial sources, including Environmental Research Associates (ERA), VGH Laboratories, High Purity Standards, and Ultra Scientific. The recommended concentrations of the NIST standard reference materials are listed on the World Wide Web; recommended concentrations for the other standards and reference materials were obtained from the analytical certificates. The standards, nitric acid blanks, and reference materials were analyzed with the water samples from the INEEL.

Precision and Accuracy of Measurements

Precision and accuracy of the standards and the measurements by DCP, ICP-MS, and ion chromatography for the major and trace elements are given in tables 1 through 6. Measured concentrations in the blanks and detection limits are also presented in the tables.

Results of Analyses

The concentrations of major elements in selected ground-water and surface-water samples from the INEEL and vicinity are tabulated in table 7. The concentrations of trace elements measured by ICP-MS are given in tables 8 and 9. When possible, concentrations were measured using up to three isotopes of the same element. For example, the total barium concentrations were determined from the isotopes having mass numbers of 135, 137, and 138, and the natural isotopic abundances of barium. The results from all three isotopes of barium are in excellent agreement (table 9).

Concentrations of major elements were measured in 103 ground-water samples (table 7). Maximum, minimum, mean, median, and standard deviations of the concentrations of calcium are 78.3, 22.6, 43.0, 39.7, and 12.9 ppm, respectively. Maximum, minimum, mean, median, and standard deviations of the concentration of magnesium are 28.6, 5.0, 15.6, 15.1, and 4.1 ppm, respectively. Maximum, minimum, mean, median, and standard deviations of the concentrations of sodium are 78.4, 5.1, 15.3, 12.7, and 11.3 ppm, respectively. Maximum, minimum, mean, median, and standard deviations of the concentration of potassium are 6.8, 0.9, 3.0, 2.8, and 1.2 ppm, respectively. Maximum, minimum, mean, median, and standard deviations of the concentrations of chloride are 218, 4.9, 27.8, 16.3, and 33.5 ppm, respectively. Maximum, minimum, mean, median, and standard deviations of the concentrations of bromide are 0.210, 0.005, 0.047, 0.037, and 0.036 ppm, respectively. Maximum, minimum, mean, median, and standard deviations of the concentrations of sulfate are 45.0, 8.8, 23.9, 22.4, and 7.7 ppm, respectively. Maximum, minimum, mean, median, and standard deviations of the concentrations of nitrate are 23.5, <0.05, 5.45, 3.60, and 4.60 ppm, respectively. Maximum, minimum, mean, median, and standard deviations of the concentrations of fluoride are 1.30, 0.11, 0.30, 0.22, and 0.19 ppm, respectively. Concentrations for selected streams and springs are shown in table 7 for comparison purposes.

Concentrations of 22 trace elements were measured in 99 ground-water samples (tables 8 and 9). Concentrations of lithium, boron, zinc, arsenic, rubidium, strontium, molybdenum, barium, and uranium were above their detection limits in all samples. Detection limits ranged from <0.05 to <10 ppb and were about 0.1 ppb for most trace elements. Beryllium, aluminum, vanadium, chromium, manganese, nickel, cobalt, copper, selenium, cadmium, cesium, tellurium, and lead were detected in 0, 99, 99, 96, 80, 87, 40, 96, 98, 17, 53, 1, and 88 percent of the ground-water samples, respectively. The minimum and maximum concentrations measured for some trace elements varied significantly. The ranges in concentrations for lithium, barium, and uranium were 1.0 to 73.5, 6.1 to 260, and 0.09 to 3.8 ppb, respectively. The range in concentrations for boron, aluminum, and rubidium were 11 to 84.0, <1 to 20.0, and 0.5 to 12.2 ppb, respectively. Mean concentrations for lithium, boron, aluminum, zinc, arsenic, rubidium, strontium, molybdenum, barium, and uranium were 9.0, 29.4, 4.9, 79.5, 2.2, 5.9, 213, 2.5, 59.6, and 1.9 ppb, respectively. The medians for these elements were 3.3, 26.0, 5.0, 11.0, 1.9, 6.2, 200, 2.3, 51.5, and 1.9 ppb, respectively. The calculated standard deviations were 10.9, 12.8, 2.9, 113, 2.2, 2.7, 73.0, 1.0, 41.2, and 0.6 ppb, respectively.

Concentrations of most of the lanthanide elements were below the detection limits of the ICP-MS method (table 10). Detectable concentrations of lanthanum and cerium were present in all samples, and the concentration ranges were 0.3 to 2.6, and 0.5 to 5.4 ppt in the ground-water samples, respectively. Concentrations of all but one (dysprosium) of the lanthanides in the Lidy Hot Springs sample either were at the detection limit of the elements analyzed or were higher than concentrations in the 11 ground-water samples. Although yttrium was detected in all the samples, scandium was above the detection limit of 1 ppb in only USGS 4.

COLLECTION AND ANALYSIS OF SAMPLES FOR ISOTOPIC COMPOSITION

Isotopes of hydrogen and oxygen of the water were measured in 141 samples from wells, 5 streams, and 3 springs at or near the INEEL. Carbon isotopes of the dissolved inorganic carbon were measured in many of the ground-water samples.

Analyses of Samples for Deuterium and Oxygen-18

Deuterium (^{2}H) and oxygen-18 (^{18}O) isotopic ratios were measured by the Isotope Fractionation Project in Reston, Virginia. Hydrogen isotope ratios were measured using the hydrogen equilibration technique at 30°C (Coplen and others, 1991), rather than the older zinc technique (Kendall and Coplen, 1985). The hydrogen equilibration technique measures deuterium activity, whereas the zinc technique measures deuterium concentration. For freshwater samples, the difference in reported isotopic compositions between the two techniques is insignificant. There may be significant differences between the activity and concentration only in brines (Sofer and Gat, 1972, 1975; Horita and others, 1993). The $\delta^{18}O$ of the water samples was measured using the carbon dioxide equilibration technique at 25°C (Epstein and Mayeda, 1953). Therefore, both oxygen and hydrogen isotopic ratio measurements are reported as activities. The isotope ratios are given by the equation:

$$\delta^{18}O = \left[\frac{{}^{18}O/{}^{16}O_{\text{sample}}}{{}^{18}O/{}^{16}O_{\text{standard}}} - 1 \right] \times 1000$$

Oxygen and hydrogen isotopic results are reported in per mil relative to VSMOW (Vienna Standard Mean Ocean Water) and were normalized (Gonfiantini, 1984; Hut, 1987; Coplen, 1988 and 1994) on the basis of the SLAP (Standard Light Antarctic Precipitation) scales. The oxygen and hydrogen isotopic values of SLAP scale are -55.5 per mil and -428 per mil, respectively. The $\delta^{18}O$ results can be expressed relative to VPDB (Vienna Peedee belemnite) by multiplying the $\delta^{18}O$ results by 0.97001 and then subtracting 29.99. The 2-sigma uncertainty of oxygen and hydrogen isotopic ratios is 0.2 and 2 per mil, respectively.

Collection and Analyses of Samples for Carbon-13 to Carbon-12 Isotopic Ratios

The samples for carbon isotope and carbon-14 analyses were collected in 1000-mL glass bottles with polyseal caps. The inorganic carbon was precipitated in the field by the addition of a filtered strontium chloride-ammonium hydroxide solution. The precipitate was filtered, then repeatedly washed with carbon dioxide-free water under a nitrogen atmosphere. The strontium carbonate solid was dried, ground, sieved, and stored in glass vials. The procedures for the preparation of the solids and analyses are discussed in other reports (McCrea, 1950; Craig, 1953; Gleason and others, 1969; Hassan, 1982).

The carbon-13/carbon-12 isotopic ratios are given by the equation:

$$\delta^{13}C = \left[\frac{{}^{13}C/{}^{12}C_{\text{sample}}}{{}^{13}C/{}^{12}C_{\text{standard}}} - 1 \right] \times 1000$$

The $\delta^{13}C$ results for 83 samples and standard deviations for replicate analyses are reported in per mil on the VPDB scale and are compiled in table 11.

Analyses of Samples for Carbon-14

Carbon-14 (^{14}C) was measured in 18 ground-water samples by accelerator mass spectroscopy (AMS) from graphite targets that were prepared from the strontium carbonate precipitate. The ^{14}C was measured by the Rafter Radiocarbon Laboratory, Institute of Geological and Nuclear Sciences of New Zealand. The procedures for ^{14}C measurement by AMS and the precision and accuracy of the method are described in detail by Gove (1992) and Beukens (1992). The ^{14}C results and standard deviations are compiled in table 11.

Analyses of Samples for Tritium

Tritium (^{3}H) in the ground water samples was measured by two methods. The ^{3}H in 42 samples was measured using electrolytic enrichment of ^{3}H followed by scintillation counting at the U.S. Geological Survey's National Water Quality Laboratory. Samples were collected in 1,000- and 500-mL glass bottles. The detection limit was ±0.3 TU. The procedure, principles for the enrichment, and scintillation counting method are described by Ostlund and Werner (1962), Hartley (1971), and Florkowski (1981).

^{3}H in 49 samples was measured using the helium-3 (^{3}He) in-growth method and mass spectroscopy by the Noble Gas Laboratory at the

Lamont-Doherty Earth Observatory of Columbia University, New York. The procedure consists of degassing the water, flame-sealing the sample in a glass bulb, then storing the sample to allow some of the ^3H present to decay to ^3He, the radioactive decay daughter product of ^3H. The ^3He is vacuum extracted from the 40- or 500-mL water sample, dried, then measured by mass spectroscopy. The precision of the determinations depends on two factors, the length of storage of the sealed glass bulb and the volume of water used. Standard deviations as small as ±0.01 TU were obtained with 500 mL water samples but were as high as ±0.5 TU for some of the 40 mL water samples. This procedure is described by Clarke and others (1976) and Jenkins (1987). The ^3H results for 92 samples and standard deviations are compiled in table 11.

Results of Analyses

The isotopic ratios of hydrogen and oxygen of the water, the isotopic ratio of dissolved inorganic carbon, and the concentrations of ^3H and ^{14}C were measured in samples of ground water, surface water, and springs from the INEEL and vicinity; results are compiled in table 11. Isotopic ratios of hydrogen, oxygen, and carbon were measured in 141, 141, and 83 ground-water samples, respectively. Maximum, minimum, mean, median, and standard deviations of δ^2H are -120.6, -143.7, -136.5, -137.0, and 3.6 per mil, respectively. Maximum, minimum, mean, median, and standard deviations of $\delta^{18}O$ are -14.79, -18.55, -17.72, -17.79, and 0.62 per mil, respectively. Maximum, minimum, mean, median, and standard deviations of ^{13}C are -5.61, -14.69, -9.58, -9.43, and 1.72 per mil, respectively. ^3H and ^{14}C were measured in 91 and 18 ground-water samples, respectively. Maximum, minimum, mean, median, and standard deviations of the concentrations of ^3H outside the tritium-contaminant plumes (Robertson, 1974; Mann and Cecil; 1990, Orr and Cecil, 1991) are 97.53, 0.0, 10.1, 3.9, and 16.4 TU, respectively. Maximum, minimum, mean, median, and standard deviations of the concentrations of ^{14}C are 86.2, 21.9, 65.4, 67.2, and 19.4 pmc, respectively. Concentrations in selected surface-water samples are shown in table 11 for comparison purposes.

COLLECTION AND ANALYSIS OF SAMPLES FOR CONCENTRATIONS OF DISSOLVED GASES

Busenberg and others (1998) reported concentrations of methane, nitrogen, oxygen, argon, dichlorodifluoromethane, trichlorofluoromethane, trichlorotrifluoroethane, and sulfur hexafluoride in many ground-water samples collected between 1994 and 1997. In this report, concentrations of helium, neon, and hydrogen are presented.

Collection and Analysis of Ground-Water Samples for Helium and Neon by Mass Spectroscopy

Samples for analyses of the isotopes of helium (He) and neon (Ne) were collected in 80-cm-long copper tubes with a 0.95-cm outer diameter. The ends of the tubes were sealed by compressing the tube with stainless-steel clamps. He and Ne were measured by mass spectroscopy after the gases were vacuum-extracted from the water dried and sorbed onto charcoal at low temperature. The gases then were desorbed, the pressures measured, and the isotopic ratios determined by mass spectroscopy. Further details of the procedure can be obtained from Jenkins and Clarke (1976), Torgersen and others (1979), Torgersen and Clark (1985), Schlosser and others (1988, 1989, 1991), Jenkin (1987), Torgersen (1989), and Heinze and others (1990).

Collection and Analysis of Ground-Water Samples for Helium, Neon, and Hydrogen by Gas Chromatography

The water samples for He, Ne, and hydrogen (H_2) analysis were collected in 150-mL septum bottles that were filled without headspace in the field. The samples were stored on ice in the field, and in a refrigerator at 4°C in the laboratory prior to analysis. After allowing the samples to come to room temperature overnight, a 10-mL headspace was created by removing some of the water through the septum with a needle connected to a vacuum pump. The water was allowed to equilibrate with this headspace overnight at room temperature before analysis. A long needle filled with water and connected to an on-off valve and through a nylon tube to a water reservoir was injected through the septum to the bottom of the bottle, then the valve was turned on. The degassed water slowly entered the bottom bottle, increasing the pressure in the headspace to one atmosphere. Another needle connected to an on-off valve and a syringe was pushed through the septum. The valve was opened and the gas in the headspace was pulled into the syringe. Water slowly replaced the gas in the headspace. With care, this procedure allows all the headspace gas to be transferred into the syringe. The valve was closed and the needle removed then the gas was injected into a gas chromatograph.

The concentrations of He, Ne, and H_2 were measured with a thermal conductivity detector (TCD). The procedure was similar to that described by Sugisaki and others (1982). The major difference was the use of a shorter, 6.1-m stainless-steel column with a 3.175-mm outer diameter. The column was packed with a 60/80 mesh, 5 angstrom, molecular sieve. The column was cooled to 0°C in an ice-water bath to improve the separation of He from Ne. The procedural changes reduced the analytical time from 60 to 22 minutes per sample and from 60 to 9 minutes for each of the five standards used. The instrument was calibrated with five standards by injections of 1, 2, and 3 cm^3 of a gravimetric standard gas containing 12.0 and 35.0 ppm volume per volume of H_2 and He, respectively. The standard was prepared by injecting known volumes of ultra-pure gases into a preweighed and evacuated aluminum gas cylinder. The cylinder was pressurized to 9500 kPaskals by adding approximately 100 g of ultra-pure nitrogen into the 0.830-L cylinder and then reweighing the cylinder to the nearest 0.01 g. The concentrations in this standard are known to within ±1 percent. The two other standards used were 2.0 and 3.0 cm^3 of dry air. The concentrations of He, Ne, and H_2 are 5.24, 18.18, and 0.5 ppm volume per volume of gas (Committee on Extension to the Standard Atmosphere, 1976).

The precisions of the gas-chromatographic results are 5, 10, and 10 percent for He, Ne, and H_2, respectively. He and Ne results obtained by gas chromatography compare very favorably with the results obtained by mass spectroscopy (table 12). Even though the precision of the H_2 measurements is better than ±10 percent, concentrations can change significantly during storage in some of the samples, therefore, the results should be considered qualitative rather than quantitative.

Results of Analyses

The concentrations of some gases in the ground-water and spring samples are tabulated in table 12. He, Ne, and H_2 concentrations were measured for 122, 126, and 66 samples, respectively. The maximum, minimum, mean, median, and standard deviations for the concentrations of He in the samples are 149, 1.59, 9.89, 6.21 and 14.4 (cm^3 STP per g of water)x10^8, respectively. The maximum, minimum, mean, median, and standard deviations for the concentrations of Ne in the samples are 28.4, 0.138, 2.34, 2.03, and 2.48 (cm^3 STP per g of water)x10^7, respectively. The maximum, minimum, mean, median, and standard deviations for the concentrations of H_2 in the samples are 769, 0.375, 18.9, 1.38 and 97.5 (cm^3 STP per g of water)x10^8, respectively.

SUMMARY

This report presents results of the chemical analysis of water samples from wells, streams, and springs at or near the Idaho National Engineering and Environmental Laboratory (INEEL). Results are given in 13 tables for major elements, 24 trace elements, and 12 lanthanide elements. Selected isotopes were measured including hydrogen, oxygen, inorganic dissolved carbon, and helium. The concentrations of dissolved helium, neon, and hydrogen were also measured.

Concentrations of major elements were measured in 103 ground-water samples. The concentration ranges of calcium, magnesium, silica, sodium, potassium, bicarbonate, chloride, sulfate, nitrate, fluoride, and bromide were 22.6

to 78.3, 5.0 to 28.6, 4.3 to 47.1, 5.1 to 78.4, 0.9 to 6.8, 87.0 to 343, 4.9 to 218, 8.8 to 45.0, <0.05 to 23.5, 0.11 to 1.30, and 0.005 to 0.210 ppm, respectively.

Concentrations of 22 trace elements were measured by ICP-MS in 99 ground-water samples. Concentrations of lithium, boron, zinc, arsenic, rubidium, strontium, molybdenum, barium, and uranium in all samples were above the detection limits for these elements. The concentration ranges for lithium, boron, zinc, arsenic, rubidium, strontium, molybdenum, barium, and uranium in the ground-water samples were 1.0 to 73.5, 11 to 84.0, 2 to 561, 0.4 to 22.3, 0.5 to 12.2, 80 to 480, 0.6 to 7.3, 6.1 to 260, and 0.09 to 3.8 ppb, respectively. The detection limits ranged from <0.05 to <10 ppb and was about 0.1 ppb for most trace elements.

Beryllium, aluminum, vanadium, chromium, manganese, nickel, cobalt, copper, selenium, cadmium, cesium, tellurium, and lead were measured in 99 ground-water samples and were detected in 0, 99, 99, 96, 80, 87, 40, 96, 98, 17, 53, 1, and 88 percent of the samples, respectively. The ranges in concentrations for these elements were <0.05, <1 to 20.0, <0.1 to 13.7, <1 to 45.0, <0.1 to 140, <0.1 to 1.9, <0.05 to 3.78, <0.1 to 7.65, <0.5 to 5.5, <0.05 to 0.340, <0.05 to 1.38, <0.05 to 0.06, and <0.05 to 18.0 ppb, respectively.

