PHYSICAL, CHEMICAL, AND BIOLOGICAL DATA ASSOCIATED WITH IRRIGATION DRAINAGE IN THE FREEZEOUT LAKE AREA, WEST-CENTRAL MONTANA, 1994-95

By Eloise Kendy, U.S. Geological Survey, and Bill Olsen, U.S. Fish and Wildlife Service

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U.S. GEOLOGICAL SURVEY
Open-File Report 97-349

U.S. GEOLOGICAL SURVEY
U.S. FISH AND WILDLIFE SERVICE
BUREAU OF RECLAMATION
BUREAU OF INDIAN AFFAIRS

Helena, Montana
August 1997

U.S. DEPARTMENT OF THE INTERIOR

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CONVERSION FACTORS, VERTICAL DATUM, ABBREVIATED UNITS, AND ACRONYMS

Multiply	By	To obtain
acre	4,047	square meter
cubic foot per second	0.028317	cubic meter per second
foot (ft)	0.3048	meter
gallon	3.785	liter (L)
inch (in.)	25.4	millimeter (mm)
inch (in.)	25,400	micrometer (μm)
mile (mi)	1.609	kilometer
ounce	28.35	gram (g)
pound	0.4536	kilogram (kg)

Degree Celsius (°C) may be converted to degree Fahrenheit (°F) by using the following equation:

$$°F = 9/5\ (°C) + 32$$

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Chemical concentration in water is reported in milligrams per liter (mg/L) or micrograms per liter (μg/L). Milligrams per liter is a unit expressing the solute mass (milligram) per unit volume (liter) of water and is about the same as parts per million unless concentrations are more than 7,000 milligrams per liter (Hem, 1989, p. 55). Chemical concentration in sediment and biological tissue is reported in micrograms per gram (μg/g), which is equal to parts per million; or in percent, which is equal to parts per hundred.

Specific conductance of water is a measure of the ability of water and dissolved constituents to conduct an electrical current and is an indication of the ionic strength of the solution. Specific conductance is expressed in microsiemens per centimeter at 25°C (μS/cm) and increases with the concentration of dissolved constituents.

Acronyms used in this report:

DOI	U.S. Department of the Interior
ICP	inductively coupled plasma
IT	incremental titration
MBMG	Montana Bureau of Mines and Geology
NWQL	U.S. Geological Survey National Water Quality Laboratory
PACF	U.S Fish and Wildlife Service Patuxent Analytical Control Facility
PVC	Polyvinyl chloride
SMOW	Standard Mean Ocean Water
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WMA	Wildlife Management Area

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Abstract

Physical, chemical, and biological data were collected during 1994-95 in the Freezeout Lake area of west-central Montana as a follow-up to a 1990-92 detailed study of the extent, magnitude, sources, and biological effects of selenium and other constituents associated with irrigation drainage in the Sun River Irrigation Project. The 1990-92 study determined that return flow from irrigated glacial-lake deposits is the primary source of selenium to wetlands in the Freezout Lake Wildlife Management Area.

Data were collected in 1994-95 to provide a basis to better understand (1) selenium distribution, mobilization processes, and transport rates in irrigated land underlain by glacial-lake deposits that drain into wetlands of Pond 5 and the southern part of Freezeout Lake, and (2) selenium distribution, toxicity risks, and accumulation in the wetlands and biota.

This report presents data for selenium and other potentially toxic constituents in solid-phase, water, and biological media. Physical and chemical data are reported for soil, drill cores, soil moisture, ground water, surface water, and bottom sediment. Biological data include selenium residues measured in aquatic plants, aquatic invertebrates, fish, water-bird eggs, and water-bird livers.

INTRODUCTION

Concerns about irrigation-induced water-quality problems have arisen in recent years as a result of documented adverse effects on biota in areas of the western United States that receive drainage water from irrigated farmland. The U.S. Department of the Interior (DOI) was directed by the U.S. Congress to identify the nature and extent of potential problems in irrigation projects administered by the DOI or in wildlife areas that receive irrigation drainage from these projects. The Sun River Irrigation Project and surrounding areas in west-central Montana (fig. 1) were selected in 1985 by the DOI for a reconnaissance investigation of potential effects associated with irrigation drainage, because available data on selenium concentrations in water and bottom sediment indicated a potential for toxicity. The reconnaissance investigation was conducted in 1986-87 (Knapton and others, 1988). Results of that study indicated that most sampling sites within the Sun River Irrigation Project had constituent concentrations less than established criteria and standards for the protection of humans, fish, and wildlife. However, several sites in Freezout Lake Wildlife Management Area (WMA) and Benton Lake National Wildlife Refuge, which receive irrigation drainage from the project, had selenium concentrations in water, bottom sediment, and biota that were moderately to considerably higher than established criteria and standards. Selenium was considered to have the greatest potential for toxicity, but other constituents also were present in concentrations higher than criteria for known biological effects.

Because several sites that receive irrigation drainage from the Greenfields Division of the Sun River Irrigation Project (herein referred to as the Greenfields Irrigation Division) had elevated concentrations of selenium, a detailed study of the extent, magnitude, sources, and biological effects of selenium and other constituents associated with irrigation drainage in the Sun River area was conducted in 1990-92 by U.S. Geological Survey (USGS) and U.S. Fish and Wildlife Service (USFWS) scientists (Lambing and others, 1994; Nimick and others, 1996). That detailed study identified elevated selenium concentrations in water draining to Freezeout Lake from irrigated land underlain by glacial-lake deposits south and east of the lake. Estimates of selenium loading indicated that these irrigated glacial-lake deposits constitute the main

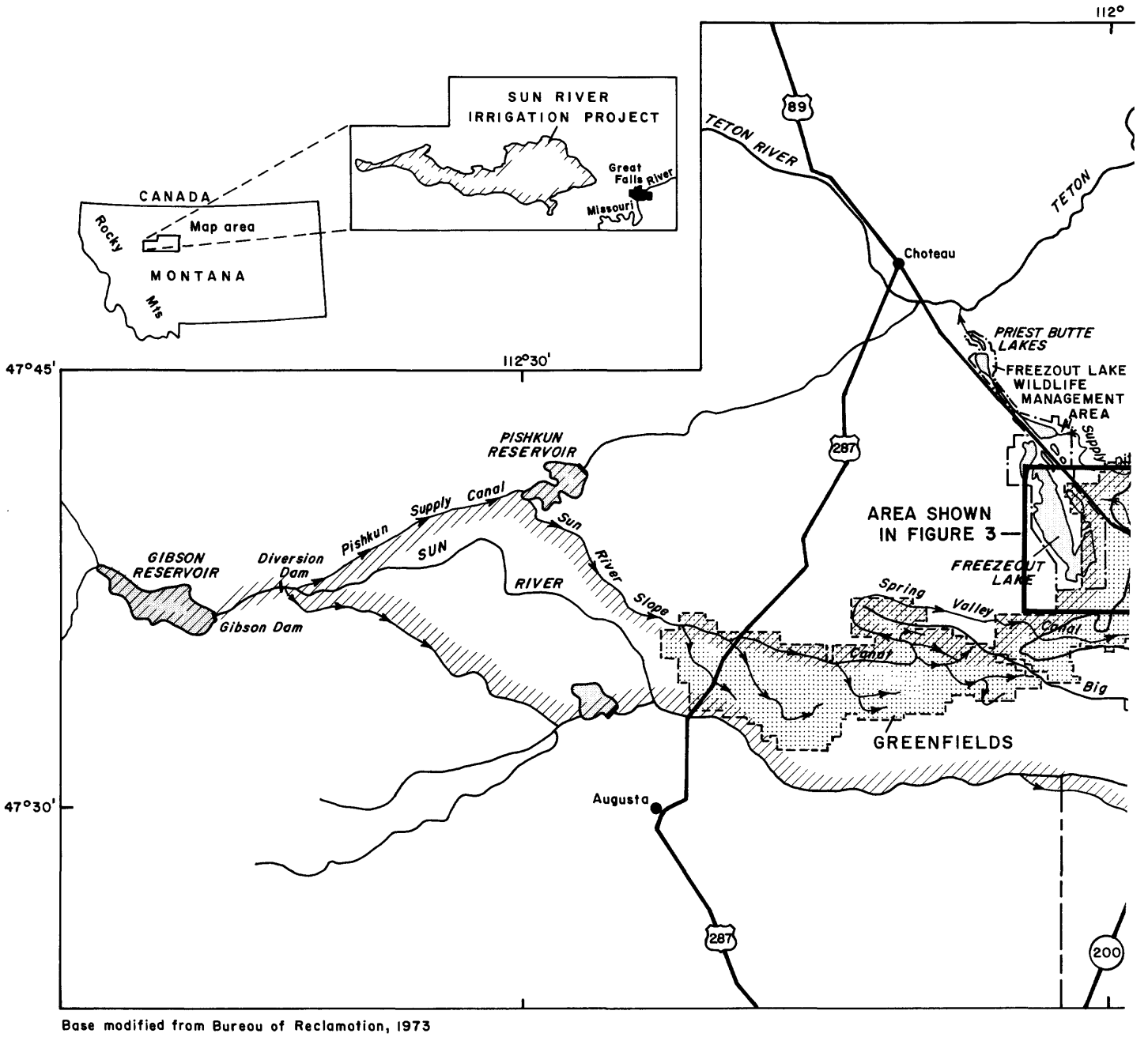
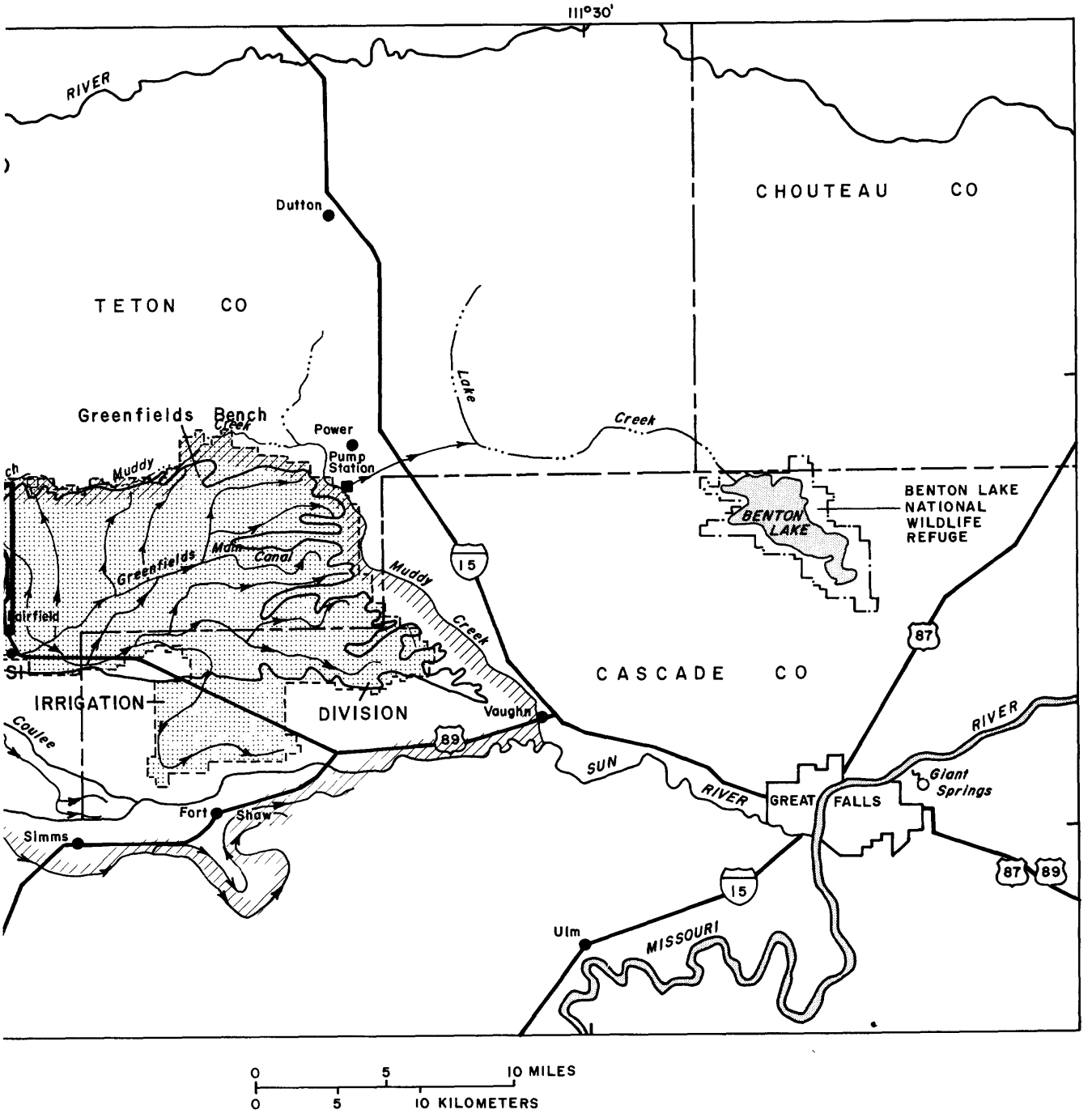


Figure 1. Location of study area.


111°30'
RIVER
CHOUTEAU CO
Dutton
TETON CO
Greenfields Bench
Power
Pump Station
Lake
Creek
Muddy
Creek
Greenfields Main Canal
BENTON LAKE
BENTON LAKE NATIONAL WILDLIFE REFUGE
15
87
Muddy Creek
CASCADE CO
IRRIGATION DIVISION
Vaughn
89
Coulee
SUN RIVER
GREAT FALLS
Giant Springs
RIVER
Fort Shaw
Simms
15
87
89
Ulm
MISSOURI
0 5 10 MILES
0 5 10 KILOMETERS

source of selenium loading to Freezeout Lake. Although selenium delivered by irrigation drainage has accumulated in wetland bottom sediments, biological effects from selenium were not evident on the basis of population characteristics and nesting success. However, elevated selenium concentrations in some bird livers and eggs indicated that bioaccumulation is occurring. In addition, samples of irrigation drainage to Freezeout Lake caused acute toxicity to aquatic food-chain organisms in toxicity tests.

These results raised concerns about elevated selenium concentrations, selenium delivery in drainage from irrigated glacial deposits, and potential toxicity to aquatic organisms in the central and southern parts of the Freezout Lake WMA. However, statistically valid inferences about the variability of selenium concentrations in water, bottom sediment, and fish in the Freezout Lake WMA were limited by small sample size during the 1990-92 study (Nimick and others, 1996). Therefore, in 1994-95, the DOI initiated a detailed, follow-up study to focus data collection on the smaller, more specific area of concern that was identified in 1990-92.

Data were collected in 1994-95 to provide a basis to better understand (1) selenium distribution, mobilization processes, and transport rates in irrigated land underlain by glacial-lake deposits that drain into wetlands of Pond 5 and the southern part of Freezeout Lake, and (2) selenium distribution, toxicity risks, and accumulation in the wetlands and biota. The 1994-95 study was conducted by an interagency study team representing the USGS, the USFWS, the Bureau of Reclamation, and the Bureau of Indian Affairs.

Purpose and Scope

The purpose of this report is to present physical, chemical, and biological data collected during 1994-95 in a detailed, follow-up study of solid-phase media, water, and biota within the central and southern parts of Freezout Lake WMA and adjacent irrigated and non-irrigated land underlain by glacial-lake deposits (fig. 1). The data in this report were collected from 7 soil and drill-core sites, 5 soil-moisture sites, 14 ground-water sites, 27 surface-water sites, 35 bottom-sediment sites, and 18 biological sites. Some of the sites had been sampled previously during the reconnaissance and detailed studies, whereas others were first sampled in this study.

Data were collected at frequencies ranging from one-time site visits to monthly monitoring. Data-collection schedules were determined principally by hydrologic conditions related to irrigation and natural runoff, seasonal variations in biological productivity, and life-cycle stages of resident and migratory biota. The data collection was a collaborative effort by scientists from the USGS and the USFWS.

System for Specifying Geographic Locations

Soil, drill-core, soil-moisture, and ground-water sampling sites are assigned local numbers according to their geographic position within the rectangular grid system used in Montana for the subdivision of public land (fig. 2). The local number consists of 14 characters. The first three characters specify the township and its position north (N) of the Montana Base Line. The next three characters specify the range and its position west (W) of the Montana Principal Meridian. The next two characters are the section number. The next four alpha characters designate the quarter section (160-acre tract), quarter-quarter section (40-acre tract), quarter-quarter-quarter section (10-acre tract), and quarter-quarter-quarter-quarter section (2.5-acre tract), respectively, in which the well or other sampling site is located. These four subdivisions of the section are designated A, B, C, and D in a counterclockwise direction, beginning in the northeastern quadrant. The last two numeric characters specify a sequence number to distinguish between multiple wells or multiple depths at a single location. For example, as shown in figure 2, well 22N03W21BCCD01 was inventoried in the SE1/4 SW1/4 SW1/4 NW1/4 sec. 21, T. 22 N., R. 3 W.

Fifteen-digit site-identification numbers also are used for soil, drill-core, soil moisture, ground-water, surface-water, bottom-sediment, and biota sites. These numbers represent the approximate latitude and longitude of the site (first 13 digits), plus the sequence number (last 2 digits). Biological samples, particularly composite samples, commonly were collected from extensive areas of a wetland. Consequently, the general geographic areas for biological sampling sites are indicated in this report in the illustration of sampling-site locations (fig. 3). The location numbers for spatially extensive biological sampling areas represent the latitude and longitude of the approximate

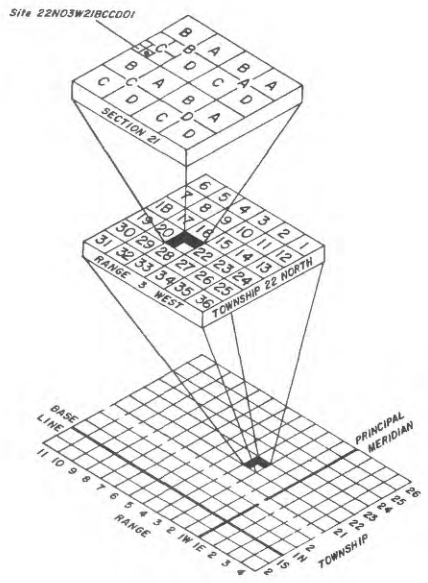


Figure 2. Numbering system for specifying geographic location of soil, drill-core, soil-moisture, and ground-water sampling sites.

central location of a broad area, unless the biological sites are located near sites at which other media were sampled, in which case the corresponding site number for the other media is used.

Description of Study Area

The study area (fig. 1) is located in Teton County of west-central Montana. Headwaters of the Sun River form along the eastern slopes of the Rocky Mountains, from which the river flows eastward to its confluence with the Missouri River at the city of Great Falls. Irrigation water is diverted from the Sun River below Gibson Reservoir, which lies at the foot of the mountains. The irrigation water is conveyed by canals to several elevated prairie plateaus, or benches. The largest of these benches served by the Sun River Irrigation Project is the Greenfields Bench, which is underlain by Tertiary (?) or Quaternary gravel.

