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# Radionuclides, Stable Isotopes, Inorganic Constituents, and Organic Compounds in Water from Selected Wells and Springs from the Southern Boundary of the Idaho National Engineering Laboratory to the Hagerman Area, Idaho, 1994

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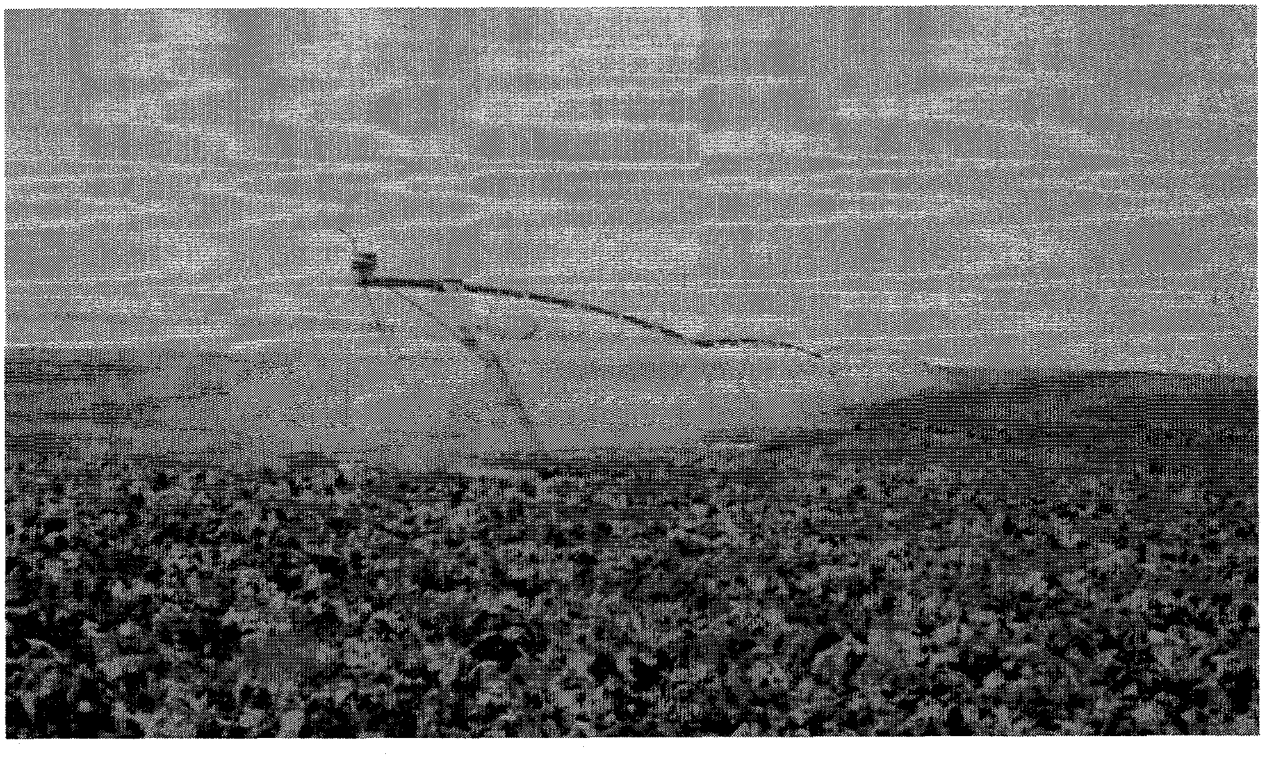
U.S. Geological Survey
Open-File Report 95-718



Prepared in cooperation with
U.S. DEPARTMENT OF ENERGY and IDAHO DEPARTMENT OF WATER RESOURCES

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Cover: Center-pivot sprinkler system on the Snake River Plain.

# Radionuclides, Stable Isotopes, Inorganic Constituents, and Organic Compounds in Water from Selected Wells and Springs from the Southern Boundary of the Idaho National Engineering Laboratory to the Hagerman Area, Idaho, 1994

By ROY C. BARTHOLOMAY and LINDA M. WILLIAMS, U.S. GEOLOGICAL SURVEY, and LINFORD J. CAMPBELL, IDAHO DEPARTMENT OF WATER RESOURCES

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**Open-File Report 95-718**

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**Idaho Falls, Idaho**
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## U.S. DEPARTMENT OF THE INTERIOR

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## CONVERSION FACTORS AND ABBREVIATED UNITS

| Multiply | By | To Obtain |
|---:|---:|:---|
| acre-foot per year (acre-ft/yr) | 1,233 | cubic meter per year |
| foot (ft) | 0.3048 | meter |
| gallon (gal) | 3.785 | liter |
| mile (mi) | 1.609 | kilometer |
| millirem per year (mrem/yr) | 0.010 | millisievert per year |
| picocurie per liter (pCi/L) | 0.037 | becquerel per liter |
| square mile ($mi^2$) | 2.590 | square kilometer |

Temperature can be converted from degrees Celsius (°C) to degrees Fahrenheit (°F) by the equation: °F = (°C × 1.8) + 32

Abbreviated units used in report: gram (g); milliliter (mL); liter (L); microgram per liter (µg/L); milligram per liter (mg/L); micrometer (µm); and microsiemens per centimeter at 25 degrees Celsius (µS/cm).

# Radionuclides, Stable Isotopes, Inorganic Constituents, and Organic Compounds in Water from Selected Wells and Springs from the Southern Boundary of the Idaho National Engineering Laboratory to the Hagerman Area, Idaho, 1994

***By*** **Roy C. Bartholomay *and* Linda M. Williams, U.S. Geological Survey, *and* Linford J. Campbell, Idaho Department of Water Resources**

## Abstract

The U.S. Geological Survey and the Idaho Department of Water Resources, in response to a request from the U.S. Department of Energy, sampled 18 sites as part of a long-term project to monitor water quality of the Snake River Plain aquifer from the southern boundary of the Idaho National Engineering Laboratory to the Hagerman area. Water samples were collected and analyzed for selected radionuclides, stable isotopes, inorganic constituents, and organic compounds. The samples were collected from seven irrigation wells, seven domestic wells, two springs, one stock well, and one observation well. Two quality assurance samples also were collected and analyzed.

None of the radionuclide, inorganic constituent, or organic compound concentrations exceeded the established maximum contaminant levels for drinking water. Many of the radionuclide and inorganic constituent concentrations exceeded their respective reporting levels. All samples analyzed for dissolved organic carbon had concentrations that exceeded their minimum reporting levels.

## INTRODUCTION

Recently, the public has expressed concern about waste disposal practices at the Idaho National Engineering Laboratory (INEL) and the impact these practices might have had on the water quality of the Snake River Plain aquifer. The U.S. Department of Energy (DOE) requested that the U.S. Geological Survey (USGS) conduct two studies to respond to the public's concern and to gain a greater understanding of the chemical quality of water in the aquifer. The first study described a one-time sampling effort in the eastern part of the A & B Irrigation District in Minidoka County (Mann and Knobel, 1990). The second study, an ongoing annual sampling effort in the area between the southern boundary of the INEL and Hagerman (fig. 1), is being conducted in cooperation with the Idaho Department of Water Resources (IDWR) and the DOE. The initial round of sampling for the second study involved analyzing water samples collected from 55 sites during August and September 1989 (Wegner and Campbell, 1991). The second round of sampling involved analyzing water samples collected from 19 of the initial 55 sites in 1990 (Bartholomay and others, 1992), another 18 of the initial 55 sites in 1991 (Bartholomay and others, 1993), and the

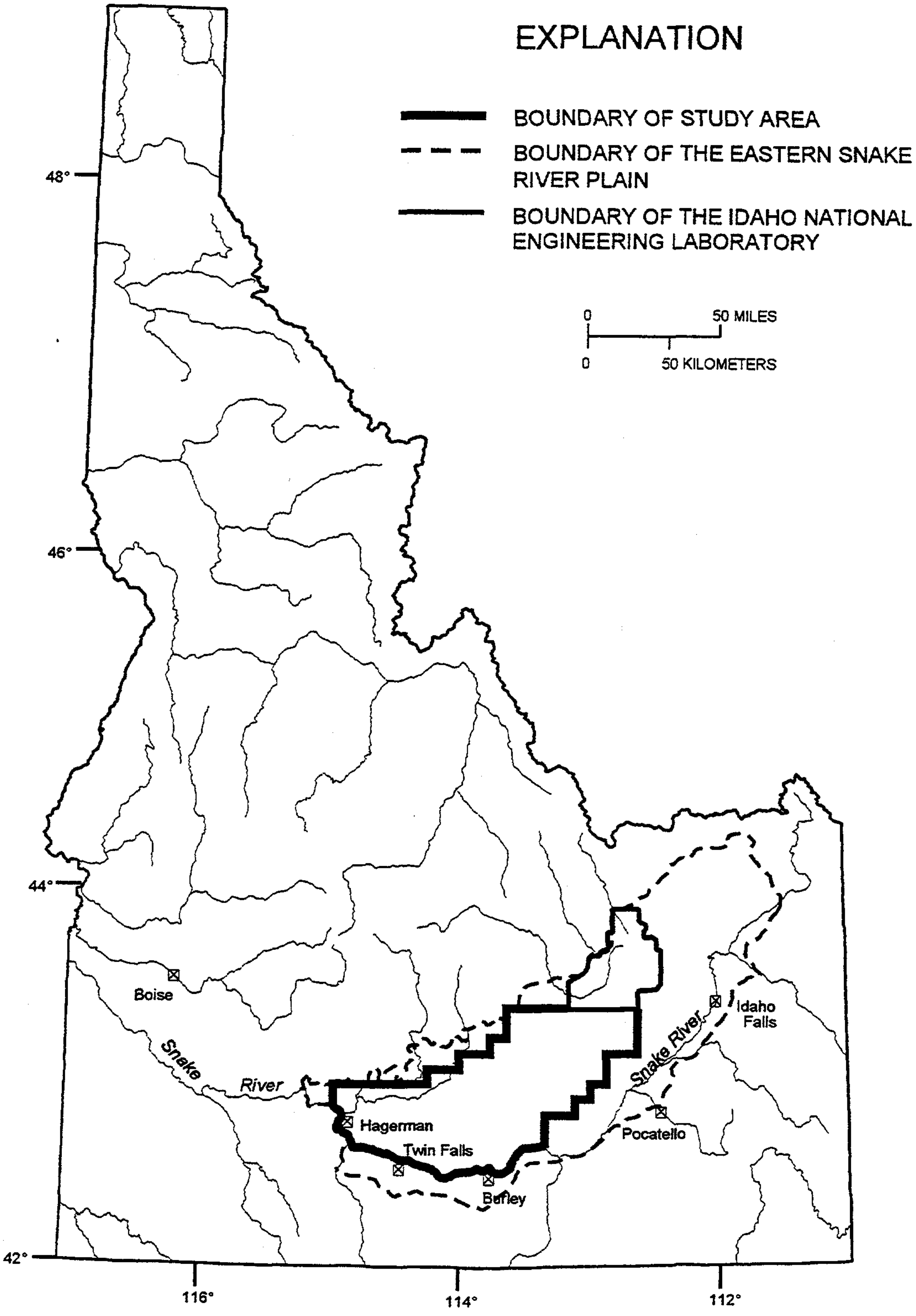

Figure 1. Location of the study area, between the Idaho National Engineering Laboratory and Hagerman, Idaho.

remaining 18 sites in 1992 (Bartholomay and others, 1994a). The third round of sampling involved analyzing water samples collected from 19 of the initial 55 sites in 1993 (Bartholomay and others, 1994b). This report summarizes the analyses of water samples collected as part of the third round in August 1994 from 18 more of the initial 55 sites.