Concentrations of the lanthanide elements were measured in samples from 11 ground-water samples and 1 spring. Lanthanum, cerium, praseodymium, neodymium, and gadolinium were detected in 100, 100, 9, 45, 18 percent of the ground-water samples, respectively. Concentrations of all the other lanthanide elements were below the detection limits of the ICP-MS method. The ranges in concentrations for lanthanum, cerium, praseodymium, neodymium, and gadolinium in the ground-water samples were 0.3 to 2.6, 0.5 to 5.4, <0.3 to 0.6, <0.5 to 2.2, and <0.5 to 1.3 ppt, respectively. Concentrations of most lanthanide elements in the Lidy Hot Springs sample were at the detection limit or higher than in the ground-water samples. Dysprosium was present above the detection limit in Lidy Hot Springs. Scandium was present above the detection limit of <1 ppb in only one ground-water sample (USGS 4). Yttrium was detected in all the samples, and the concentration ranges were 1.6 to 9.5 ppt in the ground-water samples, and 11 ppt in Lidy Hot Springs.

The isotopic ratios of hydrogen and oxygen of the water, the isotopic ratios of dissolved inorganic carbon, and the concentrations of tritium and carbon-14 were measured in the ground-water, surface-water, and spring samples. Isotopic ratios of hydrogen, oxygen, and carbon were measured in 141, 141, and 83 ground-water samples, respectively. The δ^2H, $\delta^{18}O$, and $\delta^{13}C$ ranges in the ground water are -143.7 to -120.6, -18.55 to -14.79, and -14.69 to -5.61 per mil, respectively. Tritium and ^{14}C were measured in 91 and 18 ground-water samples, respectively. Tritium and ^{14}C concentration ranges were 0 to 97.53 TU, and 21.9 to 86.2 percent modern carbon, respectively.

The concentrations of the gases helium, neon and hydrogen were measured in 122, 126, and 63 ground-water and spring samples, respectively. The minimum, maximum, mean, median, and standard deviations for the concentrations of helium in the ground-water samples are 1.59, 149, 9.89, 6.21 and 14.4 (cm^3 STP per g of water)$\times 10^8$, respectively. The minimum, maximum, mean, median, and standard deviations for the concentrations of neon in the ground-water samples are 0.138, 28.4, 2.34, 2.03 and 2.48 (cm^3 STP per g of water)$\times 10^7$, respectively. Hydrogen concentrations have a tendency to change significantly during storage in some of the samples; therefore, the results presented in this report should be considered qualitative rather than quantitative.

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Table 1. Concentrations of major elements and selected trace elements in standard reference water samples

[NIST, National Institute of Standards and Technology; NRCC, National Research Council of Canada; ppm, parts per million; (35), provisional concentrations; ---, not given]

Element	NIST standard reference materials			NRCC standard
	1643C ppm	1643B ppm	1643D ppm	SLRS-3 ppm
Calcium	36.8	(35)	31.04±0.5	6.0±0.4
Magnesium	9.45	(15)	7.989±0.035	1.6±0.2
Potassium	2.3	(3)	2.356±0.035	0.70±0.1
Sodium	12.2	(8)	22.07±0.64	2.3±0.2
Silicon	---	---	(2.7)	---
Aluminum*	114.6		127.6±3.5	31±3
Iron*	106.9	99±8	91.2±3.9	100±2
Manganese*	35.1	28±2	37.66±0.83	3.9±0.3
Strontium*	263.6	227±6	294.8±3.4	(28.1)

*Aluminum, iron, manganese, and strontium concentrations are in parts per billion.

Table 2. Standard reference materials, recommended concentrations, measured concentrations by direct-current plasma spectroscopy, and measured standard deviations

[(5), number of measurements; ppm, parts per million; ppb, parts per billion; ----, not given; nd, not determined]

Chemical or atomic symbol	Ca ppm	Mg ppm	Sr ppm	SiO_2 ppm	Na ppm	K ppm	Fe ppb	Mn ppb	Al ppb
1643C	36.8	9.45	0.264	---	12.2	2.3	107	35	115
Average (5)	36.4	9.63	0.264	0.16	nd	2.7	133	38.2	133
Standard deviation	0.7	0.06	0.01	0.04	nd	0.1	14	1.8	19
SRLS-3	6.0	1.6	0.028	---	2.30	0.7	100	4	31
Average (10)	5.9	1.59	0.032	3.56	2.37	0.7	92	4	32
Standard deviation	0.2	0.04	0.002	0.06	0.10	0.1	9	2	2
1643D	31.0	7.99	0.295	---	22.1	2.4	91	38	128
Average (2)	30.6	8.07	0.305	nd	nd	2.3	105	39.5	125
Standard deviation	0.1	0.07	0.004	nd	nd	0.1	11	0.5	20

Table 3. Standard reference materials, recommended concentrations, measured concentrations by ion chromatography, and measured standard deviations

[First row is the recommended concentration and accuracy; ppm, parts per million]

Chemical or atomic symbol	Fluoride ppm	Chloride ppm	Nitrate ppm	Sulfate ppm
Simulated rainwater 2	0.10±0.01	0.98±0.01	7.0±0.2	10.±0.31
Average of 4 analyses	0.11	1.00	6.92	10.3
Standard deviation	0.00	0.00	0.04	0.0

Table 4. Concentrations of trace elements in standard reference water samples and high purity working standards

[Concentrations are in parts per billion; NIST, National Institute of Standards and Technology; NRCC, National Research Council of Canada; ERA, Environmental Research Associates; SRM, standard reference material; (35), provisional concentrations; ---, not given]

Symbol of element	NIST water SRM 1643C	NIST water SRM 1643B	NIST water SRM 1643D	NRCC standard SLRS-3	ERA standard WW-11	ERA standard PW-34	High purity standard TMDW
Ag	2.21	9.8±0.8	1.27±0.057	---	108	106	2±0.01
Al	114.6	---	127.6±3.5	3±31	762	375	120±0.6
As	82.1	(49)	56.02±0.73	0.72±0.05	32.4	81.3	80±0.4
B	---	(94)	144.8±5.2	---	431	156	---
Ba	49.6	44±2	506.5±8.9	13.4±0.6	649	1130	50±0.25
Be	23.2	19±2	12.53±0.28	0.005±0.001	75.7	77.5	20±0.1
Bi	(12)	(11)	(13)	---	---	---	10±0.05
Cd	12.2	20±1	6.47±0.37	0.013±0.002	59.5	56.3	10±0.05
Co	23.5	26±1	25.00±0.59	0.027±0.003	184		25±0.13
Cr	19.0	18.6±1	18.53±0.2	0.30±0.04	119	375	20±0.1
Cu	22.3	21.9±0.4	20.5±3.8	1.35±0.07	238	688	20±0.1
Fe	106.9	99±8	91.2±3.9	100±2	276	225	100±0.5
Li	16.5	---	16.50±0.55	---	---	---	20±0.1
Mn	35.1	28±2	37.66±0.83	3.9±0.3	432	125	40±0.2
Mo	104.3	85±3	112.9±1.7	0.19±0.01	541	313	100±0.5
Ni	60.6	49±3	58.±2.71	0.83±0.08	324	225	60±0.3
Pb	35.3	23.7±0.7	18.15±0.64	0.068±0.007	297	56.3	40±0.2
Rb	11.4	---	(13)	---	---	---	10±0.05
Sb	---	---	54.1±1.1	0.12±0.01	86.5	43.8	10±0.05
Se	12.7	9.7±0.5	11.43±0.17	---	81.1	56.3	10±0.05
Sr	263.6	227±6	294.±3.48	(28.1)	551	---	250±1.25
Te	(2.7)	---	(1)	---	---	---	3±0.02
Tl	(7.9)	8.0±0.2	7.28±0.25	---	83.8	81.3	10±0.05
U	---	---	---	(0.045)	---	---	10±0.05
V	31.4	45.2±0.4	35.1±1.4	0.30±0.02	314	---	30±0.15
Zn	73.9	66±2	72.48±0.65	1.04±0.09	119	688	70±0.35

Table 4. Concentrations of major elements and selected trace elements in standard reference water samples, high purity working standards (continued)

Symbol of element	High Purity Standards CWW-TM-A	High Purity Standards CWW-TM-B	High Purity Standards CWW-TM-E	VGH Labs Standards QCTM #1	VGH Labs Standards QCTM #2	ULTRA Scientific QC1-700
Ag	10±0.1	50±0.3	5±0.0	69.0	---	200±2
Al	50±0.3	200±1.0	2±0.15	68.48	---	600±6
As	10±0.1	50±0.3	5±0.0	180.2	---	100±1
B	50±0.3	20±1.00	25±0.1	---	99.4	500±5
Ba	50±0.3	20±1.00	25±0.1	126.2	---	300±3
Be	10±0.1	50±0.3	5±0.0	66.7	---	100±1
Cd	10±0.1	50±0.3	25±0.1	79.3	---	200±2
Co	50±0.3	200±1.0	25±0.1	397.9	---	900±9
Cr	50±0.3	200±1.0	25±0.1	64.9	---	300±3
Cu	50±0.3	200±1.0	2±0.15	342.1	---	500±5
Fe	50±0.3	200±1.0	25±0.1	425.5	---	200±2
Mn	50±0.3	200±1.0	25±0.1	412.1	---	600±6
Mo	50±0.3	200±1.0	25±0.1	---	294.3	700±7
Ni	50±0.3	200±1.0	25±0.1	72.7	---	200±2
Pb	5±0.30	200±1.0	25±0.1	112.3	---	300±3
Sb	10±0.1	50±0.3	5±0.0	---	179.1	200±2
Se	10±0.1	50±0.3	5±0.0	50.4	---	100±1
Sr	50±0.3	200±1.0	25±0.1	---	---	400±4
Tl	10±0.1	50.0±0.3	5±0.0	224.5	---	200±2
V	5±0.30	200±1.0	25±0.1	65.2	---	100±1
Zn	50±0.3	200±1.0	25±0.1	210.2	---	400±4

Table 5. Standard reference materials, recommended concentrations, measured concentrations by inductively-coupled plasma-mass spectroscopy, and measured standard deviations

[Concentrations are in ppb (parts per billion); (3), number of analyses; <, less than]

Symbol of element	Li	Be	B	Al	V	Cr	Mn	Co	Ni	Cu	Cu	Zn	Zn	As
Mass number	7	9	11	27	51	52	55	59	62	63	65	66	68	75
CWW-TM-A		10	50	50	50	50	50	50	50	50	50	50	50	10
Average (3)	-0.07	9.6	47.0	48.2	49.0	49.9	50.4	48.5	48.9	49.3	49.1	56.7	56.0	10.7
Standard deviation	0.05	1.33	2.45	2.05	0.94	0.79	0.37	0.96	1.13	0.60	0.58	1.70	1.41	0.47
CWW-TM-B		50	200	200	200	200	200	200	200	200	200	200	200	50
Average (5)	0	52	190	196	199	197	204	199	191	194	194	218	218	53
Standard Deviation	0	3.4	3.6	5.4	3.7	2.2	2.9	4.2	3.1	1.9	1.7	5.4	6.9	1.4
CWW-TM-E		5	25	25	25	25	25	25	25	25	25	25	25	5
Average (3)	0	5	25	25	25	25	25	25	25	25	25	29	29	5
Standard Deviation	0	0.6	1.7	0.5	0.3	0.0	0.1	0.4	0.5	0.3	0.3	1.2	1.2	0.5
1643d	16.5	12.5	145	128	35.1	18.5	37.7	25	58.1	20.5	20.5	72	72	56
Average (6)	17.1	12.0	142	120	35.3	18.2	37.8	24	54.6	19.6	19.6	63	72	53
Standard Deviation	0.7	0.6	5.9	6.1	0.5	0.2	0.2	0.4	0.9	0.2	0.3	0.5	0.7	0.7
SLRS-3				31	0.3	0.3	3.9	0.03	0.83	1.35	1.35	1	1	0.7
Average (4)	0.55	0.01	4.25	31	0.26	0.24	4.0	0.12	0.80	1.43	1.45	2	2	0.8
Standard Deviation	0.05	0.01	0.83	1.5	0.03	0.14	0.1	0.10	0.02	0.02	0.04	0	0	0
QCTM #1		66.7		68.5	65.2	64.9	412.1	397.9	72.7	342.1	342.1	210.2	210.2	180
Average (6)	-0.02	66.7	8.8	68.2	64.7	64.0	422.3	397.7	72.1	349.3	341.2	214.2	212.0	188.7
Standard Deviation	0.04	4.8	1.1	2.9	0.8	0.7	6.0	7.9	0.9	5.7	2.9	4.1	4.7	3.9
QCTM #2			99.4											
Average (4)	0.025	0	105.5	-0.25	-0.06	0.14	0.09	2.30	0.04	0.29	0.29	0.75	0.75	0.15
Standard Deviation	0.043	0.007	2.7	1.48	0.03	0.12	0.07	2.04	0.03	0.06	0.06	0.43	0.43	0.05
1 ppb	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Average (8)	0.96	0.94	11.16	<5	0.94	0.98	0.98	0.98	0.94	0.91	0.91	1.00	1.00	0.98
Standard Deviation	0.10	0.11	31.21		0.06	0.10	0.08	0.02	0.03	0.01	0.01	0.00	0.00	0.07
5 ppb	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Average (8)	4.81	4.76	0.63	3.50	4.86	4.94	4.95	4.89	4.97	4.86	4.87	5.00	5.00	4.96
Standard Deviation	0.39	0.62	1.65	1.00	0.09	0.13	0.07	0.08	0.12	0.07	0.06	0.00	0.00	0.11
10 ppb	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Average (9)	9.9	9.8	0.2	10.1	10.2	10.1	10.3	10.3	10.2	10.1	10.1	10.1	10.1	10.1
Standard Deviation	0.5	0.6	0.4	1.9	0.2	0.3	0.1	0.2	0.2	0.1	0.1	0.3	0.3	0.3
50 ppb	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Average (7)	52.7	50.8	51.1	48.3	50.8	51.0	51.1	50.5	51.2	50.4	50.3	51.3	51.4	51.4
Standard Deviation	2.0	4.3	2.7	1.6	0.7	0.5	0.6	0.7	0.9	0.6	0.4	0.7	0.7	0.7
20 ppb	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Average (5)	20.5	20.6	18	21.0	20.4	20.2	20.6	20.2	20.1	20.0	20.0	20.4	20.2	20.2
Standard Deviation	1.5	1.7	1.0	1.4	0.3	0.4	0.2	0.3	0.5	0.4	0.3	0.5	0.4	0.4
100 ppb (1)	98.8	99.8	97	102	103	102	104	103	104	103	103	103	103	102
HNO_3 blank (5)	0.04	0.00	0.18	-0.71	-0.03	0.00	-0.01	-0.01	0.06	0.00	0.00	0.02	0.02	0.00
Standard Deviation	0.05	0.01	1.18	0.48	0.02	0.06	0.01	0.01	0.06	0.05	0.05	0.19	0.19	0.00
100 ppm Ca (3)	0.00	0.01		-1.00	-0.07	0.00	0.00	0.20	0.10	-0.03	0.03	0.67	0.67	0.00
Standard Deviation	0.00	0.00		0.82	0.05	0.00	0.00	0.00	0.00	0.05	0.05	0.47	0.47	0.00
200 ppm Cl (3)	-0.03	0.00		-2.00	1.29	0.00	0.00	0.00	0.00	-0.07	-0.10	0.00	0.00	0.00
Standard Deviation	0.05	0.01		0.82	0.07	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00

Table 5. Standard reference materials, recommended concentrations, measured concentrations by inductively coupled plasma-mass spectroscopy, and measured standard deviations (continued)

Symbol of element Mass number	Se 82	Rb 85	Sr 88	Mo 95	Mo 97	Mo 98	Cd 111	Cs 133	Ba 135	Ba 137	Ba 138	Tl 205	Pb 208	U 238
CWW-TM-A	10		50	50	50	50	10		50	50	50	10	50	
Average (3)	12.0	0.0	49.9	49.1	49.3	49.2	10.4	0.4	49.4	49.5	50.6	10.1	50.9	0.00
STD	0.00	0.00	0.33	0.70	0.62	0.71	0.36	0.02	1.61	1.70	2.31	0.16	0.93	0.00
CWW-TM-B	50		200	200	200	200	50		200	200	200	50	200	
Average (5)	56	0.0	201	197	196	197	52	0	198	199	203	51	206	0
STD	1.7	0.0	2.5	2.8	2.6	2.4	0.8	0.0	5.0	5.2	6.1	1.0	0.5	0.0
CWW-TM-E	5		25	25	25	25	25		25	25	25	5	25	
Average (3)	6	0.0	25	24	25	24	26	0.0	25	25	25	5	26	0
STD	0.0	0.0	0.2	0.4	0.4	0.4	0.6	0.0	0.8	0.8	1.1	0.1	0.3	0
1643d	11	13	295	113	113	113	6.47		506	506	506	7.28	18.2	
Average (6)	10	11	295	114	114	113	6.00	4.5	497	520	506	7.34	18.0	0.0
STD	0.5	0.1	3.0	0.9	0.8	0.7	0.08	0.2	11.0	9.1	11.5	0.19	0.3	0.0
SLRS-3			28.1	0.19	0.19	0.19	0.013		13.4	13.4	13.4		0.068	0.05
Average (4)	0.35	1.65	32.0	0.28	0.28	0.30	0.015	0.02	13.9	13.9	14.0	0.02	0.070	0.05
STD	0.11	0.05	0.5	0.04	0.04	0.00	0.004	0.01	0.2	0.2	0.4	0.00	0.000	0.00
QCTM #1	50						79.3		126.2	126.2	126.2	224.5	112.3	
Average (6)	55.5	0.01	106.5	0.10	0.08	0.10	80.1	0.001	123.7	124.5	127.5	231.8	115	0.00
STD	1.3	0.00	1.0	0.06	0.07	0.06	1.5	0.004	2.6	2.9	2.2	4.8	2.1	0.00
QCTM #2				294.3	294.3	294.3								
Average (4)	0.25	0.01	0.00	290.5	289	307.7	0.81	0.01	0.00	0.20	0.00	0.06	0.29	0.00
STD	0.11	0.00	0.00	2.2	2.9	14.2	0.05	0.00	0.00	0.00	0.00	0.01	0.02	0.00
1 ppb	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Average (8)	1.15	0.96	0.95	0.98	0.95	0.96	0.98	0.98	0.98	0.98	0.98	0.99	0.97	1.00
STD	0.15	0.01	0.05	0.04	0.05	0.05	0.02	0.04	0.04	0.04	0.04	0.05	0.02	0.04
5 ppb	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Average (8)	5.24	4.85	4.86	4.74	4.75	4.74	4.94	4.93	4.86	4.85	4.91	4.96	4.94	5.05
STD	0.14	0.07	0.10	0.05	0.05	0.05	0.09	0.19	0.14	0.13	0.19	0.14	0.10	0.17
10 ppb	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Average (9)	10.9	10.0	10.1	0.2	0.1	0.2	10.2	10.1	10.1	10.1	10.1	10.3	10.2	10.5
STD	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.2	0.3	0.2	0.2	0.3
50 ppb	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Average (7)	52.4	50.7	50.9	49.7	49.8	49.8	51.5	52.7	50.5	50.8	51.3	52.5	51.4	54.1
STD	0.5	0.5	0.5	0.3	0.3	0.3	0.9	0.8	1.1	1.1	1.5	1.3	0.9	1.6
20 ppb	20.0	20.0	20.0				20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Average (5)	21.2	20.0	20.2				20.4	20.3	20.0	20.1	20.3	20.8	20.6	21.3
STD	0.4	0.2	0.3				0.5	0.7	0.5	0.5	0.7	0.5	0.4	0.7
100 ppb (1)	104	103	103	98.7	98.5	98.8	101	102	102	102	104	104	102	104
HNO3 blank (5)	0.08	0.00	0.00	0.08	0.08	0.08	-0.00	0.00	-0.00	-0.01	-0.01	-0.01	-0.00	0.00
STD	0.07	0.00	0.00	0.04	0.04	0.04	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.00
100 ppm Ca (3)	0.30	-0.00	2.00	0.20	0.20	0.20	-0.00	0.00	0.17	0.20	0.20	0.00	0.04	0.00
STD	0.08	0.00	0.08	0.28	0.28	0.28	0.00	0.00	0.05	0.00	0.00	0.01	0.00	0.00
200 ppm Cl (3)	0.30	0.00	0.00	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00	0.00
STD	0.00	0.00	0.00	0.05	0.05	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6. Concentrations of scandium, yttrium, and lanthanides measured in 20 and 102 parts per trillion standards, and spike recovery obtained in samples from the Idaho National Engineering and Environmental Laboratory