The Greenfields Irrigation Division consists of about 80,000 acres of irrigated land, mostly on the Greenfields Bench, and contains about 600 farms. The predominant irrigated crops are barley and alfalfa. Some of the irrigated land is used as pasture. Most of the irrigation return flow from the Division drains into the Sun River, but the approximately 4,000-acre low-lying irrigated area between the Greenfields Bench and Freezeout Lake drains to Freezout Lake WMA. The 1994-95 study focuses on this relatively level area, which is underlain by Quaternary glacial-lake deposits, and the wetlands to which it drains.

Freezout Lake WMA is managed by the Montana Department of Fish, Wildlife and Parks and contains 12,000 acres that are about evenly divided between wetlands and uplands. The wetlands contain six marsh units or ponds, Priest Butte Lakes, and a main lake (Freezeout Lake). The WMA is adjacent to the northwest part of the Greenfields Irrigation Division near the foot of the Greenfields Bench and extends northward nearly to the Teton River. Irrigation delivery losses (canal seepage and unused excess supply) and irrigation drainage from farmlands are major sources of water for the WMA and are an important supplement to natural flows. Most delivery losses and irrigation drainage enter the WMA through drain canals that terminate either at one of the ponds or at Freezeout Lake. Variable amounts of natural runoff are contributed to the WMA from semiarid non-irrigated lands to the west and north of Freezeout Lake and to the east of Priest Butte Lakes. Water is distributed by a canal system among the inter-connected ponds of the WMA to manipulate water levels for waterfowl management. Water from Freezeout Lake can be transferred by canal to Priest Butte Lakes. Water can be discharged from Priest

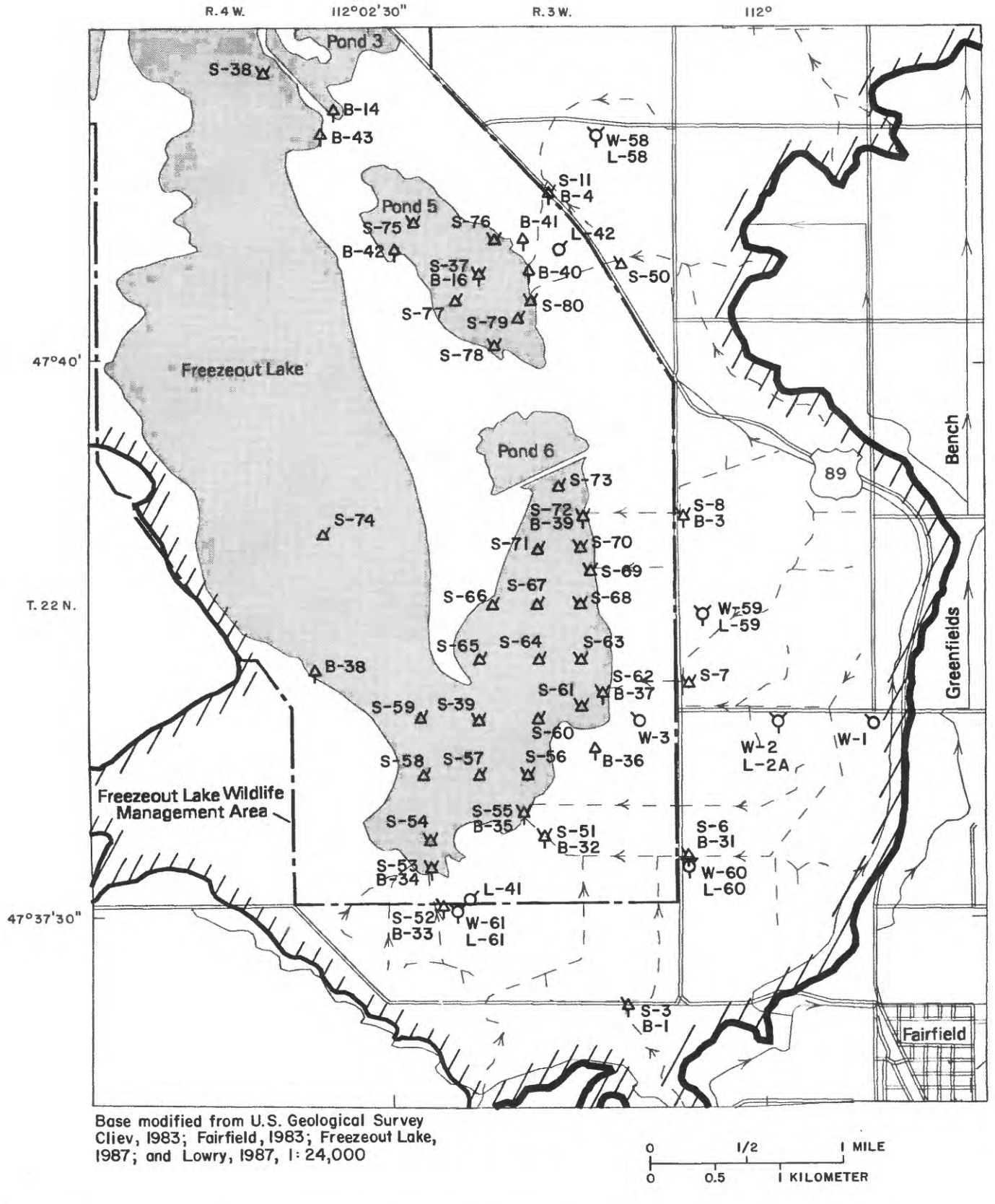
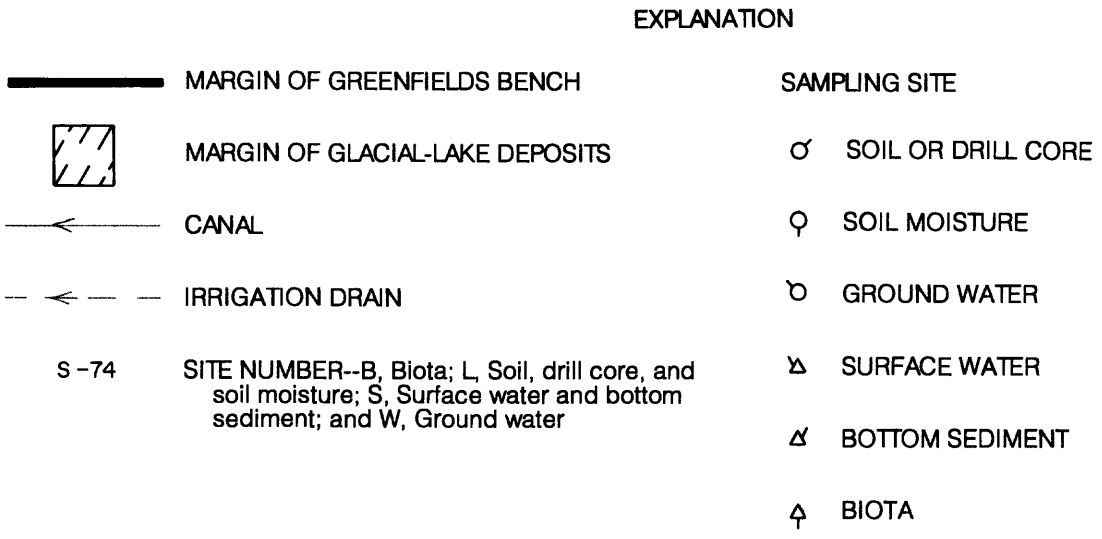


Figure 3. Location of soil, drill-core, soil-moisture, ground-water, surface-water, bottom-sediment, and biota sites that were sampled in 1995 in the Freezeout Lake area, Montana (explanation on next page.)



Butte Lakes to the Teton River through an outlet structure and canal. These discharges are regulated by the Montana Department of Environmental Quality in accordance with State criteria for discharge of saline water.

Acknowledgments

The authors acknowledge with appreciation the many individuals who assisted in the study. Particular thanks for providing historical and land-use information are given to Ronald A. Dale and Scott Boelman of the Greenfields Irrigation Division and Mark E. Schlepp and the staff at Freezout Lake WMA. Assisting in the collection of water-quality and hydrologic data were Fred A. Bailey, C. Lee Chambers, David W. Clark, Michael S. James, and Philip L. Karper of the USGS. Much of the biological data were collected by Shannon B. Heath, Melinda L. Meade, John C. Malloy, and Fern K. Thompson of the USFWS, and Kristi L. DuBois and Quentin J. Kujula of the Montana Department of Fish, Wildlife and Parks. John H. Lambing and David A. Nimick of the USGS and Donald U. Palawski of the USFWS also provided substantial guidance and assistance in collecting, reporting, and interpreting data. Richard G. Bandy of the Natural Resources Conservation Service, U.S. Department of Agriculture, identified soil series in the field and provided additional soils information. Paul J. Lamothe of the USGS and YiQiang Zhang of the University of Montana analyzed samples of solid media and contributed useful insights into their interpretation. Peter L. Schendel of the Bureau of Reclamation provided technical assistance throughout the study. Appreciation is extended to the landowners who allowed instruments to be installed and monitored on their property.

SAMPLE COLLECTION, PROCESSING, AND ANALYSIS

Sample collection was concentrated in irrigated farmland, nearby non-irrigated land, and wetlands receiving irrigation drainage (fig. 3). The data sites, data-collection methods, and sample processing and analysis methods are described in the following sections for each of the sampled media. Data for this follow-up study were collected from September 1994 through November 1995. A list of the constituents analyzed for each medium and the minimum reporting levels are given in table 1 (all tables at back of report). Variable minimum reporting levels for some constituents in water result from matrix interference, which requires sample dilution prior to analysis, resulting in increased minimum detection level.

As a basis for comparison, the State of Montana has established a human health standard and the U.S. Environmental Protection Agency (1991) has established a maximum contaminant level of 50 µg/L selenium for treated drinking water. The State and

Federal freshwater aquatic-life criteria for selenium are 20 µg/L for acute toxicity and 5 µg/L for chronic toxicity (Montana Department of Environmental Quality, 1995; U.S. Environmental Protection Agency, 1986).

Physical and Chemical Data

Samples of soil, drill core, soil moisture, ground water, surface water, and bottom sediment were collected from February through August 1995, and analyzed for various physical and chemical properties. All samples were analyzed for selenium. Selected samples were analyzed for physical characteristics, major ions, trace elements, nutrients, or isotope ratios.

Soil and Drill Core

Soil and drill-core samples were collected from two non-irrigated (L-41 and L-42), two flood-irrigated (L-58 and L-61), and three sprinkler-irrigated (L-2A, L-59, and L-60) sites in 1995 (table 2; fig. 3). In general, soils extend beneath the land surface to a depth of about 3-5 ft, whereas drill cores were collected from as deep as 80 ft. In this report, data for soil and drill-core samples are presented together because both represent solid-phase concentrations determined by the same analytical methods. Soils were identified and sampled in February 1995 and drill-core samples were obtained in March 1995. Most soil samples were obtained using either a stainless steel hand trowel or a stainless steel 3 1/4-in. hand auger. Samples deeper than about 3-4 ft were obtained using a stainless steel split-spoon sampler attached to a hollow-stem auger. Lithologic logs of boreholes are described in table 3.

Each soil or drill-core sample was placed in a plastic tray, mixed vigorously with a plastic spoon, and divided into four aliquots. Samples of approximately 0.5 kg were placed in plastic bags. The four aliquots were designated for (1) batch-leach tests, which consist of analysis of liquid leached from samples to simulate water-rock interaction over time; (2) sulfur-speciation, total-selenium, and water-extractable selenium analyses; (3) selenium-speciation analyses; and (4) extra material should any sample need to be reanalyzed. The first three aliquots were submitted to laboratories for analysis in March 1995; selected samples from the fourth aliquot were submitted for reanalysis of total and water-extractable selenium in October 1996. Samples in the first aliquot were sealed and frozen, whereas the other three aliquots were left open to dry.

Soil and drill-core samples were analyzed for major ions and trace elements in batch leachates, and for sulfur species and total and water-extractable selenium by the USGS Branch of Geochemistry Laboratory, Lakewood, Colo. Bulk, unsieved samples were air-dried at ambient air temperature and disaggregated. Bulk samples for selenium and sulfur analyses were ground to less than 0.18-mm diameter using a ceramic pulverizer according to procedures described in Arbogast (1990); batch-leach samples, including samples for selenium leachate, were not crushed or ground. For batch-leach tests and water-extractable selenium analyses, a 1:5 mixture of solid-phase sample (by dry weight) and deionized water was agitated in a reciprocating shaker for 4 hours (Crock and others, 1991). The leachate was filtered through a 0.45-µm filter and was analyzed by inductively coupled plasma (ICP) atomic emission spectrometry for selected major ions and trace elements except for chloride, sulfate, and fluoride, which were analyzed by ion chromatography. Specific conductance was measured on an aliquot of the filtrate obtained from the batch-leach test. Total sulfur and the sulfide and sulfate fractions of total sulfur were analyzed using extraction procedures described by Jackson and others (1987) and a combustion method using an automated sulfur analyzer (Arbogast, 1990). Total selenium was analyzed by hydride-generation atomic absorption spectrometry following a high-temperature digestion with a mixture of strong acids. Water-extractable selenium was analyzed by hydride-generation atomic absorption spectrometry. Results of chemical analyses of batch leachate from soil and drill-core samples are presented in table 4; results of analyses of sulfur and selenium species in soil and drill-core samples are given in table 5. To facilitate comparison between analyses, constituent concentrations in batch leachates and water extracts have been converted to micrograms of constituent leached or extracted per gram of solid material that was tested (tables 4 and 5).

Analyses of soluble, adsorbed, organic plus elemental, and oxides of selenium were performed by YiQiang Zhang of the Department of Geology, University of Montana, Missoula, Mont., using sequential extraction methods described by Tokunaga and others (1991). Many samples were divided in half, with each half analyzed separately to account for natural variations in the wet material. In these cases, results of both analyses are reported in table 5.

Soil Moisture

Soil moisture, or pore water, from above the water table was sampled at five of the seven soil-sampling sites using suction lysimeters (fig. 3). Each of the five suction lysimeters was installed in May 1995 adjacent to an existing test well or well cluster (table 2).

Suction lysimeters, each consisting of a 4-in.-long by 1.9-in.-diameter porous ceramic cup with a 1.9-in.-diameter polyvinyl chloride (PVC) riser protecting 0.25-in. polyethylene tubing, were installed in 3-in.-diameter, hand-augered boreholes. No drilling fluids were used. However, deionized water was mixed with silica flour to form a slurry into which the lysimeters were placed. To remove the deionized water from the silica slurry, the lysimeters were evacuated repeatedly until the specific conductance of the samples stabilized. The silica pack maintains a hydraulic connection between the porous ceramic cup and the surrounding soil. Therefore, the open interval of the lysimeter corresponds with the soil depth that is in physical contact with the silica flour which, at every site, exceeded the length of the porous ceramic cup.

Soil-moisture samples were collected at least twice from all lysimeters during the growing season. The 1995 growing season was unusually wet, resulting in little need for irrigation. Because the flood-irrigated sites (table 2) were flooded only once, the samples from those sites were collected once before irrigation (June 1995) and once after irrigation (August 1995). Samples from the sprinkler-irrigated sites (table 2) were collected within 3 days after two separate irrigation applications in June and August 1995.

To acquire a sample, a hand pump was used to apply a vacuum to the lysimeter, which induced soil moisture to flow through the porous ceramic cup and accumulate inside the lysimeter. After several hours to 2 days, the lysimeter would contain about 0.4 L of sample. The sample was then evacuated from the lysimeter into a dedicated glass flask, located in line between the lysimeter and the vacuum-inducing hand pump. From the flask, the homogenized sample was distributed to various bottles and sent to the USGS National Water Quality Laboratory (NWQL), Arvada, Colo., for analysis. Field filtration was not necessary because the 0.45-µm pores in the porous ceramic cup filtered the soil moisture underground as it entered the lysimeters. Owing to the small sample yielded by the lysimeters, field parameters were not determined for most soil-moisture samples.

All samples were analyzed for nutrients, major ions, and selected trace elements (including selenium) by the NWQL using methods described by Fishman and Friedman (1989) and Fishman (1993). Results of chemical analyses of soil moisture are included in table 6.

Ground Water

Ten test wells were drilled and installed at three sites during the 1990-92 study (Lambing and others, 1994). Four additional test wells (W-58, W-59, W-60, and W-61) were drilled and installed in irrigated fields in March 1995 (fig. 3). Construction records of all 14 test wells are given in table 7. Lithologic logs of the four new boreholes (L-58, L-59, L-60, L-61) are given in table 3.

Test wells were installed in boreholes made with an auger drill rig using either 8-in. hollow-stem or 5-in. solid-stem augers. No drilling fluids were used. Casing material was 2-in.-diameter PVC. The annulus, or space in the borehole between the well casing and the formation, was filled to complete each well. First, washed silica sand was added to fill the portion of the annulus adjacent to the well screen. Next, bentonite pellets were placed on top of the sand pack to form a seal 0.5 to 8.3 ft thick. Bentonite crumbles were used to fill and seal the rest of the annulus up to land surface. A concrete surface seal and protective steel surface casing were installed around each of the test wells. Test wells were developed using a surge block and PVC bailer until the specific conductance of the water obtained from each well stabilized. Because the wells were completed in silty glacial-lake deposits, water levels recovered relatively slowly, and development efforts were discontinued before the produced water became clear.

Water levels were measured approximately monthly with a steel or an electrical tape in the 4 new test wells and in the 10 older test wells from September 1994 to November 1995. These water-level measurements plus corresponding physical data and aquifer information are given in table 8.

Ground-water samples were collected from the four new test wells in March and July 1995. In July 1995, ground-water samples also were collected from the shallowest well containing water at each of the three previously established sites. Because the wells recovered slowly, they were purged by bailing dry at least two times on the day before the samples were

collected. Water samples for chemical analysis were collected using a peristaltic pump. Sample processing, filtration, and preservation for major ions and nutrients were performed in the field as described by Knapton (1985). Samples for selenium speciation were filtered and preserved with hydrochloric acid. Dissolved constituents were determined in samples filtered through a 0.45-µm cellulose-nitrate filter using a plastic filtration unit. Water samples analyzed for oxygen-18/oxygen-16 (O-18/O-16) and deuterium/hydrogen (D/H) isotopic ratios did not require filtration or preservation.

Ground-water samples were analyzed for major ions, nutrients, and trace elements by the NWQL, using methods described by Fishman and Friedman (1989) and Fishman (1993). Ground-water samples were analyzed for O-18/O-16 and D/H isotope ratios at USGS laboratories in Reston, Va. The O-18/O-16 isotope ratio was determined using a modification of the carbon-dioxide equilibration method developed by Epstein and Mayeda (1953). The D/H isotope ratio of water samples was determined by analyzing hydrogen quantitatively extracted from the water (Kendall and Coplen, 1985). The O-18/O-16 and D/H results are reported relative to Vienna Standard Mean Ocean Water (SMOW) in per mil notation.

Selenium-speciation analyses were performed by the Montana Bureau of Mines and Geology (MBMG), Butte, Mont., using hydride-generation atomic absorption spectrometry. In performing the speciation analyses, the concentration of selenite was determined on subsamples that were not reduced with hydrochloric acid prior to injection into the hydride generator (Presser and Barnes, 1984). The concentration of selenite plus selenate was determined on subsamples that were digested with hydrochloric acid. Selenium-speciation data for ground-water samples are given in table 6. In one case, the reported concentration of selenite plus selenate is as much as about 15 percent greater than the concentration of total selenium. The difference in values probably can be attributed to the different procedures used by the two analyzing laboratories.