The INEL includes about 890 $mi^2$ of the northeastern part of the eastern Snake River Plain and is about 110 mi northeast of the Hagerman area (fig. 1). Wastewater containing chemical and radiochemical wastes generated at the INEL was discharged mostly to ponds and wells in the past. Since 1983, most aqueous wastes have been discharged to infiltration ponds. Many of the constituents in the wastewater enter the aquifer indirectly following percolation through the unsaturated zone (Pittman and others, 1988).

Chemical and radioactive wastes have migrated from less than 1 to about 9 mi southwest of the disposal areas at the INEL (Pittman and others, 1988). Tritium was detected intermittently at concentrations of 3,400±200 pCi/L or less in water from three wells along the southern boundary of the INEL between 1983 and 1985. Since April 1986, tritium concentrations in water from wells near the southern boundary of the INEL have been less than the Radiological and Environmental Sciences Laboratory analytical method detection limit of 500 pCi/L (Mann and Cecil, 1990).

Water samples from 18 sites (fig. 2) were analyzed for selected radionuclides, stable isotopes, trace elements, common ions, nutrients, dissolved organic carbon (DOC), anionic surfactants as methylene blue active substances (MBAS), purgeable organic compounds, organophosphorus insecticides, organochlorine insecticides, gross polychlorinated biphenyls (PCB's), gross polychloinated naphthalenes (PCN's), chlorophenoxy-acid herbicides, and other herbicides by the USGS's National Water Quality Laboratory (NWQL) at Arvada, Colo. The same sites also were sampled for analyses of selected radionuclides by the Idaho State University (ISU) Environmental Monitoring Laboratory at Pocatello, Idaho. Two replicate water samples also were collected and analyzed as a measure of quality assurance.

## Geohydrologic Setting

The eastern Snake River Plain is a northeast-trending structural basin about 200 mi long and 50 to 70 mi wide. The basin, bounded by faults on the northwest and downwarping and faulting on the southeast, has been filled with basaltic lava flows interbedded with terrestrial sediments (Whitehead, 1986). Individual basalt flows average 20 to 25 ft in thickness with an aggregate thickness of several thousand feet in places. Alluvial fan deposits are composed primarily of sand and gravel, whereas in areas where streams were dammed by basalt flows, the sediments are predominantly silt and clay (Garabedian, 1986). Rhyolitic lava flows and tuffs are exposed locally at the surface and may exist at depth under most of the eastern plain. A 10,365-ft-deep test hole at the INEL penetrated about 2,160 ft of basalt and sediment and 8,205 ft of tuffaceous and rhyolitic volcanic rocks (Mann, 1986).

Movement of water in the aquifer generally is from the northeast to the southwest. Water moves horizontally through basalt interflow zones and vertically through joints and interfingering edges of the interflow zones. Infiltration of surface water, heavy pumpage, geologic conditions, and seasonal fluxes in recharge and discharge locally affect the movement of ground water (Garabedian, 1986).

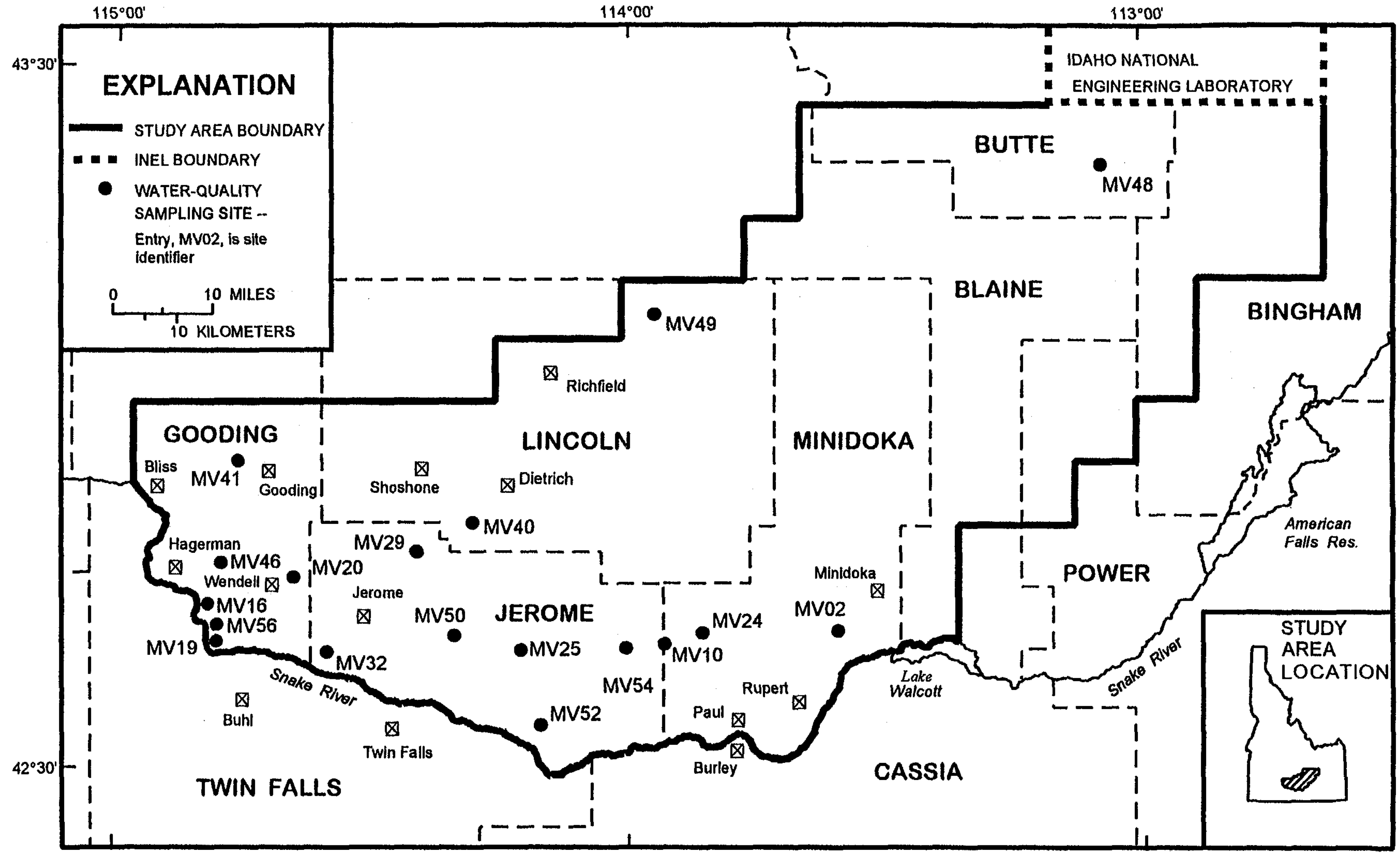

Figure 2. -- Location of selected water-quality sampling sites on the eastern Snake River Plain.

The Snake River Plain aquifer is recharged by seepage from the upper reaches of the Snake River, tributaries and canals, infiltration from irrigation and precipitation, and underflow from tributary valleys on the perimeter of the plain. Discharge from the aquifer primarily is by pumpage for irrigation and spring flow to the Snake River (Mann and Knobel, 1990). Between 1902 and 1980, spring flow to the Snake River increased from about 3.1 million to about 4.3 million acre-ft/yr, largely as a result of increased recharge from infiltration of irrigation water (Kjelstrom, 1992, fig. 27).

### Acknowledgments

The authors gratefully acknowledge the well owners for granting permission to collect the water samples and extend special thanks to Downy Strode of the Tikura Cattlemen's Association for his help in locating and pumping one of the wells for sample collection. The authors are grateful for technical review of the manuscript by LeRoy L. Knobel and Michael R. Greene of the USGS.

## METHODS AND QUALITY ASSURANCE

The methods used in sampling and analyzing for selected chemicals generally followed the guidelines established by the USGS (Goerlitz and Brown, 1972; Stevens and others, 1975; Wood, 1981; Claassen, 1982; W.L. Bradford, USGS, written commun., 1985; Wershaw and others, 1987; Fishman and Friedman, 1989; Faires, 1992; and Fishman, 1993). The methods used in the field and quality assurance practices are outlined in the following sections.

### Site Selection

Water samples were collected at 18 sites (fig. 2), including seven irrigation wells, seven domestic wells, two springs, one stock well, and one observation well. Two replicate water samples also were collected. The irrigation wells were equipped with turbine pumps. The domestic, stock, and observation wells were equipped with submersible pumps. Criteria for site selection were geographic location, ease of sample collection, and long-term access.

### Sample Containers and Preservatives

Sample containers and preservatives differ depending on the constituent(s) for which analyses are requested. Samples analyzed by the NWQL were collected and preserved in accordance with laboratory requirements specified by Timme (1994). Water samples analyzed by ISU were collected in accordance with laboratory requirements specified by the Director of the Environmental Monitoring Program at ISU. Containers and preservatives were supplied by the respective laboratories. Containers and preservatives used for this study are listed on table 1.

### Sample Collection

Irrigation wells were sampled from spigots in discharge lines near pumps; domestic and stock wells were sampled from spigots closest to pumps; and the observation well was sampled at the well head. All the wells either were pumping on arrival of the sampling team or were started on arrival and, when possible, pumped long enough to ensure that pressure tanks and pumping systems had been thoroughly flushed as evidenced by stable pH, specific conductance, and temperature measurements. The two springs were sampled as near the source as possible by collecting a grab sample from an area of moving water.

Table 1. ***Containers and preservatives used for water-sample collection***

[Abbreviations: L, liter; °C, degrees Celsius; mL, milliliter; µm, micrometer; gal, gallon. Chemical formulas: $HgCl_2$, mercuric chloride; NaCl, sodium chloride; $HNO_3$, nitric acid; $K_2Cr_2O_7$, potassium dichromate; $SrCl_2$, strontium chloride. Chilled samples were shipped by overnight-delivery mail. Analyzing laboratory: NWQL, U.S. Geological Survey's National Water Quality Laboratory; ISU, Idaho State University's Environmental Monitoring Laboratory]

| Constituent or type of constituent | Container | | Preservative | | Other treatment | Analyzing laboratory |
|---|---|---|---|---|---|---|
| | Type | Size | Type | Size | | |
| Strontium-90 | Polyethylene, acid rinsed | 1 L | $HNO_3$ | 4 mL | 0.45 µm filter | NWQL |
| | Polyethylene | 1 gal | None | None | None | ISU |
| Tritium | Polyethylene | 1 L | None | None | None | NWQL |
| | Polyethylene | 1 L | None | None | None | ISU |
| Other radionuclides | Polyethylene, acid rinsed | 1 L | $HNO_3$ | 4 mL | .45 µm filter | NWQL |
| | Polyethylene | 1 gal | None | None | None | ISU |
| Stable isotopes for: | | | | | | |
| Carbon | Glass, baked | 1 L | Ammoniacal $SrCl_2$ | 50 mL | None | NWQL |
| Nitrogen | Glass, baked | 1 L | $HgCl_2$-NaCl | 1 mL | Chill 4°C | NWQL |
| Sulfur | Polyethylene | 1 L | None | None | None | NWQL |
| Hydrogen and oxygen | Glass, baked | 125 mL | None | None | Chill 4°C | NWQL |
| Trace elements | Polyethylene, acid rinsed | 250 mL | $HNO_3$ | 1 mL | .45 µm filter | NWQL |
| | Polyethylene | 125 mL | None | None | None | NWQL |
| Mercury | Glass, acid rinsed | 250 mL | $HNO_3/K_2Cr_2O_7$ | 10 mL | .45 µm filter | NWQL |
| Common ions | Polyethylene, acid rinsed | 500 mL | $HNO_3$ | 2 mL | .45 µm filter | NWQL |
| | Polyethylene, acid rinsed | 500 mL | $HNO_3$ | 2 mL | None | NWQL |
| | Polyethylene | 250 mL | None | None | .45 µm filter | NWQL |
| | Polyethylene | 250 mL | None | None | None | NWQL |
| Nutrients | Polyethylene, brown | 125 mL | $HgCl_2$-NaCl | .5 mL | .45 µm filter, chill 4°C | NWQL |
| Dissolved organic carbon | Glass, baked | 125 mL | None | None | Silver filter, chill 4°C | NWQL |
| Anionic surfactants | Polyethylene | 250 mL | None | None | Chill 4°C | NWQL |
| Purgeable organic compounds | Glass, baked | 40 mL | None | None | Chill 4°C | NWQL |
| Pesticides | Glass, baked | 1 L | None | None | Chill 4°C | NWQL |

