RADIONUCLIDES, METALS, AND ORGANIC COMPOUNDS IN WATER, EASTERN PART OF A & B IRRIGATION DISTRICT, MINIDOKA COUNTY, IDAHO

By

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CONVERSION FACTORS

For readers who prefer to use International System (SI) units rather than units used in this report, the following conversion factors may be used:

Multiply	By	To obtain
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
acre	0.4047	hectare
square mile (mi^2)	2.590	square kilometer
acre-foot (acre-ft)	0.001233	cubic hectometer
picocurie (pCi)	0.037	becquerel
millirem (mrem)	0.01	millisievert

Metric units used in this report that do not have commonly used inch-pound equivalents are mL (milliliter); L (liter); g (gram); µg/L (microgram per liter); and mg/L (milligram per liter).

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ABSTRACT

The U.S. Geological Survey, in response to a U.S. Department of Energy request, collected and analyzed water samples from 15 sites in Minidoka County, Idaho for manmade pollutants and naturally occurring contaminants. Samples were collected from 12 ground-water and 3 irrigation wastewater sites. Samples were analyzed for tritium, gross alpha- and beta-particle radioactivity, total uranium, radium, radon-222, strontium-90, gross gamma radioactivity, trace metals, purgeable organic compounds, nutrients, and pesticides.

Tritium concentrations were determined by U.S. Geological Survey, U.S. Department of Energy, and Idaho State University laboratories. Seven samples had tritium concentrations larger than the reporting level, ranging from 0.045±0.013 to 0.106±0.013 pCi/mL (picocuries per milliliter). The maximum contaminant level for tritium is 20 pCi/mL. Ranges of dissolved concentrations for some other radionuclides or types of radioactivity follow: gross alpha-particle radioactivity as thorium-230--2.23±0.61 to 9.10±1.25 pCi/L (picocuries per liter); gross beta-particle radioactivity as strontium-90 in equilibrium with yttrium-90--2.50±1.28 to 10.3±2.5 pCi/L; total uranium--1.38±0.16 to 5.22±1.02 μg/L (micrograms per liter); radium-226--0.0102±0.0064 to 0.149±0.024 pCi/L; and strontium-90--from less than the reporting level to 0.483±0.071 pCi/L. The uncertainties are all given as two sample standard deviations (2s) except tritium, which is 1s.

Concentrations of nitrite plus nitrate as nitrogen ranged from 0.94 to 5 mg/L (milligrams per liter) and orthophosphate concentrations as phosphorous ranged from 0.01 to 0.12 mg/L. Tetrachloroethylene (0.2 μg/L)

and benzene (0.2 μg/L) were present in water from an irrigation drain. Water from three irrigation drains contained concentrations of 2,4-D ranging from 0.02 to 0.27 μg/L. Carbofuran, fonofos, dieldrin, aldicarb, diuron, bromacil, a phenylurea-like compound, diazinon, and malathion were present in one or more water samples--mostly from the irrigation drains--at small concentrations.

INTRODUCTION

Concern has been expressed by local citizens that the radioactive and chemical wastes disposed to the Snake River Plain aquifer at the INEL (Idaho National Engineering Laboratory) have migrated 65 mi southwest to an area centered in the eastern part of the A & B Irrigation District (fig. 1). Hydrologic data (Mundorff and others, 1964; Lindholm and others, 1988) indicate that ground water which passes under the INEL follows a path that lies to the north of the A & B Irrigation District. However, the area has been the focus of media attention recently as residents question the number of cases of cancer in their community. In response to the local concerns, the U.S. Department of Energy's Idaho Operations Office requested the U.S. Geological Survey to collect and analyze samples from several wells to document the types and concentrations of manmade pollutants and naturally occurring contaminants in ground water from the Snake River Plain aquifer. In addition, samples of irrigation wastewater were collected at selected irrigation drains. The constituents of most interest were tritium, gross alpha-particle radioactivity, gross beta-particle radioactivity, and gross gamma radioactivity. Because the area is geologically complex and is irrigated with ground water, samples were also collected and analyzed for naturally occurring radionuclides, such as radium-226 and radon-222, and trace metals, purgeable organic compounds, nutrients, herbicides, and insecticides.

Water samples for most constituents were analyzed by the U.S. Geological Survey's NWQL (National Water Quality Laboratory) in Arvada, Colorado. Tritium samples, however, were analyzed by three laboratories: (1) the ISU (Idaho State University) Environmental Monitoring Laboratory,

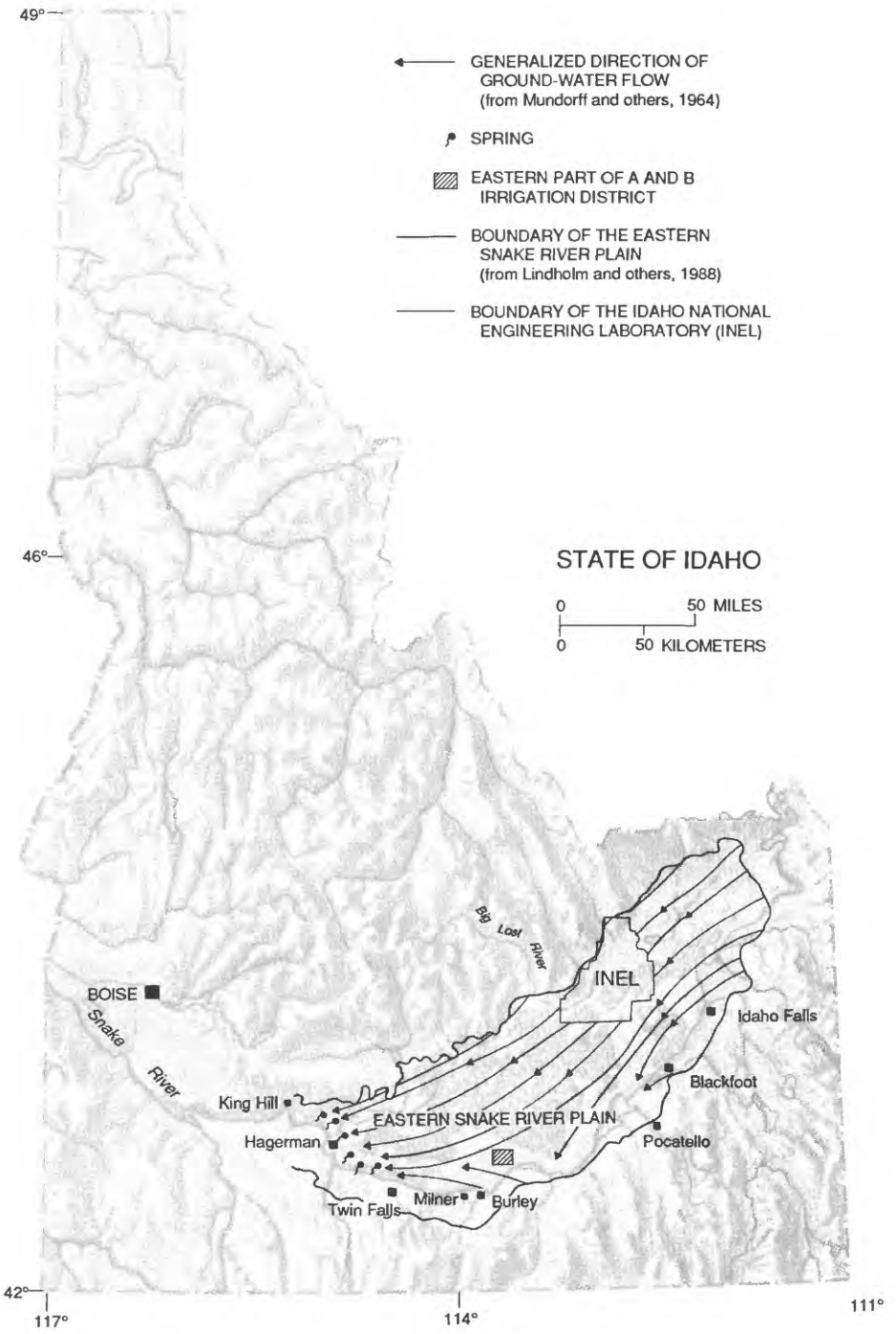


Figure 1.--Generalized direction of ground-water flow in the Snake River Plain aquifer and locations of the eastern part of the A & B Irrigation District, the eastern Snake River Plain, and the Idaho National Engineering Laboratory.

