Biosolids, Soil, Crop, Ground-Water, and Streambed-Sediment Data for a Biosolids-Application Area near Deer Trail, Colorado, 2002-2003

By Tracy J.B. Yager, David B. Smith, and James G. Crock

Prepared in cooperation with the
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Conversion Factors

Multiply	**by**	**To obtain**
acre	0.4047	hectare (ha)
centimeter (cm)	0.3937	inch
foot (ft)	0.3048	meter
gallon (gal)	3.785	liter
gram (g)	0.035	ounce
inch	2.54	centimeter
kilogram (kg)	2.205	pound (lb), avoirdupois
liter (L)	0.2642	gallon (gal)
micrometer (µm)	0.00003937	inch
mile (mi)	1.609	kilometer
milligram (mg)	0.00003527	ounce, avoirdupois
milliliter (mL)	0.0610	cubic inch
millimeter (mm)	0.03937	inch
square mile (mi^2)	2.590	square kilometer

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) using the formula °F = (1.8 x°C) + 32.

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) using the formula °C = (°F -32) /1.8

ADDITIONAL ABBREVIATIONS

gal/min	gallons per minute
ppm	parts per million
mg	milligrams
mg/g	milligrams per gram
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter at 25 degrees Celsius
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
ρCi/g	picocuries per gram
pCi/L	picocuries per liter

Veritcal coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

Horizontal coordinate information is referenced to North American Datum of 1983 (NAD 83) except as noted.

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

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius.

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

Biosolids, Soil, Crop, Ground-Water, and Streambed-Sediment Data for a Biosolids-Application Area Near Deer Trail, Colorado, 2002-2003

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Abstract

In January 1999, the U.S. Geological Survey began an expanded monitoring program near Deer Trail, Colorado, in cooperation with the Metro Wastewater Reclamation District and the North Kiowa Bijou Groundwater Management District. Monitoring components were biosolids, soils, crops, ground water, and streambed sediments. The monitoring program addresses concerns from the public about chemical effects from applications of biosolids to farmland in the Deer Trail, Colorado, area. Constituents of primary concern to the public are arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and gross beta activity, and they are included for all monitoring components. This report presents chemical data from the fourth and fifth years of the monitoring program, 2002 through 2003, for biosolids, soils, crops, alluvial and bedrock ground water, and streambed sediment. The ground-water section also includes climate data and water levels. The chemical data include the constituents of highest concern to the public in addition to many other constituents.

Introduction

Since 1993, the Metro Wastewater Reclamation District (MWRD) has been applying biosolids resulting from municipal sewage treatment in Denver, Colo., to their property near Deer Trail, Colo. The biosolids are trucked about 75 mi east from Denver to the MWRD property and are applied to nonirrigated farmland. From 1993 to 1999, the U.S. Geological Survey (USGS), in cooperation with the MWRD, monitored the quality of shallow ground water on the MWRD central property (fig. 1 in the Data Section at the back of the report), which encompassed about 15 mi^2 and was the first property the MWRD purchased near Deer Trail. In 1995, the MWRD traded some of the property and acquired additional property in the same area. The new property consisted of about 14.5 mi^2 known as the north property and about 50 mi^2 known as the south property. In 1999, the three MWRD properties together, known as the METROGRO Farm, encompassed almost 70 mi^2 of farmland, including land in Arapahoe and Elbert Counties. The three MWRD properties and surrounding private property are hereinafter referred to as “the study area” (fig. 1).

The study area is located on the eastern plains of Colorado about 10 mi east of Deer Trail. The study area is on the eastern margin of the Denver Basin, a bowl-shaped sequence of sedimentary rocks that was formed in an ocean or near-ocean environment. The geology of the study area consists of interbedded shale, siltstone, and sandstone, which may be overlain by clay, windblown silt and sand, or alluvial sand and gravel (Sharps, 1980; Major and others, 1983; Robson and Banta, 1995). The primary water-supply aquifer is the Laramie-Fox Hills aquifer, which is a bedrock aquifer that ranges from 0 to about 200 ft thick in the study area and is the bottom aquifer in the Denver Basin aquifer sequence (Robson and others, 1981; Robson and Banta, 1995). Multiple alluvial aquifers are present in the study area. These aquifers are associated with the surficial drainage network and contain water of variable quality, are of limited extent, and generally yield little water (Stevens and others, 2003; Yager and Arnold, 2003). The study area is within the South Platte River drainage basin; all streams in this area drain northward to the South Platte River (U.S. Geological Survey, 1974; Seaber and others, 1987; Yager and Arnold, 2003). Short segments of some of the streams are intermittent, but in general, the streams are ephemeral and flow only after storms. No surface water flows off the MWRD properties except after storms. Most ponds in the area have been created by detention structures. Soils in the area generally are sandy or loamy on flood plains and stream terraces, clayey to loamy on gently sloping to rolling uplands, and sandy and shaley on steeper uplands (Larsen and others, 1966; Larsen and Brown, 1971).

Land use in the study area was historically rangeland or cropland and pasture (U.S. Geological Survey, 1980). Some petroleum exploration was done in the area (Drew and others, 1979), but no oil or gas production took place within the study area during 2002-2003. Land use in the study area during 2002-2003 was rangeland or cropland. Cattle and sheep are the primary domesticated animals grazing the area, and wheat is the primary crop. Farmland is not irrigated. Land use on the MWRD properties during 2002-2003 was primarily cropland (with biosolids applied as a fertilizer) and some rangeland.

Public concern about applications of biosolids to farmland increased after the MWRD agreed to accept treated ground water from the Lowry Landfill Superfund site in Denver. The concern was that water from the Lowry Superfund site might contain radionuclides that would then contaminate the MWRD biosolids. In January 1999, the USGS began a new monitoring program in cooperation with the MWRD and the North Kiowa Bijou Groundwater Management District. The USGS refers to this monitoring program (1999–2004) as the “expanded monitoring program.”

The expanded monitoring program near Deer Trail is distinct from, but builds on, the previous monitoring program in which the USGS monitored the quality of shallow ground water on the MWRD central property (1993–99). Relative to the previous program, the expanded program includes a larger study area (fig. 1) (all three MWRD properties and private-property locations), more monitoring components (biosolids, soils, crops, and streambed sediments in addition to ground water), a more comprehensive list of chemical constituents, expanded statistical analyses of data, and an extended monitoring period (1999–2003). Both programs use USGS and MWRD funds. Both programs are designed, accomplished, and interpreted independently by the USGS, and quality-assured USGS data and reports are released to the public and the MWRD at the same time.

Biosolids are applied by the MWRD to their properties near Deer Trail according to agronomic loading rates. Land-applied biosolids must meet Colorado regulations for metals and radioactivity; otherwise, agronomic loading rates could be exceeded and soils could become overloaded. Soil quality either can be improved by biosolids applications through increased nutrients and organic matter or degraded through accumulation of excessive nutrients or metals. Pesticides, herbicides, and other fertilizers also may have been applied to the MWRD properties in the past, but little information is available about these applications.

Animal waste related to grazing domestic livestock and applications of pesticides, herbicides, and fertilizers (including biosolids) can affect soil quality, crops, water quality in alluvial and bedrock aquifers, and streambed-sediment chemistry. Water quality can be affected directly by contaminated recharge water or by infiltration of water through contaminated soils or sediments (remobilization). Water quality can be affected indirectly by tilling that mobilizes or mixes subsurface chemical constituents or by contributions to natural processes such as nitrification. Contaminated ground water or surface water could contaminate other aquifers (such as bedrock water-supply aquifers or alluvial aquifers), other surface-water bodies (ponds or streams), or streambed sediments.

The expanded monitoring program near Deer Trail addresses these concerns about biosolids applications and other farming-related effects on the environment and should increase scientific insight about Denver Basin hydrology. The objectives of this USGS program are to (1) evaluate the combined effects of biosolids applications, land use, and natural processes on soils, crops, the bedrock aquifer, alluvial aquifers, and streambed sediments by comparing chemical data to (a) regulatory standards, (b) data from a site where biosolids are not applied (a control site), or (c) earlier data from the same site (trends); (2) monitor biosolids for trace elements and radioactivity and compare trace-element concentrations and radioactivity with regulatory standards; and (3) characterize the hydrology of the study area. The monitoring of each component (such as soils or ground water) is a stand-alone study that includes radioactivity analyses because of public concerns about effects from the Lowry Landfill Superfund site. More detailed information about the monitoring of each component is included later in this report. Monitoring results for 1999 are reported by Stevens and others (2003). Monitoring results for 2000 are reported by Yager and others (2004a). Monitoring results for 2001 are reported by Yager and others (2004b).

Purpose and Scope

The purpose of this report is to present information from the expanded monitoring program near Deer Trail for January 2002 through October 2003. This report presents data for all monitoring components of the program. The report includes information about biosolids, soils, crops, ground water (alluvial and bedrock), and streambed sediments. The ground-water section includes meteorologic data, hydrologic data (depth to ground water), and water-quality data (chemistry and field measurements). This report does not include the hydrogeologic structure maps that were done as part of the bedrock ground-water monitoring component of the program. The structure maps were used to select bedrock-aquifer monitoring locations for the expanded monitoring program. The structure maps, along with a more detailed discussion of the hydrogeology of the region, are included in an interpretive USGS report (Yager and Arnold, 2003). This report does not include any results of statistical testing of selected data for exceedance of regulatory standards and trends; plans are to include the results of such statistical tests in the interpretive report for the program.

This report is organized by monitoring component because each component (such as soils or ground water) is monitored as a separate study. For each monitoring component, the specific objectives, scope, approach, analytical results, quality-assurance information, and a discussion are included. Data in this report were collected by the USGS after the water transfer from the Lowry Landfill Superfund site to the MWRD plant. The water transfer from the Lowry Landfill Superfund site to the MWRD began in July 2000.

Acknowledgments

The USGS would like to thank all private landowners for allowing access to their properties for data collection. The USGS would especially like to thank the Price and Weisensee families and the MWRD for allowing USGS instrument or well installations on their property and the Kalcevic family for timely sediment information after storms and for allowing streambed-sediment sampling on their property.

Biosolids

Biosolids are solid organic matter recovered from a sewage-treatment process that meet State and Federal regulatory criteria for beneficial use, such as for fertilizer. Land-applied biosolids must meet or exceed Grade II, Class B criteria (Colorado Department of Public Health and Environment, 1998). Grade I exceeds Grade II. The MWRD applies Grade I, Class B biosolids to their properties near Deer Trail. The biosolids-application areas, dates of application, and application rates provided by the MWRD for their properties near Deer Trail are listed in table 1 (located in the Data Section at the back of the report); application areas (called “Destination Codes”) are shown in figure 2 (in the Data Section at the back of the report).

Objectives of Monitoring Biosolids

The biosolids must meet regulatory standards for trace elements. Exceeding these standards could adversely affect the quality of soil on which the biosolids are applied and could alter MWRD plans for the application of biosolids in Arapahoe and Elbert Counties. The composition of biosolids was monitored to provide an independently determined data set against which the MWRD chemical analyses and the regulatory standards for biosolids can be compared. The data will also constitute a chemical baseline against which any future change in the concentration of constituents analyzed for in this study may be recognized, measured, and compared.

Approach for Monitoring Biosolids

In 2002 and 2003, the USGS continued the protocol established in 1999 for monitoring MWRD biosolids for concentrations of arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and gross beta activity. Radioactivity analyses were included in response to public concerns that biosolids radioactivity could increase from the transfer of water from the Lowry Landfill Superfund site.

Biosolids samples were collected directly from the MWRD facility in Denver rather than from individual trucks or fields near Deer Trail to enable the USGS to obtain a more representative sample. Samples were collected monthly during 2002 and 2003 with the exception of May and June 2003. The samples were prepared and analyzed at the chemical laboratories of the USGS Mineral Resources Program in Denver. The concentrations in the samples were compared to applicable Colorado standards for biosolids (Colorado Department of Public Health and Environment, 1998).

Sampling Methods for Biosolids

Each biosolids sample is a 24-hour composite of 12 subsamples collected about every 2 hours by MWRD personnel at the MWRD facility. The subsamples were collected from the conveyor belt that transfers the biosolids into the transport trucks. Each sample was delivered to the USGS in two acid-washed, rinsed, 1-gallon plastic or glass bottles.

Analytical Methods for Biosolids

The biosolids material was air dried and then ground to less than 150 µm prior to chemical analysis. The biosolids samples were processed and analyzed for trace elements at the laboratories of the USGS Mineral Resources Program in Denver. In 2001, the biosolids samples were analyzed for radioactivity at a commercial laboratory, Acculabs in Colorado. The January and April 2002 biosolids samples were analyzed for radioactivity through a contract with the USGS National Water Quality Laboratory (NWQL) at Severn Trent Laboratory (STL) in Washington. The July 2002 through 2003 biosolids samples were analyzed for radioactivity through a contract with the NWQL at Eberline Services in California. The methods used to analyze the biosolids for each constituent are listed in table 2 (located in the Data Section at the back of the report).

Quality Assurance for Biosolids

The purpose of the quality-assurance program developed for the biosolids monitoring component was to ensure the analytical results were within acceptable limits of both precision (the reproducibility of results) and accuracy (the degree of conformity of results for a sample having known concentrations). The precision was determined by analyzing the same biosolids sample multiple times, and accuracy was determined by analyzing National Institute of Standards and Technology (NIST) standard reference material SRM 2781, a domestic sludge. This SRM was prepared by NIST from material collected at the MWRD treatment plant in Denver. SRM 2781 has been analyzed extensively by many laboratories throughout the world, and the NIST has certified an acceptable range of values for various constituents in the SRM. The constituents include those of interest in this study. Each biosolids sample was submitted to the laboratories with a sample of the SRM. If the analytical results for the constituent of interest in the SRM were within the acceptable range, the results for the biosolids samples were accepted. The radioactivity data provided by Acculabs were further quality assured by replicate analyses of selected samples by STL. Plans are to publish quality-assurance data for biosolids samples in a separate report.

Biosolids Data

Summaries of all the chemical analyses for trace-element concentrations and radioactivity data (gross alpha activity, gross beta activity, and plutonium concentration) for the biosolids samples collected November 2001 through July 2003 are listed in table 3 (in the Data Section at the back of the report). The table also lists the maximum allowable concentrations for Grade I biosolids.

Discussion of Biosolids Data

All trace-element concentrations were less than the maximum allowable concentrations established for Grade I biosolids. Gross alpha activity did not exceed the maximum allowable for Grade I biosolids. Until 2003, there also was a regulation for gross alpha activity. However, this regulation was revised, effective June 30, 2003, deleting the previous regulation that generally restricted land application of biosolids that exceeded a gross alpha activity of 40 pCi/g (Colorado Department of Public Health and Environment, 1998).

The radioactivity data are reported in the uncensored form as received from the laboratory rather than censored by either the contract or calculated minimum detectable concentration (MDC). Relative to the censored form (data reported as less than the MDC), the uncensored form provides more information about the uncertainty, the very small concentrations of plutonium, and the gross alpha and gross beta activity. The negative activity concentration reported for the radiochemical samples means the sample count was less than the laboratory background count for that day. Radioactivity data are produced from instruments that detect radioactive decay (disintegrations) in a sample as counts per minute. The background count was subtracted from the sample count, and the resulting value was converted to activity-concentration units of picocuries per gram.

Soils

Biosolids can contain elevated concentrations of certain trace constituents. Therefore, the application of biosolids to farmland has caused public concern regarding the potential short-term and long-term effects on soil quality.

Objectives of Monitoring Soils

Soils were monitored for trace elements and plutonium and gross alpha and gross beta activity to establish independent geochemical data sets for the composition of soil before and after the application of biosolids. The data will enable the USGS to recognize and quantify significant changes in soil composition caused by the application of biosolids to agricultural soils or by other natural or human-induced processes.

Approach for Monitoring Soils

In August 1999, the USGS began monitoring soils at two sites, one site on MWRD property in Arapahoe County and one site on MWRD property in Elbert County (fig. 1). The sites were monitored for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and gross beta activity. Radioactivity analyses were included in response to public concerns that biosolids radioactivity could increase because of the transfer of water from the Lowry Landfill Superfund site to the MWRD. Soil samples were collected once before the application of biosolids to monitoring sites, and the data were reported in progress reports and in the annual data reports for 1999 (Stevens and others, 2003), 2000 (Yager and others, 2004a), and 2001 (Yager and others, 2004b). Soil monitoring will continue through two cycles of biosolids application and crop harvest. In 2002, the Elbert County monitoring site was sampled on September 19 after the wheat harvest. The Arapahoe County site was sampled on October 17, 2002.

Fields that receive biosolids applications were monitored along with fields that receive no biosolids, which represented reference conditions for comparison. Each of the two soil-monitoring sites consisted of three 20-acre (933 ft by 933 ft) fields separated by 100-ft buffer zones (figs. 3 and 4 in the back of the report). Biosolids were applied on the center 20-acre field at each site after the initial soil sampling. The other two 20-acre fields at each site did not have biosolids applied and were used as “control” fields to determine the natural variability of soil composition for the duration of the study. All three 20-acre fields at each site are farmed in a similar way as the rest of the MWRD property and have crops planted and harvested. Soils from each of the six fields were sampled in 1999 before biosolids were applied to the two center fields and are sampled again after each harvest. Data are compared after each sampling and again at the conclusion of the study to determine how the elements of interest vary with time.

Site Selection for Monitoring Soils

Sites were selected on MWRD properties where biosolids have never been applied. One site was selected on the MWRD north property in Arapahoe County, and one site was selected on the MWRD south property in Elbert County. The Arapahoe County site is located in T. 4 S., R. 58 W., sec. 22 and lies about 0.25 mi west of Badger Creek (fig. 3). The Elbert County site is located in T. 6 S., R. 57 W., sec. 8 and lies immediately west of Beaver Creek (fig. 4).

Sampling Methods for Soils

The sampling protocol was designed to answer the following question: What is the average composition of the top 12 inches of soil in each of the six 20-acre fields? To address this question, soil samples were collected with a standard soil auger to a depth of 12 inches according to a systematic grid pattern. For each of the two fields to which biosolids are applied, 30-36 subsamples are collected on approximately 133- to 150-ft centers. A similar grid is used to collect 30 subsamples from the four "control" fields.

Analytical Methods for Soils

All soil subsamples are air dried at ambient temperature in the laboratories of the USGS Mineral Resources Program in Denver. Each of the dried subsamples is disaggregated and sieved to less than 2 mm. This minus-2-mm material then is ground to less than 150 µm. Splits of each subsample are taken for archival storage, and the subsamples for each field are composited into one sample for chemical analysis. The composite soil samples, each representing one 20-acre field, were analyzed for trace elements at the laboratories of the USGS Mineral Resources Program in Denver. The 2002 soil samples were analyzed for radioactivity at Eberline Services, a commercial laboratory in California, through a contract with the USGS NWQL. Analytical methods for the soil samples are listed in table 2.

Quality Assurance for Soils

The accuracy of the soil analysis was evaluated by the analysis of NIST SRM 2709, an agricultural soil. Separate splits of this SRM were randomly placed among the soil samples and submitted to the laboratories. If the analytical results for the constituent of interest in the SRM are within an acceptable range, analytical results for the soil samples are accepted. Separate splits of each composited soil sample were analyzed independently and the results averaged to determine the concentration reported for a given constituent.

Soil Data

In 2002, the Elbert County monitoring site was sampled on September 19 after the wheat harvest. The Arapahoe County site was sampled on October 17. The samples from both sites were prepared and submitted to the laboratories for chemical analysis in 2003. Data for both sites are listed in table 4 (in the Data Section at the back of the report).

Discussion of Soil Data

The Elbert County samples for both control and biosolids-applied fields had higher trace-element concentrations than the Arapahoe County samples. This relation also was noted in the 1999 data report (Stevens and others, 2003) for the samples taken before biosolids were applied and in the 2001 data report (Yager and others, 2004b) for the samples collected after the first application of biosolids to the center 20-acre field at both the Arapahoe and Elbert County sites.

The radioactivity data are reported in the uncensored form as received from the laboratory rather than censored by either the contract or calculated MDC. Relative to the censored form (data reported as less than the MDC), the uncensored form provides more information about the uncertainty, the very small concentrations of plutonium, and the gross alpha and gross beta activity. The negative activity concentration reported for the radiochemical samples means the sample count was less than the laboratory background count for that day. Radioactivity data are produced from instruments that detect radioactive decay (disintegrations) in a sample as counts per minute. The background count was subtracted from the sample count, and the resulting value was converted to activity-concentration units of picocuries per gram.

Crops

As previously mentioned, biosolids can contain elevated concentrations of certain trace elements. The application of biosolids to farmland on which grains are grown that will eventually be consumed by animals or humans has led to public concern about the composition of the crops grown on the fields receiving biosolids.

Objectives of Monitoring Crops

Crops are monitored for trace elements (and selected samples are monitored for plutonium and gross alpha and gross beta activity) to establish independent chemical data sets for the composition of the crops before and after the application of biosolids. The data will enable the USGS to recognize and quantify significant changes in crop composition caused by the application of biosolids to agricultural soils or by other natural or human-induced processes.

Approach for Monitoring Crops

In the summer of 2000, the USGS began monitoring crops grown on the same two sites where soils were monitored. One of these sites is on MWRD property in Arapahoe County, and one site is on MWRD property in Elbert County. The crop samples were analyzed for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. Selected samples also were analyzed for plutonium and gross alpha and gross beta activity in response to public concerns that biosolids radioactivity could increase because of the transfer of water from the Lowry Landfill Superfund site to the

MWRD. Data from the 2000 harvest were reported in the 2000 data report (Yager and others, 2004a). During 2001, no crops were grown on either the Arapahoe or Elbert County soil-monitoring site. In 2002, wheat was sampled from both sites. In 2003, no crops were grown on either the Arapahoe or Elbert County soil-monitoring site.

Crops grown on fields that receive biosolids applications are monitored along with crops grown on fields that do not receive biosolids applications. The crops from fields that do not receive biosolids applications are used as a reference for comparison. Each of the two crop- and soil-monitoring sites consist of three 20-acre (933-ft by 933-ft) fields separated by 100-ft buffer zones (figs. 3 and 4). In 1999, the center 20-acre field at each site received a single biosolids application after the initial soil sampling. The other two 20-acre fields at each site do not receive biosolids and are used as "control" fields to determine the natural variability of soil and crop composition for the duration of the study. All three 20-acre fields at each site are farmed in a similar way as the rest of the MWRD property and have crops planted and harvested approximately every other year. Data will be compared after each sampling and at the conclusion of the study to determine how the concentrations of the constituents of interest vary with time.

Site Selection for Monitoring Crops

The soil-monitoring fields (figs. 3 and 4) also were used for monitoring crops. Crops were planted on each of the six 20-acre soil-monitoring fields. Sites were selected on MWRD properties where biosolids have never been applied. One site was selected on the MWRD's north property in Arapahoe County, and one site was selected on the MWRD's south property in Elbert County. The Arapahoe County site is located in T. 4 S., R. 58 W., sec. 22 and lies about 0.25 mi west of Badger Creek (fig. 3). The Elbert County site is located in T. 6 S., R. 57 W., sec. 8 and lies immediately west of Beaver Creek (fig. 4).

Sampling Methods for Crops

The sampling protocol was designed to determine the average composition of the crop in each of the six 20-acre fields. In 2002, wheat in the Arapahoe County fields was collected within days after harvest. Plants that retained grain after harvest were sampled using stainless steel pruning shears to cut the plants a few inches below the seed head. Subsamples were collected throughout each field and placed in a large plastic bag for transportation to the laboratory. For the Elbert County fields, samples were collected directly from the combine as the wheat was discharged to the transfer truck. A subsample was collected to represent each quadrant of each 20-acre field and transported to the USGS laboratories in cardboard boxes.

Analytical Methods for Crops

The grain samples were dried under forced air at room temperature. For the wheat samples from Arapahoe County, the grain was separated from the head by placing the entire sample in a heavy plastic bag and manipulating the heads by hand to free the grain. The grain was then cleaned using forced air and sieving. The grain samples from Elbert County were cleaned in a similar manner and composited into one sample for each 20-acre field. The clean wheat samples were ground to a flour using a commercial table-top mill. A split of each ground sample was ashed in a forced-air muffle furnace at 500^{o} C. Both the ashed grain samples and the dried, unashed grain samples were analyzed by the protocols described in detail by Yager and others (2004a). The crop samples were processed and analyzed for trace elements at the laboratories of the USGS Mineral Resources Program in Denver. The crop samples were analyzed for radioactivity at a commercial laboratory, Eberline Services in California, through a contract with the NWQL. The analytical methods are summarized in table 2.

Crop Data

In 2002, wheat on both the Elbert County and Arapahoe County monitoring sites was sampled in July. The samples were prepared and submitted to the laboratories for chemical analysis in 2003. Data for both these sites are listed in table 5 (in the Data Section at the back of the report).

Discussion of Crop Data

There are few differences between metal concentration of wheat grains collected in Arapahoe County and wheat grains collected in Elbert County. Fluctuations generally fall within the normal range of uncertainty associated with using a limited number of subsamples to chemically characterize a large population. The chemical differences between wheat collected from the 20-acre fields to which biosolids have been applied and wheat from the control fields where no biosolids have been applied are minimal with two exceptions. Nickel concentration in wheat grains from the Elbert County application field is 8.7 mg/kg as compared to the two control fields where the nickel values are 1.7 and 3.6 mg/kg. Similarly, lead concentration in wheat grains from the Elbert County application field is 0.07 mg/kg whereas lead in wheat grains from the two control fields is 0.01 and 0.03 mg/kg. However, the current study was conducted through only two crop cycles. In order to determine whether these variations are in any way related to the application of biosolids, data from several more crop cycles are required. For example, selenium concentrations in wheat grains in the two control fields in Elbert County were 2.6 mg/kg to 0.36 mg/kg. If this range is typical of the variability in trace metals in the control fields where no biosolids were ever applied, then the differences discussed above for lead and nickel are nothing more than the normal variations caused, again, by the uncertainties arising from characterizing a large population with a limited number of subsamples.

The radioactivity data are reported in the uncensored form as received from the laboratory rather than censored by either the contract or calculated MDC. Relative to the censored form (data reported as less than the MDC), the uncensored form provides more information about the uncertainty, the very small concentrations of plutonium, and the gross alpha and gross beta activity. The negative activity concentration reported for the radiochemical samples means the sample count was less than the laboratory background count for that day. Radioactivity data are produced from instruments that detect radioactive decay (disintegrations) in a sample as counts per minute. The background count was subtracted from the sample count, and the resulting value was converted to activity-concentration units of picocuries per gram.

Ground Water

Applications of pesticides, herbicides, or fertilizers (including biosolids) to the land surface can affect the quality of shallow ground water directly by contaminated recharge or by infiltration through contaminated soils or sediments (remobilization). These applications also can affect the quality of shallow ground water indirectly by tilling (which could mobilize subsurface constituents) or by contributions to natural processes such as nitrification. Further, discharge from contaminated alluvial ground water could contaminate surface water (ponds or streams) or bedrock water-supply aquifers. For this report, alluvial ground water is defined as the water contained in subsurface, unconsolidated (uncemented), wind- or water-transported sediments in current or historical stream channels or flood plains. Bedrock ground water is defined as the water contained in the fractures or pore spaces of the rock (consolidated sediments) that underlies soil or other uncemented materials; the primary bedrock aquifer in the study area is the Laramie-Fox Hills aquifer (Robson and Banta, 1995). Alluvial and bedrock ground water are separate components in the monitoring program but are combined in this report because the data were collected in the same way and the types of data included are the same.

Objectives of Monitoring Ground Water

Ground water was monitored to characterize the hydrology and water quality of the aquifers; to determine if concentrations of nitrate, arsenic, cadmium, copper, chromium, lead, mercury, molybdenum, nickel, selenium, zinc, and plutonium and gross alpha and gross beta activity in the ground water are significantly greater than regulatory standards; and to determine if concentrations of these constituents are increasing with time in ground water at or near the MWRD properties.

Approach for Monitoring Ground Water

Structure maps of the top and base of the Laramie-Fox Hills aquifer were compiled for the study area by using available information such as geophysical logs from oil and gas exploration and other data. The structure maps are included in an interpretive USGS report by Yager and Arnold (2003). The structure maps were used to determine locations for well pairs: two bedrock-aquifer wells and two alluvial-aquifer wells that constitute the recharge-evaluation sites. Multiple wells in the same location enable different zones of ground water to be monitored without having to consider spatial variability and can enable inferences about vertical directions of ground-water flow between zones. Each of the two bedrock-aquifer wells are nested, which means each borehole has two separate piezometers screened at two separate zones. Therefore, three different aquifer zones are monitored at each of the two recharge-evaluation sites in Muddy Creek downgradient from the MWRD properties (fig. 1). A fourth aquifer zone (well DTX11) is monitored at the DTX9 recharge site to provide information about a deeper coarse-grained part of the Muddy Creek alluvial aquifer than is monitored by well DTX9. Lithologic and well-completion information for these wells are included in the 1999 data report (Stevens and others, 2003) or the 2000 data report (Yager and others, 2004a). In 2000, electronic data-logger (EDL) equipment was installed to continuously monitor precipitation and water levels in wells DTX9, DTX10, and DTX11 and to provide more detailed information about ground-water recharge at that location. The 2002-2003 EDL data are included in this report but are not available on the Internet.

Monitoring wells for the expanded monitoring program include selected wells installed as part of the previous monitoring program and new wells. Of the 33 USGS ground-water monitoring wells from the previous study on the MWRD central property, 7 are included in this study (all 7 wells were monitored for water levels, and water-quality samples were collected from 6 of these wells). “D”-numbered wells were drilled before 1999 as part of the previous monitoring program (except for wells D6A and D25A), and “DTX”-numbered wells were drilled in 1999 or 2000 (fig. 1). Lithologic and well-completion information for these well locations are provided by Stevens and others (2003) and Yager and others (2004a). During 2002-2003, a few additional wells from the previous study on the MWRD central property also were monitored. Well D19 was monitored for ground-water level, and wells D15 and D23 were sampled once for water quality. Information for all the USGS wells monitored during 2002-2003 as part of this program is summarized in table 6 (in the Data Section at the back of the report).

In 2002, the USGS drilled and collected core from three new boreholes on the MWRD central property to provide additional information about wells from the previous study: wells D6, D9, and D25. Lithologic descriptions from core samples at these sites are described by Yager and Arnold (2003). Selected core samples were analyzed for inorganic chemistry; data for these core samples are listed in table 7 (in the Data Section at the back of the report). The new borehole adjacent to well D6, known as well D6A, and the new borehole adjacent to well D25, known as well D25A, were completed as alluvial monitoring wells, monitored monthly for water level, and sampled twice for chemistry. The new borehole adjacent to well D9 was not completed as a monitoring well but was closed after drilling along with well D9.

Water levels in the monitoring wells were measured monthly during January 2002 through September 2003, then about every other month for the remainder of 2003. Data-collection platforms (DCP's) with various sensors were installed during summer and fall of 1999 at three alluvial-aquifer wells (D25, DTX2, and DTX5) to continuously monitor ground-water levels, water temperature, precipitation, and air temperature. The data were transmitted to Denver by satellite and usually were available on the Internet. The data provided information about the hydrology in the study area and the response of ground water to climate variables.

Water samples were collected from alluvial-aquifer wells on the MWRD properties (fig. 1), and water samples were collected from the shallowest zones of the bedrock aquifer at three locations that are important to alluvial/bedrock ground-water interactions. During most of the monitoring program, the remaining USGS monitoring wells were used to provide hydrologic information only. However, water-quality samples were collected from the two alluvial-aquifer wells (DTX9 and DTX11) at one of the recharge sites once in 2003. During 1999 through September 2003, ground-water samples were collected and analyzed quarterly for physical properties, dissolved major ions and trace elements, and dissolved and total nutrients. After September 2003, ground-water samples were collected from only selected wells in the monitoring program, and not every well was sampled every quarter. Analyses were done by the USGS National Water-Quality Laboratory (NWQL) and included nitrate, arsenic, cadmium, copper, chromium, lead, mercury, molybdenum, nickel, selenium, and zinc. Samples also were collected and analyzed annually for total plutonium. Gross alpha and gross beta activity analyses were included in the 1999 monitoring but were discontinued because of matrix-interference problems caused by the high concentrations of dissolved solids in the ground-water samples. The plutonium and gross alpha and gross beta activity analyses were included in the monitoring program in response to public concerns that radioactivity in biosolids could increase from the transfer of water from the Lowry Landfill Superfund site to the MWRD. Water levels and field measurements such as pH and specific conductance were recorded with the collection of each ground-water sample. Blank and replicate samples were analyzed to evaluate bias and variability of the ground-water data.

All data are maintained in the USGS National Water Information System (NWIS) data base. Selected data were published in the "USGS Expanded Monitoring Program Near Deer Trail" quarterly and progress reports. All ground-water data collected for this program during 1999 were published in Stevens and others (2003). All ground-water data collected for this program during 2000 were published in Yager and others (2004a). All ground-water data collected for this program during 2001 were published in Yager and others (2004b). Selected water-quality data will be statistically analyzed approximately each year of the program and after about 5 years to determine (1) if concentrations in the ground water are significantly greater than regulatory standards and (2) if the concentrations are increasing significantly with time.

Site Selection for Monitoring Ground Water

Shallow aquifers can be recharged by runoff and streamflow or can contribute water to streamflow and ponds. Therefore, the sites for alluvial-aquifer wells were selected by the USGS according to the following criteria: (1) locations in proximity to a stream channel that could carry runoff from MWRD biosolids-applied fields, (2) locations at the most downstream point of the drainage basin, (3) locations at MWRD property boundaries to represent the condition of ground water leaving the properties and to consider only those effects from activities on MWRD properties and not from other landowners, (4) locations where most of the upstream basin is on MWRD property, (5) locations that represent the larger drainage basins, (6) locations where USGS monitoring wells already existed and where data already had been collected, and (7) locations accessible year round for drilling and sampling wells. Alluvial-aquifer wells were not installed upgradient from MWRD property boundaries because the constituents of concern generally are not conservative along the ground-water flow path; that is, subtracting upgradient concentrations from downgradient concentrations may not represent the effects of biosolids on the ground water for these constituents. Monitoring alluvial ground water near Rattlesnake Creek was a low priority because most of the basin is upstream from the MWRD properties, and that part of the basin that receives biosolids is relatively small. Therefore, the USGS installed two alluvial-aquifer wells on the MWRD north property and four on the MWRD south property (fig. 1). All wells on the MWRD central property used for this study (fig. 1) were installed before 1999 as part of the previous monitoring program, except for wells D6A and D25A. Wells D6A and D25A were installed in 2002 to provide additional lithologic information for those locations and to provide ground-water level and water-quality information for a more specific part of the aquifers than monitored by D6 and D25. Two additional wells from the previous monitoring program, D15 and D23, were sampled once for water quality in 2003 to provide data after biosolids were applied upgradient on the MWRD property in 1999 as part of a reclamation project near well D17 (Stevens and others, 2003).

Bedrock aquifers can be recharged by alluvial ground water or can be a source of water to alluvial aquifers. Therefore, the sites for bedrock-aquifer wells were selected by the USGS according to the following criteria: (1) locations where a particular sandstone sequence within the Laramie-Fox Hills aquifer is present at substantial areal extent and thickness, (2) locations on MWRD property where the bedrock aquifer is present without an alluvial aquifer, (3) locations where the bedrock aquifer is present beneath an alluvial aquifer that could be affected by the application of biosolids, (4) locations where USGS monitoring wells already existed and where data already had been collected, and (5) locations accessible year round for drilling and sampling wells. Locations where the particular sandstone sequence within the bedrock aquifer is present in this area were determined by the USGS on the basis of the USGS structure maps (completed in 1999) of the top and base of the Laramie-Fox Hills aquifer in this area (Yager and Arnold, 2003). For the expanded monitoring program, the USGS installed two new bedrock-aquifer wells (DTX8 and DTX10) in 1999, along with corresponding alluvial-aquifer wells (DTX7 and DTX9) (fig. 1), at locations where the bedrock aquifer is present beneath the Muddy Creek alluvial aquifer; the Muddy Creek alluvial aquifer could be affected by the application of biosolids. One previously installed USGS ground-water monitoring well, D29 (fig. 1), was included in this monitoring program because the well is on MWRD property where the bedrock aquifer is present without an alluvial aquifer, and prior sampling data are available.

DCP sites provided information about the variability in space and time of climate and hydrology in the study area as well as about the hydrologic responses to climate. This monitoring program includes three DCP sites, one on each of the MWRD north, south, and central properties (wells DTX2, DTX5, and D25, respectively). The locations of these DCP sites were selected according to the following criteria: (1) locations where alluvial-aquifer wells are sampled, (2) locations near possible streambed-sediment sampling areas (to indicate likely runoff conditions), (3) locations near other wells so the information may apply to more than one well, (4) locations far enough apart from each other to indicate spatial variability in hydrology, (5) locations needing additional hydrologic information to explain chemical variability (well D25), and (6) locations accessible year round.

Sampling Methods for Ground Water

All data-collection methods used in 2002-2003 were the same as the 1999 methods, which are detailed in the 1999 data report (Stevens and others, 2003). Monthly water-level measurements were made using a vinyl-coated electric tape. DCP and EDL data were automatically recorded hourly. Water-quality samples were collected quarterly using standard USGS methods (Horowitz and others, 1994; U.S. Geological Survey, variously dated). All sampling equipment was used exclusively by the USGS and was used only in the study area to prevent cross contamination from other sites in other study areas. All samples and sampling equipment were kept at all times in the custody of the USGS in locked, guarded facilities.

Analytical Methods for Ground Water

Ground-water samples were submitted to the USGS NWQL in Denver. Plutonium analyses were done by Severn Trent Laboratory in Richland, Wash., under a contract with the USGS NWQL. All other analyses were done by the NWQL. The methods used to analyze the 2002-2003 ground-water samples are listed in table 8 (at the back of the report) along with laboratory MRL’s for the elements of interest.

Quality Assurance for Ground Water

Quality-assurance procedures were implemented during the course of the monitoring program to ensure the quality of the data. Procedures were implemented for water-level measurements, DCP-data and core-data collection, ground-water-sampling preparation, field-parameter measurements, ground-water sampling, and laboratory analysis. Quality-assurance procedures are detailed in the 1999 data report (Stevens and others, 2003). The analytical quality-assurance practices and procedures of the NWQL are described in Friedman and Erdmann (1982).

Ground-Water Data

Monitoring at ground-water sites during 2002-2003 produced meteorologic, hydrologic, and water-quality data. Meteorologic data include precipitation at four sites and air temperature at three sites. Hydrologic data include monthly water levels at all wells, hourly water levels and water temperature at three DCP sites, and hourly water levels at three EDL wells. Water-quality data include analytical results from quarterly sampling. Information about the ground-water monitoring sites is listed in table 6.

Meteorologic Data

Precipitation and air temperature were recorded hourly during 2002-2003 at wells D25, DTX2, and DTX5 (figs. 5 through 7 at the back of the report). Precipitation was recorded hourly during 2002-2003 at the EDL site, the well cluster including well DTX11 (fig. 8 at the back of the report). Rain occurred during thunderstorms and frontal storms, usually during April–October. The precipitation data recorded during October through December could represent melted snow. The data indicate air temperatures can fluctuate more than 20°C during the day but were similar for all monitored sites.