Surface Water

Surface water was sampled in Freezeout Lake, Pond 5, and selected water courses (fig. 3). Sampling locations included 6 irrigation-drain sites, 18 lake sites, and 3 sites on springs, streams or canals that are upgradient from irrigation returns. Surface-water sampling sites and types of samples collected at each site are listed in table 9.

Sites that do not receive irrigation drainage are considered to be reference sites that are representative of areas not affected by irrigation practices. Reference sites are not necessarily considered to be representative of natural flow conditions, however, because their water-quality characteristics may be affected by other land uses.

Surface water was sampled periodically from March or April through August 1995 for chemical analysis. Samples from all 27 surface-water sites were analyzed for selenium. Nine sites were sampled for trace elements, major ions, and nutrients. Water temperature, pH, and specific conductance were measured in the field during nearly all sampling events. Dissolved oxygen was measured in the field when samples were collected for complete chemical analysis and in April at all lake sites where surface water was sampled for selenium. Field measurements of water-quality properties and field sample processing were performed as described by the U.S. Geological Survey (1977) and Knapton (1985).

Water samples from streams and irrigation drains were collected either by depth integration at multiple stream verticals according to methods described by Knapton (1985), or by grab sampling at weirs, culverts, and sites where streamflow was very small. Instantaneous streamflow was determined at the time of sampling by direct measurement. Samples from Freezeout Lake and Pond 5 were collected at more than one location. Multiple sampling locations were selected to establish a simple grid of uniformly spaced sites in areas in proximity to irrigation drains. At each lake sampling site, samples were collected near mid-depth.

Sampling equipment was nonmetal to prevent trace-element contamination of the sample. Depth-integrated samples of flowing water were collected with a plastic U.S. DH-81 hand-held sampler. Grab samples of small flows were collected directly in either a glass or polyethylene sampling bottle, or a polyethylene churn splitter. Water samples from lakes were collected in a nonmetal Van Dorn point sampler that was lowered by rope to mid-depth and triggered to seal a 10-L sample volume.

Surface-water samples were analyzed by the NWQL. Analytical methods are described by Fishman

and Friedman (1989) and Fishman (1993). Results of field measurements and trace-element analyses of surface-water samples are presented in table 10. Results of major-ion and nutrient analyses of surface-water samples are given in table 11.

Bottom Sediment

Bottom-sediment samples were collected in August 1995 from 4 irrigation drains, 24 locations in Freezeout Lake, and 7 locations in Pond 5. Twenty-two of these 35 bottom-sediment sampling locations correspond to surface-water sampling sites.

Bottom-sediment samples were collected from the upper surface at all sites to describe the selenium concentrations in surficial material to which biota are most likely to be exposed. The surficial material at most sites generally consisted of uniformly black sediment with high organic content. Where this organic-rich surficial material was present, a sample from the upper 6-8 in. of bottom sediment was obtained. However, several sites had surficial material of a different color or were underlain by a denser, distinctly different layer within 1-3 in. from the surface. At these sites, the surficial sample consisted only of the material overlying the denser sediment.

Surficial samples of bottom sediment were obtained using a U.S. BMH-53 stainless-steel, hand-held corer. The core tube is 8 in. long and has an internal piston to push the sediment out of the tube. In shallow water, the corer was used with its standard handle to extract bottom sediment. In water that was deeper than about 3 ft, PVC extension tubes were added to enable sampling of surficial sediment in water as deep as about 10 ft.

At selected sites, core samples were collected to identify the variation of selenium concentration with depth. At those sites, the core samples were separated into discrete intervals by visual observation of distinct color or texture differences. Each interval was analyzed for selenium.

Core samples of bottom sediment were obtained using coupled sections of 1-in. diameter stainless-steel pipe that was either pushed or hammered down to the dense, underlying hardpan until further penetration was minimal. The core tube was retrieved, with the dense hardpan acting as a bottom plug to prevent sediment from escaping. A PVC plunger was used to push the sediment core from the sampling tube. The sediment core then was separated into intervals of similar color and texture. Where multiple layers of sediment were present, each interval was analyzed separately. The lengths of each interval were noted for all core samples to indicate the variability in thickness of each layer.

Both surficial and core samples of bottom sediment consisted of a composite of five replicates from each sampling site to account for inherent natural variability. Each replicate was placed in a plastic mixing bowl and stirred vigorously with a plastic spoon to homogenize the sediment sample. From this composite, about 0.5 L of material was transferred to a plastic carton. If less than 0.5 L of material was obtained, the sediment was mixed and the entire sample was submitted for analysis.

Bottom-sediment samples were analyzed for total selenium by the USGS Branch of Geochemistry Laboratory. Samples were air dried at ambient temperature. The unsieved bulk samples were analyzed for total selenium by hydride-generation atomic absorption spectrometry. Detailed analytical procedures for solid-phase samples are described by Arbogast (1990). Results of selenium analyses of bottom-sediment samples are presented in table 12.

Biological Data

Biological samples collected in 1995 from the Freezout Lake WMA included aquatic plants, aquatic invertebrates, fish, bird eggs, and bird livers. All samples of biota were analyzed for selenium by hydride-generation atomic absorption spectrometry. Samples collected in April 1995 were analyzed by the USFWS Patuxent Analytical Control Facility (PACF), Laurel, Md.; samples collected in May-August 1995 were analyzed by the Geochemical and Environmental Research Group, College Station, Texas, on contract to PACF.

Aquatic Plants

Samples of aquatic plants, including filamentous algae (*Mougeotia sp.*) and sago pondweed (*Potamogeton pectinatus*), were collected using a sweep net or by hand. Plant samples were stored in acid-cleansed glass jars and frozen prior to analysis. Results of selenium analyses of aquatic plants are presented in table 13.

Aquatic Invertebrates

Samples of aquatic invertebrates included single-taxon composites of waterboatmen (Class Insecta,

Family Corixidae) and chironomid larvae (Class Insecta, Family Chironomidae) as well as multi-order composites.Where waterboatmen and chironomid larvae were not present in sufficient quantity for analysis, collected samples consisted of multi-order composites of waterboatmen, backswimmers (Class Insecta, Family Notonectidae), damselfly nymphs (Class Insecta, Suborder Zygoptera), daphnia (Class Crustacea, Order Cladocera), copepods (Class Crustacea, Order Copepoda), beetles (Class Insecta, Order Coleoptera), and amphipods (Class Crustacea, Order Amphipoda) and were collected at sites where waterboatmen and chironomid larvae were not present in sufficient quantity for analysis. Invertebrate samples were collected either with light traps using methods described by Espinosa and Clark (1972) or with a sweep net. Each sample was sorted with forceps and placed in an acid-cleansed jar. A minimum of 2.0 g of biomass was obtained for each sample of invertebrates. Results of selenium analyses of aquatic invertebrates are presented in table 14.

Fish

All fish samples consisted of brook sticklebacks (*Culaea inconstans*). Fish were collected with light traps and sweep nets, and analyzed as whole-body composites. Each sample was placed in an acid-cleansed jar and kept frozen until analyzed. Results of selenium analyses of fish are presented in table 15.

Water-Bird Eggs

Eggs of water birds were collected from the nests of pied-billed grebes (*Podilymbus podiceps*), American coots (*Fulica americana*), and American avocets (*Recurvirosta americana*). Nests of pied-billed grebes and American coots were located by searching emergent vegetation from an airboat or canoe. American avocet nests were located by searching shoreline and mudflat areas on foot.

One egg was collected randomly from each active nest. The flotation method was used to estimate the incubation stage of the eggs (Westerskov, 1950). Eggs were opened with scalpel blades and their contents weighed in disposable plastic weighing dishes. Fertility, viability, stage of development, and observable gross abnormalities were noted. The egg contents then were placed in acid-cleansed glass jars and kept frozen until analyzed. Results of selenium analyses of water-bird eggs are presented in table 16.

Water-Bird Livers

Livers were collected from young-of-the-year American avocets in two areas (B-37 and B-38) of Freezeout Lake and from young-of-the-year American coots in one area (B-14) of Pond 3. Pond 5 was searched for young-of-the-year water birds, but, although nests were located, no fledglings were found. However, fledglings were abundant near Pond 3, less than 0.5-mi north of Pond 5. Possibly, the hatchlings from Pond 5 had moved north to Pond 3. Although the birds collected at the Pond 3 sampling site (B-14) might have been exposed to conditions at Pond 5, they cannot be considered surrogates for young-of-the-year from Pond 5.

Birds were collected in banding traps or by shooting with steel shot. Their livers were excised in the field using disposable scalpels and stored in acid-cleansed glass jars. All samples were kept frozen until submitted for chemical analysis. Results of selenium analyses of water-bird livers are presented in table 17.

Quality-Assurance Procedures and Quality-Control Data

Data-collection and analytical procedures used in this study incorporated practices designed to assure, control, verify, and assess the quality of sample data. Methods and associated quality control for collection and processing of water samples are described by Ward and Harr (1990), Guy and Norman (1970), Knapton (1985), and Knapton and Nimick (1991).

The Branch of Geochemistry Laboratory, the NWQL, and the MBMG laboratory provided quality control of analyses performed within their facilities. Quality-assurance procedures used by the Branch of Geochemistry Laboratory are described by Arbogast (1990); quality-assurance procedures used by the NWQL are described by Friedman and Erdmann (1982) and Jones (1987). All sample bottles, standard solutions, and preservatives for water samples analyzed by the NWQL were provided by the NWQL and were systematically tested by internal quality control for conformance with criteria described in Bench-Level Protocols on file in the Quality Control Office of the laboratory. In addition, selected analytical schedules, requirements for sample treatments, and required sample bottles are described in the laboratory's analytical services catalog (Pritt and Jones, 1989). Sample bottles and preservatives for water

samples analyzed by the MBMG laboratory were provided by the MBMG laboratory and were similarly quality controlled.

Quality-control data to document sample contamination and reproducibility of analytical results were provided by test samples that consisted of either a field-blank sample of deionized water or a replicate environmental sample. Quality-control samples comprised about 10 percent of the total number of samples submitted for analysis. A field-blank sample is a volume of deionized water that is treated as an environmental sample in all aspects, including exposure to sampling equipment, sample containers, filtration apparatus, and chemical preservatives in the field, and to holding times and laboratory processing. A replicate environmental sample is a volume of sampled medium split into subsamples in such a manner that the physical and chemical characteristics of each subsample are considered to be essentially identical in composition. Results of chemical analyses of duplicate soil and drill-core samples are listed in tables 4 and 5, alongside the data for which they provide quality control. Similarly, results of chemical analyses of field blanks and replicate water analyses are included in tables 6, 10, and 11. Differences in replicate analyses of solid material may indicate the relative heterogeneity of the solid material and the difficulty of completely homogenizing and splitting heterogeneous solid samples.

Laboratory quality control of biological samples was assured through the PACF. The precision and accuracy of laboratory analyses were confirmed with procedural blanks, duplicate analyses, and reference-material analyses. In addition, a subset of submitted samples was "spiked" with a known concentration of each constituent, and the percent recovery was determined. For quality assurance, the percent recovery must be within 20 percent of the known concentration. Round-robin tests in which samples were split and analyzed by both USFWS and contract analytical laboratories also were part of the PACF quality-assurance review. All USFWS contaminant analyses received a quality-assurance review by the PACF.

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DATA

Table 1. Minimum reporting levels for constituents analyzed in water, soil, drill core, bottom sediment, and biota

[Abbreviations: µg/g, micrograms per gram of sample dry weight; µg/L, micrograms per liter; mg/L, milligrams per liter; ND, not determined; percent, parts per hundred; SMOW, Standard Mean Ocean Water. Symbol: --, constituent not analyzed in the indicated medium]

Constituent	Minimum reporting level[1]			
	Water	Soil, drill core, and bottom sediment, total	Soil and drill core, water extract, and batch leachate	Biota
	TRACE ELEMENTS			
Aluminum	--	--	2.0 µg/g	--
Antimony	--	--	.5 µg/g	--
Arsenic	1 µg/L	--	1.0 µg/g	--
Barium	--	--	.10 µg/g	--
Beryllium	--	--	.1 µg/g	--
Boron	10 µg/L	--	.50 µg/g	--
Cadmium	1 µg/L	--	.2 µg/g	--
Chromium	1-5 µg/L	--	.2 µg/g	--
Cobalt	--	--	.2 µg/g	--
Copper	1-10 µg/L	--	.1 µg/g	--
Iron	3-60 µg/L	--	1.0 µg/g	--
Lead	1-10 µg/L	--	.4 µg/g	--
Lithium	--	--	.20 µg/g	--
Manganese	1-10 µg/L	--	.2 µg/g	--
Molybdenum	1-100 µg/L	--	.2 µg/g	--
Nickel	1-10 µg/L	--	.2 µg/g	--
Selenium	1-2 µg/L	0.1 µg/g	.003 µg/g	0.5 µg/g
Selenium, adsorbed	--	.005 µg/g	--	--
Selenium, organic plus elemental	--	.010 µg/g	--	--
Selenium, oxides	--	.005 µg/g	--	--
Selenium, selenite	.5 µg/L	--	--	--
Selenium, selenite plus selenate	.5 µg/L	--	--	--
Silver	--	--	.2 µg/g	--
Strontium	10 µg/L	--	.02 µg/g	--
Titanium	--	--	1.0 µg/g	--
Vanadium	1-60 µg/L	--	.2 µg/g	--
Zinc	3-32 µg/L	--	.2 µg/g	--
	MAJOR IONS			
Alkalinity	1 mg/L	--	--	--
Bicarbonate	1 mg/L	--	--	--
Calcium	.02 mg/L	--	1 µg/g	--
Carbonate	0 mg/L	--	--	--
Chloride	.1 mg/L	--	.4 µg/g	--
Fluoride	.1 mg/L	--	.05 µg/g	--
Magnesium	.01 mg/L	--	.2 µg/g	--

Table 1. Minimum reporting levels for constituents analyzed in water, soil, drill core, bottom sediment, and biota (Continued)

Constituent	Minimum reporting level[1]						
	Water		Soil, drill core, and bottom sediment, total		Soil and drill core, water extract, and batch leachate		Biota
MAJOR IONS--Continued							
Phosphorus	--[2]		--		2.0	µg/g	--
Potassium	.1	mg/L	--		1	µg/g	--
Silica	--		--		.05	µg/g	--
Sodium	.2	mg/L	--		1	µg/g	--
Sulfur, total	--		0.05	percent	--		--
Sulfur, sulfide	--		.05	percent	--		--
Sulfur, sulfate	.1	mg/L	.05	percent	.5	µg/g	--
Sulfur, organic	--		.05	percent	--		--
NUTRIENTS							
Nitrogen, ammonia	.02	mg/L	--		--		--
Nitrogen, nitrite	.01	mg/L	--		--		--
Nitrogen, nitrite plus nitrate	.05	mg/L	--		--		--
Phosphorus, orthophosphate	.01	mg/L	--		--		--
ISOTOPE RATIOS							
Deuterium/hydrogen relative to SMOW	ND		--		--		--
Oxygen-18/oxygen-16 relative to SMOW	ND		--		--		--

[1]Minimum reporting levels for several elements vary as a result of method detection capabilities, sample dilution, and matrix interferences.

[2]See phosphorus, orthophosphate in Nutrients section.

Table 2. Soil, drill-core, soil-moisture, and ground-water sampling sites in the Freezeout Lake area, Montana

[Site number: Site numbers established for sites previously sampled during the 1990-92 detailed study have been reused in this 1995 study. Site numbers of W-58 or higher, L-2A, and L-41 or higher are new sites that were not sampled prior to 1995. Data type: B, batch-leach tests on soil and drill-core samples; D, soil and drill-core chemistry; Q, ground-water quality; S, soil-moisture quality; W, monthly water levels. Soil: Et, Ethridge clay loam; Kr, Kremlin clay loam (calcareous); Ri, Richey silty clay loam; Ro, Rothiemay clay loam. Symbol: --, no corresponding site number]

Site number for ground water (fig. 3)	Corresponding site number for soil, drill core, and soil moisture (fig. 3)	U.S. Geological Survey site-identification number[1]	Local number[2]	Data type collected in 1995	Soil[3]	Land use[4]
W-1A	L-22[5]	473823111591203	22N03W28AAAA03	Q, W	Ro	Flood-irrigated
W-1B	--	473823111591202	22N03W28AAAA02	W	Ro	Flood-irrigated
W-1C[5]	--	473823111591201	22N03W28AAAA01	W	Ro	Flood-irrigated
W-2A	L-23[5], L-2A[6,7]	473824111595003	22N03W28ABBB03	D, Q, S, W	Ro	Sprinkler-irrigated
W-2B	--	473824111595002	22N03W28ABBB02	W	Ro	Sprinkler-irrigated
W-2C	--	473824111595001	22N03W28ABBB01	W	Ro	Sprinkler-irrigated
W-3A	L-24[5]	473826112004504	22N03W29AABA04	W	Ri	Non-irrigated
W-3B	--	473826112004503	22N03W29AABA03	Q, W	Ri	Non-irrigated
W-3C	--	473826112004502	22N03W29AABA02	W	Ri	Non-irrigated
W-3D[5]	--	473826112004501	22N03W29AABA01	W	Ri	Non-irrigated
--	L-41	473735112015201	22N03W30DDDD01	B, D	Kr	Non-irrigated
--	L-42	474029112011701	22N03W08CADC01	B, D	Ri	Non-irrigated
W-58	L-58[7]	474100112010201	22N03W08ABBA01	D, Q, S, W	Et	Flood-irrigated
W-59	L-59[7]	473852112002001	22N03W21BCCD01	B, D, Q, S, W	Et	Sprinkler-irrigated
W-60	L-60[7]	473745112002701	22N03W28CBBB01	D, Q, S, W	Kr	Sprinkler-irrigated
W-61	L-61[7]	473732112015701	22N03W31AABB01	B, D, Q, S, W	Kr	Flood-irrigated

[1]Fifteen-digit site-identification number is a unique identifier that represents the approximate latitude and longitude location of the site (first 13 digits), plus the sequence number (last 2 digits). Sequence number refers to test well if ground-water site is present; if ground-water site is not present, number refers to soil-sampling site.

[2]Local number represents the township, range, section, and quadrants of the section, plus the sequence number. Sequence number refers to test well if ground-water site is present; if ground-water site is not present, number refers to suction lysimeter at soil-moisture site.

[3]Identified by R.G. Bandy, Resource Soil Scientist, Natural Resources Conservation Service, U.S. Department of Agriculture.

[4]Based on field observation.

[5]Drill-core or soil data reported in Lambing and others (1994).

[6]Local number for suction lysimeter at soil-moisture site is 22N03W28BAAA01.

[7]Soil-moisture sampling site.