Pocatello, Idaho; (2) the U.S. Department of Energy's RESL (Radiological and Environmental Sciences Laboratory) at the INEL; and (3) the U.S. Geological Survey's NWQL. This report summarizes the analyses of water samples collected on May 1-3, 1989.

Geohydrologic Setting and Wastewater Disposal at the INEL

The eastern Snake River Plain is a northeast-trending structural basin about 200 mi long and 50 to 70 mi wide. The plain is underlain by a layered sequence of basaltic lava flows and cinder beds intercalated with alluvium and lakebed deposits. Individual lava flows generally range from 10 to 50 ft in thickness, although the average thickness may be from 20 to 25 ft (Mundorff and others, 1964, p. 143). The sedimentary deposits consist mainly of lenticular beds of sand, silt, and clay with lesser amounts of gravel. Locally, rhyolitic lava flows and tuffs are exposed at the land surface or occur at depth. The basaltic lava flows and intercalated sedimentary deposits combine to form the Snake River Plain aquifer, which is the main source of ground water on the plain (Pittman and others, 1988, p. 2).

The Snake River Plain aquifer is recharged by the infiltration of precipitation and irrigation water, and by underflow from tributary valleys on the perimeter of the plain. Water recharged to the aquifer generally moves to the southwest along the axis of the plain and is discharged to springs along the Snake River (Mann, 1989, p. 4).

In 1980, about 1.33 million acres of land were irrigated on the eastern Snake River Plain (Garabedian, 1986, p. 7). About 8.3 million acre-ft of water were diverted from the Snake River and its tributaries for irrigation. From 1902 to 1980, springflow discharge to the Snake River increased from about 3.1 million acre ft/year to about 4.3 million acre-ft/year as a result of increased recharge to the Snake River Plain aquifer from the infiltration of irrigation water.

The INEL includes about 890 mi^2 of the northeastern part of the eastern Snake River Plain. The general direction of ground-water movement in the

Snake River Plain aquifer is southwestward from the INEL to the springs along the Snake River between Milner and King Hill (Mann, 1989, p. 2-3). The INEL is about 65 mi northeast of the study area, which is centered in the eastern part of the A & B Irrigation District (fig. 1).

Aqueous chemical and radioactive wastes generated at the INEL were discharged to ponds and wells from 1952 to 1983. Since 1983, most of the aqueous wastes have been discharged to unlined infiltration ponds. Many of the constituents contained in the wastewater enter the aquifer indirectly following percolation through the unsaturated zone; prior to 1984, much of the waste was injected directly into the aquifer through a deep disposal well.

The 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 periodically at concentrations of 3.4±0.2 pCi/mL or less in water from two wells along the southern boundary of the INEL in 1983-86. Since April 1986, tritium concentrations in water from wells along the southern boundary have been less than the analytical method detection limit of 0.5 pCi/mL.

Acknowledgments

The authors gratefully acknowledge the well owners for granting permission to collect the water samples. Special thanks are given to R.C. Bailes with the A & B Irrigation District and H.D. Mohlman who provided information on irrigation wells, irrigation water drains, and irrigation practices in the area.

METHODS AND QUALITY ASSURANCE

The methodology used in sampling for selected chemicals generally followed the guidelines established by the U.S. Geological Survey (Goerlitz and Brown, 1972; Stevens and others, 1975; Skougstad and others, 1979; Wood,

1981; Claassen, 1982; W.L. Bradford, U.S. Geological Survey, written commun., 1985; Wershaw and others, 1987). The methods used in the field and quality assurance practices are outlined in following sections.

Sample Containers and Preservatives

Sample containers and preservatives differ depending on the constituent(s) for which analyses are requested. Samples analyzed by the NWQL are containerized and preserved in accordance with laboratory requirements specified by Feltz and others (1985). Containers and preservatives were supplied by the NWQL and had undergone a rigorous quality control procedure (Pritt, 1989, p. 75) to eliminate sample contamination. Samples analyzed by ISU and the RESL were containerized in accordance with laboratory requirements specified by the director of the Environmental Monitoring Program at ISU and by the chief and research chemists of the Analytical Chemistry Branch of the RESL, respectively. Containers and preservatives used for this study are listed in table 1.

Sampling Locations and Sample Collection

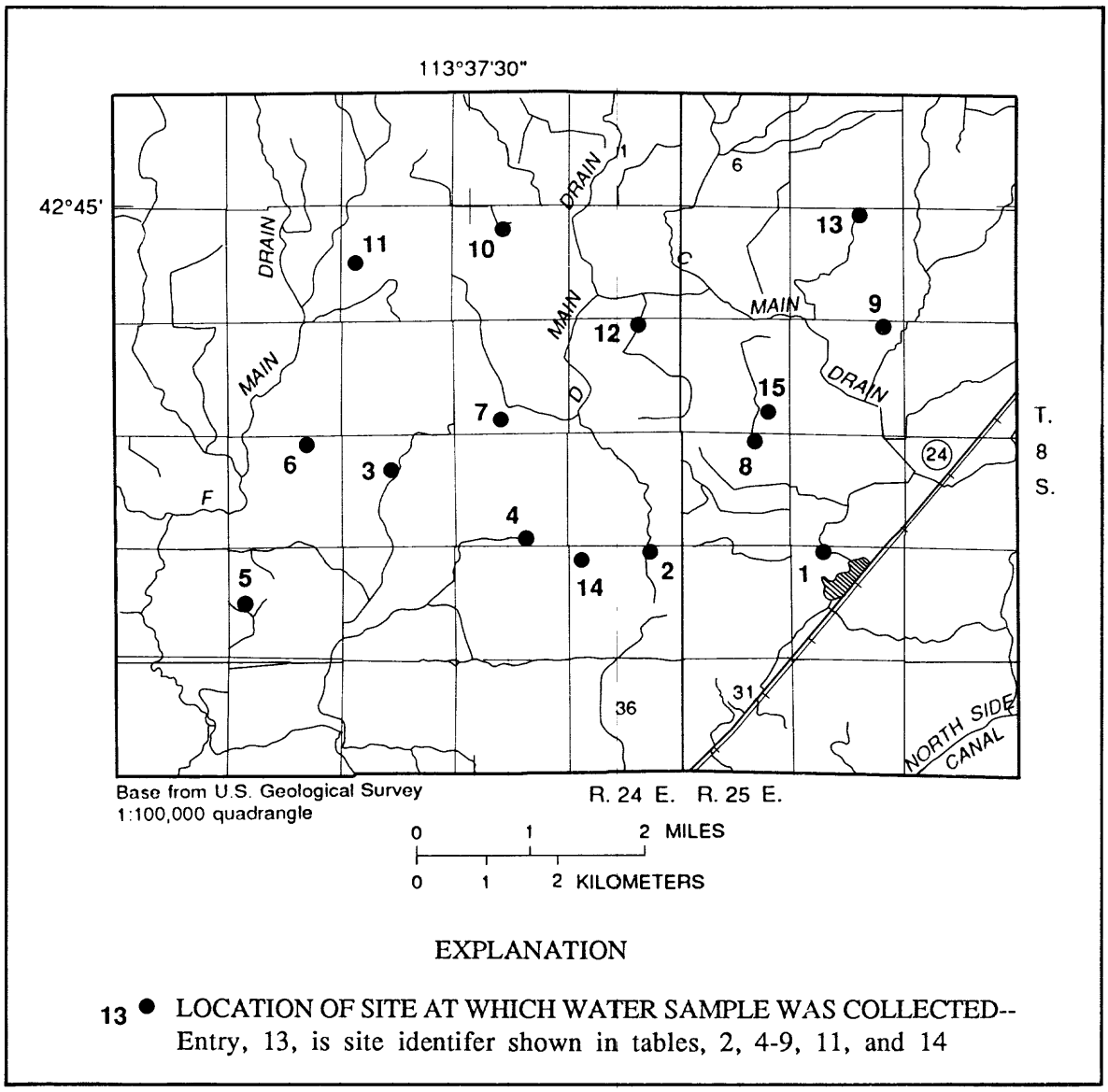
Samples were collected at 15 locations (fig. 2): 3 irrigation water drains--C Main Drain (site 1), D Main Drain (site 2), and E Main Drain (site 3); 6 irrigation wells (sites 4, 6, 7, and 9-11); 2 irrigation well clusters consisting of 2 wells each (sites 8 and 12); and 4 domestic wells (sites 5 and 13-15). The irrigation wells were equipped with turbine pumps that discharged into stilling ponds and the domestic wells were equipped with submersible pumps.