Hydrologic Data

Monthly water-level data and continuous water-level and water-temperature data can be useful for describing the hydrology of the aquifers in the area near Deer Trail. The monthly water-level data for the USGS monitoring wells used in this study are listed in table 9 (at the back of the report), and the continuous water-level and water-temperature data for the three DCP sites (D25, DTX2, and DTX5; fig. 1) are shown in figures 5 through 7 (at the back of the report). Continuous water-level data for the EDL site (wells DTX9, DTX10, and DTX11; fig. 1) and precipitation data are shown in figure 8 (at the back of the report). Monthly water-level data are listed as depth to water below measuring point at a specific time. Continuous water-level data are shown as daily maximum depth to water below land surface. Water-level data can indicate seasonal effects and can aid in the interpretation of chemical data.

Water-level data also can indicate ground-water recharge information. Robson and others (1981) showed that recharge of the Laramie-Fox Hills aquifer along the margin of the Denver Basin (such as in the Deer Trail area) can be from deeper parts of the Denver Basin, from alluvial aquifers and surficial features, or from infiltration of precipitation on or near outcrop areas. Recharge of the alluvial aquifers in the Deer Trail area can be from the Laramie-Fox Hills aquifer, from surface-water features, or from infiltration of precipitation (Robson and others, 1981). Hydrologic interactions between alluvial and bedrock aquifers can be inferred using water-level data for the same point in time for wells drilled into the aquifers at the same site. The direction of the vertical movement of ground water, or the recharge direction, may be indicated by noting that water moves from areas of high hydraulic head (high water-level elevation) to areas of low hydraulic head (low water-level elevation). For the expanded monitoring program, such interactions were monitored at two recharge-evaluation sites, each of which included at least one alluvial-aquifer well and one nested bedrock-aquifer well. The interactions in the bedrock aquifer were monitored in two different zones (designated by “A” [shallow] or “B” [deep] after the well name). Therefore, three aquifer zones (one alluvial, one shallow bedrock, and one deep bedrock) were monitored at the north recharge-evaluation site (wells DTX7 and DTX8), and four aquifer zones (two alluvial, one shallow bedrock, and one deep bedrock) were monitored at the south recharge-evaluation site (wells DTX9, DTX10, and DTX11). Water levels for the paired alluvial-aquifer and bedrock-aquifer wells at the north recharge-evaluation site are shown for discrete time periods in figure 9 (2002; at the back of the report) and figure 10 (2003; at the back of the report). Water levels for the paired alluvial-aquifer and bedrock-aquifer wells at the south recharge-evaluation site are shown for the continuous period 2002-2003 in figure 11 (at the back of the report). The May/June water levels shown in figures 9 and 10 represent spring-recharge (rainy) conditions. The July water levels shown in figures 9 and 10 represent hot, dry summer conditions. The September water levels shown in figures 9 and 10 represent summer-recharge (rainy) conditions.

Water-Quality Data

Water-quality data for samples collected quarterly from 11 alluvial-aquifer and 3 bedrock-aquifer wells (fig. 1) in 2002-2003 are listed in table 10 (at the back of the report). Data are given for field parameters, physical properties, major ions, nutrients, and trace elements. Radioactivity data are included for January 2002 and January 2003 samples. Quality-control water-quality data for the blank samples are listed in table 11 (at the back of the report), and comparison data for replicate samples are listed in table 12 (at the back of the report).

Discussion of Ground-Water Data

Concentrations for the blank samples (table 11) generally indicate little or no contamination bias. The blank samples collected January 10, 2002, January 8, 2003, and October 7, 2003, were from the submersible pump, and these data indicate a slight high bias in some major- and trace-element concentrations; this pump is used only at wells DTX8A, DTX10A, and D29, so only samples from these wells may be affected. In general, concentrations for the blank samples were much less than those for the ground-water samples. Data for some of the blank samples (table 11) and rerun samples (not included in this report) indicate occasional slight contamination bias in laboratory analyses of aluminum, arsenic, copper, nickel, and zinc. Therefore, the sample data that indicate small concentrations of aluminum, arsenic, copper, nickel, and zinc could be affected by a slight high bias.

The relative percent differences (RPD) between the ground-water samples and the replicate samples were computed to summarize sample variability (table 12). Many of the larger RPD’s are due to values or concentrations near the MRL where precision is expected to be poor. In these cases, concentrations may vary little but result in large RPD’s. For example, a ground-water sample concentration of 0.01 mg/L and a replicate-sample concentration of 0.02 mg/L would result in an RPD of 67 percent, but the difference might be considered to be within the precision of the method at that concentration. Data values for individual replicate pairs also are listed in table 12 to help the reader determine if large RPD’s are the result of substantial differences between replicate-sample concentrations or just small differences between small concentrations. Variability in the data was highest for analyses of copper, nickel, selenium, and zinc. However, most if not all of this variability likely is from the analyses, not inherently present in the ground water or contributed through field processing. The replicate-sample data indicate generally reproducible analytical results.

The radioactivity data are reported in the uncensored form as received from the laboratory rather than censored by either the contract or calculated MDC. Relative to the censored form (data reported as less than the MDC), the uncensored form provides more information about the uncertainty, the very small concentrations of plutonium, and the gross alpha and gross beta activity. Plutonium data indicate that only two of the samples analyzed could possibly be considered as having detectable plutonium: plutonium-239+240 in the

01/14/02 ground-water sample from D30 and the field-blank sample from 01/02/03. However, the concentration reported by the laboratory for these samples was barely greater than the minimum detectable concentration calculated by the laboratory for these samples, and no source of plutonium has been identified by the USGS. Therefore, these plutonium concentrations likely represent a “false positive” produced by high laboratory bias. The negative activity concentration reported for the radiochemical samples means the sample count was less than the laboratory background count for that day. Radioactivity data are produced from instruments that detect radioactive decay (disintegrations) in a sample as counts per minute. The background count was subtracted from the sample count, and the resulting value was converted to activity-concentration units of picocuries per liter.

The data included in this report indicate alluvial- and bedrock-aquifer hydrology and chemistry are variable in space (from site to site) and in time (from one data-collection time to the next at the same site) in the study area. The distribution of concentrations at each well for selected constituents during 2002-2003 compared to Colorado regulatory standards is shown in figure 12 (at the back of the report). Time-series graphs (concentration plotted with time) of selected constituents for selected wells are included as figure 13 (at the back of the report). All concentrations of nitrite plus nitrate at well D6 were greater than the Colorado Human Health standard, and concentrations increased with time. The concentration of dissolved arsenic in a single sample (well D17 on January 7, 2002) was greater than the Colorado Human Health standard, but quality-control data for that sampling period indicate that concentration may be affected by a high laboratory bias. The concentration of dissolved selenium in a single sample (well D6 on October 3, 2003) was greater than the Colorado Human Health standard. Plans are to include the results of testing the 1999 through 2003 ground-water data for exceedance of Colorado regulatory standards and for trends in a USGS interpretive report for the 1999 through 2003 monitoring program.

Streambed Sediment

Animal waste related to grazing livestock and applications of pesticides, herbicides, or fertilizers (including biosolids) to the land surface could affect surface-water quality directly by contaminated inflow or by runoff over contaminated soils or sediments (remobilization). These applications also can affect surface-water quality indirectly by tilling that mobilizes or changes surface constituents or surface characteristics; by inflow, base flow, or recharge to surface water from contaminated ground water; or by contributions to natural processes such as nitrification. Contaminated surface water could contaminate downstream, previously uncontaminated ponds, streams, streambed sediments, alluvial aquifers, or bedrock water-supply aquifers in aquifer-recharge zones.

Surface-water contamination from biosolids applications is a public concern. However, because streams flow off the MWRD properties only after intense thunderstorms, surface-water sampling is impractical, and monitoring extreme surface-water events is difficult. Monitoring streambed-sediment chemistry is more practical and cost effective and offers greater opportunity to establish comparison or baseline sites than monitoring surface-water chemistry. For the expanded monitoring program, streambed sediment is defined as the fine-grained alluvium freshly deposited in the drainage bottoms by surface-water flow after rainstorms.

Sediment affected by the applications of biosolids could be transported off MWRD property into streambeds when precipitation is intense enough to cause overland flow. Therefore, streambed-sediment chemistry is used as an indirect indicator of surface-water quality because of the close contact between surface flows and sediment during transport. Contaminants in the streambed sediment could cause contamination in ground water or surface water if the contaminants are resuspended in water or leached from the bed sediment. Furthermore, concentrations of trace elements and plutonium and gross alpha and gross beta activity may be higher in the bed sediment than in the surface water.

Objectives of Monitoring Streambed Sediment

Streambed sediment was monitored to determine if concentrations of nitrate, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, organic carbon, gross alpha and gross beta radioactivity, and plutonium in sediments derived from (or transported through) biosolids-application areas are significantly higher than in bed sediments derived from nearby farmland that did not receive biosolids applications.

Approach for Monitoring Streambed Sediment

Two small drainage basins were selected for comparison of streambed-sediment chemistry (fig. 1). The basins have similar physical characteristics, but one basin (known as the biosolids-applied basin) receives biosolids applications and is part of the MWRD farming program, and the other basin (known as the control basin) receives no biosolids applications and is farmed privately.

A DCP site (with a rain gage) is near the biosolids-applied basin. The DCP data were transmitted remotely to enable the USGS to determine when rainfall of sufficient intensity and duration had occurred near the basins. For sampling to take place, sufficient rainfall was needed to cause the fine-grained materials and dissolved constituents to wash off the hillsides of the drainage basins into downgradient streambeds. Paired streambed-sediment samples were collected when freshly deposited streambed sediment was available from both the biosolids-applied basin and the control basin at the same time (after the same storm). The USGS determined that at least 0.50 inch of rain in a single hour had to be received by the tipping-bucket rain gage at DTX2 before runoff in the biosolids-applied basin was enough for a streambed-sediment sample to be collected. This rainfall scenario occurred only three times in 2002 and only twice in 2003; the USGS was able to collect three paired samples during 2002 and two paired samples in 2003.

During most of the monitoring program, streambed sediment samples were analyzed for nitrate, phosphorus, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, carbon, gross alpha and gross beta radioactivity, and plutonium. The radioactivity analyses were included in response to public concerns that biosolids radioactivity concentrations could increase from the transfer of water from the Lowry Landfill Superfund site to the MWRD. During 2002-2003, additional trace elements were included in the analyses. When enough paired samples are collected, data will be statistically tested to determine if streambed-sediment chemistry is significantly different between the two basins.

Site Selection for Monitoring Streambed Sediment

Several pairs of similar small basins (one on MWRD property and one on nearby private property) were considered by the USGS for monitoring. Only small (less than 5-mi^2) basins were considered because (1) the large biosolids basins did not have a nearby corresponding control basin that had similar characteristics, (2) the thunderstorms likely to cause runoff were usually localized and were not likely to affect two large basins with the same duration and intensity, (3) sampling is more efficient in small basins because each streambed-sediment sample is a composite of sediment collected throughout the basin, and (4) the large basins in the study area are more variable with respect to geology, soil type, and land use. Sediment collected from the large basins is more likely to be affected by this variability and, therefore, may not indicate effects from biosolids. The criteria used to pair basins included distance between basins; proximity to a USGS ground-water-monitoring well that included DCP instrumentation; land use (farmed); likely accessibility even after severe thunderstorms; and similar bedrock geology, soil type, aspect, stream order, channel length, channel slope, relief, and ponding. From the three basin pairs identified as candidates for streambed-sediment monitoring (Stevens and others, 2003), the pair on Badger Creek tributaries (on and near the MWRD's north property) was selected. The selected basins are shown as streambed-sediment sampling areas in figure 1.

Sampling Methods for Streambed Sediment

Before sampling, equipment was washed with phosphate-free detergent, rinsed three times with deionized (DI) water and wrapped in clean, plastic bags for transport to the sampling site. Trace-element sampling equipment received an additional rinse with 5-percent trace-element-grade nitric-acid solution and three more rinses with DI water. Clean sieves were used for each sample. The trace-element equipment was allowed to air dry and was stored in plastic bags. Stainless-steel equipment (which was not used to prepare trace-element samples) was allowed to air dry and was wrapped in aluminum foil and stored in sealed plastic containers.

DCP data transmitted by satellite to the USGS were monitored daily throughout the year to determine the occurrence, intensity, and duration of rainfall in the study area. If sufficient rainfall in the area of the paired basins was indicated by the data, the sampling crew visited the sites to determine if the rainfall had produced sediment transport from the hillsides to the alluvial channel in both basins. If transport occurred in both basins, a streambed-sediment sample was collected from the newly transported sediment in the mainstream channel of the basin.

Freshly deposited bed sediment from the basins (fig. 1) was sampled after rainfall runoff by using dedicated equipment for each basin in accordance with the procedures of U.S. Geological Survey (variously dated). Bed sediment was collected from various locations in the alluvial channel in each of the selected basins by using Teflon spoons. The upper 2 cm of fine-grained, wet sediment that collects in depositional areas was removed, composited in a clean sealable plastic bag, and transported in a cooler containing ice to the USGS Colorado District laboratory in Denver for processing. Processing consisted of homogenizing, sieving, and bottling each sample. For the trace-element sample, the sediment was washed into an acid-rinsed polypropylene sample jar through a nylon, 0.63-µm sieve using DI water. The sediment in the jar was allowed to settle, and then any clear water was removed from the top of the sample by using a plastic syringe. This procedure was repeated until sufficient sediment (about 50 g total) was sieved for the sample. The procedure was repeated using a 2-mm stainless-steel sieve to fill sample containers for analyses of inorganic and organic carbon, nutrients, gross alpha, gross beta, and plutonium. The samples were labeled and transported to the laboratories for analyses.

Analytical Methods for Streambed Sediment

During 2002, nutrient and trace-element analyses were done by Severn Trent Laboratory in Arvada, Colo., under a contract with the USGS. Gross alpha, gross beta, and plutonium analyses were done by Severn Trent Laboratory in Richland, Wash., under a contract with the USGS NWQL. Carbon analyses were done by the NWQL. During 2003, the carbon analyses also were done by Severn Trent Laboratory (in Chicago, Ill.) under a contract with the USGS. Gross alpha, gross beta, and plutonium analyses in 2003 were done by Eberline Services in Richmond, Calif., under a contract with the NWQL. The analytical methods used to analyze the streambed-sediment samples and the laboratory MRL's or MDC's are listed in table 13 (at the back of the report).

Quality Assurance for Streambed Sediment

Quality-assurance procedures were implemented during the course of the monitoring program to ensure the quality of the data. Laboratory and field cleaning procedures were rigorous and designed to prevent contamination of samples. Prior to sample collection, all sampling equipment and materials were cleaned according to standard procedures given in Horowitz and others (1994) and U.S. Geological Survey (variously dated).

If NWQL results for a particular constituent were questionable, the sample was reanalyzed by the laboratory. If results from the second analysis were more consistent with known characteristics of the site or the particular sample, the new results were used instead of the previous results; otherwise, the initial result was retained. The analytical quality-assurance practices and procedures of the NWQL are described in Friedman and Erdmann (1982). Reanalysis by the contract laboratories usually was not an option.

Sufficient streambed sediment was available for replicate samples, so a replicate July 7, 2002, sample of the biosolids-applied site, a replicate August 5, 2002, sample of the control site, a replicate June 1, 2003, sample of the control site, and a replicate August 8, 2003, sample from the biosolids-applied site also were analyzed. These data provide information about variability in the sediment itself or contributed by the laboratory. Other quality-control data for 2002-2003 not included in this report are laboratory replicates, laboratory method blanks, and laboratory spikes. The laboratory replicates were used to assess analytical precision. Laboratory blanks were used to assess contamination bias. Laboratory spikes were prepared by the laboratory using known concentrations of a constituent to assess recovery and analytical precision. The laboratory quality-control samples provided information about the bias and variability contributed by the laboratory but not the bias and variability contributed by field conditions or sampling equipment or about the variability of the sediment.

Streambed-Sediment Data

The USGS collected three paired samples during 2002: June 4, July 7, and August 5. The USGS collected two paired samples during 2003: June 1 and August 8. Chemical and radioactivity data for the paired samples and corresponding replicate samples are listed in table 14 (at the back of the report). A calculation of the relative percent difference (RPD) in sample data between the two paired sites, and a calculation of the RPD between the environmental sample and the replicate also are included in table 14.

Discussion of Streambed-Sediment Data

A comparison of the sample data with the replicate data (table 14) indicates variability within the sample may be about the same as variability between the basins for most constituents. Plans are to include any further evaluations of the 1999 through 2003 data in a USGS interpretive report.

The radioactivity data are reported in the uncensored form as received from the laboratory rather than censored by either the contract or calculated MDC. Relative to the censored form (data reported as less than the MDC), the uncensored form provides more information about the uncertainty, the very small concentrations of plutonium, and the gross alpha and gross beta activity. Plutonium data indicate that only two of the samples analyzed could possibly be considered as having detectable plutonium: plutonium-239+240 in the 06/04/02 streambed-sediment samples from both the biosolids-applied site and the control (no biosolids) site. However, the concentration reported by the laboratory for these samples was barely greater than the minimum detectable concentration calculated by the laboratory for these samples, and no source of plutonium has been identified by the USGS. Therefore, these plutonium concentrations likely represent a “false positive” produced by high laboratory bias. The negative activity concentration reported for the radiochemical samples means the sample count was less than the laboratory background count for that day. Radioactivity data are produced from instruments that detect radioactive decay (disintegrations) in a sample as counts per minute. The background count was subtracted from the sample count, and the resulting value was converted to activity-concentration units of picocuries per gram.

The streambed-sediment data in this report were all collected after the Lowry Landfill Superfund site water transfer to the MWRD and can provide information about contamination associated with biosolids applications and that water transfer. The beginning of the water transfer from the Lowry site to the MWRD was July 25, 2000.

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Data Section

TERMS AND ABBREVIATIONS

The following terms and abbreviations are used in this section:

bls	below land surface
bmp	below the measuring point of the well casing
mi	mile
ft or ’	feet
hhmm	24-hour time
mm/dd/yy	numerical date format for two-digit month/two-digit day/and the last two digits of the year
C	Celsius
cm	centimeters
°	degree
in. or ”	inch
µS/cm	microsiemens per centimeter at 25°C
pH units	are the negative base-10 log of the hydrogen-ion activity in moles per liter
mg/L	milligrams per liter
µg/L	micrograms per liter
ppm	parts per million
pCi/g	picocuries per gram
pCi/L	picocuries per liter
dissolved	refers to that fraction of material in a water sample that passes through a 0.45-µm membrane filter
>	greater than
<	less than
WH	whole water (unfiltered) sample
g/kg	gram per kilogram
mg/kg	milligrams per kilogram
µg/g	micrograms per gram
NAD 83	North American Datum 1983
NAVD 88	North American Vertical Datum 1988

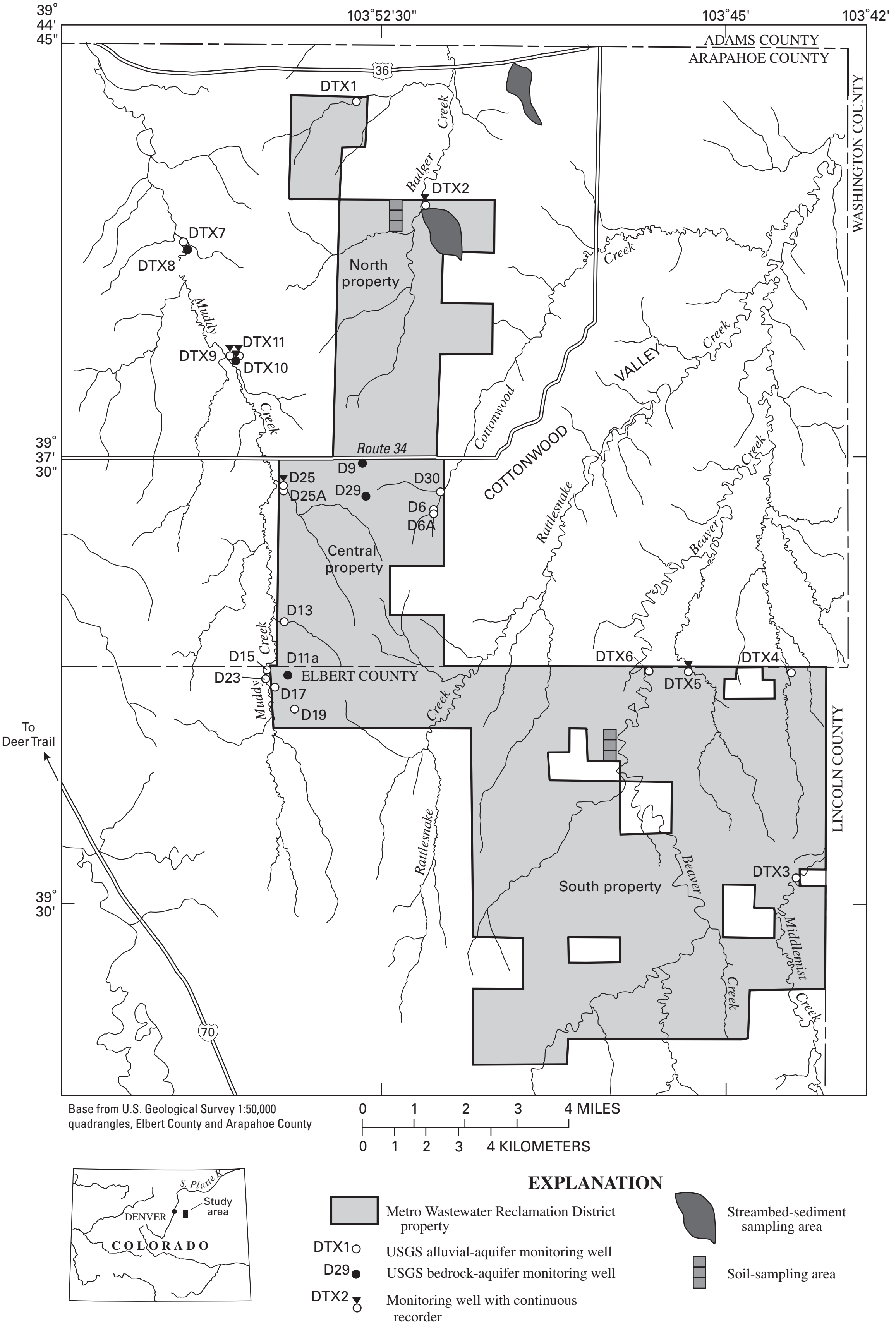

Figure 1. Location of study area and U.S. Geological Survey monitoring sites near Deer Trail, Colorado, 2002-2003. Metro Wastewater Reclamation District property boundaries shown are from 1999.

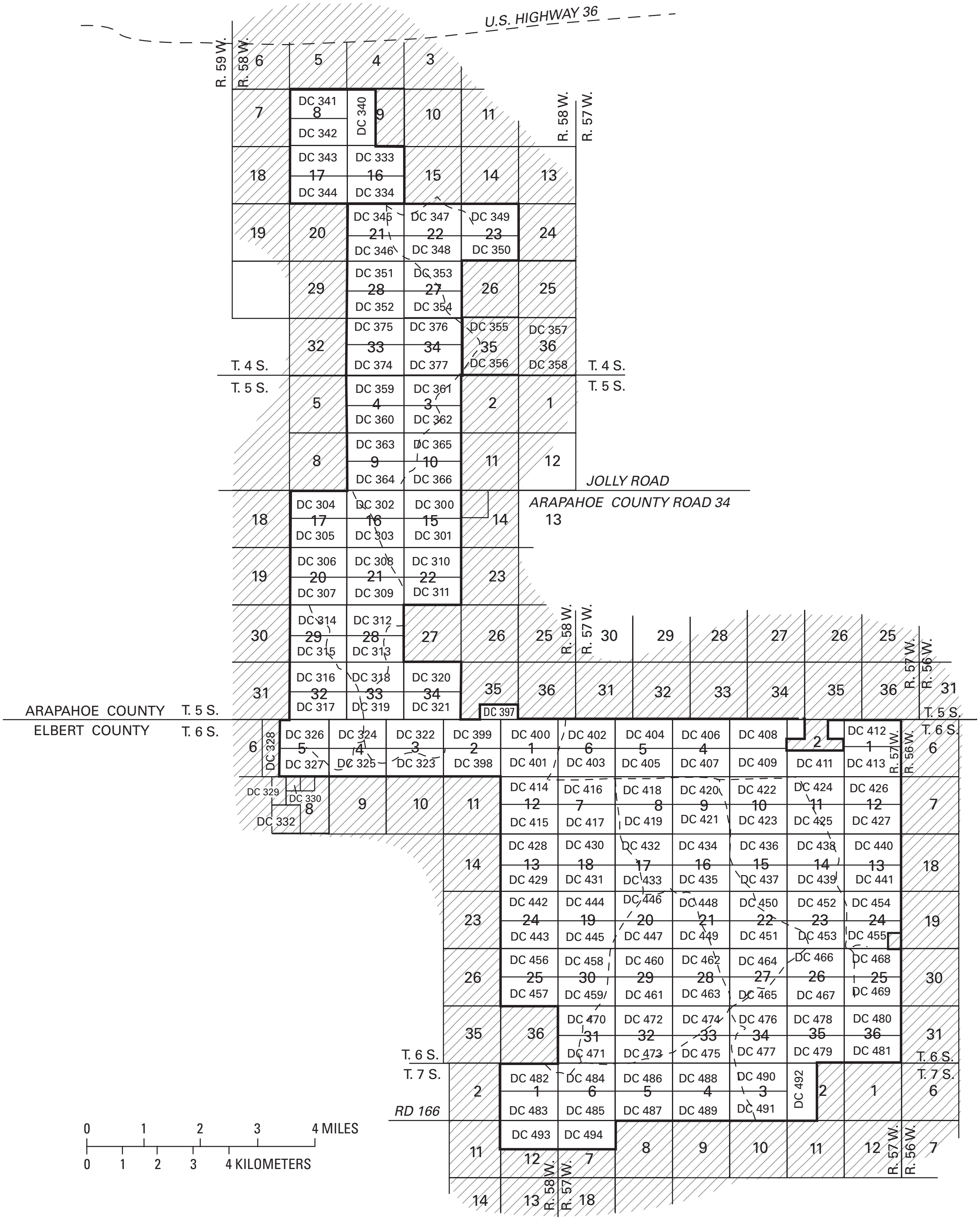

Figure 2. Metro Wastewater Reclamation District biosolids-application areas (METROGRO Farm) near Deer Trail, Colorado, 2002-2003 (from Metro Wastewater Reclamation District). (DC, Destination Code)

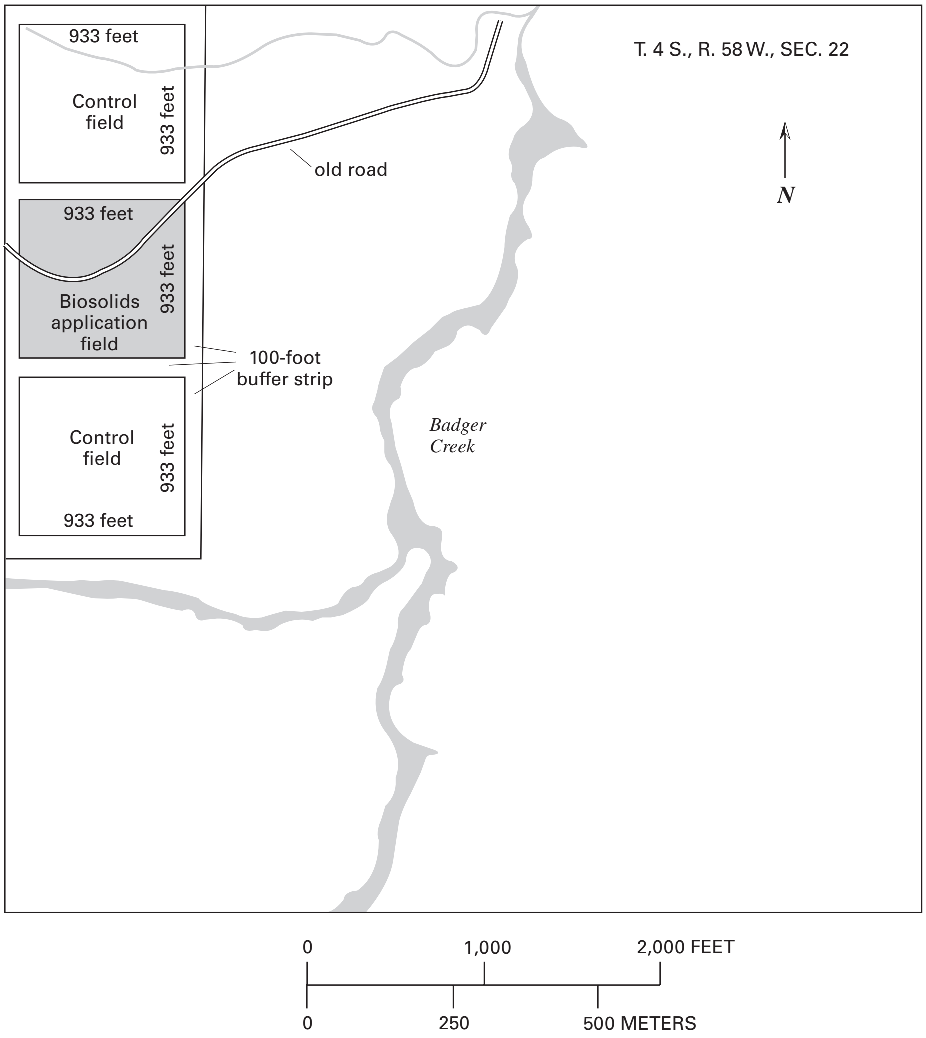

Figure 3. Arapahoe County, Colorado, soil-monitoring site: T. 4 S., R. 58 W., sec. 22 (from Metro Wastewater Reclamation District).

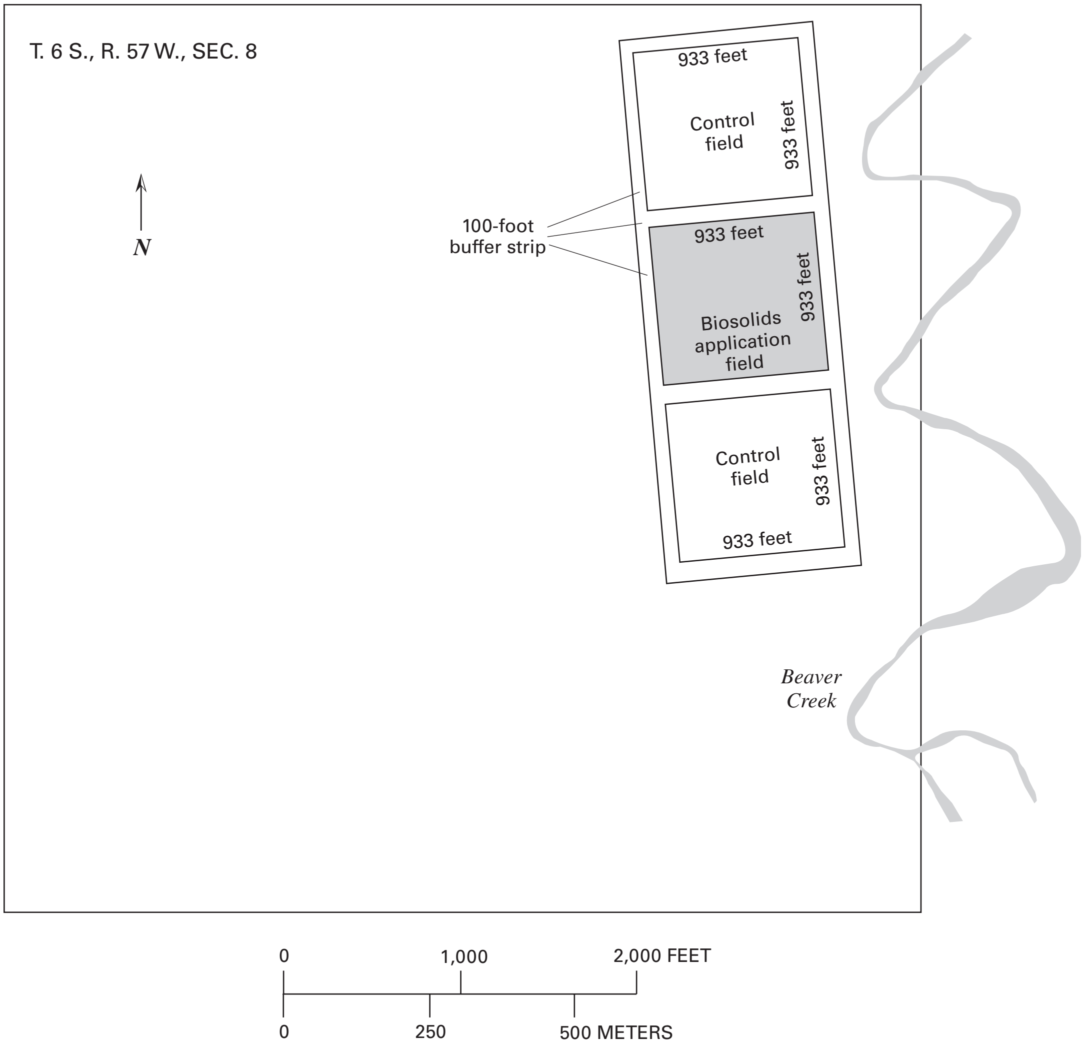

Figure 4. Elbert County, Colorado, soil-monitoring site: T. 6 S., R. 57 W., sec. 8 (from Metro Wastewater Reclamation District).

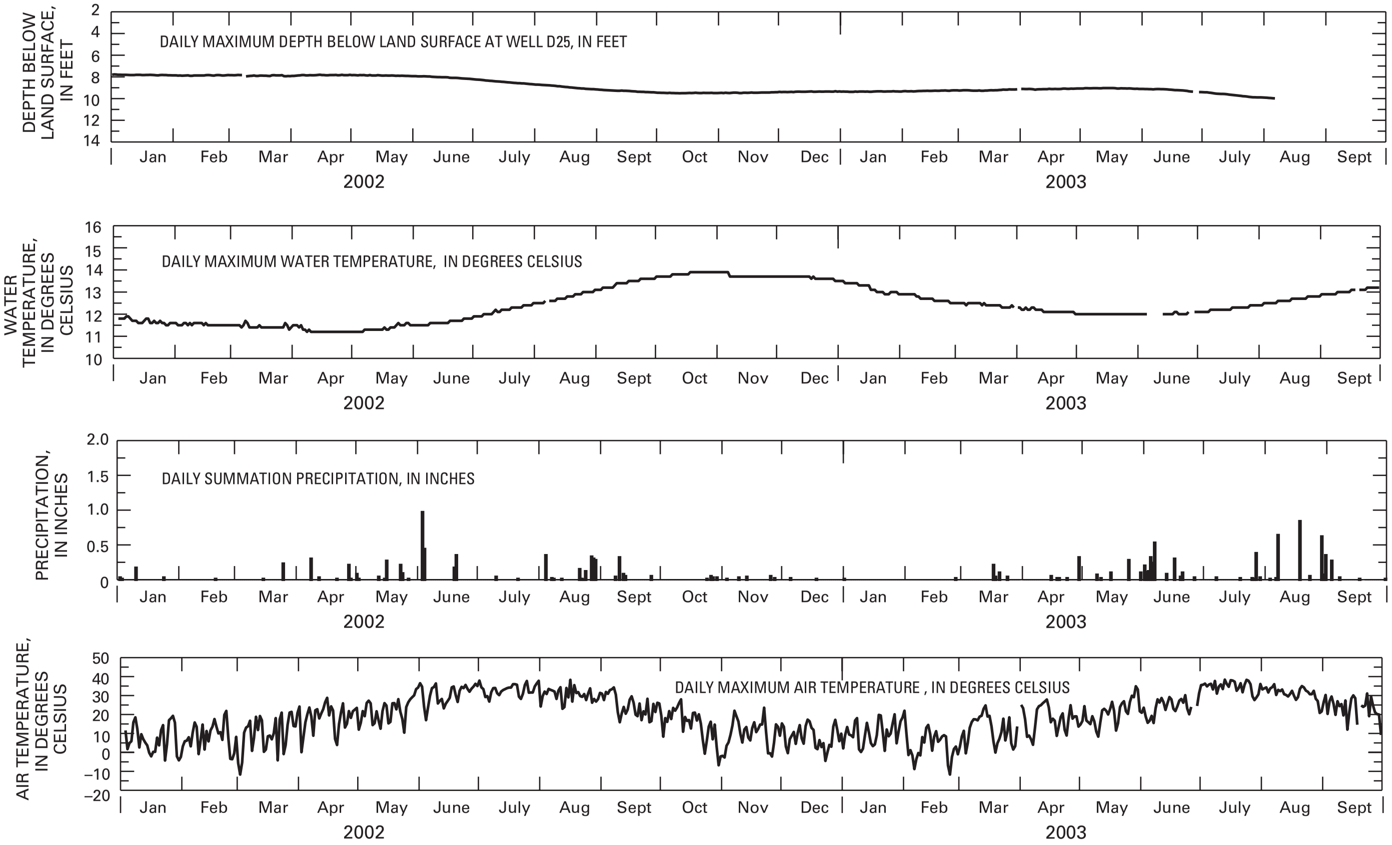

Figure 5. Continuous water-level, water-temperature, precipitation, and air-temperature data for well D25 near Deer Trail, Colorado, 2002-2003.