Chemical and physical characteristics monitored at the water-sampling sites included pH, specific conductance, water temperature, alkalinity, and dissolved oxygen. These characteristics were monitored during pumping using methods described by Wood (1981) and Hardy and others (1989). A water sample was collected when measurements of these properties indicated probable hydraulic and chemical stability. After collection, sample containers were sealed with laboratory film, labeled, and packed into ice chests for shipment by overnight-delivery mail to the NWQL. The samples collected for the ISU were stored in coolers until they were hand-delivered to the laboratory.

Measurements of pH, specific conductance, water temperature, alkalinity, and dissolved oxygen are shown on table 2. Measured pH of water from sampling sites ranged from 7.4 to 8.2, which is within the U.S. Environmental Protection Agency's (1994b) recommended range of 6.5 to 8.5 for community water systems. Specific conductance measurements ranged from 311 to 1,012 μS/cm. Measurements of water temperature ranged from 10.5 to 16.0°C. The Idaho Department of Health and Welfare (IDHW) (1989) has established a secondary maximum contaminant level of 26.6°C for water temperature. Alkalinity as calcium carbonate ranged from 117 to 261 mg/L. Dissolved oxygen ranged from 6.0 to 9.3 mg/L.

Conditions at the sampling site during sample collection were recorded in a field logbook; a chain-of-custody record was used to track the samples from the time of collection until delivery to the analyzing laboratory. These records are available for inspection at the USGS's Project Office at the INEL.

### Quality Assurance

Detailed descriptions of internal quality control and overall quality assurance practices used by the NWQL are provided in reports by Friedman and Erdmann (1982), Jones (1987), and Pritt and Raese (1992). Water samples analyzed by the NWQL were collected in accordance with a quality assurance plan for quality-of-water activities conducted by personnel at the INEL Project Office. The plan was finalized in June 1989, revised in March 1992, and is available for inspection at the USGS's Project Office at the INEL. Water samples analyzed by ISU were collected in accordance with procedures described by B. Graham (ISU, written commun., 1991). About 10 percent of the water samples were quality assurance samples. Sample MV-28 is a replicate of sample MV-10. Sample MV-34 is a replicate of sample MV-56.

## RADIONUCLIDES

Water samples were analyzed for strontium-90, tritium, gross alpha- and gross beta-particle radioactivity. In addition, gamma-emitting radionuclides were identified. The samples were analyzed using methods described by Thatcher and others (1977). Maximum contaminant levels for the types of radioactivity and for selected radionuclides are listed on table 3.

An analytical uncertainty, **s**, is calculated for each radionuclide concentration. This report presents the analytical uncertainty as 2**s**. Guidelines for interpreting analytical results are based on an extension of the method described by Currie (1984). In radiochemical analyses, laboratory measurements are made on a target sample and a prepared blank. Instrument signals for the sample and blank vary randomly. Therefore, it is essential to distinguish between two key aspects of

Table 2. ***Results of field measurements of water for pH, specific conductance, temperature, alkalinity, and dissolved oxygen from selected wells and springs, eastern Snake River Plain***

[See figure 2 for location of sites. Site use: H, domestic; I, irrigation; Sp, spring; QA, quality assurance (MV-28 is a replicate of MV-10; MV-34 is a replicate of MV-56); S, stock; O, observation. Date sampled: month/day/year. Units: pH, negative base-10 logarithm of hydrogen ion activity in moles per liter; specific conductance, microsiemens per centimeter at 25°C (degrees Celsius); temperature, °C; alkalinity, milligrams per liter (mg/L) as calcium carbonate using digital titration with 0.16 normal sulfuric acid; dissolved oxygen, mg/L using azide modification of Winkler method (American Public Health Association and Water Pollution Control Federation, 1985). Symbol: --, analysis was not recorded]

| Site identifier | Site use | Date sampled | pH | Specific conductance | Temperature | Alkalinity | Dissolved oxygen |
|---|---|---|---|---|---|---|---|
| MV-02 | H | 8/11/94 | 7.8 | 590 | 14.0 | 169 | 6.0 |
| MV-10 | I | 8/11/94 | 7.8 | 742 | 14.0 | 187 | 7.4 |
| MV-16 | Sp | 8/09/94 | 7.9 | 418 | 14.5 | 134 | 8.3 |
| MV-19 | Sp | 8/09/94 | 7.9 | 528 | 14.0 | 156 | 8.3 |
| MV-20 | I | 8/10/94 | 7.7 | 428 | 16.0 | 146 | 8.1 |
| MV-24 | H | 8/11/94 | 7.7 | 1,012 | 15.0 | 243 | 7.0 |
| MV-25 | H | 8/08/94 | 7.7 | 751 | 14.0 | 238 | -- |
| MV-28 | QA | 8/11/94 | 7.8 | 742 | 14.0 | 187 | 7.4 |
| MV-29 | I | 8/10/94 | 8.0 | 349 | 14.0 | 117 | 8.1 |
| MV-32 | H | 8/12/94 | 7.7 | 724 | 15.5 | 222 | 7.5 |
| MV-34 | QA | 8/09/94 | 7.8 | 421 | 16.0 | 132 | 7.7 |
| MV-40 | I | 8/10/94 | 8.0 | 336 | 14.5 | 125 | 7.9 |
| MV-41 | I | 8/10/94 | 7.4 | 751 | 14.5 | 261 | 7.3 |
| MV-46 | I | 8/09/94 | 8.1 | 311 | 15.5 | 117 | 7.6 |
| MV-48 | O | 8/16/94 | 8.2 | 356 | 12.0 | 139 | 7.3 |
| MV-49 | S | 8/16/94 | 7.7 | 384 | 10.5 | 169 | 9.3 |
| MV-50 | I | 8/11/94 | 7.8 | 725 | 14.5 | 183 | 8.0 |
| MV-52 | H | 8/08/94 | 7.8 | 634 | 16.0 | 192 | 8.6 |
| MV-54 | H | 8/08/94 | 7.7 | 808 | 15.0 | 182 | 7.5 |
| MV-56 | H | 8/09/94 | 7.8 | 421 | 16.0 | 132 | 7.7 |

Table 3. ***Maximum contaminant levels for types of radioactivity and selected radionuclides in drinking water***

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994a, p. 660) for community water systems and are included for comparison purposes only. Maximum contaminant levels given for strontium-90 and tritium are average annual concentrations assumed to produce a total body or organ dose of 4 mrem/yr (millirem per year) of beta-particle radiation. The maximum contaminant level given for gross alpha-particle radioactivity includes radium-226 but excludes radon and uranium. The maximum contaminant level given for gross beta-particle and gamma radioactivity excludes radioactivity from natural sources and is included for comparison purposes only. Abbreviation: pCi/L, picocurie per liter]

| Type of radioactivity or radionuclide | Maximum contaminant level |
|---|---|
| Strontium-90 | 8 pCi/L |
| Tritium | 20,000 pCi/L |
| Gross alpha-particle radioactivity | 15 pCi/L |
| Gross beta-particle and gamma radioactivity | 4 mrem/yr |

the problem of detection: (1) The instrument signal for the sample must be greater than the signal for the blank to make the decision that there was detection; and (2) an estimation must be made of the minimum concentration that will yield a sufficiently large signal to make the correct decision for detection or nondetection most of the time. The first aspect of the problem is a qualitative decision based on signals and a definite criterion for detection. The second aspect of the problem is an estimation of the detection capabilities of a complete measurement process that includes hypothesis testing.

In the laboratory, instrument signals must exceed a critical level of 1.6s to make the qualitative decision whether the radionuclide or radioactivity was detected. At 1.6s, there is about a 95-percent probability that the correct decision—not detected—will be made. Given a large number of samples, as many as 5 percent of the samples with measured concentrations greater than or equal to 1.6s, which were concluded as being detected, might not contain the radioactive constituent. These measurements are referred to as false positives and are errors of the first kind in hypothesis testing.

Once the critical level of 1.6s has been defined, the minimum detectable concentration can be established. Concentrations that equal 3s represent a measurement at the minimum detectable concentration. For true concentrations of 3s or greater, there is a 95-percent-or-more probability of correctly concluding that the radioactive constituent was detected in a sample. Given a large number of samples, as many as 5 percent of the samples with measured concentrations greater than or equal to 3s, which were concluded as being not detected, could contain the radioactive constituent at the minimum detectable concentration. These measurements are referred to as false negatives and are errors of the second kind in hypothesis testing.

True radionuclide concentrations between 1.6s and 3s have larger errors of the second kind. That is, there is a greater-than-5-percent probability of false negative results for samples with true concentrations between 1.6s and 3s, and although the radionuclide or radioactivity might have been detected, such detection may not be considered reliable; at 1.6s, the probability of a false negative is about 50 percent.

These guidelines are based on counting statistics alone and do not include systematic or random errors inherent in laboratory procedures. The values 1.6s and 3s vary slightly with background or blank counts and with the number of gross counts for individual analyses. The use of the critical level and minimum detectable concentration aids the reader in the interpretation of analytical results and does not represent absolute concentrations of radioactivity that may or may not have been detected. In this report, if the concentration of a selected radionuclide was equal to or greater than 3s, the concentration is considered to be above a "reporting level." The reporting level should not be confused with the analytical method detection limit, which is based on laboratory procedures. At small concentrations, the reporting level approaches the analytical method detection limit; however, at larger concentrations, they may be significantly different.

### Strontium-90

Strontium-90 is a fission product that was widely distributed in the environment during atmospheric weapons tests. Strontium-90 generally is present in ground water as a result of these tests and from nuclear industry waste-disposal practices. All water samples analyzed contained concentrations of dissolved strontium-90 less than the reporting level (table 4).

### Tritium

Tritium, a radioactive isotope of hydrogen, is formed in nature by interactions of cosmic rays with gases in the upper atmosphere. Tritium also is produced in thermonuclear detonations and is a waste product of the nuclear power industry. Samples were submitted to the ISU laboratory and the NWQL. The ISU laboratory used a liquid scintillation technique and the NWQL used an enrichment and gas counting technique. The analytical method detection limit for the laboratories differed. The analytical method detection limit for the ISU laboratory was 300 pCi/L using a 200-minute counting period, and that for the NWQL was 0.3 pCi/L using a 360- to 1,200-minute counting period.