Samples were collected from the midpoints of the channels at the three irrigation water drains, from the stilling ponds at the irrigation wells, and from spigots downstream from pressure tanks at the domestic wells. Prior to sampling, the domestic wells were pumped long enough to ensure that the pressure tanks and plumbing systems had been thoroughly flushed. When flushing was complete, samples were collected by filling the sample

Table 1.--Containers and preservatives used for water samples, eastern part of A & B Irrigation District, Minidoka County, Idaho

[Abbreviations: L, liter; mL, milliliter; $HgCl_2$, mercuric chloride; NaCl, sodium chloride; HNO_3, nitric acid; $K_2Cr_2O_7$, potassium dichromate; HCl, hydrochloric acid; °C, degrees Celsius. Samples for pesticides, nutrients, purgeable organic compounds, trace metals, and radon-222 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; RESL--U.S. Department of Energy's Radiological and Environmental Sciences Laboratory.]

Type of constituent	Container		Preservative		Other treatment	Analyzing laboratory
	Type	Size	Type	Size		
Pesticides	Glass, baked	1 L	None	None	Chill 4 °C	NWQL
Nutrients	Polyethylene, brown	250 mL	$HgCl_2$/ NaCl	1 mL	Filter, chill 4 °C	NWQL
Purgeable organic compounds	Glass, baked	40 mL	None	None	Chill 4 °C	NWQL
Metals	Polyethylene, acid-rinsed	500 mL	HNO_3	2 mL	Filter	NWQL
Mercury	Glass, acid-rinsed	250 mL	$K_2Cr_2O_7$/ HNO_3	10 mL	Filter	NWQL
Tritium	Polyethylene	25 mL	None	None	None	NWQL
	Polyethylene	500 mL	None	None	None	RESL
	Polyethylene	250 mL	None	None	None	ISU
Radium	Polyethylene, acid-rinsed	1 L	HCl	5 mL	Filter	NWQL
Radon-222	Glass vials	20 mL	Scintillation cocktail	10 mL	None	NWQL
Uranium	Polyethylene, acid-rinsed	1 L	HCl	5 mL	Filter	NWQL
Other radionuclides	Polyethylene, acid-rinsed	1 L	None	None	None	NWQL



EXPLANATION

13 ● LOCATION OF SITE AT WHICH WATER SAMPLE WAS COLLECTED--Entry, 13, is site identifer shown in tables, 2, 4-9, 11, and 14

Figure 2.--Locations of sites at which water samples were collected.

containers from the spigot. After collection, sample containers were sealed with laboratory film, labeled, and stored under secured conditions. Water samples to be analyzed for radon-222, trace metals, purgeable organic compounds, nutrients, herbicides, and insecticides were stored in sealed ice chests. The sealed ice chests were shipped daily by overnight-delivery mail to the NWQL. Water samples to be analyzed for tritium, gross alpha and gross beta radioactivity, uranium, radium-226, radium-228, strontium-90, and gross gamma radioactivity were transported to the INEL Project Office where they were packed into ice chests, sealed, and shipped to the NWQL on May 9, 1989. Replicate water samples for tritium analyses were hand-delivered to the RESL on May 8, 1989, and the ISU Environmental Monitoring Laboratory on June 20, 1989.

Conditions at the sampling site during sample collection were recorded in a field logbook and a chain-of-custody record was used to track samples from the time of collection until delivery to the analyzing laboratory. These records are available for inspection at the U.S. Geological Survey Project Office at the INEL. The results of field measurements for pH, specific conductance, and water temperature are listed in table 2.

Quality Assurance

A detailed description of internal quality control and of the overall quality assurance practices used by the U.S. Geological Survey's NWQL is provided in reports by Friedman and Erdmann (1982) and Jones (1987). The water samples were collected in accordance with a draft quality assurance plan for quality of water activities conducted by personnel assigned to the INEL Project Office; the draft plan was finalized in June 1989 and is available for inspection at the U.S. Geological Survey's Project Office at the INEL. A comparative study to determine agreement between analytical results for individual water-sample pairs by laboratories involved in the INEL Project Office's quality assurance program is summarized by Wegner (1989). Additional quality assurance instituted for this sampling program was limited to tritium samples. Replicate samples for tritium analysis were collected at all sites and sent to three laboratories--ISU, the RESL, and

the NWQL. The analytical results from the three laboratories are discussed in the section of this report entitled "Tritium."

Table 2.--Results of field measurements for pH, specific conductance, and temperature of water from selected sites, eastern part of A & B Irrigation District, Minidoka County, Idaho

[Site identifier: see figure 2 for location of sites. 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.]

Site identifier	Date sampled mo/da/yr	Time	pH[1]	Specific conductance	Temperature
1	05/01/89	1030	8.8	570	13.7
2	05/01/89	1300	8.2	595	13.2
3	05/01/89	1615	8.2	635	18.2
4	05/01/89	1800	7.6	620	15.0
5	05/02/89	0900	7.8	795	14.2
6	05/02/89	1100	7.8	640	14.5
7	05/02/89	1230	7.7	670	14.0
8	05/02/89	1400	7.8	595	14.2
9	05/02/89	1700	7.8	535	13.3
10	05/02/89	1845	7.8	535	13.2
11	05/03/89	0900	7.9	585	13.9
12	05/03/89	1100	7.8	580	13.4
13	05/03/89	1300	7.9	500	13.2
14	05/03/89	1500	7.5	630	15.6
15	05/03/89	1800	7.8	585	15.0

[1]Secondary maximum contaminant level for pH is 6.5-8.5 (U.S. Environmental Protection Agency, 1987b, p. 593).

RADIOACTIVITY OR RADIONUCLIDES

Water samples were analyzed for: tritium; gross alpha-particle radioactivity; gross beta-particle radioactivity; total uranium; radium-226; radium-228; radon-222; strontium-90; and gross gamma radioactivity. The samples were analyzed using methods described by Thatcher and others (1977) and U.S. Environmental Protection Agency (1987a). The maximum contaminant levels for the types of radioactivity and for selected radionuclides are on table 3.