Table 3. Lithologic logs of boreholes drilled in 1995 in the Freezeout Lake area, Montana

[Abbreviations: ft, feet below land surface; in., inches. Symbol: --, no test well installed at site]

Site number (fig. 3)	Lithology	Top of interval (ft)	Bottom of interval (ft)
L-2A	Sand, fine, clayey, silty	0	3
	Sand and gravel; sand very fine, calcitic; gravel primarily limestone and argillite	3	5
	Silt; contains fine sand and clay, few round argillite pebbles	5	10
	Shale, weathered, dense; contains alternating gray and rust-colored mottled laminae	10	20
	Shale, weathered	20	30
	Shale, gray, soft	30	35
	Shale, dark gray, massive; contains thin, interbedded varves of black mudstone and light gray, very fine-grained sandstone	35	80
L-41	Clay loam, calcareous throughout	0	1
	Clay loam, with distinct calcareous deposits	1	4.3
L-42	Silty clay loam, cambic, weak prismatic structure	0	1
	Silty clay loam, lime accumulation zone	1	2.5
	Loam	2.5	4.5
L-58	Clay loam, slightly calcareous, dry	0	.5
	Clay, argillic, blocky, dry	.5	1.1
	Clay loam; contains common fine threads and masses of white calcite, dry	1.1	4
	Silt, clayey, very fine sandy, damp	4	5
	Silt, dark brown, clayey, fine sandy, hard, dense, calcareous, damp	5	10
	Sand, dark brown to brown, fine, silty, clayey, wet	10	23
	Sand, yellowish brown, very fine to fine, silty, clayey	23	24
	Silt, light brown, very fine to fine sandy, clayey; contains sporadic gravel, black, rounded	24	33
	Silt, sandy, clayey	33	38
	Shale, very dark brown, very weathered, crumbly with oxidized iron streaks and gypsum crystals	38	48
L-59	Clay loam, dry	0	.3
	Clay, sandy, argillic, noncalcareous, dry	.3	.9
	Clay, brown, calcareous, dense, sticky, slightly damp	.9	4
	Clay, brown, silty; contains some sand, very fine	4	6
	Silt, brown, clayey; contains some sand, very fine, and some vugs of gypsum crystals	6	9
	Silt, brown, clayey, calcareous; contains some sand, very fine, and sporadic vugs of gypsum crystals	9	12
	Silt, brown, clayey, calcareous; contains some sand, very fine, and sparse gypsum crystals	12	14
	Sand, light brown, very fine, silty, clayey, wet	14	17.5
	Sand, yellowish brown, very fine to fine, and gravel, silty, clayey; gravel rounded, to 3/4-in. diameter	17.5	18
	Shale, dark gray, weathered; contains thin (to 1/4-in.) interbedded sandy, rust-colored varves	18	18.2
L-60	Calcareous clay loam, dark brown, dense, hard	0	.7
	Calcareous clay loam, brown, sandy, cambic, soft	.7	1.1
	Calcareous clay loam, sandy	1.1	3
	Sand, very fine; contains limestone and argillite gravel	3	5.3
	Silt, brown, clayey, sandy, hard, slightly damp; contains some vugs of gypsum crystals and sporadic fine gravel	5.3	8
	Shale, dark gray, weathered, damp; contains thin (to 1/4-in.) interbedded sandy, rust-colored laminae	8	15
	Shale, partly weathered, dry	15	16
L-61	Calcareous clay loam	0	.5
	Calcareous clay loam, cambic	.5	1.2
	Calcareous clay loam, brown, dry	1.2	3.5
	Clay loam, damp; contains gypsum crystals	3.5	4
	Silt, clayey, very fine sandy; contains rounded argillite gravel 1/2-in. to 2-in. diameter	4	4.5
	Silt, clayey, damp; contains some very fine sandy laminae	4.5	8
	Silt, clayey, sandy, wet; contains sporadic rounded gravel	8	11.2
	Shale, weathered, wet; contains gray and rust-colored laminae with plates of unweathered shale to 1/4-in. diameter	11.2	14.7
	Shale, weathered, slightly damp	14.7	15.4

Table 4. Results of batch-leach tests of soil and drill-core samples collected in 1995 in the Freezeout Lake area, Montana

[Geologic unit: Ql, Quaternary glacial-lake deposits. Sampling device: H, hand auger; S, split-spoon sampler; T, hand trowel. Abbreviations: ft, feet below land surface; µg/g, micrograms per gram of dry sample weight; µS/cm, microsiemens per centimeter at 25 degrees Celsius. Symbols: <, less than; --, no data]

Site number (fig. 3)	Date sampled	Top of sampled interval (ft)	Bottom of sampled interval (ft)	Geologic unit	Sampling device	Specific conductance (µS/cm)	Aluminum (µg/g)	Calcium (µg/g)	Iron (µg/g)	Magnesium (µg/g)	Phosphorus (µg/g)
L-41	02-27-95	0.4	1.0	Ql	T	--	<2.0	160	<1.0	30	<2.0
	02-27-95	1.7	2.1	Ql	H	1,790	<2.0	350	<1.0	420	<2.0
	02-27-95	3.5	4.3	Ql	H	2,260	<2.0	150	<1.0	290	<2.0
L-42	02-27-95	.3	1.1	Ql	T	220	<2.0	150	1.5	53	<2.0
	02-27-95	2.0	2.5	Ql	H	1,150	<2.0	240	<1.0	200	<2.0
	02-27-95	4.0	4.5	Ql	H	1,050	<2.0	110	<1.0	92	<2.0
L-59	02-27-95	.3	.9	Ql	H	190	<2.0	160	<1.0	33	<2.0
	03-08-95	3.0	4.0	Ql	S	500	13	40	11	39	<2.0
	03-08-95	6.0	7.4	Ql	S	1,650	<2.0	240	<1.0	200	<2.0
L-59[1]	03-08-95	6.0	7.4	Ql	S	2,160	<2.0	540	<1.0	330	<2.0
L-61	02-27-95	.5	1.2	Ql	T	200	<2.0	120	1.7	44	<2.0
	02-27-95	1.3	1.7	Ql	T	280	<2.0	120	1.0	55	<2.0
	02-27-95	3.5	4.0	Ql	H	2,770	<2.0	2,200	<1.0	360	<2.0

[1]Duplicate analysis of sample split in field.

Site number (fig. 3)	Top of sampled interval (ft)	Bottom of sampled interval (ft)	Potassium (µg/g)	Sodium (µg/g)	Sulfur, sulfate (µg/g)	Chloride (µg/g)	Fluoride (µg/g)	Antimony (µg/g)	Arsenic (µg/g)	Barium (µg/g)	Beryllium (µg/g)
L-41	0.4	1.0	35	13	22	8.7	1.2	<0.5	<1.0	0.36	<0.1
	1.7	2.1	35	1,100	4,700	120	3.7	<.5	<1.0	.17	<.1
	3.5	4.3	36	2,000	5,600	120	6.9	<.5	<1.0	<.10	<.1
L-42	.3	1.1	16	33	120	4.0	3.0	<.5	<1.0	.40	<.1
	2.0	2.5	16	780	2,800	42	4.6	<.5	<1.0	.15	<.1
	4.0	4.5	14	910	2,000	65	6.1	<.5	<1.0	.13	<.1
L-59	.3	.9	21	15	31	3.3	2.0	<.5	<1.0	.35	<.1
	3.0	4.0	13	530	430	63	23	<.5	<1.0	.20	<.1
	6.0	7.4	33	1,300	3,900	640	7.6	<.5	<1.0	.14	<.1
L-59[1]	6.0	7.4	41	1,400	5,000	670	7.8	<.5	<1.0	.11	<.1
L-61	.5	1.2	15	54	120	7.3	4.5	<.5	<1.0	.39	<.1
	1.3	1.7	11	99	360	16	3.9	<.5	<1.0	.39	<.1
	3.5	4.0	26	630	9,600	28	11	<.5	<1.0	.15	<.1

Table 4. Results of batch-leach tests of soil and drill-core samples collected in 1995 in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Top of sampled interval (ft)	Bottom of sampled interval (ft)	Boron (µg/g)	Cadmium (µg/g)	Chromium (µg/g)	Cobalt (µg/g)	Copper (µg/g)	Lead (µg/g)	Lithium (µg/g)	Manganese (µg/g)	Molybdenum (µg/g)
L-41	0.4	1.0	<0.50	<0.2	<0.2	<0.2	<0.1	<0.4	<0.20	<0.2	<0.2
	1.7	2.1	.69	<.2	<.2	<.2	<.1	<.4	.38	<.2	<.2
	3.5	4.3	3.9	<.2	<.2	<.2	<.1	<.4	.53	<.2	<.2
L-42	.3	1.1	.56	<.2	<.2	<.2	<.1	<.4	<.20	<.2	<.2
	2.0	2.5	2.2	<.2	<.2	<.2	<.1	<.4	.22	<.2	<.2
	4.0	4.5	1.6	<.2	<.2	<.2	<.1	<.4	<.20	<.2	<.2
L-59	.3	.9	<.50	<.2	<.2	<.2	<.1	<.4	<.20	<.2	<.2
	3.0	4.0	2.9	<.2	<.2	<.2	<.1	<.4	<.20	<.2	<.2
	6.0	7.4	2.0	<.2	<.2	<.2	<.1	<.4	<.20	<.2	<.2
L-59[1]	6.0	7.4	2.0	<.2	<.2	<.2	<.1	<.4	<.20	<.2	<.2
L-61	.5	1.2	.64	<.2	<.2	<.2	<.1	<.4	<.20	<.2	<.2
	1.3	1.7	.74	<.2	<.2	<.2	<.1	<.4	<.20	<.2	<.2
	3.5	4.0	1.8	<.2	<.2	<.2	<.1	<.4	.40	<.2	<.2

Site number (fig. 3)	Top of sampled interval (ft)	Bottom of sampled interval (ft)	Nickel (µg/g)	Silica (µg/g)	Silver (µg/g)	Strontium (µg/g)	Titanium (µg/g)	Vanadium (µg/g)	Zinc (µg/g)
L-41	0.4	1.0	<0.2	13	<0.2	0.42	<1.0	<0.2	<0.2
	1.7	2.1	<.2	7.8	<.2	4.2	<1.0	<.2	<.2
	3.5	4.3	<.2	10	<.2	3.1	<1.0	<.2	<.2
L-42	.3	1.1	<.2	14	<.2	1.4	<1.0	<.2	<.2
	2.0	2.5	<.2	9.2	<.2	4.5	<1.0	<.2	<.2
	4.0	4.5	<.2	9.6	<.2	2.1	<1.0	<.2	<.2
L-59	.3	.9	<.2	38	<.2	.58	<1.0	<.2	<.2
	3.0	4.0	<.2	34	<.2	.73	1.5	<.2	<.2
	6.0	7.4	<.2	15	<.2	4.4	<1.0	<.2	<.2
L-59[1]	6.0	7.4	<.2	16	<.2	7.9	<1.0	<.2	<.2
L-61	.5	1.2	<.2	17	<.2	.95	<1.0	<.2	<.2
	1.3	1.7	<.2	8.3	<.2	1.7	<1.0	<.2	<.2
	3.5	4.0	<.2	14	<.2	37	<1.0	<.2	<.2

Table 5. Concentrations of sulfur and selenium species in soil and drill-core samples collected in 1995 in the Freezeout Lake area, Montana

[Selenium species analyzed by YiQiang Zhang, Department of Geology, University of Montana; all other analyses by U.S. Geological Survey. Geologic unit: Ql, Quaternary glacial-lake deposits; Kc, weathered shale of the Cretaceous Colorado Group; G, gypsum crystals concentrated in vug in Quaternary glacial-lake deposits. Sampling device: H, hand auger; S, split-spoon sampler; T, hand trowel. Abbreviations: ft, feet below land surface; µg/g, micrograms per gram of dry sample weight; percent, percent of dry sample weight. Symbols: <, less than; --, no data]

Site number (fig. 3)	Date sampled	Top of sampled interval (ft)	Bottom of sampled interval (ft)	Geologic unit	Sampling device	Sulfur species in whole sample				Sulfur, sulfate, batch leachate (µg/g)
						Sulfur, total (percent)	Sulfur, sulfide (percent as S)	Sulfur, sulfate (percent as S)	Sulfur, organic (percent as S)	
L-2A	03-08-95	3.0	3.4	Ql	S	<0.05	<0.05	<0.05	<0.05	--
	03-08-95	7.0	7.8	Ql	S	<.05	<.05	<.05	<.05	--
	03-08-95	10.0	11.2	Kc	S	<.05	<.05	<.05	<.05	--
	03-08-95	13.0	13.5	Kc	S	<.05	<.05	<.05	<.05	--
	03-08-95	19.0	19.7	Kc	S	<.05	<.05	<.05	<.05	--
	03-08-95	20.0	21.2	Kc	S	--	--	--	--	--
L-41	02-27-95	.4	1.0	Ql	T	--	--	--	--	22
L-41[3]						--	--	--	--	--
L-41	02-27-95	1.7	2.1	Ql	H	.16	<.05	.16	<.05	4,700
L-41[3]						--	--	--	--	--
L-41	02-27-95	3.5	4.3	Ql	H	.17	<.05	.17	<.05	5,600
L-41[3]						--	--	--	--	--
L-42	02-27-95	.3	1.1	Ql	T	--	--	--	--	120
	02-27-95	2.0	2.5	Ql	H	.08	<.05	.08	<.05	2,800
	02-27-95	4.0	4.5	Ql	H	<.05	<.05	<.05	<.05	2,000
L-58	03-06-95	3.0	4.0	Ql	S	<.05	<.05	<.05	<.05	--
	03-06-95	8.0	9.0	Ql	S	<.05	<.05	<.05	<.05	--
	03-06-95	14.0	15.0	Ql	S	<.05	<.05	<.05	<.05	--
	03-06-95	23.0	23.9	Ql	S	<.05	<.05	<.05	<.05	--
L-59	02-27-95	.3	.9	Ql	H	<.05	<.05	<.05	<.05	31
	03-08-95	3.0	4.0	Ql	S	<.05	<.05	<.05	<.05	430
	03-08-95	6.0	7.4	Ql	S	.10	<.05	.10	<.05	3,900
L-59[4]						.14	<.05	.14	<.05	5,000
L-59	03-08-95	12.0	13.4	Ql	S	<.05	<.05	<.05	<.05	--
	03-08-95	15.0	17.5	Ql	S	<.05	<.05	<.05	<.05	--
L-60	03-07-95	3.0	3.6	Ql	S	<.05	<.05	<.05	<.05	--
	03-07-95	5.5	6.5	G	S	1.08	<.05	1.08	<.05	--
	03-07-95	8.0	8.9	Kc	S	1.39	<.05	1.39	<.05	--
L-61	02-27-95	.5	1.2	Ql	T	<.05	<.05	<.05	<.05	120
L-61[3]						--	--	--	--	--
L-61	02-27-95	1.3	1.7	Ql	T	<.05	<.05	<.05	<.05	360
L-61[3]						--	--	--	--	--
L-61	02-27-95	3.5	4.0	Ql	H	.62	<.05	.62	<.05	9,600
L-61[3]						--	--	--	--	--
L-61	03-07-95	6.0	7.3	Ql	S	.05	<.05	.05	<.05	--
L-61[3]						--	--	--	--	--
L-61	03-07-95	11.0	11.2	Ql	S	.14	<.05	.14	<.05	--
L-61[3]						--	--	--	--	--
L-61	03-07-95	11.2	12.2	Kc	S	.13	<.05	.13	<.05	--
L-61[3]						--	--	--	--	--
L-61	03-07-95	14.7	15.4	Kc	S	<.05	<.05	<.05	<.05	--
L-61[3]						--	--	--	--	--

[1]Value in parentheses was obtained from a separate aliquot which was also analyzed for water-extractable selenium.
[2]Constituent concentrations that are less than the minimum reporting level are not included in the sum.
[3]Duplicate analysis of sample split in laboratory.
[4]Duplicate analysis of sample split in field.

Selenium[1], total (µg/g)	Selenium, water extract (µg/g)	Selenium, batch leachate (µg/g)	Selenium species in whole sample: Soluble selenium (µg/g)	Adsorbed selenium (µg/g)	Organic plus elemental selenium (µg/g)	Selenium associated with oxides (µg/g)	Sum of four selenium species[2] (µg/g)	Top of sampled interval (ft)	Bottom of sampled interval (ft)	Site number (fig. 3)
0.9 (0.2)	0.005	--	0.007	0.015	0.126	0.427	0.575	3.0	3.4	L-2A
1.5 (1.4)	.028	--	.011	<.005	.094	.485	.590	7.0	7.8	
1.7 (1.9)	.027	--	.017	.007	.103	.918	1.045	10.0	11.2	
2.0 (2.3)	.037	--	.021	.011	.156	1.036	1.224	13.0	13.5	
1.3 (1.6)	.007	--	<.005	.006	.114	1.198	1.318	19.0	19.7	
1.8	--	--	--	--	--	--	--	20.0	21.2	
.5	--	.005	<.005	.023	.198	.136	.357	.4	1.0	L-41
--	--	--	<.005	.021	.235	.061	.317			L-41[3]
.3	--	.21	<.005	.017	.098	.045	.160	1.7	2.1	L-41
--	--	--	<.005	.017	.108	.048	.173			L-41[3]
.3	--	.005	<.005	.015	.074	.059	.148	3.5	4.3	L-41
--	--	--	<.005	.015	.130	.054	.199			L-41[3]
.4	--	.005	<.005	.011	.134	.045	.190	.3	1.1	L-42
.3	--	.005	<.005	.015	.100	.057	.172	2.0	2.5	
.3	--	.02	.013	.014	.088	.054	.169	4.0	4.5	
.2 (.2)	<.003	--	--	--	--	--	--	3.0	4.0	L-58
.3 (.3)	.008	--	--	--	--	--	--	8.0	9.0	
.3 (.3)	.022	--	--	--	--	--	--	14.0	15.0	
.2 (.1)	.006	--	--	--	--	--	--	23.0	23.9	
.6	--	.01	<.005	.022	.302	.086	.410	.3	.9	L-59
2.4	--	.08	.048	.294	.662	.029	1.033	3.0	4.0	
2.5 (2.6)	2.6	2.3	1.64	.248	.248	.049	2.180	6.0	7.4	
2.7	--	2.6	1.73	.233	.255	.048	2.268			L-59[4]
.8 (.8)	.13	--	.080	.149	.341	.046	.616	12.0	13.4	L-59
.5 (.5)	.13	--	.038	.029	.116	.055	.238	15.0	17.5	
.5 (.5)	.018	--	--	--	--	--	--	3.0	3.6	L-60
1.8 (2.0)	.017	--	.014	.006	.101	.213	.334	5.5	6.5	
1.5 (1.6)	.023	--	--	--	--	--	--	8.0	8.9	
.4	--	.005	<.005	.008	.157	.087	.252	.5	1.2	L-61
--	--	--	<.005	.009	.172	.093	.274			L-61[3]
.5	--	.005	<.005	.018	.140	.155	.313	1.3	1.7	L-61
--	--	--	<.005	.019	.138	.151	.308			L-61[3]
.5	--	.01	<.005	.024	.125	.095	.244	3.5	4.0	L-61
--	--	--	<.005	.021	.156	.045	.222			L-61[3]
.2 (.1)	<.003	--	<.005	.005	.037	.103	.145	6.0	7.3	L-61
--	--	--	<.005	.006	.048	.056	.110			L-61[3]
.4	--	--	<.005	<.005	.064	.192	.256	11.0	11.2	L-61
--	--	--	<.005	<.005	.056	.169	.225			L-61[3]
1.7 (1.4)	<.003	--	<.005	.007	.771	.503	1.281	11.2	12.2	L-61
-- (1.5)	.004	--	<.005	.007	.493	.568	1.068			L-61[3]
2.6 (3.3)	.035	--	<.005	.022	2.615	.610	3.247	14.7	15.4	L-61
--	--	--	<.005	.009	.931	.436	1.376			L-61[3]