[Concentrations are in ppt (parts per trillion) except for scandium, and yttrium which are in ppb (parts per billion); spike recoveries are expressed in percent; nd, not determined; <, less than]

Symbol of element Mass number	Sc 45	Y 89	La 139	Ce 140	Pr 141	Nd 146	Sm 147	Eu 151	Gd 158	Tb 159	Dy 164	Ho 165	Er 166	Tm 169	Yb 174	Lu 175
20 ppt	<1	20.5	20.3	20.4	20.7	20.4	19.7	20.8	20.6	20.6	20.6	20.3	20.6	20.4	20.6	20.2
102 ppt	<1	105	104	104	104	105	102	105	104	104	103	104	107	103	105	103
Blank	<1	<0.2	<0.2	<0.2	<0.3	<0.5	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
Detection limits	1	0.2	0.2	0.2	0.3	0.5	1.6	0.3	0.5	0.2	0.5	0.2	0.7	0.3	0.4	0.2
USGS 4 + 102 ppt spike	nd	103	102	101	101	101	102	101	99	102	103	103	103	102	101	102
CFA1 + 102 ppt spike	nd	104	99	102	98	102	96	95	95	97	96	96	97	96	97	95
USGS 2 + 102 ppt spike	nd	103	98	98	97	101	96	97	95	97	99	97	95	96	97	95

Table 7. Temperature, pH, and concentrations of cations and anions in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity

[Concentrations are in parts per million except for iron and aluminum which are in parts per billion; Temp. °C, temperature in degrees Celsius; pH, negative base-10 logarithm of the hydrogen ion activity; DOC, nonpurgeable organic carbon; <, less than; *, archived water sample; nd, not determined or not available]

Well identifier	Date sampled	Temp. °C	pH	Ca	Mg	Sr	[1]Ba	SiO_2	Na	K	HCO_3^-	Cl	SO_4^{2-}	NO_3^-	Br	F	Fe	[2]Al	DOC
ANP 6	06/15/95	13.4	7.98	45.1	16.7	0.216	0.066	20.2	9.7	2.3	179	16.3	33.5	3.6	0.037	0.25	41	33	1.06
ANP 6	07/19/96	13.3	7.98	46.2	17.2	0.218	0.072	20.7	9.6	2.5	180	17.2	32.2	3.7	0.031	0.26	61	67	1.64
ANP 9	10/14/96	13.9	8.12	38.1	15.7	0.208	nd	30.6	13.7	2.9	177	12.6	29.1	3.1	0.028	0.39	27	16	1.06
Arco City Well 4	05/13/97	9.6	7.97	53.5	13.5	0.257	0.135	13.4	5.4	1.0	209	6.5	19.9	2.8	nd	0.20	43	1	0.29
Arbor Test 1	04/21/95	13.2	8.03	33.7	10.9	0.116	0.028	27.8	15.2	3.0	159	14.3	12.5	5.7	0.036	0.62	45	33	1.44
Arbor Test 1	10/10/96	13.5	8.02	34.9	11.5	0.125	nd	34.0	14.4	3.1	162	14.5	12.4	5.5	0.032	0.64	36	16	1.36
Area II	07/18/96	14.3	8.05	34.2	13.8	0.152	0.036	28.7	14.3	3.4	170	17.3	16.8	4.8	0.044	0.44	56	51	2.29
Atomic City	10/09/96	14.2	8.20	34.1	13.4	0.164	nd	31.4	14.7	3.4	168	17.2	16.1	4.8	0.044	0.49	28	17	0.73
BFW	07/16/96	12.1	8.12	37.9	14.1	0.197	0.035	24.4	9.7	2.3	162	16.9	21.4	3.0	0.038	0.22	57	54	0.93
CFA 1*	04/05/90	nd	nd	58.8	21.0	0.370	nd	21.0	17.2	3.9	nd	92.5	39.8	12.8	0.119	0.17	74	22	nd
CFA 1	07/16/96	12.3	7.91	61.6	18.6	0.370	0.091	20.9	14.4	3.2	160	74.0	27.7	15.4	0.030	0.25	68	91	1.19
CFA 2	07/16/96	12.1	7.88	71.9	26.4	0.483	0.096	23.6	21.4	4.3	149	115.0	45.0	16.6	0.152	0.39	158	108	1.18
EBR I	10/16/96	18.8	8.20	22.6	15.3	0.195	nd	33.8	8.0	3.1	144	7.0	15.7	1.6	<0.02	0.19	34	7	0.14
Engberson Well	05/14/97	11.0	7.67	68.7	28.6	0.331	0.151	32.3	38.2	5.8	281	55.0	42.1	23.5	nd	0.19	73	2	nd
Fire Station 2	10/16/96	11.3	8.00	54.8	17.8	0.303	nd	22.7	8.1	2.4	204	17.6	23.5	5.2	0.038	0.19	56	30	1.97
IET 1 Disposal	07/18/96	14.0	7.93	49.0	13.9	0.251	0.120	18.8	15.9	3.6	189	18.7	29.9	6.0	0.061	0.21	86	69	5.65
INEL-1 WS	06/12/95	12.5	7.87	67.5	27.4	0.309	0.062	20.9	14.5	2.6	195	66.6	40.4	15.9	0.210	0.12	105	42	1.53
Leo Rogers 1	07/17/96	14.5	8.10	39.6	14.3	0.145	0.043	27.0	17.0	3.2	171	18.8	18.1	5.0	0.043	0.44	58	52	1.86
Neville Well	05/24/97	12.5	8.00	32.4	10.5	0.092	0.006	35.5	16.0	2.8	148	11.7	14.7	15.0	nd	0.81	33	4	0.65
NPR Test	04/17/95	11.8	8.10	51.4	14.3	0.242	0.074	19.2	7.5	2.0	196	14.7	23.1	3.4	0.035	0.19	61	44	1.59
NPR Test	10/10/96	12.2	8.14	49.1	14.1	0.244	nd	22.7	7.2	2.1	195	13.6	20.9	3.0	0.036	0.22	45	23	1.26
Pancheri 6	05/13/97	8.2	7.97	43.6	14.5	0.135	0.071	14.0	5.8	0.9	186	10.1	15.5	1.9	nd	0.15	29	1	0.41
Park Bell	05/21/97	11.7	8.05	25.1	5.0	0.078	0.067	46.4	22.6	5.0	155	6.1	10.2	<0.05	nd	0.70	110	3	0.37

Table 7. Temperature, pH, and concentrations of cations and anions in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	Temp °C	pH	Ca	Mg	Sr	[1]Ba	SiO_2	Na	K	HCO_3^-	Cl	SO_4^{2-}	NO_3^-	Br	F	Fe	[2]Al	DOC
PSTF Test	10/14/96	13.3	8.16	30.4	14.9	0.132	nd	23.7	6.5	2.4	164	6.6	14.4	2.6	<0.02	0.21	28	8	0.39
P&W 2	04/19/95	9.5	8.15	38.0	14.3	0.137	0.045	12.1	7.5	1.2	171	5.5	25.8	1.4	0.016	0.19	38	30	1.22
P&W 2	10/15/96	9.5	8.09	39.6	15.2	0.164	nd	14.5	7.3	1.2	170	7.5	24.7	1.7	0.021	0.21	41	17	1.44
RWMC M3S	07/22/96	13.7	8.13	43.4	15.0	0.244	0.045	23.6	8.2	2.6	176	13.4	24.3	3.3	0.034	0.30	51	64	1.46
RWMC M7S	07/22/96	13.8	8.19	39.6	14.0	0.231	0.046	23.5	7.8	2.7	172	11.9	22.2	2.9	0.026	0.20	53	61	2.05
Site 04	10/16/96	11.3	8.09	45.3	14.1	0.231	nd	22.5	7.8	1.8	192	10.1	19.4	2.5	0.021	0.20	30	20	nd
Site 09	07/22/96	13.7	8.05	35.7	14.7	0.188	0.060	23.7	11.2	2.8	166	13.1	22.9	2.7	0.033	0.28	51	51	2.01
Site 14	10/14/96	16.3	8.00	34.0	13.3	0.215	nd	29.7	12.9	3.0	165	9.5	23.4	2.5	0.024	0.41	37	13	0.52
Site 17	06/16/95	12.3	7.89	51.0	17.3	0.206	0.074	14.5	9.8	1.3	219	9.9	20.4	4.4	0.027	0.12	59	130	1.19
Site 19	07/16/96	15.2	8.04	42.4	17.5	0.211	0.049	18.8	8.0	1.9	200	11.6	20.7	4.0	0.032	0.19	55	64	1.57
TAN Exploration	10/14/96	10.4	8.11	34.0	15.2	0.181	nd	25.7	10.0	3.5	139	19.9	24.2	2.7	0.043	0.29	80	27	0.66
USGS 001	10/09/96	14.6	8.16	31.2	11.9	0.133	nd	32.5	13.5	3.2	158	13.0	13.0	3.8	0.026	0.57	51	9	0.19
USGS 002	07/17/96	13.9	8.08	35.4	12.1	0.131	0.034	28.7	15.1	3.3	166	17.0	14.1	5.5	0.046	0.57	87	51	1.24
USGS 004	04/19/95	11.1	7.79	74.4	25.8	0.322	0.150	24.0	41.9	6.1	343	42.4	34.1	13.4	0.084	0.18	103	48	2.11
USGS 004	10/15/96	11.0	7.75	68.9	26.0	0.312	nd	28.0	37.9	6.8	340	40.4	31.9	21.7	0.086	0.21	78	46	1.97
USGS 005	10/10/96	14.9	8.05	39.8	12.6	0.189	nd	23.1	7.1	2.0	171	9.4	18.7	2.0	0.026	0.21	39	18	1.24
USGS 006	07/18/96	14.1	8.12	28.7	11.3	0.182	0.078	24.9	11.7	2.4	146	9.4	18.1	1.2	0.024	0.23	53	43	1.31
USGS 007	10/14/96	18.8	8.07	24.6	9.3	0.120	nd	47.1	20.8	4.4	142	9.1	16.1	1.7	0.022	1.30	35	6	1.03
USGS 008	10/08/96	11.4	8.01	46.8	15.0	0.254	nd	18.9	6.9	1.8	201	8.4	21.0	3.8	<0.02	0.20	45	25	1.47
USGS 009	04/20/95	11.2	8.20	39.7	15.1	0.189	0.034	19.7	11.9	3.2	168	19.4	26.9	2.9	0.050	0.18	51	31	4.21
USGS 009	10/11/96	11.4	8.24	40.7	15.6	0.202	nd	23.1	12.2	3.5	172	20.9	26.0	2.9	0.053	0.20	40	21	1.89
USGS 011	04/20/95	11.7	8.12	41.2	14.2	0.220	0.052	19.2	8.2	2.1	173	11.8	23.1	2.8	0.033	0.19	42	51	1.62
USGS 011	10/09/96	11.8	8.08	40.7	14.5	0.234	nd	22.7	8.0	2.3	177	11.8	22.0	2.7	0.031	0.22	39	22	2.19
USGS 012	06/14/95	12.0	7.83	71.1	23.3	0.357	0.179	18.2	15.9	2.2	261	37.6	37.0	10.1	0.083	0.13	85	54	1.34
USGS 014	10/09/96	14.7	8.16	36.9	15.3	0.178	nd	30.4	15.5	2.8	168	21.0	21.5	4.8	0.042	0.79	37	20	0.71
USGS 015	06/14/95	11.6	7.96	32.7	15.3	0.188	0.065	18.0	8.9	1.6	167	7.0	18.5	1.8	0.018	0.11	30	25	1.12
USGS 015	05/13/97	11.3	8.09	34.8	16.0	0.191	0.074	21.0	9.3	1.6	171	10.0	19.9	2.3	nd	0.15	37	3	0.56

Table 7. Temperature, pH, and concentrations of cations and anions in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	Temp °C	pH	Ca	Mg	Sr	[1]Ba	SiO_2	Na	K	HCO_3^-	Cl	SO_4^{2-}	NO_3^-	Br	F	Fe	[2]Al	DOC
USGS 017	06/13/95	13.3	8.15	37.4	10.1	0.208	0.035	21.8	6.9	2.3	151	4.9	19.1	1.5	0.018	0.21	40	40	1.28
USGS 018	07/19/96	15.6	8.01	35.1	15.8	0.165	0.055	25.8	12.1	2.9	168	10.2	24.7	1.9	0.021	0.30	47	43	2.81
USGS 019	04/19/95	17.0	7.86	43.8	16.4	0.249	0.082	27.6	11.2	1.4	205	8.9	22.3	3.8	0.027	0.14	51	33	1.31
USGS 019	10/15/96	16.9	7.80	44.1	16.9	0.256	nd	14.9	10.5	1.5	197	9.9	20.6	3.7	0.025	0.21	46	22	1.17
USGS 022	06/13/95	20.0	7.92	34.7	10.6	0.114	0.017	17.9	21.0	5.6	87	66.5	21.0	1.8	0.140	0.17	54	35	2.35
USGS 022	07/18/96	19.6	8.08	36.5	10.5	0.113	0.018	20.3	21.3	5.8	91	62.8	20.9	2.4	0.130	0.17	80	55	1.39
USGS 023	04/19/95	15.4	7.87	37.4	15.8	0.219	0.055	16.1	9.2	1.6	182	9.9	17.6	2.5	0.027	0.21	54	29	1.25
USGS 023	10/15/96	15.4	7.84	37.5	16.0	0.226	nd	18.5	8.5	1.7	184	10.4	17.6	2.5	0.032	0.23	40	22	1.15
USGS 026	10/15/96	14.9	7.97	41.2	14.9	0.196	nd	32.7	13.2	3.5	182	13.3	28.6	3.4	0.037	0.43	56	20	1.24
USGS 027	10/15/96	15.5	8.03	54.0	19.1	0.256	nd	37.2	24.0	6.4	170	61.9	38.5	10.6	0.143	0.58	101	29	1.24
USGS 029	06/15/95	12.7	7.97	48.5	14.1	0.158	0.052	28.2	19.0	3.4	192	26.0	16.7	9.0	0.069	0.43	55	61	1.23
USGS 029	07/19/96	12.8	7.99	46.7	13.8	0.150	0.059	29.7	18.0	3.5	195	27.2	16.0	8.7	0.070	0.42	59	70	1.52
USGS 031	06/15/95	15.5	7.82	42.1	15.0	0.188	0.040	28.9	14.8	3.5	169	21.2	28.7	3.6	0.050	0.42	45	37	1.00
USGS 031	07/19/96	15.8	7.98	41.0	15.3	0.196	0.043	30.9	14.4	3.9	172	22.5	27.7	3.6	0.048	0.41	48	55	0.71
USGS 032	06/15/95	14.6	7.88	49.5	18.7	0.246	0.058	28.9	17.7	4.2	163	42.0	39.1	6.2	0.110	0.38	67	46	2.56
USGS 032	07/19/96	14.7	7.90	52.9	19.3	0.260	0.065	29.9	18.2	4.5	170	53.0	40.5	6.5	0.119	0.43	80	73	2.86
USGS 036	07/16/96	12.6	8.03	60.9	15.4	0.334	0.126	19.3	16.7	2.8	199	33.9	27.7	8.0	0.042	0.22	57	82	2.92
USGS 057*	04/30/67	nd	nd	27.8	13.5	0.322	nd	19.6	61.8	4.9	nd	110.5	33.1	8.4	0.015	0.23	230	15	nd
USGS 057*	05/24/68	nd	nd	23.5	11.8	0.265	nd	19.9	47.8	3.8	nd	73.5	28.0	11.2	0.005	0.22	70	12	nd
USGS 077*	05/31/89	nd	nd	70.3	18.8	0.425	nd	19.6	34.9	5.0	nd	133.4	36.6	19.8	0.051	0.22	88	29	nd
USGS 082	07/16/96	12.3	8.14	35.7	13.4	0.214	0.057	22.6	10.4	3.0	152	18.0	21.0	2.4	0.044	0.21	62	51	1.36
USGS 083	04/11/95	11.8	8.19	27.3	10.6	0.157	0.095	25.5	9.7	2.5	123	10.8	20.1	2.9	0.040	0.24	26	23	0.61
USGS 086	10/11/96	10.0	8.30	37.0	10.2	0.171	nd	25.5	11.0	2.9	132	19.6	22.7	6.3	0.059	0.16	37	17	0.66
USGS 089	07/17/96	13.1	8.58	27.2	15.6	0.118	0.018	24.7	17.9	3.7	103	38.8	34.9	8.0	0.125	0.33	63	42	0.76
USGS 097	06/13/95	11.5	7.89	73.0	24.3	0.316	0.143	18.2	15.4	2.2	269	38.0	35.9	9.6	0.079	0.20	68	54	1.32
USGS 098	06/12/95	12.3	7.97	48.9	18.3	0.222	0.043	20.9	10.0	2.3	209	15.2	21.7	4.8	0.036	0.12	50	30	0.91