Table 3.--Maximum contaminant levels for types of radioactivity or radionuclides for which water samples were analyzed

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1987b, p. 532-533) for community water systems and are for comparison purposes only. 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 radioactivity excludes radioactivity from natural sources and should be used only for comparison. Maximum contaminant level values listed for strontium-90 and tritium are average annual concentrations assumed to produce a total body or organ dose of 4 mrem/year (millirem per year) of beta-particle radiation; a maximum contaminant level has not been established for gross gamma radiation, radon-222, and total uranium. Abbreviations: pCi/L--picocuries per liter; pCi/mL--picocuries per milliliter. Symbols: -- indicates that a maximum contaminant level has not been established for that radionuclide or type of radioactivity.]

Type of radioactivity or radionuclide	Maximum contaminant level
Gross alpha-particle radioactivity	15 pCi/L
Gross beta-particle radioactivity	4 mrem/year
Gross gamma radioactivity	--
Radium-226 plus radium-228	5 pCi/L
Radon-222	--
Strontium-90	8 pCi/L
Total uranium	--
Tritium	20 pCi/mL

For each radionuclide concentration determined by a laboratory, an associated analytical uncertainty, **s**, is calculated such that there is a 67-percent probability that the true concentration of a radionuclide in a sample is in the range of the reported concentration plus or minus the analytical uncertainty. For example, given an analytical result of 1.0±0.2 pCi/mL, there is a 67-percent probability that the true concentration is in the range of 0.8 to 1.2 pCi/mL. Some laboratories report the analytical uncertainty as 2**s**. At 2**s**, there is a 95-percent probability that the true concentration of the above example is in the range of 0.6 to 1.4 pCi/mL.

In this report, if the concentration of a specific radionuclide is less than 3**s**--for example, -0.1±0.1 or 0.8±0.3 pCi/mL--the concentration is considered to be less than a "reporting level." The use of the reporting level aids in the interpretation of analytical results and does not represent absolute concentrations of radioactivity which may or may not have been detected.

Tritium.--Multiple water samples were collected for tritium and submitted to three laboratories for analyses:

(1) the Environmental Monitoring Laboratory at Idaho State University, Pocatello, Idaho;

(2) the U.S. Department of Energy's Radiological and Environmental Sciences Laboratory at the Idaho National Engineering Laboratory, near Idaho Falls, Idaho; and

(3) the U.S. Geological Survey's National Water Quality Laboratory, Arvada, Colorado.

Each laboratory analyzed the samples for tritium using the liquid scintillation technique. However, the analytical method detection limits differed from one laboratory to another, mainly because of differences in counting times in the liquid scintillation unit and background concentrations of tritium in the laboratory. The analytical method detection limit for the Idaho State University was 0.35 pCi/mL using a 200-minute count period; U.S. Department of Energy was 0.2 pCi/mL using a 100-minute count period; and U.S. Geological Survey was 0.026 pCi/mL using a 1,200-minute count period.

Tritium concentrations in water samples analyzed by the ISU laboratory and the RESL were less than the analytical method detection limit for the respective laboratories. However, 7 of the 15 water samples analyzed by the U.S. Geological Survey laboratory contained concentrations of tritium larger than the reporting level, ranging from 0.045±0.013 to 0.106±0.013 pCi/mL and averaging 0.073±0.013 pCi/mL. For the purpose of comparison, the maximum contaminant level for tritium in drinking water is 20 pCi/mL (table 3). The maximum tritium concentration for the seven samples was about one-half of the smallest analytical method detection limit for the other laboratories. Therefore, the analyses by the three different laboratories are consistent with one another, given the differences in the analytical method detection limit for each laboratory. Concentrations of tritium in the water are shown on table 4. The analytical uncertainties in table 4 are reported as 1s.

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. For convenience, laboratories report the radioactivity as if it were all given off by one radionuclide. In this report, concentrations are reported two ways: as natural uranium in μg/L, and as thorium-230 in pCi/L; however, only the latter can be directly compared to the maximum contaminant level listed in table 3. In addition, gross alpha-particle radioactivity was measured in both the dissolved and suspended fractions of the water samples. All the water samples contained concentrations of gross alpha-particle radioactivity in the dissolved fraction larger than the reporting level (table 5). The concentrations reported as thorium-230 ranged from 2.23±0.61 to 9.10±1.25 pCi/L. Concentrations of gross alpha-particle radioactivity in the suspended fractions of the water samples--reported as thorium-230--ranged from less than the reporting level to 7.86±1.92 pCi/L. Water samples from six sites (1, 3-5, 10 and 11) contained concentrations larger than the reporting level. The sum of the dissolved and suspended concentrations of gross alpha-particle radioactivity in water from site 3--E Main Drain--exceeds the maximum contaminant level of 15 pCi/L (table 3). All other samples contained total concentrations less than the maximum contaminant level.

Table 4.--Concentrations of tritium in water from selected sites, eastern part of A & B Irrigation District, Minidoka County, Idaho

[Analytical results and uncertainties--for example, 0.045±0.013--in picocuries per milliliter. Analytical uncertainties are reported as 1s. Concentrations that exceed the reporting level are shown in bold-face type; see section entitled "Radioactivity or radionuclides" for discussion of the reporting level and analytical method detection limit. Site identifier: see figure 2 for location of sites.]

Site identifier	Idaho State University	U.S. Department of Energy	U.S. Geological Survey
1	-0.20±0.11	0.06±0.07	0.035±0.013
2	-0.13±0.11	0.02±0.07	0.032±0.013
3	-0.01±0.11	-0.07±0.07	**0.045±0.013**
4	0.10±0.11	0.12±0.07	**0.083±0.013**
5	0.13±0.11	0.04±0.07	**0.080±0.013**
6	0.06±0.11	0.09±0.07	**0.067±0.013**
7	0.16±0.11	0.03±0.07	**0.080±0.013**
8	0.04±0.11	0±0.07	**0.051±0.013**
9	-0.06±0.11	-0.03±0.07	0±0.013
10	-0.05±0.11	0±0.07	0.003±0.013
11	0.19±0.11	0.02±0.07	0.003±0.013
12	-0.08±0.11	-0.12±0.07	0.026±0.013
13	0.29±0.11	-0.12±0.07	-0.010±0.013
14	0.03±0.11	0±0.07	**0.106±0.013**
15	0.00±0.11	0±0.07	0.035±0.013

Table 5.--Concentrations of gross alpha-particle radioactivity in water, eastern part of A & B Irrigation District, Minidoka County, Idaho

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using a residue procedure. Analytical results and uncertainties--for example, 3.18±0.62--in indicated units. Analytical uncertainties are reported as 2s. Concentrations that exceed the reporting level of 3 times the 1s value are shown in bold-face type. Site identifier: see figure 2 for location of sites. Abbreviations: µg/L--micrograms per liter; pCi/L--picocuries per liter.]