The concentrations of tritium in the water samples are shown on table 4. Concentrations of tritium in all of the water samples analyzed by the NWQL exceeded the reporting level and ranged from 2.62±0.576 to 80.00±5.12 pCi/L (table 4). Concentrations of tritium in all water samples analyzed by the ISU laboratory were less than the reporting level. For the purpose of comparison, background concentrations of tritium in ground water in Idaho generally range from 0 to 40 pCi/L (Knobel and others, 1992). The maximum contaminant level for tritium in public drinking-water supplies is 20,000 pCi/L (table 3).

### Gross Alpha-Particle Radioactivity

Gross alpha-particle radioactivity is a measure of the total radioactivity given off as alpha particles during the radioactive decay process; however, laboratories normally report the radioactivity as if it were all given off by one radionuclide. In this report, concentrations are reported both as natural uranium in micrograms per liter and as thorium-230 in

Table 4. ***Concentrations of strontium-90 and tritium in water from selected wells and springs, eastern Snake River Plain***

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory (NWQL) and Idaho State University's (ISU) Environmental Monitoring Laboratory using the following methods: strontium-90 by chemical separation and precipitation; tritium by enrichment and gas counting at the NWQL and by liquid scintillation at ISU. Analytical results and uncertainties—for example 35.84±2.56—in picocuries per liter. Analytical uncertainties are reported as 2s. Concentrations that exceed the reporting level of 3 times 1s are shown in bold-face type. Symbols: *, quality assurance sample (MV-28 is a replicate of MV-10; MV-34 is a replicate of MV-56)]

| Site identifier | Strontium-90, NWQL | Tritium, NWQL | Tritium, ISU |
|---|---|---|---|
| MV-02 | 0.079±0.263 | **35.84±2.56** | -300±200 |
| MV-10 | .232±0.263 | **35.52±2.56** | 100±200 |
| MV-16 | .227±0.241 | **9.89±0.960** | -400±200 |
| MV-19 | .400±0.453 | **14.27±0.960** | -300±200 |
| MV-20 | .175±0.515 | **16.96±1.15** | -400±200 |
| MV-24 | .217±0.307 | **80.00±5.12** | -100±200 |
| MV-25 | .294±0.294 | **61.44±3.84** | -300±200 |
| MV-28* | .336±0.294 | **40.96±2.56** | -100±200 |
| MV-29 | .159±0.248 | **2.62±0.576** | -200±200 |
| MV-32 | .208±0.293 | **58.88±3.84** | 100±200 |
| MV-34* | .273±0.273 | **8.80±0.704** | -100±200 |
| MV-40 | -.011±0.247 | **11.68±0.768** | 0±200 |
| MV-41 | .166±0.267 | **60.16±3.84** | -100±200 |
| MV-46 | .251±0.271 | **8.80±0.704** | -400±200 |
| MV-48 | .053±0.308 | **30.72±1.92** | 100±200 |
| MV-49 | .070±0.274 | **63.68±4.48** | 100±200 |
| MV-50 | .149±0.277 | **52.16±3.20** | -200±200 |
| MV-52 | .0434±0.241 | **63.04±4.48** | -300±200 |
| MV-54 | .218±0.283 | **64.96±4.48** | -200±200 |
| MV-56 | .280±0.276 | **7.81±0.576** | -300±200 |

picocuries per liter by the NWQL, and as americium-241 in picocuries per liter by the ISU laboratory.

Concentrations of dissolved gross alpha-particle radioactivity reported as uranium and thorium-230 in eight of the water samples analyzed by the NWQL exceeded the reporting level (table 5) and ranged from 2.58±1.48 to 10.2±4.51 µg/L, and 1.92±1.18 to 7.21±3.16 pCi/L, respectively. Total concentrations of gross alpha-particle radioactivity reported as americium-241 in all the water samples analyzed by ISU were less than the reporting level.

### Gross Beta-Particle Radioactivity

Gross beta-particle radioactivity is a measure of the total radioactivity given off as beta particles during the radioactive decay process. The laboratory instruments for these measurements are calibrated to either a single radionuclide, cesium-137, or a pair of radionuclides, strontium-90 in equilibrium with yttrium-90. In this report, concentrations are reported as cesium-137 in picocuries per liter and as strontium-90 in equilibrium with yttrium-90 in picocuries per liter. Reporting of the concentrations of gross beta-particle radioactivity in either one of these ways is for reference purposes only and does not imply that the radioactivity is attributed to these specific isotopes. The average annual concentrations of strontium-90 and cesium-137 in public drinking-water supplies that produce a 4-mrem/yr dose are 8 pCi/L and 120 pCi/L, respectively. Gross beta-particle radioactivity measurements should not be compared directly with these concentrations.

Concentrations of dissolved gross beta-particle radioactivity reported as cesium-137 and as strontium-90 in equilibrium with yttrium-90 in all of the water samples analyzed by the NWQL exceeded the reporting levels (table 6) and ranged from 3.11±0.926 to 11.0±2.39 pCi/L, and 2.41±0.728 to 8.22±1.78 pCi/L, respectively. Concentrations of total gross beta-particle radioactivity reported as cesium-137 in 12 of the water samples analyzed by ISU equaled or exceeded the reporting level (table 6) and ranged from 3±2 to 6±2 pCi/L.

### Cesium-137

Gamma spectrometry involves using a series of detectors to simultaneously determine the concentrations of a variety of radionuclides by the identification of their characteristic gamma emissions. When no gamma-emitting radionuclides are identified, the concentration of total cesium-137 is reported by ISU. Cesium-137 is a fission product of uranium-235, uranium-233, or plutonium-239. One water sample (MV-02) had a concentration of cesium-137 of 4.8±3.2, which equaled the reporting level (table 7).

## STABLE ISOTOPES

Water samples were analyzed for relative concentrations of stable isotopes of hydrogen (H), oxygen (O), carbon (C), sulfur (S), and nitrogen (N). Because the absolute measurement of isotopic ratios is analytically difficult, relative isotopic ratios are measured instead (Toran, 1982). For example,

$^{18}O/^{16}O$ of a sample is compared with $^{18}O/^{16}O$ of a standard:

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

$R_{sample} = {}^{18}O/^{16}O$ in the sample,

$R_{standard} = {}^{18}O/^{16}O$ in the standard, and

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

Table 5. ***Concentrations of gross alpha-particle radioactivity in water from selected wells and springs, eastern Snake River Plain***

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory (NWQL) and the Idaho State University's (ISU) Environmental Monitoring Laboratory using a residue procedure. Analytical results and uncertainties—for example 2.02±2.13—in indicated units. Analytical uncertainties are reported as 2s. Concentrations that exceed the reporting level of 3 times 1s are shown in bold-face type. Abbreviations: µg/L, microgram per liter; pCi/L, picocurie per liter. Symbol: *, quality assurance sample (MV-28 is a replicate of MV-10; MV-34 is a replicate of MV-56)]

| Site identifier | Dissolved as uranium, NWQL (µg/L) | Dissolved as thorium-230, NWQL (pCi/L) | Total as americium-241, ISU (pCi/L) |
|---|---|---|---|
| MV-02 | 2.02±2.13 | 1.55±1.63 | 1±3 |
| MV-10 | **4.46±2.97** | **3.22±2.14** | 1±4 |
| MV-16 | 1.99±1.34 | 1.42±0.958 | 0±2 |
| MV-19 | 2.15±1.73 | 1.99±1.60 | -1±4 |
| MV-20 | **2.93±1.57** | **3.02±1.62** | 1±2 |
| MV-24 | 3.80±3.46 | 2.73±2.49 | 1±6 |
| MV-25 | 4.50±3.12 | 3.16±2.19 | 0±2 |
| MV-28* | 3.64±3.09 | 2.32±1.97 | -2±10 |
| MV-29 | 1.40±1.17 | 1.00±0.837 | 1±2 |
| MV-32 | 3.84±2.78 | 2.85±2.06 | 3±5 |
| MV-34* | 2.23±1.63 | 1.58±1.15 | 0±2 |
| MV-40 | **2.75±1.70** | **1.92±1.18** | 3±3 |
| MV-41 | **10.2±4.51** | **7.21±3.16** | 2±6 |
| MV-46 | .954±1.04 | .732±0.799 | 1±2 |
| MV-48 | **2.58±1.48** | **1.92±1.09** | 0±2 |
| MV-49 | **3.96±1.95** | **3.04±1.49** | 0±3 |
| MV-50 | 3.65±2.78 | 2.59±1.97 | 4±5 |
| MV-52 | **5.62±2.99** | **4.15±2.20** | 3±16 |
| MV-54 | **6.35±3.68** | **4.51±2.60** | -2±6 |
| MV-56 | 1.59±1.45 | 1.11±1.01 | 2±3 |

Table 6. ***Concentrations of gross beta-particle radioactivity in water from selected wells and springs, eastern Snake River Plain***

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory (NWQL) and Idaho State University's (ISU) Environmental Monitoring Laboratory using a residue procedure. Analytical results and uncertainties—for example 7.64±1.58—in picocuries per liter. Analytical uncertainties are reported as 2s. Concentrations that equal or exceed the reporting level of 3 times 1s are shown in bold-face type. Abbreviation: Sr-90/Y-90, strontium-90 in equilibrium with yttrium-90. Symbol: *, quality assurance sample (MV-28 is a replicate of MV-10; MV-34 is a replicate of MV-56)]

| Site identifier | Dissolved as cesium-137, NWQL | Dissolved as Sr-90/Y-90, NWQL | Total as cesium-137, ISU |
|---|---|---|---|
| MV-02 | **7.64±1.58** | **5.70±1.17** | **6±2** |
| MV-10 | **9.93±1.96** | **7.48±1.48** | **5±2** |
| MV-16 | **4.66±1.15** | **3.51±0.864** | **3±2** |
| MV-19 | **6.50±1.44** | **4.93±1.09** | 2±2 |
| MV-20 | **5.48±1.27** | **4.13±0.958** | 2±2 |
| MV-24 | **11.0±2.39** | **8.22±1.78** | **6±2** |
| MV-25 | **10.5±2.2** | **7.79±1.63** | **5±2** |
| MV-28* | **9.03±1.88** | **6.71±1.40** | **4±2** |
| MV-29 | **4.68±1.36** | **3.47±0.836** | -1±1 |
| MV-32 | **9.45±1.90** | **7.14±1.44** | **4±2** |
| MV-34* | **4.53±1.15** | **3.43±0.869** | 2±2 |
| MV-40 | **4.13±1.18** | **3.07±0.757** | 2±2 |
| MV-41 | **7.24±1.81** | **5.38±1.35** | **4±2** |
| MV-46 | **4.21±1.24** | **3.12±1.16** | 1±1 |
| MV-48 | **3.11±0.926** | **2.42±0.719** | 0±1 |
| MV-49 | **3.15±0.951** | **2.41±0.728** | 2±2 |
| MV-50 | **9.43±1.87** | **7.11±1.41** | **5±2** |
| MV-52 | **8.44±1.68** | **6.37±1.27** | **5±2** |
| MV-54 | **9.40±2.05** | **7.02±1.53** | **6±2** |
| MV-56 | **5.21±1.24** | **3.91±0.933** | **3±2** |

Table 7. ***Concentrations of cesium-137 in water from selected wells and springs, eastern Snake River Plain***