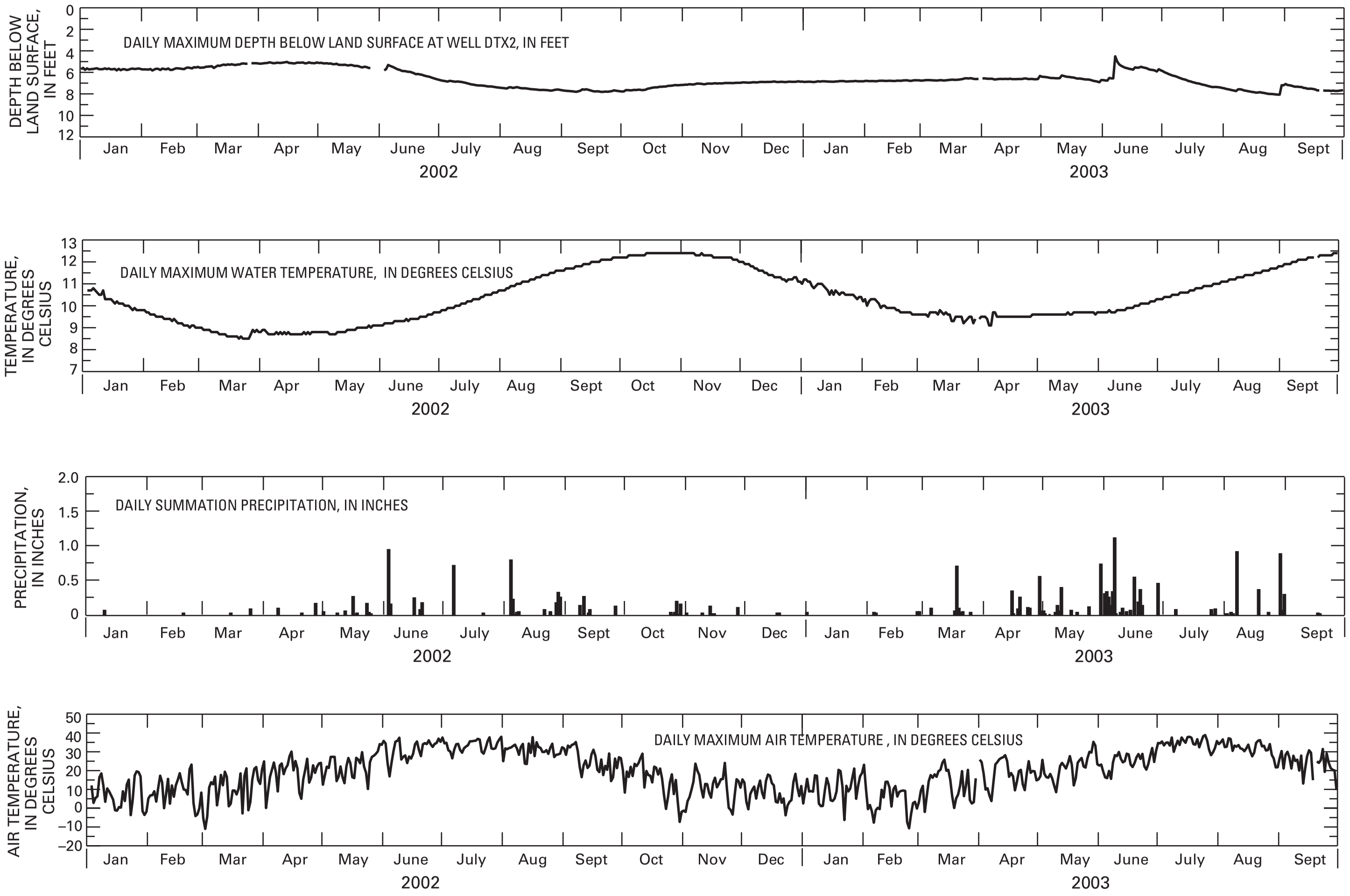

Figure 6. Continuous water-level, water-temperature, precipitation, and air-temperature data for well DTX2 near Deer Trail, Colorado, 2002-2003.

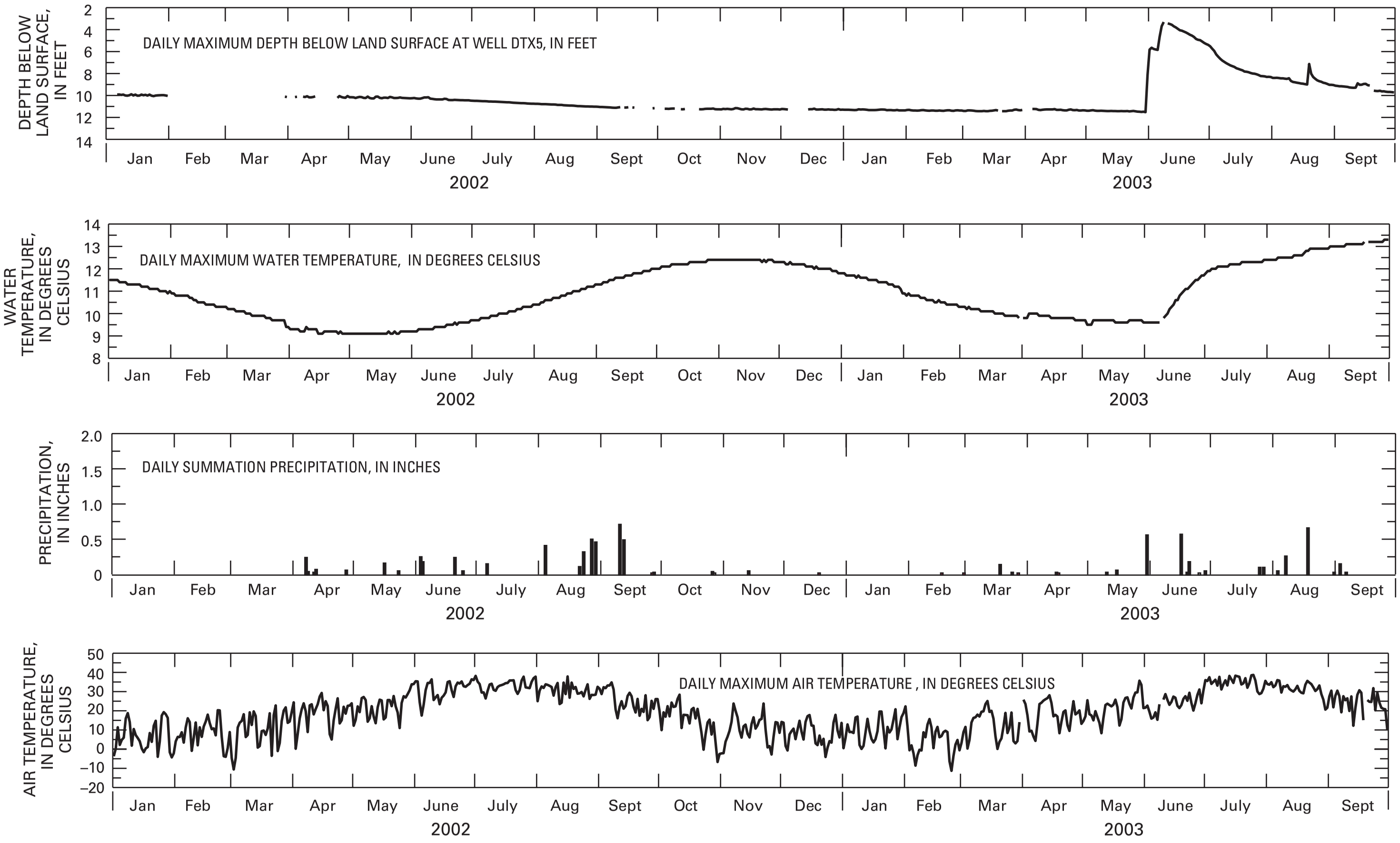

Figure 7. Continuous water-level, water-temperature, precipitation, and air-temperature data for well DTX5 near Deer Trail, Colorado, 2002-2003.

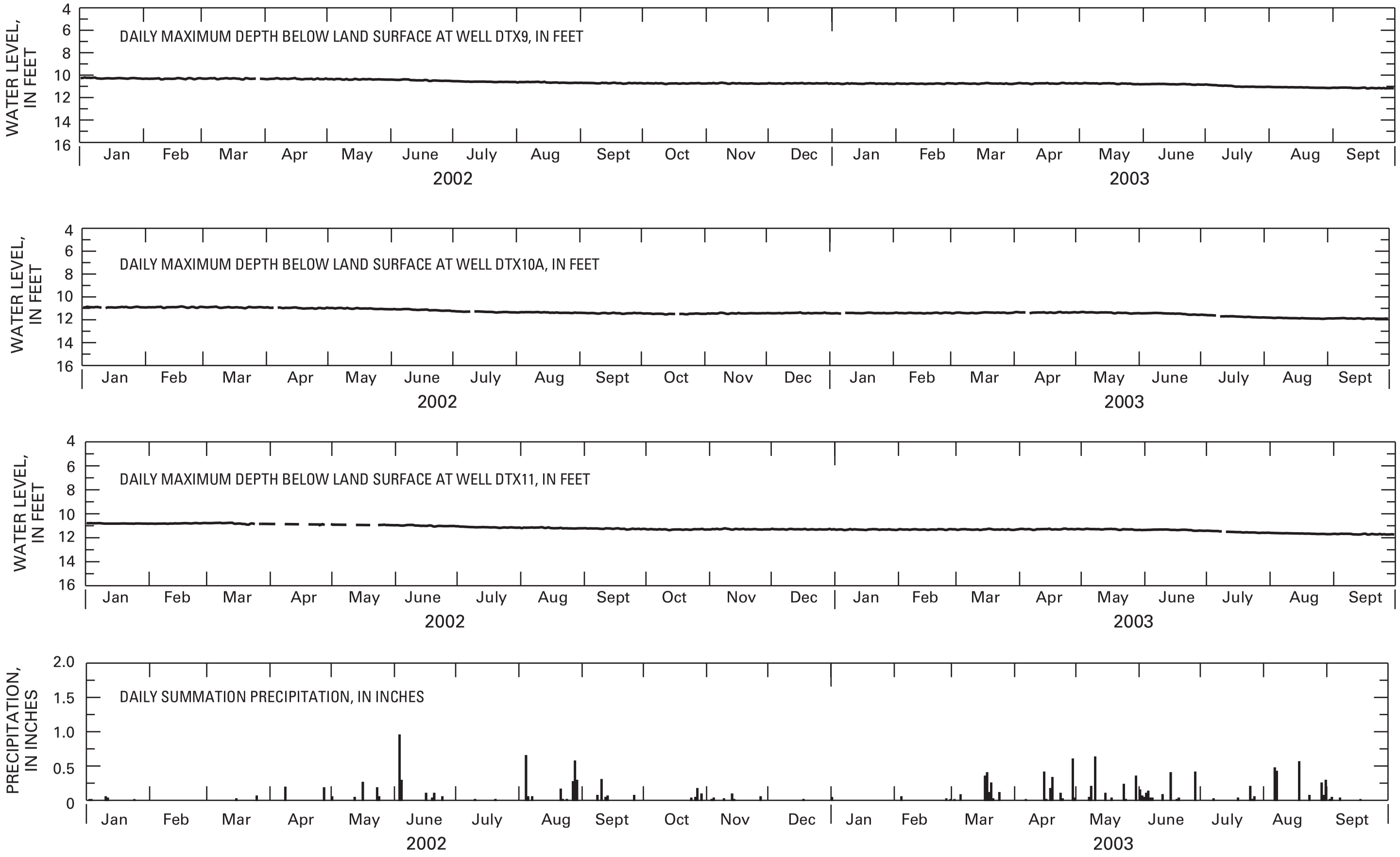

Figure 8. Continuous water-level data for wells DTX9, DTX10A, and DTX11, and precipitation data for the EDL recharge-evaluation site near Deer Trail, Colorado, 2002-2003 (EDL, electronic data logger).

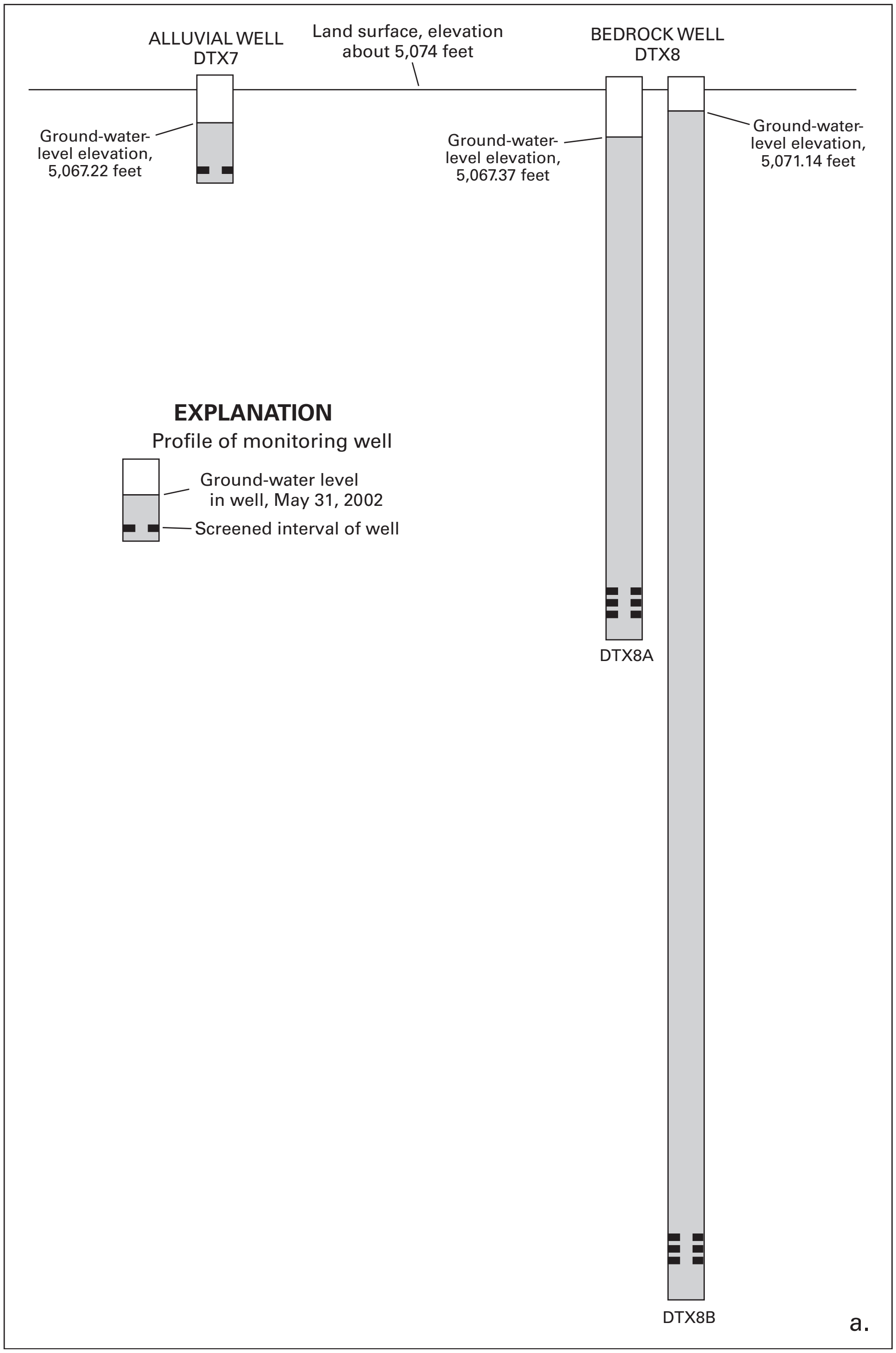

Figure 9. Water levels for the recharge-evaluation site containing well DTX7 and nested well DTX8 near Deer Trail, Colorado, for (a) May, (b) July, and (c) September 2002. (Elevation is in feet above NAVD 88.)

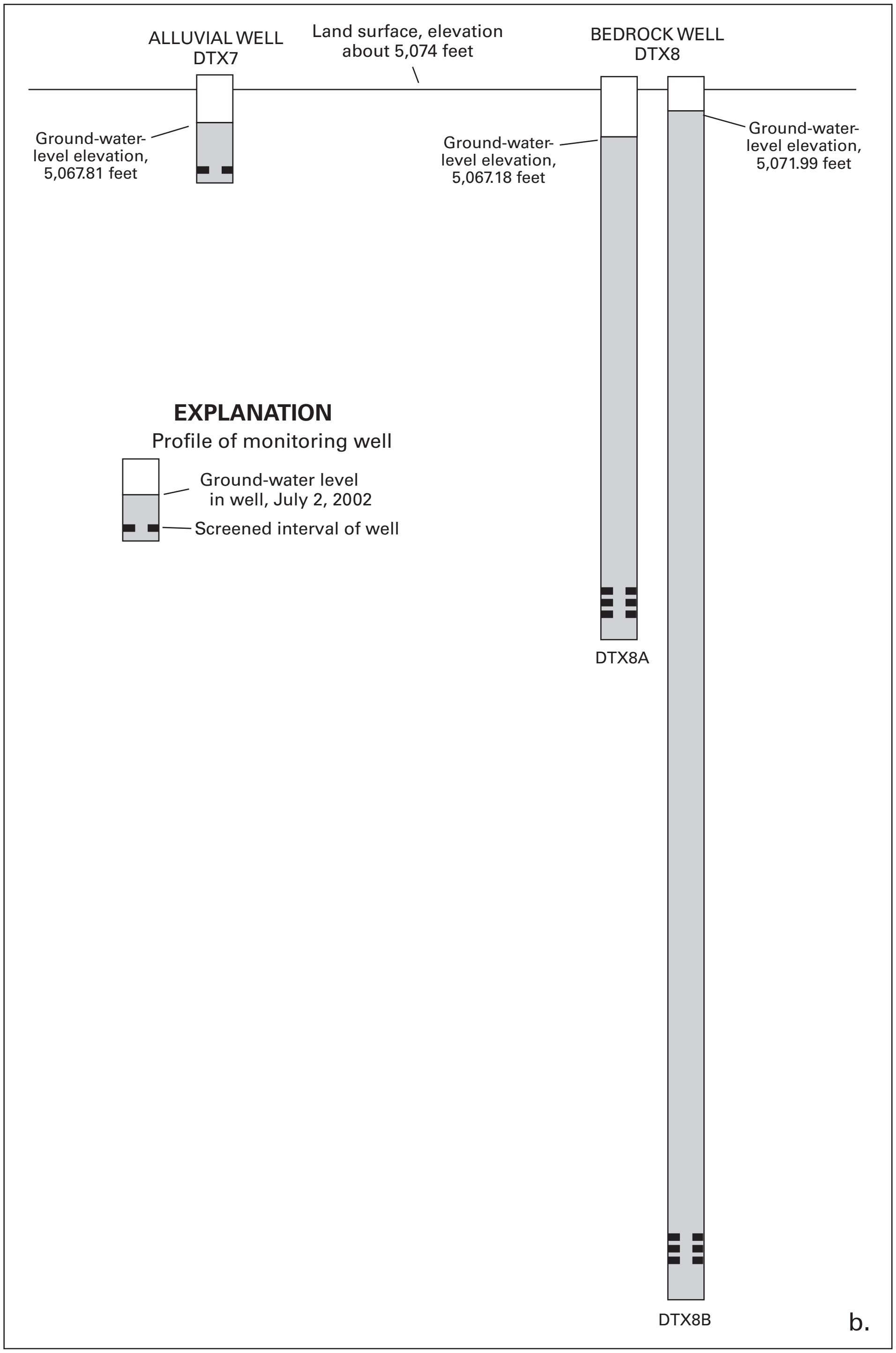

Figure 9. Water levels for the recharge-evaluation site containing well DTX7 and nested well DTX8 near Deer Trail, Colorado, for (a) May, (b) July, and (c) September 2002. (Elevation is in feet above NAVD 88.)—Continued

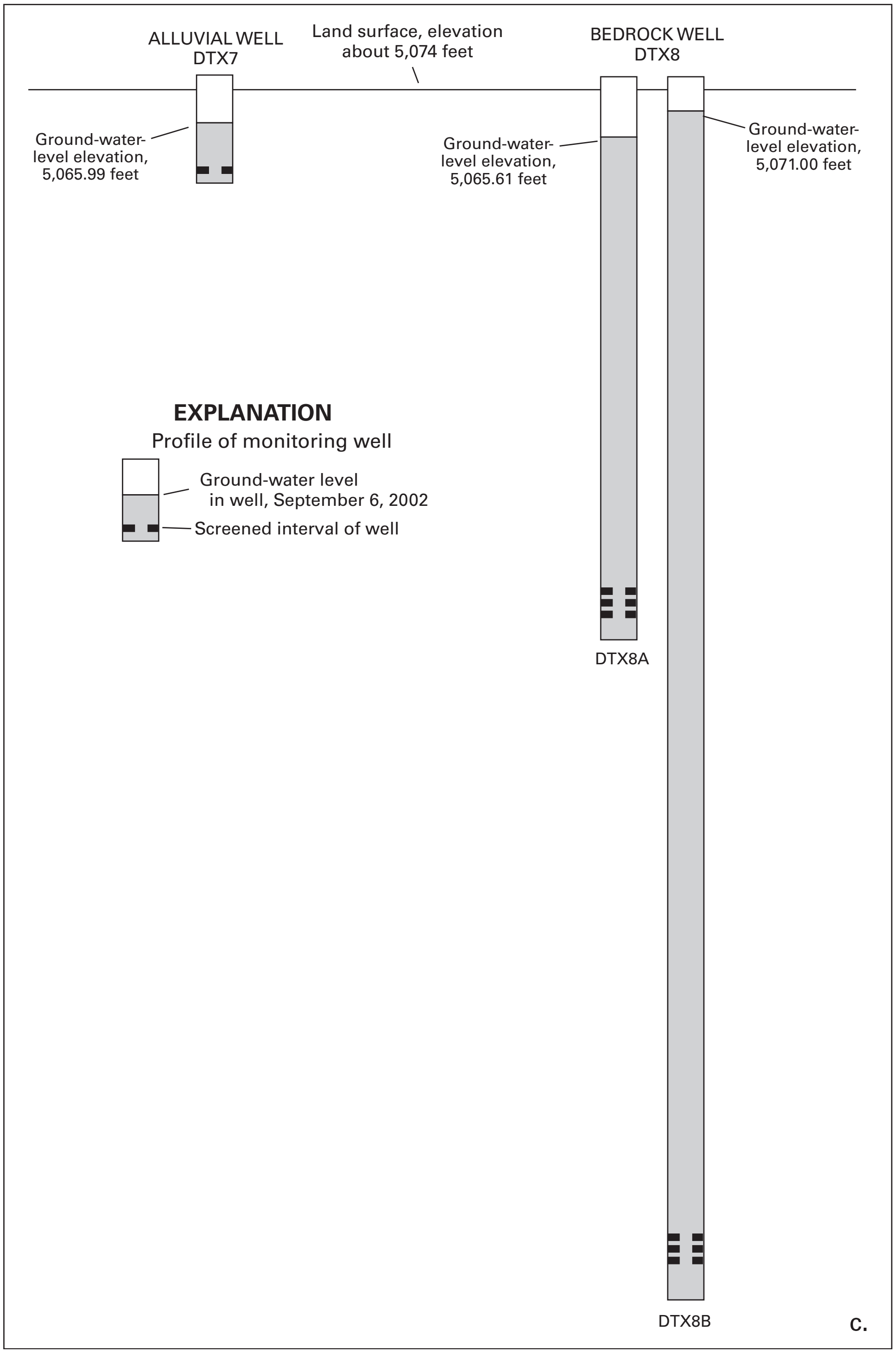

Figure 9. Water levels for the recharge-evaluation site containing well DTX7 and nested well DTX8 near Deer Trail, Colorado, for (a) May, (b) July, and (c) September 2002. (Elevation is in feet above NAVD 88.)—Continued

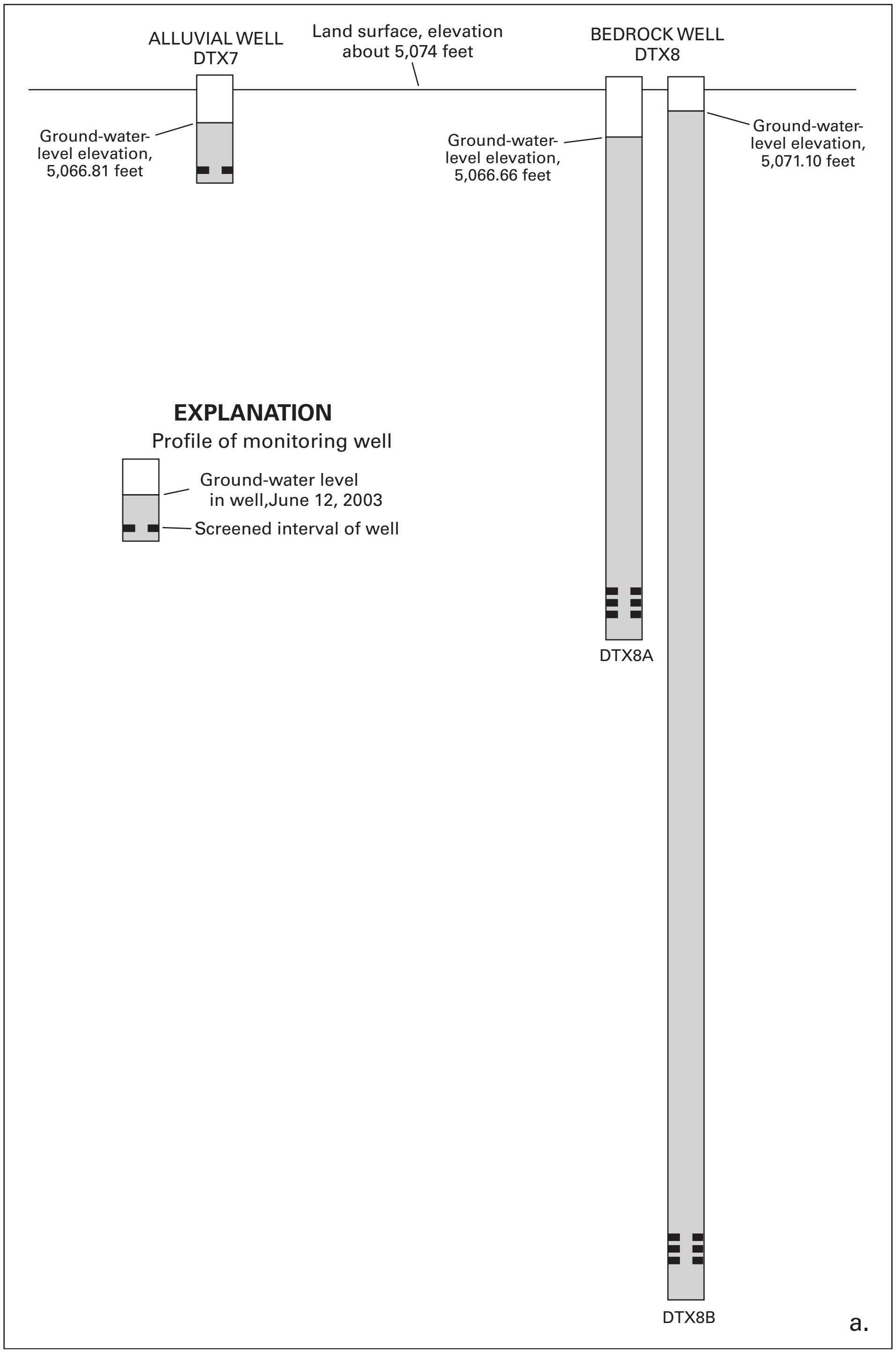

Figure 10. Water levels for the recharge-evaluation site containing well DTX7 and nested well DTX8 near Deer Trail, Colorado, for (a) June, (b) July, and (c) September 2003. (Elevation is in feet above NAVD 88.)

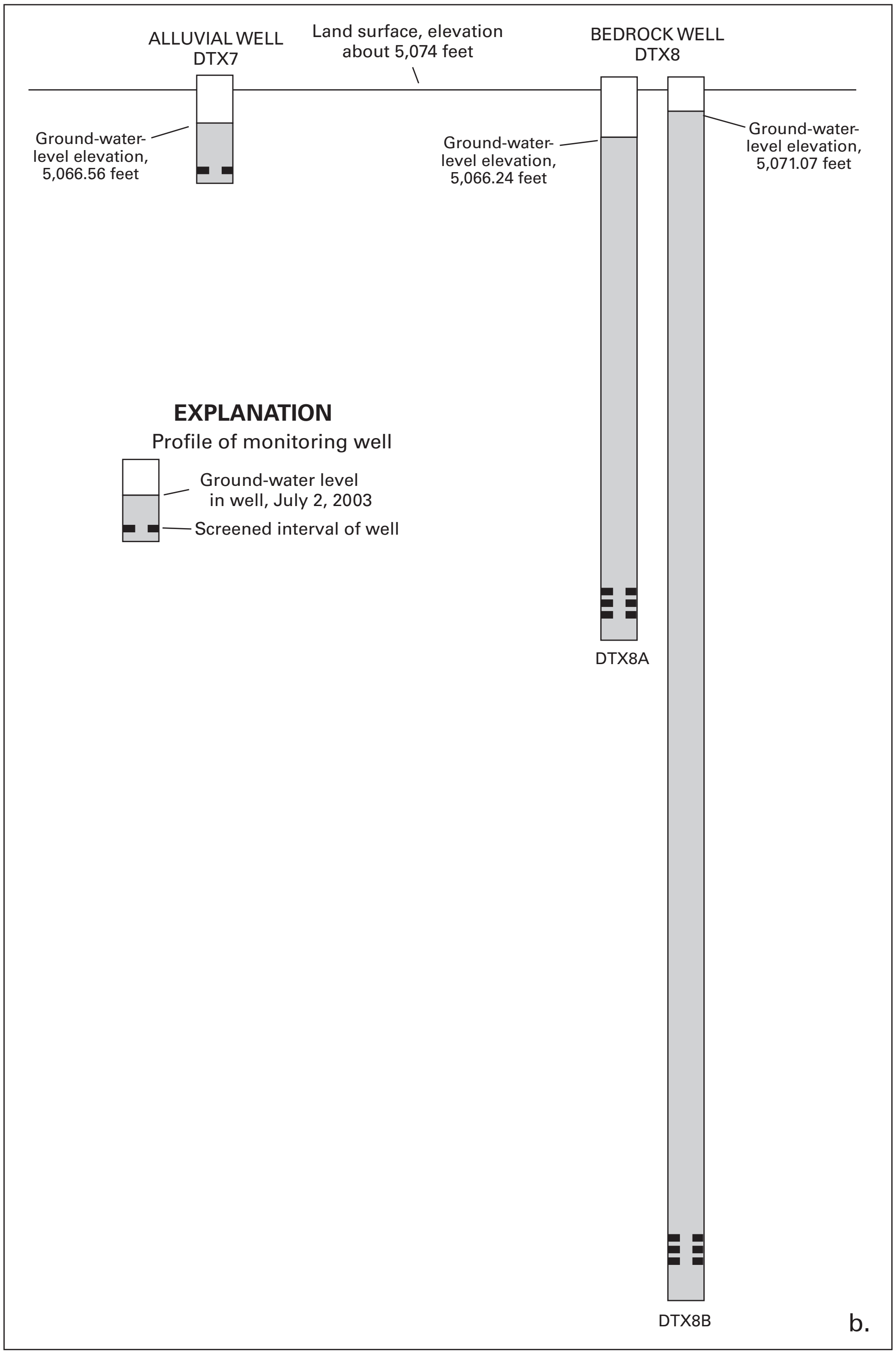

Figure 10. Water levels for the recharge-evaluation site containing well DTX7 and nested well DTX8 near Deer Trail, Colorado, for (a) June, (b) July, and (c) September 2003. (Elevation is in feet above NAVD 88.)—Continued

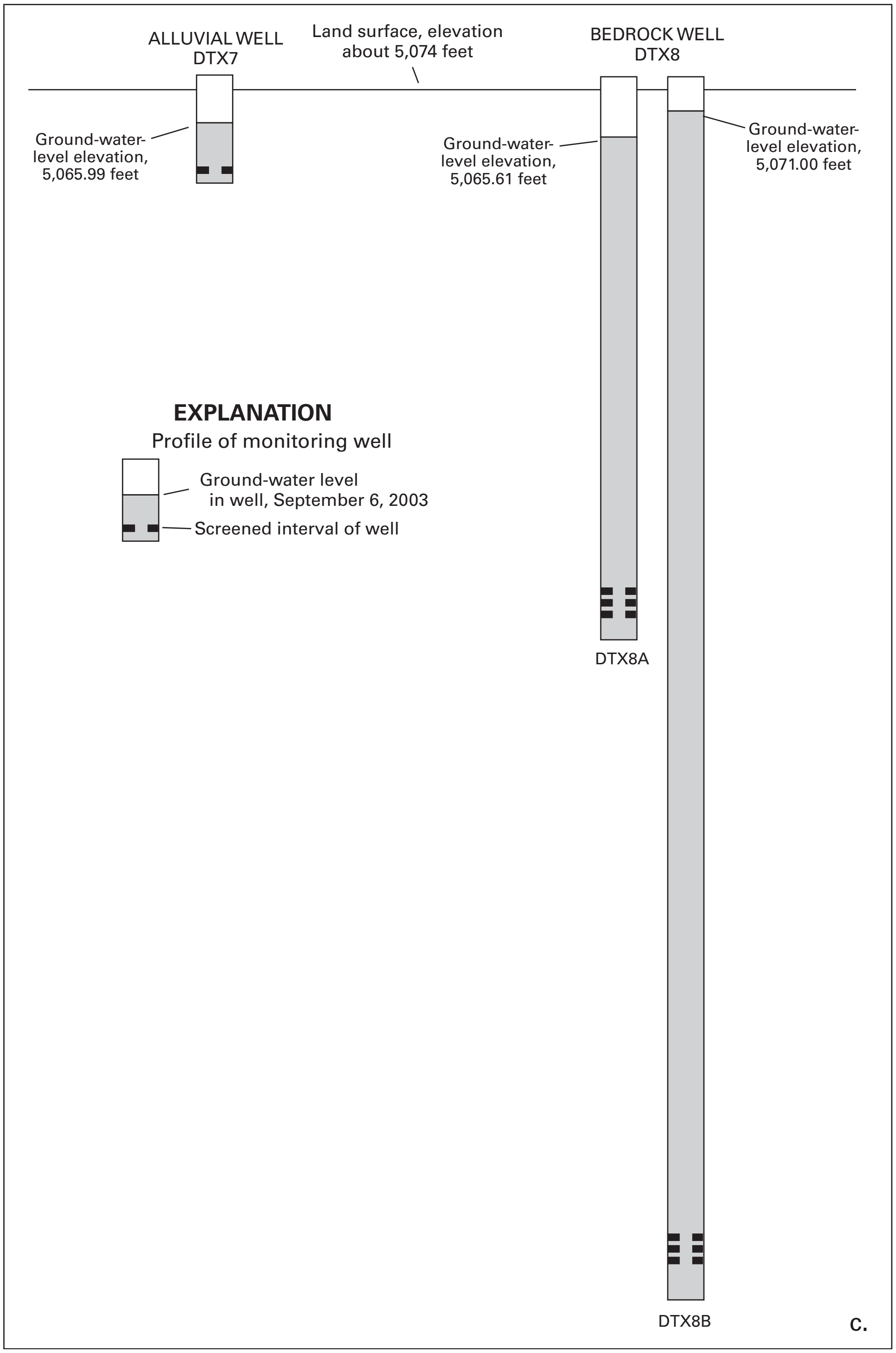

Figure 10. Water levels for the recharge-evaluation site containing well DTX7 and nested well DTX8 near Deer Trail, Colorado, for (a) June, (b) July, and (c) September 2003. (Elevation is in feet above NAVD 88.)—Continued

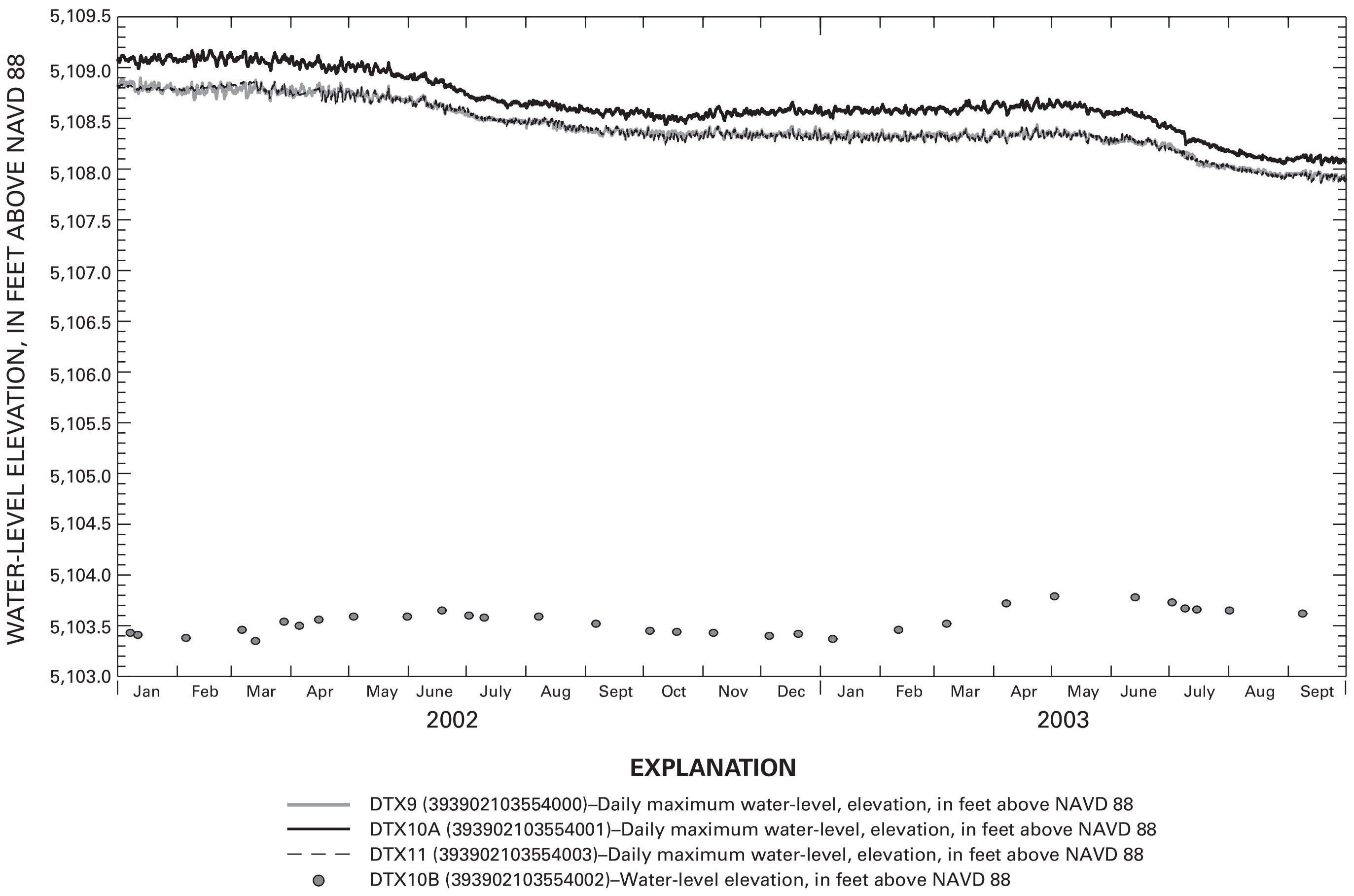

Figure 11. Data for the recharge-evaluation site containing wells DTX9, DTX10, and DTX11 near Deer Trail, Colorado, 2002-2003.