Site identifier	Dissolved		Suspended	
	as uranium (µg/L)	as thorium-230 (pCi/L)	as uranium (µg/L)	as thorium-230 (pCi/L)
1	**3.18±0.62**	**3.33±0.65**	**0.718±0.286**	**0.753±0.301**
2	**3.68±0.65**	**3.86±0.68**	1.46±1.10	1.62±1.23
3	**8.68±1.19**	**9.10±1.25**	**7.18±1.75**	**7.86±1.92**
4	**3.40±0.63**	**3.24±0.59**	**0.571±0.154**	**0.560±0.151**
5	**3.93±0.70**	**4.12±0.73**	**0.163±0.103**	**0.161±0.102**
6	**3.18±0.58**	**3.32±0.61**	-0.040±0.050	-0.039±0.049
7	**4.41±0.71**	**4.59±0.74**	0.020±0.069	0.021±0.071
8	**3.18±0.59**	**3.33±0.62**	0.077±0.055	0.075±0.054
9	**2.32±0.52**	**2.47±0.55**	-0.063±0.070	-0.063±0.071
10	**2.30±0.479**	**2.41±0.50**	**0.793±0.184**	**0.781±0.182**
11	**3.20±0.58**	**3.34±0.60**	**0.350±0.170**	**0.354±0.172**
12	**4.16±0.77**	**4.35±0.81**	0.035±0.050	0.034±0.049
13	**2.04±0.56**	**2.23±0.61**	-0.018±0.050	-0.017±0.049
14	**3.95±0.67**	**4.12±0.70**	0.032±0.043	0.031±0.042
15	**2.51±0.63**	**2.74±0.68**	-0.047±0.053	-0.046±0.052

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. For convenience, laboratories report the radioactivity as if it were all given off by one radionuclide or a chemically similar pair of radionuclides in equilibrium. In this report, concentrations are reported two ways: as strontium-90 in equilibrium with yttrium-90 in pCi/L, and as cesium-137 in pCi/L; however, only the former can be directly compared to the maximum contaminant level for strontium-90 listed in table 3. In addition, gross beta-particle radioactivity was measured in both the dissolved and suspended fractions of the water samples. All the water samples contained concentrations of gross beta-particle radioactivity in the dissolved fraction larger than the reporting level (table 6). The concentrations reported as strontium-90 in equilibrium with yttrium-90 ranged from 2.50±1.28 to 10.3±2.5 pCi/L. Concentrations of gross beta-particle radioactivity in the suspended fractions of the water samples--reported as strontium-90 in equilibrium with yttrium-90--ranged from less than the reporting level to 7.11±1.36 pCi/L. Water samples from two sites (1 and 3) contained concentrations larger than the reporting level. The sum of dissolved and suspended concentrations of gross beta-particle radioactivity in water from sites 2-4 and 15 exceeds the maximum contaminant level of 4 mrem/year (table 3)--8 pCi/L of strontium-90 is equivalent to 4 mrem/year. All other samples contained total concentrations less than the maximum contaminant level.

Total uranium.--Uranium is a widely distributed element that has three naturally occurring radioactive isotopes: uranium-238, uranium-235, and uranium-234. These isotopes undergo a complex series of radioactive decay that results in their ultimate conversion to stable isotopes of lead (Haglund, 1972, p. 1,215-1,222). Total uranium concentrations larger than the reporting levels (table 7) were detected in all water samples. The dissolved total uranium concentrations ranged from 1.38±0.16 to 5.22±1.02 μg/L. A maximum contaminant level has not been established for individual isotopes of uranium or for total uranium.

Table 6.--Concentrations of gross beta-particle radioactivity in water, eastern part of A & B Irrigation District, Minidoka County, Idaho

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using a residue procedure. Analytical uncertainties are reported as 2s. Concentrations that exceed the reporting level of 3 times the 1s value are shown in bold-face type. Analytical results and uncertainties--for example, 4.33±1.81--in picocuries per liter. Site identifier: see figure 2 for location of sites.]

Site identifier	Dissolved		Suspended	
	as strontium-90 in equilibrium with yttrium-90	as cesium-137	as strontium-90 in equilibrium with yttrium-90	as cesium-137
1	**4.33±1.81**	**5.47±2.28**	**1.35±0.35**	**1.67±0.43**
2	**10.3±2.5**	**13.0±3.1**	0.597±0.904	0.755±1.143
3	**8.05±2.17**	**10.2±2.74**	**7.11±1.36**	**8.98±1.72**
4	**8.34±2.52**	**10.5±3.2**	-0.100±0.252	-0.099±0.249
5	**7.58±2.78**	**9.58±3.51**	0.131±0.276	0.135±0.284
6	**6.94±2.08**	**8.78±2.63**	-0.340±0.234	-0.326±0.224
7	**4.31±2.00**	**5.45±2.52**	-0.281±0.238	-0.330±0.279
8	**6.04±2.12**	**7.64±2.68**	-0.334±0.234	-0.320±0.225
9	**3.55±1.69**	**4.49±2.14**	-0.122±0.244	-0.137±0.275
10	**3.16±1.58**	**4.00±2.00**	-0.171±0.251	-0.174±0.256
11	**7.25±2.37**	**9.16±2.99**	-0.347±0.235	-0.403±0.272
12	**6.23±1.94**	**7.87±2.45**	-0.436±0.241	-0.380±0.210
13	**2.50±1.28**	**3.16±1.62**	-0.297±0.251	-0.285±0.241
14	**5.48±1.99**	**6.93±2.52**	-0.217±0.252	-0.208±0.241
15	**8.04±2.07**	**10.2±2.62**	0.274±0.282	0.279±0.287

Radium.--Radium-228 and radium-224 are naturally occurring radioactive decay products of thorium-232. Radium-226 is a naturally occurring decay product of uranium-238. Water from C Main Drain--site 1--contained 2.55±1.15 pCi/L of dissolved radium-228 (table 7). Water from E Main Drain--site 3--contained 0.828±0.439 pCi/L of suspended radium-224 (table 7). All other water samples had concentrations less than the reporting levels for radium-228 and radium-224. All water samples collected contained concentrations of dissolved radium-226 larger than the reporting levels (table 7). The radium-226 concentrations ranged from 0.0102±0.0064 to 0.149±0.024 pCi/L. The sum of radium-226 plus radium-228 concentrations in all the water samples was less than the maximum contaminant level of 5 pCi/L (table 3).

Radon-222.--Radon-222 is a radioactive gas that is a naturally occurring decay product of radium-226. Water from sites 4, 5, and 7 contained 46±30, 114±25, and 42±25 pCi/L of radon-222, respectively. All other water samples collected contained concentrations of radon-222 that were less than the reporting level (table 8).

Strontium-90.--Strontium-90 was widely distributed in the environment during atmospheric nuclear-weapons testing. Eight water samples (sites 1-3, 6, 9, 11, 12, and 14) contained dissolved strontium-90 concentrations greater than the reporting level (table 8). The concentrations of all samples ranged from less than the reporting level to 0.483±0.071 pCi/L. All concentrations measured in water samples were less than the maximum contaminant level of 8 pCi/L (table 3).

Lead-212, potassium-40, cesium-137, cobalt-60, and thorium-234.--Gamma spectrometry involves using a series of detectors to simultaneously determine the concentrations of a variety of radionuclides by the detection of characteristic gamma-emission. Six radionuclides were detected in the suspended fraction of water samples by gamma spectrometry (tables 7-9) and are reported in units of pCi/L. Radium-224 was discussed in this report along with the other radium isotopes.

Table 7.--Concentrations of total uranium and selected radium isotopes in water, eastern part of A & B Irrigation District, Minidoka County, Idaho

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using the following methods: radium-226 by radon emanation; radium-228 by separation and beta counting; radium-224 by gamma spectroscopy; and total uranium by extraction and laser-induced phosphorimetry. Analytical results and uncertainties--for example, 2.43±0.37--in indicated units. Analytical uncertainties are reported as 2s. Concentrations that exceed the reporting level of 3 times the 1s value are shown in bold-face type. Site identifier: see figure 2 for location of sites. Abbreviations: pCi/L--picocuries per liter; µg/L--micrograms per liter. Symbols: -- indicates that the radionuclide was not detected in that sample.]