[See figure 2 for location of sites. Analyses were performed by the Idaho State University's Environmental Monitoring Laboratory using gamma spectrometry. Analytical results and uncertainties—for example 4.8±3.2—are for total concentrations in picocuries per liter. Analytical uncertainties are reported as 2s. Symbol: *, quality assurance sample (MV-28 is a replicate of MV-10; MV-34 is a replicate of MV-56)]

| Site identifier | Cesium-137 |
|---|---|
| MV-02 | 4.8±3.2 |
| MV-10 | 2.0±2.8 |
| MV-16 | -1.0±2.6 |
| MV-19 | .7±2.6 |
| MV-20 | .7±2.8 |
| MV-24 | 2.2±2.9 |
| MV-25 | -.7±2.8 |
| MV-28* | -4.2±2.7 |
| MV-29 | -2.2±2.6 |
| MV-32 | -1.9±2.8 |
| MV-34* | 1.0±2.7 |
| MV-40 | -2.2±2.8 |
| MV-41 | -.3±2.6 |
| MV-46 | 0±2.9 |
| MV-48 | -1.4±2.8 |
| MV-49 | -.6±2.8 |
| MV-50 | 2.9±2.9 |
| MV-52 | .6±2.6 |
| MV-54 | .6±2.8 |
| MV-56 | 0±2.6 |

Delta $^{18}O$ ($\delta^{18}O$) is referred to as delta notation and is the value reported by isotopic laboratories for stable isotope analysis. $^{2}H/^{1}H$, $^{13}C/^{12}C$, $^{34}S/^{32}S$, and $^{15}N/^{14}N$ are defined in a similar manner with the respective ratios replacing $^{18}O/^{16}O$ in $R_{sample}$ and $R_{standard}$. The standard used for determining $\delta^{18}O$ and $\delta^{2}H$ in water is standard mean ocean water as defined by Craig (1961). The standard used for determining $\delta^{13}C$ in water is the PeeDee Belemnite reference standard (Timme, 1994, p. 69). The standard used for determining $\delta^{34}S$ in water is the Vienna Canyon Diablo Troilite reference standard (Carmody, USGS, written commun., 1995). The standard used for determining $\delta^{15}N$ in water is air (Timme, 1994, p. 69). The respective precisions of measurement for $\delta^{2}H$, $\delta^{18}O$, $\delta^{13}C$, $\delta^{34}S$, and $\delta^{15}N$ are 2 permil, 0.2 permil, 0.3 permil, 0.5 permil, and 0.2 permil at the 95-percent confidence level (Timme, 1994, p. 69-70).

Relative concentrations of stable isotopes are shown in table 8. Relative isotopic ratios reported as $\delta^{2}H$ for water from 20 sites ranged from -138 to -126 permil. Relative isotopic ratios reported as $\delta^{18}O$ for water from 20 sites ranged from -17.99 to -16.13 permil. Relative isotopic ratios reported as $\delta^{13}C$ for water from 19 sites ranged from -14.3 to -9.2 permil. Relative isotopic ratios reported as $\delta^{34}S$ for water from 20 sites ranged from 5.6 to 14.7 permil. Relative isotopic ratios reported as $\delta^{15}N$ for water from 19 sites ranged from 3.2 to 6.1 permil.

## INORGANIC CONSTITUENTS

Water samples were analyzed for selected inorganic constituents. These constituents included trace elements, common ions, and nutrients. In this report, minimum reporting levels and method detection limits established for these constituents are not to be confused with reporting levels and analytical method detection limits for selected radionuclides. The minimum reporting level for inorganic and organic constituents is the smallest measured concentration of a constituent that may be reliably reported using a given analytical method (Timme, 1994, p. 78). The method detection limit is defined as the minimum concentration of a substance that can be measured and reported with 99-percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (U.S. Environmental Protection Agency, 1992).

### Trace Elements

Water samples were analyzed for selected dissolved trace elements including aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, vanadium, and zinc. Water samples also were analyzed for hexavalent and total chromium. The maximum or secondary maximum contaminant levels and minimum reporting levels of selected trace elements are shown on table 9. The concentrations of dissolved trace elements and hexavalent and total chromium are shown on table 10.

Aluminum.—Concentrations of aluminum in all samples were less than the minimum reporting level of 10 µg/L. The secondary maximum contaminant level is 50 to 200 µg/L.

Arsenic.—Concentrations of arsenic in all samples were equal to or greater than the minimum reporting level and ranged from 1 to 7 µg/L. The maximum contaminant level is 50 µg/L.

Table 8. ***Relative concentrations of stable isotopes in water from selected wells and springs, eastern Snake River Plain***

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Symbols: $\delta^{2}$H, delta notation for stable hydrogen isotope ratios; $\delta^{18}$O, delta notation for stable oxygen isotope ratios; $\delta^{13}$C, delta notation for stable carbon isotope ratios; $\delta^{34}$S, delta notation for stable sulfur isotope ratios; $\delta^{15}$N, delta notation for stable nitrogen isotope ratios; ±, plus or minus; permil, parts per thousand relative to a standard; *, quality assurance sample (MV-28 is a replicate of MV-10; MV-34 is a replicate of MV-56); BL, bottle broke in laboratory; SD, sample destroyed in laboratory]

| Site identifier | $\delta^{2}$H (±2 permil) | $\delta^{18}$O (±0.2 permil) | $\delta^{13}$C (±0.3 permil) | $\delta^{34}$S (±0.5 permil) | $\delta^{15}$N (±0.2 permil) |
|---|---|---|---|---|---|
| MV-02 | -133 | -17.25 | -10.3 | 14.4 | SD |
| MV-10 | -133 | -17.26 | -11 | 12.3 | 3.9 |
| MV-16 | -136 | -17.75 | -11.5 | 14.7 | 3.8 |
| MV-19 | -135 | -17.61 | -9.2 | 13.6 | 4.9 |
| MV-20 | -135 | -17.49 | -11.3 | 13.7 | 3.3 |
| MV-24 | -127 | -16.39 | -12.6 | 10.9 | 4 |
| MV-25 | -127 | -16.22 | -13.4 | 14.7 | 6.1 |
| MV-28* | -133 | -17.3 | -11.1 | 12.3 | 3.2 |
| MV-29 | -137 | -17.99 | BL | 14.5 | 3.2 |
| MV-32 | -130 | -16.69 | -12.6 | 12.4 | 6.1 |
| MV-34* | -137 | -17.81 | -10.2 | 14.2 | 4.1 |
| MV-40 | -135 | -17.74 | -10.1 | 12.1 | 3.5 |
| MV-41 | -126 | -16.13 | -14.3 | 13.1 | 5.1 |
| MV-46 | -138 | -17.83 | -10 | 11.0 | 3.6 |
| MV-48 | -138 | -17.89 | -9.5 | 5.6 | 5.6 |
| MV-49 | -133 | -17.21 | -13.2 | 6.3 | 4.2 |
| MV-50 | -131 | -16.94 | -11.3 | 11.5 | 5 |
| MV-52 | -128 | -16.4 | -10.4 | 13.1 | 4.4 |
| MV-54 | -130 | -16.76 | -13.4 | 11.4 | 3.9 |
| MV-56 | -135 | -17.81 | -10.4 | 14.1 | 4.4 |

Table 9. ***Maximum contaminant levels and minimum reporting levels of selected trace elements in drinking water***

[The maximum contaminant levels are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994a, p. 753; 1994b) for community water systems and are for comparison purposes only. Secondary maximum contaminant levels—in brackets—are from U.S. Environmental Protection Agency (1994a, p. 836). Minimum reporting levels for the U.S. Geological Survey's National Water Quality Laboratory are from Timme (1994). Units are in micrograms per liter (µg/L). Symbols: ••, maximum contaminant level has not been established; *, lead has an action level of 15 µg/L]

| Constituent | Maximum contaminant level | Minimum reporting level |
|---|---|---|
| Aluminum | [50 to 200] | 10 |
| Arsenic | 50 | 1 |
| Barium | 2,000 | 1 |
| Beryllium | 4 | .5 |
| Cadmium | 5 | 1 |
| Chromium, dissolved | •• | 5 |
| Chromium, hexavalent | •• | 1 |
| Chromium, total | 100 | 1 |
| Cobalt | •• | 3 |
| Copper | [1,000] | 10 |
| Iron | [300] | 3 |
| Lead | * | 1 |
| Lithium | •• | 4 |
| Manganese | [50] | 1 |
| Mercury | 2 | .1 |
| Molybdenum | •• | 10 |
| Nickel | 100 | 10 |
| Selenium | 50 | 1 |
| Silver | [100] | 1 |
| Strontium | •• | .5 |
| Vanadium | •• | 6 |
| Zinc | [5,000] | 3 |

Table 10. ***Concentrations of dissolved trace elements and hexavalent and total chromium in water from selected wells and springs, eastern Snake River Plain***

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Analytical results in micrograms per liter. Symbols: <, concentration was less than the respective minimum reporting level; *, quality assurance sample (MV-28 is a replicate of MV-10; MV-34 is a replicate of MV-56)]

| Site identifier | Aluminum | Arsenic | Barium | Beryllium | Cadmium | Chromium | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | dissolved | hexavalent | total |
| MV-02 | <10 | 3 | 62 | <.5 | 1 | <5 | <1 | 1.1 |
| MV-10 | <10 | 3 | 74 | <.5 | <1 | <5 | <1 | 1.3 |
| MV-16 | <10 | 3 | 22 | <.5 | <1 | <5 | <1 | 2.5 |
| MV-19 | <10 | 3 | 30 | <.5 | <1 | <5 | <1 | 2 |
| MV-20 | <10 | 3 | 21 | <.5 | <1 | <5 | 1 | 2.7 |
| MV-24 | <10 | 4 | 130 | <.5 | <1 | <5 | <1 | 2.2 |
| MV-25 | <10 | 4 | 67 | .6 | <1 | <5 | <1 | 1 |
| MV-28* | <10 | 3 | 76 | <.5 | 1 | <5 | <1 | 1.2 |
| MV-29 | <10 | 2 | 19 | <.5 | <1 | <5 | 4 | 3.4 |
| MV-32 | <10 | 2 | 87 | <.5 | <1 | <5 | <1 | 1.2 |
| MV-34* | <10 | 3 | 24 | .7 | <1 | <5 | <1 | 3 |
| MV-40 | <10 | 3 | 17 | <.5 | 1 | <5 | 2 | 3.5 |
| MV-41 | <10 | 3 | 77 | <.5 | 2 | <5 | <1 | 1.1 |
| MV-46 | <10 | 2 | 16 | <.5 | <1 | <5 | 2 | 3.3 |
| MV-48 | <10 | 1 | 49 | <.5 | <1 | <5 | 3 | 3.6 |
| MV-49 | <10 | 2 | 55 | <.5 | <1 | <5 | <1 | 4.5 |
| MV-50 | <10 | 2 | 58 | <.5 | 1 | <5 | <1 | 1.5 |
| MV-52 | <10 | 7 | 79 | <.5 | <1 | <5 | <1 | <1 |
| MV-54 | <10 | 3 | 100 | <.5 | <1 | <5 | <1 | 1.9 |
| MV-56 | <10 | 3 | 24 | .7 | <1 | <5 | <1 | 3 |