Table 7. Temperature, pH, and concentrations of cations and anions in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	Temp °C	pH	Ca	Mg	Sr	[1]Ba	SiO_2	Na	K	HCO_3^-	Cl	SO_4^{2-}	NO_3^-	Br	F	Fe	[2]Al	DOC
USGS 099	06/12/95	11.8	7.90	59.8	22.6	0.252	0.112	16.2	12.2	1.7	247	22.2	27.0	6.7	0.052	0.15	58	54	1.23
USGS 100	04/21/95	13.5	8.10	38.3	12.3	0.133	0.032	28.2	16.0	3.1	164	17.7	21.0	6.5	0.044	0.57	39	31	1.02
USGS 100	10/10/96	13.8	8.14	36.9	12.0	0.166	nd	32.7	14.5	3.2	169	16.4	14.8	6.1	0.037	0.60	43	18	0.83
USGS 101	04/21/95	13.5	8.16	28.3	9.1	0.081	0.018	28.7	13.7	2.7	145	8.5	8.8	3.6	0.023	0.77	34	31	0.89
USGS 101	10/10/96	13.9	8.19	28.8	9.2	0.111	nd	33.6	12.9	2.8	148	8.5	9.0	3.6	0.022	0.78	39	9	0.67
USGS 102	06/13/95	11.6	7.90	73.9	23.2	0.308	0.124	18.2	13.5	2.2	264	34.0	35.5	9.1	0.078	0.13	70	60	0.86
USGS 103	04/18/95	13.6	8.14	36.2	14.8	0.183	0.047	23.7	13.0	2.7	167	17.1	24.2	3.3	0.040	0.31	36	38	0.96
USGS 103	07/15/96	13.9	8.27	36.1	15.3	0.186	0.045	24.3	12.6	3.0	167	16.3	23.1	3.3	0.040	0.32	49	53	1.3
USGS 104	04/18/95	11.6	8.05	35.4	13.5	0.190	0.035	24.4	8.1	2.4	154	11.8	19.7	3.2	0.032	0.19	86	89	0.74
USGS 104	07/15/96	12.3	8.13	34.9	13.7	0.184	0.032	24.7	7.6	2.4	156	12.6	19.3	3.2	0.033	0.20	62	54	0.53
USGS 105	04/18/95	13.7	8.11	40.8	15.2	0.235	0.038	21.2	12.7	2.8	180	13.6	26.0	3.0	0.041	0.19	45	63	1.20
USGS 107	10/09/96	14.9	8.06	37.6	16.6	0.120	nd	29.7	15.4	3.5	176	21.3	25.3	4.6	0.037	0.34	34	13	2.92
USGS 108	04/19/95	12.8	8.09	37.0	15.0	0.189	0.038	23.3	10.6	2.4	165	14.0	22.4	2.9	0.024	0.24	41	36	0.74
USGS 109	04/20/95	13.4	8.07	41.2	16.2	0.228	0.029	20.7	11.4	2.7	176	19.4	26.9	2.9	0.050	0.20	68	34	2.65
USGS 109	10/11/96	13.6	8.13	39.8	15.7	0.307	nd	24.4	10.5	2.7	181	14.0	25.0	2.5	0.036	0.23	46	15	1.39
USGS 110A	10/09/96	14.8	8.07	36.7	14.9	0.205	nd	31.7	15.2	3.6	173	19.0	18.0	5.0	0.035	0.45	125	15	0.89
USGS 112	07/15/96	13.6	8.04	76.0	21.0	0.484	0.250	21.5	54.0	4.9	173	151.0	29.0	14.0	0.041	0.26	89	119	2.59
USGS 113	07/16/96	13.1	8.00	78.3	23.1	0.532	0.342	21.5	78.4	6.2	164	218.0	31.2	10.6	0.046	0.15	122	117	0.55
USGS 115	07/15/96	13.3	8.08	42.9	13.3	0.244	0.065	21.5	13.2	3.3	146	38.0	21.2	5.6	0.039	0.23	54	60	0.9
USGS 116	07/15/96	12.7	8.18	56.4	16.0	0.333	0.136	22.2	24.8	4.6	122	89.3	34.2	13.2	0.122	0.30	84	80	0.46
USGS 117	07/17/96	13.4	8.29	25.7	11.2	0.144	0.018	27.7	9.6	2.6	121	13.7	17.1	2.6	0.040	0.22	49	40	0.46
USGS 120	07/17/96	12.0	8.18	34.0	18.4	0.197	0.048	22.4	25.4	4.0	186	21.7	38.0	3.4	0.063	0.26	70	55	0.81
USGS 124	04/20/95	13.4	7.91	39.3	16.0	0.191	0.029	21.8	8.9	2.2	172	14.3	22.4	3.3	0.035	0.31	219	41	4.00
USGS 124	10/09/96	13.6	8.03	38.6	16.2	0.256	nd	25.7	8.8	2.4	176	14.8	21.5	3.2	0.024	0.30	89	14	1.91
USGS 125	06/16/95	12.8	8.00	40.8	15.9	0.230	0.035	21.6	11.8	2.7	178	14.9	25.8	2.8	0.042	0.21	56	33	3.97
USGS 125	10/11/96	12.7	8.08	39.8	15.8	0.285	nd	24.2	10.9	2.9	181	14.8	24.5	2.5	0.032	0.23	67	17	2.21
Wagoner Ranch	05/22/97	7.0	7.80	48.6	15.8	0.163	0.069	11.9	5.1	1.1	201	5.5	21.9	0.8	nd	0.22	48	0	0.75

Table 7. Temperature, pH, and concentrations of cations and anions in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Site identifier	Date sampled	Temp. °C	pH	Ca	Mg	Sr	[1]Ba	SiO_2	Na	K	HCO_3^-	Cl	SO_4^{2-}	NO_3^-	Br	F	Fe	[2]Al	DOC
Big Lost River at Mackay Dam	06/28/95	13.1	8.15	26.1	6.3	0.146	0.059	8.7	3.8	1.3	108	2.3	13.1	nd	0.006	0.19	61	52	2.36
Big Lost River bridge at Mackay	06/17/95	11.0	8.07	25.9	6.3	0.148	0.057	9.1	3.8	1.4	105	2.3	12.6	0.4	0.006	0.18	43	50	2.96
Big Lost River, near NRF, Lincoln Blvd., INEEL	06/19/95	12.5	7.67	31.2	7.4	0.164	0.060	10.7	4.8	1.7	123	3.1	17.5	0.8	0.007	0.21	100	85	3.52
Big Springs, ID	06/27/95	10.8	6.88	4.9	0.8	0.005	<0.005	38.5	12.0	2.7	41	2.6	2.3	nd	0.010	2.85	5	23	0.52
Big Springs, ID	05/21/97	13.1	6.83	5.0	0.6	0.005	0.000	51.1	14.3	3.1	48	4.2	6.4	0.6	nd	3.30	25	41	0.34
Birch Creek at Blue Dome	06/17/95	14.1	8.90	38.5	14.6	0.142	0.065	7.6	5.3	0.8	173	4.8	26.4	0.8	0.010	0.19	36	30	0.86
Birch Creek at Blue Dome	06/28/95	9.4	8.46	41.9	15.1	0.150	0.061	7.7	5.2	0.9	183	4.8	25.3	1.0	0.007	0.18	28	34	0.75
Camas Creek at Kilgore	07/20/96	17.7	8.21	23.3	5.3	0.082	0.045	22.1	4.6	2.2	106	3.0	4.0	0.2	<0.02	0.16	92	48	nd
Camas Creek near Mud Lake	06/17/95	14.7	8.48	28.4	6.5	0.118	0.040	14.7	5.2	2.1	125	2.5	4.3	nd	0.006	0.12	58	72	5.40
Condie Hot Springs	06/21/95	50.2	6.94	61.3	11.5	0.990	0.333	24.6	58.1	18.0	361	13.6	26.6	nd	0.029	1.19	268	60	1.53
Condie Hot Springs	05/22/97	50.2	7.01	58.2	11.6	1.010	0.275	28.7	52.5	19.4	342	13.1	24.0	<0.05	nd	1.26	281	1	nd
Lidy Hot Springs	07/20/96	60.0	7.06	59.4	15.0	0.607	0.113	35.0	21.4	11.5	179	7.2	94.3	0.2	0.021	4.15	100	88	1.21
Lidy Hot Springs	05/14/97	47.3	7.06	88.8	17.2	1.080	0.044	34.4	23.9	14.3	168	7.6	196.0	0.6	nd	4.06	103	1	0.79
Little Lost River near INEEL	06/17/95	12.8	8.55	49.4	23.3	0.147	0.124	10.0	15.3	1.8	239	23.2	23.6	2.7	0.044	0.08	62	45	1.57
Little Lost River north of Howe	06/28/95	14.1	8.13	26.8	8.7	0.091	0.051	10.1	4.0	1.2	120	3.8	8.5	0.5	0.005	0.10	39	51	3.20
Madison River at bridge US 191, Montana	07/20/96	19.6	8.01	5.0	0.7	0.010	0.005	63.7	50.3	6.1	101	32.1	9.2	0.2	0.092	4.58	73	47	2.7

[1] Barium concentrations measured by direct-current plasma spectroscopy compare favorably with results obtained by inductively coupled mass spectroscopy.

[2] Aluminum concentrations measured by direct-current plasma spectroscopy are semi-quantitative because of calcium spectral interferences. Aluminum concentrations obtained by inductively coupled mass spectroscopy are superior and should be used.

Table 8. Concentrations of lithium, beryllium, boron, aluminum, vanadium, chromium, manganese, nickel, cobalt, copper, zinc, and arsenic in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity

[Concentrations are in ppb (parts per billion); <, less than]

Symbol of element Mass number	Date sampled	Li 7	Be 9	B 11	Al 27	V 51	Cr 52	Mn 55	Ni 62	Co 59	Cu 63	Cu 65	Zn 66	Zn 68	As 75
ANP 6	06/15/95	3.0	<0.05	26	4	4.7	3	0.9	0.2	<0.05	0.4	0.5	45	46	2.5
ANP 6	07/19/96	2.9	<0.05	26	6	4.7	3	1.1	0.3	<0.05	0.2	0.3	42	43	2.4
ANP 9	10/14/96	10.2	<0.05	35	5	5.3	3	0.9	<0.1	<0.05	0.2	0.3	10	12	2.6
Arbor Test 1	04/21/95	24.7	<0.05	44	5	5.5	2	0.4	0.4	<0.05	0.9	0.8	219	216	2.3
Arbor Test 1	10/10/96	24.9	<0.05	46	5	5.6	2	0.3	0.3	0.10	0.4	0.4	212	209	2.3
Arco City Well 4	05/13/97	1.0	<0.05	11	1	1.0	1	<0.1	<0.1	0.22	0.9	1.0	2	5	1.2
Area II	07/18/96	17.7	<0.05	41	7	6.3	3	<0.1	0.15	<0.05	1.0	1.1	3	3	2.6
Atomic City	10/09/96	18	<0.05	40	7	6.4	3	0.1	0.1	<0.05	0.2	0.2	24	24	2.5
BFW	07/16/96	3.9	<0.05	21	5	8.0	9	0.2	<0.1	0.09	0.9	0.9	66	66	1.9
CFA 1	07/16/96	2.5	<0.05	21	4	5.0	10	0.2	0.5	0.05	0.6	0.7	3	5	1.3
CFA 2	07/16/96	3.6	<0.05	27	4	4.8	10	2.8	0.2	0.09	0.4	0.5	2	4	1.2
EBR I	10/16/96	2.7	<0.05	20	10	13.7	7	0.4	0.1	<0.05	0.2	0.2	6	7	1.9
Engberson Well	05/14/97	14.4	<0.05	36	2	4.9	11	<0.1	0.1	0.06	0.6	0.7	104	104	3.8
Fire Station 2	10/16/96	2.0	<0.05	24	7	5.4	7	0.5	0.2	0.07	2.4	2.5	13	14	1.6
IET 1 Disposal	07/18/96	2.3	<0.05	72	3	2.7	<1	140	0.9	0.30	0.5	0.5	46	48	2.6
INEL-1 WS	06/12/95	2.8	<0.05	19	1	4.9	8	3.6	0.2	0.18	1.0	1.1	167	165	1.4
Leo Rogers 1	07/17/96	16	<0.05	40	6	6.6	3	<0.1	0.1	<0.05	1.0	1.0	129	127	2.6
Neville Well	05/14/97	25.0	<0.05	58	4	5.1	<1	<0.1	0.5	0.11	0.8	0.8	11	11	2.5
NPR Test	04/17/95	2.0	<0.05	16	14	4.6	7	1.2	0.3	<0.05	0.5	0.5	96	96	1.9
NPR Test	10/10/96	2.2	<0.05	20	3	4.6	7	1.2	0.2	<0.05	0.3	0.4	94	94	1.95
Pancheri 6	05/13/97	1.5	<0.05	16	1	2.0	2	<0.1	<0.1	<0.05	<0.1	<0.1	1	2	1.2
Park Bell	05/21/97	73.5	<0.05	84	3	<0.1	<1	91.1	<0.1	<0.05	<0.1	<0.1	19	20	22.3
PSTF Test	10/14/96	1.8	<0.05	19	4	4.8	3	<0.1	0.5	<0.05	0.1	0.2	3	5	1.9
P&W 2	10/15/96	2.9	<0.05	18	5	2.3	2	0.2	<0.1	<0.05	<0.1	0.2	53	54	1.9
P&W 2	04/19/95	2.9	<0.05	17	5	2.2	1	0.3	0.1	<0.05	0.6	0.7	53	53	1.8

Table 8. Concentrations of lithium, beryllium, boron, aluminum, vanadium, chromium, manganese, nickel, cobalt, copper, zinc, and arsenic in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Symbol of element Mass number	Date sampled	Li 7	Be 9	B 11	Al 27	V 51	Cr 52	Mn 55	Ni 62	Co 59	Cu 63	Cu 65	Zn 66	Zn 68	As 75
RWMC M3S	07/22/96	2.4	<0.05	18	7	6.1	15	0.1	1.8	<0.05	2.7	2.8	10	11	1.6
RWMC M7S	07/22/96	2.2	<0.05	17	6	6.1	11	0.1	0.8	<0.05	0.7	0.8	4	5	1.5
Site 04	10/16/96	1.7	<0.05	20	7	4.8	8	<0.1	<0.1	<0.05	0.3	0.4	2	3	1.9
Site 09	07/22/96	3.5	<0.05	30	9	6.1	4	3.8	0.2	<0.05	0.4	0.5	3	4	2.1
Site 14	10/14/96	11.5	<0.05	35	6	7.0	5	<0.1	<0.1	<0.05	<0.1	<0.1	2	4	4.4
Site 17	06/16/95	2.4	<0.05	26	18	2.9	4	0.2	0.9	<0.05	0.6	0.7	3	5	1.7
Site 19	07/16/96	2.5	<0.05	25	5	3.9	3	<0.1	<0.1	0.12	1.0	1.1	59	59	1.6
TAN Exploration	10/14/96	2.5	<0.05	20	20	4.3	8	2.1	0.3	0.13	0.2	0.3	3	4	2.0
USGS 001	10/09/96	18	<0.05	42	6	6.4	2	0.8	0.2	<0.05	1.3	1.3	2	3	2.5
USGS 002	07/17/96	20.4	<0.05	45	5	5.9	2	3.7	1.2	<0.05	0.8	0.8	3	4	2.2
USGS 004	04/19/95	24.2	<0.05	48	3	5.6	10	0.1	0.2	0.07	1.3	1.2	18	20	3.9
USGS 004	10/15/96	23.7	<0.05	48	3	5.5	11	<0.1	0.2	0.06	0.4	0.4	5	8	3.8
USGS 005	10/10/96	2.0	<0.05	19	6	2.5	2	47.4	1.0	0.12	<0.1	0.1	3	4	1.1
USGS 006	07/18/96	7.3	<0.05	25	4	7.2	28	0.9	0.8	<0.05	0.1	0.2	4	6	5.8
USGS 007	10/14/96	25.9	<0.05	57	5	7.0	2	3.6	0.5	<0.05	0.2	0.2	2	3	3.7
USGS 008	10/08/96	1.3	<0.05	13	6	3.1	2	1.1	0.4	0.15	1.6	1.6	5	7	1.1
USGS 009	04/20/95	3.2	<0.05	22	4	4.8	4	3.4	0.2	0.08	0.4	0.5	198	195	1.3
USGS 009	10/11/96	3.3	<0.05	25	4	4.4	4	3.9	1.2	0.06	0.3	0.4	296	293	1.2
USGS 011	04/20/95	2.1	<0.05	16	6	4.5	4	0.6	0.9	0.11	0.5	0.5	54	54	1.4
USGS 011	10/09/96	2.1	<0.05	17	6	4.3	3	0.4	0.5	0.06	0.2	0.3	102	102	1.3
USGS 012	06/14/95	2.7	<0.05	33	3	3.9	7	1.1	0.2	0.06	0.5	0.6	3	7	1.8
USGS 014	10/09/96	24.3	<0.05	36	6	6.0	4	0.6	0.5	<0.05	<0.1	0.1	54	53	2.6
USGS 015	06/14/95	2.1	<0.05	18	3	6.5	7	<0.1	<0.1	<0.05	0.2	0.2	2	3	2.0
USGS 015	05/13/97	2.1	<0.05	19	2	6.1	7	<0.1	<0.1	<0.05	<0.1	0.2	<1	2	2.0
USGS 017	06/13/95	1.4	<0.05	13	9	6.3	2	0.7	<0.1	<0.05	0.3	0.4	3	3	2.0