Site identifier	Total uranium dissolved, µg/L	Radium-224 suspended, pCi/L	Radium-226 dissolved, pCi/L	Radium-228 dissolved, pCi/L
1	**2.97±0.51**	--	**0.149±0.024**	**2.55±1.15**
2	**3.87±0.71**	6.33±5.07	**0.138±0.024**	-0.209±1.210
3	**3.28±0.61**	**0.828±0.439**	**0.0863±0.0194**	0.889±0.865
4	**3.67±0.62**	--	**0.0951±0.0178**	0.200±0.646
5	**5.22±1.02**	1.37±2.31	**0.0766±0.0174**	-0.089±0.409
6	**3.27±0.59**	0.706±1.38	**0.0549±0.0122**	0.812±1.970
7	**1.38±0.16**	0.189±2.63	**0.111±0.0196**	0.717±0.687
8	**2.15±0.38**	--	**0.0694±0.0152**	0.0364±0.679
9	**2.60±0.48**	--	**0.103±0.019**	0.834±0.847
10	**2.43±0.43**	--	**0.0491±0.0136**	0.315±0.520
11	**2.72±0.49**	1.28±1.73	**0.0946±0.0178**	0.847±0.809
12	**2.74±0.49**	1.39±2.32	**0.0671±0.0154**	0.468±0.793
13	**3.02±0.54**	0.22±2.43	**0.0501±0.0122**	-0.0174±0.660
14	**4.40±0.77**	--	**0.108±0.022**	0.00±1.17
15	**1.87±0.20**	--	**0.0102±0.0064**	-0.849±0.729

Table 8.--Concentrations of radon-222, strontium-90, and lead-212 in water, eastern part of A & B Irrigation District, Minidoka County, Idaho

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using the following methods: radon-222 by liquid scintillation; strontium-90 by chemical separation and precipitation; and lead-212 by gamma spectroscopy. Analytical results and uncertainties--for example, 30±23--in indicated units. Analytical uncertainties are reported as 2s. Concentrations that exceed the reporting level of 3 times the 1s value are shown in bold-face type. Site identifier: see figure 2 for location of sites. Abbreviations: pCi/L--picocuries per liter. Symbols: -- indicates that the radionuclide was not detected in that sample.]

Site identifier	Radon-222 dissolved, pCi/L	Strontium-90 dissolved, pCi/L	Lead-212 suspended, pCi/L
1	30±23	**0.483±0.071**	--
2	-8±22	**0.0888±0.0494**	5.45±4.37
3	-58±30	**0.204±0.072**	**0.714±0.379**
4	**46±30**	-0.234±0.065	--
5	**114±25**	-0.0778±0.0745	1.18±1.99
6	11±25	**0.209±0.079**	0.609±1.19
7	**42±25**	-0.011±0.069	0.163±2.27
8	31±26	0.0324±0.0545	--
9	-2±30	**0.0860±0.0426**	--
10	-17±31	-0.008±0.046	--
11	-8±29	**0.188±0.051**	1.10±1.49
12	4±30	**0.217±0.065**	1.20±2.00
13	-13±28	-0.0957±0.0427	0.19±2.10
14	20±25	**0.127±0.063**	--
15	-40±20	-0.225±0.080	--

Table 9.--Concentrations of potassium-40, cesium-137, cobalt-60, and thorium-234 in water, eastern part of A & B Irrigation District, Minidoka County, Idaho

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using gamma spectroscopy. Analytical uncertainties are reported as 2s. All analytical results and uncertainties--for example 2.72±6.73--are for suspended concentrations in picocuries per liter and are less than the reporting level of 3 times the 1s value. Site identifier: see figure 2 for location of sites. Symbols: -- indicates that the radionuclide was not detected in that sample.]

Site identifier	Potassium-40	Cesium-137	Cobalt-60	Thorium-234
1	2.72±6.73	--	--	--
2	--	--	--	--
3	2.57±4.79	0.034±0.321	--	--
4	33.1±22.3	--	1.95±1.63	--
5	--	--	--	--
6	12.2±15.2	--	--	--
7	--	--	--	--
8	10.2±26.0	0.010±1.71	--	--
9	27.5±26.8	--	--	--
10	--	--	--	--
11	7.79±18.2	--	--	--
12	--	--	--	--
13	--	--	--	16.9±14.1
14	7.50±16.6	--	--	--
15	--	--	--	--

Lead-212 was detected in several water samples, but water from E Main Drain contained the only concentration larger than the reporting level--0.714±0.379 pCi/L (table 8). Lead-212 is a decay product of radium-224 in the thorium-232 decay series. All the water samples that contained detectable radium-224 also contained detectable lead-212. Water from E Main Drain that contained the concentration of lead-212 larger than the reporting level (0.714±0.379 pCi/L) also contained the concentration of radium-224 larger than the reporting level (0.828±0.439 pCi/L).

Potassium makes up approximately 2.6 percent of the Earth's continental crust and about 0.0119 percent of all potassium is the radioactive isotope potassium-40 (Kretz, 1972, p. 971). Potassium-40 was detected in eight water samples (table 9); however, all eight concentrations were less than the reporting levels.

Cesium-137 was detected in two water samples and cobalt-60 and thorium-234 were each detected in one sample. All four concentrations were less than the respective reporting levels (table 9).

TRACE METALS

Water samples were collected and analyzed for eight dissolved trace metals--arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. The maximum contaminant level and reporting level for each of the eight trace metals are shown on table 10. The concentrations of cadmium, lead, mercury, and selenium in the water samples were less than their respective reporting levels. Arsenic, barium, chromium, and silver were detectable at concentrations greater than the reporting level. The concentrations of dissolved arsenic, barium, chromium, and silver are shown on table 11.

Arsenic concentrations ranged from 2 to 4 µg/L, and were less than the maximum contaminant level of 50 µg/L. Concentrations of barium ranged from 35 to 110 µg/L and were less than the maximum contaminant level of 1,000 µg/L. Chromium concentrations ranged from less than the reporting level at

Table 10.--Maximum contaminant levels and reporting levels of trace metals for which analyses were performed on water samples

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1987b, p. 530) for community water systems and are included only for comparison purposes; proposed maximum contaminant levels--shown in parentheses--are from J. Rodin (U.S. Environmental Protection Agency, written commun., 1989). Units are in micrograms per liter. Reporting levels are from Feltz and others (1985).]

Constituent	Maximum contaminant level	Reporting level
Arsenic	50 (30)	1
Barium	1,000 (5,000)	2
Cadmium	10 (5)	1
Chromium	50 (100)	1
Lead	50	5
Mercury	2	0.1
Selenium	10	1
Silver	50	1

Table 11.--Concentrations of selected trace metals dissolved in water, eastern part of A & B Irrigation District, Minidoka County, Idaho

[Analyses by U.S. Geological Survey's National Water Quality Laboratory. Analytical results in μg/L (micrograms per liter); <1 indicates the concentration was less than the reporting level of 1 μg/L. Concentrations of cadmium, lead, mercury, and selenium were less than their respective reporting levels (see table 10). Site identifier: see figure 2 for location of sites.]

Site identifier	Date sampled	Arsenic	Barium	Chromium	Silver	Remarks
1	05/01/89	3	67	2	<1	C Main Drain
2	05/01/89	3	76	2	<1	D Main Drain
3	05/01/89	3	92	2	<1	E Main Drain
4	05/01/89	3	64	2	<1	
5	05/02/89	4	110	2	1	
6	05/02/89	4	73	2	<1	
7	05/02/89	4	75	2	<1	
8	05/02/89	3	64	2	<1	
9	05/02/89	3	45	2	<1	
10	05/02/89	3	45	2	<1	
11	05/03/89	3	56	2	<1	
12	05/03/89	3	54	2	1	
13	05/03/89	2	35	3	1	
14	05/03/89	3	75	<1	<1	
15	05/03/89	2	60	2	2	

one site to 3 µg/L and were less than the maximum contaminant level of 50 µg/L. The concentrations of silver were less than the reporting level at 11 sites, ranged from 1 to 2 µg/L at 4 sites, and were less than the maximum contaminant level of 50 µg/L.