Table 10. ***Concentrations of dissolved trace elements and hexavalent and total chromium in water from selected wells and springs, eastern Snake River Plain—Continued***

| Site identifier | Cobalt | Copper | Iron | Lead | Lithium | Manganese | Mercury | Molybdenum |
|---|---|---|---|---|---|---|---|---|
| MV-02 | <3 | <10 | <3 | 2 | 37 | <1 | <0.1 | <10 |
| MV-10 | <3 | <10 | <3 | <1 | 43 | <1 | <.1 | <10 |
| MV-16 | <3 | <10 | <3 | <1 | 23 | <1 | <.1 | <10 |
| MV-19 | <3 | <10 | <3 | <1 | 28 | <1 | <.1 | <10 |
| MV-20 | <3 | <10 | <3 | <1 | 17 | <1 | <.1 | <10 |
| MV-24 | <3 | <10 | <3 | 1 | 47 | <1 | <.1 | <10 |
| MV-25 | <3 | <10 | 4 | <1 | 26 | <1 | <.1 | <10 |
| MV-28* | <3 | <10 | <3 | <1 | 46 | <1 | <.1 | <10 |
| MV-29 | <3 | <10 | 36 | <1 | 20 | <1 | <.1 | <10 |
| MV-32 | <3 | <10 | <3 | <1 | 37 | 1 | <.1 | <10 |
| MV-34* | <3 | <10 | <3 | <1 | 24 | <1 | <.1 | <10 |
| MV-40 | <3 | <10 | <3 | <1 | 11 | <1 | <.1 | <10 |
| MV-41 | <3 | <10 | 3 | <1 | 9 | <1 | <.1 | 10 |
| MV-46 | <3 | <10 | <3 | <1 | 9 | <1 | <.1 | <10 |
| MV-48 | <3 | <10 | 8 | 1 | <4 | 3 | <.1 | <10 |
| MV-49 | <3 | <10 | 20 | 1 | <4 | 2 | <.1 | <10 |
| MV-50 | <3 | <10 | <3 | <1 | 40 | <1 | <.1 | <10 |
| MV-52 | <3 | <10 | <3 | <1 | 26 | <1 | <.1 | <10 |
| MV-54 | <3 | <10 | <3 | <1 | 46 | <1 | <.1 | <10 |
| MV-56 | <3 | <10 | <3 | <1 | 24 | <1 | <.1 | <10 |

Table 10. ***Concentrations of dissolved trace elements and hexavalent and total chromium in water from selected wells and springs, eastern Snake River Plain—Continued***

| Site identifier | Nickel | Selenium | Silver | Strontium | Vanadium | Zinc |
|---|---|---|---|---|---|---|
| MV-02 | <10 | <1 | 1 | 300 | 7 | 45 |
| MV-10 | <10 | <1 | <1 | 350 | <6 | <3 |
| MV-16 | <10 | <1 | <1 | 190 | 6 | 14 |
| MV-19 | <10 | <1 | <1 | 240 | 8 | 7 |
| MV-20 | <10 | <1 | <1 | 190 | 8 | 4 |
| MV-24 | <10 | 1 | <1 | 400 | <6 | 22 |
| MV-25 | <10 | <1 | <1 | 250 | 16 | 24 |
| MV-28* | <10 | <1 | 2 | 360 | 7 | <3 |
| MV-29 | <10 | <1 | 2 | 160 | 7 | <3 |
| MV-32 | <10 | <1 | <1 | 360 | 7 | 32 |
| MV-34* | <10 | <1 | <1 | 200 | 7 | 28 |
| MV-40 | <10 | <1 | 3 | 150 | 8 | 3 |
| MV-41 | <10 | <1 | <1 | 340 | 12 | <3 |
| MV-46 | <10 | <1 | 2 | 140 | 9 | 4 |
| MV-48 | <10 | 1 | <1 | 220 | <6 | 150 |
| MV-49 | <10 | <1 | <1 | 170 | <6 | 480 |
| MV-50 | <10 | 1 | 1 | 330 | 7 | 4 |
| MV-52 | <10 | <1 | <1 | 260 | 14 | 34 |
| MV-54 | <10 | <1 | <1 | 410 | <6 | 13 |
| MV-56 | <10 | <1 | <1 | 200 | 8 | 30 |

Barium.—Concentrations of barium in all samples were greater than the minimum reporting level and ranged from 16 to 130 µg/L. The maximum contaminant level is 2,000 µg/L.

Beryllium.—Concentrations of beryllium in three samples were greater than the minimum reporting level and ranged from 0.6 to 0.7 µg/L. The maximum contaminant level is 4 µg/L.

Cadmium.—Concentrations of cadmium in five samples were equal to or greater than the minimum reporting level and ranged from 1 to 2 µg/L. The maximum contaminant level is 5 µg/L.

Chromium.—Chromium analyses included dissolved, hexavalent, and total chromium. All the samples had concentrations of dissolved chromium less than the minimum reporting level of 5 µg/L. Concentrations of hexavalent chromium in five samples equaled or exceeded the minimum reporting level and ranged from 1 to 4 µg/L. Concentrations of total chromium in 19 samples equaled or exceeded the minimum reporting level and ranged from 1 to 4.5 µg/L; the maximum contaminant level is 100 µg/L.

Cobalt.—Concentrations of cobalt in all samples were less than the minimum reporting level of 3 µg/L.

Copper.—Concentrations of copper in all samples were less than the minimum reporting level of 10 µg/L. The secondary maximum contaminant level is 1,000 µg/L.

Iron.—Concentrations of iron in five samples equaled or exceeded the minimum reporting level and ranged from 3 to 36 µg/L. The secondary maximum contaminant level is 300 µg/L.

Lead.—Concentrations of lead in four samples equaled or exceeded the minimum reporting level and ranged from 1 to 2 µg/L. Lead has an action level of 15 µg/L.

Lithium.—Concentrations of lithium in 18 samples exceeded the minimum reporting level and ranged from 9 to 47 µg/L.

Manganese.—Concentrations of manganese in three samples equaled or exceeded the minimum reporting level and ranged from 1 to 3 µg/L. The secondary maximum contaminant level is 50 µg/L.

Mercury.—Concentrations of mercury in all the samples were less than the minimum reporting level of 0.1 µg/L. The maximum contaminant level is 2 µg/L.

Molybdenum.—All but one sample had molybdenum concentrations less than the minimum reporting level of 10 µg/L. MV-41 had a concentration of 10 µg/L.

Nickel.—All the samples had concentrations of nickel less than the minimum reporting level of 10 µg/L. The maximum contaminant level is 100 µg/L.

Selenium.—Concentrations of selenium in three samples were equal to the minimum reporting level of 1 µg/L. The maximum contaminant level is 50 µg/L.

Silver.—Concentrations of silver in six samples equaled or exceeded the minimum reporting level and ranged from 1 to 3 µg/L. The secondary maximum contaminant level is 100 µg/L.

Strontium.—Concentrations of strontium in all samples exceeded the minimum reporting level and ranged from 140 to 410 µg/L.

Vanadium.—Concentrations of vanadium in 15 samples equaled or exceeded the minimum reporting level and ranged from 6 to 16 µg/L.

Zinc.—Concentrations of zinc in 16 samples equaled or exceeded the minimum reporting level and ranged from 3 to 480 µg/L. The secondary maximum contaminant level is 5,000 µg/L.

### Common Ions

Water samples were analyzed for dissolved common ions including bromide, calcium, chloride, fluoride, magnesium, potassium, silica, sodium, and sulfate. The maximum or secondary maximum contaminant levels and the minimum reporting levels of these ions are shown on table 11. The concentrations of dissolved common ions are shown on table 12.

Bromide.—Concentrations of bromide in all samples exceeded the minimum reporting level and ranged from 0.02 to 0.23 mg/L.

Calcium.—Concentrations of calcium in all samples exceeded the minimum reporting level and ranged from 27 to 72 mg/L.

Chloride.—Concentrations of chloride in all samples exceeded the minimum reporting level and ranged from 3.1 to 93 mg/L. The secondary maximum contaminant level is 250 mg/L.

Fluoride.—Concentrations of fluoride in all samples exceeded the minimum reporting level and ranged from 0.2 to 0.6 mg/L. The maximum contaminant level is 4 mg/L.

Magnesium.—Concentrations of magnesium in all samples exceeded the minimum reporting level and ranged from 13 to 33 mg/L.

Potassium.—Concentrations of potassium in all samples exceeded the minimum reporting level and ranged from 2.1 to 8.1 mg/L.

Silica.—Concentrations of silica in all samples were greater than the minimum reporting level and ranged from 24 to 41 mg/L.

Sodium.—Concentrations of sodium in all samples were greater than the minimum reporting level and ranged from 7.6 to 74 mg/L. IDHW (1989) recommends an optimum concentration of 20 mg/L of sodium for public drinking-water supplies.

Sulfate.—Concentrations of sulfate in all samples exceeded the minimum reporting level and ranged from 15 to 98 mg/L. The secondary maximum contaminant level is 250 mg/L.

### Nutrients

Water samples were analyzed for dissolved ammonia (as nitrogen), nitrite (as nitrogen), nitrite plus nitrate (as nitrogen), and orthophosphate (as phosphorus). The maximum and secondary maximum contaminant levels established by the U.S. Environmental Protection Agency (1994a) and the minimum reporting levels are shown on table 13. A maximum contaminant level has not been established or proposed for ammonia or orthophosphate. Concentrations of nutrients are shown on table 14.

Ammonia (as nitrogen).—Concentrations of ammonia (as nitrogen) in 17 of the samples equaled or exceeded the minimum reporting level and ranged from 0.01 to 0.03 mg/L.

Nitrite (as nitrogen).—Concentrations of nitrite (as nitrogen) in all the samples were less than the minimum reporting level of 0.01 mg/L. The maximum contaminant level is 1 mg/L.

Nitrite plus nitrate (as nitrogen).—Concentrations of nitrite plus nitrate (as nitrogen) in all samples exceeded the

Table 11. ***Maximum contaminant levels and minimum reporting levels of selected common ions in drinking water***

[The maximum contaminant levels are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994a, p. 753) for community water systems and are for comparison purposes only. Secondary maximum contaminant levels—in brackets—are from U.S. Environmental Protection Agency (1994a, p. 836). Minimum reporting levels for the U.S. Geological Survey's National Water Quality Laboratory are from Timme (1994). Units are in milligrams per liter (mg/L). Symbol: ••, maximum contaminant level has not been established]

| Constituent | Maximum contaminant level | Minimum reporting level |
|---|---|---|
| Bromide | •• | 0.01 |
| Calcium | •• | .02 |
| Chloride | [250] | .1 |
| | •• | |
| Fluoride | 4 | .1 |
| | [2] | |
| Magnesium | •• | .01 |
| Potassium | •• | .1 |
| Silica | •• | .01 |
| Sodium[1] | •• | .2 |
| Sulfate | [250] | .1 |
| | •• | |

[1] Idaho Department of Health and Welfare (1989) recommends an optimum concentration of 20 mg/L.