Table 8. Concentrations of lithium, beryllium, boron, aluminum, vanadium, chromium, manganese, nickel, cobalt, copper, zinc, and arsenic in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Symbol of element Mass number	Date sampled	Li 7	Be 9	B 11	Al 27	V 51	Cr 52	Mn 55	Ni 62	Co 59	Cu 63	Cu 65	Zn 66	Zn 68	As 75
USGS 018	07/19/96	5.2	<0.05	33	7	6.1	3	0.5	0.1	<0.05	0.2	0.2	3	4	2.8
USGS 019	04/19/95	3.5	<0.05	33	5	2.3	3	0.2	0.1	<0.05	0.9	1	8	9	1.8
USGS 019	10/15/96	3.5	<0.05	32	5	2.3	3	0.3	<0.1	<0.05	<0.1	0.1	4	5	1.7
USGS 022	06/13/95	3.7	<0.05	33	4	2.6	2	15.1	0.9	<0.05	0.5	0.6	7	7	0.4
USGS 022	07/18/96	3.8	<0.05	36	5	3.0	2	15.8	0.7	<0.05	0.2	0.2	2	2	0.4
USGS 023	04/19/95	4.3	<0.05	26	5	3.3	3	0.9	0.2	0.08	0.6	0.7	5	6	1.5
USGS 023	10/15/96	4.2	<0.05	26	6	3.2	3	0.9	0.4	<0.05	<0.1	<0.1	3	5	1.5
USGS 026	10/15/96	18.4	<0.05	38	4	4.2	3	0.6	0.2	<0.05	<0.1	0.1	3	4	2.5
USGS 027	10/15/96	36.4	<0.05	52	2	5.6	5	5.7	0.2	0.34	0.1	0.2	2	4	2.8
USGS 029	06/15/95	23.7	<0.05	36	4	6.0	4	<0.1	0.2	<0.05	0.5	0.5	2	3	2.4
USGS 029	07/19/96	24	<0.05	36	7	5.8	4	<0.1	0.1	<0.05	0.4	0.4	3	4	2.4
USGS 031	06/15/95	17.8	<0.05	35	3	5.4	4	<0.1	0.3	<0.05	0.6	0.6	5	5	2.5
USGS 031	07/19/96	18.1	<0.05	37	4	5.3	5	0.2	0.4	0.06	0.3	0.4	3	4	2.5
USGS 032	06/15/95	19.1	<0.05	43	2	5.4	5	0.4	0.4	<0.05	0.3	0.5	2	3	2.6
USGS 032	07/16/96	18.1	<0.05	38	5	5.4	5	0.3	0.3	<0.05	0.5	0.6	10	11	2.5
USGS 036	07/16/96	1.7	<0.05	21	3	3.9	13	<0.1	0.2	<0.05	0.5	0.6	4	6	1.5
USGS 082	07/16/96	2.2	<0.05	19	3	6.5	6	1.3	0.2	<0.05	0.5	0.6	112	110	1.6
USGS 083	04/11/95	3.0	<0.05	15	5	9.2	14	0.3	0.6	<0.05	0.7	0.8	193	189	2.5
USGS 086	10/11/96	2.3	<0.05	18	2	6.7	12	0.8	1.8	<0.05	0.2	0.3	328	317	1.1
USGS 089	07/17/96	4.2	<0.05	30	3	11.8	45	0.4	0.3	<0.05	0.7	0.8	11	11	2.5
USGS 097	06/13/95	2.6	<0.05	29	2	3.8	6	<0.1	0.3	0.06	0.9	1.1	98	97	1.7
USGS 098	06/12/95	2.5	<0.05	22	2	6.0	6	6	0.2	<0.05	1.5	1.6	194	188	1.6
USGS 099	06/12/95	2.5	<0.05	30	3	3.2	5	0.9	1.2	0.06	0.7	0.8	85	84	1.6
USGS 100	04/21/95	23.4	<0.05	44	2	5.6	3	0.5	1.0	0.06	1.2	1.3	375	362	1.9
USGS 100	10/10/96	22.6	<0.05	46	3	5.3	2	0.8	0.7	<0.05	0.5	0.5	294	286	1.9

Table 8. Concentrations of lithium, beryllium, boron, aluminum, vanadium, chromium, manganese, nickel, cobalt, copper, zinc, and arsenic in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Symbol of element Mass number	Date sampled	Li 7	Be 9	B 11	Al 27	V 51	Cr 52	Mn 55	Ni 62	Co 59	Cu 63	Cu 65	Zn 66	Zn 68	As 75
USGS 101	04/21/95	27.7	<0.05	45	6	5.5	2	0.2	0.1	<0.05	0.8	0.8	172	168	2.0
USGS 101	10/10/96	27.8	<0.05	47	6	5.5	2	0.2	0.1	<0.05	0.2	0.2	181	178	2.0
USGS 102	06/13/95	2.9	<0.05	30	4	4.0	7	<0.1	0.2	0.07	0.6	0.8	3	5	1.8
USGS 103	04/18/95	6.9	<0.05	29	3	7.6	6	0.6	0.2	<0.05	0.8	0.9	351	340	2.2
USGS 103	07/15/96	6.9	<0.05	30	6	6.1	6	2.2	0.3	<0.05	0.6	0.7	283	274	1.8
USGS 104	04/18/95	2.4	<0.05	16	4	7.6	8	0.4	1.4	0.08	0.8	0.9	296	288	1.7
USGS 104	07/15/96	2.2	<0.05	16	3	7.3	7	0.3	0.7	0.08	2.1	2.2	252	245	1.7
USGS 105	04/18/95	2.5	<0.05	22	5	6.1	7	0.1	0.2	<0.05	0.9	1.0	177	173	1.8
USGS 107	10/09/96	10.5	<0.05	35	4	7.6	5	<0.1	0.1	<0.05	0.1	0.2	3	4	2.7
USGS 108	04/19/95	4.3	<0.05	23	4	7.7	7	0.1	0.2	<0.05	1.4	1.5	129	126	2.1
USGS 109	04/20/95	3.0	<0.05	20	2	5.0	5	7.1	0.9	0.21	0.6	0.7	241	233	1.4
USGS 109	10/11/96	2.7	<0.05	23	4	4.7	5	5.8	1.9	0.06	0.2	0.3	227	220	1.3
USGS 110A	10/09/96	15.9	<0.05	38	6	4.6	3	7.2	1.4	<0.05	0.1	0.2	3	3	2.0
USGS 112	07/15/96	2.4	<0.05	24	5	4.9	6	0.1	0.1	0.06	1.3	1.3	158	156	1.2
USGS 113	07/16/96	2.8	<0.05	26	2	5.4	6	0.1	0.2	0.06	2.5	2.3	196	195	1.3
USGS 115	07/15/96	2.1	<0.05	18	5	4.2	7	1.5	0.4	0.05	0.7	0.8	569	553	1.0
USGS 116	07/15/96	2.5	<0.05	18	3	5.7	12	0.3	0.3	<0.05	0.6	0.7	223	218	1.4
USGS 117	07/17/96	5.1	<0.05	23	3	11.6	21	0.8	1.9	<0.05	0.6	0.6	24	24	2.5
USGS 120	07/17/96	3.6	<0.05	39	5	8.9	9	1.0	0.7	<0.05	7.6	7.7	14	15	2.5
USGS 124	04/20/95	6.9	<0.05	20	9	4.9	5	16.2	0.8	0.25	0.3	0.4	10	11	1.4
USGS 124	10/09/96	6.7	<0.05	21	5	4.9	4	9.4	0.1	<0.05	0.1	0.1	8	9	1.5
USGS 125	06/16/95	3.2	<0.05	21	6	5.5	5	5.5	0.4	0.05	0.6	0.7	3	3	1.6
USGS 125	10/11/96	3.1	<0.05	22	5	5.3	4	11.0	0.8	<0.05	0.2	0.3	3	3	1.5
Wagoner Ranch	05/22/97	3.3	<0.05	18	<1	0.9	<1	2.7	0.2	0.07	3.1	3.2	367	360	1.5

Table 8. Concentrations of lithium, beryllium, boron, aluminum, vanadium, chromium, manganese, nickel, cobalt, copper, zinc, and arsenic in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Symbol of element Mass number	Date sampled	Li 7	Be 9	B 11	Al 27	V 51	Cr 52	Mn 55	Ni 62	Co 59	Cu 63	Cu 65	Zn 66	Zn 68	As 75
Big Lost River at Mackay Dam	06/28/95	1.7	<0.05	12	60	1.2	<1	3.5	1.0	0.06	0.6	0.7	13	14	1.7
Big Lost River at Mackay Bridge	06/17/95	1.7	<0.05	11	42	1.1	<1	3.1	1.0	0.06	0.8	0.8	<1	2	1.6
Big Lost River, near NRF, Lincoln Blvd.	06/19/95	2.0	<0.05	13	116	3.0	<1	1.6	1.3	0.10	1.9	2.0	2	3	2.3
Big Springs	06/27/95	52.7	0.48	52	14	<0.1	<1	0.1	<0.1	<0.05	<0.1	<0.1	10	10	1.3
Big Springs	05/21/97	67.1	0.58	67	41	<0.1	<1	0.3	0.1	<0.05	0.1	<0.1	3	4	2.1
Birch Creek at Blue Dome	06/19/95	3.2	<0.05	14	4	0.8	<1	0.5	<0.1	0.07	<0.1	<0.1	3	4	2.0
Birch Creek at Blue Dome	06/17/95	3.1	<0.05	14	1	1.0	<1	0.6	<0.1	0.04	<0.1	0.2	<1	2	2.2
Camas Creek at Kilgore	07/20/96	2.9	<0.05	11	25	2.1	<1	58.9	1	0.19	1.2	1.2	2	2	2.2
Camas Creek near Mud Lake	06/17/95	3.4	<0.05	14	42	1.3	<1	2.7	0.7	0.08	0.8	0.8	2	3	1.7
Condie Hot Springs	06/21/95	83.1	0.07	235	2	<0.1	<1	6.9	<0.1	<0.05	0.1	<0.1	<1	6	4.6
Condie Hot Springs	05/22/97	82.4	0.07	234	1	<0.1	<1	6.8	0.1	<0.05	0.1	<0.1	3	8	4.6
Lidy Hot Springs	07/20/96	42.8	<0.05	88	6	<0.1	<1	2.9	0.3	0.07	0.5	0.8	3	5	15
Lidy Hot Springs	05/14/97	43.3	<0.05	81	1	<0.1	<1	13.8	0.2	0.09	0.1	0.8	6	6	10
Little Lost River near INEEL	06/17/95	2.4	<0.05	37	3	1.6	1	1.1	0.3	0.07	0.3	0.3	<1	3	1.1
Little Lost River north of Howe	06/28/95	1.1	<0.05	12	30	2.2	<1	1.5	0.6	0.06	0.4	0.5	4	5	1.2
Madison River at US 191, Montana	07/20/96	535	0.73	540	53	0.5	<1	4.1	0.3	<0.05	0.2	<0.1	<1	<1	184

Table 9. Concentrations of selenium, rubidium, strontium, molybdenum, cadmium, cesium, barium, tellurium, lead, and uranium in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity

[All concentrations are in parts per billion; <, less than]

Symbol of element Mass number	Date sampled	Se 82	Rb 85	Sr 88	Mo 95	Mo 97	Mo 98	Cd 111	Cs 133	Ba 135	Ba 137	Ba 138	Tl 205	Pb 208	U 238
ANP 6	06/15/95	2.1	3.1	224	3.2	3.2	3.2	<0.05	0.19	65.1	65.6	66.4	<0.05	0.63	2.3
ANP 6	07/19/96	2.0	3.0	221	3.0	3.1	3.0	<0.05	0.18	64.5	64.9	65.7	<0.05	0.56	2.2
ANP 9	10/14/96	1.5	7.0	192	2.9	2.9	2.9	<0.05	0.32	85.4	85.5	86.9	<0.05	0.09	2.5
Arbor Test 1	04/21/95	0.5	7.3	123	2.3	2.3	2.4	<0.05	0.23	28.7	29.0	29.9	<0.05	1.9	1.8
Arbor Test 1	10/10/96	0.5	7.4	124	2.1	2.2	2.2	<0.05	0.23	28.6	28.8	29.5	<0.05	1.9	1.8
Arco City Well 4	05/13/97	1.6	0.5	266	2.1	2.1	2.1	<0.05	<0.05	133	133	135	<0.05	1.2	2.5
Area II	07/18/96	1.2	8.0	163	2.3	2.3	2.3	<0.05	0.29	34.0	34.2	34.5	<0.05	0.09	2.1
Atomic City	10/09/96	1.1	7.6	152	2.1	2.1	2.1	<0.05	0.23	31.4	31.4	31.8	<0.05	0.09	2.0
BFW	07/16/96	1.6	5.2	205	2.8	2.8	2.8	<0.05	<0.05	32.6	32.6	32.9	<0.05	0.81	1.9
CFA 1	07/16/96	1.5	8.4	369	2.1	2.1	2.1	<0.05	0.13	80.2	81.1	82.0	<0.05	<0.05	2.3
CFA 2	07/16/96	3.7	10.5	463	1.9	1.9	1.9	<0.05	<0.05	79.2	79.5	81.6	<0.05	0.64	2.3
EBR I	10/16/96	1.1	9.2	192	1.6	1.7	1.6	<0.05	<0.05	20.7	20.8	21.0	<0.05	1.2	1.8
Engberson Well	05/14/97	5.5	5.7	306	1.4	1.4	1.4	<0.05	0.29	149	149	151	<0.05	0.49	3.2
Fire Station 2	10/16/96	1.7	4.0	297	1.8	1.8	1.8	<0.05	0.06	73.5	73.7	75.1	<0.05	6.65	2.0
IET 1 Disposal	07/18/96	1.2	2.5	255	3.3	3.3	3.3	<0.05	0.08	110	110	111	<0.05	0.43	1.8
INEL-1 WS	06/12/95	2.6	5.8	304	0.6	0.6	0.6	0.08	<0.05	58.7	58.7	55.5	<0.05	0.61	1.6
Leo Rogers 1	07/17/96	1.3	7.8	170	2.3	2.3	2.3	<0.05	0.24	33.3	33.5	34.0	<0.05	0.18	2.2
Neville Well	05/14/97	<0.5	9.1	98	2.2	2.2	2.2	<0.05	0.11	6.0	6.1	6.1	<0.05	0.11	1.8
NPR Test	04/17/95	1.4	4.4	257	2.6	2.6	2.6	0.13	<0.05	75.9	76.4	78.0	<0.05	0.68	2.2
NPR Test	10/10/96	1.5	4.3	245	2.5	2.6	2.6	0.10	<0.05	72.2	72.4	74.1	<0.05	1.1	2.0
Pancheri 6	05/13/97	1.4	0.8	142	0.8	0.7	0.8	<0.05	<0.05	68.7	69.1	71.1	<0.05	<0.05	1.2
Park Bell	05/21/97	<0.5	3.7	80	2.6	2.6	2.6	<0.05	<0.05	64.3	64.7	66.5	<0.05	<0.05	0.1
PSTF Test	10/14/96	1.4	3.1	144	1.7	1.8	1.8	<0.05	0.17	66.9	67.3	68.4	<0.05	0.07	1.7
P&W 2	10/15/96	1.5	1.8	152	3.5	3.6	3.5	<0.05	<0.05	45.6	45.8	46.2	<0.05	0.63	2.0
P&W 2	04/19/95	1.4	1.8	148	3.8	3.9	3.8	<0.05	<0.05	44.5	44.6	45.0	<0.05	0.71	1.9

Table 9. Concentrations of selenium, rubidium, strontium, molybdenum, cadmium, cesium, barium, tellurium, lead, and uranium in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Symbol of element Mass number	Date sampled	Se 82	Rb 85	Sr 88	Mo 95	Mo 97	Mo 98	Cd 111	Cs 133	Ba 135	Ba 137	Ba 138	Tl 205	Pb 208	U 238
RWMC M3S	07/22/96	1.4	6.5	249	2.2	2.2	2.3	<0.05	<0.05	40.4	40.7	41.0	<0.05	0.29	2.1
RWMC M7S	07/22/96	1.3	6.5	247	2.2	2.2	2.2	<0.05	<0.05	42.4	42.6	43.1	<0.05	<0.05	2.0
Site 04	10/16/96	1.5	3.1	193	2.5	2.5	2.5	<0.05	<0.05	63.4	63.4	64.3	<0.05	0.43	1.9
Site 09	07/22/96	1.5	5.3	196	2.8	2.8	2.8	<0.05	0.08	56.3	56.5	58.0	<0.05	0.11	1.8
Site 14	10/14/96	1.5	5.6	173	2.95	3.0	3.0	<0.05	0.28	59.8	59.4	60.9	<0.05	0.11	2.2
Site 17	06/16/95	1.4	1.6	211	0.8	0.9	0.9	<0.05	0.05	75.1	75.5	77.5	<0.05	0.19	1.5
Site 19	07/16/96	1.6	4.0	226	1.1	1.1	1.1	<0.05	0.08	43.6	43.7	44.2	<0.05	1.2	1.7
TAN Exploration	10/14/96	2.8	4.3	180	5.9	5.9	5.9	<0.05	0.35	68.4	68.4	69.8	<0.05	<0.05	1.8
USGS 001	10/09/96	0.8	7.4	132	2.3	2.3	2.3	<0.05	0.23	24.6	24.6	24.7	<0.05	0.17	1.9
USGS 002	07/17/96	0.8	7.3	139	2.2	2.1	2.2	<0.05	0.19	31.3	31.6	32.0	<0.05	0.19	2.0
USGS 004	04/19/95	3.5	7.5	308	2.0	2.0	2.0	<0.05	0.21	138	138	140	<0.05	0.39	3.8
USGS 004	10/15/96	3.5	7.3	303	1.8	1.8	1.8	<0.05	0.21	135	136	138	<0.05	0.11	3.6
USGS 005	10/10/96	1.5	3.0	186	2.8	2.9	2.8	<0.05	<0.05	63.4	63.8	65.3	<0.05	<0.05	1.6
USGS 006	07/18/96	1.8	2.8	198	3.6	3.6	3.6	<0.05	<0.05	72.5	73.1	75.2	<0.05	0.08	1.9
USGS 007	10/14/96	0.9	12.2	115	3.7	3.7	3.7	<0.05	0.09	15.8	15.9	16.1	<0.05	0.05	2.5
USGS 008	10/08/96	1.6	2.7	248	2.1	2.1	2.1	<0.05	<0.05	75.4	76.1	77.9	<0.05	0.25	2.3
USGS 009	04/20/95	1.5	6.2	199	2.8	2.8	2.9	<0.05	<0.05	32.9	33.1	34.2	<0.05	0.5	1.7
USGS 009	10/11/96	1.4	6.3	199	2.9	2.9	2.85	0.12	<0.05	33.0	33.2	34.1	0.06	2.2	1.4
USGS 011	04/20/95	1.3	4.4	237	2.7	2.7	2.7	<0.05	<0.05	52.9	53.0	54.7	<0.05	0.72	1.9
USGS 011	10/09/96	1.3	4.3	236	2.6	2.6	2.6	<0.05	<0.05	51.7	52.2	53.9	<0.05	1.15	1.7
USGS 012	06/14/95	2.7	2.4	341	1.5	1.5	1.5	<0.05	0.09	161	161	164	<0.05	0.22	2.8
USGS 014	10/09/96	2.0	8.5	172	4.2	4.2	4.2	<0.05	1.38	20.0	20.1	20.4	<0.05	1.6	2.6
USGS 015	06/14/95	1.6	2.2	197	0.9	0.9	0.9	<0.05	<0.05	65.5	65.6	67.5	<0.05	0.09	1.4
USGS 015	05/13/97	2.0	2.1	201	0.8	0.8	0.8	<0.05	<0.05	72.5	72.6	73.5	<0.05	<0.05	1.4
USGS 017	06/13/95	1.3	5.1	218	3.0	3.0	3.0	<0.05	<0.05	35.5	35.8	36.2	<0.05	0.12	1.8
USGS 018	07/19/96	1.2	5.2	169	2.8	2.8	2.8	<0.05	0.15	51.5	51.7	50.8	<0.05	0.10	2.0