PURGEABLE ORGANIC COMPOUNDS

Concentrations of 36 purgeable organic compounds (table 12) were determined by the NWQL using a method equivalent to U.S. Environmental Protection Agency method 524 (Feltz and others, 1985, p. 4-29). One site--C Main Drain--had reportable concentrations of two purgeable organic compounds; benzene was 0.2 µg/L and tetrachloroethylene was 0.2 µg/L. These concentrations are at the reporting level of the method and are less than the maximum contaminant level of 5 µg/L for benzene and the proposed maximum contaminant level of 5 µg/L for tetrachloroethylene (table 12).

NUTRIENTS

Water samples were analyzed for dissolved ammonia (as nitrogen), nitrite (as nitrogen), nitrite plus nitrate (as nitrogen), and orthophosphate (as phosphorous). The proposed maximum contaminant levels and reporting levels for nitrite, and nitrite plus nitrate are shown on table 13. A maximum contaminant level has not been established or proposed for ammonia and orthophosphate.

Concentrations of ammonia, nitrite, nitrite plus nitrate, and orthophosphate dissolved in water are shown on table 14. Concentrations of ammonia ranged from less than the reporting level to 0.220 mg/L. Nitrite concentrations ranged from less than the reporting level to 0.041 mg/L and consistently were less than the proposed maximum contaminant level of 1 mg/L. The concentrations of nitrite plus nitrate ranged from 0.94 to 5.00 mg/L; the largest concentration was 50 percent of the proposed maximum contaminant level of 10 mg/L. Orthophosphate concentrations ranged from 0.010 to 0.120 mg/L.

Table 12.--Purgeable organic compounds for which water samples were analyzed and their maximum contaminant levels

[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 (Feltz and others, 1985). Reporting level for all compounds is 0.2 micrograms per liter (Feltz and others, 1985). Maximum contaminant level: A indicates that total trihalomethanes--which includes bromoform, chloroform, dibromochloromethane, and dichlorobromomethane--in community water systems serving 10,000 or more persons cannot exceed 100 micrograms per liter (U.S. Environmental Protection Agency, 1987b, p. 530); -- indicates that a maximum contaminant level has not been established or proposed for that compound; other maximum contaminant levels--values in parentheses are proposed maximum contaminant levels--are from J. Rodin (U.S. Environmental Protection Agency, written commun., 1989); units are micrograms per liter.]

Compound	Maximum contaminant level	Compound	Maximum contaminant level
Benzene	5.0	Cis-1,3-Dichloropropene	--
Bromoform	A	Trans-1,3-Dichloropropene	--
Carbon tetrachloride	5.0	1,3-Dichloropropene	--
Chlorobenzene	(100)	Ethylbenzene	(70)
Chloroethane	--	Methyl bromide	--
2-Chloroethyl vinyl ether	--	Styrene	(5.0)
Chloroform	A	Methylene chloride	--
Chloromethane	--	1,1,2,2-Tetrachloroethane	--
Dibromochloromethane	A	Tetrachloroethylene	(5.0)
Dichlorobromomethane	A	Toluene	(2,000)
1,2-Dichlorobenzene	(600)	Trichlorofluoromethane	--
1,3-Dichlorobenzene	--	1,1,1-Trichloroethane	200
1,4-Dichlorobenzene	75	1,1,2-Trichloroethane	--
Dichlorodifluoromethane	--	Trichloroethylene	5.0
1,2-Dibromoethylene	--	Vinyl chloride	2.0
1,1-Dichloroethane	--	Xylenes, mixed	(10,000)
1,2-Dichloroethane	5.0		
1,1-Dichloroethylene	7.0		
1,2-trans-Dichloroethylene	(70)		
1,2-Dichloropropane	(5.0)		

Table 13.--Proposed maximum contaminant levels and reporting levels of nutrients for which analyses were performed on water samples

[Proposed maximum contaminant level: established maximum contaminant level for nitrate (as nitrogen) is 10 milligrams per liter in both community and non-community water systems (U.S. Environmental Protection Agency, 1987b, p. 530; proposed maximum contaminant levels are from J. Rodin, U.S. Environmental Protection Agency, written commun., 1989). Units are milligrams per liter. Reporting levels are from Feltz and others (1985). Symbols: -- indicates that a maximum contaminant level has not been established or proposed for that constituent.]

Constituent	Proposed maximum contaminant level	Reporting level
Ammonia (as nitrogen)	--	0.010
Nitrite (as nitrogen)	1	0.010
Nitrite plus nitrate (as nitrogen)	10	0.010
Orthophosphate (as phosphorus)	--	0.010

Table 14.--Concentrations of nutrients dissolved in water, eastern part of A & B Irrigation District, Minidoka County, Idaho

[Analyses by U.S. Geological Survey's National Water Quality Laboratory. Analytical results in mg/L (milligrams per liter); <0.010 indicates the concentration was less than the reporting level of 0.010 mg/L. Site identifier: see figure 2 for location of sites.]

Site identifier	Date sampled	Ammonia (as nitrogen)	Nitrite (as nitrogen)	Nitrite plus nitrate (as nitrogen)	Orthophosphate (as phosphorus)
1	05/01/89	0.041	0.021	0.94	0.090
2	05/01/89	0.110	0.021	1.60	0.110
3	05/01/89	0.220	0.041	1.90	0.120
4	05/01/89	0.031	<0.010	3.00	0.030
5	05/02/89	0.041	<0.010	5.00	0.041
6	05/02/89	0.030	<0.010	1.50	0.021
7	05/02/89	0.030	<0.010	2.20	0.030
8	05/02/89	0.030	<0.010	1.10	0.010
9	05/02/89	<0.010	<0.010	1.20	0.010
10	05/02/89	0.010	<0.010	1.20	0.010
11	05/03/89	0.010	0.010	1.40	0.021
12	05/03/89	<0.010	<0.010	1.30	0.010
13	05/03/89	<0.010	<0.010	1.10	0.010
14	05/03/89	<0.010	<0.010	3.20	0.030
15	05/03/89	0.021	<0.010	1.20	0.030

HERBICIDES

Concentrations of 16 herbicides (table 15) were determined by the NWQL. Three sites had reportable concentrations (table 15) of 2,4-D. C Main Drain contained 0.27 µg/L, D Main Drain contained 0.02 µg/L, and E Main Drain contained 0.14 µg/L. All three concentrations are less than the established maximum contaminant level of 100 µg/L (table 15). The three drains did not have reportable concentrations of any other herbicides and herbicides were not detected in any wells at concentrations larger than the reporting levels.

INSECTICIDES AND POLYCHLORINATED COMPOUNDS

Concentrations of 10 carbamate insecticides, 11 organophosphorus insecticides, 15 organochlorine insecticides, gross polychlorinated biphenyls (PCB), and gross polychlorinated naphthalenes (PCN) (table 16) were determined by the NWQL. The three irrigation-water drains contained reportable concentrations (table 16) of some combination of carbamate, organophosphorus, and organochlorine insecticides. Water from the C Main Drain contained 0.5 µg/L of carbofuran and 0.04 µg/L of fonofos. Water from the D Main Drain contained 0.4 µg/L of fonofos and 0.01 µg/L of dieldrin. Water from the E Main Drain contained 0.6 µg/L of fonofos, 0.02 µg/L of dieldrin, and 0.6 µg/L of aldicarb. In addition, the following insecticides were identified but could not be quantified: C Main Drain--diuron; D Main Drain--aldicarb; and E Main Drain--diuron, bromacil, and a phenylurea-like compound. Concentrations of aldicarb and carbofuran are less than their respective proposed maximum contaminant levels of 10 µg/L and 40 µg/L. Maximum contaminant levels have not been established or proposed for other pesticides detected in the irrigation-water drains.