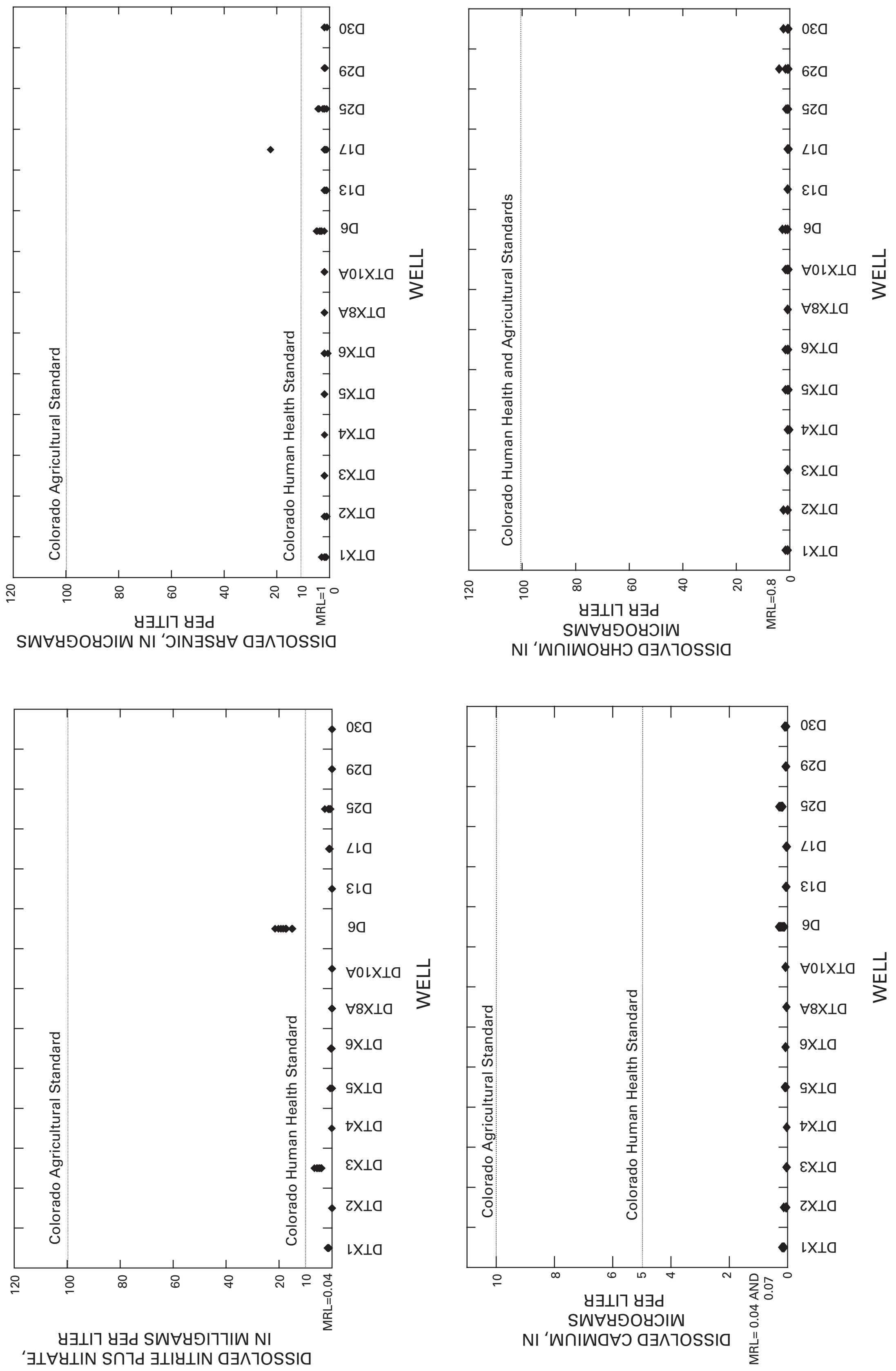

Figure 12. Distribution of ground-water constituent data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 2002-2003.

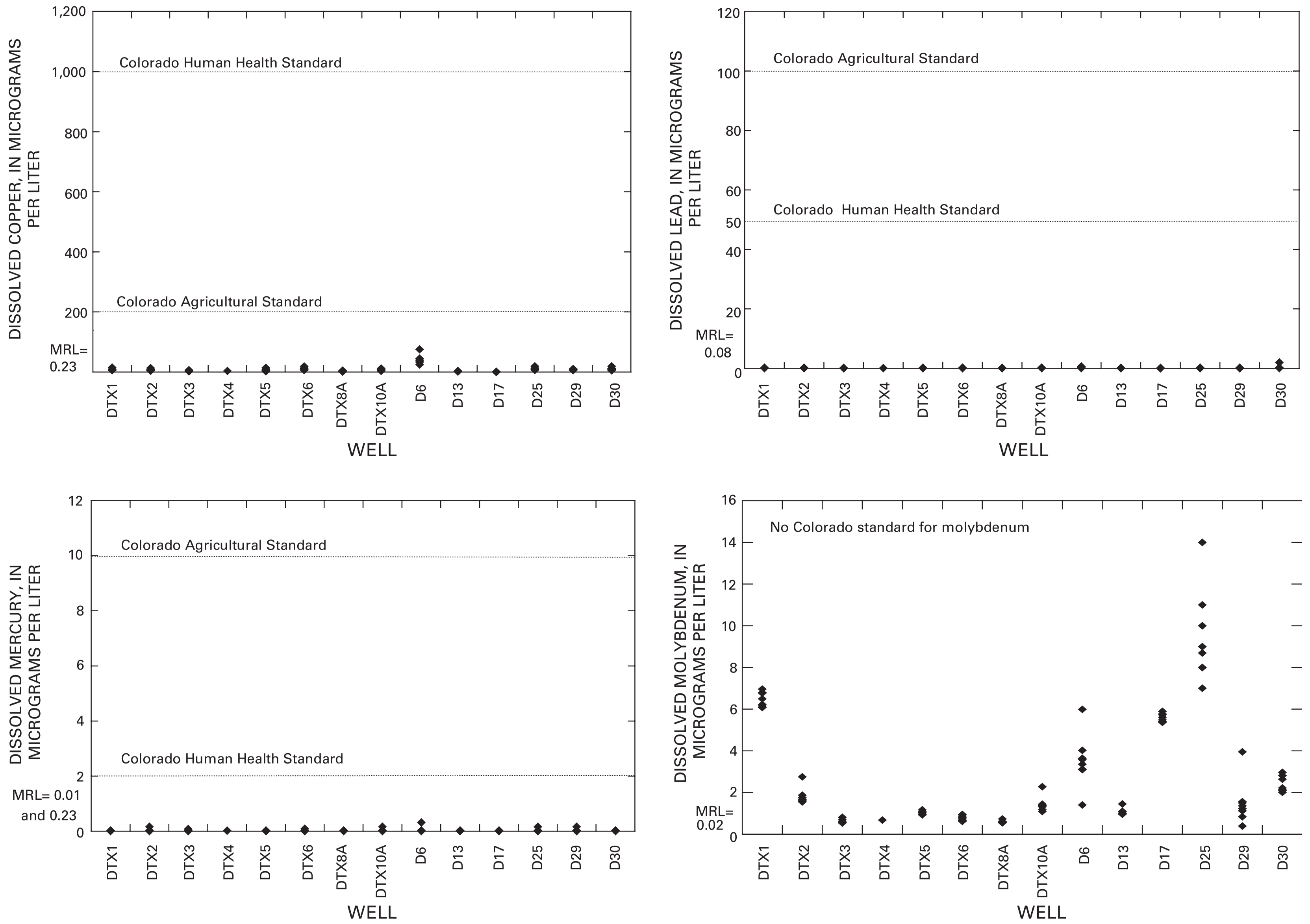

Figure 12. Distribution of ground-water constituent data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 2002-2003.—Continued

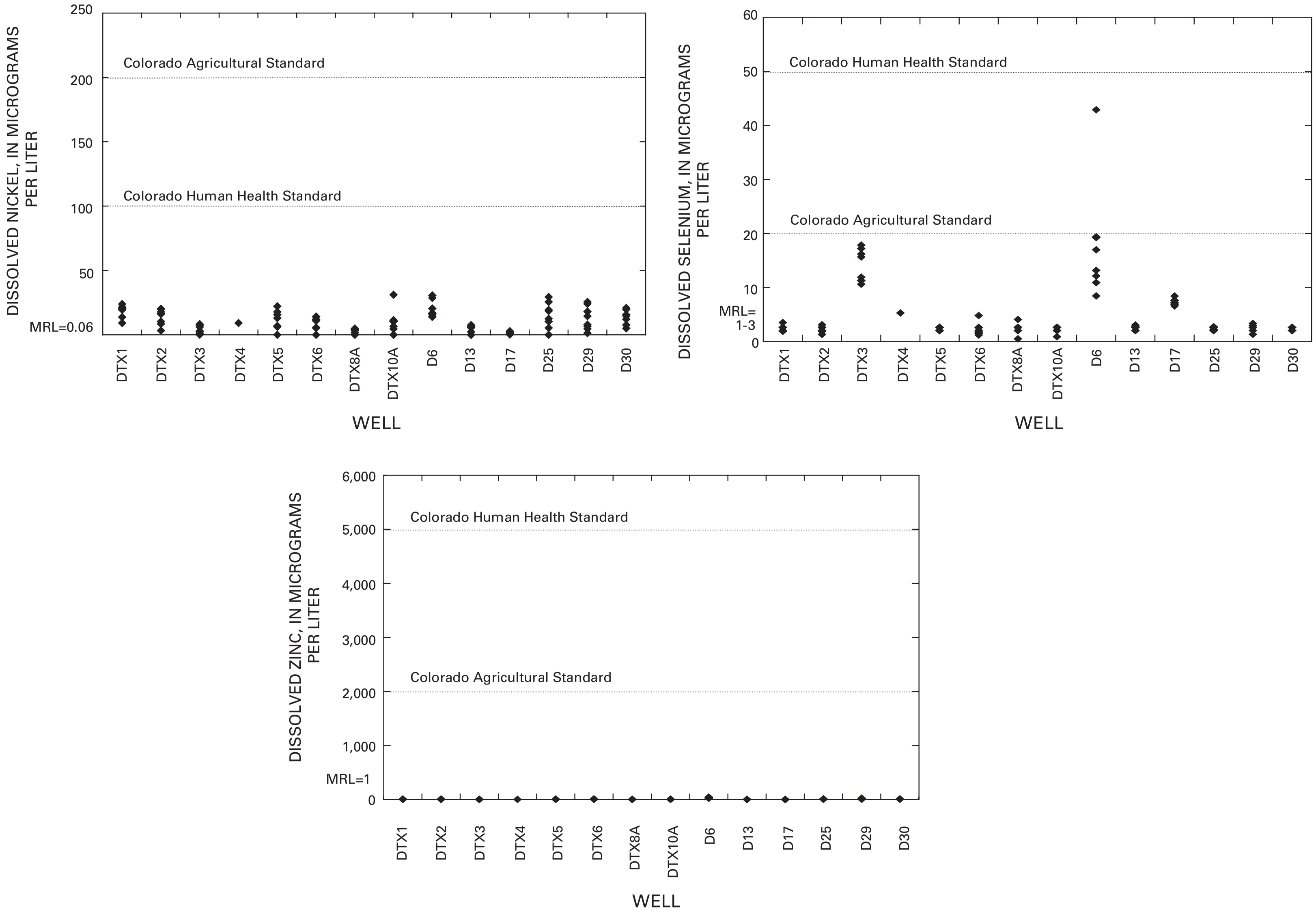

Figure 12. Distribution of ground-water constituent data collected near Deer Trail, Colorado, compared to regulatory standards for selected constituents, 2002-2003.—Continued

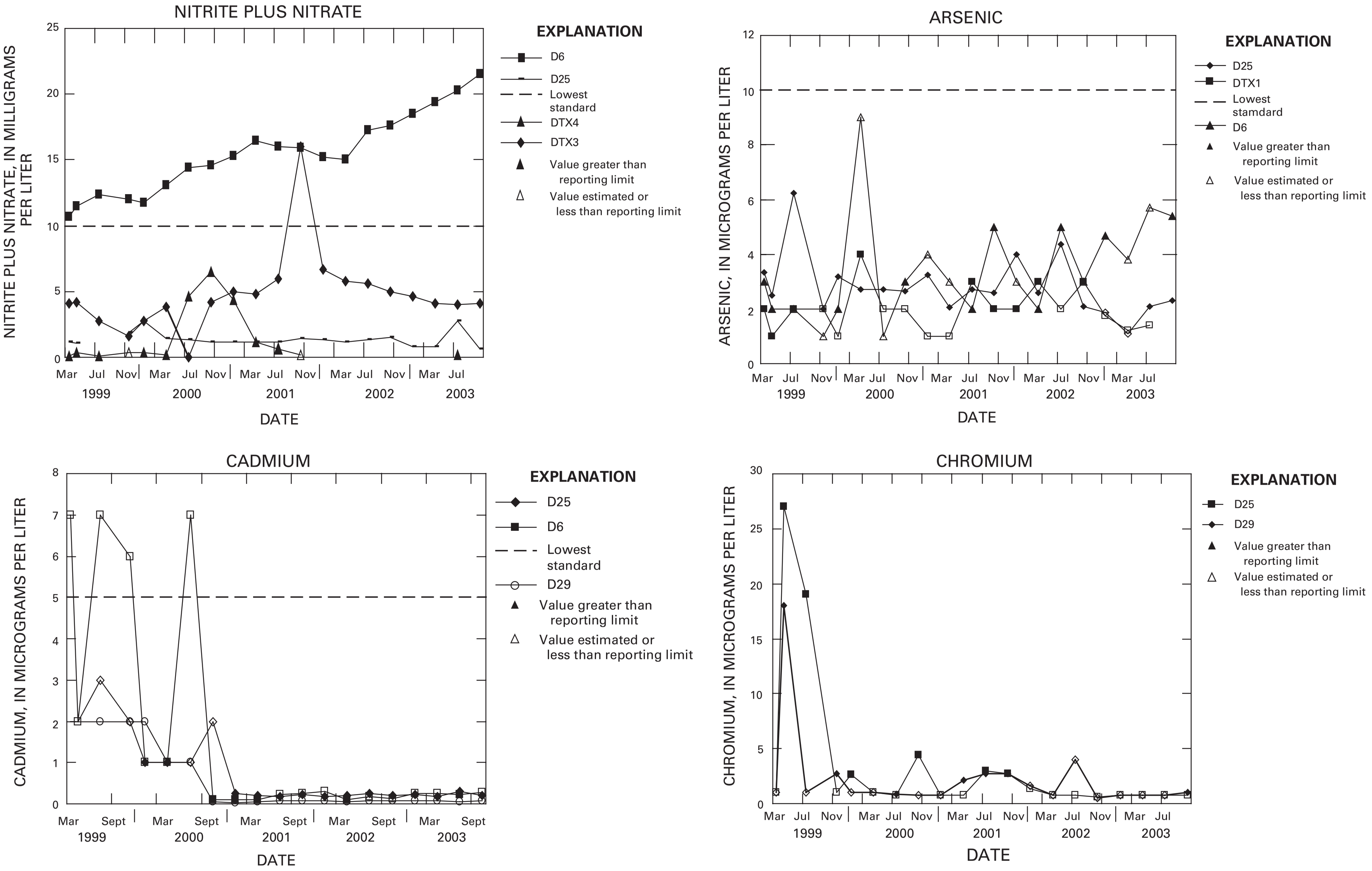

Figure 13. Ground-water concentrations near Deer Trail, Colorado, for selected constituents and selected wells, 1999-2003.

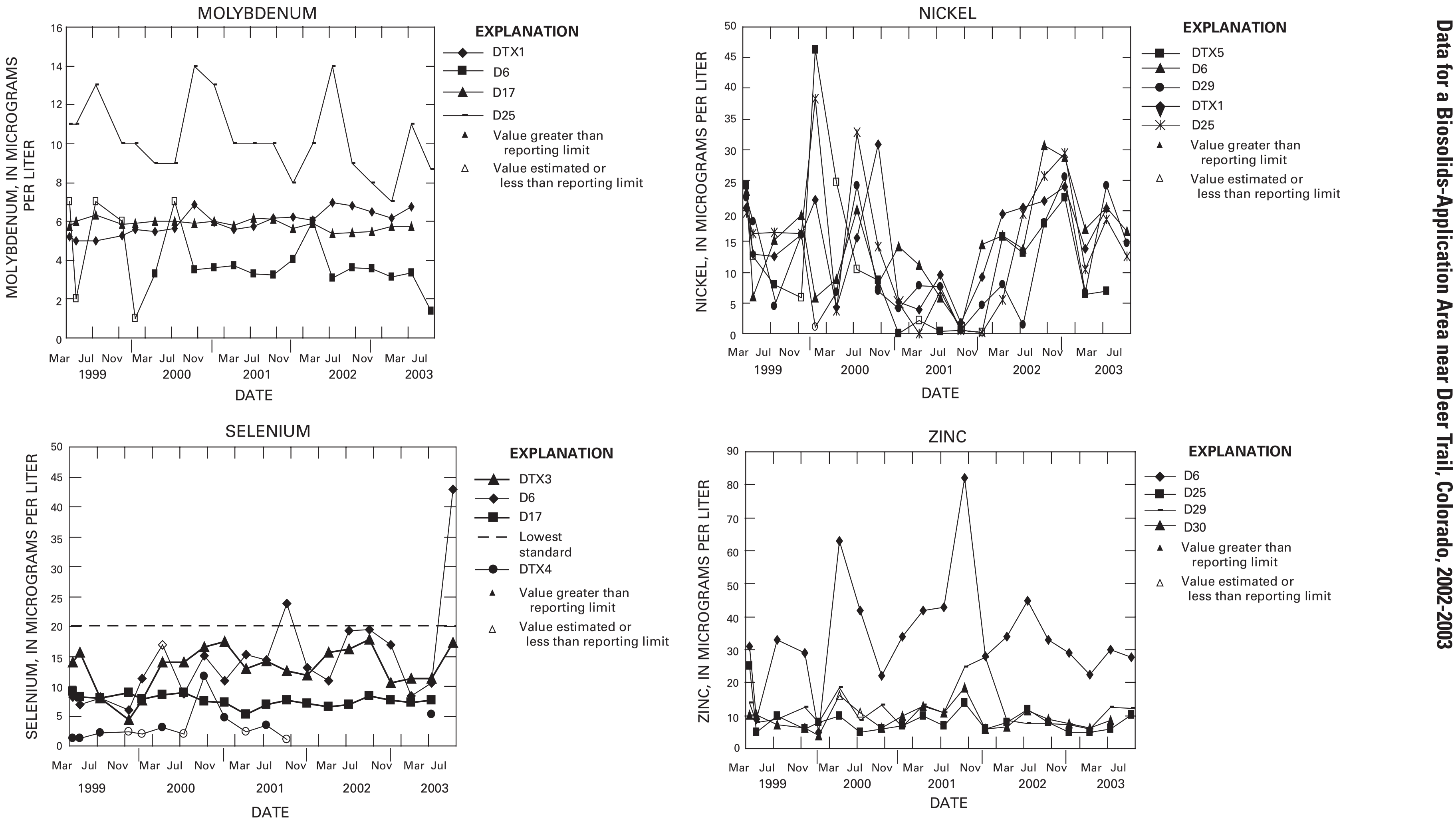

Figure 13. Ground-water concentrations near Deer Trail, Colorado, for selected constituents and selected wells, 1999-2003. —Continued

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, Colorado, 2002-2003.

[All information provided by Metro Wastewater Reclamation District; DC, destination code (shown in fig. 2); legal description is of the form quarter-section section township range; CAKE, Grade I Class B biosolids; MAC, biosolids amended with wood fiber; lbs/acre, pounds per acre; N, no; Y, yes]

DC	Legal description	Area applied to (acres)	County	Biosolids product applied	Application method	Start date	Stop date	Total loads	Total wet tons	Total dry tons	Loading rate, dry tons per acre		Nitrogen loading rate (lbs/acre)	Crop	Rec-lamation project
											CAKE	MAC			
300	N 1/2 SEC 15 T5S R58W	142.9	ARAPAHOE	CAKE/MAC	SURFACE	02/07/02	02/12/02	52	1166.54	205.33	1.33	0.11	40	WHEAT	N
300	N 1/2 SEC 15 T5S R58W	138.83	ARAPAHOE	CAKE/MAC	SURFACE	02/09/03	02/20/03	25	544.78	105.36	0.63	0.13	19	WHEAT	N
301	S 1/2 SEC 15 T5S R58W	138.7	ARAPAHOE	CAKE	SURFACE	02/11/02	02/14/02	51	1134.33	187.83	1.36	0.00	40	WHEAT	N
302	N 1/2 SEC 16 T5S R58W	189.1	ARAPAHOE	CAKE/MAC	SURFACE	02/01/02	02/07/02	120	2622.26	450.62	2.22	0.16	66	WHEAT	N
302	N 1/2 SEC 16 T5S R58W	83.57	ARAPAHOE	CAKE	SURFACE	02/20/03	04/28/03	56	1232.69	206.09	2.46	0.00	69	WHEAT	N
303	S 1/2 SEC 16 T5S R58W	147.2	ARAPAHOE	CAKE	SURFACE	02/07/02	02/08/02	34	743.83	123.87	0.84	0.00	25	WHEAT	N
303	S 1/2 SEC 16 T5S R58W	95	ARAPAHOE	CAKE/MAC	SURFACE	02/15/03	02/18/03	62	1402.22	261.47	2.38	0.38	72	WHEAT	N
304	N 1/2 SEC 17 T5S R58W	240.4	ARAPAHOE	CAKE/MAC	SURFACE	01/17/02	01/26/02	151	3298.01	573.92	2.12	0.27	65	WHEAT	N
304	N 1/2 SEC 17 T5S R58W	2	ARAPAHOE	CAKE	INCORPORATED	04/21/03	04/21/03	1	23.74	19.8	10.00	0.00	92	NATIVE GRASS	Y
305	S 1/2 SEC 17 T5S R58W	225.7	ARAPAHOE	CAKE/MAC	SURFACE	01/26/02	02/01/02	110	2457.37	449.67	1.71	0.28	51	WHEAT	N
306	N 1/2 SEC 20 T5S R58W	81	ARAPAHOE	CAKE	SURFACE	05/31/03	06/03/03	37	828.4	134.26	1.65	0.00	42	WHEAT	N
307	S 1/2 SEC 20 T5S R58W	107	ARAPAHOE	CAKE	SURFACE	04/08/02	06/06/02	68	1524.62	252.19	2.36	0.00	68	WHEAT	N
307	S 1/2 SEC 20 T5S R58W	85	ARAPAHOE	CAKE	SURFACE	09/10/02	11/03/02	30	661.42	104.71	1.24	0.00	32	WHEAT	N
308	N 1/2 SEC 21 T5S R58W	160	ARAPAHOE	CAKE/MAC	SURFACE	03/06/02	04/08/02	104	2338.92	370.29	2.22	0.09	66	WHEAT	N
308	N 1/2 SEC 21 T5S R58W	138.58	ARAPAHOE	CAKE/MAC	SURFACE	02/09/03	02/16/03	64	1433.79	249.7	1.67	0.14	49	WHEAT	N
309	S 1/2 SEC 21 T5S R58W	182	ARAPAHOE	CAKE/MAC	SURFACE	01/11/02	01/25/02	41	916.72	160.44	0.80	0.08	25	WHEAT	N
309	S 1/2 SEC 21 T5S R58W	108.95	ARAPAHOE	CAKE	SURFACE	02/10/03	02/13/03	75	1671.98	261.46	2.40	0.00	69	WHEAT	N
310	N 1/2 SEC 22 T5S R58W	65.99	ARAPAHOE	CAKE	SURFACE	02/08/03	02/10/03	27	597.9	91	1.38	0.00	37	WHEAT	N
311	S 1/2 SEC 22 T5S R58W	72.24	ARAPAHOE	CAKE	SURFACE	02/07/03	02/09/03	49	1070.88	174.17	2.41	0.00	65	WHEAT	N
312	N 1/2 SEC 28 T5S R58W	160	ARAPAHOE	CAKE/MAC	SURFACE	02/04/02	02/28/02	102	2229.82	373.81	2.24	0.09	65	WHEAT	N
312	N 1/2 SEC 28 T5S R58W	171.3	ARAPAHOE	CAKE	SURFACE	10/30/02	11/03/02	38	818.69	129.1	0.75	0.00	21	WHEAT	N
313	S 1/2 SEC 28 T5S R58W	199	ARAPAHOE	CAKE	SURFACE	11/03/02	06/01/03	74	1674.3	271.8	1.37	0.00	36	WHEAT	N
314	N 1/2 SEC 29 T5S R58W	205	ARAPAHOE	CAKE	SURFACE	06/06/02	07/07/02	75	1699.89	292.72	1.43	0.00	37	GRASS	N
315	S 1/2 SEC 29 T5S R58W	65	ARAPAHOE	CAKE	SURFACE	07/07/02	08/30/02	25	562.58	97.74	1.51	0.00	39	GRASS	N
315	S 1/2 SEC 29 T5S R58W	28	ARAPAHOE	CAKE	SURFACE	04/27/03	04/28/03	12	264.05	43.9	1.57	0.00	42	WHEAT	N
318	N 1/2 SEC 33 T5S R58W	125.56	ARAPAHOE	CAKE/MAC	SURFACE	01/29/03	02/07/03	89	1964.96	313.86	2.34	0.16	65	WHEAT	N
319	S 1/2 SEC 33 T5S R58W	50	ARAPAHOE	CAKE	SURFACE	11/14/02	11/15/02	32	698.25	112.51	2.26	0.00	63	WHEAT	N
322	N 1/2 SEC 3 T6S R58W	215	ELBERT	CAKE	SURFACE	11/07/02	11/14/02	142	3214.34	504.86	2.35	0.00	65	WHEAT	N
323	S 1/2 SEC 3 T6S R58W	244.52	ELBERT	CAKE/MAC	SURFACE	01/15/03	02/02/03	156	3519.55	542.23	2.14	0.08	63	WHEAT	N
325	S 1/2 SEC 4 T6S R58W	34.56	ELBERT	CAKE	SURFACE	01/31/03	01/31/03	23	526.27	79.99	2.31	0.00	64	WHEAT	N
334	S 1/2 SEC 16 T4S R58W	310	ARAPAHOE	CAKE/MAC	SURFACE	01/01/02	01/16/02	210	4645.03	780.18	2.36	0.16	68	WHEAT	N
340	W 1/2 SEC 9 T4S R58W	219.5	ARAPAHOE	CAKE/MAC	SURFACE	11/08/02	04/16/03	80	1742.89	326.73	1.32	0.17	37	WHEAT	N
341	N 1/2 SEC 8 T4S R58W	220.96	ARAPAHOE	CAKE/MAC	SURFACE	04/14/03	04/27/03	109	2346.96	423.04	1.75	0.16	49	WHEAT	N
342	S 1/2 SEC 8 T4S R58W	6	ARAPAHOE	CAKE	SURFACE	04/16/03	04/16/03	3	62.48	9.87	1.67	0.00	46	WHEAT	N
343	N 1/2 SEC 17 T4S R58W	266.44	ARAPAHOE	CAKE	SURFACE	07/23/03	08/01/03	135	3056.24	519.67	1.95	0.00	49	WHEAT	N
344	S 1/2 SEC 17 T4S R58W	279.2	ARAPAHOE	CAKE/MAC	SURFACE	11/19/01	01/17/02	62	1354.67	253.29	0.79	0.11	23	WHEAT	N
345	N 1/2 SEC 21 T4S R58W	292	ARAPAHOE	CAKE	SURFACE	11/18/02	11/21/02	68	1535.6	241.56	0.83	0.00	23	WHEAT	N
346	S 1/2 SEC 21 T4S R58W	234	ARAPAHOE	CAKE	SURFACE	11/15/02	11/25/02	156	3491.29	555.6	2.38	0.00	65	WHEAT	N
347	N 1/2 SEC 22 T4S R58W	135	ARAPAHOE	CAKE	SURFACE	11/18/02	11/28/02	44	972.7	153.78	1.14	0.00	31	WHEAT	N
348	S 1/2 SEC 22 T4S R58W	84	ARAPAHOE	CAKE	SURFACE	11/25/02	11/30/02	57	1265.55	199.15	2.37	0.00	65	WHEAT	N
352	S 1/2 SEC 28 T4S R58W	323.9	ARAPAHOE	CAKE/MAC	SURFACE	12/14/02	12/28/02	218	4607.51	708.64	2.07	0.11	59	WHEAT	N
359	N 1/2 SEC 4 T5S R58W	227.82	ARAPAHOE	CAKE/MAC	SURFACE	12/19/02	01/06/03	157	3520.81	549.05	2.24	0.17	65	WHEAT	N
360	S 1/2 SEC 4 T5S R58W	8	ARAPAHOE	CAKE	SURFACE	03/10/02	03/10/02	6	142.08	21.17	2.63	0.00	73	WHEAT	N

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, Colorado, 2002-2003.–Continued

[All information provided by Metro Wastewater Reclamation District; DC, destination code (shown in fig. 2); legal description is of the form quarter-section section township range; CAKE, Grade I Class B biosolids; MAC, biosolids amended with wood fiber; lbs/acre, pounds per acre; N, no; Y, yes]

DC	Legal description	Area applied to (acres)	County	Biosolids product applied	Application method	Start date	Stop date	Total loads	Total wet tons	Total dry tons	Loading rate, dry tons per acre		Nitrogen loading rate (lbs/acre)	Crop	Rec-lamation project
											CAKE	MAC			
360	S 1/2 SEC 4 T5S R58W	125.42	ARAPAHOE	CAKE	SURFACE	06/03/03	06/11/03	63	1440.73	244.55	1.95	0.00	51	WHEAT	N
361	N 1/2 SEC 3 T5S R58W	54.12	ARAPAHOE	CAKE	SURFACE	08/07/03	08/07/03	10	227.65	37.79	0.70	0.00	18	WHEAT	N
362	S 1/2 SEC 3 T5S R58W	107.99	ARAPAHOE	CAKE	SURFACE	08/07/03	08/11/03	54	1174.57	202.08	1.87	0.00	45	WHEAT	N
363	N 1/2 SEC 9 T5S R58W	81.7	ARAPAHOE	CAKE	SURFACE	03/07/02	03/10/02	54	1222.63	187.31	2.29	0.00	64	WHEAT	N
363	N 1/2 SEC 9 T5S R58W	170.02	ARAPAHOE	CAKE	SURFACE	06/09/03	08/02/03	85	1960.53	335.71	1.98	0.00	51	WHEAT	N
364	S 1/2 SEC 9 T5S R58W	145	ARAPAHOE	CAKE/MAC	SURFACE	02/28/02	03/07/02	99	2228.07	363.52	2.40	0.10	70	WHEAT	N
364	S 1/2 SEC 9 T5S R58W	182.38	ARAPAHOE	CAKE/MAC	SURFACE	08/01/03	08/07/03	91	2070.47	359.68	1.86	0.11	50	WHEAT	N
365	N 1/2 SEC 10 T5S R58W	160.2	ARAPAHOE	CAKE/MAC	SURFACE	02/16/02	03/10/02	107	2413.17	417.66	2.42	0.19	70	WHEAT	N
365	N 1/2 SEC 10 T5S R58W	138.63	ARAPAHOE	CAKE/MAC	SURFACE	08/06/03	08/13/03	38	827.96	151.08	0.94	0.15	26	WHEAT	N
366	S 1/2 SEC 10 T5S R58W	186.7	ARAPAHOE	CAKE/MAC	SURFACE	02/11/02	03/06/02	118	2667.21	463.8	2.32	0.16	69	WHEAT	N
366	S 1/2 SEC 10 T5S R58W	143.73	ARAPAHOE	CAKE/MAC	SURFACE	08/04/03	08/15/03	38	840.86	155.27	0.94	0.14	26	WHEAT	N
374	S 1/2 SEC 33 T4S R58W	310.4	ARAPAHOE	CAKE	SURFACE	08/20/02	08/25/02	56	1236.74	203.75	0.66	0.00	19	GRASS	N
375	N 1/2 SEC 33 T4S R58W	210	ARAPAHOE	CAKE	SURFACE	08/20/02	08/22/02	38	826.98	130.28	0.62	0.00	18	GRASS	N
376	N 1/2 SEC 34 T4S R58W	303.6	ARAPAHOE	CAKE	SURFACE	08/24/02	08/30/02	55	1235.52	204.24	0.67	0.00	18	WHEAT	N
377	S 1/2 SEC 34 T4S R58W	287	ARAPAHOE	CAKE	SURFACE	08/25/02	08/28/02	52	1156.71	190.35	0.66	0.00	18	GRASS	N
403	S 1/2 SEC 6 T6S R57W	265	ELBERT	CAKE	SURFACE	10/29/02	11/06/02	100	2179.71	350.46	1.32	0.00	36	WHEAT	N
406	N 1/2 SEC 4 T6S R57W	298.4	ELBERT	CAKE	SURFACE	10/15/02	10/23/02	141	3101.58	468.43	1.57	0.00	41	WHEAT	N
407	S 1/2 SEC 4 T6S R57W	265.3	ELBERT	CAKE	SURFACE	10/10/02	10/25/02	168	3755.5	578.4	2.18	0.00	59	WHEAT	N
408	N 1/2 SEC 3 T6S R57W	325	ELBERT	CAKE/MAC	SURFACE	09/28/02	10/10/02	201	4531.47	752.33	2.14	0.17	58	WHEAT	N
414	N 1/2 SEC 12 T6S R58W	204	ELBERT	CAKE	SURFACE	10/25/02	11/02/02	132	2892.74	456.36	2.24	0.00	61	WHEAT	N
416	N 1/2 SEC 7 T6S R57W	223.15	ELBERT	CAKE/MAC	SURFACE	05/26/03	06/15/03	109	2475	429.24	1.75	0.17	49	WHEAT	N
417	S 1/2 SEC 7 T6S R57W	221.44	ELBERT	CAKE	SURFACE	06/16/03	06/21/03	40	907.71	148.72	0.67	0.00	17	WHEAT	N
418	N 1/2 SEC 8 T6S R57W	111.29	ELBERT	CAKE	SURFACE	09/23/02	09/26/02	47	1057.09	167.11	1.05	0.00	39	WHEAT	N
419	S 1/2 SEC 8 T6S R57W	253.24	ELBERT	CAKE	SURFACE	09/20/02	09/30/02	166	3766.28	568.98	2.25	0.00	59	WHEAT	N
422	N 1/2 SEC 10 T6S R57W	290	ELBERT	CAKE/MAC	SURFACE	04/09/02	04/18/02	199	4582.49	733.24	2.46	0.07	75	WHEAT	N
423	S 1/2 SEC 10 T6S R57W	300	ELBERT	CAKE/MAC	SURFACE	04/18/02	04/29/02	205	4662.12	751.24	2.39	0.12	72	WHEAT	N
426	N 1/2 SEC 12 T6S R57W	202.04	ELBERT	CAKE	SURFACE	07/04/03	07/09/03	98	2233.45	395.18	1.96	0.00	49	WHEAT	N
427	S 1/2 SEC 12 T6S R57W	296.5	ELBERT	CAKE/MAC	SURFACE	07/02/03	07/09/03	53	1206.1	240.15	0.74	0.07	21	WHEAT	N
430	N 1/2 SEC 18 T6S R57W	142.79	ELBERT	CAKE	SURFACE	12/02/02	06/18/03	53	1184.07	188.45	1.32	0.00	34	WHEAT	N
431	S 1/2 SEC 18 T6S R57W	221.33	ELBERT	CAKE	SURFACE	11/30/02	06/18/03	79	1715.2	268.62	1.22	0.00	32	WHEAT	N
432	N 1/2 SEC 17 T6S R57W	132	ELBERT	CAKE/MAC	SURFACE	09/14/02	09/20/02	89	2024.62	334.92	2.39	0.15	66	WHEAT	N
433	S 1/2 SEC 17 T6S R57W	222.26	ELBERT	CAKE/MAC	SURFACE	06/17/03	06/23/03	91	2033.58	350.33	1.49	0.09	38	WHEAT	N
436	N 1/2 SEC 15 T6S R57W	246.18	ELBERT	CAKE	SURFACE	11/05/03	11/11/03	95	2116.66	472.02	1.92	0.00	50	WHEAT	N
437	S 1/2 SEC 15 T6S R57W	286.1	ELBERT	CAKE/MAC	SURFACE	04/25/02	05/01/02	64	1469.45	239.91	0.78	0.06	24	WHEAT	N
437	S 1/2 SEC 15 T6S R57W	229.29	ELBERT	CAKE	SURFACE	10/30/03	11/05/03	97	2127.46	463.98	2.02	0.00	53	WHEAT	N
440	N 1/2 SEC 13 T6S R57W	199.3	ELBERT	CAKE	SURFACE	07/08/02	07/11/02	45	1024.63	174.76	0.88	0.00	23	WHEAT	N
440	N 1/2 SEC 13 T6S R57W	204.25	ELBERT	CAKE	SURFACE	11/13/03	11/15/03	34	730.74	161.79	0.79	0.00	22	WHEAT	N
441	S 1/2 SEC 13 T6S R57W	300	ELBERT	CAKE	SURFACE	07/04/02	07/14/02	110	2510.13	432.43	1.44	0.00	39	WHEAT	N
441	S 1/2 SEC 13 T6S R57W	287.4	ELBERT	CAKE	SURFACE	11/15/03	11/20/03	51	1139.02	248.4	0.86	0.00	23	WHEAT	N
445	S 1/2 SEC 19 T6S R57W	86.8	ELBERT	CAKE	SURFACE	07/19/02	07/27/02	159	3559.53	585.71	6.75	0.00	183	GRASS	Y
446	N 1/2 SEC 20 T6S R57W	153	ELBERT	CAKE	INCORPORATED	08/02/02	08/19/02	279	6358.88	1040.06	6.80	0.00	179	GRASS	Y
447	S 1/2 SEC 20 T6S R57W	64.2	ELBERT	CAKE	INCORPORATED	07/27/02	08/02/02	118	2655.66	430.15	6.70	0.00	173	GRASS	Y
447	S 1/2 SEC 20 T6S R57W	53	ELBERT	CAKE	SURFACE	08/06/02	08/07/02	26	586.13	94.04	1.77	0.00	46	WHEAT	N

Table 1. Biosolids applications by Metro Wastewater Reclamation District to the study area near Deer Trail, Colorado, 2002-2003.–Continued