Table 9. Concentrations of selenium, rubidium, strontium, molybdenum, cadmium, cesium, barium, tellurium, lead, and uranium in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Symbol of element Mass number	Date sampled	Se 82	Rb 85	Sr 88	Mo 95	Mo 97	Mo 98	Cd 111	Cs 133	Ba 135	Ba 137	Ba 138	Tl 205	Pb 208	U 238
USGS 019	04/19/95	1.3	2.0	252	1.0	1.0	1.0	<0.05	0.15	74.3	74.4	74.7	<0.05	0.31	1.5
USGS 019	10/15/96	1.1	1.9	248	0.9	0.9	0.9	<0.05	0.15	73.1	73.1	73.6	<0.05	0.12	1.5
USGS 022	06/13/95	1.0	6.9	115	4.2	4.2	4.3	<0.05	<0.05	15.7	15.7	15.4	<0.05	<0.05	0.25
USGS 022	07/18/96	1.2	7.1	117	4.1	4.1	4.2	<0.05	<0.05	15.1	15.2	14.9	<0.05	<0.05	0.32
USGS 023	04/19/95	1.9	3.1	230	1.8	1.8	1.8	<0.05	0.10	57.0	57.2	55.4	<0.05	0.22	1.9
USGS 023	10/15/96	2.0	2.9	227	1.9	1.9	1.9	<0.05	0.10	56.5	56.7	57.0	<0.05	<0.05	1.9
USGS 026	10/15/96	1.3	9.3	191	2.8	2.8	2.8	<0.05	0.51	36.8	36.9	35.9	<0.05	0.07	2.4
USGS 027	10/15/96	2.3	11.2	237	1.9	1.9	1.9	<0.05	0.43	76.4	76.7	76.5	<0.05	<0.05	2.9
USGS 029	06/15/95	1.6	8.1	156	1.6	1.5	1.6	<0.05	0.28	52.3	52.9	51.4	<0.05	0.13	2.0
USGS 029	07/19/96	1.6	7.9	154	1.5	1.5	1.5	<0.05	0.27	51.8	51.9	50.9	<0.05	0.13	2.0
USGS 031	06/15/95	1.3	9.8	194	2.3	2.3	2.3	<0.05	0.56	39.1	39.1	38.1	<0.05	0.24	2.2
USGS 031	07/19/96	1.4	9.9	196	2.7	2.7	2.7	<0.05	0.57	38.9	39.1	38.1	<0.05	0.19	2.2
USGS 032	06/15/95	1.7	10.5	248	2.1	2.1	2.1	<0.05	0.61	54.2	54.4	53.4	<0.05	0.10	2.4
USGS 032	07/16/96	1.7	10.7	261	2.0	2.0	2.0	<0.05	0.61	57.1	57.6	57.9	<0.05	0.21	2.5
USGS 036	07/16/96	1.6	5.3	313	2.1	2.1	2.1	<0.05	<0.05	110	110	110	<0.05	0.15	2.5
USGS 082	07/16/96	1.5	7.2	225	3.4	3.4	3.5	<0.05	<0.05	51.4	51.5	50.2	<0.05	0.26	1.7
USGS 083	04/11/95	1.9	5.9	167	3.3	3.3	3.3	0.15	<0.05	94.1	94.3	95.3	<0.05	2.2	1.5
USGS 086	10/11/96	2.2	5.5	143	3.1	3.1	3.1	0.07	<0.05	16.5	16.5	16.1	<0.05	1.9	1.0
USGS 089	07/17/96	3.8	3.3	135	7.3	7.3	7.3	<0.05	<0.05	15.5	15.7	15.4	<0.05	0.08	1.2
USGS 097	06/13/95	2.5	2.8	297	1.3	1.3	1.4	<0.05	0.07	131	132	133	<0.05	0.91	2.4
USGS 098	06/12/95	1.6	4.4	218	1.5	1.5	1.5	0.25	<0.05	43.9	44.1	43.1	<0.05	9.3	1.5
USGS 099	06/12/95	1.9	2.4	245	0.8	0.8	0.8	<0.05	0.06	104	104	105	<0.05	0.93	1.8
USGS 100	04/21/95	0.9	7.5	138	2.2	2.2	2.2	0.34	0.23	34.0	34.4	33.6	<0.05	18	1.5
USGS 100	10/10/96	0.8	7.4	134	2.1	2.1	2.1	0.29	0.23	33.1	33.1	32.4	<0.05	16	1.5

Table 9. Concentrations of selenium, rubidium, strontium, molybdenum, cadmium, cesium, barium, tellurium, lead, and uranium in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Symbol of element Mass number	Date sampled	Se 82	Rb 85	Sr 88	Mo 95	Mo 97	Mo 98	Cd 111	Cs 133	Ba 135	Ba 137	Ba 138	Tl 205	Pb 208	U 238
USGS 101	04/21/95	0.5	7.3	89	2.3	2.3	2.3	0.11	0.18	17.6	17.8	18.0	<0.05	7.9	1.4
USGS 101	10/10/96	0.4	7.4	91	2.3	2.3	2.3	0.11	0.18	17.7	17.7	18.0	<0.05	12.5	1.4
USGS 102	06/13/95	2.5	3.1	313	1.6	1.6	1.6	<0.05	0.07	122	122	123	<0.05	0.2	2.5
USGS 103	04/18/95	1.8	6.2	198	2.7	2.8	2.8	<0.05	<0.05	46.0	46.2	45.2	<0.05	4.6	1.7
USGS 103	07/15/96	1.7	6.1	193	2.8	2.8	2.8	<0.05	<0.05	41.5	41.7	40.7	<0.05	1.7	1.5
USGS 104	04/18/95	1.6	6.1	206	2.7	2.7	2.7	0.11	<0.05	31.7	31.9	31.0	<0.05	5.7	1.6
USGS 104	07/15/96	1.6	6.0	202	2.5	2.4	2.5	0.11	<0.05	30.4	30.3	29.6	<0.05	8.8	1.5
USGS 105	04/18/95	1.6	6.8	247	2.5	2.5	2.5	<0.05	<0.05	36.3	36.3	35.5	<0.05	0.62	2.1
USGS 107	10/09/96	2.0	7.0	199	2.5	2.5	2.6	<0.05	0.11	51.7	52.2	50.7	<0.05	0.10	2.2
USGS 108	04/19/95	1.7	5.8	200	2.7	2.7	2.7	<0.05	<0.05	36.0	36.2	35.5	<0.05	2.4	1.7
USGS 109	04/20/95	1.6	6.5	242	2.9	2.9	2.9	0.06	<0.05	28.7	29	28.4	<0.05	0.42	1.8
USGS 109	10/11/96	1.6	6.2	240	2.7	2.8	2.8	0.09	<0.05	28.6	28.7	28.0	<0.05	3.1	1.7
USGS 110A	10/09/96	1.6	7.5	167	2.3	2.3	2.4	<0.05	0.19	34.4	34.5	33.8	<0.05	<0.05	2.0
USGS 112	07/15/96	1.7	9.1	428	2.6	2.6	2.6	<0.05	0.07	206.3	206.4	208	<0.05	0.51	2.3
USGS 113	07/16/96	1.6	11.6	480	2.8	2.8	2.8	<0.05	0.08	258.4	257.7	263	<0.05	0.48	2.1
USGS 115	07/15/96	1.6	7.5	247	2.9	2.9	2.9	0.05	<0.05	56.6	56.9	56.6	<0.05	2.7	1.3
USGS 116	07/15/96	2.8	9.9	328	4.8	4.8	4.8	<0.05	<0.05	112	112	114	<0.05	0.41	1.4
USGS 117	07/17/96	1.5	4.7	155	3.5	3.5	3.5	<0.05	<0.05	17.7	17.8	16.7	<0.05	0.08	1.1
USGS 120	07/17/96	1.5	9.1	201	2.8	2.8	2.8	<0.05	<0.05	43.4	43.2	40.8	<0.05	0.08	2.8
USGS 124	04/20/95	1.2	6.8	198	1.8	1.8	1.8	<0.05	0.43	27.8	28.1	26.5	<0.05	0.09	1.5
USGS 124	10/09/96	1.3	6.8	199	1.8	1.8	1.8	<0.05	0.44	28.1	28.3	26.5	<0.05	0.07	1.5
USGS 125	06/16/95	1.3	6.8	228	2.5	2.5	2.5	<0.05	<0.05	33.9	34.2	31.9	<0.05	0.10	2.1
USGS 125	10/11/96	1.2	6.6	226	2.3	2.3	2.3	<0.05	<0.05	34.0	34.3	32.5	<0.05	0.16	2.0
Wagoner Ranch	05/22/97	1.1	1.0	165	3.4	3.4	3.4	0.12	<0.05	66.8	67.2	68.5	<0.05	0.29	1.9

Table 9. Concentrations of selenium, rubidium, strontium, molybdenum, cadmium, cesium, barium, tellurium, lead, and uranium in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Symbol of element Mass number	Date sampled	Se 82	Rb 85	Sr 88	Mo 95	Mo 97	Mo 98	Cd 111	Cs 133	Ba 135	Ba 137	Ba 138	Tl 205	Pb 208	U 238
Big Lost River at Mackay Dam	06/28/95	1.1	0.7	159	3.1	3.1	3.1	<0.05	<0.05	62.1	62.4	62.2	<0.05	0.07	1.4
Big Lost River at Mackay Bridge	06/1795	1.1	0.7	156	3.0	3.0	3.1	<0.05	<0.05	59.1	59.3	59.5	<0.05	0.07	1.4
Big Lost River, near NRF, Lincoln Blvd.	06/19/95	1.7	0.6	177	3.3	3.3	3.3	<0.05	<0.05	59.9	60.1	60.4	<0.05	0.12	1.9
Big Springs	06/27/95	<0.5	19.4	5.8	2.6	2.6	2.6	<0.05	5.0	<1	<1	<1	<0.05	0.1	0.67
Big Springs	05/21/97	<0.5	20.7	5.5	3.7	3.7	3.7	<0.05	5.6	<1	<1	<1	<0.05	0.05	0.54
Birch Creek at Blue Dome	06/19/95	1.5	1.1	155	3.5	3.5	3.55	<0.05	0.06	61.4	61.8	61.9	<0.05	<0.05	2.2
Birch Creek at Blue Dome	06/17/95	1.7	1.1	150	3.7	3.7	3.7	<0.05	<0.05	60.0	60.1	60.2	<0.05	<0.05	2.3
Camas Creek at Kilgore	07/20/96	<0.5	3.0	91	0.5	0.5	0.5	<0.05	<0.05	41.1	41.5	41.5	<0.05	0.21	0. 45
Camas Creek near Mud Lake	06/17/95	<0.5	1.5	122	0.9	0.9	0.9	<0.05	<0.05	39.1	39.2	39.5	<0.05	0.16	0.47
Condie Hot Springs	06/21/95	<0.5	43.3	886	0.6	0.6	0.6	<0.05	14.9	271	273	276	<0.05	0.07	0.02
Condie Hot Springs	05/22/97	<0.5	43.1	891	0.6	0.6	0.6	<0.05	14.9	272	272	275	<0.05	<0.05	0.02
Lidy Hot Springs	07/20/96	<0.5	17.7	579	1.0	0.9	1.0	<0.05	2.6	92.7	92.7	93.95	<0.05	0.4	<0.01
Lidy Hot Springs	05/14/97	<0.5	22.1	985	0.4	0.4	0.5	<0.05	2.6	43.5	44.0	44.0	<0.05	0.35	0.02
Little Lost River near INEEL	06/17/95	1.8	1.0	149	1. 5	1.5	1.5	<0.05	<0.05	117	118	118.5	<0.05	0.17	2.3
Little Lost River north of Howe	06/28/95	<0.5	0.9	99	0.7	0.7	0.7	<0.05	<0.05	48.3	48.4	48.3	<0.05	0.07	0.91
Madison River at US 191, Montana	07/20/96	<0.5	35.6	12.2	8.8	8.9	8.8	<0.05	26.7	4.7	4.8	4.8	0.05	<0.05	0.63

Table 10. Concentrations of scandium, yttrium and the lanthanide elements in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity

[Concentrations of the lanthanides are in parts per trillion, concentrations of scandium and yttrium are in parts per billion; Sc, chemical symbol of scandium; (7/16/96), month/day/year of sampling; <, less than]

Symbol of element Mass number	Sc 45	Y 89	La 139	Ce 140	Pr 141	Nd 146	Sm 147	Eu 151	Gd 158	Tb 159	Dy 164	Ho 165	Er 166	Tm 169	Yb 174	Lu 175
Blank	<1	<0.2	<0.2	<0.2	<0.3	<0.5	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
ANP 6 (7/16/96)	<1	4.7	1.6	2.5	<0.3	1.3	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
CFA 1 (7/16/96)	<1	4.0	0.6	0.5	<0.3	<0.5	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	0.42	<0.2
P&W 2 (10/15/96)	<1	4.6	0.7	0.8	<0.3	1.0	<1.6	<0.3	1.2	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
USGS 2 (7/17/96)	<1	2.4	0.3	1.1	<0.3	<0.5	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
USGS 4 (10/15/96)	2	5.4	2.1	1.7	<0.3	1.7	<1.6	<0.3	1.3	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
USGS 12 (6/14/96)	<1	9.5	2.0	0.6	<0.3	1.2	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
USGS 18 (7/19/96)	<1	3.5	2.6	5.4	0.6	2.2	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
USGS 19 (10/15/96)	<1	4.8	0.8	0.5	<0.3	<0.5	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
USGS 26 (10/15/96)	<1	1.8	1.0	0.8	<0.3	<0.5	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
USGS 100 (10/10/96)	<1	1.6	0.5	0.6	<0.3	<0.5	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
USGS 104 (7/15/96)	<1	3.0	0.6	1.4	<0.3	<0.5	<1.6	<0.3	<0.5	<0.2	<0.5	<0.2	<0.7	<0.3	<0.4	<0.2
Lidy Hot Springs (7/20/96)	<1	11	4.2	7.4	0.7	3.3	<1.6	<0.3	<0.5	<0.2	0.5	<0.2	<0.7	<0.3	<0.4	<0.2

Table 11. Concentrations of isotopes of oxygen, hydrogen, and carbon in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity

[Concentrations of deuterium (2H), oxygen-18 (18O), and carbon-13 (13C) are in per mil. Tritium (3H) is given in tritium units (TU), and 14C in percent modern (pmc). Bold 3H concentrations were determined by mass spectroscopy, others by scintillation counting. STD, standard deviation; d, see "Conversion Factors and Abbreviated Units"; nd, not determined; ---, not applicable only one measurement or not measured]

Well identifier	Date sampled	δ^2H per mil	$\delta^{18}O$ per mil	Tritium TU	Tritium STD	$\delta^{13}C$ per mil	$\delta^{13}C$ STD	Carbon-14 pmc	Carbon-14 STD
ANP 6	10/14/94	-139.1	-18.28	**1.00**	0.04	nd	---	nd	---
ANP 6	06/15/95	-140.9	-18.31	nd	---	-6.67	---	30.91	0.28
ANP 6	07/19/96	-138.7	-18.27	0.50	0.40	-6.06	---	nd	---
ANP 9	10/14/94	[1][-131.3]	[1][-16.34]	**0.07**	0.05	nd	---	nd	---
ANP 9	10/14/96	-137.9	-17.88	0.00	0.30	-8.21	0.07	nd	---
Arbor Test 1	04/21/95	-135.6	-17.77	**3.90**	0.02	nd	---	nd	---
Arbor Test 1	10/10/96	-133.6	-17.74	3.60	0.30	-11.21	0.01	nd	---
Arco City Well 4	05/13/97	-134.7	-17.69	26.20	0.90	nd	---	nd	---
Area II	07/19/94	-133.8	-17.69	3.84	0.57	nd	---	nd	---
Area II	07/18/96	-134.8	-17.73	3.90	0.30	-10.23	0.01	nd	---
Atomic City	10/03/94	nd	nd	**3.72**	0.09	nd	---	nd	---
Atomic City	10/09/96	-135.8	-17.72	3.30	0.40	-10.57	0.01	nd	---
BFW	07/16/96	-139.2	-17.90	7.10	0.40	-9.39	---	nd	---
CFA 1	07/16/96	-137.4	-17.71	nd	---	-9.43	---	nd	---
CFA 2	07/16/96	-136.6	-17.23	nd	---	-11.99	0.05	nd	---
EBR I	10/16/96	-139.4	-18.13	nd	---	-7.97	---	nd	---
Engberson Well	05/14/97	-120.8	-14.88	16.60	0.60	-12.65	---	nd	---
Fire Station 2	10/16/96	-138.7	-17.94	11.40	0.50	-9.32	---	nd	---
IET 1 Disposal	07/18/94	-137.6	-17.66	nd	---	nd	---	nd	---
IET 1 Disposal	07/18/96	-135.7	-17.58	nd	---	-8.80	0.01	nd	---
INEL-1 WS	06/12/95	-138.6	-17.97	15.10	0.60	-8.88	---	59.48	0.55
Leo Rogers 1	07/17/96	-134.7	-17.62	3.90	0.40	-10.59	0.02	nd	---
Neville Well	05/24/97	-132.6	-17.47	nd	---	nd	---	nd	---
NPR Test	04/17/95	-135.8	-17.72	15.40	0.60	nd	---	nd	---
NPR Test	10/10/96	-137.6	-17.76	**17.93**	0.07	-9.90	---	nd	---
Pancheri 6	05/13/97	-141.8	-18.14	16.30	0.60	-8.42	---	nd	---
Park Bell	05/21/97	-137.3	-17.69	0.70	0.30	-11.38	---	nd	---
PSTF Test 1	10/13/94	-133.1	-17.68	**0.77**	0.02	nd	---	nd	---
PSTF Test 1	10/14/96	-133.4	-17.64	0.40	0.27	-5.61	---	nd	---
P&W 2	10/25/94	-140.4	-18.40	**2.52**	0.07	nd	---	nd	---
P&W 2	04/19/95	-139.7	-18.40	**3.87**	0.10	-6.66	---	50.84	0.41
P&W 2	10/15/96	-141.3	-18.50	2.70	0.30	-6.13	---	nd	---
RWMC M3S	07/22/96	-137.5	-17.98	nd	---	-8.87	---	nd	---
RWMC M7S	07/22/96	-137.7	-17.92	nd	---	-9.22	---	nd	---
Site 04	10/16/96	-137.9	-17.74	16.10	0.60	-10.19	---	nd	---