Table 12. ***Concentrations of dissolved common ions in water from selected wells and springs, eastern Snake River Plain***

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Analytical results in milligrams per liter. Symbols: *, quality assurance sample (MV-28 is a replicate of MV-10, MV-34 is a replicate of MV-56)]

| Site identifier | Bromide | Calcium | Chloride | Fluoride | Magnesium | Potassium | Silica | Sodium | Sulfate |
|---|---|---|---|---|---|---|---|---|---|
| MV-02 | 0.1 | 51 | 47 | 0.5 | 19 | 5.3 | 35 | 34 | 53 |
| MV-10 | .15 | 59 | 66 | .4 | 23 | 6.4 | 34 | 50 | 72 |
| MV-16 | .04 | 35 | 17 | .6 | 16 | 3.4 | 32 | 19 | 32 |
| MV-19 | .07 | 44 | 29 | .6 | 19 | 4 | 32 | 22 | 44 |
| MV-20 | .04 | 35 | 16 | .5 | 17 | 3.8 | 32 | 22 | 34 |
| MV-24 | .23 | 72 | 93 | .4 | 33 | 8.1 | 34 | 74 | 98 |
| MV-25 | .08 | 60 | 35 | .3 | 26 | 7.7 | 35 | 52 | 58 |
| MV-28* | .16 | 59 | 66 | .5 | 24 | 5.4 | 34 | 50 | 71 |
| MV-29 | .04 | 31 | 15 | .5 | 14 | 2.9 | 32 | 17 | 29 |
| MV-32 | .14 | 67 | 48 | .4 | 26 | 6.1 | 38 | 40 | 63 |
| MV-34* | .06 | 37 | 24 | .6 | 16 | 3.5 | 32 | 20 | 37 |
| MV-40 | .04 | 30 | 10 | .4 | 14 | 2.8 | 32 | 16 | 23 |
| MV-41 | .08 | 67 | 31 | .4 | 29 | 4.6 | 39 | 44 | 70 |
| MV-46 | .03 | 27 | 7.9 | .4 | 13 | 3.2 | 31 | 14 | 20 |
| MV-48 | .04 | 42 | 12 | .2 | 14 | 2.3 | 24 | 8.1 | 23 |
| MV-49 | .02 | 49 | 3.1 | .2 | 14 | 2.1 | 27 | 7.6 | 15 |
| MV-50 | .18 | 66 | 62 | .4 | 24 | 4.8 | 32 | 40 | 75 |
| MV-52 | .08 | 49 | 31 | .5 | 21 | 5.9 | 41 | 49 | 58 |
| MV-54 | .18 | 70 | 69 | .4 | 26 | 7.6 | 35 | 51 | 76 |
| MV-56 | .06 | 37 | 23 | .6 | 16 | 3.5 | 32 | 20 | 36 |

Table 13. ***Maximum contaminant levels and minimum reporting levels of selected nutrients, dissolved organic carbon, and anionic surfactants in drinking water***

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994a, p. 753) for community water systems and are included for comparison purposes only. The secondary maximum contaminant level—in brackets—is from U.S. Environmental Protection Agency (1994a, p. 836). Minimum reporting levels are from Timme (1994). Units are milligrams per liter. Symbol: ••, maximum contaminant level has not been established or proposed]

| Constituent | Maximum contaminant level | Minimum reporting level |
|---|---|---|
| Ammonia (as nitrogen) | •• | 0.01 |
| Nitrite (as nitrogen) | 1 | .01 |
| Nitrite plus nitrate (as nitrogen) | 10 | .05 |
| Orthophosphate (as phosphorus) | •• | .01 |
| Dissolved organic carbon | •• | .1 |
| Anionic surfactants | [0.5] | .02 |

minimum reporting level and ranged from 0.64 to 6.5 mg/L. The maximum contaminant level is 10 mg/L.

Orthophosphate (as phosphorus).—Concentrations of orthophosphate (as phosphorus) in 14 samples equaled or exceeded the minimum reporting level and ranged from 0.01 to 0.11 mg/L.

## ORGANIC COMPOUNDS

Water samples were analyzed for selected organic compounds. These compounds included DOC, anionic surfactants as MBAS, purgeable organic compounds, insecticides, polychlorinated compounds, and herbicides. Minimum reporting levels established for these constituents (Timme, 1994) are not to be confused with reporting levels and analytical method detection limits for selected radionuclides.

### Dissolved Organic Carbon

Water samples were analyzed for DOC (table 14). Concentrations of DOC in all the samples were greater than the minimum reporting level of 0.1 mg/L and ranged from 0.2 to 2 mg/L; no maximum contaminant level has been established.

### Anionic Surfactants

Water samples were analyzed for anionic surfactants as MBAS (table 14). Concentrations of surfactants in three of the samples equaled or exceeded the minimum reporting

Table 14. ***Concentrations of nutrients, dissolved organic carbon, and anionic surfactants in water from selected wells and springs, eastern Snake River Plain***

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Analytical results in milligrams per liter. Abbreviation: MBAS, methylene blue active substances. Symbols: <, concentration was less than the respective minimum reporting level; *, quality assurance sample (MV-28 is a replicate of MV-10; MV-34 is a replicate of MV-56)]

| Site identifier | Ammonia (as nitrogen) | Nitrite (as nitrogen) | Nitrite plus nitrate (as nitrogen) | Orthophosphate (as phosphorus) | Dissolved organic carbon | Anionic surfactants as MBAS |
|---|---|---|---|---|---|---|
| MV-02 | 0.01 | <0.01 | 1.2 | <0.01 | 0.4 | <0.02 |
| MV-10 | .01 | <.01 | 2.6 | <.01 | .9 | <.02 |
| MV-16 | .01 | <.01 | 1.2 | .01 | .5 | <.02 |
| MV-19 | .01 | <.01 | 2.6 | .01 | .7 | <.02 |
| MV-20 | .01 | <.01 | 1.6 | .01 | .4 | <.02 |
| MV-24 | .02 | <.01 | 6.5 | .02 | 2 | <.02 |
| MV-25 | .01 | <.01 | 4.5 | .11 | 1.4 | <.02 |
| MV-28* | .02 | <.01 | 2.6 | .01 | .9 | <.02 |
| MV-29 | <.01 | <.01 | .67 | <.01 | .2 | <.02 |
| MV-32 | .02 | <.01 | 3.6 | <.01 | .8 | .02 |
| MV-34* | .02 | <.01 | 1 | .03 | .4 | <.02 |
| MV-40 | <.01 | <.01 | .74 | .01 | .2 | <.02 |
| MV-41 | .01 | <.01 | 2.9 | .05 | 1.1 | <.02 |
| MV-46 | <.01 | <.01 | .72 | .01 | .2 | <.02 |
| MV-48 | .03 | <.01 | .64 | <.01 | .3 | <.02 |
| MV-49 | .03 | <.01 | 1.6 | .02 | .4 | <.02 |
| MV-50 | .01 | <.01 | 2.2 | .02 | .9 | .03 |
| MV-52 | .01 | <.01 | 1.9 | .01 | .8 | .02 |
| MV-54 | .02 | <.01 | 4.5 | <.01 | 1 | <.02 |
| MV-56 | .01 | <.01 | 1 | .01 | .4 | <.02 |

level and ranged from 0.02 to 0.03 mg/L; the secondary maximum contaminant level is 0.5 mg/L.

### Purgeable Organic Compounds

Water samples were analyzed for 63 purgeable organic compounds. The maximum contaminant levels and minimum reporting levels of these compounds are shown on table 15. One sample, MV-24, contained concentrations of benzene of 2.2 µg/L; ethylbenzene of 0.2 µg/L; toluene of 0.4 µg/L; 1,2,4-trimethylbenzene of 0.4 µg/L; 1,3,5-trimethylbenzene of 1.6 µg/L; and total xylenes of 8.7 µg/L. Other samples did not contain any concentrations equal to or greater than their respective minimum reporting levels (table 15).

### Insecticides and Gross Polychlorinated Compounds

Water samples were analyzed for concentrations of 11 organophosphorus insecticides, 15 organochlorine insecticides, gross PCB's, and gross PCN's (table 16). The minimum reporting levels ranged from 0.01 to 1.0 µg/L. Water samples also were analyzed for an additional group of 20 insecticides that included 8 of the organophosphorus and organochlorine insecticides mentioned above. Analyses for the 20 insecticides were made using different laboratory schedules with different minimum reporting levels; therefore, eight insecticides are listed twice with two different minimum reporting levels. The maximum contaminant levels and minimum reporting levels for all the compounds are shown on table 16. None of the samples contained concentrations of insecticides or polychlorinated compounds larger than their respective minimum reporting levels; however, one sample (MV-24) had a concentration of DDE, p, p'- of 0.001 µg/L, that was above the method detection limit.

### Herbicides

Water samples were analyzed for concentrations of 4 chlorophenoxy-acid herbicides and 27 other herbicides. Maximum contaminant levels and minimum reporting levels for these compounds are shown on table 17. Because a new laboratory schedule with lower method detection limits and minimum reporting levels than past schedules was used, several samples had concentrations of some herbicides that exceeded the method detection limits and minimum reporting levels (table 18). Some of the samples in table 18 had concentrations that exceeded the method detection limit but were less than the minimum reporting level. Concentrations of atrazine in nine samples ranged from 0.003 to 0.019 µg/L. Concentrations of desethyl atrazine in eight samples ranged from 0.001 to 0.018 µg/L. EPTC was detected in one sample (MV-50) at a concentration of 0.005 µg/L. Concentrations of metribuzin in three samples ranged from 0.004 to 0.037 µg/L. Simazine was detected in two samples (MV-24 and MV-54) at concentrations of 0.004 and 0.005 µg/L, respectively. Pebulate was detected in one sample (MV-48) at a concentration of 0.081 µg/L. Samples from wells not listed in table 18 had concentrations less than their respective minimum reporting levels for all herbicides. Concentrations of herbicides not listed in table 18 were below the minimum reporting level in all the samples.

## SUMMARY

The USGS and the IDWR, in response to a request from the DOE, sampled 18 sites as part of a long-term project to monitor water quality of the Snake River Plain aquifer from the southern boundary of the Idaho National Engineering Laboratory to the Hagerman area. Water samples were collected and

Table 15. ***Maximum contaminant levels and minimum reporting levels of selected purgeable organic compounds in drinking water***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using an analytical method equivalent to U.S. Environmental Protection Agency method 524.2. Maximum contaminant levels were established pursuant to the recommendation of the U.S. Environmental Protection Agency (1994b) for community water systems and are included for comparison purposes only. Minimum reporting levels are from Timme (1994). Units are in micrograms per liter (µg/L). Symbols: ••, maximum contaminant level has not been established or proposed; *, total trihalomethanes—which include bromoform, chlorodibromomethane, chloroform, and dichlorobromomethane—in community water systems serving 10,000 or more persons cannot exceed 100 µg/L (U.S. Environmental Protection Agency, 1994b, p. 2). Abbreviations: MCL, maximum contaminant level; MRL, minimum reporting level]