Table 6. Results of field measurements and chemical analyses of soil-moisture and ground-water samples collected in 1995 in the Freezeout Lake area, Montana

[Site number: letter preceding number indicates medium type (L, soil moisture from suction lysimeter; W, ground water from test well). Water levels were measured in shallowest well at each site within 2 days of sampling, except as indicated. Constituent concentrations are dissolved. Analyses by U.S. Geological Survey except for selenite (Se^{+4}) and selenite plus selenate (Se^{+6}), which were analyzed by the Montana Bureau of Mines and Geology. Abbreviations: °C, degrees Celsius; ft, feet below land surface; IT, incremental titration; lab, laboratory; µg/L micrograms per liter; µS/cm, microsiemens per centimeter at 25 °C; mg/L milligrams per liter; per mil, parts per thousand. Symbols: --, no data or not applicable; <, less than]

Site number (fig. 3)	Date sampled	Top of sampled interval (ft)	Bottom of sampled interval (ft)	Water level (ft)	Specific conductance, field (µS/cm)	Specific conductance, lab (µS/cm)	pH, field (standard units)	pH, lab (standard units)	Temperature, water (°C)	Oxygen (mg/L)
W-1A	07-26-95	7.0	17	2.41	561	582	7.9	7.8	8.5	6.0
L-2A	06-23-95	2.5	4.4	3.49	--	16,200	--	7.6	--	--
	08-18-95			4.30	--	13,300	--	7.6	--	--
W-2A	07-26-95	9.0	16	1.41	5,170	5,090	7.6	7.6	7.0	3.3
W-3B	07-27-95	18	23	12.51	13,800	14,100	7.6	7.5	9.0	1.6
L-58	06-23-95	3.4	5.0	3.25	--	1,140	--	7.6	--	--
	08-18-95			4.82	--	1,350	--	7.6	--	--
W-58	03-21-95	12	22	10.55	1,330	1,310	7.7	7.5	7.5	--
	07-26-95			6.62	1,270	1,290	7.6	7.6	7.5	1.4
	07-26-95[1]			--	--	--	--	--	--	--
L-59	06-23-95	3.2	5.1	13.71	--	3,640	--	8.0	--	--
	08-18-95			--	--	4,910	--	7.8	--	--
W-59	03-21-95	6.9	16.9	13.54	1,520	1,560	7.9	7.6	7.5	--
	07-26-95			11.66	1,720	1,800	7.6	7.6	7.0	4.2
L-60	06-20-95	1.9	4.1	[2]3.71	863	843	7.6	8.1	--	--
	06-20-95[1]			--	--	814	--	8.2	--	--
	08-18-95			5.94	--	1,120	--	7.9	--	--
W-60	03-21-95	2.9	7.9	6.94	5,460	--	--	--	7.5	--
	07-26-95			4.16	--	3,470	7.5	7.5	11.0	5.4
L-61	06-23-95	1.4	3.7	4.20	--	16,200	--	7.9	--	--
	08-18-95			6.20	--	19,800	--	7.8	--	--
	08-18-95[1]			--	--	20,000	--	8.0	--	--
W-61	03-21-95	4.6	14.9	5.19	16,000	16,000	7.7	7.4	7.5	--
	03-21-95[1]			--	--	16,100	--	7.4	--	--
	07-26-95			4.98	16,200	16,000	7.4	7.4	7.0	6.0
Blank[3]	07-27-95	--	--	--	2	7	--	8.0	--	--

[1]Replicate sample for quality control.
[2]Water level measured 06-16-95.
[3]Field blank consisting of deionized water that was exposed to the same equipment and procedures as routine samples.

Site number (fig. 3)	Date sampled	Hardness (mg/L as $CaCO_3$)	Calcium (mg/L as Ca)	Magnesium (mg/L as Mg)	Sodium (mg/L as Na)	Potassium (mg/L as K)	Bicarbonate, field (IT) (mg/L as HCO_3)	Carbonate, field (IT) (mg/L as CO_3)	Alkalinity, field (IT) (mg/L as $CaCO_3$)	Alkalinity, lab (mg/L as $CaCO_3$)
W-1A	07-26-95	290	31	51	12	3.7	336	0	272	289
L-2A	06-23-95	11,000	510	2,300	2,100	17	--	--	--	399
	08-18-95	8,400	570	1,700	1,700	17	--	--	--	500
W-2A	07-26-95	2,400	290	400	560	5.5	485	0	393	408
W-3B	07-27-95	4,800	400	920	2,300	15	1,080	0	867	839
L-58	06-23-95	630	110	85	28	4.3	--	--	--	488
	08-18-95	740	130	100	28	4.3	--	--	--	578
W-58	03-21-95	330	59	45	180	2.2	703	0	570	540
	07-26-95	320	57	43	180	2.0	696	0	867	565
	07-26-95[1]	--	--	--	--	--	--	--	--	--
L-59	06-23-95	980	160	140	620	4.9	--	--	--	634
	08-18-95	1,400	230	210	820	5.2	--	--	--	890
W-59	03-21-95	300	46	44	260	1.4	746	0	609	588
	07-26-95	360	56	52	280	1.4	730	0	598	598
L-60	06-20-95	500	51	90	8.5	6.2	--	--	--	468
	06-20-95[1]	510	52	91	8.5	6.4	--	--	--	468
	08-18-95	610	85	97	12	10	--	--	--	577
W-60	03-21-95	2,200	430	280	610	10	--	--	--	--
	07-26-95	1,200	180	180	300	7.9	571	0	459	306
L-61	06-23-95	4,600	410	870	3,700	17	--	--	--	489
	08-18-95	6,100	450	1,200	5,000	21	--	--	--	811
	08-18-95[1]	6,100	450	1,200	5,000	21	--	--	--	733
W-61	03-21-95	5,900	370	1,200	3,200	12	618	0	503	521
	03-21-95[1]	5,900	380	1,200	3,200	13	--	--	--	521
	07-26-95	5,300	310	1,100	3,100	14	636	0	512	526
Blank[3]	07-27-95	--	<.02	.02	<.2	.2	--	--	--	2.3

Table 6. Results of field measurements and chemical analyses of soil-moisture and ground-water samples collected in 1995 in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Date sampled	Sulfate (mg/L as SO_4)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Dissolved solids, calculated (mg/L)	Nitrite (mg/L as N)	Nitrite plus nitrate (mg/L as N)	Ammonia (mg/L as N)	Phosphorus, ortho (mg/L as P)
W-1A	07-26-95	35	0.8	0.9	313	<0.01	0.35	0.02	<0.01
L-2A	06-23-95	14,000	410	2.0	19,700	<.01	<.05	.28	.37
	08-18-95	11,000	330	1.7	15,700	<.01	<.05	.56	.41
W-2A	07-26-95	2,900	89	2.7	4,540	<.01	7.5	.05	<.01
W-3B	07-27-95	5,900	2,000	1.2	10,700	<.01	.07	.13	<.01
L-58	06-23-95	150	22	.4	758	<.01	.06	.02	.06
	08-18-95	210	15	.4	899	<.01	.14	.03	.04
W-58	03-21-95	130	6.9	.8	796	.02	4.0	.03	<.01
	07-26-95	120	7.0	.8	784	.02	5.4	<.02	<.01
	07-26-95[1]	--	--	--	--	.02	5.5	<.02	<.01
L-59	06-23-95	1,500	18	.6	2,900	<.01	1.2	.03	.25
	08-18-95	2,300	7.8	.7	4,180	<.01	.60	.13	.06
W-59	03-21-95	260	7.5	.9	996	.01	.23	.03	<.01
	07-26-95	370	13	.8	1,140	<.01	.10	<.02	<.01
L-60	06-20-95	38	1.8	.5	541	<.01	2.9	.05	.17
	06-20-95[1]	38	1.8	.5	543	.01	2.8	.05	.17
	08-18-95	58	4.6	.5	707	<.01	6.9	.05	.37
W-60	03-21-95	--	--	--	--	--	--	--	--
	07-26-95	1,700	21	1.3	2,720	<.01	8.1	.02	<.01
L-61	06-23-95	11,000	340	1.1	16,800	.36	8.2	1.5	.64
	08-18-95	15,000	420	.9	22,700	.11	6.0	1.7	.98
	08-18-95[1]	15,000	430	.9	22,700	.11	6.1	1.7	.97
W-61	03-21-95	11,000	260	.4	16,400	.01	3.0	.04	<.01
	03-21-95[1]	11,000	270	.4	16,400	.01	3.0	.05	<.01
	07-26-95	11,000	270	.5	14,100	<.01	3.0	.05	<.01
Blank[3]	07-27-95	.2	<.1	<.1	--	--	--	--	--

Site number (fig. 3)	Date sampled	Iron (µg/L as Fe)	Manganese (µg/L as Mn)	Selenium (µg/L as Se)	Selenite (µg/L as Se)	Selenite plus selenate (µg/L as Se)	Strontium (µg/L as Sr)	Deuterium/ hydrogen stable-isotope ratio (per mil)	Oxygen-18/ oxygen-16 stable-isotope ratio (per mil)
W-1A	07-26-95	<3	<1	3	--	--	610	--	--
L-2A	06-23-95	700	1,500	590	--	--	15,000	--	--
	08-18-95	<30	2,300	50	--	--	12,000	--	--
W-2A	07-26-95	<15	<5	150	--	--	4,900	--	--
W-3B	07-27-95	<10	140	2	--	--	7,200	--	--
L-58	06-23-95	<3	44	20	--	--	1,400	--	--
	08-18-95	<3	14	16	--	--	1,700	--	--
W-58	03-21-95	<3	41	2	--	--	930	--	--
	07-26-95	<3	29	<1	<0.5	0.9	930	--	--
	07-26-95[1]	--	--	--	--	--	--	--	--
L-59	06-23-95	26	15	1,100	--	--	2,500	--	--
	08-18-95	<3	74	710	--	--	4,100	--	--
W-59	03-21-95	5	57	36	--	--	720	--	--
	07-26-95	<3	25	40	.8	46.3	870	-135.9	-17.80
L-60	06-20-95	10	200	5	--	--	610	--	--
	06-20-95[1]	8	200	9	--	--	600	--	--
	08-18-95	7	68	6	--	--	730	--	--
W-60	03-21-95	<9	7	39	--	--	5,500	--	--
	07-26-95	<9	<3	22	1.0	23.7	2,700	-124.2	-15.93
L-61	06-23-95	35	1,300	8	--	--	8,900	--	--
	08-18-95	<60	1,300	9	--	--	10,000	--	--
	08-18-95[1]	<60	1,300	7	--	--	10,000	--	--
W-61	03-21-95	<10	40	8	--	--	8,000	--	--
	03-21-95[1]	10	40	7	--	--	7,700	--	--
	07-26-95	<10	<10	7	<.5	8.1	8,700	-138.1	-17.62
Blank[3]	07-27-95	<3	<1	<1	--	--	<10	--	--

Table 7. Construction records of test wells in the Freezeout Lake area, Montana

[All well casings are 2-in. diameter. Drilling method: A, hollow-stem auger; R, hydraulic rotary. Abbreviations: in., inches; ft, feet below land surface]

Site number (fig. 3)	Local number	Date well constructed	Depth of hole (feet)	Top of open screen interval (ft)	Bottom of open screen interval (ft)	Top of sand pack (ft)	Bottom of sand pack (ft)	Width of screened openings (in.)	Drilling method
W-1A	22N03W28AAAA03	10-19-91	17	7	17	5	17	0.014	R
W-1B	22N03W28AAAA02	10-19-91	38	27	37	23	37.5	.014	R
W-1C	22N03W28AAAA01	10-19-91	81	66	81	59	81	.014	R
W-2A	22N03W28ABBB03	10-20-91	16	9	16	7	16	.014	R
W-2B	22N03W28ABBB02	10-20-91	37	27	37	24	37	.014	R
W-2C	22N03W28ABBB01	10-20-91	80	67	80	63	80	.014	R
W-3A	22N03W29AABA04	10-01-91	14	9	14	6.5	14	.014	R
W-3B	22N03W29AABA03	10-01-91	23	18	23	16.5	23	.014	R
W-3C	22N03W29AABA02	10-01-91	45	40	45	37.5	45	.014	R
W-3D	22N03W29AABA01	09-30-91	75	60	75	57.5	75	.014	R
W-58	22N03W08ABBA01	03-06-95	25	12	22	12	25	.012	A
W-59	22N03W21BCCD01	03-08-95	17	6.9	16.9	6	17	.012	A
W-60	22N03W28CBBB01	03-07-95	8	2.9	7.9	2.5	8	.012	A
W-61	22N03W31AABB01	03-07-95	15.4	4.6	14.9	4	15.4	.012	A

Table 8. Physical data and 1994-95 water levels for test wells in the Freezeout Lake area, Montana

[Principal aquifer: Ql, Quaternary glacial-lake deposits; Kc, Cretaceous Colorado Group. Irrigation season defined as June 3 to Sept. 22, 1995, the period during which irrigation water was delivered from Greenfields Main Canal to land in the Freezout Lake Wildlife Management Area drainage (Scott Boelman, Greenfields Irrigation Division Manager, written commun., 1996)]

Site number (fig. 3)	Local number[1]	Principal aquifer	Altitude of land surface (feet above sea level)	Depth of well (feet below land surface)	Non-irrigation season			Irrigation season		
					Date of water level measurement	Water level (feet below land surface)	Altitude of water level (feet above sea level)	Date of water level measurement	Water level (feet below land surface)	Altitude of water level (feet above sea level)
W-1A	22N03W28AAAA03	Ql	3,881.58	17	09-19-94	5.91	3,875.67	06-16-95	3.91	3,877.67
					10-27-94	6.98	3,874.60	07-25-95	2.41	3,879.17
					12-14-94	7.58	3,874.00	09-13-95	3.62	3,877.96
					01-27-95	7.99	3,873.59			
					02-22-95	8.27	3,873.31			
					03-15-95	8.50	3,873.08			
					05-09-95	9.12	3,872.46			
					10-24-95	4.43	3,877.15			
					11-21-95	4.95	3,876.63			
W-1B	22N03W28AAAA02	Kc	3,881.43	37	09-19-94	1.38	3,880.05	06-16-95	7.93	3,873.50
					10-27-94	2.41	3,879.02	07-26-95	4.14	3,877.29
					12-14-94	4.48	3,876.95			
					01-27-95	6.27	3,875.16			
					02-22-95	7.27	3,874.16			
					03-15-95	7.93	3,873.50			
					05-09-95	9.29	3,872.14			
W-1C	22N03W28AAAA01	Kc	3,881.44	81	09-19-94	15.18	3,866.26	06-16-95	16.51	3,864.93
					10-27-94	15.09	3,866.35	07-26-95	15.98	3,865.46
					12-14-94	15.45	3,865.99			
					01-27-95	15.88	3,865.56			
					02-22-95	16.23	3,865.21			
					03-15-95	16.45	3,864.99			
					05-09-95	16.82	3,864.62			
W-2A	22N03W28ABBB03	Ql	3,813.19	16	09-19-94	5.86	3,807.33	06-13-95	1.72	3,811.47
					10-27-94	6.46	3,806.73	06-16-95	2.35	3,810.84
					12-14-94	6.86	3,806.33	06-23-95	3.49	3,809.70
					01-27-95	7.17	3,806.02	07-25-95	1.41	3,811.78
					02-22-95	7.20	3,805.99	08-09-95	3.41	3,809.78
					03-15-95	7.48	3,805.71	08-18-95	4.30	3,808.89
					05-09-95	6.65	3,806.54	09-13-95	4.56	3,808.63
					05-23-95	5.01	3,808.18			
					10-24-95	5.30	3,807.89			
					11-21-95	5.68	3,807.51			
W-2B	22N03W28ABBB02	Kc	3,813.03	37	09-19-94	3.11	3,809.92	06-13-95	4.00	3,809.03
					10-27-94	3.24	3,809.79	06-16-95	3.84	3,809.19
					12-14-94	3.71	3,809.32	06-23-95	4.02	3,809.01
					01-27-95	4.16	3,808.87	07-25-95	3.06	3,809.97
					02-22-95	4.47	3,808.56	08-09-95	2.99	3,810.04
					03-08-95	4.47	3,808.56	09-13-95	3.03	3,810.00
					03-15-95	4.65	3,808.38			
					05-09-95	4.96	3,808.07			
					05-23-95	4.73	3,808.30			
					10-24-95	3.08	3,809.95			
					11-21-95	3.27	3,809.76			

Table 8. Physical data and 1994-95 water levels for test wells in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Local number[1]	Principal aquifer	Altitude of land surface (feet above sea level)	Depth of well (feet below land surface)	Non-irrigation season			Irrigation season		
					Date of water level measurement	Water level (feet below land surface)	Altitude of water level (feet above sea level)	Date of water level measurement	Water level (feet below land surface)	Altitude of water level (feet above sea level)
W-2C	22N03W28ABBB01	Kc	3,813.14	80	09-19-94	4.69	3,808.45	06-13-95	5.15	3,807.99
					10-27-94	4.78	3,808.36	06-16-95	5.10	3,808.04
					12-14-94	4.90	3,808.24	06-23-95	5.21	3,807.93
					01-27-95	4.96	3,808.18	07-25-95	4.91	3,808.23
					02-22-95	5.14	3,808.00	08-09-95	4.94	3,808.20
					03-08-95	5.17	3,807.97	09-13-95	4.89	3,808.25
					03-15-95	5.22	3,807.92			
					05-09-95	5.21	3,807.93			
					05-23-95	5.31	3,807.83			
					10-24-95	4.86	3,808.28			
					11-21-95	4.89	3,808.25			
W-3A	22N03W29AABA04	Ql	3,778.57	14	09-19-94	12.78	3,765.79	06-16-95	12.85	3,765.72
					10-27-94	12.47	3,766.10	07-25-95	12.90	3,765.67
					12-14-94	12.66	3,765.91	08-09-95	12.43	3,766.14
					01-27-95	12.83	3,765.74	09-13-95	12.95	3,765.62
					02-22-95	12.91	3,765.66			
					03-15-95	12.87	3,765.70			
					05-09-95	12.90	3,765.67			
					10-24-95	12.88	3,765.69			
					11-21-95	12.99	3,765.58			
W-3B	22N03W29AABA03	Kc	3,778.46	23	09-19-94	12.45	3,766.01	06-16-95	12.46	3,766.00
					10-27-94	11.85	3,766.61	07-25-95	12.51	3,765.95
					12-14-94	12.21	3,766.25	08-09-95	12.86	3,765.60
					01-27-95	12.33	3,766.13	09-13-95	12.62	3,765.84
					02-22-95	12.53	3,765.93			
					03-15-95	12.53	3,765.93			
					05-09-95	12.69	3,765.77			
					10-24-95	12.40	3,766.06			
					11-21-95	12.53	3,765.93			
W-3C	22N03W29AABA02	Kc	3,778.50	45	09-19-94	10.33	3,768.17	06-16-95	10.29	3,768.21
					10-27-94	10.12	3,768.38	07-25-95	10.44	3,768.06
					12-14-94	10.21	3,768.29	08-09-95	10.54	3,767.96
					01-27-95	10.20	3,768.30	09-13-95	10.47	3,768.03
					02-22-95	10.28	3,768.22			
					03-15-95	10.31	3,768.19			
					05-09-95	10.22	3,768.28			
					10-24-95	10.53	3,767.97			
					11-21-95	10.52	3,767.98			
W-3D	22N03W29AABA01	Kc	3,778.60	75	09-19-94	6.89	3,771.71	06-16-95	6.61	3,771.99
					10-27-94	6.32	3,772.28	07-25-95	6.84	3,771.76
					12-14-94	6.83	3,771.77	08-09-95	6.96	3,771.64
					01-27-95	6.85	3,771.75	09-13-95	7.83	3,770.77
					02-22-95	6.89	3,771.71			
					03-15-95	6.89	3,771.71			
					05-09-95	6.66	3,771.94			
					10-24-95	6.97	3,771.63			
					11-21-95	6.97	3,771.63			