Water from the irrigation wells did not contain reportable concentrations of insecticides. However, water from two domestic wells had reportable concentrations of organophosphorus insecticides. Water from site 14 contained 0.01 µg/L of diazinon and site 15 contained 0.02 µg/L of malathion. Both concentrations are near the reporting level of 0.01 µg/L.

Table 15.--Maximum contaminant levels and reporting levels of herbicides for which water samples were analyzed

[Maximum contaminant levels are shown in μg/L (micrograms per liter) and apply only to community water systems (U.S. Environmental Protection Agency, 1987b, p. 530); maximum contaminant levels have not been established or proposed for most of the herbicides shown on the table; values shown in parentheses are proposed maximum contaminant levels (J. Rodin, U.S. Environmental Protection Agency, written commun., 1989). Reporting levels are from Feltz and others (1985). Symbols: -- indicates that a maximum contaminant level has not been established or proposed for that compound.]

Triazines and other nitrogen-containing herbicides: reporting level is 0.1 μg/L

Herbicide	Maximum contaminant level	Herbicide	Maximum contaminant level
Alachlor	(2.0)	Prometon	--
Ametryn	--	Prometryn	--
Atrazine	(2.0)	Propazine	--
Cyanazine	--	Simazine	--
Metolachlor	--	Simetryn	--
Metribuzin	--	Trifluralin	--

Chlorophenoxy acid herbicides: reporting level is 0.01 μg/L

Herbicide	Maximum contaminant level	Herbicide	Maximum contaminant level
2,4-D	100 (70)	Silvex	10 (50)
2,4-DP	--	2,4,5-T	--

Table 16.--Maximum contaminant levels and reporting levels of insecticides and gross polychlorinated compounds for which water samples were analyzed

[Maximum contaminant levels are shown in μg/L (micrograms per liter) and apply only to community water systems (U.S. Environmental Protection Agency, 1987b, p. 530); values shown in parentheses are proposed maximum contaminant levels (J. Rodin, U.S. Environmental Protection Agency, written commun., 1989). Reporting levels are from Feltz and others (1985). Symbols: -- indicates that a maximum contaminant level has not been established or proposed for that compound.]

Carbamate insecticides: reporting level is 0.5 μg/L

Insecticide	Maximum contaminant level	Insecticide	Maximum contaminant level
Aldicarb	(10)	Methomyl	--
Aldicarb sulfone	(40)	1-Naphthol	--
Aldicarb sulfoxide	(10)	Oxamyl	--
Carbofuran	(40)	Propham	--
3-Hydroxycarbofuran	--	Carbaryl (Sevin)	--

Organophosphorus insecticides: reporting level is 0.01 μg/L

Insecticide	Maximum contaminant level	Insecticide	Maximum contaminant level
Chlorpyrifos; Dursban	--	Methyl parathion	--
Diazinon	--	Methyl trithion	--
Disulfoton	--	Parathion	--
Ethion	--	Phorate	--
Fonofos	--	Trithion	--
Malathion	--		

Table 16.--Maximum contaminant levels and reporting levels of insecticides and gross polychlorinated compounds for which water samples were analyzed--Continued

Organochlorine insecticides: reporting level is 0.01 µg/L except for chlordane and perthane (0.1 µg/L), and toxaphene (1.0 µg/L)

Insecticide	Maximum contaminant level	Insecticide	Maximum contaminant level
Aldrin	--	Heptachlor	(0.4)
Chlordane	(2.0)	Heptachlor epoxide	(0.2)
DDD	--	Lindane	4.0
DDE	--		(0.2)
DDT	--	Methoxychlor	100
Dieldrin	--		(400)
Endosulfan	--	Mirex	--
Endrin	0.2	Perthane	--
		Toxaphene	5.0

Gross polychlorinated compounds: reporting level is 0.1 µg/L

Compound	Maximum contaminant level
Gross polychlorinated biphenyls (PCB)	(0.5)
Gross polychlorinated naphthalenes (PCN)	--

Maximum contaminant levels have not been established or proposed for these insecticides. Both domestic wells were resampled in August 1989 for insecticides and herbicides. Analyses of the August 1989 samples indicated that concentrations of all compounds were less than the reporting levels in water from site 15, but site 14 contained 0.01 μg/L of diazinon, confirming the earlier analysis.

Polychlorinated biphenyls and polychlorinated naphthalenes were less than the reporting levels in all water samples collected.

SUMMARY

The U.S. Geological Survey, in response to a U.S. Department of Energy request, collected and analyzed water samples from 15 sites in Minidoka County, Idaho for manmade pollutants and naturally occurring contaminants. Samples were collected from 12 ground-water and 3 irrigation wastewater sites. The samples were analyzed for tritium, gross alpha- and beta-particle radioactivity, total uranium, radium, radon-222, strontium-90, gross gamma radioactivity, trace metals, purgeable organic compounds, nutrients, herbicides, and insecticides. Tritium concentrations were determined independently by U.S. Geological Survey, U.S. Department of Energy, and Idaho State University laboratories. The U.S. Department of Energy and Idaho State University laboratories counted samples for 100 and 200 minutes, respectively. Concentrations reported by both laboratories were less than the respective analytical method detection limits. The U.S. Geological Survey laboratory counted samples for 1,200 minutes and seven samples had tritium concentrations larger than the reporting level; ranging from 0.045±0.013 to 0.106±0.013 pCi/mL. The largest of these concentrations--0.106±0.013--is about one-half of the smallest analytical method detection limit for the other laboratories. Therefore, the analyses by the three laboratories are consistent with one another, given the differences in counting periods and the associated analytical method detection limits. For comparison purposes, the maximum contaminant level for tritium is 20 pCi/mL. Ranges of dissolved concentrations for some other radionuclides or types of

radioactivity follow: gross alpha-particle radioactivity as thorium-230--2.23±0.61 to 9.10±1.25 pCi/L; gross beta-particle radioactivity as strontium-90 in equilibrium with yttrium-90--2.50±1.28 to 10.3±2.5 pCi/L; total uranium--1.38±0.16 to 5.22±1.02 µg/L; radium-226--0.0102±0.0064 to 0.149±0.024 pCi/L; and strontium-90--from less than the reporting level to 0.483±0.071 pCi/L. The uncertainties are all given as two sample standard deviations (2s) except tritium, which is 1s.

Concentrations of nitrite plus nitrate as nitrogen ranged from 0.94 to 5 mg/L and orthophosphate concentrations as phosphorous ranged from 0.01 to 0.12 mg/L. Tetrachloroethylene (0.2 µg/L) and benzene (0.2 µg/L) were present in water from an irrigation drain. Water from three irrigation drains contained concentrations of 2,4-D ranging from 0.02 to 0.27 µg/L. Carbofuran, fonofos, dieldrin, aldicarb, diuron, bromacil, and a phenylurea-like compound were present in one or more water samples from the irrigation drains at small concentrations. Diazinon and malathion were each present in water from one domestic well at respective concentrations of 0.01 µg/L--site 14--and 0.02 µg/L--site 15. Resampling of the domestic wells in August 1989 confirmed the concentration of diazinon (0.01 µg/L) in water from site 14.

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