Table 11. Concentrations of isotopes of oxygen, hydrogen, and carbon in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	δ^2H per mil	$\delta^{18}O$ per mil	Tritium TU	Tritium STD	$\delta^{13}C$ per mil	$\delta^{13}C$ STD	Carbon-14 pmc	Carbon-14 STD
Site 09	07/21/94	-137.0	-17.97	nd	---	nd	---	nd	---
Site 09	07/22/96	-137.7	-17.98	1.30	0.30	-8.51	0.02	nd	---
Site 14	10/13/94	-135.8	-17.84	**1.17**	0.09	nd	---	nd	---
Site 14	10/14/96	-137.8	-17.96	0.80	0.30	-8.17	---	nd	---
Site 17	06/16/95	-138.9	-18.10	nd	---	-8.48	---	53.99	0.39
Site 19	07/16/96	-139.0	-18.04	4.20	0.30	-8.35	---	nd	---
Squirrel Cemetery	05/21/97	-140.5	-18.39	nd	---	nd	---	nd	---
TAN Exploration	10/13/94	-127.3	-15.78	**0.04**	0.01	nd	---	nd	---
TAN Exploration	10/14/96	-130.4	-15.86	-0.20	0.30	-8.76	---	nd	---
USGS 001	10/03/94	-136.6	-17.79	**2.08**	0.52	nd	---	nd	---
USGS 001	10/09/96	-136.2	-17.82	1.80	0.30	-10.71	0.00	nd	---
USGS 002	07/19/94	-134.4	-17.63	**4.42**	0.56	nd	---	nd	---
USGS 002	07/17/96	-135.0	-17.71	3.80	0.40	-11.67	0.02	nd	---
USGS 004	10/24/94	-120.9	-14.79	**19.00**	0.38	nd	---	nd	---
USGS 004	04/19/95	-121.4	-14.91	**17.38**	0.07	nd	---	nd	---
USGS 004	10/15/96	-120.6	-14.84	16.80	0.60	-13.32	0.04	nd	---
USGS 005	10/12/94	-135.9	-17.72	**8.88**	0.13	nd	---	nd	---
USGS 005	10/10/96	-138.3	-17.82	6.10	0.40	-9.64	---	nd	---
USGS 006	07/19/94	-135.1	-17.57	nd	---	nd	---	nd	---
USGS 006	07/18/96	-135.2	-17.62	0.09	0.24	-8.64	---	nd	---
USGS 007	10/14/96	-137.6	-17.93	**-0.05**	0.02	-9.48	---	nd	---
USGS 008	10/04/94	-135.8	-17.78	**14.81**	0.17	nd	---	nd	---
USGS 008	10/08/96	-135.7	-17.78	13.70	0.50	-9.41	0.00	nd	---
USGS 009	10/04/94	-137.8	-17.89	**14.97**	0.07	nd	---	nd	---
USGS 009	04/20/95	-137.0	-17.82	**19.09**	0.08	nd	---	nd	---
USGS 009	10/11/96	-136.2	-17.75	nd	---	-9.51	---	nd	---
USGS 011	04/20/95	-138.3	-17.98	**9.95**	0.05	nd	---	nd	---
USGS 011	10/09/96	-138.6	-17.92	nd	---	-9.17	0.03	nd	---
USGS 012	10/27/94	-135.7	-17.44	**23.24**	0.60	nd	---	nd	---
USGS 012	06/14/95	-135.0	-17.47	**22.48**	0.21	-10.18	---	85.21	0.47
USGS 014	10/26/94	nd	nd	**5.99**	0.04	nd	---	nd	---
USGS 014	10/09/96	-135.5	-17.61	nd	---	-9.29	0.00	nd	---
USGS 015	06/14/95	-141.8	-18.49	**0.55**	0.01	-8.01	---	42.76	0.31
USGS 015	05/13/97	-142.6	-18.41	nd	---	nd	---	nd	---
USGS 017	10/27/94	-136.6	-17.58	nd	---	nd	---	nd	---
USGS 017	06/13/95	-135.7	-17.53	**15.61**	0.16	-10.09	---	82.90	0.47

Table 11. Concentrations of isotopes of oxygen, hydrogen, and carbon in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	δ^2H per mil	$\delta^{18}O$ per mil	Tritium TU	Tritium STD	$\delta^{13}C$ per mil	$\delta^{13}C$ STD	Carbon-14 pmc	Carbon-14 STD
USGS 018	07/18/94	nd	nd	**0.17**	0.15	nd	---	nd	---
USGS 018	07/19/96	-138.6	-18.11	0.09	0.26	-7.37	---	nd	---
USGS 019	10/25/94	-138.3	-18.12	**3.65**	0.09	nd	---	nd	---
USGS 019	04/19/95	-139.4	-18.09	**3.69**	0.08	nd	---	nd	---
USGS 019	10/15/96	-138.1	-18.07	3.10	0.30	-7.06	0.03	nd	---
USGS 022	06/13/95	-137.9	-17.57	**50.28**	0.13	-14.69	---	69.91	0.52
USGS 022	07/18/96	-136.8	-17.62	48.70	1.50	-13.55	---	nd	---
USGS 023	10/25/94	-136.3	-17.94	**0.41**	0.36	nd	---	nd	---
USGS 023	04/19/95	-135.5	-17.90	**0.40**	0.04	-6.59	---	21.88	0.24
USGS 023	10/15/96	-138.1	-17.94	nd	---	-5.72	---	nd	---
USGS 026	10/14/94	-136.5	-17.87	**0.00**	0.02	nd	---	nd	---
USGS 026	10/15/96	-134.6	-17.80	0.15	0.26	-8.61	---	nd	---
USGS 027	10/11/94	nd	nd	**1.22**	0.02	nd	---	nd	---
USGS 027	10/15/96	-134.0	-17.66	0.93	0.26	-9.87	---	nd	---
USGS 029	10/11/94	-133.8	-17.67	nd	---	nd	---	nd	---
USGS 029	06/15/95	-135.1	-17.60	**7.09**	0.11	-13.29	---	85.85	0.51
USGS 029	07/19/96	-134.5	-17.67	5.90	0.30	-11.75	---	nd	---
USGS 031	10/11/94	-134.9	-17.54	nd	---	nd	---	nd	---
USGS 031	06/15/95	-135.7	-17.79	nd	---	-10.07	---	64.56	0.44
USGS 031	07/19/96	-135.9	-17.81	-0.50	0.26	-9.39	---	nd	---
USGS 031	10/15/96	-135.5	-17.78	nd	---	nd	---	nd	---
USGS 032	10/11/94	-135.5	-17.76	**0.38**	0.04	nd	---	nd	---
USGS 032	06/15/95	-134.8	-17.67	**0.85**	0.07	-10.30	---	62.28	0.43
USGS 032	07/19/96	-135.4	-17.68	0.39	0.26	-9.47	---	nd	---
USGS 036	07/16/96	-137.6	-17.78	nd	---	-8.78	---	nd	---
USGS 037	10/07/94	-137.5	-17.57	nd	---	nd	---	nd	---
USGS 065	10/12/94	-130.8	-16.79	nd	---	nd	---	nd	---
USGS 076	10/12/94	-138.3	-18.00	nd	---	nd	---	nd	---
USGS 082	07/16/96	-137.5	-17.89	nd	---	-10.02	---	nd	---
USGS 083	04/17/95	-138.9	-18.14	nd	---	nd	---	nd	---
USGS 086	10/04/94	-137.0	-18.07	nd	---	nd	---	nd	---
USGS 086	10/11/96	-139.4	-18.13	0.90	0.30	-8.90	0.01	nd	---
USGS 089	10/07/94	-141.5	-18.35	nd	---	nd	---	nd	---
USGS 089	07/17/96	-140.4	-18.34	nd	---	-12.78	---	nd	---
USGS 097	06/13/95	-137.1	-17.55	**21.55**	0.30	-10.09	---	84.42	0.53
USGS 098	10/04/94	nd	nd	**6.26**	0.01	nd	---	nd	---
USGS 098	06/12/95	-137.6	-18.07	**6.58**	0.11	-8.84	---	63.17	0.44
USGS 099	06/12/95	-136.8	-17.99	**11.31**	0.17	-9.68	---	76.30	0.51

Table 11. Concentrations of isotopes of oxygen, hydrogen, and carbon in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	δ^2H per mil	$\delta^{18}O$ per mil	Tritium TU	Tritium STD	$\delta^{13}C$ per mil	$\delta^{13}C$ STD	Carbon-14 pmc	Carbon-14 STD
USGS 100	04/21/95	-133.8	-17.78	**4.39**	0.10	-11.17	---	79.83	0.50
USGS 100	10/10/96	-134.1	-17.70	4.60	0.30	nd	---	nd	---
USGS 101	04/21/95	-135.0	-17.89	**1.30**	0.02	nd	---	nd	---
USGS 101	10/10/96	-135.3	-17.84	0.90	0.30	-10.60	---	nd	---
USGS 102	06/13/95	-135.3	-17.50	**22.13**	0.20	-9.81	---	86.17	0.52
USGS 103	07/20/94	-135.9	-17.84	nd	---	nd	---	nd	---
USGS 103	04/18/95	-135.6	-17.73	**3.69**	0.03	nd	---	nd	---
USGS 103	07/15/96	-136.9	-17.80	nd	---	-8.93	---	nd	---
USGS 104	07/20/94	-138.9	-18.00	nd	---	nd	---	nd	---
USGS 104	04/18/95	-138.4	-18.11	nd	---	nd	---	nd	---
USGS 104	07/15/96	-139.1	-18.09	nd	---	-9.30	0.03	nd	---
USGS 105	10/03/94	-136.6	-17.84	nd	---	nd	---	nd	---
USGS 105	04/18/95	-136.7	-17.84	**97.53**	0.62	nd	---	nd	---
USGS 106	10/05/94	-137.6	-17.99	nd	---	nd	---	nd	---
USGS 107	10/05/94	-135.6	-17.61	nd	---	nd	---	nd	---
USGS 107	10/09/96	-134.3	-17.55	3.20	0.30	-9.21	0.05	nd	---
USGS 108	10/03/94	-136.4	-17.78	nd	---	nd	---	nd	---
USGS 108	04/18/95	-137.2	-17.85	nd	---	nd	---	nd	---
USGS 109	10/04/94	-137.5	-17.76	**33.53**	0.20	nd	---	nd	---
USGS 109	04/20/95	-138.4	-17.82	nd	---	nd	---	nd	---
USGS 109	10/11/96	-137.0	-17.78	nd	---	-9.08	---	nd	---
USGS 110A	10/09/96	-134.4	-17.64	3.40	0.30	-10.64	0.01	nd	---
USGS 112	07/15/96	-137.8	-17.62	nd	---	-9.92	---	nd	---
USGS 113	07/16/96	-137.1	-17.51	nd	---	-10.67	---	nd	---
USGS 115	07/15/96	-140.1	-17.87	nd	---	-10.27	0.02	nd	---
USGS 116	07/15/96	-138.9	-17.74	nd	---	-10.56	0.00	nd	---
USGS 117	07/17/96	-139.3	-18.05	nd	---	-10.56	---	nd	---
USGS 119	10/06/94	-143.7	-18.55	nd	---	nd	---	nd	---
USGS 120	10/06/94	-137.5	-17.68	nd	---	nd	---	nd	---
USGS 120	07/17/96	-136.8	-17.61	**54.40**	1.70	-9.38	---	nd	---
USGS 121	10/24/94	-137.6	-17.70	**19.24**	0.08	nd	---	nd	---
USGS 124	07/20/94	-138.3	-17.93	83.89	0.67	nd	---	nd	---
USGS 124	04/20/95	-138.9	-17.97	nd	---	nd	---	nd	---
USGS 124	10/09/96	-138.8	-17.95	nd	---	-8.75	---	nd	---
USGS 125	06/16/95	-137.8	-17.79	**22.74**	0.20	-9.77	---	76.65	0.46
USGS 125	10/11/96	-136.3	-17.82	nd	---	-9.38	---	nd	---
Wagoner Ranch	05/22/97	-141.7	-18.13	4.60	0.30	-8.97	---	nd	---

Table 11. Concentrations of isotopes of oxygen, hydrogen, and carbon in ground water and surface water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	δ^2H per mil	$\delta^{18}O$ per mil	Tritium TU	Tritium STD	$\delta^{13}C$ per mil	$\delta^{13}C$ STD	Carbon-14 pmc	Carbon-14 STD
Big Lost River, near NRF, Lincoln Blvd.	05/21/97	-132.2	-17.17	nd	---	nd	---	nd	---
Big Lost River bridge at Mackay	06/27/95	-134.9	-17.60	nd	---	nd	---	nd	---
Big Lost River at Mackay Dam	06/28/95	-134.4	-17.57	nd	---	nd	---	nd	---
Big Springs	06/22/95	-135.9	-18.36	nd	---	nd	---	nd	---
Big Springs	05/21/97	-136.5	-18.28	nd	---	nd	---	nd	---
Birch Creek at Blue Dome	06/17/95	-140.9	-18.47	nd	---	nd	---	nd	---
Birch Creek at Blue Dome	06/28/95	-140.1	-18.62	nd	---	nd	---	nd	---
Camas Creek at Kilgore	06/20/95	-121.3	-16.03	nd	---	nd	---	nd	---
Camas Creek near Mud Lake	06/17/95	-122.9	-15.97	nd	---	nd	---	nd	---
Condie Hot Springs	06/21/95	-144.4	-18.81	nd	---	nd	---	nd	---
Condie Hot Springs	05/22/97	-146.1	-18.74	nd	---	nd	---	nd	---
Lidy Hot Springs	06/20/95	-134.0	-17.89	nd	---	nd	---	nd	---
Lidy Hot Springs	07/10/96	nd	nd	nd	---	-2.96	0.05	nd	---
Lidy Hot Springs	07/20/97	-134.2	-17.91	0.50	0.30	nd	---	nd	---
Little Lost River near INEEL	06/17/95	-137.4	-17.91	nd	---	nd	---	nd	---
Little Lost River north of Howe	06/28/95	-134.1	-17.72	nd	---	nd	---	nd	---
Madison River at US 191, Montana	07/20/96	-135.5	-17.84	nd	---	-1.19	---	nd	---

[1] The δ^2H and $\delta^{18}O$ results for well ANP 9 collected October 14, 1994 are probably incorrect.

Table 12. Concentrations of helium, neon, hydrogen, and helium-3 in ground-water and surface-water samples from the Idaho National Engineering and Environmental Laboratory and vicinity

[All concentrations are in cc (cubic centimeters) per gram at 0 degrees Celsius and one atmosphere pressure (ccSTP/g). Hydrogen concentrations can change significantly during storage in some of the samples; therefore, the results should be considered qualitative rather than quantitative. The symbol δ is defined in "Conversion Factors and Abbreviated Units"; ---, not applicable or not determined; ^{4}He, helium-4 isotope; ^{3}He, helium-3 isotope; Ne, neon; per mil, per thousand; **bold numbers**, concentrations determined by mass spectroscopy, others by gas chromatography]

Well identifier	Date sampled	^{4}He (ccSTP/g)x10^8	Error in ^{4}He (ccSTP/g)x10^8	Ne (ccSTP/g)x10^7	Error in Ne (ccSTP/g)x10^7	H_2 (ccSTP/g)x10^8	δ^3He per mil	Error in $\delta\ ^3$He per mil
ANP 6	06/15/95	**5.92**	**0.015**	**1.99**	**0.021**	---	**15.75**	**0.23**
ANP 6	07/19/96	6.16	0.31	2.05	0.21	1.10	---	---
ANP 9	10/14/94	**15.19**	**0.037**	**2.21**	**0.023**	---	---	---
ANP 9	10/14/94	**15.77**	**0.027**	**2.09**	**0.013**	---	**-99.95**	**0.54**
ANP 9	10/14/96	**15.4**	**0.77**	**2.09**	**0.21**	**2.47**	---	---
Arbor Test 1	04/21/95	**8.42**	**0.021**	**1.88**	**0.021**	---	**3.36**	**0.22**
Arbor Test 1	10/10/96	8.44	0.42	1.97	0.20	1.36	---	---
Arco City Well 4	05/13/97	6.18	0.31	2.58	0.25	1.38	---	---
Area II	07/19/94	**15.50**	**0.036**	**1.83**	**0.015**	---	**-99.75**	**0.50**
Area II	07/18/96	10.7	0.57	3.02	0.30	0.71	---	---
Atomic City	10/03/94	**5.24**	**0.010**	**1.69**	**0.031**	---	**17.07**	**0.21**
Atomic City	10/09/96	5.63	0.28	---	---	---	---	---
BFW	07/15/96	3.96	0.20	2.06	0.21	1.06	---	---
CFA 1	07/22/96	6.18	0.31	2.39	0.24	0.53	---	---
CFA 2	07/16/96	5.22	0.26	2.16	0.22	2.11	---	---
EBR I	10/16/96	5.46	0.27	1.72	0.17	1.65	---	---
Engerson Well	05/14/97	7.15	0.36	2.58	0.25	1.52	---	---
Fire Station 2	10/16/96	4.60	0.23	1.98	0.20	1.29	---	---
IET 1 Disposal	07/18/96	6.07	0.30	2.79	0.28	7.12	---	---
Leo Rogers 1	07/17/96	6.66	0.33	1.92	0.19	1.18	---	---
Neville Well	05/24/97	22.1	1.1	2.34	0.15	1.53	---	---