| Compound | MCL | MRL | Compound | MCL | MRL |
|---|---|---|---|---|---|
| Acrolein | •• | 20 | 1,2-Dichloropropane | 5 | 0.2 |
| Acrylonitrile | •• | 20 | 1,3-Dichloropropane | •• | .2 |
| Benzene | 5 | .2 | 2,2-Dichloropropane | •• | .2 |
| Bromobenzene | •• | .2 | Cis-1,3-Dichloropropene | •• | .2 |
| Bromochloromethane | •• | .2 | Trans-1,3-Dichloropropene | •• | .2 |
| Bromoform | * | .2 | 1,1-Dichloropropene | •• | .2 |
| Bromomethane | •• | .2 | Ethylbenzene | 700 | .2 |
| n-Butylbenzene | •• | .2 | Hexachlorobutadiene | •• | .2 |
| Sec-butylbenzene | •• | .2 | Isopropylbenzene | •• | .2 |
| Tert-butylbenzene | •• | .2 | p-Isopropyltoluene | •• | .2 |
| Carbon tetrachloride | 5 | .2 | Methylene chloride | 5 | .2 |
| Chlorobenzene | 100 | .2 | Methyltertbutylether | •• | 1 |
| Chlorodibromomethane | * | .2 | Naphthalene | •• | .2 |
| Chloroethane | •• | .2 | n-Propylbenzene | •• | .2 |
| 2-Chloroethylvinylether | •• | 1 | Styrene | 100 | .2 |
| Chloroform | * | .2 | 1,1,1,2-Tetrachloroethane | •• | .2 |
| Chloromethane | •• | .2 | 1,1,2,2-Tetrachloroethane | •• | .2 |
| 2-Chlorotoluene | •• | .2 | Tetrachloroethene | 5 | .2 |
| 4-Chlorotoluene | •• | .2 | Toluene | 1,000 | .2 |
| 1,2-Dibromo-3-chloropropane | .2 | 1 | 1,2,3-Trichlorobenzene | •• | .2 |
| 1,2-Dibromoethane | .05 | .2 | 1,2,4-Trichlorobenzene | 70 | .2 |
| Dibromomethane | •• | .2 | 1,1,1-Trichloroethane | 200 | .2 |
| 1,2-Dichlorobenzene | 600 | .2 | 1,1,2-Trichloroethane | 5 | .2 |
| 1,3-Dichlorobenzene | 600 | .2 | Trichloroethene | 5 | .2 |
| 1,4-Dichlorobenzene | 75 | .2 | Trichlorofluoromethane | •• | .2 |
| Dichlorobromomethane | * | .2 | 1,2,3-Trichloropropane | •• | .2 |
| Dichlorodifluoromethane | •• | .2 | Trichlorotrifluoroethane | •• | .5 |
| 1,1-Dichloroethane | •• | .2 | 1,2,4-Trimethylbenzene | •• | .2 |
| 1,2-Dichloroethane | 5 | .2 | 1,3,5-Trimethylbenzene | •• | .2 |
| Cis-1,2-Dichloroethene | •• | .2 | Vinyl chloride | 2 | .2 |
| 1,1-Dichloroethene | 7 | .2 | Xylenes, total ortho, meta, and para | 10,000 | .2 |
| 1,2-Transdichloroethene | 100 | .2 | | | |

Table 16. ***Maximum contaminant levels and minimum reporting levels of selected insecticides and gross polychlorinated compounds in drinking water***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. The maximum contaminant level was established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994b) for community water systems and are included for comparison purposes only. Minimum reporting levels are from Timme (1994). Units are in micrograms per liter. Symbols: ••, maximum contaminant level has not been established or proposed; *, samples analyzed using two different laboratory schedules with different minimum reporting levels. Abbreviations: MRL, minimum reporting level; MCL, maximum contaminant level]

Organophosphorus insecticides

| Insecticide | MCL | MRL | Insecticide | MCL | MRL |
|---|---|---|---|---|---|
| *Chlorpyrifos; Dursban | •• | 0.01 | Malathion | •• | 0.01 |
| DEF | •• | .01 | Methyl parathion | •• | .01 |
| *Diazinon | •• | .01 | Parathion | •• | .01 |
| *Disulfoton | •• | .01 | *Phorate | •• | .01 |
| Ethion | •• | .01 | Trithion | •• | .01 |
| *Fonofos | •• | .01 | | | |

Organochlorine insecticides

| Insecticide | MCL | MRL | Insecticide | MCL | MRL |
|---|---|---|---|---|---|
| Aldrin | •• | 0.01 | Heptachlor | 0.4 | 0.01 |
| Chlordane | 2 | 0.1 | Heptachlor epoxide | .2 | .01 |
| DDD | •• | .01 | *Lindane | .2 | .01 |
| *DDE | •• | .01 | Methoxychlor | 40 | .01 |
| DDT | •• | .01 | Mirex | •• | .01 |
| *Dieldrin | •• | .01 | Perthane | •• | .1 |
| Endosulfan | •• | .01 | Toxaphene | 3 | 1.0 |
| Endrin | 2 | .01 | | | |

Gross polychlorinated compounds

| Compound | MCL | MRL |
|---|---|---|
| Gross polychlorinated biphenyls (PCB's) | 0.5 | 0.1 |
| Gross polychlorinated naphthalenes (PCN's) | •• | 0.1 |

Table 16. ***Maximum contaminant levels and minimum reporting levels of selected insecticides and gross polychlorinated compounds in drinking water—Continued***

20 insecticides with different MRLs

| Insecticide | MCL | MRL | Insecticide | MCL | MRL |
|---|---|---|---|---|---|
| Azinphos, Methyl- | •• | 0.038 | *Fonofos | •• | 0.008 |
| Carbaryl (Sevin) | •• | .046 | HCH, alpha- | •• | .007 |
| Carbofuran | 40 | .013 | *HCH, gamma- (Lindane) | 0.2 | .011 |
| *Chlorpyrifos | •• | .005 | Malathion | •• | .010 |
| *DDE, p, p'- | •• | .010 | Parathion, Ethyl- | •• | .022 |
| *Diazinon | •• | .008 | Parathion, Methyl- | •• | .035 |
| *Dieldrin | •• | .008 | Permethrine, cis- | •• | .019 |
| Dimethoate | •• | .024 | *Phorate | •• | .011 |
| *Disulfoton (Di-syston) | •• | .028 | Propargite | •• | .006 |
| Ethoprop | •• | .012 | Terbufos | •• | .012 |

analyzed for selected radionuclides, stable isotopes, inorganic constituents, and organic compounds. The samples were collected from seven irrigation wells, seven domestic wells, two springs, one stock well, and one observation well. Two quality assurance samples also were collected and analyzed.

Concentrations of strontium-90 in all samples were less than the reporting level. Concentrations of tritium in all of the samples analyzed by the NWQL exceeded the reporting level, but none exceeded the maximum contaminant level for drinking water. All samples analyzed by ISU had concentrations of tritium less than the reporting level. Concentrations of dissolved gross alpha-particle radioactivity in eight of the samples analyzed by the NWQL exceeded the reporting level; none exceeded the U.S. Environmental Protection Agency maximum contaminant level. Concentrations of dissolved gross beta-particle radioactivity in all samples analyzed by the NWQL exceeded the reporting level. Concentrations of total gross beta-particle radioactivity in 12 of the samples analyzed by ISU equaled or exceeded the reporting level. Concentrations of cesium-137 were reported using gamma spectroscopy. The concentration of cesium-137 in one sample equaled the reporting level; concentrations in the other 19 samples were less than the reporting level.

Water samples were analyzed for concentrations of stable isotopes of H, O, C, S, and N. Relative isotopic ratios ranged from -138 to -126 permil for $\delta^{2}H$, -17.99 to -16.13 permil for $\delta^{18}O$, -14.3 to -9.2 permil for $\delta^{13}C$, 5.6 to 14.7 permil for $\delta^{34}S$, and 3.2 to 6.1 permil for $\delta^{15}N$.

All the samples contained one or more dissolved trace elements and common ions in concentrations greater than the minimum reporting levels. No concentration exceeded an established maximum contaminant level.

Concentrations of ammonia (as nitrogen) in 17 of the water samples equaled or exceeded the minimum reporting level. Concentrations of nitrite (as nitrogen) in all

Table 17. ***Maximum contaminant levels and minimum reporting levels of chlorophenoxy-acid herbicides and other herbicides in drinking water***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. The maximum contaminant level was established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994b) for community water systems and are included for comparison purposes only. Minimum reporting levels are from Timme (1994). Units are in micrograms per liter. Symbol: ••, maximum contaminant level has not been established or proposed. Abbreviations: MCL, maximum contaminant level; MRL, minimum reporting level]

Chlorophenoxy-acid herbicides

| Herbicide | MCL | MRL | Herbicide | MCL | MRL |
|---|---|---|---|---|---|
| 2,4-D | 70 | 0.01 | Silvex | 50 | 0.01 |
| 2,4-DP | •• | .01 | 2,4,5-T | •• | .01 |

Other herbicides

| Herbicide | MCL | MRL | Herbicide | MCL | MRL |
|---|---|---|---|---|---|
| Alachlor | 2 | 0.009 | Napropamide | •• | 0.010 |
| Atrazine | 3 | .017 | Pebulate | •• | .009 |
| Atrazine, Desethyl- | •• | .005 | Pendimethalin | •• | .018 |
| Benfluralin | •• | .013 | Prometon | •• | .008 |
| Butylate | •• | .008 | Pronamide | •• | .009 |
| Cyanazine | •• | .013 | Propachlor | •• | .015 |
| DCPA (Dacthal) | •• | .004 | Propanil | •• | .016 |
| Diethylanaline | •• | .006 | Simazine | 4 | .008 |
| EPTC (Eptam) | •• | .005 | Tebuthiuron | •• | .015 |
| Ethalfluralin | •• | .013 | Terbacil | •• | .030 |
| Linuron | •• | .039 | Thiobencarb | •• | .008 |
| Metolachlor | •• | .009 | Triallate | •• | .008 |
| Metribuzin | •• | .012 | Trifluralin | •• | .012 |
| Molinate | •• | .007 | | | |

Table 18. ***Concentrations of herbicides in water from selected wells and springs, eastern Snake River Plain***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Units are in micrograms per liter. Symbols: <, indicates concentration was less than the respective minimum reporting level; *, indicates quality assurance sample (MV-28 is a replicate of MV-10). Samples from wells not listed had concentrations below the minimum reporting level for all herbicides and concentrations of herbicides not listed were below the minimum reporting level in all samples]

| Site identifier | Atrazine | Desethyl atrazine | EPTC | Metribuzin | Simazine | Pebulate |
|---|---|---|---|---|---|---|
| MV-02 | 0.004 | <0.005 | <0.005 | <0.012 | <0.008 | <0.009 |
| MV-10 | .003 | .002 | <.005 | <.012 | <.008 | <.009 |
| MV-16 | <.017 | .001 | <.005 | <.012 | <.008 | <.009 |
| MV-19 | .012 | .01 | <.005 | .004 | <.008 | <.009 |
| MV-20 | .004 | .002 | <.005 | .005 | <.008 | <.009 |
| MV-24 | .014 | .012 | <.005 | .037 | .004 | <.009 |
| MV-25 | .011 | .005 | <.005 | <.012 | <.008 | <.009 |
| MV-28* | .005 | <.005 | <.005 | <.012 | <.008 | <.009 |
| MV-41 | .019 | .018 | <.005 | <.012 | <.008 | <.009 |
| MV-48 | <.017 | <.005 | <.005 | <.012 | <.008 | .081 |
| MV-50 | <.017 | <.005 | .005 | <.012 | <.008 | <.009 |
| MV-54 | .012 | .01 | <.005 | <.012 | .005 | <.009 |

the samples were less than minimum reporting level. Concentrations of nitrite plus nitrate (as nitrogen) in all the water samples exceeded the minimum reporting level. Concentrations of orthophosphate (as phosphorus) in 14 of the water samples equaled or exceeded the minimum reporting level. No nutrient concentration exceeded an established maximum contaminant level.

Concentrations of dissolved organic carbon in all the samples exceeded the minimum reporting level. Concentrations of anionic surfactants in three of the water samples equaled or exceeded the minimum reporting level but did not exceed the secondary maximum contaminant level. The concentrations of benzene, ethylbenzene, toluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and total xylenes in one sample equaled or exceeded their minimum reporting levels. No organophosphorus insecticides, organochlorine insecticides, gross PCB's, or gross PCN's were detected at concentrations exceeding their respective minimum reporting levels. Concentrations of several herbicides exceeded their method detection limits and minimum reporting levels, but none exceeded established maximum contaminant levels.

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