Table 8. Physical data and 1994-95 water levels for test wells in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Local number[1]	Principal aquifer	Altitude of land surface (feet above sea level)	Depth of well (feet below land surface)	Non-irrigation season			Irrigation season		
					Date of water level measurement	Water level (feet below land surface)	Altitude of water level (feet above sea level)	Date of water level measurement	Water level (feet below land surface)	Altitude of water level (feet above sea level)
W-58	22N03W08ABBA01	Ql	3,784	22	03-14-95	10.60	3,773.40	06-16-95	9.74	3,774.26
					03-20-95	10.55	3,773.45	06-23-95	3.25	3,780.75
					05-09-95	9.92	3,774.08	07-25-95	6.62	3,777.38
					05-23-95	9.44	3,774.56	08-09-95	1.46	3,782.54
					10-24-95	8.47	3,775.53	08-17-95	4.82	3,779.18
					11-21-95	8.97	3,775.03	09-13-95	7.56	3,776.44
W-59	22N03W21BCCD01	Ql	3,790	16.9	03-14-95	13.73	3,776.27	06-16-95	13.52	3,776.48
					03-21-95	13.54	3,776.46	06-23-95	13.71	3,776.29
					05-09-95	13.89	3,776.11	07-25-95	11.66	3,778.34
					05-23-95	13.84	3,776.16	09-13-95	11.86	3,778.14
					10-24-95	11.96	3,778.04			
					11-21-95	12.33	3,777.67			
W-60	22N03W28CBBB01	Ql	3,780	7.9	03-14-95	7.02	3,772.98	06-16-95	3.71	3,776.29
					03-21-95	6.94	3,773.06	06-23-95	2.45	3,777.55
					05-09-95	5.06	3,774.94	07-25-95	4.16	3,775.84
					05-23-95	3.54	3,776.46	08-09-95	5.44	3,774.56
					10-24-95	6.50	3,773.50	08-18-95	5.94	3,774.06
					11-21-95	6.59	3,773.41	09-13-95	6.39	3,773.61
W-61	22N03W31AABB01	Ql	3,787	14.6	03-14-95	5.05	3,781.95	06-16-95	3.77	3,783.23
					03-21-95	5.19	3,781.81	06-23-95	4.20	3,782.80
					05-09-95	4.71	3,782.29	07-25-95	4.98	3,782.02
					05-23-95	3.35	3,783.65	08-09-95	6.38	3,780.62
					10-24-95	5.24	3,781.76	08-18-95	6.20	3,780.80
					11-21-95	4.98	3,782.02	09-13-95	5.15	3,781.85

[1]Local number represents the township, range, section, and quadrants of the section, plus the sequence number.

Table 9. Surface-water, bottom-sediment, and biological sampling sites in the Freezeout Lake area, Montana

[Site number: Sites numbers established for sites previously sampled during the 1990-92 detailed study have been reused in this 1995 study. Site numbers of S-50 or higher and B-31 or higher are new sites that were not sampled prior to 1995. Site type: DR, irrigation drain; LK, lake; ST1, natural stream that receives irrigation drainage; ST2, stream or canal that receives no irrigation drainage (reference site). Surface-water data type: WC, surface water analyzed for full chemistry (major ions, nutrients, and trace elements); WS, surface water analyzed for selenium. Bottom-sediment data type: BC, bottom-sediment core for which discrete increments, segregated by visually determined differences in color and texture, were analyzed for selenium; BS, surficial bottom sediment analyzed for selenium. Biota data type: BE, water-bird egg; BL, water-bird liver; F, fish; I, aquatic invertebrate; P, aquatic plant. Abbreviation: WMA, Wildlife Management Area. Symbol: --, no data]

Site number for water and sediment (fig. 3)	Corresponding site number for biota (fig. 3)	U.S. Geological Survey site-identification number[1]	Site name	Site type	Data type collected in 1995		
					Surface water	Bottom sediment	Biota
			GREENFIELDS IRRIGATION DIVISION				
S-1[2,3]	--	473601111582201	Greenfields Main Canal 0.8 mi south of Fairfield	ST2	WC	--	--
S-3[2]	B-1[2]	473708112005001	Lower Wilke Coulee near Fairfield	ST1	WS	--	F, I
S-6[2]	B-31	473747112002701	Drain at old Highway 89 (south) near Fairfield	DR	WC	--	F, I
S-7[2]	--	473833112002701	Drain at old Highway 89 (middle) near Fairfield	DR	WS	BS	--
S-8[2]	B-3[2]	473918112002801	Drain at old Highway 89 (north) near Fairfield	DR	WC	BS	F, I
S-11[2]	B-4[2]	474045112012101	Drain to Pond 5 at Highway 89 near Fairfield	DR	WC	BS	F, I
S-50	--	474026112005201	Drain below developed spring at Highway 89 near Fairfield	DR	WS	--	--
S-51	B-32	473753112012201	Drain southeast of Freezeout Lake near Fairfield	DR	WC	BS	F, I
S-52	B-33	473734112020301	Drain southwest of Freezeout Lake near Fairfield	DR	WC	--	F, I
			FREEZOUT LAKE WMA				
S-53	B-34	473744112020701	Freezeout Lake near Fairfield	LK	WS	BS	F, I, P
S-54	--	473752112020701	Freezeout Lake near Fairfield	LK	WS	BC	--
S-55	B-35	473759112013101	Freezeout Lake near Fairfield	LK	WS	BS	F, I, P
--	B-36	473819112010201	Freezeout Lake near Fairfield	LK	--	--	BE
S-56	--	473809112012901	Freezeout Lake near Fairfield	LK	WS	BC	--
S-57	--	473809112014801	Freezeout Lake near Fairfield	LK	--	BS	--
S-58	--	473809112021101	Freezeout Lake near Fairfield	LK	--	BS	--
S-59	--	473824112021101	Freezeout Lake near Fairfield	LK	--	BS	--
S-39[2]	--	473825112013001	Freezeout Lake near Fairfield	LK	WC	BC	--
S-60	--	473824112012501	Freezeout Lake near Fairfield	LK	--	BS	--
S-61	--	473827112010801	Freezeout Lake near Fairfield	LK	WS	BS	--
S-62	B-37	473832112005901	Freezeout Lake near Fairfield	LK	WS	BC	BL, F, I, P
--	B-38	473835112030001	Freezeout Lake near Fairfield	LK	--	--	BL, I, P
S-63	--	473840112010801	Freezeout Lake near Fairfield	LK	WS	BS	--
S-64	--	473840112012501	Freezeout Lake near Fairfield	LK	--	BS	--
S-65	--	473840112014801	Freezeout Lake near Fairfield	LK	--	BS	--
S-66	--	473855112014301	Freezeout Lake near Fairfield	LK	--	BS	--
S-67	--	473855112012501	Freezeout Lake near Fairfield	LK	--	BS	--
S-68	--	473855112010801	Freezeout Lake near Fairfield	LK	WS	BS	--
S-69	--	473904112010401	Freezeout Lake near Fairfield	LK	WS	BS	--

Table 9. Surface-water, bottom-sediment, and biological sampling sites in the Freezeout Lake area, Montana (Continued)

Site number for water and sediment (fig. 3)	Corresponding site number for biota (fig. 3)	U.S. Geological Survey site-identification number[1]	Site name	Site type	Data type collected in 1995		
					Surface water	Bottom sediment	Biota
			FREEZOUT LAKE WMA--Continued				
S-70	--	473910112010801	Freezeout Lake near Fairfield	LK	WS	BS	--
S-71	--	473910112012501	Freezeout Lake near Fairfield	LK	--	BS	--
S-72	B-39	473918112010801	Freezeout Lake near Fairfield	LK	WS	BC	F, I, P
--	B-43	474100112025101	Freezeout Lake near Fairfield	LK	--	--	I, P
S-73	--	473926112011701	Freezeout Lake near Fairfield	LK	--	BS	--
S-74	--	473913112025101	Freezeout Lake near Fairfield	LK	--	BC	--
S-38[2]	--	474117112031401	Freezeout Lake near Fairfield	LK	WC	BS	--
S-75	--	474037112021401	Freezout Lake WMA Pond 5 near Fairfield	LK	WS	BS	--
S-76	--	474032112014201	Freezout Lake WMA Pond 5 near Fairfield	LK	WS	BC	--
S-37[2]	B-16[2]	474023112014901	Freezout Lake WMA Pond 5 near Fairfield	LK	WC	BC	BE
S-77	--	474016112015801	Freezout Lake WMA Pond 5 near Fairfield	LK	--	BS	--
S-78	--	474004112014201	Freezout Lake WMA Pond 5 near Fairfield	LK	WS	BS	--
S-79	--	474011112013301	Freezout Lake WMA Pond 5 near Fairfield	LK	--	BS	--
S-80	--	474016112012801	Freezout Lake WMA Pond 5 near Fairfield	LK	WS	BS	--
--	B-40	474024112012901	Freezout Lake WMA Pond 5 near Fairfield	LK	--	--	F, I, P
--	B-41	474035112013001	Freezout Lake WMA Pond 5 near Fairfield	LK	--	--	BE
--	B-42	474030112022201	Freezout Lake WMA Pond 5 near Fairfield	LK	--	--	F, I, P
--	B-14[2]	474107112024601	Freezout Lake WMA Pond 3 near Fairfield	LK	--	--	BL

[1] Fifteen-digit site-identification number is a unique identifier that represents the approximate latitude and longitude location of the site (first 13 digits), plus the sequence number (last 2 digits).

[2] Site (or nearby location) previously sampled during 1990-92 (data reported in Lambing and others, 1994).

[3]Shown on fig. 1.

Table 10. Results of field measurements and trace-element analyses of surface-water samples collected in 1995 in the Freezeout Lake area, Montana

[Constituents are dissolved. Abbreviations: °C, degrees Celsius; inst., instantaneous; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; mg/L, milligrams per liter. Symbols: <, less than; --, no data]

Site number (fig. 3)	Date sampled	Discharge, inst. (cubic feet per second)	Specific conductance, field (µS/cm)	pH, field (standard units)	Temperature, water (°C)	Oxygen, field (mg/L)	Arsenic (µg/L as As)	Boron (µg/L as B)	Cadmium (µg/L as Cd)	Chromium (µg/L as Cr)	Copper (µg/L as Cu)	Lead (µg/L as Pb)	Molybdenum (µg/L as Mo)	Nickel (µg/L as Ni)	Selenium (µg/L as Se)	Vanadium (µg/L as V)	Zinc (µg/L as Zn)
GREENFIELDS IRRIGATION DIVISION																	
S-1[1]	08-28-95	260	275	8.2	17.0	10.2	<1	10	<1	<1	<1	<1	<1	<1	<2	<1	<3
S-3	03-20-95	.27	518	8.6	.5	--	--	--	--	--	--	--	--	--	1	--	--
	04-03-95	.22	535	8.7	5.0	--	--	--	--	--	--	--	--	--	1	--	--
	05-03-95	.28	458	8.6	13.0	--	--	--	--	--	--	--	--	--	1	--	--
	05-18-95	.30	558	8.4	14.0	--	--	--	--	--	--	--	--	--	1	--	--
	06-14-95	.82	504	8.2	16.0	--	--	--	--	--	--	--	--	--	1	--	--
	06-28-95	5.0	385	8.7	14.5	--	--	--	--	--	--	--	--	--	<1	--	--
	08-28-95	5.2	438	8.4	16.0	--	--	--	--	--	--	--	--	--	<2	--	--
S-6	03-20-95	.09	3,600	8.2	.5	--	--	--	--	--	--	--	--	--	72	--	--
	04-03-95	.07	3,560	8.6	6.0	17.3	<1	--	<1	<1	1	<1	<30	3	90	<18	<9
	05-03-95	2.4	956	9.4	11.0	--	--	--	--	--	--	--	--	--	5	--	--
	05-18-95	.41	1,940	8.1	17.0	--	--	--	--	--	--	--	--	--	17	--	--
	06-14-95	.38	1,840	8.2	17.5	--	--	--	--	--	--	--	--	--	16	--	--
	06-28-95	3.4	785	8.0	14.0	--	--	--	--	--	--	--	--	--	3	--	--
	08-28-95	.94	1,140	8.5	16.5	10.5	1	180	<1	<1	2	<1	1	1	20	2	4
S-7	03-20-95	.06	5,280	8.4	2.0	--	--	--	--	--	--	--	--	--	58	--	--
	04-04-95	.06	5,430	8.4	1.0	--	--	--	--	--	--	--	--	--	75	--	--
	05-03-95	.09	5,820	8.6	14.0	--	--	--	--	--	--	--	--	--	69	--	--
	05-18-95	.14	5,990	7.7	19.0	--	--	--	--	--	--	--	--	--	93	--	--
	06-14-95	.33	5,120	8.2	19.5	--	--	--	--	--	--	--	--	--	68	--	--
	06-28-95	.38	4,390	8.4	17.0	--	--	--	--	--	--	--	--	--	85	--	--
	08-28-95	.25	4,070	8.2	27.0	--	--	--	--	--	--	--	--	--	64	--	--
	08-28-95[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	62	--	--

Table 10. Results of field measurements and trace-element analyses of surface-water samples collected in 1995 in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Date sampled	Discharge, inst. (cubic feet per second)	Specific conductance, field (µS/cm)	pH, field (standard units)	Temperature, water (°C)	Oxygen, field (mg/L)	Arsenic (µg/L as As)	Boron (µg/L as B)	Cadmium (µg/L as Cd)	Chromium (µg/L as Cr)	Copper (µg/L as Cu)	Lead (µg/L as Pb)	Molybdenum (µg/L as Mo)	Nickel (µg/L as Ni)	Selenium (µg/L as Se)	Vanadium (µg/L as V)	Zinc (µg/L as Zn)
						GREENFIELDS IRRIGATION DIVISION–Continued											
S-8	03-20-95	.04	4,910	8.5	3.5	--	--	--	--	--	--	--	--	--	130	--	--
	04-05-95	.06	4,830	8.4	2.0	14.4	<1	--	<1	<1	1	<1	90	3	180	<24	18
	05-03-95	.04	5,040	8.2	10.0	--	--	--	--	--	--	--	--	--	130	--	--
	05-18-95	.11	5,300	7.6	17.0	--	--	--	--	--	--	--	--	--	120	--	--
	05-18-95[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	120	--	--
	06-14-95	.12	5,180	8.2	18.0	--	--	--	--	--	--	--	--	--	150	--	--
	06-28-95	3.7	745	8.1	15.0	--	--	--	--	--	--	--	--	--	9	--	--
	08-28-95	1.5	650	8.3	19.0	9.6	<1	80	<1	<1	1	<1	<1	<1	9	1	<3
	08-28-95[2]	--	650	8.5	--	--	<1	90	<1	<1	<1	<1	<1	<1	8	2	<3
S-11	03-20-95	.24	5,700	8.2	5.5	--	--	--	--	--	--	--	--	--	61	--	--
	04-04-95	.12	5,780	8.3	8.0	14.4	1	--	<1	<1	1	<1	<100	8	61	<60	<30
	05-03-95	.10	6,400	8.2	8.0	--	--	--	--	--	--	--	--	--	59	--	--
	05-18-95	.28	6,000	7.8	9.5	--	--	--	--	--	--	--	--	--	65	--	--
	06-14-95	.21	6,050	7.9	11.5	--	--	--	--	--	--	--	--	--	30	--	--
	06-14-95[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--
	06-28-95	7.8	988	7.9	10.0	--	--	--	--	--	--	--	--	--	12	--	--
	08-29-95	.18	6,140	8.2	19.0	9.3	2	910	<1	<1	1	<1	3	7	65	3	<10
S-50	03-20-95	.23	1,720	8.6	7.5	--	--	--	--	--	--	--	--	--	11	--	--
	04-04-95	.19	890	8.6	1.0	--	--	--	--	--	--	--	--	--	9	--	--
	05-03-95	.17	980	8.5	9.0	--	--	--	--	--	--	--	--	--	8	--	--
	05-03-95[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	9	--	--
	05-18-95	.25	1,520	8.0	11.5	--	--	--	--	--	--	--	--	--	11	--	--
	06-14-95	19	241	8.4	17.0	--	--	--	--	--	--	--	--	--	<1	--	--
	06-28-95	3.2	366	8.5	11.0	--	--	--	--	--	--	--	--	--	1	--	--
	08-29-95	3.0	437	8.5	13.0	--	--	--	--	--	--	--	--	--	<2	--	--