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DC	Legal description	Area applied to (acres)	County	Biosolids product applied	Application method	Start date	Stop date	Total loads	Total wet tons	Total dry tons	Loading rate, dry tons per acre		Nitrogen loading rate (lbs/acre)	Crop	Rec-lamation project
											CAKE	MAC			
450	N 1/2 SEC 22 T6S R57W	116	ELBERT	CAKE	SURFACE	05/01/02	05/02/02	28	659.56	102.22	0.88	0.00	26	WHEAT	N
450	N 1/2 SEC 22 T6S R57W	95	ELBERT	CAKE	SURFACE	11/11/03	11/13/03	32	690.72	159.1	1.67	0.00	48	WHEAT	N
454	N 1/2 SEC 24 T6S R57W	270	ELBERT	CAKE	SURFACE	06/26/02	10/06/02	187	4212.14	722.42	2.67	0.00	70	WHEAT	N
454	N 1/2 SEC 24 T6S R57W	264.56	ELBERT	CAKE	SURFACE	10/24/03	10/30/03	102	2276.18	488.6	1.85	0.00	47	WHEAT	N
455	S 1/2 SEC 24 T6S R57W	190.5	ELBERT	CAKE	SURFACE	06/23/02	06/26/02	69	1561.89	266.36	1.40	0.00	37	WHEAT	N
455	S 1/2 SEC 24 T6S R57W	176.93	ELBERT	CAKE	SURFACE	10/22/03	10/24/03	34	765.24	164.48	0.93	0.00	25	WHEAT	N
462	N 1/2 SEC 28 T6S R57W	237.06	ELBERT	CAKE	SURFACE	06/26/03	06/28/03	65	1475.07	250.22	1.05	0.00	28	WHEAT	N
463	S 1/2 SEC 28 T6S R57W	232.59	ELBERT	CAKE/MAC	SURFACE	06/24/03	07/02/03	116	2613.81	472.74	1.95	0.08	54	WHEAT	N
464	N 1/2 SEC 27 T6S R57W	55	ELBERT	CAKE	SURFACE	07/18/02	07/19/02	32	725.38	127.04	2.31	0.00	62	WHEAT	N
466	N 1/2 SEC 26 T6S R57W	271	ELBERT	CAKE/MAC	SURFACE	05/02/02	05/17/02	183	4195.15	697.08	2.51	0.06	69	WHEAT	N
466	N 1/2 SEC 26 T6S R57W	258.69	ELBERT	CAKE	INCORPORATED	08/30/03	09/22/03	117	2654.28	554.92	2.15	0.00	52	WHEAT	N
467	S 1/2 SEC 26 T6S R57W	232	ELBERT	CAKE	SURFACE	05/03/02	05/09/02	149	3409.88	532.89	2.30	0.00	65	WHEAT	N
467	S 1/2 SEC 26 T6S R57W	220.17	ELBERT	CAKE	INCORPORATED	08/21/03	08/30/03	111	2543.39	507.84	2.31	0.00	56	WHEAT	N
468	N 1/2 SEC 25 T6S R57W	230	ELBERT	CAKE	SURFACE	06/09/02	06/22/02	119	2692.61	451.28	1.96	0.00	53	WHEAT	N
468	N 1/2 SEC 25 T6S R57W	210.46	ELBERT	CAKE	INCORPORATED	09/09/03	10/22/03	91	2062	455.64	2.17	0.00	53	WHEAT	N
469	S 1/2 SEC 25 T6S R57W	261	ELBERT	CAKE	SURFACE	06/14/02	06/23/02	116	2594.84	436.36	1.67	0.00	47	WHEAT	N
469	S 1/2 SEC 25 T6S R57W	263.38	ELBERT	CAKE	INCORPORATED	09/25/03	10/17/03	105	2339.98	491.35	1.86	0.00	47	WHEAT	N
474	N 1/2 SEC 33 T6S R57W	62.2	ELBERT	CAKE	SURFACE	07/14/02	07/16/02	37	833.43	136.36	2.19	0.00	58	WHEAT	N
474	N 1/2 SEC 33 T6S R57W	149	ELBERT	CAKE	SURFACE	08/12/02	08/14/02	54	1207.47	188.26	1.26	0.00	36	WHEAT	N
476	N 1/2 SEC 34 T6S R57W	61.6	ELBERT	CAKE	SURFACE	07/16/02	07/18/02	37	833.59	141.46	2.29	0.00	60	WHEAT	N
477	S 1/2 SEC 34 T6S R57W	236	ELBERT	CAKE	SURFACE	09/07/02	09/14/02	152	3238.15	510.76	2.17	0.00	58	WHEAT	N
478	N 1/2 SEC 35 T6S R57W	115	ELBERT	CAKE	SURFACE	05/21/02	05/24/02	74	1659.07	273.33	2.37	0.00	63	WHEAT	N
478	N 1/2 SEC 35 T6S R57W	119.54	ELBERT	CAKE/MAC	INCORPORATED	08/12/03	08/25/03	58	1328.45	264.04	1.87	0.34	49	WHEAT	N
479	S 1/2 SEC 35 T6S R57W	133	ELBERT	CAKE/MAC	SURFACE	05/17/02	05/21/02	66	1519.28	255.6	1.80	0.12	50	WHEAT	N
479	S 1/2 SEC 35 T6S R57W	119.77	ELBERT	CAKE/MAC	INCORPORATED	08/12/03	08/26/03	60	1363.68	249.67	1.92	0.16	47	WHEAT	N
480	N 1/2 SEC 36 T6S R57W	301	ELBERT	CAKE	SURFACE	05/25/02	06/09/02	152	3430.58	572.63	1.90	0.00	51	WHEAT	N
480	N 1/2 SEC 36 T6S R57W	257.6	ELBERT	CAKE	INCORPORATED	09/23/03	10/09/03	109	2451.52	516.34	2.00	0.00	50	WHEAT	N
481	S 1/2 SEC 36 T6S R57W	300	ELBERT	CAKE/MAC	SURFACE	05/24/02	06/01/02	150	3389.48	583.38	1.89	0.05	50	WHEAT	N
481	S 1/2 SEC 36 T6S R57W	268.38	ELBERT	CAKE	INCORPORATED	09/22/03	10/03/03	113	2527.36	536.19	2.00	0.00	51	WHEAT	N
488	N 1/2 SEC 4 T7S R57W	45	ELBERT	CAKE	SURFACE	09/04/02	09/05/02	22	497.55	79.75	1.78	0.00	45	WHEAT	N
489	S 1/2 SEC 4 T7S R57W	50	ELBERT	CAKE	SURFACE	09/02/02	09/04/02	31	701.82	108.54	2.18	0.00	56	WHEAT	N
490	N 1/2 SEC 3 T7S R57W	107	ELBERT	CAKE	SURFACE	09/05/02	09/07/02	38	864.26	132.74	1.24	0.00	31	WHEAT	N
491	S 1/2 SEC 3 T7S R57W	112.6	ELBERT	CAKE	SURFACE	08/31/02	09/02/02	58	1324.24	212.73	1.89	0.00	49	WHEAT	N

Table 2. Methods used to analyze biosolids, soil, and crop samples collected near Deer Trail, Colorado, 2002–2003

Constituent	Medium	Analytical method	Reference
Arsenic	Biosolids, Soil, and Crops	HG-AAS[1]	Hageman and Welsch (1996)
Cadmium	Biosolids and Crops	ICP-MS[2]	Briggs and Meier (1999)
Cadmium	Soil	ICP-AES[3]	Motooka (1996)
Copper	Biosolids and Crops	ICP-MS[2]	Briggs and Meier (1999)
Copper	Soil	ICP-AES[3]	Briggs (1996)
Lead	Biosolids and Crops	ICP-MS[2]	Briggs and Meier (1999)
Lead	Soil	ICP-AES[3]	Briggs (1996)
Mercury	Biosolids, Soil, and Crops	CV-AAS[4]	O'Leary and others (1996)
Molybdenum	Biosolids and Crops	ICP-MS[2]	Briggs and Meier (1999)
Molybdenum	Soil	ICP-AES[3]	Motooka (1996)
Nickel	Biosolids and Crops	ICP-MS[2]	Briggs and Meier (1999)
Nickel	Soil	ICP-AES[3]	Briggs (1996)
Selenium	Biosolids, Soil, and Crops	HG-AAS[1]	Hageman and Welsch (1996)
Zinc	Biosolids and Crops	ICP-MS[2]	Briggs and Meier (1999)
Zinc	Soil	ICP-AES[3]	Briggs (1996)
Gross Alpha, Total	Biosolids, Soil, and Crops	Radiological method	Greenberg (1992)
Gross Beta, Total	Biosolids, Soil, and Crops	Radiological method	Greenberg (1992)
Plutonium-238, Total	Biosolids, Soil, and Crops	Radiological method	Whittaker and Grothaus (1979); Lyon (1980)
Plutonium-239+240, Total	Biosolids, Soil, and Crops	Radiological method	Whittaker and Grothaus (1979); Lyon (1980)

[1] Hydride Generation-Atomic Absorption Spectrometry.

[2] Inductively Coupled Plasma-Mass Spectrometry.

[3] Inductively Coupled Plasma-Atomic Emission Spectrometry.

[4] Continuous Flow-Cold Vapor-Atomic Absorption Spectrometry.

Table 3. Chemical and radioactivity data for biosolids samples collected at the Metro Wastewater Reclamation District November 2001 through July 2003.

[Standards from Colorado Department of Public Health and Environment, 1993; ppm, parts per million; %, percent; <, less than; pCi/g, picocuries per gram; Pu, plutonium; ND, not determined; +/-, plus or minus the analytical uncertainty]

Sample site	Arsenic, ppm	Cadmium, ppm	Copper, ppm	Lead, ppm	Mercury, ppm	Molyb-denum, ppm	Nickel, ppm	Selenium, ppm	Zinc, ppm	Total sulfur, %	Gross alpha, pCi/g	Gross beta, pCi/g	Pu238, pCi/g	Pu239+240, pCi/g
November 2001	1.7	2.5	620	60.0	1.8	32.0	24.0	11.0	650	1.51	ND	ND	ND	ND
December 2001	1.5	2.6	570	60.0	1.5	29.0	22.0	9.6	600	1.42	ND	ND	ND	ND
January 2002	1.6	2.9	600	58.0	1.6	29.0	23.0	9.4	630	1.49	37+/-9	27+/-5	0+/-0.02	0+/-0.02
February 2002	1.1	3.0	590	71.0	1.1	31.0	23.0	8.3	610	1.45	ND	ND	ND	ND
March 2002	1.1	2.9	560	67.0	1.3	30.0	22.0	8.3	580	1.51	ND	ND	ND	ND
April 2002	1.2	3.0	570	63.0	1.5	35.0	21.0	8.3	580	1.47	40+/-11	23+/-4	0+/-0.022	0+/-0.022
May 2002	2.2	2.7	689	58.3	1.5	37.7	24.7	9.9	717	1.54	ND	ND	ND	ND
June 2002	2.2	2.6	735	61.2	1.7	39.4	30.4	11.0	754	1.59	ND	ND	ND	ND
July 2002	2.2	2.2	722	62.7	2.2	47.6	26.2	10.0	778	1.62	18.4+/-2.3	23+/-2.5	0.0025+/-0.0013	0.0012+/-0.0024
August 2002	2.1	2.3	731	77.6	1.6	60.6	25.2	10.0	796	1.58	ND	ND	ND	ND
September 2002	2.2	2.2	709	64.1	1.7	50.3	23.0	9.7	747	1.46	ND	ND	ND	ND
October 2002	2.0	2.2	736	58.4	1.2	43.0	24.7	9.8	749	1.45	16.3+/-2.1	19.2+/-2.1	0+/-0.0016	0.0025+/-0.0025
November 2002	1.7	2.2	710	56.0	1.5	34.2	23.4	9.1	702	1.39	ND	ND	ND	ND
December 2002	1.6	2.4	705	53.5	1.5	40.0	25.5	9.5	705	1.40	ND	ND	ND	ND
January 2003	1.6	2.3	701	55.0	1.2	41.3	23.9	9.2	675	1.45	19+/-2.4	19.1+/-2.1	-0.0008+/-0.0008	0.0016+/-0.0008
February 2003	1.4	2.2	648	46.2	1.2	43.7	25.2	7.7	657	1.36	ND	ND	ND	ND
March 2003	1.3	2.4	619	47.0	1.2	40.9	23.1	7.4	627	1.30	ND	ND	ND	ND
April 2003	1.9	2.3	650	51.0	1.3	38.0	22.0	8.7	599	1.43	23.1+/-2.8	25.9+/-2.8	0.0018+/-0.0019	0.0009+/-0.0018
July 2003	2.5	2.4	694	58.0	1.5	34.0	22.0	12.0	709	1.58	14.4+/-1.9	24.4+/-2.6	0.0016+/-0.0016	-0.0008+/-0.0008
Maximum allowable for Grade 1	41	39	1,500	200	17.0	75 (Grade II)	420	100	2,800	No standard set	[1]40	No standard set	No standard set	No standard set

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[1] The Colorado regulatory limit on gross alpha activity of 40 pCi/g was removed from the regulation effective June 30, 2003.

Table 4. Chemical and radioactivity data for soil samples collected October 17, 2002, at the Arapahoe County site and September 19, 2002, at the Elbert County site.

[Sampling sites are shown in figures 3 and 4; mg/kg, milligrams per kilogram; <, less than; pCi/g, picocuries per gram; Pu, plutonium; +/-, plus or minus the analytical uncertainty]

Field sampled	Arsenic, mg/kg	Cadmium, mg/kg	Copper, mg/kg	Lead, mg/kg	Mercury, mg/kg	Molyb-denum, mg/kg	Nickel, mg/kg	Selenium, mg/kg	Zinc, mg/kg	Gross alpha, pCi/g	Gross beta, pCi/g	Pu238, pCi/g	Pu239+240, pCi/g
Arapahoe County north field (Control)	7.4	0.205	12.1	18.3	0.11	0.70	14.1	0.43	54.8	5.5+/-1.0	20.8+/-2.3	0+/-0.0040	0.0040+/-0.0040
Arapahoe County middle field (Biosolids applied)	7.0	0.236	15.5	18.8	0.02	0.79	15.8	0.33	59.2	18.9+/-2.4	28.4+/-3.0	0+/-0.0042	0.0041+/-0.0080
Arapahoe County south field (Control)	6.5	0.208	12.2	18.0	0.02	0.71	14.2	0.37	54.0	11.6+/-1.6	23.3+/-2.5	-0.00037+/-0.0037	0+/-0.0027
Elbert County north field (Control)	12.8	0.192	20.0	25.5	0.03	1.30	24.3	0.9	90.8	14.7+/-1.9	25.7+/-2.7	0+/-0.0018	-0.0018+/-0.0027
Elbert County middle field (Biosolids applied)	15.7	0.214	22.6	27.7	0.04	1.65	23.1	1.0	92.1	15.6+/-2.0	27.4+/-2.9	0+/-0.0010	-0.0018+/-0.0028
Elbert County south field (Control)	12.5	0.213	17.2	24.3	0.03	1.40	19.8	0.8	78.1	18.6+/-2.3	24.3+/-2.6	0+/-0.0036	-0.0106+/-0.007

Table 5. Chemical and radioactivity data for wheat-grain samples collected near Deer Trail, Colorado, July 2002.

[Samples were collected from soil sites shown in figures 3 and 4; mg/kg, milligrams per kilogram; <, less than; ND, not determined; pCi/g, picocuries per gram; Pu, plutonium; +/-, plus or minus the analytical uncertainty]

Field sampled	Arsenic, mg/kg	Cadmium, mg/kg	Copper, mg/kg	Lead, mg/kg	Mercury, mg/kg	Molyb-denum, mg/kg	Nickel, mg/kg	Selenium, mg/kg	Zinc, mg/kg	Gross alpha, pCi/g	Gross beta, pCi/g	Pu238, pCi/g	Pu239+240, pCi/g
Arapahoe County north field (Control)	<0.05	0.03	5.1	0.01	<0.02	0.8	1.6	0.26	24.3	ND	ND	ND	ND
Arapahoe County middle field (Biosolids applied)	0.05	0.02	7.5	0.01	<0.02	1.0	3.4	1.1	22.9	0.6+/-0.5	3.5+/-0.8	0.0036+/-0.0070	-0.0035+/-0.0035
Arapahoe County south field (Control)	<0.05	0.03	6.7	0.02	<0.02	0.9	3.0	0.83	21.4	ND	ND	ND	ND
Elbert County north field (Control)	<0.05	0.01	6.1	0.01	<0.02	1.2	1.7	2.6	28.5	ND	ND	ND	ND
Elbert County middle field (Biosolids applied)	0.07	0.01	6.1	0.07	<0.02	1.7	8.7	0.37	34.7	1.1+/-0.5	5.0+/-0.9	0+/-0.0040	0+/-0.0039
Elbert County south field (Control)	< 0.05	0.01	4.9	0.03	<0.02	1.0	3.6	0.36	23.5	ND	ND	ND	ND

Table 6. Information for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.

[Latitude and longitude are in the format degrees minutes seconds referenced to NAD 83; bmp, below measuring point (stickup); Wells shown in bold routinely are sampled for water quality; Elev., elevation in feet above NAVD 88; Metro, Metro Wastewater Reclamation District; HUC, Hydrologic Unit Code (Seaber and others, 1987); NWIS, USGS National Water Information System database; ID, identification number]

Well	Latitude	Longitude	Elev. of stickup (feet)	Elev. of land surface (feet)	Property owner	County	Drill date	Current stickup (feet)	Total depth (feet bmp)	Screen top (feet bmp)	Screen bottom (feet bmp)	Screen size	Screen length (feet)	Sump length (feet)	Well diam-eter (inches)	HUC	NWIS station ID
DTX1	39°43'33"	103°52'51"	4,909	4,906	Metro	ARAPAHOE	02/16/99	2.56	25.50	20.59	22.19	0.010	1.60	3.31	2	10190012	394333103525100
DTX2*	39°41'49"	103°51'38"	4,903	4,900	Metro	ARAPAHOE	02/16/99	3.23	20.50	15.59	17.19	0.010	1.60	3.31	2	10190012	394148103513300
DTX3	39°30'24"	103°43'28"	5,195	5,192	Metro	ELBERT	02/12/99	3.11	18.71	13.80	15.40	0.010	1.60	3.31	2	10190013	393024103432800
DTX4	39°33'58"	103°43'42"	4,957	4,954	Metro	ELBERT	02/10/99	2.70	16.72	11.81	13.41	0.010	1.60	3.31	2	10190013	393358103434200
DTX5*	39°33'58"	103°45'48"	4,975	4,973	Metro	ELBERT	02/10/99	2.30	20.90	16.09	17.69	0.010	1.60	3.21	2	10190013	393358103454800
DTX6	39°33'58"	103°46'48"	4,970	4,968	Metro	ELBERT	02/09/99	2.36**	39	34	36	0.010	1.60	3.31	2	10190013	393358103464800
DTX7	39°40'54"	103°56'46"	5,076	5,073	Price	ARAPAHOE	02/18/99	2.77	16.10	11.19	12.79	0.010	1.60	3.31	2	10190011	394054103564600
DTX8A	39°40'54"	103°56'45"	5,076	5,074	Price	ARAPAHOE	03/02/99	2.46	77.52	67.56	71.83	0.010	4.27	5.69	2	10190011	394054103564501
DTX8B	39°40'54"	103°56'45"	5,076	5,074	Price	ARAPAHOE	03/02/99	2.49	177.48	167.52	171.79	0.010	4.27	5.69	2	10190011	394054103564502
DTX9*	39°39'02"	103°55'40"	5,121	5,119	Weisensee	ARAPAHOE	02/17/99	2.46	30.15	22.72	24.32	0.010	1.60	5.83	2	10190011	393902103554000
DTX10A*	39°39'02"	103°55'40"	5,122	5,120	Weisensee	ARAPAHOE	03/04/99	2.03	61.97	52.01	56.28	0.010	4.27	5.69	2	10190011	393902103554001
DTX10B	39°39'02"	103°55'40"	5,122	5,120	Weisensee	ARAPAHOE	03/04/99	2.11	121.73	111.77	116.04	0.010	4.27	5.69	2	10190011	393902103554002
DTX11*	39°39'02"	103°55'40"	5,122	5,120	Weisensee	ARAPAHOE	01/19/00	2.24	32	28	30	0.020	2	2.35	2	10190011	393902103554003
D6	39°36'33"	103°51'22"	5,128.78	5,126	Metro	ARAPAHOE	09/12/93	2.65	25	15	25	0.010	10	0.3	2	10190013	393633103512300
D6A	39°36'33"	103°51'22"	5,129	5,126	Metro	ARAPAHOE	02/06/02	2.42	32.96	28.42	30.71	0.010	2.29	2.25	2	10190013	393633103512301
D11a	39°33'45"	103°54'23"	5,377	5,374	Metro	ELBERT	10/23/97	2.46	143	113	123	0.010	10	20.38	2	10190011	393334103543600
D13	39°34'42"	103°54'38"	5,235.33	5,234	Metro	ARAPAHOE	04/04/94	1.81	16	6	16	0.010	10	0.3	2	10190011	393439103543400
D15	39°33'59"	103°54'54.2"	5,246.77	5,245	Keen	ELBERT	04/07/94	1.86	25	15	25	0.010	10	0.3	2	10190011	393357103545200
D17	39°33'34"	103°54'36"	5,277.73	5,276	Metro	ELBERT	04/05/94	1.90	21	11	21	0.010	10	0.3	2	10190011	393327103541200
D19	39°33'17"	103°54'18.1"	5,304.24	5,303	Metro	ELBERT	04/05/94	1.69	30	20	30	0.010	10	0.3	2	10190011	393311103541800
D23	39°33'42"	103°55'01.1"	5,256.05	5,254	Keen	ELBERT	04/08/94	2.54	15	10	15	0.010	5	0.3	2	10190011	393330103545300
D25*	39°37'02"	103°54'42"	5,167.13	5,165	Metro	ARAPAHOE	05/01/95	2.23	23	13	23	0.010	10	0.3	2	10190011	393702103544100
D25A	39°37'02"	103°54'42"	5,167	5,165	Metro	ARAPAHOE	02/05/02	2.57	24.67	20.13	22.42	0.010	2.29	2.25	2	10190011	393702103544102
D29	39°36'41"	103°52'48"	5,371	5,369	Metro	ARAPAHOE	11/04/97	2.38	183	148	158	0.010	10	25.38	2	10190013	393632103524300
D30	39°36'55"	103°51'22"	5,096.43	5,094	Metro	ARAPAHOE	05/05/95	1.98	19	9	19	0.010	10	0.3	2	10190013	393655103512200

* Wells having continuous-recorder equipment.

**DTX6 stickup went from 2.43 ft to 2.36 ft between mid-October 2002 and early November 2002.

Table 7. Data from core samples collected near Deer Trail, Colorado, February 2002.

[%, percent; ppm, parts per million; ", inch; <, less than; --, not applicable; ICP, Inductively Coupled Plasma; ICP-MS, Inductively Coupled Plasma-Mass Spectrometry; HG-AAS, Hydride Generation-Atomic Absorption Spectrometry; C-IR, combustion-infrared absorption; CV-AAS, Continuous Flow-Cold Vapor-Atomic Absorption Spectrometry; SRM, Standard Reference Material used for quality assurance; all analyses by the U.S. Geological Survey Mineral Resources Laboratory using methods indicated]

Sample site (fig. 1)	Depth of sample below land surface, in feet	Sample description	Aluminum, %	Antimony, ppm	Arsenic, ppm	Barium, ppm	Beryllium, ppm	Bismuth, ppm	Cadmium, ppm	Calcium, %	Cerium, ppm	Cesium, ppm	Chromium, ppm	Cobalt, ppm	Copper, ppm	Dysprosium, ppm	Erbium, ppm
			by ICP	by ICP-MS	by HG-AAS	by ICP	by ICP-MS	by ICP-MS	by ICP-MS	by ICP	by ICP-MS	by ICP-MS	by ICP	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS
D6A	14	Wet brown loamy silt zone in brown clay	5.8	0.61	10	560	1.7	0.09	0.11	2.52	64	4.6	43	8.1	14	4.4	2.5
D6A	16.5	Brown clayey loam with black particles and a gray zone	5.8	0.71	9.0	604	2.3	0.10	0.22	1.90	70	4.9	45	10	15	4.7	2.7
D6A	19-19.5	White sugary crystals on large (3"-6") planar void surfaces in brown loamy clay	5.8	0.73	13	531	2.0	0.10	0.10	2.39	74	5.4	45	9.8	16	4.8	2.7
D6A	22.5	Brown clayey silt with small pods of white sugary crystals	5.8	0.66	20	585	2.0	0.10	0.12	1.72	71	5.1	43	7.5	15	4.6	2.6
D6A	27.5-28	Wet brown loam with abundant coarse arkosic sand and gravel; includes large white angular crystals formed in situ	3.5	1.92	33	822	1.9	< 0.08	0.37	10.5	51	3.1	24	11	16	4.8	3.1
D9[1]	32	Brown loamy silt and very fine sand with 1/8"-1/4" coal stringers	4.7	0.48	6.1	586	1.6	< 0.08	0.15	0.75	53	3.0	26	5.7	9	3.4	1.9
D9[1]	48.5	Brown silt with weathered sandstone and coal fragments	5.1	0.52	6.2	621	1.7	< 0.08	0.11	1.08	59	3.3	36	6.3	9	3.6	2.1
D9[1]	49.5-50	Orange and gray fine sand and silt with large (1") gray-black streaks	4.0	0.54	6.0	601	1.6	< 0.08	0.23	0.60	53	2.9	19	6.2	9	3.2	1.7
D9[1]	56.5	Oxidized orange and dark gray shale	4.8	0.66	23	2670	2.4	0.08	0.01	2.04	29	3.7	41	5.6	13	2.6	1.5
D9[1]	59.5	Dark brownish-orange very weathered siltstone and sandstone with concretions	4.0	0.55	14	505	1.5	< 0.08	0.01	1.09	73	3.0	46	6.6	7	3.2	1.8
D25A	14.5-16.5	Brown loamy clay with white sugary crystals and orange and black streaks	6.4	0.64	7.8	647	2.1	< 0.08	0.18	0.89	72	4.4	43	8.1	14	4.6	2.5

Table 7. Data from core samples collected near Deer Trail, Colorado, February 2002.—Continued

[%, percent; ppm, parts per million; ", inch; <, less than; --, not applicable; ICP, Inductively Coupled Plasma; ICP-MS, Inductively Coupled Plasma-Mass Spectrometry; HG-AAS, Hydride Generation-Atomic Absorption Spectrometry; C-IR, combustion-infrared absorption; CV-AAS, Continuous Flow-Cold Vapor-Atomic Absorption Spectrometry; SRM, Standard Reference Material used for quality assurance; all analyses by the U.S. Geological Survey Mineral Resources Laboratory using methods indicated]

Sample site (fig. 1)	Depth of sample below land surface, in feet	Sample description	Aluminum, %	Antimony, ppm	Arsenic, ppm	Barium, ppm	Beryllium, ppm	Bismuth, ppm	Cadmium, ppm	Calcium, %	Cerium, ppm	Cesium, ppm	Chromium, ppm	Cobalt, ppm	Copper, ppm	Dysprosium, ppm	Erbium, ppm
			by ICP	by ICP-MS	by HG-AAS	by ICP	by ICP-MS	by ICP-MS	by ICP-MS	by ICP	by ICP-MS	by ICP-MS	by ICP	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS
D25A	17-17.5	Wet brown loamy silt with larger sandstone fragments and many white pods of sugary crystals	4.9	0.51	15	662	1.9	< 0.08	0.15	1.63	50	2.7	29	6.3	9	3.5	1.8
D25A	18-18.5	Wet orange and brown fine sand with white gray streaks	4.6	0.52	8.6	672	1.7	< 0.08	0.15	1.30	58	2.9	28	6.4	9	3.6	2.0
D25A	19.0-19.5	Poorly sorted wet brown sand with angular rock fragments	4.3	0.43	8.4	677	1.3	< 0.08	0.12	1.12	46	2.3	22	4.8	7	2.8	1.5
D25A	20-20.5	Semi-lithified; distinct orange bands in gray fine sand and silt	4.1	0.37	2.7	641	1.6	< 0.08	0.02	0.39	44	1.8	18	2.1	3	2.4	1.4
SRM SGR-1	--	--	3.6	3.08	58	283	1.2	0.86	1.13	6.08	35	5.3	34	12	65	2.1	1.2

Table 7. Data from core samples collected near Deer Trail, Colorado, February 2002.—Continued

[%, percent; ppm, parts per million; ", inch; <, less than; --, not applicable; ICP, Inductively Coupled Plasma; ICP-MS, Inductively Coupled Plasma-Mass Spectrometry; HG-AAS, Hydride Generation-Atomic Absorption Spectrometry; C-IR, combustion-infrared absorption; CV-AAS, Continuous Flow-Cold Vapor-Atomic Absorption Spectrometry; SRM, Standard Reference Material used for quality assurance; all analyses by the U.S. Geological Survey Mineral Resources Laboratory using methods indicated]

Sample site (fig. 1)	Depth of sample below land surface, in feet	Sample description	Europium, ppm	Gado-linium, ppm	Gallium, ppm	German-ium, ppm	Gold, ppm	Holmium, ppm	Indium, ppm	Iron, %	Lan thanum, ppm	Lead, ppm	Lithium, ppm	Mag-nesium, %	Man-ganese, ppm	Mercury, ppm	Molyb-denum, ppm	Neo-dymium, ppm
			by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP	by ICP-MS	by ICP-MS	by ICP	by ICP	by ICP-MS	by CV-AAS	by ICP-MS	by ICP-MS
D6A	14	Wet brown loamy silt zone in brown clay	1.07	4.8	13	1.2	< 0.005	0.9	0.051	2.3	35	18	31	1.06	331	0.02	0.66	29
D6A	16.5	Brown clayey loam with black particles and a gray zone	1.19	5.1	14	1.2	0.005	0.9	0.052	2.3	39	20	30	1.03	2360	0.02	1.19	32
D6A	19-19.5	White sugary crystals on large (3"-6") planar void surfaces in brown loamy clay	1.19	5.3	14	1.3	0.007	1.0	0.058	2.4	40	21	33	1.08	200	<0.02	0.73	33
D6A	22.5	Brown clayey silt with small pods of white sugary crystals	1.17	5.2	14	1.3	< 0.005	1.0	0.059	2.3	39	19	31	1.06	222	0.02	0.64	33
D6A	27.5-28	Wet brown loam with abundant coarse arkosic sand and gravel; includes large white angular crystals formed in situ	1.03	4.7	9	0.9	< 0.005	1.0	0.044	8.3	30	22	18	0.74	1330	0.06	3.03	25
D9[1]	32	Brown loamy silt and very fine sand with 1/8"-1/4" coal stringers	0.93	3.7	11	1.2	< 0.005	0.7	0.033	1.4	30	14	13	0.49	221	<0.02	0.46	24
D9[1]	48.5	Brown silt with weathered sandstone and coal fragments	1.02	4.1	12	1.2	< 0.005	0.7	0.036	1.8	33	16	18	0.63	215	<0.02	0.51	27
D9[1]	49.5-50	Orange and gray fine sand and silt with large (1") gray-black streaks	0.91	3.6	11	1.2	< 0.005	0.6	0.034	1.2	30	15	12	0.34	1420	0.02	0.96	25
D9[1]	56.5	Oxidized orange and dark gray shale	0.68	2.8	13	1.0	< 0.005	0.5	0.048	7.9	18	16	10	0.43	82.8	0.04	2.95	17
D9[1]	59.5	Dark brownish-orange very weathered siltstone and sandstone with concretions	0.85	3.6	10	1.1	< 0.005	0.6	0.059	2.7	38	17	10	0.39	210	0.02	1.62	26
D25A	14.5-16.5	Brown loamy clay with white sugary crystals and orange and black streaks	1.22	5.0	15	1.4	< 0.005	0.9	0.052	2.3	39	19	25	0.77	427	0.02	0.87	32

Table 7. Data from core samples collected near Deer Trail, Colorado, February 2002.—Continued

[%, percent; ppm, parts per million; ", inch; <, less than; --, not applicable; ICP, Inductively Coupled Plasma; ICP-MS, Inductively Coupled Plasma-Mass Spectrometry; HG-AAS, Hydride Generation-Atomic Absorption Spectrometry; C-IR, combustion-infrared absorption; CV-AAS, Continuous Flow-Cold Vapor-Atomic Absorption Spectrometry; SRM, Standard Reference Material used for quality assurance; all analyses by the U.S. Geological Survey Mineral Resources Laboratory using methods indicated]

Sample site (fig. 1)	Depth of sample below land surface, in feet	Sample description	Europium, ppm	Gado-linium, ppm	Gallium, ppm	German-ium, ppm	Gold, ppm	Holmium, ppm	Indium, ppm	Iron, %	Lan thanum, ppm	Lead, ppm	Lithium, ppm	Mag-nesium, %	Man-ganese, ppm	Mercury, ppm	Molyb-denum, ppm	Neo-dymium, ppm
			by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP	by ICP-MS	by ICP-MS	by ICP	by ICP	by ICP-MS	by CV-AAS	by ICP-MS	by ICP-MS
D25A	17-17.5	Wet brown loamy silt with larger sandstone fragments and many white pods of sugary crystals	0.91	3.5	10	1.2	< 0.005	0.6	0.032	1.9	28	16	17	0.49	272	<0.02	0.64	23
D25A	18-18.5	Wet orange and brown fine sand with white gray streaks	1.02	4.2	11	1.3	< 0.005	0.7	0.036	1.7	33	17	15	0.44	290	<0.02	0.69	26
D25A	19.0-19.5	Poorly sorted wet brown sand with angular rock fragments	0.82	3.2	9	1.2	< 0.005	0.6	0.028	1.6	25	15	13	0.37	233	<0.02	0.55	20
D25A	20-20.5	Semi-lithified; distinct orange bands in gray fine sand and silt	0.74	2.7	10	1.0	< 0.005	0.5	0.025	0.7	26	12	10	0.27	102	<0.02	0.3	19
SRM SGR-1	--	--	0.50	2.3	9	0.1	0.008	0.4	0.043	2.0	21	44	137	2.82	256	0.22	34.9	15

Table 7. Data from core samples collected near Deer Trail, Colorado, February 2002.—Continued

[%, percent; ppm, parts per million; ", inch; <, less than; --, not applicable; ICP, Inductively Coupled Plasma; ICP-MS, Inductively Coupled Plasma-Mass Spectrometry; HG-AAS, Hydride Generation-Atomic Absorption Spectrometry; C-IR, combustion-infrared absorption; CV-AAS, Continuous Flow-Cold Vapor-Atomic Absorption Spectrometry; SRM, Standard Reference Material used for quality assurance; all analyses by the U.S. Geological Survey Mineral Resources Laboratory using methods indicated]

Sample site (fig. 1)	Depth of sample below land surface, in feet	Sample description	Nickel, ppm	Niobium, ppm	Nitrate+ Nitrite as N, Soluble N, ppm	Nitrogen, Ammonia as N, Soluble N, ppm	Nitrogen, Total as N Kjeldahl, ppm	Phos- phorus, %	Potas- sium, %	Praseo- dymium, ppm	Rubidium, ppm	Samarium, ppm	Scandium, ppm	Selenium, ppm	Silica, %	Silver, ppm
			by ICP-MS	by ICP-MS	by contract	by contract	by contract	by ICP-MS	by ICP	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by HG-AAS	by ICP	by ICP-MS
D6A	14	Wet brown loamy silt zone in brown clay	16	14	1.7	<2	40	0.07	1.94	7.7	91	5.4	7.9	<0.2	30.2	0.10
D6A	16.5	Brown clayey loam with black particles and a gray zone	23	14	<1	<2	67	0.08	1.97	8.4	96	6.0	8.7	<0.2	31.2	0.10
D6A	19-19.5	White sugary crystals on large (3"-6") planar void surfaces in brown loamy clay	18	15	<1	<2	94	0.08	1.89	8.4	94	6.2	8.7	0.3	30.1	0.10
D6A	22.5	Brown clayey silt with small pods of white sugary crystals	16	13	2.6	<2	96	0.08	1.98	8.3	98	5.9	8.7	1.3	31.2	0.10
D6A	27.5-28	Wet brown loam with abundant coarse arkosic sand and gravel; includes large white angular crystals formed in situ	21	9	3.2	<2	46	0.11	1.19	6.3	59	4.8	6.4	3.5	19.3	0.08
D9[1]	32	Brown loamy silt and very fine sand with 1/8"-1/4" coal stringers	10	11	5.2	<2	51	0.06	1.86	6.2	83	4.3	5.9	0.3	35.5	0.06
D9[1]	48.5	Brown silt with weathered sandstone and coal fragments	11	11	5.4	<2	<10	0.06	1.94	7.0	87	4.8	6.7	0.2	33.9	0.07
D9[1]	49.5-50	Orange and gray fine sand and silt with large (1") gray-black streaks	14	9	4.1	<2	32	0.04	1.82	6.3	84	4.3	5.8	<0.2	35.0	0.07
D9[1]	56.5	Oxidized orange and dark gray shale	6	13	8.4	4.0	92	0.07	1.63	3.9	77	3.4	8.3	1.5	26.8	0.09
D9[1]	59.5	Dark brownish-orange very weathered siltstone and sandstone with concretions	8	15	<1	<2	52	0.10	1.59	7.4	72	4.5	7.2	0.3	35.1	0.09
D25A	14.5-16.5	Brown loamy clay with white sugary crystals and orange and black streaks	17	13	1.5	<2	71	0.06	2.00	8.3	93	5.8	8.9	0.3	32.5	0.10

Table 7. Data from core samples collected near Deer Trail, Colorado, February 2002.—Continued

[%, percent; ppm, parts per million; ", inch; <, less than; --, not applicable; ICP, Inductively Coupled Plasma; ICP-MS, Inductively Coupled Plasma-Mass Spectrometry; HG-AAS, Hydride Generation-Atomic Absorption Spectrometry; C-IR, combustion-infrared absorption; CV-AAS, Continuous Flow-Cold Vapor-Atomic Absorption Spectrometry; SRM, Standard Reference Material used for quality assurance; all analyses by the U.S. Geological Survey Mineral Resources Laboratory using methods indicated]

Sample site (fig. 1)	Depth of sample below land surface, in feet	Sample description	Nickel, ppm	Niobium, ppm	Nitrate+ Nitrite as N, Soluble N, ppm	Nitrogen, Ammonia as N, Soluble N, ppm	Nitrogen, Total as N Kjeldahl, ppm	Phos-phorus, %	Potas-sium, %	Praseo-dymium, ppm	Rubidium, ppm	Samarium, ppm	Scandium, ppm	Selenium, ppm	Silica, %	Silver, ppm
			by ICP-MS	by ICP-MS	by contract	by contract	by contract	by ICP-MS	by ICP	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by HG-AAS	by ICP	by ICP-MS
D25A	17-17.5	Wet brown loamy silt with larger sandstone fragments and many white pods of sugary crystals	11	8	<1	<2	78	0.05	1.93	5.8	79	3.9	5.2	0.5	34.2	0.08
D25A	18-18.5	Wet orange and brown fine sand with white gray streaks	11	7	<1	<2	62	0.05	1.93	6.8	84	4.7	6.0	0.3	34.2	0.07
D25A	19.0-19.5	Poorly sorted wet brown sand with angular rock fragments	9	6	<1	<2	78	0.04	1.93	5.2	75	3.6	4.5	0.4	35.6	0.06
D25A	20-20.5	Semi-lithified; distinct orange bands in gray fine sand and silt	4	8	<1	<2	41	0.04	1.86	4.9	76	3.4	4.6	<0.2	36.9	0.06
SRM SGR-1	--	--	30	12	<1	110.0	1,000	0.14	1.35	4.1	80	2.6	5.7	4.1	13.0	0.15

Table 7. Data from core samples collected near Deer Trail, Colorado, February 2002.—Continued

[%, percent; ppm, parts per million; ", inch; <, less than; --, not applicable; ICP, Inductively Coupled Plasma; ICP-MS, Inductively Coupled Plasma-Mass Spectrometry; HG-AAS, Hydride Generation-Atomic Absorption Spectrometry; C-IR, combustion-infrared absorption; CV-AAS, Continuous Flow-Cold Vapor-Atomic Absorption Spectrometry; SRM, Standard Reference Material used for quality assurance; all analyses by the U.S. Geological Survey Mineral Resources Laboratory using methods indicated]

Sample site (fig. 1)	Depth of sample below land surface, in feet	Sample description	Sodium, %	Strontium, ppm	Sulfur, %	Terbium, ppm	Thallium, ppm	Thorium, ppm	Thulium, ppm	Titanium, %	Uranium, ppm	Vanadium, ppm	Ytterbium, ppm	Yttrium, ppm	Zinc, ppm	Zirconium, ppm
			by ICP	by ICP	C-IR	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP
D6A	14	Wet brown loamy silt zone in brown clay	0.74	193	0.7	0.69	0.63	11.4	0.41	0.30	2.9	77	2.6	26	64	356
D6A	16.5	Brown clayey loam with black particles and a gray zone	0.73	174	0.39	0.79	0.69	12.6	0.43	0.29	4.3	85	2.7	29	72	343
D6A	19-19.5	White sugary crystals on large (3"-6") planar void surfaces in brown loamy clay	0.66	163	0.92	0.79	0.65	12.7	0.45	0.31	3.3	89	2.9	30	74	411
D6A	22.5	Brown clayey silt with small pods of white sugary crystals	0.75	169	0.33	0.78	0.67	12.6	0.44	0.30	3.2	85	2.8	30	71	365
D6A	27.5-28	Wet brown loam with abundant coarse arkosic sand and gravel; includes large white angular crystals formed in situ	0.45	302	1.51	0.74	0.40	8.7	0.45	0.17	3.9	79	2.8	32	102	203
D9[1]	32	Brown loamy silt and very fine sand with 1/8"-1/4" coal stringers	0.57	108	<0.05	0.56	0.51	8.6	0.31	0.22	2.2	53	2.0	21	55	295
D9[1]	48.5	Brown silt with weathered sandstone and coal fragments	0.67	127	<0.05	0.62	0.58	9.7	0.34	0.22	2.9	60	2.2	22	54	294
D9[1]	49.5-50	Orange and gray fine sand and silt with large (1") gray-black streaks	0.54	96	<0.05	0.53	0.57	8.4	0.29	0.16	2.2	57	1.8	19	50	251
D9[1]	56.5	Oxidized orange and dark gray shale	0.52	157	1.82	0.42	0.52	8.1	0.25	0.25	1.9	110	1.6	14	66	223
D9[1]	59.5	Dark brownish-orange very weathered siltstone and sandstone with concretions	0.61	106	0.62	0.53	0.43	14.1	0.30	0.38	2.7	82	2.0	19	57	835
D25A	14.5-16.5	Brown loamy clay with white sugary crystals and orange and black streaks	0.62	135	<0.05	0.75	0.71	11.7	0.42	0.28	2.5	82	2.7	28	71	252

Table 7. Data from core samples collected near Deer Trail, Colorado, February 2002.—Continued

[%, percent; ppm, parts per million; ", inch; <, less than; --, not applicable; ICP, Inductively Coupled Plasma; ICP-MS, Inductively Coupled Plasma-Mass Spectrometry; HG-AAS, Hydride Generation-Atomic Absorption Spectrometry; C-IR, combustion-infrared absorption; CV-AAS, Continuous Flow-Cold Vapor-Atomic Absorption Spectrometry; SRM, Standard Reference Material used for quality assurance; all analyses by the U.S. Geological Survey Mineral Resources Laboratory using methods indicated]

Sample site (fig. 1)	Depth of sample below land surface, in feet	Sample description	Sodium, %	Strontium, ppm	Sulfur, %	Terbium, ppm	Thallium, ppm	Thorium, ppm	Thulium, ppm	Titanium, %	Uranium, ppm	Vanadium, ppm	Ytterbium, ppm	Yttrium, ppm	Zinc, ppm	Zirconium, ppm
			by ICP	by ICP	C-IR	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP-MS	by ICP
D25A	17-17.5	Wet brown loamy silt with larger sandstone fragments and many white pods of sugary crystals	0.61	130	0.05	0.52	0.55	7.4	0.31	0.20	1.9	56	1.9	20	45	188
D25A	18-18.5	Wet orange and brown fine sand with white gray streaks	0.59	120	<0.05	0.61	0.56	9.2	0.32	0.18	2.1	64	2.1	22	50	186
D25A	19.0-19.5	Poorly sorted wet brown sand with angular rock fragments	0.59	115	<0.05	0.46	0.49	7.0	0.25	0.17	1.6	50	1.6	17	38	269
D25A	20-20.5	Semi-lithified; distinct orange bands in gray fine sand and silt	0.75	128	0.05	0.40	0.46	6.0	0.23	0.15	1.7	41	1.5	14	21	253
SRM SGR-1	--	--	2.26	397	1.43	0.34	0.69	5.0	0.20	0.14	6.2	138	1.3	13	76	50

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[1] Data for D9 site is from the borehole drilled in 2002 about 15 feet northeast of well D9.