Table 12. Concentrations of helium, neon, hydrogen, and helium-3 in ground-water and surface-water samples from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	^4He (ccSTP/g)x10^8	Error in ^4He (ccSTP/g)x10^8	Ne (ccSTP/g)x10^7	Error in Ne (ccSTP/g)x10^7	H_2 (ccSTP/g)x10^8	δ^3He per mil	Error in $\delta\ ^3He$ per mil
NPR Test	04/17/95	5.69	0.014	2.16	0.024	---	56.96	0.23
NPR Test	10/10/96	6.43	0.32	2.23	0.22	1.89	---	---
Pancheri 6	05/13/96	10.0	0.50	---	---	2.85	---	---
Park Bell	05/21/97	41.8	2.09	2.36	0.23	1.85	---	---
PSTF Test	10/13/94	5.94	0.016	2.36	0.009	---	-0.28	0.18
PSTF Test	10/14/96	5.75	0.29	2.20	0.22	1.29	---	---
P&W 2	10/25/94	4.46	0.014	1.81	0.010	---	5.61	0.19
P&W 2	04/19/95	4.11	0.008	1.74	0.034	---	-0.84	0.22
P&W 2	10/15/96	6.26	0.31	2.13	0.21	3.23		
RWMC M3S	07/17/96	6.35	0.32	2.45	0.25	0.90	---	---
RWMC M7S	07/18/96	5.60	0.28	2.55	0.26	---	---	---
Site 04	10/16/96	5.86	0.29	2.17	0.22	0.84	---	---
Site 09	07/22/96	12.7	0.63	2.15	0.22	0.68	---	---
Site 14	10/13/94	---	---	2.10	0.022	---	---	---
Site 14	10/13/94	---	---	---	---	---	---	---
Site 14	10/14/96	38.4	1.92	2.35	0.24	1.00	---	---
Site 19	07/15/96	4.73	0.236	2.20	0.22	0.87	---	---
TAN Exploration	10/13/94	9.67	0.022	3.33	0.028	---	-1.13	0.19
USGS 001	10/03/94	10.86	0.027	1.82	0.019	---	21.21	0.23
USGS 001	10/09/96	11.2	0.56	1.79	0.18	0.83	---	---
USGS 002	07/19/94	6.38	0.020	1.78	0.010	---	11.12	0.22
USGS 002	07/17/96	6.92	0.35	2.15	0.22	0.56	---	---
USGS 004	10/24/94	4.80	0.013	1.92	0.008	---	16.81	0.21
USGS 004	04/19/95	4.80	0.013	1.94	0.008	---	13.47	0.20
USGS 004	10/15/96	5.38	0.27	2.10	0.21	3.04	---	---

Table 12. Concentrations of helium, neon, hydrogen, and helium-3 in ground-water and surface-water samples from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	^{4}He (ccSTP/g)x10^8	Error in ^{4}He (ccSTP/g)x10^8	Ne (ccSTP/g)x10^7	Error in Ne (ccSTP/g)x10^7	H_2 (ccSTP/g)x10^8	δ^3He per mil	Error in $\delta\,^3$He per mil
USGS 005	10/12/94	**6.76**	**0.017**	**1.97**	**0.020**	**---**	**4.17**	**0.23**
USGS 005	10/12/94	**6.91**	**0.019**	**2.02**	**0.008**	**---**	**4.58**	**0.18**
USGS 005	10/10/96	7.73	0.39	2.07	0.21	1.91	---	---
USGS 006	07/18/96	11.7	0.59	2.25	0.23	770	---	---
USGS 007	10/14/94	---	---	2.09	0.023	---	---	---
USGS 007	10/14/96	**149**	**7.4**	**---**	**---**	**3.38**		
USGS 008	10/04/94	**4.30**	**0.008**	**1.67**	**0.008**	**---**	**25.65**	**0.28**
USGS 008	10/08/96	5.93	0.30	1.86	0.19	1.11	---	---
USGS 009	10/04/94	**5.44**	**0.011**	**1.78**	**0.032**	**---**	**88.19**	**0.21**
USGS 009	04/20/95	**6.32**	**0.016**	**2.04**	**0.022**	**---**	**81.74**	**0.22**
USGS 009	10/11/96	7.19	0.36	2.26	0.23	2.26	---	---
USGS 011	04/20/95	**5.08**	**0.014**	**1.86**	**0.007**	**---**	**43.10**	**0.18**
USGS 011	10/09/96	4.80	0.24	1.80	0.18	0.84	---	---
USGS 012	10/27/94	**4.30**	**0.019**	**1.74**	**0.008**	**---**	**14.17**	**0.23**
USGS 012	06/14/95	**4.28**	**0.011**	**1.74**	**0.005**	**---**	**13.57**	**0.19**
USGS 014	10/26/94	**4.75**	**0.011**	**1.72**	**0.014**	**---**	**25.39**	**0.20**
USGS 014	10/09/96	6.07	0.30	2.06	0.21	0.72	---	---
USGS 015	06/14/95	---	---	1.96	0.008	---	---	---
USGS 015	05/13/97	23.0	1.15	1.43	0.16	1.55	---	---
USGS 017	10/27/94	**9.21**	**0.016**	**2.66**	**0.017**	**---**	**25.53**	**0.15**
USGS 017	06/13/95	**9.05**	**0.016**	**3.47**	**0.016**	**---**	**25.75**	**0.26**
USGS 018	07/18/94	---	---	1.82	0.035	---	---	---
USGS 018	07/19/96	28.8	1.44	2.21	0.22	0.69	---	---
USGS 019	10/25/94	**6.13**	**0.020**	**1.63**	**0.009**	**---**	**-23.99**	**0.27**
USGS 019	10/25/94	**6.18**	**0.012**	**1.64**	**0.008**	**---**	**-24.24**	**0.22**
USGS 019	04/19/95	**6.10**	**0.015**	**1.63**	**0.018**	**---**	**-24.20**	**0.24**

Table 12. Concentrations of helium, neon, hydrogen, and helium-3 in ground-water and surface-water samples from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	^4He (ccSTP/g)x10^8	Error in ^4He (ccSTP/g)x10^8	Ne (ccSTP/g)x10^7	Error in Ne (ccSTP/g)x10^7	H_2 (ccSTP/g)x10^8	δ^3He per mil	Error in $\delta\ ^3He$ per mil
USGS 019	10/15/95	6.65	0.33	1.82	0.18	3.08	---	---
USGS 022	06/13/95	4.67	0.009	1.95	0.036	---	106.80	0.25
USGS 022	07/18/96	4.26	0.21	2.19	0.22	1.21	---	---
USGS 023	04/19/94	9.16	0.019	1.67	0.033	---	1.62	0.20
USGS 023	10/25/94	9.24	0.021	1.69	0.014	---	1.62	0.19
USGS 023	10/15/96	8.55	0.428	2.03	0.20	1.48	---	---
USGS 026	10/15/96	27.7	1.38	2.01	0.20	1.80	---	---
USGS 027	10/11/94	---	---	2.24	0.088	---	869.50	2.57
USGS 027	10/15/96	32.4	1.62	1.94	0.19	2.51	---	---
USGS 029	06/15/95	16.33	0.033	1.95	0.035	---	-41.64	0.20
USGS 029	10/11/95	16.03	0.039	1.89	0.020	---	---	---
USGS 029	07/19/96	10.3	0.51	2.21	0.22	0.67	---	---
USGS 031	07/19/96	20. 6	1.03	2.31	0.23	1.40	---	---
USGS 032	10/11/94	6.71	0.015	1.75	0.020	---	32.99	0.20
USGS 032	06/15/95	6.08	0.013	1.76	0.034	---	27.18	0.22
USGS 032	06/15/95	6.08	0.012	1.73	0.032	---	27.16	0.20
USGS 032	07/19/96	5.14	0.26	2.18	0.22	0.46	---	---
USGS 036	07/16/96	4.48	0.22	2.10	0.21	1.63	---	---
USGS 082	07/16/96	5.56	0.28	2.59	0.26	0.75	---	---
USGS 086	10/04/94	7.35	0.018	2.85	0.030	---	0.14	0.23
USGS 086	10/11/96	7.19	0.36	2.74	0.27	1.45	---	---
USGS 089	07/19/96	6.11	0.31	2.79	0.28	1.27	---	---
USGS 097	06/13/95	4.55	0.009	1.82	0.035	---	28.20	0.22

Table 12. Concentrations of helium, neon, hydrogen, and helium-3 in ground-water and surface-water samples from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	^{4}He (ccSTP/g)x10^{8}	Error in ^{4}He (ccSTP/g)x10^{8}	Ne (ccSTP/g)x10^{7}	Error in Ne (ccSTP/g)x10^{7}	H_2 (ccSTP/g)x10^{8}	$\delta^{3}He$ per mil	Error in $\delta\,^{3}He$ per mil
USGS 098	06/12/95	5.49	0.011	2.20	0.041	---	6.33	0.21
USGS 099	06/17/95	4.49	0.008	1.77	0.008	---	0.75	0.27
USGS 099	06/17/95	4.52	0.012	1.79	0.005	---	1.00	0.18
USGS 100	04/21/95	10.79	0.021	2.17	0.041	---	12.27	0.20
USGS 100	04/21/95	9.78	0.027	1.89	0.007	---	14.23	0.17
USGS 100	10/10/96	10.4	0.52	2.11	0.21	2.25	---	---
USGS 101	04/21/95	10.18	0.028	1.91	0.007	---	-33.16	0.18
USGS 101	10/10/96	10.4	0.52	2.07	0.21	0.98	---	---
USGS 102	06/13/95	4.69	0.009	1.95	0.009	---	28.96	0.27
USGS 103	04/18/95	4.97	0.014	1.77	0.007	---	26.48	0.18
USGS 103	07/15/96	4.76	0.24	2.13	0.21	0.44	---	---
USGS 104	07/15/96	11.5	0.57	6.83	0.68	1.04	---	---
USGS 105	04/18/95	5.25	0.009	2.03	0.010	---	-31.11	0.42
USGS 107	10/09/96	6.96	0.35	1.99	0.199	1.51	---	---
USGS 109	10/04/94	5.49	0.013	1.94	0.020	---	206.16	0.27
USGS 109	04/20/95	4.55	0.012	1.64	0.019	---	207.28	0.25
USGS 109	10/11/96	5.99	0.30	1.85	0.19	1.70	---	---
USGS 110A	10/09/96	9.69	0.48	2.06	0.21	1.92	---	---
USGS 112	07/18/96	5.37	0.27	2.20	0.22	0.86	---	---
USGS 113	07/18/96	5.36	0.27	2.33	0.23	0.70	---	---
USGS 115	07/15/96	6.85	0.34	3.08	0.31	0.37	---	---
USGS 116	07/19/96	6.18	0.31	2.66	0.27	1.24	---	---
USGS 117	07/18/96	6.28	0.31	2.40	0.24	1.39	---	---

Table 12. Concentrations of helium, neon, hydrogen, and helium-3 in ground-water and surface-water samples from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Well identifier	Date sampled	^{4}He (ccSTP/g)x10^8	Error in ^{4}He (ccSTP/g)x10^8	Ne (ccSTP/g)x10^7	Error in Ne (ccSTP/g)x10^7	H_2 (ccSTP/g)x10^8	δ^3He per mil	Error in δ ^{3}He per mil
USGS 120	07/18/96	4.94	0.25	2.35	0.24	---	---	---
USGS 121	10/24/94	**5.90**	**0.012**	**2.30**	**0.044**	**---**	**74.81**	**0.22**
USGS 124	07/20/94	**6.24**	**0.028**	**2.00**	**0.009**	**---**	**629.85**	**0.43**
USGS 124	04/20/95	**6.23**	**0.013**	**1.94**	**0.036**	**---**	**646.05**	**0.31**
USGS 124	10/09/96	7.27	0.36	2.24	0.22	2.3	---	---
USGS 125	10/11/96	4.99	0.25	2.00	0.20	2.3	---	---
Wagoner Ranch	05/22/97	6.27	0.31	2.38	0.23	8.2	---	---
Big Springs	05/21/97	153	7.7	2.31	0.23	1,560	---	---
Condie Hot Springs	05/22/97	1,040	52	---	---	5.81	---	---
Lidy Hot Springs	05/14/97	120	0.6	---	---	14.3	---	---

Table 13. Statistical parameters for selected constituents in ground water from the Idaho National Engineering and Environmental Laboratory and vicinity

[Mean, median, standard deviation, and sample size include all wells sampled at any given date. Concentration of the detection limit was used in the statistical analyses for all samples below the detection limit. Ca, chemical symbol for the element calcium; na, non applicable; ppm, parts per million; ppb, parts per billion; per mil, per thousand; pmc, percent modern carbon-14; TU, tritium units; d, see text for definition; *, detection limits not available or non applicable, see text for details.

Constituent (chemical symbol)	Analyte mass	Concentration units	Sample size	Number below detection	Minimum	Maximum	Mean	Median	Standard	Detection
Ca	na	ppb	103	0	22.6	78.3	43.0	39.7	12.9	0.1
Mg	na	ppb	103	0	5.0	28.6	15.6	15.1	4.1	0.01
Sr	na	ppb	103	0	0.1	0.5	0.2	0.2	0.1	0.005
Ba	na	ppb	68	0	0.01	0.34	0.07	0.06	0.05	0.03
SiO_2	na	ppb	103	0	4.3	47.1	23.9	23.3	6.5	0.1
Na	na	ppb	103	0	5.1	78.4	15.3	12.7	11.3	0.05
K	na	ppb	103	0	0.9	6.8	3.0	2.8	1.2	0.1
HCO_3^-	na	ppb	99	0	87.0	343	176	171	38.2	<1
Cl	na	ppb	103	0	4.9	218	27.8	16.3	33.5	<1
SO_4^{2-}	na	ppb	103	0	8.8	45.0	23.9	22.4	7.7	<2
NO_3^-	na	ppb	103	0	<0.05	23.5	5.45	3.60	4.60	<0.05
Br	na	ppb	99	0	0.005	0.210	0.047	0.037	0.036	1
F	na	ppb	103	0	0.11	1.30	0.30	0.22	0.19	<0.05
Fe	na	ppb	103	0	0.026	0.230	0.061	0.053	0.033	0.01
Li	7	ppb	99	0	1.0	73.5	9.0	3.3	10.9	<1
Be	9	ppb	99	99	<0.05	<0.05	na	na	na	<0.05
B	11	ppb	99	0	11	84.0	29.4	26.0	12.8	<10
Al	27	ppb	99	1	<1	20.0	4.9	5.0	2.9	<1
V	51	ppb	99	1	<0.1	13.7	5.3	5.3	2.1	<0.1
Cr	52	ppb	99	4	<1	45.0	5.9	5.0	5.8	<1
Mn	55	ppb	99	20	<1	140	4.5	0.5	17.3	<0.1
Ni	62	ppb	99	13	<0.1	1.9	0.4	0.2	0.4	<0.1
Co	59	ppb	99	59	<0.05	3.78	0.11	0.05	0.38	<0.05
Cu	63	ppb	99	10	<0.1	7.60	0.69	0.50	0.91	<0.1
Cu	65	ppb	99	4	<0.1	7.70	0.75	0.60	0.91	<0.1
Zn	66	ppb	99	1	<1	569	79.9	11.0	115	<1
Zn	68	ppb	99	0	2.0	553	79.0	11.0	111	<1
As	75	ppb	99	0	0.4	22.3	2.2	1.9	2.2	<0.1
Se	82	ppb	99	2	<0.5	5.5	1.6	1.5	0.7	<0.5
Rb	85	ppb	99	0	0.5	12.2	5.9	6.2	2.7	<0.1
Sr	88	ppb	99	0	80	480	213	200	73.0	<1
Mo	95	ppb	99	0	0.6	7.3	2.5	2.3	1.0	<0.1
Mo	97	ppb	99	0	0.6	7.3	2.5	2.3	1.0	<0.1
Mo	98	ppb	99	0	0.6	7.3	2.5	2.4	1.0	<0.1
Cd	111	ppb	99	82	<0.05	0.340	na	na	na	<0.05
Cs	133	ppb	99	47	<0.05	1.38	0.172	0.090	0.177	<0.05
Ba	135	ppb	99	0	6.0	258	59.3	51.7	40.9	<0.1
Ba	137	ppb	99	0	6.1	258	59.5	51.9	40.9	<0.1
Ba	138	ppb	99	0	6.1	263	59.9	50.8	41.8	<0.1
Tl	205	ppb	99	98	<0.05	0.1	na	na	na	<0.05
Pb	208	ppb	99	12	<0.05	18.0	1.38	0.26	3.09	<0.05
U	238	ppb	99	0	0.09	3.8	1.9	1.9	0.6	<0.05

Table 13. Statistical parameters for selected constituents in ground water from the Idaho National Engineering and Environmental Laboratory and vicinity (continued)

Constituent (chemical symbol)	Analyte mass	Concentration units	Sample size	Number below detection	Minimum	Maximum	Mean	Median	Standard	Detection
^{13}C	13	per mil	85	0	-14.69	-5.61	-9.58	-9.43	1.72	*
$\delta^{2}H$	2	per mil	141	0	-143.7	-120.6	-136.5	-137.0	3.6	*
$\delta^{18}O$	18	per mil	141	0	-18.55	-14.79	-17.72	-17.79	0.62	*
^{14}C	14	pmc	18	0	21.9	86.2	65.4	67.2	19.4	*
^{3}H	3	TU	91	[2]13	0	97.53	10.1	3.9	16.4	*
He	na	ccSTP/g	120	0	1.59E-8	1.49E-6	9.89E-8	6.21E-8	1.44E-7	*
Ne	na	ccSTP/g	122	0	1.38E-8	2.84E-6	2.34E-7	2.03E-7	2.48E-7	*
H_2	na	ccSTP/g	62	0	3.75E-9	7.69E-6	1.89E-7	1.38E-8	9.75E-7	3
Ar	na	ccSTP/g	59	0	2.18E-4	6.99E-4	3.11E-4	3.04E-4	6.72E-5	*

[1] The detection limit varies with the volume of the sample loop injected into the ion chromatograph. The range of detection limits were from <0.005 to <0.02 ppm.

[2] Number of samples with measured concentrations equal to or less than two standard deviations of the measured tritium concentration in the sample.

[3] Hydrogen concentrations can change during storage in some of the samples; therefore, the results should be considered qualitative rather than quantitative.