Table 10. Results of field measurements and trace-element analyses of surface-water samples collected in 1995 in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Date sampled	Discharge, inst. (cubic feet per second)	Specific conductance, field (µS/cm)	pH, field (standard units)	Temperature, water (°C)	Oxygen, field (mg/L)	Arsenic (µg/L as As)	Boron (µg/L as B)	Cadmium (µg/L as Cd)	Chromium (µg/L as Cr)	Copper (µg/L as Cu)	Lead (µg/L as Pb)	Molybdenum (µg/L as Mo)	Nickel (µg/L as Ni)	Selenium (µg/L as Se)	Vanadium (µg/L as V)	Zinc (µg/L as Zn)
						GREENFIELDS IRRIGATION DIVISION--Continued											
S-51	03-20-95	.35	1,090	8.7	7.0	--	--	--	--	--	--	--	--	--	5	--	--
	04-04-95	1.0	1,180	8.6	10.5	15.0	<1	--	<1	<1	1	<1	20	1	9	<6	4
	05-03-95	3.4	643	8.5	12.0	--	--	--	--	--	--	--	--	--	2	--	--
	05-18-95	2.8	1,230	8.2	13.0	--	--	--	--	--	--	--	--	--	5	--	--
	06-14-95	4.0	877	8.4	13.0	--	--	--	--	--	--	--	--	--	2	--	--
	06-28-95	1.1	649	8.2	10.0	--	--	--	--	--	--	--	--	--	<1	--	--
	08-28-95	11	550	8.4	18.5	11.0	<1	80	<1	<1	<1	<1	2	<1	<2	3	9
S-52	03-20-95	.15	2,800	8.1	5.0	--	--	--	--	--	--	--	--	--	11	--	--
	03-20-95[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	9	--	--
	04-04-95	.08	2,810	8.2	10.5	11.8	<1	--	<1	<1	<1	<1	<30	2	10	<18	<9
	04-04-95[2]	--	--	--	--	--	<1	--	<1	<1	1	<1	30	1	13	<18	<9
	05-03-95	.09	2,860	8.4	14.0	--	--	--	--	--	--	--	--	--	9	--	--
	05-18-95	.22	3,200	7.8	12.0	--	--	--	--	--	--	--	--	--	6	--	--
	06-14-95	.16	3,320	8.0	12.5	--	--	--	--	--	--	--	--	--	7	--	--
	06-28-95	11	753	8.3	12.5	--	--	--	--	--	--	--	--	--	2	--	--
	06-28-95[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--
	08-28-95	.45	2,020	7.9	18.0	7.7	2	500	<1	<1	2	<1	1	2	7	3	17
						FREEZEOUT LAKE											
S-53	04-03-95	--	5,550	9.0	6.5	13.7	--	--	--	--	--	--	--	--	2	--	--
	04-03-95[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
	08-29-95	--	4,480	9.7	17.5	--	--	--	--	--	--	--	--	--	<2	--	--
S-54	04-03-95	--	5,590	9.0	6.5	11.4	--	--	--	--	--	--	--	--	1	--	--
	08-29-95	--	4,950	9.8	18.0	--	--	--	--	--	--	--	--	--	<2	--	--
S-55	04-03-95	--	5,460	9.0	7.0	11.3	--	--	--	--	--	--	--	--	2	--	--
	08-29-95	--	789	8.6	15.5	--	--	--	--	--	--	--	--	--	<2	--	--
S-56	04-03-95	--	5,430	9.0	6.0	10.1	--	--	--	--	--	--	--	--	2	--	--
	08-29-95	--	3,120	9.8	18.5	--	--	--	--	--	--	--	--	--	<2	--	--

Table 10. Results of field measurements and trace-element analyses of surface-water samples collected in 1995 in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Date sampled	Discharge, Inst. (cubic feet per second)	Specific conductance, field (µS/cm)	pH, field (standard units)	Temperature, water (°C)	Oxygen, field (mg/L)	Arsenic (µg/L as As)	Boron (µg/L as B)	Cadmium (µg/L as Cd)	Chromium (µg/L as Cr)	Copper (µg/L as Cu)	Lead (µg/L as Pb)	Molybdenum (µg/L as Mo)	Nickel (µg/L as Ni)	Selenium (µg/L as Se)	Vanadium (µg/L as V)	Zinc (µg/L as Zn)
						FREEZEOUT LAKE–Continued											
S-39	04-03-95	--	5,550	9.0	--	11.1	10	--	<1	<1	1	<1	<50	2	1	<30	<15
	08-29-95	--	4,420	9.7	19.0	14.9	18	640	<1	<1	<1	<1	2	<1	<2	6	<10
S-61	04-04-95	--	5,360	8.9	5.0	9.0	--	--	--	--	--	--	--	--	2	--	--
	08-29-95	--	3,770	9.7	18.5	7.3	--	--	--	--	--	--	--	--	<2	--	--
S-62	04-04-95	--	5,360	8.9	5.0	9.4	--	--	--	--	--	--	--	--	2	--	--
	08-29-95	--	3,860	9.6	17.5	--	--	--	--	--	--	--	--	--	10	--	--
S-63	04-04-95	--	5,370	8.8	5.0	8.6	--	--	--	--	--	--	--	--	2	--	--
	08-29-95	--	3,920	9.7	18.5	--	--	--	--	--	--	--	--	--	3	--	--
S-68	04-04-95	--	5,390	8.7	4.5	9.1	--	--	--	--	--	--	--	--	2	--	--
	08-29-95	--	3,830	10.0	19.0	--	--	--	--	--	--	--	--	--	2	--	--
S-69	04-04-95	--	5,390	9.0	4.5	11.2	--	--	--	--	--	--	--	--	2	--	--
	08-29-95	--	3,720	9.5	19.0	--	--	--	--	--	--	--	--	--	<2	--	--
S-70	04-04-95	--	5,450	9.0	4.5	10.6	--	--	--	--	--	--	--	--	2	--	--
	08-29-95	--	3,220	9.9	19.0	--	--	--	--	--	--	--	--	--	2	--	--
S-72	04-04-95	--	5,270	8.8	4.5	9.3	--	--	--	--	--	--	--	--	3	--	--
	04-04-95[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--
	08-29-95	--	2,880	8.8	18.5	--	--	--	--	--	--	--	--	--	7	--	--
S-38	04-03-95	--	5,780	9.0	6.5	10.2	13	--	<1	<1	<1	<1	60	<1	1	<30	<32
	08-29-95	--	6,050	9.3	19.5	10.0	26	930	<1	<1	2	<1	1	<1	<2	8	<10

Table 10. Results of field measurements and trace-element analyses of surface-water samples collected in 1995 in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Date sampled	Discharge, inst. (cubic feet per second)	Specific conductance, field (µS/cm)	pH, field (standard units)	Temperature, water (°C)	Oxygen, field (mg/L)	Arsenic (µg/L as As)	Boron (µg/L as B)	Cadmium (µg/L as Cd)	Chromium (µg/L as Cr)	Copper (µg/L as Cu)	Lead (µg/L as Pb)	Molybdenum (µg/L as Mo)	Nickel (µg/L as Ni)	Selenium (µg/L as Se)	Vanadium (µg/L as V)	Zinc (µg/L as Zn)
								POND 5									
S-75	04-04-95	--	1,850	8.8	5.0	12.6	--	--	--	--	--	--	--	--	1	--	--
	08-30-95	--	1,010	9.5	14.0	--	--	--	--	--	--	--	--	--	<2	--	--
S-76	04-04-95	--	2,040	8.6	4.0	10.2	--	--	--	--	--	--	--	--	2	--	--
	08-30-95	--	1,330	9.0	13.5	--	--	--	--	--	--	--	--	--	<2	--	--
S-37	04-04-95	--	1,910	8.6	4.5	9.3	2	--	<1	<1	<1	<1	<30	1	2	<18	<9
	08-30-95	--	578	8.6	15.0	3.2	<1	90	<1	<1	<1	<1	1	<1	<2	2	<3
S-78	04-04-95	--	1 930	8.8	4.0	11.0	--	--	--	--	--	--	--	--	2	--	--
	08-30-95	--	670	9.7	14.5	--	--	--	--	--	--	--	--	--	<2	--	--
S-80	04-04-95	--	1,890	8.7	4.5	11.8	--	--	--	--	--	--	--	--	2	--	--
	08-30-95	--	346	8.4	12.0	--	--	--	--	--	--	--	--	--	<2	--	--
								FIELD BLANKS[3]									
--	04-04-95	--	2	6.0	--	--	<1	--	1	<5	<10	<10	10	<10	<1	<6	<3
--	05-03-95	--	2	5.4	--	--	--	--	--	--	--	--	--	--	<1	--	--
--	05-18-95	--	2	5.1	18.0	--	--	--	--	--	--	--	--	--	<1	--	--
--	06-14-95	--	2	5.1	--	--	--	--	--	--	--	--	--	--	<1	--	--
--	06-28-95	--	2	6.2	19.0	--	--	--	--	--	--	--	--	--	<1	--	--
--	08-28-95	--	1	--	--	--	<1	<10	<1	<1	<1	<1	<1	<1	<1	<1	<3

[1]Greenfields Main Canal 0.8 mi south of Fairfield. Shown on figure 1.

[2]Field replicate sample split from a composite surface-water sample.

[3]Field blank consisting of deionized water that was exposed to the same equipment and procedures as routine samples.

Table 11. Results of major-ion and nutrient analyses of surface-water samples collected in 1995 in the Freezeout Lake area, Montana

[Constituents are dissolved. Abbreviation: lab, laboratory; mg/L, milligrams per liter. Symbols: <, less than; --, no data]

Site number (fig. 3)	Date sampled	Hardness (mg/L as $CaCO_3$)	Calcium (mg/L as Ca)	Magnesium (mg/L as Mg)	Sodium (mg/L as Na)	Sodium (percent)	Sodium adsorption ratio	Potassium (mg/L as K)	Alkalinity, lab (mg/L as $CaCO_3$)
S-1[1]	08-28-95	150	41	11	1.7	2	0.1	0.7	129
S-6	04-03-95	2,100	350	290	210	18	2	7.7	271
	08-28-95	560	93	79	53	17	1	5.1	275
S-8	04-05-95	2,200	330	330	510	34	5	2.3	373
	08-28-95	270	57	32	35	22	.9	1.4	146
	08-28-95[2]	280	58	32	35	21	.9	1.4	146
S-11	04-04-95	4,000	370	740	290	14	2	11	443
	08-29-95	4,300	330	840	320	14	2	12	376
S-51	04-04-95	550	95	76	56	18	1	3.1	263
	08-28-95	270	47	37	17	12	.5	1.8	225
S-52	04-04-95	1,700	380	180	120	13	1	6.4	280
	04-04-95[2]	1,700	380	180	110	12	1	6.3	281
	08-28-95	1,100	260	120	78	13	1	14	294
S-39	04-03-95	1,400	40	320	950	59	11	8.4	688
	08-29-95	1,200	8.6	290	740	57	9	5.3	505
S-38	04-03-95	1,500	38	330	980	59	11	8.0	723
	08-29-95	1,500	7.8	370	1,000	58	11	8.0	705
S-37	04-04-95	880	87	160	120	23	2	7.7	346
	08-30-95	260	40	39	23	16	.6	1.8	146
Blank[3]	04-04-95	--	<.02	<.01	<.2	--	--	<.1	1.2
Blank[3]	08-28-95	--	<.02	<.01	<.2	--	--	<.1	1.3

Site number (fig. 3)	Date sampled	Sulfate (mg/L as SO_4)	Chloride (mg/L as Cl)	Fluoride (mg/L as F)	Dissolved solids, calculated (mg/L)	Nitrite (mg/L as N)	Nitrite plus nitrate (mg/L as N)	Ammonia (mg/L as N)	Phosphorus, ortho (mg/L as P)
S-1[1]	08-28-95	16	0.2	0.1	148	<0.01	<0.05	<0.02	<0.01
S-6	04-03-95	2,100	40	.5	3,190	.01	4.1	--	--
	08-28-95	360	14	.5	770	<.01	.13	<.02	.01
S-8	04-05-95	2,800	63	1.2	4,280	.01	2.3	--	--
	08-28-95	190	4.8	.2	409	<.01	.16	<.02	<.01
	08-28-95[2]	190	4.9	.3	416	.12	1.4	.12	.06
S-11	04-04-95	4,000	35	.6	5,720	.02	.34	--	--
	08-29-95	4,200	39	.6	5,970	<.01	1.1	.02	.26
S-51	04-04-95	380	7.2	.6	795	.02	2.4	--	--
	08-28-95	72	2.3	.5	318	<.01	1.1	<.02	.03
S-52	04-04-95	1,600	9.6	.3	2,490	.02	2.7	--	--
	04-04-95[2]	1,600	9.9	.3	2,480	.02	2.7	--	--
	08-28-95	940	6.7	.5	1,610	.03	2.1	.03	.22
S-39	04-03-95	2,500	170	1.1	4,410	<.01	<.05	--	--
	08-29-95	2,000	130	1.0	3,480	<.01	<.05	<.02	<.01
S-38	04-03-95	2,600	180	1.2	4,570	<.01	<.05	--	--
	08-29-95	2,700	180	1.2	4,690	<.01	<.05	<.02	<.01
S-37	04-04-95	760	24	.6	1,370	<.01	<.05	--	--
	08-30-95	150	3.4	.3	345	<.01	<.05	<.02	<.01
Blank[3]	04-04-95	<.1	<.1	<.1	--	<.01	<.05	--	--
Blank[3]	08-28-95	.2	<.1	<.1	--	<.01	<.05	<.02	<.01

[1]Greenfields Main Canal 0.8 mi south of Fairfield. Shown on figure 1.
[2]Duplicate sample split from a composite surface-water sample for quality control.
[3]Field blank consisting of deionized water that was exposed to the same equipment and procedures as routine samples.

Table 12. Results of selenium analyses of bottom-sediment samples collected in 1995 in the Freezeout Lake area, Montana

[All concentrations are total. Analyses conducted on bulk, unsieved sediment. For sites with more than one interval sampled (core sample), sediment intervals were separated in the field on the basis of visually distinct differences in color and texture of bottom sediment. Abbreviations: in., inches below sediment surface; µg/g, micrograms per gram of dry sample weight]

Site number (fig. 3)	Date sampled	Top of sampled interval (in.)	Bottom of sampled interval (in.)	Selenium (µg/g)
		IRRIGATION DRAINS		
S-7	08-03-95	0	8	7.8
S-8	08-03-95	0	8	13
S-11	08-03-95	0	8	23
S-51	08-02-95	0	8	.8
		FREEZEOUT LAKE		
S-53	08-02-95	0	6	13
S-54	08-02-95	0	7	1.4
		7	13	1.0
S-55	08-02-95	0	8	1.6
S-56	08-02-95	0	4	4.4
		4	7	1.1
S-57	08-02-95	0	6	7.4
S-58	08-02-95	0	8	1.0
S-59	08-02-95	0	5	3.8
S-39	08-02-95	0	4	.5
		4	7	.2
		7	16	.3
S-60	08-02-95	0	6	1.8
S-61	08-02-95	0	6	7.0
S-62	08-03-95	0	8	12
		8	12	2.6
		12	14	.8
S-63	08-02-95	0	3	1.8
S-64	08-02-95	0	7	.7
S-65	08-03-95	0	6	.9
S-66	08-03-95	0	8	1.1
S-67	08-03-95	0	8	1.5
S-68	08-03-95	0	8	.8
S-69	08-03-95	0	6	.7
S-70	08-03-95	0	6	1.4
S-71	08-03-95	0	8	1.5
S-72	08-03-95	0	8	12
		8	12	11
		12	14	.8
S-73	08-03-95	0	8	.7
S-74	08-02-95	0	1	3.3
		1	3	.2
		3	5	.2
S-38	08-02-95	0	8	1.0
		POND 5		
S-75	08-03-95	0	6	.9
S-76	08-03-95	0	8	2.4
		8	12	1.6
S-37	08-03-95	0	8	3.8
		8	11	.2
S-77	08-03-95	0	8	3.2
S-78	08-03-95	0	8	1.1
S-79	08-03-95	0	6	2.7
S-80	08-03-95	0	8	.7

Table 13. Results of selenium analyses of aquatic plants collected in 1995 in the Freezeout Lake area, Montana

[All concentrations are total. Abbreviation: µg/g, micrograms per gram of dry sample weight. Symbol: <, less than]

Site number (fig. 3)	Sample identification	Date	Taxon	Selenium concentration (µg/g)
B-34	FL1AAL95	08/02/95	ALGAE-FILAMENTOUS	<0.5
B-34	FL1BAL95	08/02/95	ALGAE-FILAMENTOUS	<.5
B-34	FL1CAL95	08/02/95	ALGAE-FILAMENTOUS	<.5
B-34	FL1APO95	08/02/95	SAGO PONDWEED	<.5
B-34	FL1BPO95	08/02/95	SAGO PONDWEED	<.5
B-34	FL1CPO95	08/02/95	SAGO PONDWEED	.6
B-35	FL2AAL95	08/02/95	ALGAE-FILAMENTOUS	.5
B-35	FL2BAL95	08/02/95	ALGAE-FILAMENTOUS	<.5
B-35	FL2CAL95	08/02/95	ALGAE-FILAMENTOUS	.7
B-35	FL2APO95	08/02/95	SAGO PONDWEED	1.8
B-35	FL2BPO95	08/02/95	SAGO PONDWEED	2.3
B-35	FL2CPO95	08/02/95	SAGO PONDWEED	2.0
B-37	FL4AAL95	08/03/95	ALGAE-FILAMENTOUS	2.4
B-37	FL4BAL95	08/03/95	ALGAE-FILAMENTOUS	1.5
B-37	FL4CAL95	08/03/95	ALGAE-FILAMENTOUS	<.5
B-37	FL4APO95	08/03/95	SAGO PONDWEED	1.2
B-37	FL4BPO95	08/03/95	SAGO PONDWEED	1.1
B-37	FL4CPO95	08/03/95	SAGO PONDWEED	.8
B-38	FL7AAL95	08/01/95	ALGAE-FILAMENTOUS	1.3
B-38	FL7BAL95	08/01/95	ALGAE-FILAMENTOUS	1.3
B-38	FL7CAL95	08/01/95	ALGAE-FILAMENTOUS	1.7
B-39	FL5AAL95	08/02/95	ALGAE-FILAMENTOUS	5.5
B-39	FL5BAL95	08/02/95	ALGAE-FILAMENTOUS	5.2
B-39	FL5CAL95	08/02/95	ALGAE-FILAMENTOUS	5.7
B-39	FL5APO95	08/02/95	SAGO PONDWEED	6.0
B-39	FL5BPO95	08/02/95	SAGO PONDWEED	4.9
B-39	FL5CPO95	08/02/95	SAGO PONDWEED	7.2
B-40	FL8AAL95	08/03/95	ALGAE-FILAMENTOUS	3.2
B-40	FL8BAL95	08/03/95	ALGAE-FILAMENTOUS	3.1
B-40	FL8CAL95	08/03/95	ALGAE-FILAMENTOUS	3.3
B-40	FL8APO95	08/03/95	SAGO PONDWEED	2.4
B-40	FL8BPO95	08/03/95	SAGO PONDWEED	2.2
B-40	FL8CPO95	08/03/95	SAGO PONDWEED	2.3
B-42	FL9AAL95	08/01/95	ALGAE-FILAMENTOUS	2.4
B-42	FL9BAL95	08/01/95	ALGAE-FILAMENTOUS	3.0
B-42	FL9CAL95	08/01/95	ALGAE-FILAMENTOUS	1.7
B-43	FL6AAL95	08/01/95	ALGAE-FILAMENTOUS	1.9
B-43	FL6BAL95	08/01/95	ALGAE-FILAMENTOUS	1.5
B-43	FL6CAL95	08/01/95	ALGAE-FILAMENTOUS	1.3
B-43	FL6APO95	08/01/95	SAGO PONDWEED	.8
B-43	FL6BPO95	08/01/95	SAGO PONDWEED	.6
B-43	FL6CPO95	08/01/95	SAGO PONDWEED	.6

Table 14. Results of selenium analyses of aquatic invertebrates collected in 1995 in the Freezeout Lake area, Montana

[All concentrations are total. Abbreviation: µg/g, micrograms per gram of dry sample weight. Symbol: <, less than]