Table 8. Methods used to analyze ground-water samples collected near Deer Trail, Colorado, 2002-2003.

[MRL, minimum reporting level, and dilutions for samples having high specific conductance may result in higher MRL's for some samples; MDC, minimum detectable concentration (radiochemical samples); ICP, inductively coupled plasma; AA, atomic absorption spectrometry; MS, mass spectroscopy; ASF, automated segmented-flow spectrophotometry; IC, ion chromatography; GF, graphite furnace; CVAF, atomic fluorescence cold vapor; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter]

Property or constituent	Units	Analytical method	MRL or MDC	Method Reference
Major ions and mineral characteristics				
Specfic conductance, lab	µS/cm	Wheatstone bridge	3	Fishman and Friedman (1989)
pH, lab	units	Electrometric electrode	0.1	Fishman and Friedman (1989)
Calcium, dissolved	mg/L	ICP	0.01	Fishman (1993)
Magnesium, dissolved	mg/L	ICP	0.008	Fishman (1993)
Sodium, dissolved	mg/L	ICP	0.09	Fishman (1993)
Potassium, dissolved	mg/L	AA[1]	0.10	Fishman and Friedman (1989)
Acid-neutralizing capacity, lab, as $CaCO_3$	mg/L	Electrometric titration	2	Fishman and Friedman (1989)
Sulfate, dissolved	mg/L	IC	0.2	Fishman and Friedman (1989)
Chloride, dissolved	mg/L	IC	0.20	Fishman and Friedman (1989)
Fluoride, dissolved	mg/L	Colorimetry, ASF, ion-selective electrode	0.2	Fishman and Friedman (1989)
Bromide, dissolved	mg/L	Colorimetry, ASF, fluorescein	0.02	Fishman and Friedman (1989)
Silica, dissolved	mg/L	ICP	0.13	Fishman (1993)
Dissolved solids, residue at 180°C	mg/L	Gravimetric	10	Fishman and Friedman (1989)
Nutrients				
Nitrite plus nitrate, dissolved as N	mg/L	Colorimetry, ASF, cadmium reduction, diazotization	0.05	Fishman (1993)
Nitrogen, ammonia, dissolved as N	mg/L	Colorimetry, ASF, salicylate-hypochlorite	0.05	Fishman (1993)
Nitrogen, ammonia plus organic, total as N	mg/L	Colorimetry, ASF, microkjeldahl digestion	0.1	Patton and Truitt (2000)
Nitrogen, ammonia plus organic, dissolved as N	mg/L	Colorimetry, ASF, microkjeldahl digestion	0.1	Patton and Truitt (2000)
Phosphorus, total as P	mg/L	Colorimetry, ASF, microkjeldahl digestion	0.05	Patton and Truitt (1992)
Phosphorus, dissolved as P	mg/L	Colorimetry, ASF, microkjeldahl digestion	0.05	Patton and Truitt (1992)
Trace elements				
Aluminum, dissolved as Al	µg/L	ICP-MS	2	Faires (1993)
Antimony, dissolved as Sb	µg/L	ICP-MS	0.3	Faires (1993)

Table 8. Methods used to analyze ground-water samples collected near Deer Trail, Colorado, 2002-2003.–Continued

[MRL, minimum reporting level, and dilutions for samples having high specific conductance may result in higher MRL's for some samples; MDC, minimum detectable concentration (radiochemical samples); ICP, inductively coupled plasma; AA, atomic absorption spectrometry; MS, mass spectroscopy; ASF, automated segmented-flow spectrophotometry; IC, ion chromatography; GF, graphite furnace; CVAF, atomic fluorescence cold vapor; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter]

Property or constituent	Units	Analytical method	MRL or MDC	Method Reference
Arsenic, dissolved as As	µg/L	Hydride generation[2]	2	Jones and Garbarino (1999)
Barium, dissolved as Ba	µg/L	ICP-MS	1	Faires (1993)
Beryllium, dissolved as Be	µg/L	ICP-MS	0.06	Faires (1993)
Boron, dissolved as B	µg/L	ICP	10	Struzeski, DeGiacomo, and Zayhowski (1996)
Cadmium, dissolved as Cd	µg/L	ICP-MS	0.04	Faires (1993)
Chromium, dissolved as Cr	µg/L	GF AA	0.8	McLain (1993)
Cobalt, dissolved as Co	µg/L	ICP-MS	0.02	Faires (1993)
Copper, dissolved as Cu	µg/L	ICP-MS	0.4	Faires (1993)
Iron, dissolved as Fe	µg/L	ICP	10	Fishman (1993)
Lead, dissolved as Pb	µg/L	ICP-MS	0.08	Faires (1993)
Manganese, dissolved as Mn	µg/L	ICP-MS	0.2	Faires (1993)
Mercury, dissolved as Hg	µg/L	CVAF	0.02	Garbarino and Damrau (2001)
Molybdenum, dissolved as Mo	µg/L	ICP-MS	0.4	Faires (1993)
Nickel, dissolved as Ni	µg/L	ICP-MS	1	Faires (1993)
Selenium, dissolved as Se	µg/L	Hydride generation[2]	3	Jones and Garbarino (1999)
Silver, dissolved as Ag	µg/L	ICP-MS	1	Faires (1993)
Strontium, dissolved as Sr	µg/L	ICP	1.4	Fishman (1993)
Zinc, dissolved as Zn	µg/L	ICP-MS	1	Faires (1993)
Radioactivity				
Uranium, natural, dissolved	µg/L	ICP-MS	0.04	Faires (1993)
Plutonium-238, dissolved	pCi/L	Alpha spectrometry	[3] 0.1	Not available
Plutonium-239+240, dissolved	pCi/L	Alpha spectrometry	[3] 0.1	Not available

[1] Method was ICP for July and October 2003 samples; method reference is American Public Health Association, 1998.

[2] Method was ICP-MS for October 2003 samples; method reference is Garbarino, 1999.

[3] Contractual MDC; reported value may be lower depending upon the sample.

Table 9. Monthly water-level data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.

[W.L. bmp, depth to water below measuring point in feet measured with an electric tape; *, Water level is below the screened interval of the well; --, no data; uncertainty of the water-level measurements is 0.02 feet or less]

Well	January (01/07/02) W.L. bmp	Febuary (02/01/02-02/05/02) W.L. bmp	March (03/06/02) W.L. bmp	April (04/15/02) W.L. bmp	May (05/03/02) W.L. bmp	June (05/31/02) W.L. bmp	July (07/02/02) W.L. bmp	August (08/07/02) W.L. bmp	September (09/06/02) W.L. bmp	October (10/04/02) W.L. bmp	November (11/06/02) W.L. bmp	December (12/05/02) W.L. bmp
DTX1	8.58	8.59	8.60	8.64	8.81	9.42	10.58	11.44	11.96	12.35	12.27	12.25
DTX2	8.67	8.64	8.41	8.02	8.11	8.63	8.59	10.32	10.67	10.61	10.13	9.95
DTX3	11.24	11.36	11.52	11.70	11.80	11.93	12.18	12.35	12.54	12.68	12.83	12.99
DTX4	13.48*	13.51*	13.50*	13.50*	13.51*	13.55*	13.54*	13.54*	13.46*	13.47*	13.46*	13.48*
DTX5	12.31	12.42	12.43	12.38	12.52	12.65	12.89	13.20	13.44	13.60	13.66	13.67
DTX6	22.42	22.52	22.58	22.60	22.67	22.72	22.83	22.99	23.16	23.30	23.30	23.38
DTX7	7.96	7.87	7.77	7.70	7.80	8.30	8.96	9.48	9.53	9.39	9.08	8.90
DTX8A	8.37	8.32	8.15	8.03	8.13	8.63	9.76	10.29	10.39	10.32	9.66	9.29
DTX8B	4.83	4.87	4.82	4.80	4.86	4.91	4.98	5.03	5.05	5.07	5.06	5.09
DTX9	12.67	12.74	12.72	12.72	12.77	12.86	12.99	13.04	13.15	13.19	13.20	13.21
DTX10A	12.91	12.92	12.90	12.89	12.99	13.10	13.28	13.34	13.43	13.48	13.48	13.46
DTX10B	18.66	18.71	18.63	18.53	18.52	18.50	18.49	18.50	18.57	18.64	18.66	18.69
DTX11	13.02	13.06	12.99	13.05	13.10	13.19	13.28	13.36	13.45	13.54	13.53	13.54
D6	9.62	6.81	9.80	9.89	9.89	10.00	10.09	10.18	10.20	10.25	10.39	10.35
D6A	--	--	9.63	9.69	9.77	9.86	9.94	9.96	10.06	10.13	10.18	10.21
D11a	112.73	112.86	112.66	112.30	112.64	112.60	112.60	112.54	112.43	112.68	112.69	112.66
D13	6.79	6.60	6.41	6.27	6.42	6.83	7.14	8.22	8.89	8.95	8.37	8.06
D17	11.47	11.46	11.42	11.36	11.36	11.40	11.39	12.02	12.69	12.86	12.71	12.62
D19	21.22	21.24	21.26	21.28	21.33	21.35	21.39	21.41	21.45	21.47	21.50	21.54
D25	10.02	10.01	10.05	10.01	10.06	10.15	10.46	10.98	11.45	11.69	11.70	11.63
D25A	--	--	10.33	10.24	10.28	10.38	10.67	11.20	11.64	11.89	11.90	11.84
D29	154.32	154.48	154.04	153.61	154.04	154.12	154.15	154.12	154.00	154.11	154.26	154.29
D30	4.12	4.19	4.22	4.13	4.22	4.60	5.58	6.37	6.67	6.69	6.48	6.21

Table 9. Monthly water-level data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.–Continued

[W.L. bmp, depth to water below measuring point in feet measured with an electric tape; *, Water level is below the screened interval of the well; --, no data; uncertainty of the water-level measurements is 0.02 feet or less]

Well	January (01/02/03-01/07/03) W.L. bmp	Febuary (02/10/03) W.L. bmp	March (03/07/03) W.L. bmp	April (04/02/03-04/08/03) W.L. bmp	May (05/02/03) W.L. bmp	June (06/12/03) W.L. bmp	July (07/02/03) W.L. bmp	August (08/01/03) W.L. bmp	September (09/08/03) W.L. bmp	October (10/08/03) W.L. bmp	December (12/03/03) W.L. bmp
DTX1	12.26	12.29	12.30	12.30	12.34	12.01	11.92	12.94	13.04	13.29	13.27
DTX2	9.85	9.77	9.71	9.65	9.41	5.53	8.98	10.40	10.28	10.45	10.02
DTX3	13.16	13.36	13.50	13.63	13.78	14	14.08	14.25	14.47	14.62	14.91
DTX4	13.49*	13.49*	13.49*	--	13.5*	6.51	8.90	11.30	12.32	--	12.89
DTX5	13.71	13.74	13.82	13.61	13.80	5.89	8.04	10.80	11.61	12.20	12.54
DTX6	23.49	23.45	23.46	23.46	23.51	22.17	22.06	22.51	22.74	23.01	23.33
DTX7	8.76	8.61	8.53	8.33	8.33	8.71	9.23	9.92	9.92	9.87	9.39
DTX8A	9.09	8.94	8.86	8.67	8.65	9.34	9.50	10.62	10.72	10.27	9.79
DTX8B	5.05	5.01	5.00	4.87	4.93	4.95	5.01	5.65	5.32	5.30	5.29
DTX9	13.22	13.19	13.18	13.24	13.17	13.25	13.32	13.50	13.55	13.60	13.53
DTX10A	13.46	13.41	13.43	13.42	13.38	13.47	13.60	13.82	13.87	13.87	13.80
DTX10B	18.72	18.63	18.57	18.37	18.30	18.31	18.36	18.44	18.47	18.55	18.58
DTX11	13.56	13.56	13.52	13.56	13.50	13.58	13.65	13.83	13.88	13.91	13.86
D6	10.35	10.44	10.41	10.29	10.26	10.25	10.04	10.33	9.4	9.50	9.79
D6A	10.31	10.31	10.29	10.16	10.08	9.92	9.91	10.51	9.22	9.28	9.68
D11a	112.56	112.57	112.68	112.41	112.68	112.62	112.63	112.65	112.54	112.64	112.71
D13	7.83	7.61	7.47	6.89	6.89	7.33	8.05	9.55	10.09	9.85	9.06
D17	12.55	12.46	12.41	12.37	12.30	12.09	12.07	12.50	12.97	13.04	12.93
D19	21.57	21.61	21.63	21.65	21.68	21.67	21.69	21.74	21.78	21.80	21.85
D25	11.57	11.51	12.24	11.36	11.27	11.36	11.64	12.12	12.61	12.80	12.57
D25A	11.78	11.80	12.25	11.58	11.50	11.56	11.87	12.32	12.80	12.94	12.77
D29	154.27	153.93	154.00	153.91	154.23	153.98	154.07	154.11	153.85	153.91	154.2
D30	6.01	5.83	5.72	5.48	5.25	4.92	5.47	6.92	5.92	6.37	6.18

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.

[μS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; μg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigm a precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Specific conductance, field (μS/cm)	pH, field (standard units)	Water temperature (°C)	Water level before sampling, depth below measuring point (feet)	Oxygen, dissolved (mg/L)	Specific conductance, lab (μS/cm)	pH, laboratory (standard units)	Hardness, total (mg/L as $CaCO_3$)
D13	01/09/2002	1450	1,400	7.2	9.0	6.77	0.8	1,440	7.5	650
D13	04/09/2002	1530	1,400	7.0	7.0	6.27	.8	1,380	7.5	620
D13	07/08/2002	1420	1,490	7.0	13.4	7.28	.4	1,380	7.3	670
D13	10/22/2002	1205	1,420	7.2	12.6	8.65	1.7	1,430	7.5	720
D13	01/02/2003	1300	1,300	7.2	8.6	7.83	1.0	1,320	7.5	680
D13	04/02/2003	1415	1,310	7.0	8.1	6.89	1.1	1,270	7.2	650
D13	07/07/2003	1350	1,430	7.3	13.5	8.39	.8	1,230	7.3	710
D15	01/06/2003	1300	5,290	6.7	12.0	8.22	1.1	5,420	6.9	2,700
D17	01/07/2002	1335	500	7.7	13.0	11.47	.6	484	7.8	220
D17	04/03/2002	1520	460	7.4	11.0	11.39	.7	481	7.8	220
D17	07/08/2002	1300	550	7.5	13.0	11.46	.4	472	7.8	210
D17	10/17/2002	1330	500	7.5	9.9	12.82	--	452	7.6	220
D17	01/02/2003	1515	447	7.7	12.5	12.55	.8	446	7.6	230
D17	04/02/2003	1240	468	7.4	11.6	12.37	.7	453	E7.5	230
D17	07/07/2003	1225	488	7.7	12.8	12.11	.6	430	E7.4	220
D23	01/06/2003	1445	3,070	7.0	10.0	6.87	--	3,160	7.1	1,700
D25	01/07/2002	1515	4,400	7.2	12.0	10.02	.6	4,540	7.3	2,600
D25	04/05/2002	1350	4,400	6.9	11.0	10.09	.7	4,520	7.3	2,600
D25	07/12/2002	1200	4,780	7.0	13.1	10.61	.4	4,620	7.4	2,800
D25	10/18/2002	1255	4,420	7.1	14.2	11.71	1.2	4,320	7.3	2,700
D25	01/03/2003	1435	4,710	7.2	9.8	11.57	.8	4,490	7.3	2,600
D25	04/08/2003	1035	4,270	7.4	10.6	11.36	.7	4,420	7.2	2,800
D25	07/10/2003	1415	4,880	7.2	14.3	11.79	1.0	4,550	7.3	2,700
D25	10/02/2003	1325	4,510	7.1	14.5	12.77	.7	4,260	7.3	2,700
D25A	04/05/2002	1235	4,300	6.8	11.0	10.30	.7	4,340	7.3	2,500
D25A	10/18/2002	1405	4,280	7.0	12.8	11.92	.7	4,090	7.3	2,400
D29	01/07/2002	1115	3,700	6.9	19.0	154.32	4.7	4,050	6.8	2,600
D29	04/03/2002	1330	3,900	6.7	17.0	154.26	3.9	3,990	6.9	2,700
D29	07/08/2002	1100	4,120	6.5	21.9	154.34	2.5	3,960	6.8	2,700
D29	10/16/2002	1100	3,980	6.6	19.9	154.12	4.5	3,870	6.7	2,800
D29	01/02/2003	1035	3,640	6.8	17.8	154.27	--	3,960	7.0	2,700
D29	04/02/2003	1050	4,030	6.5	18.6	153.91	1.8	4,060	6.9	2,900
D29	07/07/2003	1010	4,070	6.5	21.4	154.04	3.6	3,830	6.8	2,900
D29	10/02/2003	1100	4,090	6.6	19.3	154.03	3.4	3,840	7.0	2,700

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigm a precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Specific conductance, field (µS/cm)	pH, field (standard units)	Water temperature (°C)	Water level before sampling, depth below measuring point (feet)	Oxygen, dissolved (mg/L)	Specific conductance, lab (µS/cm)	pH, laboratory (standard units)	Hardness, total (mg/L as $CaCO_3$)
D30	01/14/2002	1220	5,000	6.9	10.0	4.14	0.5	5,070	7.1	2,800
D30	04/09/2002	1430	5,000	6.8	9.0	4.15	.4	5,070	7.2	2,900
D30	07/11/2002	0955	5,150	6.8	11.5	5.63	.8	4,800	7.2	2,900
D30	10/17/2002	1150	5,150	7.0	9.2	6.63	--	4,890	7.2	2,900
D30	01/03/2003	1240	4,960	7.1	11.4	6.01	1.0	5,010	7.3	2,900
D30	04/07/2003	1135	4,870	6.9	8.5	5.48	.8	4,940	7.2	3,000
D30	07/10/2003	1250	5,340	7.0	12.4	5.97	.6	4,960	7.3	3,000
D6	01/14/2002	1015	15,000	7.0	10.0	9.66	2.6	16,600	7.2	9,700
D6	04/04/2002	1215	16,000	7.0	11.0	9.88	3.4	15,900	7.2	10,000
D6	07/09/2002	1235	1,7600	7.0	12.6	10.09	.8	15,800	7.2	10,000
D6	10/17/2002	1030	17,000	7.0	7.0	10.26	--	E16,000	7.1	10,000
D6	01/03/2003	1015	16,200	7.1	11.2	10.35	.9	E16,200	7.2	10,000
D6	04/04/2003	1415	16,600	6.8	11.0	10.29	1.9	E15,600	7.3	10,000
D6	07/10/2003	1035	17,700	6.9	12.5	10.06	.5	E16,300	7.3	11,000
D6	10/03/2003	1505	17,200	7.0	12.4	9.40	.6	E15,200	7.3	12,000
D6A	04/04/2002	1355	16,000	7.0	11.0	10.53	.9	15,900	7.2	11,000
D6A	07/09/2002	1535	17,800	7.0	12.9	10.63	.5	15,900	7.2	11,000
DTX1	01/09/2002	1020	4,000	7.1	11.0	8.59	.6	4,090	7.4	2,000
DTX1	04/10/2002	1500	4,100	6.9	11.0	8.63	.5	4,050	7.4	2,000
DTX1	07/10/2002	1505	4,260	7.0	11.8	10.82	.5	3,870	--	2,000
DTX1	10/16/2002	1515	4,150	7.1	12.1	12.44	.6	3,860	7.2	2,100
DTX1	01/05/2003	1445	4,120	7.1	11.6	12.26	.6	4,060	7.3	2,100
DTX1	04/08/2003	1320	3,850	7.5	11.0	12.30	.6	3,970	7.2	2,100
DTX1	07/10/2003	1550	4,220	7.2	11.8	12.38	.6	3,880	7.4	2,000
DTX10A	01/11/2002	1245	3,000	7.2	13.0	12.96	4.2	3,140	7.2	1,800
DTX10A	04/05/2002	1035	3,000	6.8	16.0	12.96	2.6	3,120	7.2	1,800
DTX10A	07/10/2002	1120	3,310	6.9	18.3	13.32	.4	3,020	7.2	1,800
DTX10A	10/18/2002	1045	2,590	7.0	15.2	13.49	--	3,040	7.3	1,900
DTX10A	01/07/2003	1105	3,000	7.2	14.0	13.46	.9	3,130	7.1	1,900
DTX10A	04/07/2003	1400	3,010	7.2	10.6	13.42	.9	3,080	7.2	1,900
DTX10A	07/09/2003	1115	3,270	7.1	17.0	13.69	.5	3,120	7.3	1,900
DTX10A	10/03/2003	1100	2,800	7.0	16.0	13.89	6.4	3,030	7.3	1,800
DTX11	07/09/2003	1315	3,500	6.9	19.5	13.72	3.0	3,350	7.2	2,100

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Specific conductance, field (µS/cm)	pH, field (standard units)	Water temperature (°C)	Water level before sampling, depth below measuring point (feet)	Oxygen, dissolved (mg/L)	Specific conductance, lab (µS/cm)	pH, laboratory (standard units)	Hardness, total (mg/L as $CaCO_3$)
DTX2	01/11/2002	1015	4,200	7.0	11.0	8.70	1.3	4,460	7.2	2,100
DTX2	04/10/2002	1335	4,600	6.7	10.0	8.07	.6	4,570	7.2	2,100
DTX2	07/10/2002	1325	4,540	6.8	11.1	9.78	.7	4,120	7.2	2,000
DTX2	10/16/2002	1350	4,430	6.9	12.4	10.43	1.8	4,130	7.0	2,100
DTX2	01/05/2003	1310	4,530	6.9	11.0	9.85	1.0	4,460	7.2	2,200
DTX2	04/08/2003	1200	4,430	7.3	9.8	9.65	1.0	4,550	7.2	2,300
DTX2	07/15/2003	1055	4,740	6.9	11.8	6.73	.5	4,450	7.2	2,000
DTX2	10/06/2003	1430	4,590	7.1	13.0	7.49	.8	4,360	7.2	2,100
DTX3	01/08/2002	1015	1,900	6.9	12.0	11.24	4.9	1,950	7.3	910
DTX3	04/09/2002	1005	2,100	6.8	9.0	11.68	6.1	2,110	7.3	1,100
DTX3	07/09/2002	1025	2,230	7.0	12.9	12.16	6.2	2,130	7.3	1,100
DTX3	10/21/2002	1025	2,100	7.0	14.0	12.76	6.4	2,070	7.4	1,100
DTX3	01/06/2003	1100	2,060	7.0	11.3	13.16	7.0	2,110	7.2	1,100
DTX3	04/03/2003	1010	2,140	6.8	10.2	13.63	6.7	2,080	7.3	1,100
DTX3	07/08/2003	0945	2,170	7.0	12.0	14.11	6.7	2,030	7.1	1,100
DTX3	10/03/2003	1330	2,010	7.0	13.9	14.60	7.0	1,960	7.3	980
DTX4	07/08/2003	1140	2,200	7.0	12.7	9.58	3.1	2,060	7.1	1,200
DTX5	01/08/2002	1235	3,000	6.9	12.0	12.31	1.0	3,010	7.2	1,500
DTX5	04/09/2002	1140	3,000	6.8	10.0	12.52	1.7	3,060	7.3	1,500
DTX5	07/11/2002	1140	3,290	6.9	12.2	12.95	.6	3,010	7.3	1,600
DTX5	10/21/2002	1225	3,100	7.0	12.2	13.66	.9	3,040	7.3	1,700
DTX5	01/07/2003	1530	3,010	7.2	11.6	13.71	1.0	3,100	7.2	1,600
DTX5	04/03/2003	1210	3,100	6.8	10.4	13.61	1.4	2,990	7.2	1,600
DTX5	07/09/2003	1555	1,780	7.1	14.8	7.01	.8	1,670	7.3	930
DTX6	01/08/2002	1415	4,200	7.0	12.0	22.44	1.0	4,300	7.2	2,300
DTX6	04/09/2002	1300	4,200	6.9	13.0	22.64	1.5	4,280	7.3	2,200
DTX6	07/11/2002	1345	4,440	7.0	13.4	22.87	1.5	4,070	7.2	2,200
DTX6	10/21/2002	1415	4,230	7.1	12.6	23.37	2.2	4,140	7.2	2,400
DTX6	01/07/2003	1342	4,130	7.2	12.6	23.49	1.8	4,270	7.2	2,400
DTX6	04/03/2003	1440	4,340	6.9	13.7	23.46	2.4	4,270	7.3	2,400
DTX6	07/08/2003	1425	4,380	7.1	14.3	22.17	2.6	4,120	7.2	2,200
DTX6	10/06/2003	1030	3,920	7.1	12.8	23.01	2.0	3,700	7.3	2,000
DTX8A	01/09/2002	1250	1,800	7.5	12.0	8.37	4.4	1,900	7.7	480
DTX8A	04/10/2002	1055	1,800	7.2	16.0	8.07	--	1,910	7.6	480
DTX8A	07/12/2002	1005	1,920	7.4	14.8	9.98	1.9	1,830	7.6	500
DTX8A	10/22/2002	1035	1,820	7.4	11.1	10.17	5.9	1,860	7.6	510
DTX8A	01/05/2003	1105	1,880	7.4	12.1	9.09	.4	1,870	7.6	520
DTX8A	04/04/2003	1200	1,320	6.9	11.8	8.67	--	1,830	7.6	510
DTX8A	07/11/2003	1055	1,940	7.4	17.0	9.84	.3	1,860	E7.4	500
DTX8A	10/06/2003	1245	1,650	7.5	12.9	10.31	--	1,840	7.6	520
DTX9	07/15/2003	1330	3,410	7.0	16.2	13.42	1.2	3,160	7.2	1,900

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Potassium, dissolved (mg/L as K)	Sodium adsorption ratio	Sodium, dissolved (mg/L an Na)	Sodium (percent)	Acid neutralizing capacity, titration to pH 4.5 lab (mg/L as $CaCO_3$)	Bromide, dissolved (mg/L)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
D13	01/09/2002	1450	178	50.4	2.21	1	65.4	18	266	0.17	3.08	1.3
D13	04/09/2002	1530	169	46.6	2.13	1	64.5	19	265	.17	4.13	1.3
D13	07/08/2002	1420	183	50.6	2.13	1	72.2	19	285	.16	3.87	1.36
D13	10/22/2002	1205	201	53.2	3.01	1	65.7	16	E247	.15	3.20	1.4
D13	01/02/2003	1300	184	51.8	2.04	1	63.8	17	239	.14	2.95	1.41
D13	04/02/2003	1415	182	47.2	2.02	1	58.1	16	241	.14	2.18	1.37
D13	07/07/2003	1350	194	54.2	3.03	1	65.1	17	242	.15	3.54	1.4
D15	01/06/2003	1300	492	349	5.58	5	607	33	604	.84	17.0	1.55
D17	01/07/2002	1335	56.9	17.7	1.71	.5	16.2	14	202	.06	2.05	1.5
D17	04/03/2002	1520	58.1	18.3	1.61	.5	16.6	14	204	.08	2.68	1.7
D17	07/08/2002	1300	56.9	17.5	1.39	.5	16.0	14	203	.06	2.37	1.31
D17	10/17/2002	1330	59.0	17.8	1.52	.5	16.5	14	E206	.07	2.07	1.4
D17	01/02/2003	1515	59.0	18.8	1.42	.5	17.2	14	203	.06	1.99	1.37
D17	04/02/2003	1240	60.4	18.1	1.44	.5	15.9	13	205	.06	1.56	1.45
D17	07/07/2003	1225	59.5	18.4	1.64	.5	16.6	14	204	.06	2.80	1.4
D23	01/06/2003	1445	522	105	5.75	2	207	21	368	.26	11.2	1.00
D25	01/07/2002	1515	688	209	7.51	2	281	19	444	1.73	119	1.1
D25	04/05/2002	1350	685	215	6.94	2	282	19	442	1.76	116	.9
D25	07/12/2002	1200	663	271	7.02	3	359	22	610	1.50	80.6	1.03
D25	10/18/2002	1255	739	213	6.80	2	279	18	E425	1.67	116	1.0
D25	01/03/2003	1435	715	203	7.27	2	269	18	392	1.67	125	1.08
D25	04/08/2003	1035	743	217	9.80	2	277	18	395	1.63	121	.97
D25	07/10/2003	1415	684	249	7.05	2	287	19	498	1.45	97.7	1.1
D25	10/02/2003	1325	730	207	7.79	2	270	18	377	1.69	130	1.0
D25A	04/05/2002	1235	732	164	7.10	2	283	20	397	1.98	130	1.0
D25A	10/18/2002	1405	728	152	7.20	2	262	19	E342	1.65	125	1.0
D29	01/07/2002	1115	540	312	11.2	1	135	10	283	.18	13.1	.6
D29	04/03/2002	1330	537	321	11.1	1	141	10	288	.15	13.1	.6
D29	07/08/2002	1100	556	327	10.7	1	144	10	292	.20	11.1	.54
D29	10/16/2002	1100	569	328	9.80	1	145	10	E292	.19	13.6	.6
D29	01/02/2003	1035	556	320	9.45	1	149	11	294	.19	9.48	.61
D29	04/02/2003	1050	587	338	9.75	1	148	10	297	.23	9.90	.55
D29	07/07/2003	1010	584	350	11.6	1	144	10	301	.19	13.5	.6
D29	10/02/2003	1100	547	332	11.1	1	143	10	293	.26	13.1	.6

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Potassium, dissolved (mg/L as K)	Sodium adsorption ratio	Sodium, dissolved (mg/L an Na)	Sodium (percent)	Acid neutralizing capacity, titration to pH 4.5 lab (mg/L as $CaCO_3$)	Bromide, dissolved (mg/L)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
D30	01/14/2002	1220	445	407	4.07	3	367	22	371	0.83	62.7	0.8
D30	04/09/2002	1430	457	430	4.14	3	379	22	370	.73	61.7	.7
D30	07/11/2002	0955	468	425	4.05	3	380	22	359	.72	57.7	.87
D30	10/17/2002	1150	466	409	3.91	3	383	23	E329	.71	53.5	.9
D30	01/03/2003	1240	485	400	4.00	3	379	22	323	.71	52.1	.97
D30	04/07/2003	1135	492	430	3.84	3	414	23	323	.69	53.2	.86
D30	07/10/2003	1250	489	440	4.66	3	407	23	323	.70	62.8	.9
D6	01/14/2002	1015	409	2,110	11.9	9	1,930	30	637	4.50	386	.8
D6	04/04/2002	1215	405	2,300	12.7	8	1,970	29	641	4.53	392	.9
D6	07/09/2002	1235	422	2,290	11.5	9	2,010	29	641	4.25	403	.88
D6	10/17/2002	1030	442	2,270	11.1	9	2,150	31	E651	4.38	382	1.0
D6	01/03/2003	1015	424	2,170	12.1	9	2,060	31	642	4.26	364	1.08
D6	04/04/2003	1415	415	2,280	14.5	9	2,120	31	644	4.26	366	.95
D6	07/10/2003	1035	443	2,390	15.0	9	2,180	30	643	4.36	408	1.1
D6	10/03/2003	1505	443	2,630	15.4	8	2,040	27	644	4.44	408	1.2
D6A	04/04/2002	1355	428	2,300	12.3	9	2,140	31	639	4.39	402	.8
D6A	07/09/2002	1535	433	2,340	12.6	9	2,090	30	640	4.26	403	.91
DTX1	01/09/2002	1020	459	201	3.54	3	331	27	308	.72	45.7	.8
DTX1	04/10/2002	1500	474	203	3.16	3	339	27	311	.72	47.1	.7
DTX1	07/10/2002	1505	459	198	2.86	3	323	26	312	.72	46.3	.80
DTX1	10/16/2002	1515	490	203	2.89	3	350	27	E313	.71	49.4	.8
DTX1	01/05/2003	1445	491	201	3.25	3	348	27	306	.74	45.3	.89
DTX1	04/08/2003	1320	495	214	4.16	3	363	27	307	.73	46.4	.80
DTX1	07/10/2003	1550	473	197	3.47	3	350	28	306	.71	50.8	.8
DTX10A	01/11/2002	1245	461	166	7.65	2	151	15	220	.29	19.3	.9
DTX10A	04/05/2002	1035	454	169	8.17	2	158	16	222	.24	19.0	.8
DTX10A	07/10/2002	1120	461	162	7.72	2	157	16	223	.30	17.8	.92
DTX10A	10/18/2002	1045	481	171	7.79	2	160	15	E210	[1].66	18.0	.9
DTX10A	01/07/2003	1105	475	168	8.86	2	162	16	221	.26	13.9	.93
DTX10A	04/07/2003	1400	472	171	8.07	2	160	16	223	.29	15.7	.90
DTX10A	07/09/2003	1115	467	173	9.14	2	169	16	223	.24	17.9	.9
DTX10A	10/03/2003	1100	452	167	8.91	2	156	16	200	.32	19.1	.9
DTX11	07/09/2003	1315	571	173	7.06	1	150	13	299	.35	23.9	1.0

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Potassium, dissolved (mg/L as K)	Sodium adsorption ratio	Sodium, dissolved (mg/L an Na)	Sodium (percent)	Acid neutralizing capacity, titration to pH 4.5 lab (mg/L as $CaCO_3$)	Bromide, dissolved (mg/L)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
DTX2	01/11/2002	1015	505	200	7.59	4	424	31	416	0.73	49.6	0.6
DTX2	04/10/2002	1335	493	201	7.84	4	465	33	414	.78	59.1	.5
DTX2	07/10/2002	1325	493	194	6.97	4	416	31	416	.60	44.1	.52
DTX2	10/16/2002	1350	507	207	7.43	4	396	29	E425	.62	44.4	.6
DTX2	01/05/2003	1310	526	210	8.25	4	444	31	416	.70	51.2	.59
DTX2	04/08/2003	1200	538	224	8.55	5	529	34	418	.82	60.1	.56
DTX2	07/15/2003	1055	488	199	8.97	5	492	34	422	.72	62.2	.6
DTX2	10/06/2003	1430	507	207	9.02	4	459	32	416	.77	61.6	.6
DTX3	01/08/2002	1015	223	85.9	7.23	1	97.7	19	291	.24	24.8	.4
DTX3	04/09/2002	1005	254	101	6.32	1	109	18	282	.23	28.7	.3
DTX3	07/09/2002	1025	266	99.9	6.48	2	116	19	276	.20	26.2	.41
DTX3	10/21/2002	1025	273	101	7.22	2	121	19	E238	.19	20.5	.4
DTX3	01/06/2003	1100	265	102	7.04	2	125	20	277	.18	18.6	.41
DTX3	04/03/2003	1010	265	101	7.30	2	120	19	277	.18	17.9	.39
DTX3	07/08/2003	0945	261	102	8.08	2	131	21	267	.17	19.4	.4
DTX3	10/03/2003	1330	238	92.0	7.53	2	119	21	220	.18	19.4	.4
DTX4	07/08/2003	1140	390	61.7	8.38	1	107	16	266	.07	7.24	.3
DTX5	01/08/2002	1235	489	74.8	5.30	2	193	21	279	.24	11.4	.3
DTX5	04/09/2002	1140	470	71.1	4.66	2	196	23	276	.23	11.0	.3
DTX5	07/11/2002	1140	507	77.6	4.61	2	227	24	275	.23	10.9	.34
DTX5	10/21/2002	1225	528	80.4	4.56	3	239	24	E284	.24	10.9	.4
DTX5	01/07/2003	1530	511	79.5	4.99	3	254	26	281	.24	8.78	.34
DTX5	04/03/2003	1210	495	77.1	5.09	2	217	23	274	.24	8.62	.34
DTX5	07/09/2003	1555	290	49.2	3.93	1	86.7	17	262	.08	4.27	.4
DTX6	01/08/2002	1415	477	256	11.7	3	326	24	264	.15	23.1	.5
DTX6	04/09/2002	1300	473	258	12.3	3	333	24	263	.17	21.4	.4
DTX6	07/11/2002	1345	478	250	12.0	3	339	25	261	.15	19.9	.52
DTX6	10/21/2002	1415	514	266	11.4	3	347	24	E264	.16	19.6	.5
DTX6	01/07/2003	1342	502	265	11.6	3	346	24	259	.17	15.9	.53
DTX6	04/03/2003	1440	499	274	14.1	3	337	23	256	.19	18.8	.49
DTX6	07/08/2003	1425	453	246	13.2	3	344	26	255	.17	20.9	.5
DTX6	10/06/2003	1030	419	227	12.4	3	310	25	247	.14	18.2	.5
DTX8A	01/09/2002	1250	141	31.2	6.24	5	231	51	222	.32	25.0	.3
DTX8A	04/10/2002	1055	140	30.9	5.90	5	231	51	226	.31	30.4	.3
DTX8A	07/12/2002	1005	148	31.0	5.25	5	244	51	224	.31	26.1	.38
DTX8A	10/22/2002	1035	152	30.9	6.01	5	234	50	E217	.31	26.5	.4
DTX8A	01/05/2003	1105	155	32.2	6.19	5	245	50	217	.30	23.6	.40
DTX8A	04/04/2003	1200	148	32.4	5.77	5	239	50	224	.35	25.4	.36
DTX8A	07/11/2003	1055	148	31.7	6.52	5	250	52	224	.32	28.0	.3
DTX8A	10/06/2003	1245	151	32.7	6.60	5	241	50	212	.31	27.8	.3
DTX9	07/15/2003	1330	506	152	6.50	1	137	14	304	.35	25.8	1.0

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L)	Nitrogen ammonia plus organic, dissolved (mg/L as N)	Nitrogen organic plus ammonia, total (mg/L as N)	Nitrogen ammonia dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L)	Phosphorus, total (mg/L)	Solids, residue on evaporation at 180°C, dissolved (mg/L)
D13	01/09/2002	1450	12.0	561	0.2	0.17	E0.042	<0.04	<0.05	<0.06	1,150
D13	04/09/2002	1530	11.4	516	.16	.14	E.028	<.04	<.05	<.06	1,060
D13	07/08/2002	1420	14.0	517	.16	.18	.061	<.04	<.05	<.06	1,080
D13	10/22/2002	1205	14.9	593	.14	.13	E.034	<.05	<.05	E.03	1,150
D13	01/02/2003	1300	13.2	534	.13	.19	E.029	<.05	<.05	<.04	1,060
D13	04/02/2003	1415	12.5	496	.12	[1]E.08	<.050	<.05	<.05	<.04	1,020
D13	07/07/2003	1350	15.8	506	.13	.14	E.031	<.05	<.05	E.02	1,070
D15	01/06/2003	1300	18.6	3,080	1.6	1.6	1.04	<.05	E.04	.05	5,490
D17	01/07/2002	1335	18.5	47.8	E.08	E.07	E.028	.91	.08	.08	296
D17	04/03/2002	1520	18.3	44.8	E.06	E.07	<.050	1.20	.07	.08	292
D17	07/08/2002	1300	17.9	44.0	E.09	E.08	E.044	1.14	.09	.08	280
D17	10/17/2002	1330	19.2	46.2	E.07	E.08	<.050	.83	.08	.09	308
D17	01/02/2003	1515	19.8	42.5	E.07	.15	<.050	.94	.07	.09	293
D17	04/02/2003	1240	19.1	40.8	E.06	E.05	<.050	.94	.09	.08	282
D17	07/07/2003	1225	19.2	39.9	E.06	E.05	<.050	1.01	.08	.08	283
D23	01/06/2003	1445	17.3	1,720	1.2	1.2	1.05	<.05	<.05	E.04	3,080
D25	01/07/2002	1515	27.8	2,620	.66	.73	.066	2.35	.12	.12	4,690
D25	04/05/2002	1350	26.4	2,590	[2].71	.65	E.026	2.19	.13	.12	4,620
D25	07/12/2002	1200	30.9	2,800	[2].97	.90	.069	5.51	.19	.17	5,190
D25	10/18/2002	1255	30.6	2,570	[2].65	.58	.059	1.40	.10	.10	4,640
D25	01/03/2003	1435	29.4	2,590	.63	.59	.094	.79	.10	.11	4,630
D25	04/08/2003	1035	28.1	2,630	[2].65	.60	E.048	.78	.10	.10	4,670
D25	07/10/2003	1415	29.4	2,660	.69	.68	E.048	2.75	.16	.16	4,940
D25	10/02/2003	1325	28.9	2,560	.64	.68	.092	.58	.10	.12	4,480
D25A	04/05/2002	1235	27.1	2,440	.54	.50	E.028	<.04	.22	.22	4,390
D25A	10/18/2002	1405	35.6	2,450	.54	.56	.099	<.05	.08	.09	4,370
D29	01/07/2002	1115	20.4	2,680	.46	.49	.478	<.04	<.05	.14	4,330
D29	04/03/2002	1330	20.6	2,640	.44	.42	.420	<.04	<.05	E.03	4,260
D29	07/08/2002	1100	21.6	2,680	[2].50	.45	.462	.05	E.04	E.04	4,330
D29	10/16/2002	1100	22.0	2,650	[2].46	.38	.433	<.05	E.04	.04	4,290
D29	01/02/2003	1035	21.6	2,660	.43	.40	.453	<.05	E.04	E.04	4,260
D29	04/02/2003	1050	22.6	2,640	.46	.47	.457	<.05	E.04	.06	4,340
D29	07/07/2003	1010	22.3	2,680	.41	.40	.409	<.05	E.03	E.03	4,420
D29	10/02/2003	1100	21.4	2,630	.43	.40	.359	E.03	<.04	.05	4,310

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L)	Nitrogen ammonia plus organic, dissolved (mg/L as N)	Nitrogen organic plus ammonia, total (mg/L as N)	Nitrogen ammonia dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L)	Phosphorus, total (mg/L)	Solids, residue on evaporation at 180°C, dissolved (mg/L)
D30	01/14/2002	1220	21.1	3,210	0.28	0.31	0.090	<0.04	E0.03	E0.04	5,260
D30	04/09/2002	1430	20.8	3,210	.33	.32	.049	<.04	E.03	E.05	5,260
D30	07/11/2002	0955	22.4	3,170	.34	.32	.150	<.04	E.05	E.05	5,430
D30	10/17/2002	1150	23.5	3,180	.29	.28	.087	<.05	E.04	E.04	5,310
D30	01/03/2003	1240	22.7	3,160	[2].30	.21	.092	<.05	E.04	.04	5,180
D30	04/07/2003	1135	22.2	3,320	[2].33	.26	.051	<.05	<.05	E.03	5,450
D30	07/10/2003	1250	24.2	3,130	.24	.24	E.032	<.05	<.05	E.04	5,530
D6	01/14/2002	1015	21.7	13,600	[2].57	.48	.098	15.2	<.05	<.06	21,500
D6	04/04/2002	1215	20.3	13,500	1.1	1.3	<.050	15.0	<.05	E.04	21,900
D6	07/09/2002	1235	21.5	13,000	1.6	1.6	<.050	17.3	E.03	E.04	21,200
D6	10/17/2002	1030	22.6	13,500	.67	1.5	<.200	17.6	<.05	E.03	20,800
D6	01/03/2003	1015	21.2	13,000	1.5	[1].39	.082	18.5	<.05	<.04	20,700
D6	04/04/2003	1415	21.8	13,500	1.6	1.6	E.043	19.4	<.10	E.02	22,000
D6	07/10/2003	1035	22.5	13,000	.86	[1,2].77	.083	20.3	E.03	<.04	21,300
D6	10/03/2003	1505	21.5	13,300	.56	1.6	.094	21.6	E.02	<.04	22,500
D6A	04/04/2002	1355	22.3	13,600	[2]1.2	1.1	E.034	16.8	<.05	<.06	22,200
D6A	07/09/2002	1535	22.3	13,100	[2]1.7	1.4	<.050	18.8	<.05	E.04	21,300
DTX1	01/09/2002	1020	33.2	2,380	.22	<.50	E.033	1.27	.07	<.30	4,170
DTX1	04/10/2002	1500	32.7	2,360	.18	.18	<.050	1.20	.08	.08	4,070
DTX1	07/10/2002	1505	31.8	2,360	.20	.16	.06	1.33	.08	.07	4,130
DTX1	10/16/2002	1515	34.7	2,340	.20	.17	E.044	1.47	.07	.07	4,060
DTX1	01/05/2003	1445	35.2	2,360	[2].22	.17	.050	1.58	.07	.07	4,120
DTX1	04/08/2003	1320	34.2	2,350	[2].28	.21	E.034	1.60	.07	.08	4,090
DTX1	07/10/2003	1550	35.7	2,290	.16	.18	<.050	1.76	.07	.09	4,070
DTX10A	01/11/2002	1245	17.0	1,870	1.4	1.3	1.41	<.04	<.05	<.06	3,140
DTX10A	04/05/2002	1035	16.8	1,850	1.4	1.3	1.18	<.04	<.05	<.06	3,050
DTX10A	07/10/2002	1120	17.3	1,890	1.4	1.3	1.28	<.04	<.05	<.06	3,140
DTX10A	10/18/2002	1045	17.9	1,850	1.3	1.3	1.28	<.05	<.05	<.04	3,100
DTX10A	01/07/2003	1105	17.5	1,840	1.4	1.3	1.30	<.05	<.05	<.04	3,090
DTX10A	04/07/2003	1400	17.4	1,860	1.3	1.3	1.28	<.05	<.05	<.04	3,100
DTX10A	07/09/2003	1115	17.4	1,870	1.3	1.3	1.31	<.05	<.05	<.04	3,150
DTX10A	10/03/2003	1100	16.9	1,850	1.4	1.3	1.25	<.04	<.04	<.04	3,090
DTX11	07/09/2003	1315	23.2	2,030	.47	.53	.362	<.05	<.05	.08	3,450

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L)	Nitrogen ammonia plus organic, dissolved (mg/L as N)	Nitrogen organic plus ammonia, total (mg/L as N)	Nitrogen ammonia dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L)	Phosphorus, total (mg/L)	Solids, residue on evaporation at 180°C, dissolved (mg/L)
DTX2	01/11/2002	1015	16.7	2,560	[2]0.94	0.87	0.742	<0.04	<0.05	<0.06	4,450
DTX2	04/10/2002	1335	16.0	2,560	.96	.95	.649	<.04	<.05	<.06	4,480
DTX2	07/10/2002	1325	16.6	2,450	.98	.98	.731	<.04	<.05	<.06	4,370
DTX2	10/16/2002	1350	17.6	2,410	[2].93	.82	.655	<.05	<.05	E.03	4,310
DTX2	01/05/2003	1310	18.1	2,530	[2].97	.89	.727	<.05	<.05	<.04	4,510
DTX2	04/08/2003	1200	17.6	2,650	[2]1.1	.93	.711	<.05	<.05	E.02	4,660
DTX2	07/15/2003	1055	16.6	2,520	1.1	1.0	.710	<.05	<.05	E.03	4,500
DTX2	10/06/2003	1430	17.5	2,520	1.0	1.0	.706	<.04	E.02	<.04	4,510
DTX3	01/08/2002	1015	15.9	834	.24	.27	E.025	6.67	<.05	<.06	1,640
DTX3	04/09/2002	1005	15.7	936	.22	.23	<.050	5.80	<.05	<.06	1,770
DTX3	07/09/2002	1025	16.5	969	.20	.22	<.050	5.65	<.05	<.06	1,830
DTX3	10/21/2002	1025	18.3	979	.23	.21	E.028	4.96	<.05	<.04	1,850
DTX3	01/06/2003	1100	17.2	981	.28	.24	E.032	4.67	<.05	<.04	1,830
DTX3	04/03/2003	1010	16.3	971	.19	.19	<.050	4.11	<.05	E.02	1,820
DTX3	07/08/2003	0945	17.9	932	.13	.15	<.050	3.98	<.05	<.04	1,770
DTX3	10/03/2003	1330	17.3	908	.19	.20	<.040	4.08	<.04	<.04	1,690
DTX4	07/08/2003	1140	10.5	1,020	.14	.18	<.050	.15	<.05	<.04	1,870
DTX5	01/08/2002	1235	11.2	1,700	.15	.15	<.050	.08	<.05	<.06	2,850
DTX5	04/09/2002	1140	10.2	1,710	.11	.23	<.050	E.03	<.05	<.06	2,860
DTX5	07/11/2002	1140	11.2	1,780	.15	.12	.069	<.04	<.05	<.06	3,030
DTX5	10/21/2002	1225	12.6	1,740	.13	.13	.055	<.05	<.05	<.04	2,980
DTX5	01/07/2003	1530	12.0	1,720	.14	.13	.073	<.05	<.05	<.04	2,940
DTX5	04/03/2003	1210	11.2	1,670	E.10	.10	E.031	<.05	<.05	<.04	2,880
DTX5	07/09/2003	1555	11.7	733	.17	.23	<.050	.75	<.05	<.04	1,300
DTX6	01/08/2002	1415	11.2	2,710	.13	.14	E.025	.32	<.05	<.06	4,470
DTX6	04/09/2002	1300	11.5	2,660	.11	E.09	<.050	.26	<.05	<.06	4,370
DTX6	07/11/2002	1345	11.4	2,700	.10	E.09	E.027	.20	<.05	<.06	4,490
DTX6	10/21/2002	1415	12.1	2,660	.12	.10	.049	.20	<.05	<.04	4,420
DTX6	01/07/2003	1342	11.8	2,640	E.09	.11	E.032	.20	<.05	<.04	4,430
DTX6	04/03/2003	1440	11.9	2,680	E.06	E.09	<.050	.17	<.05	E.02	4,510
DTX6	07/08/2003	1425	10.9	2,580	E.07	.13	<.050	.49	<.05	<.04	4,350
DTX6	10/06/2003	1030	11.1	2,280	.12	.11	E.033	.52	<.04	<.04	3,820
DTX8A	01/09/2002	1250	13.0	784	1.5	1.6	1.55	<.04	<.05	<.06	1,460
DTX8A	04/10/2002	1055	13.0	758	1.5	1.5	1.36	<.04	<.05	<.06	1,380
DTX8A	07/12/2002	1005	13.6	764	1.5	1.4	1.42	<.04	<.05	<.06	1,440
DTX8A	10/22/2002	1035	13.5	761	1.4	1.4	1.36	<.05	<.05	<.04	1,420
DTX8A	01/05/2003	1105	14.3	756	1.5	1.4	1.44	<.05	<.05	<.04	1,420
DTX8A	04/04/2003	1200	14.1	749	[2]1.5	1.3	1.39	.11	E.03	<.04	1,410
DTX8A	07/11/2003	1055	13.7	756	1.3	1.5	1.40	<.05	<.05	<.04	1,440
DTX8A	10/06/2003	1245	14.1	748	1.6	1.5	1.44	<.04	<.04	<.04	1,400
DTX9	07/15/2003	1330	23.9	1,920	.33	.30	.180	<.05	<.05	E.03	3,300

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Aluminum, dissolved (µg/L)	Antimony, dissolved (µg/L)	Arsenic, dissolved (µg/L)	Barium, dissolved (µg/L)	Beryllium, dissolved (µg/L)	Boron, dissolved (µg/L)	Cadmium, dissolved (µg/L)	Chromium, dissolved (µg/L)	Cobalt, dissolved (µg/L)	Copper, dissolved (µg/L)	Iron, dissolved (µg/L)	Lead, dissolved (µg/L)	Manganese, dissolved (µg/L)	Mercury, dissolved (µg/L)
D13	01/09/2002	1450	<1	0.06	E1	17	<0.06	80	<0.04	<0.8	0.53	1.8	17	<0.08	81.7	<0.01
D13	04/09/2002	1530	<1	.05	<2	17	<.06	70	.07	<.8	.61	2.1	15	<.08	89.7	<.01
D13	07/08/2002	1420	<1	.09	<2	18	<.06	110	<.04	<.8	.58	3.2	18	<.08	89.2	<.01
D13	10/22/2002	1205	<2	<.30	E1	21	<.06	110	<.04	<.8	.65	3.9	30	.13	98.8	<.02
D13	01/02/2003	1300	<2	<.30	<2	20	<.06	90	<.04	<.8	.60	2.2	17	<.08	68.4	<.02
D13	04/02/2003	1415	<2	<.30	<2	16	<.06	80	<.04	<.8	.65	2.9	12	<.08	57.8	<.02
D13	07/07/2003	1350	<2	<.30	E1	17	<.06	100	<.04	<.8	.72	2.4	21	<.08	143	<.02
D15	01/06/2003	1300	<5	<.90	4	13	<.18	500	<.11	<.8	14.6	7.5	3,370	<.24	8,130	<.02
D17	01/07/2002	1335	<1	.08	[1]22	59	<.06	60	.04	<.8	.17	.4	<10	<.08	248	<.01
D17	04/03/2002	1520	<1	.26	E1	56	<.06	60	E.02	<.8	.22	.6	<10	<.08	274	<.01
D17	07/08/2002	1300	<1	.09	<2	53	<.06	60	.05	<.8	.21	.9	<10	<.08	335	<.01
D17	10/17/2002	1330	<2	E.15	E2	57	<.06	70	E.03	<.8	.19	1.0	<10	<.08	337	<.02
D17	01/02/2003	1515	<2	<.30	<2	62	<.06	70	<.04	<.8	.22	.8	<10	<.08	274	<.02
D17	04/02/2003	1240	<2	<.30	<2	53	<.06	50	E.02	<.8	.25	.5	<10	<.08	264	<.02
D17	07/07/2003	1225	<2	<.30	E2	55	<.06	60	<.04	<.8	.21	.8	<8	<.08	358	<.02
D23	01/06/2003	1445	<3	<.60	3	19	<.12	380	<.07	<.8	4.81	4.0	2,360	<.16	14,500	<.02
D25	01/07/2002	1515	<2	.20	4	19	<.10	360	.18	<2.4	3.38	7.1	<10	<.20	3,200	<.01
D25	04/05/2002	1350	<1	.33	3	16	<.06	370	.20	<.8	3.62	8.7	<30	<.08	3,150	<.01
D25	07/12/2002	1200	<2	.28	4	16	<.10	740	.25	<.8	3.30	19.3	<30	<.20	2,500	<.01
D25	10/18/2002	1255	<3	<.60	2	17	<.12	410	.19	E.6	3.76	13.5	<30	<.16	3,310	<.02
D25	01/03/2003	1435	<3	E.40	E2	23	<.12	370	.22	<.8	4.30	7.1	<30	<.16	3,220	<.02
D25	04/08/2003	1035	<3	<.60	E1	16	<.12	320	.17	<.8	4.11	11.5	<30	<.16	2,960	<.02
D25	07/10/2003	1415	E2	<.60	2	16	<.12	580	.29	E.4	3.43	10.2	<80	<.16	2,520	<.02
D25	10/02/2003	1325	<3	<.40	2.3	19	<.12	310	.21	<.8	4.57	23.6	<19	<.16	3,180	<.02
D25A	04/05/2002	1235	2	.28	[1]11	29	<.10	150	<.07	<.8	4.08	9.9	1,240	<.20	4,220	<.01
D25A	10/18/2002	1405	<3	<.60	3	21	<.12	180	<.07	E.5	3.48	12.4	294	<.16	3,930	<.02
D29	01/07/2002	1115	<2	<.10	<2	9	<.10	180	<.07	<1.6	1.10	6.1	5,890	<.20	881	<.01
D29	04/03/2002	1330	<1	.22	<2	8	<.06	200	<.04	<.8	1.47	9.6	6,940	E.04	919	<.01
D29	07/08/2002	1100	<2	E.07	E2	9	<.10	200	<.07	<4.0	1.51	10.2	7,350	.18	946	<.01
D29	10/16/2002	1100	<3	<.60	<2	8	<.12	200	<.07	E.5	1.09	10.1	7,170	E.15	927	<.02
D29	01/02/2003	1035	<3	<.60	<2	10	<.12	210	<.07	<.8	1.36	7.3	7,500	<.16	972	<.02
D29	04/02/2003	1050	<3	<.60	<2	9	<.12	200	<.07	<.8	1.69	9.6	7,080	<.16	837	<.02
D29	07/07/2003	1010	<3	<.60	<2	9	<.12	200	E.05	<.8	1.54	8.6	7,780	E.11	969	<.02
D29	10/02/2003	1100	<3	<.40	E.4	9	<.12	200	<.08	1.0	2.09	22.8	5,950	<.16	914	<.02

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Aluminum, dissolved (µg/L)	Antimony, dissolved (µg/L)	Arsenic, dissolved (µg/L)	Barium, dissolved (µg/L)	Beryllium, dissolved (µg/L)	Boron, dissolved (µg/L)	Cadmium, dissolved (µg/L)	Chromium, dissolved (µg/L)	Cobalt, dissolved (µg/L)	Copper, dissolved (µg/L)	Iron, dissolved (µg/L)	Lead, dissolved (µg/L)	Manganese, dissolved (µg/L)	Mercury, dissolved (µg/L)
D30	01/14/2002	1220	<3	<0.10	<2	10	<0.20	410	<0.10	<2.4	2.12	5.9	E49	<0.20	387	<0.01
D30	04/09/2002	1430	<3	<.10	<2	10	<.20	450	<.10	<.8	2.21	9.5	E31	<.20	410	<.01
D30	07/11/2002	0955	<2	E.07	<2	10	<.10	440	E.04	<.8	2.63	19.6	91	<.20	324	<.01
D30	10/17/2002	1150	<3	<.60	<2	11	<.12	430	.08	E.5	2.13	12.3	108	<.16	241	<.02
D30	01/03/2003	1240	<5	<.90	M	12	<.18	430	E.08	<.8	2.46	8.0	E47	<.24	288	<.02
D30	04/07/2003	1135	<3	<.60	<2	9	<.12	400	E.07	<.8	2.51	12.3	60	<.16	257	<.02
D30	07/10/2003	1250	E2	<.60	<2	9	<.12	380	.08	<.8	2.42	11.7	64	<.16	288	<.02
D6	01/14/2002	1015	<7	<.30	E3	<7	<.40	720	<.30	E2.8	7.88	24.6	<300	E.29	4,690	<.01
D6	04/04/2002	1215	2	1.43	2	6	<.06	810	.11	<.8	8.35	45.3	<10	<.08	4,820	<.01
D6	07/09/2002	1235	<7	E.28	5	<7	<.40	830	E.17	<.8	6.76	75.6	<100	<.60	3,980	E.01
D6	10/17/2002	1030	<11	<2.10	E3	6	<.42	930	E.13	<1.6	7.74	43.7	<100	<.56	4,400	<.02
D6	01/03/2003	1015	<11	<2.10	5	6	<.42	1,020	<.26	<1.6	8.59	33.4	<300	<.56	4,240	<.02
D6	04/04/2003	1415	<11	<2.10	<4	5	<.42	840	<.26	<1.6	6.87	39.5	<100	<.56	3,690	<.02
D6	07/10/2003	1035	<11	<2.10	<5.7	5	<.42	760	E.22	<1.6	7.45	36.9	<80	<.56	4,350	<.02
D6	10/03/2003	1505	<11	<1.40	5.4	6	<.42	810	<.28	<1.6	7.53	29.5	<64	E.32	4,580	<.02
D6A	04/04/2002	1355	3	1.03	3	6	<.06	860	.08	<.8	11.0	44.6	<10	<.08	4,750	<.01
D6A	07/09/2002	1535	<7	E.32	5	<7	<.40	860	E.21	<.8	9.75	74.1	<100	<.60	4,060	E.01
DTX1	01/09/2002	1020	<2	.11	2	8	<.10	590	.12	<1.6	.86	6.5	<30	<.20	140	<.01
DTX1	04/10/2002	1500	<2	.11	3	7	<.10	560	.17	<.8	1.03	7.3	<30	<.20	134	<.01
DTX1	07/10/2002	1505	<2	.12	E2	7	<.10	500	.12	<.8	1.28	15.3	<30	<.20	131	<.01
DTX1	10/16/2002	1515	<3	<.60	3	8	<.12	560	.13	<.8	.73	9.9	<30	<.16	140	<.02
DTX1	01/05/2003	1445	<3	<.60	E2	9	<.12	590	.13	<.8	.99	6.0	<30	<.16	153	<.02
DTX1	04/08/2003	1320	<3	<.60	E1	7	<.12	530	.14	<.8	1.36	7.0	<30	<.16	120	<.02
DTX1	07/10/2003	1550	E2	<.60	E1	7	<.12	450	.19	<.8	1.22	8.4	<24	<.16	186	<.02
DTX10A	01/11/2002	1245	<2	<.10	<2	10	<.10	240	<.07	<1.6	.67	4.0	4,330	<.20	255	<.01
DTX10A	04/05/2002	1035	<2	E.09	<2	12	<.10	260	<.07	<.8	.93	7.0	4,250	<.20	294	<.01
DTX10A	07/10/2002	1120	<2	<.10	<2	12	<.10	240	<.07	<.8	1.23	11.9	4,180	<.20	302	<.01
DTX10A	10/18/2002	1045	<3	<.60	<2	11	<.12	270	<.07	E.5	.83	8.7	4,480	<.16	264	<.02
DTX10A	01/07/2003	1105	<3	<.60	<2	12	<.12	250	<.07	<.8	1.35	5.7	4,380	<.16	305	<.02
DTX10A	04/07/2003	1400	<3	<.60	<2	11	<.12	250	<.07	<.8	1.32	7.3	4,390	<.16	284	<.02
DTX10A	07/09/2003	1115	<3	<.60	<2	12	<.12	250	<.07	1.1	.70	4.4	4,450	<.16	308	<.02
DTX10A	10/03/2003	1100	<3	<.40	E.3	12	<.12	240	<.08	E.4	.78	4.6	4,430	<.16	312	<.02
DTX11	07/09/2003	1315	<3	<.60	E1	12	<.12	200	.08	<.8	2.50	5.1	636	<.16	4770	<.02

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Aluminum, dissolved (µg/L)	Antimony, dissolved (µg/L)	Arsenic, dissolved (µg/L)	Barium, dissolved (µg/L)	Beryllium, dissolved (µg/L)	Boron, dissolved (µg/L)	Cadmium, dissolved (µg/L)	Chromium, dissolved (µg/L)	Cobalt, dissolved (µg/L)	Copper, dissolved (µg/L)	Iron, dissolved (µg/L)	Lead, dissolved (µg/L)	Manganese, dissolved (µg/L)	Mercury, dissolved (µg/L)
DTX2	01/11/2002	1015	<2	0.43	E1	14	<0.10	310	E0.05	<2.4	4.88	4.4	537	<0.20	4,660	<0.01
DTX2	04/10/2002	1335	<2	.29	<2	14	<.10	280	E.05	<.8	4.75	6.8	476	<.20	4,910	<.01
DTX2	07/10/2002	1325	<2	.11	E1	13	<.10	320	E.04	<.8	5.25	13.4	503	<.20	4,350	<.01
DTX2	10/16/2002	1350	<3	2.89	E1	12	<.12	360	.13	<.8	4.08	8.8	406	<.16	3,940	<.02
DTX2	01/05/2003	1310	<3	E.49	<2	16	<.12	370	E.05	<.8	5.63	5.9	675	<.16	4,340	<.02
DTX2	04/08/2003	1200	<3	E.33	<2	13	<.12	310	E.06	<.8	5.32	9.0	472	<.16	4,460	<.02
DTX2	07/15/2003	1055	<3	<.60	E1	13	<.12	290	E.04	<.8	5.40	6.2	471	<.16	4,280	<.02
DTX2	10/06/2003	1430	<3	<.40	1.1	14	<.12	320	E.04	<.8	5.34	6.2	591	<.16	4,880	E.01
DTX3	01/08/2002	1015	<1	E.05	<2	17	<.06	220	<.04	<.8	.35	2.4	<10	<.08	.1	<.01
DTX3	04/09/2002	1005	<1	E.03	<2	16	<.06	230	E.02	<.8	.61	3.3	<30	<.08	.2	<.01
DTX3	07/09/2002	1025	<1	.07	<2	16	<.06	260	<.04	<.8	.58	6.6	<30	<.08	<.1	<.01
DTX3	10/21/2002	1025	<2	<.30	<2	16	<.06	270	<.04	<.8	.52	5.5	<30	<.08	<.2	<.02
DTX3	01/06/2003	1100	<2	<.30	<2	18	<.06	250	<.04	<.8	.69	4.2	<10	<.08	<.2	<.02
DTX3	04/03/2003	1010	<2	<.30	<2	14	<.06	230	<.04	<.8	.72	5.3	<10	<.08	<.2	<.02
DTX3	07/08/2003	0945	<2	<.30	<2	15	<.06	240	<.04	<.8	.42	2.6	<8	<.08	<.2	<.02
DTX3	10/03/2003	1330	<2	<.20	1.3	15	<.06	240	<.04	<.8	.41	3.0	<6	<.08	<.2	<.02
DTX4	07/08/2003	1140	<2	<.30	<2	12	<.06	220	E.03	<.8	.60	3.8	<8	<.08	E.1	<.02
DTX5	01/08/2002	1235	<2	.16	<2	12	<.10	410	<.07	<1.6	1.06	4.5	30	<.20	92.1	<.01
DTX5	04/09/2002	1140	<2	1.28	<2	13	<.10	350	.10	<.8	1.28	6.2	<30	<.20	85.2	<.01
DTX5	07/11/2002	1140	<2	.36	<2	12	<.10	400	.09	<.8	1.52	14.3	<30	<.20	87.2	<.01
DTX5	10/21/2002	1225	<3	<.60	<2	11	<.12	480	<.07	E.5	1.18	9.6	E16	<.16	93.4	<.02
DTX5	01/07/2003	1530	<3	E.34	<2	12	<.12	440	<.07	<.8	1.35	6.0	49	<.16	96.7	<.02
DTX5	04/03/2003	1210	<3	E.36	<2	10	<.12	400	E.05	<.8	1.49	9.2	<10	<.16	83.9	<.02
DTX5	07/09/2003	1555	E1	.73	<2	11	<.06	350	.08	<.8	.52	2.7	<8	E.05	88.9	<.02
DTX6	01/08/2002	1415	<2	<.10	<2	9	<.10	370	<.07	<1.6	.74	6.7	<30	<.20	.2	<.01
DTX6	04/09/2002	1300	<2	<.10	<2	9	<.10	340	<.07	<.8	.99	8.2	<30	<.20	<.2	<.01
DTX6	07/11/2002	1345	<2	E.06	<2	8	<.10	350	<.07	<.8	1.22	19.2	<30	<.20	E.2	<.01
DTX6	10/21/2002	1415	<3	<.60	<2	8	<.12	370	<.07	E.6	.88	13.3	<30	<.16	E.2	<.02
DTX6	01/07/2003	1342	<3	<.60	<2	9	<.12	390	<.07	<.8	.70	9.8	<30	E.12	<.4	<.02
DTX6	04/03/2003	1440	<3	<.60	<2	8	<.12	390	<.07	<.8	1.35	11.5	<30	<.16	<.4	<.02
DTX6	07/08/2003	1425	<3	<.60	<2	8	<.12	350	<.07	<.8	.72	7.1	<24	<.16	<.4	<.02
DTX6	10/06/2003	1030	E2	<.40	.6	8	<.12	330	<.08	<.8	.72	6.9	<19	E.09	E.2	<.02
DTX8A	01/09/2002	1250	2	<.05	<2	14	<.06	250	<.04	<.8	.83	1.9	430	<.08	151	<.01
DTX8A	04/10/2002	1055	2	<.05	<2	14	<.06	260	<.04	<.8	.75	2.3	444	<.08	156	<.01
DTX8A	07/12/2002	1005	2	E.04	<2	13	<.06	260	<.04	<.8	.78	5.0	474	<.08	139	<.01
DTX8A	10/22/2002	1035	2	<.30	<2	12	<.06	270	<.04	<.8	.68	3.9	543	<.08	144	<.02
DTX8A	01/05/2003	1105	2	<.30	<2	15	<.06	280	<.04	<.8	.72	2.0	547	<.08	130	<.02
DTX8A	04/04/2003	1200	2	<.30	<2	12	<.06	260	<.04	<.8	.80	3.6	550	.09	125	<.02
DTX8A	07/11/2003	1055	2	<.30	<2	11	<.06	250	<.04	<.8	.79	2.0	557	<.08	119	<.02
DTX8A	10/06/2003	1245	E2	<.20	.3	13	<.06	250	<.04	<.8	.62	1.9	612	<.08	115	<.02
DTX9	07/15/2003	1330	<3	<.60	<2	12	<.12	160	.09	<.8	2.33	5.5	E17	<.16	3050	<.02

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Molybdenum, dissolved (µg/L)	Nickel, dissolved (µg/L)	Selenium, dissolved (µg/L)	Silver, dissolved (µg/L)	Strontium, dissolved (µg/L)	Uranium, dissolved (µg/L)	Zinc, dissolved (µg/L)	Plutonium-238 whole water (pCi/L)	Plutonium-238 analytical uncertainty (pCi/L)	Plutonium-238 MDC (pCi/L)	Plutonium-239+240, whole water (pCi/L)	Plutonium-239+240 analytical uncertainty (pCi/L)	Plutonium-239+240 MDC (pCi/L)
D13	01/09/2002	1450	1.0	[1]<0.06	3	<1	967	7.55	1	-0.0022	0.0025	0.0141	0	0.0044	0.0049
D13	04/09/2002	1530	1.0	5.61	<2	<1	888	7.91	1	--	--	--	--	--	--
D13	07/08/2002	1420	1.1	[1]<.06	<2	<1	962	7.64	2	--	--	--	--	--	--
D13	10/22/2002	1205	1.4	6.52	3	<.20	1,050	5.35	2	--	--	--	--	--	--
D13	01/02/2003	1300	1.1	7.55	<3	<.20	998	6.47	2	0	.0055	.0061	0	.0055	.0061
D13	04/02/2003	1415	1.0	2.31	<3	<.20	937	6.90	1	--	--	--	--	--	--
D13	07/07/2003	1350	1.1	6.53	<3	<.20	1,080	5.65	3	--	--	--	--	--	--
D15	01/06/2003	1300	5.5	30.9	<3	<.60	6,590	52.4	9	.0048	.0097	.0132	.0048	.0097	.0131
D17	01/07/2002	1335	5.6	[1].25	7	<1	305	4.21	<1	.0003	.0038	.0113	-.0013	.0019	.0113
D17	04/03/2002	1520	5.9	1.03	7	<1	308	4.48	2	--	--	--	--	--	--
D17	07/08/2002	1300	5.4	.61	7	<1	289	4.18	1	--	--	--	--	--	--
D17	10/17/2002	1330	5.4	2.79	8	<.20	300	3.89	<1	--	--	--	--	--	--
D17	01/02/2003	1515	5.5	2.76	8	<.20	320	4.27	M	0	.0039	.0043	.0032	.0063	.0116
D17	04/02/2003	1240	5.7	.92	7	<.20	310	4.52	<1	--	--	--	--	--	--
D17	07/07/2003	1225	5.8	2.18	8	<.20	311	4.53	M	--	--	--	--	--	--
D23	01/06/2003	1445	3.4	16.5	<3	<.40	4,100	11.4	6	0	.0072	.0187	-.0051	.0072	.0236
D25	01/07/2002	1515	8.2	[1]<.10	<2	<2	3,430	37.4	6	.0049	.0098	.0132	0	.012	.013
D25	04/05/2002	1350	9.5	5.46	<2	<2	3,320	35.6	8	--	--	--	--	--	--
D25	07/12/2002	1200	13.6	19.4	3	<2	3,620	54.1	12	--	--	--	--	--	--
D25	10/18/2002	1255	8.6	25.6	<3	<.40	3,470	33.0	8	--	--	--	--	--	--
D25	01/03/2003	1435	8.4	29.4	<3	<.40	3,590	38.1	6	.0033	.0067	.0090	0	.0082	.0090
D25	04/08/2003	1035	7.6	10.5	<3	<.40	3,610	34.7	5	--	--	--	--	--	--
D25	07/10/2003	1415	11.8	18.6	<3	<.40	3,610	41.7	7	--	--	--	--	--	--
D25	10/02/2003	1325	8.7	12.5	2.2	<.40	3,620	33.6	10	--	--	--	--	--	--
D25A	04/05/2002	1235	5.1	4.16	E1	<5	3,260	25.5	7	--	--	--	--	--	--
D25A	10/18/2002	1405	4.6	21.8	<3	--	3,610	22.9	7	--	--	--	--	--	--
D29	01/07/2002	1115	1.2	4.62	3	<2	5,800	.07	28	0	.0077	.0085	0	.0076	.0085
D29	04/03/2002	1330	1.4	7.94	<2	<1	5,940	.06	9	--	--	--	--	--	--
D29	07/08/2002	1100	1.6	1.40	3	<2	5,910	.06	7	--	--	--	--	--	--
D29	10/16/2002	1100	4.0	18.1	<3	<.40	6,120	.05	7	--	--	--	--	--	--
D29	01/02/2003	1035	.8	25.6	<3	<.40	6,270	.07	7	0	.011	.012	.0044	.0088	.0119
D29	04/02/2003	1050	E.4	6.74	<3	<.40	6,410	.06	6	--	--	--	--	--	--
D29	07/07/2003	1010	1.1	24.1	<3	M	6,160	.07	12	--	--	--	--	--	--
D29	10/02/2003	1100	1.5	14.6	1.3	<.40	6,040	E.07	12	--	--	--	--	--	--