Site number (fig. 3)	Sample identification	Date	Taxon	Selenium concentration (µg/g)
B-1	FL3AIN95	04/04/95	MULTIPLE ORDERS	1.2
B-1	FL3BIN95	04/04/95	MULTIPLE ORDERS	1.3
B-1	FL3CIN95	04/04/95	MULTIPLE ORDERS	<.5
B-1	FL3DIN95	08/03/95	MULTIPLE ORDERS	1.4
B-1	FL3EIN95	08/03/95	MULTIPLE ORDERS	.9
B-1	FL3FIN95	08/03/95	MULTIPLE ORDERS	1.2
B-3	FLDNAC95	08/04/95	MULTIPLE ORDERS	21.1
B-3	FLDNBC95	08/04/95	MULTIPLE ORDERS	17.2
B-3	FLDNCC95	08/04/95	MULTIPLE ORDERS	21.6
B-4	FLD5A195	04/18/95	MULTIPLE ORDERS	8.2
B-4	FLD5BI95	04/19/95	MULTIPLE ORDERS	16.9
B-4	FLD5CI95	04/19/95	MULTIPLE ORDERS	6.7
B-4	FLD5DI95	08/03/95	MULTIPLE ORDERS	41.5
B-4	FLD5EI95	08/03/95	MULTIPLE ORDERS	28.5
B-4	FLD5FI95	08/03/95	MULTIPLE ORDERS	26.8
B-31	FLDSAC95	04/19/95	MULTIPLE ORDERS	18.2
B-31	FLDSBC95	04/20/95	MULTIPLE ORDERS	8.4
B-31	FLDSCC95	04/20/95	MULTIPLE ORDERS	5.6
B-31	FLDSDC95	08/03/95	MULTIPLE ORDERS	16.9
B-31	FLDSEC95	08/03/95	MULTIPLE ORDERS	14.5
B-31	FLDSFC95	08/03/95	MULTIPLE ORDERS	21.8
B-32	FLD2AC95	04/19/95	MULTIPLE ORDERS	2.2
B-32	FLD2BC95	04/19/95	MULTIPLE ORDERS	3.5
B-32	FLD2CC95	04/19/95	MULTIPLE ORDERS	2.6
B-32	FLD2DC95	08/03/95	MULTIPLE ORDERS	4.7
B-32	FLD2EC95	08/03/95	MULTIPLE ORDERS	4.6
B-32	FLD2FC95	08/03/95	MULTIPLE ORDERS	4.9
B-33	FLSDDC95	08/03/95	MULTIPLE ORDERS	7.6
B-33	FLSDEC95	08/03/95	MULTIPLE ORDERS	5.8
B-33	FLSDFC95	08/03/95	MULTIPLE ORDERS	3.7
B-34	FL1AWB95	04/04/95	WATERBOATMEN	2.4
B-34	FL1BWB95	04/05/95	WATERBOATMEN	2.8
B-34	FL1CWB95	04/05/95	WATERBOATMEN	2.4
B-34	FL1DWB95	07/31/95	WATERBOATMEN	4.4
B-34	FL1EWB95	07/31/95	WATERBOATMEN	5.0
B-34	FL1FWB95	07/31/95	WATERBOATMEN	3.8
B-34	FL1ACH95	04/04/95	CHIRONOMID	14.1
B-34	FL1BCH95	04/04/95	CHIRONOMID	12.7
B-34	FL1CCH95	04/04/95	CHIRONOMID	17.4
B-34	FL1DCH95	07/31/95	CHIRONOMID	14.4
B-34	FL1ECH95	07/31/95	CHIRONOMID	13.7
B-34	FL1FCH95	07/31/95	CHIRONOMID	13.3
B-35	FL2AWB95	04/05/95	WATERBOATMEN	2.4
B-35	FL2BWB95	04/05/95	WATERBOATMEN	2.2
B-35	FL2CWB95	04/05/95	WATERBOATMEN	2.3
B-35	FL2DWB95	08/02/95	WATERBOATMEN	4.2
B-35	FL2EWB95	08/02/95	WATERBOATMEN	5.0
B-35	FL2FWB95	08/02/95	WATERBOATMEN	5.3
B-35	FL2ACH95	04/04/95	CHIRONOMID	5.4
B-35	FL2BCH95	04/06/95	CHIRONOMID	5.9

Table 14. Results of selenium analyses of aquatic invertebrates collected in 1995 in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Sample identification	Date	Taxon	Selenium concentration (µg/g)
B-35	FL2CCH95	04/07/95	CHIRONOMID	5.3
B-35	FL2DCH95	08/04/95	CHIRONOMID	8.3
B-35	FL2ECH95	08/04/95	CHIRONOMID	13.8
B-35	FL2FCH95	08/04/95	CHIRONOMID	15.8
B-37	FL4AIN95	04/04/95	MULTIPLE ORDERS	2.3
B-37	FL4BIN95	04/04/95	MULTIPLE ORDERS	2.0
B-37	FL4CIN95	04/04/95	MULTIPLE ORDERS	2.2
B-37	FL4DIN95	08/03/95	MULTIPLE ORDERS	6.3
B-37	FL4EIN95	08/03/95	MULTIPLE ORDERS	4.9
B-37	FL4FIN95	08/03/95	MULTIPLE ORDERS	6.8
B-38	FL7AWB95	04/06/95	WATERBOATMEN	.8
B-38	FL7BWB95	04/06/95	WATERBOATMEN	.6
B-38	FL7CWB95	04/06/95	WATERBOATMEN	2.9
B-38	FL7DWB95	08/01/95	WATERBOATMEN	2.3
B-38	FL7EWB95	08/01/95	WATERBOATMEN	2.2
B-38	FL7FWB95	08/01/95	WATERBOATMEN	2.3
B-38	FL7ACH95	04/06/95	CHIRONOMID	6.8
B-38	FL7BCH95	04/06/95	CHIRONOMID	6.9
B-38	FL7CCH95	04/06/95	CHIRONOMID	5.9
B-38	FL7DCH95	08/01/95	CHIRONOMID	5.1
B-38	FL7ECH95	08/01/95	CHIRONOMID	5.2
B-38	FL7FCH95	08/01/95	CHIRONOMID	3.9
B-39	FL5AWB95	04/07/95	WATERBOATMEN	3.8
B-39	FL5BWB95	04/07/95	WATERBOATMEN	4.1
B-39	FL5CWB95	04/07/95	WATERBOATMEN	4.5
B-39	FL5DWB95	08/02/95	WATERBOATMEN	8.0
B-39	FL5EWB95	08/02/95	WATERBOATMEN	7.8
B-39	FL5FWB95	08/02/95	WATERBOATMEN	7.8
B-39	FL5ACH95	04/07/95	CHIRONOMID	26.3
B-39	FL5BCH95	04/20/95	CHIRONOMID	24.8
B-39	FL5CCH95	04/20/95	CHIRONOMID	24.8
B-39	FL5DCH95	08/01/95	CHIRONOMID	17.0
B-39	FL5ECH95	08/01/95	CHIRONOMID	14.4
B-39	FL5FCH95	08/01/95	CHIRONOMID	13.6
B-40	FL8AWB95	04/17/95	WATERBOATMEN	3.5
B-40	FL8BWB95	04/18/95	WATERBOATMEN	4.1
B-40	FL8CWB95	04/18/95	WATERBOATMEN	4.0
B-40	FL8DWB95	08/03/95	WATERBOATMEN	5.3
B-40	FL8EWB95	08/03/95	WATERBOATMEN	6.5
B-40	FL8FWB95	08/03/95	WATERBOATMEN	6.2
B-40	FL8ACH95	04/17/95	CHIRONOMID	15.0
B-40	FL8BCH95	04/17/95	CHIRONOMID	12.3
B-40	FL8CCH95	04/18/95	CHIRONOMID	13.3
B-40	FL8DCH95	08/02/95	CHIRONOMID	16.5
B-40	FL8ECH95	08/02/95	CHIRONOMID	16.6
B-40	FL8FCH95	08/02/95	CHIRONOMID	17.5
B-42	FL9AWB95	04/19/95	WATERBOATMEN	.6
B-42	FL9BWB95	04/20/95	WATERBOATMEN	2.5
B-42	FL9CWB95	04/20/95	WATERBOATMEN	2.3
B-42	FL9DWB95	08/01/95	WATERBOATMEN	4.0
B-42	FL9EWB95	08/01/95	WATERBOATMEN	3.9
B-42	FL9FWB95	08/01/95	WATERBOATMEN	4.5
B-42	FL9ACH95	04/20/95	CHIRONOMID	5.3
B-42	FL9BCH95	04/20/95	CHIRONOMID	4.8
B-42	FL9CCH95	04/20/95	CHIRONOMID	5.1

Table 14. Results of selenium analyses of aquatic invertebrates collected in 1995 in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Sample identification	Date	Taxon	Selenium concentration (µg/g)
B-42	FL9DIN95	08/04/95	MULTIPLE ORDERS	3.3
B-42	FL9EIN95	08/04/95	MULTIPLE ORDERS	3.9
B-42	FL9FIN95	08/04/95	MULTIPLE ORDERS	3.1
B-43	FL6AWB95	04/19/95	WATERBOATMEN	3.0
B-43	FL6BWB95	04/19/95	WATERBOATMEN	2.9
B-43	FL6CWB95	04/19/95	WATERBOATMEN	3.2
B-43	FL6DWB95	07/31/95	WATERBOATMEN	1.3
B-43	FL6EWB95	07/31/95	WATERBOATMEN	1.4
B-43	FL6FWB95	07/31/95	WATERBOATMEN	1.6
B-43	FL6ACH95	04/19/95	CHIRONOMID	8.4
B-43	FL6BCH95	04/19/95	CHIRONOMID	9.6
B-43	FL6CCH95	04/19/95	CHIRONOMID	8.1
B-43	FL6DCH95	07/31/95	CHIRONOMID	4.6
B-43	FL6ECH95	07/31/95	CHIRONOMID	4.5
B-43	FL6FCH95	07/31/95	CHIRONOMID	2.7

Table 15. Results of selenium analyses of fish collected in 1995 in the Freezeout Lake area, Montana

[All concentrations are total. Abbreviation: µg/g, micrograms per gram of dry sample weight]

Site number (fig. 3)	Sample identification	Date	Taxon	Selenium concentration (µg/g)
B-1	FL3ASB95	04/05/95	BROOK STICKLEBACK	5.7
B-1	FL3BSB95	04/05/95	BROOK STICKLEBACK	3.6
B-1	FL3CSB95	04/05/95	BROOK STICKLEBACK	3.8
B-3	FLDNAF95	04/20/95	BROOK STICKLEBACK	47.2
B-3	FLDNBF95	04/20/95	BROOK STICKLEBACK	30.3
B-3	FLDNCF95	04/20/95	BROOK STICKLEBACK	41.8
B-3	FLDNDF95	08/04/95	BROOK STICKLEBACK	39.2
B-3	FLDNEF95	08/04/95	BROOK STICKLEBACK	40.3
B-3	FLDNFF95	08/04/95	BROOK STICKLEBACK	44.7
B-4	FLD5AF95	04/18/95	BROOK STICKLEBACK	25.0
B-4	FLD5BF95	04/18/95	BROOK STICKLEBACK	23.6
B-4	FLD5CF95	04/18/95	BROOK STICKLEBACK	25.3
B-4	FLD5DF95	08/03/95	BROOK STICKLEBACK	97.6
B-4	FLD5EF95	08/03/95	BROOK STICKLEBACK	86.0
B-4	FLD5FF95	08/03/95	BROOK STICKLEBACK	97.0
B-31	FLDSAF95	04/19/95	BROOK STICKLEBACK	8.5
B-31	FLDSBF95	04/20/95	BROOK STICKLEBACK	6.9
B-31	FLDSCF95	04/20/95	BROOK STICKLEBACK	8.9
B-31	FLDSDF95	08/03/95	BROOK STICKLEBACK	22.1
B-31	FLDSEF95	08/03/95	BROOK STICKLEBACK	19.1
B-31	FLDSFF95	08/03/95	BROOK STICKLEBACK	20.4
B-32	FLD2AF95	08/03/95	BROOK STICKLEBACK	6.6
B-32	FLD2BF95	08/03/95	BROOK STICKLEBACK	5.6
B-32	FLD2CF95	08/03/95	BROOK STICKLEBACK	7.2
B-33	FLSDDF95	08/03/95	BROOK STICKLEBACK	11.5
B-33	FLSDEF95	08/03/95	BROOK STICKLEBACK	11.0
B-33	FLSDFF95	08/03/95	BROOK STICKLEBACK	11.4
B-34	FL1ASB95	04/05/95	BROOK STICKLEBACK	5.0
B-34	FL1BSB95	04/05/95	BROOK STICKLEBACK	5.0
B-34	FL1CSB95	04/05/95	BROOK STICKLEBACK	4.4
B-34	FL1DSB95	07/31/95	BROOK STICKLEBACK	11.2
B-34	FL1ESB95	08/02/95	BROOK STICKLEBACK	13.7
B-34	FL1FSB95	08/02/95	BROOK STICKLEBACK	12.4
B-35	FL2ASB95	04/05/95	BROOK STICKLEBACK	4.2
B-35	FL2BSB95	04/05/95	BROOK STICKLEBACK	5.6
B-35	FL2CSB95	04/05/95	BROOK STICKLEBACK	4.7
B-35	FL2DSB95	08/02/95	BROOK STICKLEBACK	8.4
B-35	FL2ESB95	08/02/95	BROOK STICKLEBACK	7.3
B-35	FL2FSB95	08/02/95	BROOK STICKLEBACK	6.4
B-37	FL4DSB95	08/03/95	BROOK STICKLEBACK	7.6
B-37	FL4ESB95	08/03/95	BROOK STICKLEBACK	6.1
B-37	FL4FSB95	08/03/95	BROOK STICKLEBACK	8.4
B-39	FL5ASB95	04/18/95	BROOK STICKLEBACK	5.1
B-39	FL5BSB95	04/21/95	BROOK STICKLEBACK	15.9
B-39	FL5CSB95	04/21/95	BROOK STICKLEBACK	22.1
B-39	FL5DSB95	08/02/95	BROOK STICKLEBACK	19.4
B-39	FL5ESB95	08/02/95	BROOK STICKLEBACK	16.1
B-39	FL5FSB95	08/02/95	BROOK STICKLEBACK	17.4
B-40	FL8ASB95	04/17/95	BROOK STICKLEBACK	2.8
B-40	FL8BSB95	04/17/95	BROOK STICKLEBACK	9.2
B-40	FL8CSB95	04/17/95	BROOK STICKLEBACK	10.8
B-40	FL8DSB95	08/03/95	BROOK STICKLEBACK	13.1
B-40	FL8ESB95	08/03/95	BROOK STICKLEBACK	8.4
B-40	FL8FSB95	08/03/95	BROOK STICKLEBACK	15.9
B-42	FL9ASB95	04/19/95	BROOK STICKLEBACK	1.8

Table 15. Results of selenium analyses of fish collected in 1995 in the Freezeout Lake area, Montana (Continued)

Site number (fig. 3)	Sample identification	Date	Taxon	Selenium concentration (µg/g)
B-42	FL9BSB95	04/19/95	BROOK STICKLEBACK	2.3
B-42	FL9CSB95	04/19/95	BROOK STICKLEBACK	6.5
B-42	FL9DSB95	08/01/95	BROOK STICKLEBACK	5.0
B-42	FL9ESB95	08/01/95	BROOK STICKLEBACK	4.3
B-42	FL9FSB95	08/01/95	BROOK STICKLEBACK	5.5

Table 16. Results of selenium analyses of water-bird eggs collected in 1995 in the Freezeout Lake area, Montana

[All concentrations are total. Abbreviation: µg/g, micrograms per gram of dry sample weight]

Site number (fig. 3)	Sample identification	Date	Taxon	Selenium concentration (µg/g)
B-16	FL9501EG	06/26/95	PIED-BILLED GREBE	7.3
B-16	FL9502EG	07/05/95	PIED-BILLED GREBE	5.6
B-16	FL9501C	06/13/95	AMERICAN COOT	11.7
B-16	FL9502C	06/13/95	AMERICAN COOT	7.2
B-16	FL9503C	05/26/95	AMERICAN COOT	4.2
B-16	FL9504C	05/26/95	AMERICAN COOT	5.4
B-16	FL9505C	07/05/95	AMERICAN COOT	5.3
B-36	FL956A	06/06/95	AMERICAN AVOCET	8.0
B-36	FL9512A	06/12/95	AMERICAN AVOCET	6.3
B-36	FL9513A	06/12/95	AMERICAN AVOCET	7.1
B-36	FL953A	06/12/95	AMERICAN AVOCET	8.1
B-36	FL952A	06/12/95	AMERICAN AVOCET	7.0
B-36	FL9515A	06/12/95	AMERICAN AVOCET	5.6
B-36	FL951A	06/12/95	AMERICAN AVOCET	8.4
B-36	FL955A	06/12/95	AMERICAN AVOCET	22.2
B-36	FL957A	06/12/95	AMERICAN AVOCET	7.1
B-36	FL958A	06/12/95	AMERICAN AVOCET	5.9
B-36	FL959A	06/12/95	AMERICAN AVOCET	5.3
B-36	FL9520A	06/13/95	AMERICAN AVOCET	7.3
B-36	FL9517A	06/13/95	AMERICAN AVOCET	18.1
B-36	FL9516A	06/13/95	AMERICAN AVOCET	13.4
B-36	FL9524A	06/13/95	AMERICAN AVOCET	7.5
B-36	FL9523A	06/13/95	AMERICAN AVOCET	7.1
B-36	FL9522A	06/13/95	AMERICAN AVOCET	10.2
B-36	FL9521A	06/13/95	AMERICAN AVOCET	8.4
B-36	FL9518A	06/13/95	AMERICAN AVOCET	9.7
B-36	FL9519A	06/13/95	AMERICAN AVOCET	6.7
B-41	FL9525A	06/13/95	AMERICAN AVOCET	6.0
B-41	FL9526A	06/19/95	AMERICAN AVOCET	9.4
B-41	FL9527A	06/19/95	AMERICAN AVOCET	6.4
B-41	FL9529A	06/19/95	AMERICAN AVOCET	6.2
B-41	FL9528A	06/19/95	AMERICAN AVOCET	5.2

Table 17. Results of selenium analyses of water-bird livers collected in 1995 in the Freezeout Lake area, Montana

[All concentrations are total. Abbreviation: µg/g, micrograms per gram of dry sample weight]

Site number (fig. 3)	Sample identification	Date	Taxon	Selenium concentration (µg/g)
B-14	FLP3C195	08/01/95	AMERICAN COOT	8.3
B-14	FLP3C295	08/01/95	AMERICAN COOT	6.7
B-14	FLP3C395	08/01/95	AMERICAN COOT	7.9
B-14	FLP3C595	08/03/95	AMERICAN COOT	9.5
B-14	FLP3C495	08/03/95	AMERICAN COOT	4.5
B-14	FLP3C795	08/04/95	AMERICAN COOT	2.3
B-14	FLP3C695	08/04/95	AMERICAN COOT	8.4
B-14	FLP3C895	08/04/95	AMERICAN COOT	5.2
B-14	FLP3C095	08/04/95	AMERICAN COOT	5.2
B-14	FLP3C995	08/04/95	AMERICAN COOT	5.4
B-37	FL4AAV95	07/19/95	AMERICAN AVOCET	14.1
B-38	FL4BAV95	07/19/95	AMERICAN AVOCET	2.9

* U.S. GOVERNMENT PRINTING OFFICE:1997-576-455/65073