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Molybdenum, dissolved (µg/L)	Nickel, dissolved (µg/L)	Selenium, dissolved (µg/L)	Silver, dissolved (µg/L)	Strontium, dissolved (µg/L)	Uranium, dissolved (µg/L)	Zinc, dissolved (µg/L)	Plutonium-238 whole water (pCi/L)	Plutonium-238 analytical uncertainty (pCi/L)	Plutonium-238 MDC (pCi/L)	Plutonium-239+240, whole water (pCi/L)	Plutonium-239+240 analytical uncertainty (pCi/L)	Plutonium-239+240 MDC (pCi/L)
D30	01/14/2002	1220	3.0	5.08	<2	<3	6,230	40.0	6	0.009	0.018	0.024	[1]0.026	0.031	0.024
D30	04/09/2002	1430	2.8	15.7	<2	<3	6,310	40.1	7	--	--	--	--	--	--
D30	07/11/2002	0955	2.6	14.7	<2	<2	6,360	38.6	12	--	--	--	--	--	--
D30	10/17/2002	1150	2.0	20.9	<3	<.40	6,170	38.1	9	--	--	--	--	--	--
D30	01/03/2003	1240	2.1	19.7	<3	<.60	6,370	43.6	7	0	.014	.036	-.010	.014	.045
D30	04/07/2003	1135	2.1	7.69	<3	<.40	6,740	41.4	6	--	--	--	--	--	--
D30	07/10/2003	1250	2.2	12.2	<3	<.40	6,480	38.1	9	--	--	--	--	--	--
D6	01/14/2002	1015	4.0	14.5	13	<7	16,000	197	27	.08	.12	.12	0	.10	.12
D6	04/04/2002	1215	6.0	16.0	11	<1	16,400	184	34	--	--	--	--	--	--
D6	07/09/2002	1235	3.1	13.9	19	<7	15,700	170	45	--	--	--	--	--	--
D6	10/17/2002	1030	3.6	30.6	19	<1	17,200	172	33	--	--	--	--	--	--
D6	01/03/2003	1015	3.6	28.7	17	<1	16,800	198	29	0	.015	.017	0	.015	.017
D6	04/04/2003	1415	3.1	16.9	8	<1	17,100	180	22	--	--	--	--	--	--
D6	07/10/2003	1035	3.4	20.5	10.5	<1	17,200	161	30	--	--	--	--	--	--
D6	10/03/2003	1505	3.8	16.6	[1]42.9	<1	17,100	179	28	--	--	--	--	--	--
D6A	04/04/2002	1355	4.9	18.0	13	<1	17,400	185	35	--	--	--	--	--	--
D6A	07/09/2002	1535	3.5	15.8	19	<7	16,100	174	45	--	--	--	--	--	--
DTX1	01/09/2002	1020	6.2	9.23	3	<2	5,520	47.6	5	-.0017	.0034	.0242	.012	.018	.033
DTX1	04/10/2002	1500	6.1	19.5	E2	<2	5,580	50.4	4	--	--	--	--	--	--
DTX1	07/10/2002	1505	7.0	20.6	<2	<2	5,330	49.7	9	--	--	--	--	--	--
DTX1	10/16/2002	1515	6.8	21.6	E2	<.40	5,760	45.6	6	--	--	--	--	--	--
DTX1	01/05/2003	1445	6.5	24.0	<3	<.40	5,970	54.1	5	0	.0081	.0090	.0033	.0066	.0090
DTX1	04/08/2003	1320	6.2	13.8	<3	<.40	5,910	50.8	4	--	--	--	--	--	--
DTX1	07/10/2003	1550	6.8	20.4	<3	<.40	5,660	44.6	6	--	--	--	--	--	--
DTX10A	01/11/2002	1245	1.1	[1]<.10	3	<2	5,340	.12	3	-.0042	.0042	.0224	-.0021	.0030	.0179
DTX10A	04/05/2002	1035	1.4	[1]<.10	<2	<2	5,330	.15	6	--	--	--	--	--	--
DTX10A	07/10/2002	1120	1.3	11.4	<2	<2	5,350	.15	7	--	--	--	--	--	--
DTX10A	10/18/2002	1045	1.4	11.2	<3	<.40	5,600	.14	6	--	--	--	--	--	--
DTX10A	01/07/2003	1105	1.4	11.5	<3	<.40	5,620	.19	4	.0067	.0095	.0090	0	.0081	.0090
DTX10A	04/07/2003	1400	1.2	4.62	<3	<.40	5,610	.15	4	--	--	--	--	--	--
DTX10A	07/09/2003	1115	1.4	10.3	<3	<.40	5,460	.15	4	--	--	--	--	--	--
DTX10A	10/03/2003	1100	1.4	6.65	.9	<.40	5,570	.14	3	--	--	--	--	--	--
DTX11	07/09/2003	1315	2.8	14.7	<3	<.40	4,870	17.0	11	--	--	--	--	--	--

Table 10. Water-quality data for U.S. Geological Survey monitoring wells near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, millgrams per liter; µg/L micrograms per liter; <, less than; °C, degrees Celsius; --, no data available; E, value estimated by laboratory; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Site number	Sample date (mm/dd/yy)	Sample time (hhmm)	Molybdenum, dissolved (µg/L)	Nickel, dissolved (µg/L)	Selenium, dissolved (µg/L)	Silver, dissolved (µg/L)	Strontium, dissolved (µg/L)	Uranium, dissolved (µg/L)	Zinc, dissolved (µg/L)	Plutonium-238 whole water (pCi/L)	Plutonium-238 analytical uncertainty (pCi/L)	Plutonium-238 MDC (pCi/L)	Plutonium-239+240, whole water (pCi/L)	Plutonium-239+240 analytical uncertainty (pCi/L)	Plutonium-239+240 MDC (pCi/L)
DTX2	01/11/2002	1015	1.6	3.30	3	<2	5,180	35.9	5	0.005	0.014	0.031	0	0.011	0.012
DTX2	04/10/2002	1335	1.7	17.9	<2	<2	5,130	35.4	5	--	--	--	--	--	--
DTX2	07/10/2002	1325	1.6	16.1	<2	<2	5,200	34.1	9	--	--	--	--	--	--
DTX2	10/16/2002	1350	2.8	16.8	<3	<.40	5,500	33.7	8	--	--	--	--	--	--
DTX2	01/05/2003	1310	1.6	19.8	<3	<.40	5,910	40.2	5	0	.013	.014	0	.021	.048
DTX2	04/08/2003	1200	1.6	8.59	<3	<.40	5,840	36.1	5	--	--	--	--	--	--
DTX2	07/15/2003	1055	1.9	20.3	E1	<.40	5,000	36.6	5	--	--	--	--	--	--
DTX2	10/06/2003	1430	1.8	10.4	1.9	<.40	5,590	33.8	5	--	--	--	--	--	--
DTX3	01/08/2002	1015	.6	[1].15	12	<1	2,660	25.7	2	-.0008	.0017	.0117	0	.0051	.0056
DTX3	04/09/2002	1005	.5	1.08	16	<1	2,980	28.0	2	--	--	--	--	--	--
DTX3	07/09/2002	1025	.6	2.37	16	<1	3,010	26.7	3	--	--	--	--	--	--
DTX3	10/21/2002	1025	.5	8.38	18	<.20	3,130	23.3	3	--	--	--	--	--	--
DTX3	01/06/2003	1100	.8	7.42	11	<.20	3,170	26.5	2	-.0020	.0040	.0146	.0020	.0040	.0054
DTX3	04/03/2003	1010	.6	2.73	11	<.20	3,040	27.4	2	--	--	--	--	--	--
DTX3	07/08/2003	0945	.6	6.08	11	<.20	3,190	25.9	2	--	--	--	--	--	--
DTX3	10/03/2003	1330	.7	3.04	17.2	<.20	2,920	22.9	1	--	--	--	--	--	--
DTX4	07/08/2003	1140	.7	9.23	5	<.20	3,140	19.0	3	--	--	--	--	--	--
DTX5	01/08/2002	1235	1.0	[1]<.10	<2	<2	4,330	34.6	4	-.0018	.0025	.0152	.010	.010	.012
DTX5	04/09/2002	1140	.9	15.7	<2	<2	4,100	36.2	3	--	--	--	--	--	--
DTX5	07/11/2002	1140	1.1	13.1	<2	<2	4,500	35.7	8	--	--	--	--	--	--
DTX5	10/21/2002	1225	.9	17.9	<3	<.40	4,550	32.0	5	--	--	--	--	--	--
DTX5	01/07/2003	1530	1.2	22.2	<3	<.40	4,590	34.9	5	0	.0086	.0095	0	.0086	.0095
DTX5	04/03/2003	1210	1.0	6.30	<3	<.40	4,370	36.0	4	--	--	--	--	--	--
DTX5	07/09/2003	1555	1.0	6.94	<3	<.20	2,870	23.8	2	--	--	--	--	--	--
DTX6	01/08/2002	1415	.7	[1]<.10	<2	<2	5,470	36.3	6	.006	.012	.016	.012	.016	.016
DTX6	04/09/2002	1300	.7	12.1	E2	<2	5,600	36.7	5	--	--	--	--	--	--
DTX6	07/11/2002	1345	.8	11.7	E1	<2	5,480	35.0	11	--	--	--	--	--	--
DTX6	10/21/2002	1415	E.7	14.2	E3	<.40	5,730	33.4	8	--	--	--	--	--	--
DTX6	01/07/2003	1342	.9	14.1	<3	<.40	5,830	36.4	5	0	.013	.014	.016	.023	.038
DTX6	04/03/2003	1440	.7	5.28	E1	<.40	5,880	36.7	5	--	--	--	--	--	--
DTX6	07/08/2003	1425	E.6	11.0	E2	<.40	5,140	35.0	6	--	--	--	--	--	--
DTX6	10/06/2003	1030	.9	5.79	4.8	<.40	5,090	29.4	5	--	--	--	--	--	--
DTX8A	01/09/2002	1250	.6	[1]<.06	4	<1	2,480	.17	2	0	.0048	.0053	.0004	.0045	.0134
DTX8A	04/10/2002	1055	.6	4.24	<2	<1	2,410	.23	2	--	--	--	--	--	--
DTX8A	07/12/2002	1005	.6	3.41	<2	<1	2,490	.20	5	--	--	--	--	--	--
DTX8A	10/22/2002	1035	.7	4.89	<3	<.20	2,460	.20	3	--	--	--	--	--	--
DTX8A	01/05/2003	1105	.6	4.93	<3	<.20	2,700	.21	2	0	.0041	.0046	0	.0067	.0156
DTX8A	04/04/2003	1200	.6	1.87	<3	<.20	2,620	.20	2	--	--	--	--	--	--
DTX8A	07/11/2003	1055	.5	4.21	<3	<.20	2,510	.18	2	--	--	--	--	--	--
DTX8A	10/06/2003	1245	.6	1.60	.5	<.20	2,650	.19	1	--	--	--	--	--	--
DTX9	07/15/2003	1330	2.3	17.6	<3	<.40	4,510	19.1	12	--	--	--	--	--	--

[1] Value is significantly different from historical or subsequent data at the same site, and analytical bias is suspected. However, insufficient evidence from laboratory to reject or change value.

[2] Value for dissolved is at least 0.05 mg/L greater than value for total; difference is not from rounding the values. The value likely is affected by some analytical bias.

Table 11. Quality-control data for blank samples associated with ground-water sample collected near Deer Trail, Colorado, 2002-2003.

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; µg/L micrograms per liter; <, less than; F, field blank; Q, equipment blank; S, source-water blank; E, value estimated by laboratory; M, presence of material verified but not quantified; --, no sample submitted; °C, degrees Celsius; site number refers to site where sample was processed or, for equipment blank, site where equipment was last used; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Blank type	Sample date (mm/dd/yy)	Sample time (hhmm)	Site number	Specific conductance, lab (µS/cm)	pH, laboratory (standard units)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Potassium, dissolved (mg/L as K)	Sodium, dissolved (mg/L as Na)	Acid neutralizing capacity, titration to pH 4.5, lab (mg/L as $CaCO_3$)	Chloride, dissolved (mg/L as Cl)
F	01/08/2002	1215	DTX5	<3	7.2	<0.01	<0.008	<0.10	<0.09	<1	<0.30
F	01/09/2002	1000	DTX1	<3	6.8	<.01	<.008	<.10	<.09	<1	<.30
Q	01/10/2002	1200	DTX10A	4	7.8	.02	<.008	<.10	<.09	1	<.30
F	04/03/2002	1500	D17	<3	6.9	<.01	<.008	<.10	<.09	2	<.30
F	04/05/2002	1330	D25	<3	7.3	<.01	<.008	<.10	<.09	2	<.30
F	07/08/2002	1230	D17	<3	7.6	<.01	<.008	<.10	<.09	<1	<.30
F	07/09/2002	1500	D6A	<3	7.4	<.01	<.008	<.10	<.09	<1	<.30
F	10/21/2002	1000	DTX3	E4	7.3	E.01	<.008	<.10	E.05	<2	<.20
F	10/21/2002	1205	DTX5	E4	7.6	<.01	<.008	<.10	[1].41	<2	<.20
F	01/02/2003	1230	D13	E3	5.9	E.01	<.008	<.10	<.09	<2	E.18
F	01/06/2003	1415	D23	E4	6.9	<.01	<.008	<.10	E.05	<2	<.20
Q	01/08/2003	1645	DTX10A	E4	7.5	.09	.031	<.10	.11	<2	<.20
F	04/02/2003	1355	D13	E4	7.0	<.01	<.008	<.10	E.07	<2	E.14
F	04/07/2003	1110	D30	E4	7.6	<.01	<.008	<.16	<.09	<2	[1].29
F	07/08/2003	1110	DTX4	E2	6.1	E.01	<.008	<.16	<.10	<2	<.20
F	10/06/2003	1000	DTX6	E2	6.2	E.01	E.004	<.16	<.10	<2	<.20
S	10/07/2003	1500	DTX8A	E4	5.2	<.01	<.008	<.16	<.10	<2	<.20
Q	10/07/2003	1530	DTX8A	E3	E6.5	.04	<.008	E.10	<.10	2	<.20

Table 11. Quality-control data for blank samples associated with ground-water sample collected near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; µg/L micrograms per liter; <, less than; F, field blank; Q, equipment blank; S, source-water blank; E, value estimated by laboratory; M, presence of material verified but not quantified; --, no sample submitted; °C, degrees Celsius; site number refers to site where sample was processed or, for equipment blank, site where equipment was last used; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Blank type	Sample date (mm/dd/yy)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Sulfate, dissolved (mg/L as SO_4)	Nitrogen, ammonia plus organic, dissolved (mg/L as N)	Nitrogen, ammonia plus organic, total (mg/L as N)	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrite plus nitrate, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Phosphorus, total (mg/L as P)	Solids, residue on evaporation at 180 °C, dissolved (mg/L)
F	01/08/2002	<0.1	<0.13	<0.1	E0.05	<0.10	E0.026	<0.04	<0.05	<0.06	<10
F	01/09/2002	<.1	<.13	<.1	<.10	<.10	<.050	<.04	<.05	<.06	<10
Q	01/10/2002	<.1	<.13	E.1	E.05	<.10	E.027	<.04	<.05	<.06	<10
F	04/03/2002	E.1	<.13	<.1	<.10	<.10	<.050	<.04	<.05	<.06	<10
F	04/05/2002	E.1	<.13	E.1	<.10	<.10	<.050	<.04	<.05	<.06	<10
F	07/08/2002	<.10	<.13	<.1	E.06	<.10	[1].061	<.04	<.05	<.06	<10
F	07/09/2002	<.10	<.13	<.1	<.10	<.10	<.050	<.04	<.05	<.06	<10
F	10/21/2002	<.17	<.13	<.2	E.05	<.10	<.050	<.05	<.05	<.04	<10
F	10/21/2002	<.17	<.13	<.2	<.10	E.08	<.050	<.05	<.05	<.04	<10
F	01/02/2003	<.17	<.13	<.2	<.10	<.10	<.050	<.05	<.05	<.04	<10
F	01/06/2003	<.17	<.13	<.2	<.10	E.06	<.050	<.05	<.05	<.04	<10
Q	01/08/2003	<.17	<.13	<.2	E.06	<.10	<.050	<.05	<.05	<.04	<10
F	04/02/2003	[1].01	<.13	<.2	E.06	<.10	<.050	<.05	<.05	<.04	<10
F	04/07/2003	[1].03	E.06	<.2	[1].14	<.10	<.050	<.05	<.05	<.04	<10
F	07/08/2003	<.2	E.01	<.2	<.10	<.10	<.050	<.05	<.05	<.04	<10
F	10/06/2003	<.2	<.04	<.2	<.10	<.10	<.040	<.04	<.04	<.04	<10
S	10/07/2003	<.2	<.04	<.2	<.10	<.10	<.040	<.04	<.04	<.04	<10
Q	10/07/2003	<.2	<.04	<.2	<.10	<.10	<.040	E.02	<.04	<.04	<10

Table 11. Quality-control data for blank samples associated with ground-water sample collected near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; µg/L micrograms per liter; <, less than; F, field blank; Q, equipment blank; S, source-water blank; E, value estimated by laboratory; M, presence of material verified but not quantified; --, no sample submitted; °C, degrees Celsius; site number refers to site where sample was processed or, for equipment blank, site where equipment was last used; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Blank type	Sample date (mm/dd/yy)	Aluminum, dissolved (µg/L as Al)	Antimony, dissolved (µg/L as Sb)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L as Be)	Boron, dissolved (µg/L as B)	Bromide, dissolved (mg/L as Br)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (mg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)
F	01/08/2002	<1	<0.05	<2	<1	<0.06	<10	<0.03	<0.04	<0.8	<0.02	<0.2
F	01/09/2002	<1	<.05	<2	<1	<.06	<10	<.03	<.04	<.8	<.02	<.2
Q	01/10/2002	<1	<.05	<2	<1	<.06	<10	<.03	<.04	<.8	E.01	.4
F	04/03/2002	<1	E.03	<2	<1	<.06	<10	E.02	<.04	<.8	<.02	<.2
F	04/05/2002	<1	[1].05	<2	<1	<.06	<10	<.03	<.04	<.8	<.02	<.2
F	07/08/2002	<1	<.05	<2	<1	<.06	<10	<.03	<.04	<.8	E.01	E.2
F	07/09/2002	<1	<.05	<2	<1	<.06	<10	<.03	E.03	<.8	<.02	E.2
F	10/21/2002	<2	<.30	<2	<.050	<.06	<10	<.02	<.04	<.8	<.01	[1]1.1
F	10/21/2002	<2	<.30	<2	<.050	<.06	<10	<.02	<.04	<.8	<.01	[1].3
F	01/02/2003	<2	<.30	<2	<.050	<.06	<10	<.02	<.04	E.4	<.01	<.2
F	01/06/2003	<2	<.30	<2	M	<.06	<10	<.02	<.04	<.8	<.01	E.2
Q	01/08/2003	<2	<.30	<2	M	<.06	<10	<.02	<.04	<.8	.02	1.4
F	04/02/2003	<2	<.30	<2	<.050	<.06	<10	<.02	<.04	<.8	<.01	E.2
F	04/07/2003	<2	<.30	<2	<.050	<.06	<10	<.02	<.04	<.8	<.01	[1].4
F	07/08/2003	<2	<.30	<2	<.050	<.06	<7	<.02	<.04	<.8	<.01	E.2
F	10/06/2003	<2	<.20	<.2	<.2	<.06	<7.0	<.02	<.04	<.8	<.01	E.4
S	10/07/2003	<2	<.20	<.2	<.2	<.06	<7.0	<.02	<.04	<.8	<.01	<.4
Q	10/07/2003	<2	<.20	<.2	M	<.06	<7.0	<.02	<.04	<.8	.01	.6

Table 11. Quality-control data for blank samples associated with ground-water sample collected near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; µg/L micrograms per liter; <, less than; F, field blank; Q, equipment blank; S, source-water blank; E, value estimated by laboratory; M, presence of material verified but not quantified; --, no sample submitted; °C, degrees Celsius; site number refers to site where sample was processed or, for equipment blank, site where equipment was last used; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Blank type	Sample date (mm/dd/yy)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Selenium, dissolved (µg/L as Se)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Zinc, dissolved (µg/L as Zn)	Uranium natural, dissolved (µg/L as U)
F	01/08/2002	<10	<0.08	<0.1	<0.01	<0.2	<0.06	<2	<1	<0.6	<1	<0.02
F	01/09/2002	<10	<.08	<.1	<.01	<.2	<.06	<2	<1	<.6	<1	<.02
Q	01/10/2002	<10	<.08	<.1	<.01	<.2	.10	<2	<1	<.6	<1	<.02
F	04/03/2002	<10	<.08	<.1	<.01	<.2	<.06	<2	<1	<.6	<1	<.02
F	04/05/2002	<10	<.08	E.1	<.01	<.2	<.06	<2	<1	<.6	<1	<.02
F	07/08/2002	<10	<.08	[1].1	<.01	E.1	<.06	<2	<1	<.6	<1	E.01
F	07/09/2002	<10	<.08	<.1	<.01	<.2	<.06	<2	<1	<.6	<1	<.02
F	10/21/2002	<10	<.08	<.2	<.02	<.3	E.04	<3	<.20	<.6	<1	E.01
F	10/21/2002	<10	<.08	<.2	<.02	<.3	<.06	<3	<.20	<.6	M	<.02
F	01/02/2003	<10	<.08	<.2	<.02	<.3	<.06	<3	<.20	<.6	[1]3	E.01
F	01/06/2003	<10	[1].08	<.2	<.02	E.2	<.06	<3	<.20	<.6	M	[1].03
Q	01/08/2003	<10	<.08	.3	<.02	<.3	.18	<3	<.20	1.0	1	E.01
F	04/02/2003	<10	<.08	<.2	<.02	<.3	<.06	<3	<.20	<.6	<1	<.02
F	04/07/2003	<10	<.08	<.2	<.02	<.3	<.06	<3	<.20	<.6	<1	<.02
F	07/08/2003	E4	<.08	<.2	<.02	<.3	<.06	<3	<.20	E.3	M	E.01
F	10/06/2003	<6	<.08	<.2	<.02	<.4	<.06	<.4	<.20	<1.4	<.6	<.04
S	10/07/2003	<6	<.08	<.2	<.02	<.4	<.06	<.4	<.20	<1.4	<.6	<.04
Q	10/07/2003	<6	<.08	.3	<.02	<.4	.24	<.4	<.20	<1.4	M	<.04

Table 11. Quality-control data for blank samples associated with ground-water sample collected near Deer Trail, Colorado, 2002-2003.—Continued

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; µg/L micrograms per liter; <, less than; F, field blank; Q, equipment blank; S, source-water blank; E, value estimated by laboratory; M, presence of material verified but not quantified; --, no sample submitted; °C, degrees Celsius; site number refers to site where sample was processed or, for equipment blank, site where equipment was last used; analytical uncertainty is the 2-sigma precision estimate calculated by the laboratory as a combined standard analytical uncertainty; MDC, minimum detectable concentration calculated for that sample; negative activity reported for some of the radiochemical samples means the sample counts were less than the laboratory background counts for that day]

Blank type	Sample date (mm/dd/yy)	Plutonium-238, whole water (pCi/L)	Plutonium-238 anallytical uncertainty (pCi/L)	Plutonium-238 MDC (pCi/L)	Plutonium-239+240, whole water (pCi/L)	Plutonium-239+240 analytical uncertainty (pCi/L)	Plutonium-239+240 MDC (pCi/L)
F	01/08/2002	0.0009	0.0032	0.0084	-0.0006	0.0012	0.0084
F	01/09/2002	.0010	.0034	.0090	.0035	.0058	.0110
Q	01/10/2002	.0020	.0039	.0053	0	.0048	.0053
F	04/03/2002	--	--	--	--	--	--
F	04/05/2002	--	--	--	--	--	--
F	07/08/2002	--	--	--	--	--	--
F	07/09/2002	--	--	--	--	--	--
F	10/21/2002	--	--	--	--	--	--
F	10/21/2002	--	--	--	--	--	--
F	01/02/2003	.0037	.0053	.0050	[1].0056	.0065	.0050
F	01/06/2003	.0018	.0037	.0050	.0018	.0037	.0050
Q	01/08/2003	0	.0037	.0041	0	.0037	.0041
F	04/02/2003	--	--	--	--	--	--
F	04/07/2003	--	--	--	--	--	--
F	07/08/2003	--	--	--	--	--	--
F	10/06/2003	--	--	--	--	--	--
S	10/07/2003	--	--	--	--	--	--
Q	10/07/2003	--	--	--	--	--	--

[1] Analytical bias is suspected. However, insufficient evidence from laboratory to reject or change value.

Table 12. Comparison of water-quality data for ground-water and replicate samples collected near Deer Trail, Colorado, 2002-2003.

[RPD, relative percent difference, which is defined as [(sample value - replicate value)/[(sample value + replicate value)/2]] x 100, using unrounded laboratory data; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; E, value estimated by laboratory; --, not analyzed; ND, not determined because data were less than the minimum reporting limit; n, below the laboratory reporting level and above the long-term method-detection level; R, no data because sample ruined at laboratory]

	D25 01/07/02			D6 01/14/02			D6 04/04/02		
Property or constituents	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**
Specific conductance, lab (µS/cm at 25°C)	4,540	4,540	0	16,600	16,600	0	15,900	15,800	1
pH, laboratory (standard units)	7.3	7.2	0	7.2	7.2	0	7.2	7.2	0
Calcium, dissolved (mg/L as Ca)	688	686	0	409	417	-2	405	424	-5
Magnesium, dissolved (mg/L as Mg)	209	214	-2	2,110	2,150	-2	2,300	2,300	0
Sodium, dissolved (mg/L as Na)	281	282	0	1,930	1,920	1	1,970	2,090	-6
Potassium, dissolved (mg/L as K)	7.51	7.17	5	11.9	11.7	2	12.7	12.6	1
Acid neutralizing capacity, titration to pH 4.5, lab (mg/L as $CaCO_3$)	444	445	0	637	634	0	641	637	1
Sulfate, dissolved (mg/L as SO_4)	2,620	2,620	0	13,600	13,700	-1	13,500	13,500	0
Chloride, dissolved (mg/L as Cl)	119	117	2	386	385	0	392	398	-2
Fluoride, dissolved (mg/L as F)	1.1	1.0	2	0.8	0.9	-2	0.9	0.9	0
Bromide, dissolved (mg/L as Br)	1.73	1.72	1	4.5	4.4	2	4.53	4.60	-2
Silica, dissolved (mg/L as SiO_2)	27.8	28.0	-1	21.7	21.6	0	20.3	21.5	-6
Solids, residue on evaporation at 180°C, dissolved (mg/L)	4,690	4,730	-1	21,500	21,700	-1	21,900	21,400	2
Nitrite plus nitrate, dissolved (mg/L as N)	2.35	2.31	2	15.2	15.0	1	15	15	0
Nitrogen ammonia, dissolved (mg/L as N)	0.066	0.058	13	0.098	0.113	-14	< 0.05	E 0.03	ND
Nitrogen ammonia plus organic, total (mg/L as N)	0.73	0.72	1	[2] 0.48	0.59	-21	1.3	1.3	0
Nitrogen ammonia plus organic, dissolved (mg/L as N)	0.66	0.70	-6	0.57	0.49	15	1.1	0.99	11
Phosphorus, total (mg/L as P)	0.12	0.13	-12	< .06	< .06	0	E 0.04	< 0.06	ND
Phosphorus, dissolved (mg/L as P)	0.12	0.11	4	< .05	< .05	0	< 0.05	< 0.05	0
Aluminum, dissolved (µg/L as Al)	< 2	< 2	0	< 7	< 7	0	2	2	0
Antimony, dissolved (µg/L as Sb)	0.20	0.21	-5	< 0.30	< 0.30	0	1.43	1.25	13
Arsenic, dissolved (µg/L as As)	4	2	63	E 3	E 3	0	2	2	0
Barium, dissolved (µg/L as Ba)	19	19	0	< 7	< 7	0	6	5	18
Beryllium, dissolved (µg/L as Be)	< 0.10	< 0.1	0	< 0.4	< 0.4	0	< 0.06	< 0.06	0
Boron, dissolved (µg/L as B)	360	400	-11	720	700	3	810	940	-15
Cadmium, dissolved (µg/L as Cd)	0.18	0.18	0	< 0.3	< 0.3	0	0.11	0.10	10
Chromium, dissolved (µg/L as Cr)	< 2.4	< 2.4	0	E 2.8	E 2.8	0	< 0.8	< 0.8	0
Cobalt, dissolved (µg/L as Co)	3.38	3.45	-2	7.88	7.03	11	8.35	7.74	8
Copper, dissolved (µg/L as Cu)	7.1	6.8	4	24.6	23.4	5	45.3	44.8	1
Iron, dissolved (µg/L as Fe)	< 10	< 30	ND	< 300	< 300	0	< 10	< 10	0
Lead, dissolved (µg/L as Pb)	< 0.20	< 0.20	0	E 0.29	< 0.60	ND	< 0.08	< 0.08	0
Manganese, dissolved (µg/L as Mn)	3,200	3,100	3	4,690	4,300	9	4,820	4,610	4
Mercury, dissolved (µg/L as Hg)	< 0.1	< 0.1	0	< 0.01	< 0.01	0	< 0.01	< 0.01	0
Molybdenum, dissolved (µg/L as Mo)	8.2	8.4	-3	4	4	0	6	6	0
Nickel, dissolved (µg/L as Ni)	[1] < 0.1	4	ND	14.5	14.5	0	16	16	0
Selenium, dissolved (µg/L as Se)	< 2	< 2	0	13	14	-7	11	10	10
Silver, dissolved (µg/L as Ag)	< 2	< 2	0	< 7	< 7	0	< 1	< 1	0
Strontium, dissolved (µg/L as Sr)	3,430	3,400	1	16,000	16,000	0	16,400	17,400	-6
Zinc, dissolved (µg/L as Zn)	6	5	18	27	26	1	34	33	3
Uranium, natural, dissolved (µg/L as U)	37.4	38.6	-3	197	187	5	184	180	2
Plutonium-238, whole water (pCi/L as Pu)	0.0049	0.010	-71	0.08	0.027	99	--	--	--
Plutonium-239+240, whole water (pCi/L as Pu)	0	-0.0026	-200	0	0.027	-200	--	--	--

Table 12. Comparison of water-quality data for ground-water and replicate samples collected near Deer Trail, Colorado, 2002-2003.—Continued

[RPD, relative percent difference, which is defined as [(sample value - replicate value)/[(sample value + replicate value)/2]] x 100, using unrounded laboratory data; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; E, value estimated by laboratory; --, not analyzed; ND, not determined because data were less than the minimum reporting limit; n, below the laboratory reporting level and above the long-term method-detection level; R, no data because sample ruined at laboratory]

	DTX3 04/09/02			D6 07/09/02			DTX2 07/10/02		
Property or constituents	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**
Specific conductance, lab (µS/cm at 25°C)	2,110	2,110	0	15,800	15,700	1	4,120	4,120	0
pH, laboratory (standard units)	7.3	7.3	0	7.2	7.1	1	7.2	7.2	0
Calcium, dissolved (mg/L as Ca)	254	250	2	422	427	-1	493	496	-1
Magnesium, dissolved (mg/L as Mg)	101	96	5	2,290	2,280	0	194	197	-2
Sodium, dissolved (mg/L as Na)	109	105	4	2,010	2,040	-1	416	420	-1
Potassium, dissolved (mg/L as K)	6.32	6.95	-9	11.5	12.4	-8	6.97	7.32	-5
Acid neutralizing capacity, titration to pH 4.5, lab (mg/L as $CaCO_3$)	282	282	0	641	641	0	416	416	0
Sulfate, dissolved (mg/L as SO_4)	936	942	-1	13,000	13,000	0	2,450	2,450	0
Chloride, dissolved (mg/L as Cl)	28.7	30.4	-6	403	409	-1	44.1	44.2	0
Fluoride, dissolved (mg/L as F)	0.3	0.3	0	0.9	0.9	0	0.52	0.49	6
Bromide, dissolved (mg/L as Br)	0.23	0.22	4	4.25	4.21	1	0.60	0.61	-2
Silica, dissolved (mg/L as SiO_2)	15.7	15.2	3	21.5	21.7	-1	16.6	16.8	-1
Solids, residue on evaporation at 180°C, dissolved (mg/L)	1,770	1,790	-1	21,200	21,300	0	4,370	4,370	0
Nitrite plus nitrate, dissolved (mg/L as N)	5.80	5.80	0	17.3	16.8	3	<0.04	<0.04	0
Nitrogen ammonia, dissolved (mg/L as N)	<0.05	<0.05	0	<0.05	<0.05	0	0.731	0.715	2
Nitrogen ammonia plus organic, total (mg/L as N)	0.23	0.20	14	1.6	1.6	0	0.98	0.97	1
Nitrogen ammonia plus organic, dissolved (mg/L as N)	0.22	0.23	-4	1.6	1.6	0	0.98	0.99	-1
Phosphorus, total (mg/L as P)	<0.06	<0.06	0	E 0.04	E 0.04	0	<0.06	<0.06	0
Phosphorus, dissolved (mg/L as P)	<0.05	<0.05	0	E 0.03	E 0.04	-29	<0.05	<0.05	0
Aluminum, dissolved (µg/L as Al)	<1	<1	0	<7	<7	0	<2	<2	0
Antimony, dissolved (µg/L as Sb)	E0.03	0.06	-67	E 0.28	E 0.23	20	0.11	0.11	0
Arsenic, dissolved (µg/L as As)	<2	<2	0	5	4	22	E1	E2	-67
Barium, dissolved (µg/L as Ba)	16	16	0	<7	<7	0	13	13	0
Beryllium, dissolved (µg/L as Be)	<0.06	<0.06	0	<0.40	<0.40	0	<0.10	<0.10	0
Boron, dissolved (µg/L as B)	230	200	14	830	850	-2	320	320	0
Cadmium, dissolved (µg/L as Cd)	E0.02	E 0.03	-40	E 0.17	E 0.22	-26	E 0.04	E 0.04	0
Chromium, dissolved (µg/L as Cr)	<0.8	<0.8	0	<0.8	<1.6	ND	<0.8	<0.8	0
Cobalt, dissolved (µg/L as Co)	0.6	0.6	0	6.76	6.88	-2	5.25	5.28	-1
Copper, dissolved (µg/L as Cu)	3.3	3.6	-9	75.6	69.1	9	13.4	13.7	-2
Iron, dissolved (µg/L as Fe)	<30	<30	0	<100	<100	0	503	507	-1
Lead, dissolved (µg/L as Pb)	<0.08	<0.08	0	<0.60	<0.60	0	<0.20	<0.20	0
Manganese, dissolved (µg/L as Mn)	0.2	< 0.1	ND	3,980	3,940	1	4,350	4,366	0
Mercury, dissolved (µg/L as Hg)	<0.01	<0.01	0	E 0.01	<0.01	ND	<0.01	<0.01	0
Molybdenum, dissolved (µg/L as Mo)	0.5	0.5	0	3.1	3.3	-6	1.6	1.7	-6
Nickel, dissolved (µg/L as Ni)	1.08	5.04	-129	13.9	14.7	-6	16.1	15.9	1
Selenium, dissolved (µg/L as Se)	16	18	-12	19	17	11	<2	E2	ND
Silver, dissolved (µg/L as Ag)	<1	<1	0	<7	<7	0	<2	<2	0
Strontium, dissolved (µg/L as Sr)	2,980	2,940	1	15,700	16,000	-2	5,200	5,150	1
Zinc, dissolved (µg/L as Zn)	2	2	0	45	43	5	9	9	0
Uranium, natural, dissolved (µg/L as U)	28	28	0	170	168	1	34.1	34.0	0
Plutonium-238, whole water (pCi/L as Pu)	--	--	--	--	--	--	--	--	--
Plutonium-239+240, whole water (pCi/L as Pu)	--	--	--	--	--	--	--	--	--

Table 12. Comparison of water-quality data for ground-water and replicate samples collected near Deer Trail, Colorado, 2002-2003.—Continued

[RPD, relative percent difference, which is defined as [(sample value - replicate value)/[(sample value + replicate value)/2]] x 100, using unrounded laboratory data; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; E, value estimated by laboratory; --, not analyzed; ND, not determined because data were less than the minimum reporting limit; n, below the laboratory reporting level and above the long-term method-detection level; R, no data because sample ruined at laboratory]

	D6 01/03/03			DTX6 01/07/03			D6 04/04/03		
Property or constituents	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**
Specific conductance, lab (µS/cm at 25 °C)	E16,200	E16,200	0	4,270	4,130	3	E15,600	E16,000	-3
pH, laboratory (standard units)	7.2	7.3	-1	7.2	7.1	1	7.3	7.3	0
Calcium, dissolved (mg/L as Ca)	424	425	0	502	496	1	415	411	1
Magnesium, dissolved (mg/L as Mg)	2,170	2,160	0	265	264	0	2,820	2,250	22
Sodium, dissolved (mg/L as Na)	2,060	2,040	1	346	347	0	2,120	2,100	1
Potassium, dissolved (mg/L as K)	12.1	11.8	3	11.6	11.8	-2	14.5	9.87	38
Acid neutralizing capacity, titration to pH 4.5, lab (mg/L as $CaCO_3$)	642	643	0	259	260	0	644	646	0
Sulfate, dissolved (mg/L as SO_4)	13,000	12,900	1	2,640	2,640	0	13,500	14,100	-4
Chloride, dissolved (mg/L as Cl)	364	366	-1	15.9	15.9	0	366	364	1
Fluoride, dissolved (mg/L as F)	1.08	1.08	0	0.53	0.50	5	0.95	0.96	-1
Bromide, dissolved (mg/L as Br)	4.26	4.25	0	0.17	0.17	0	4.26	4.26	0
Silica, dissolved (mg/L as SiO_2)	21	22	-5	11.8	11.7	1	22	22	0
Solids, residue on evaporation at 180 °C, dissolved (mg/L)	20,700	20,900	-1	4,430	4,440	0	22,000	20,900	5
Nitrite plus nitrate, dissolved (mg/L as N)	18.5	18.6	-1	0.20	0.19	4	19.4	19.3	1
Nitrogen ammonia, dissolved (mg/L as N)	0.082	0.066	22	E0.032	E0.041	-28	E0.043	E0.031	32
Nitrogen ammonia plus organic, total (mg/L as N)	[1,2] 0.39	1.10	-95	0.11	E0.07	4	1.61	1.61	0
Nitrogen ammonia plus organic, dissolved (mg/L as N)	1.51	1.51	0	E0.09	0.07	25	1.61	1.71	-6
Phosphorus, total (mg/L as P)	<0.04	E0.02	ND	<0.04	<0.04	0	E0.02	E0.02	-18
Phosphorus, dissolved (mg/L as P)	<0.05	E0.04	ND	<0.05	<0.05	0	<0.10	<0.10	0
Aluminum, dissolved (µg/L as Al)	<11	<11	0	<3	<3	0	<11	<11	0
Antimony, dissolved (µg/L as Sb)	<2.10	E1.54	ND	<0.60	<0.60	0	<2.10	<2.10	0
Arsenic, dissolved (µg/L as As)	5	4	11	<2	<2	0	<4	<4	0
Barium, dissolved (µg/L as Ba)	6	6	0	9	9	0	5	5	0
Beryllium, dissolved (µg/L as Be)	<0.42	<0.42	0	<0.12	<0.12	0	<0.42	<0.42	0
Boron, dissolved (µg/L as B)	1,020	964	6	390	380	3	840	880	-5
Cadmium, dissolved (µg/L as Cd)	<0.26	<0.26	0	<0.07	<0.07	0	<0.26	<0.26	0
Chromium, dissolved (µg/L as Cr)	<1.6	<1.6	0	<0.8	<0.8	0	<1.6	<1.6	0
Cobalt, dissolved (µg/L as Co)	8.59	8.50	1	0.70	0.80	-13	6.87	6.91	-1
Copper, dissolved (µg/L as Cu)	33.4	32.0	4	9.8	8.6	13	39.5	38.7	2
Iron, dissolved (µg/L as Fe)	<300	<300	0	<30	<30	0	<100	<100	0
Lead, dissolved (µg/L as Pb)	<0.56	<0.56	0	E,n 0.12	E,n 0.15	-22	<0.56	<0.56	0
Manganese, dissolved (µg/L as Mn)	4,240	4,140	2	<0.4	E,n 0.2	62	3,690	3,690	0
Mercury, dissolved (µg/L as Hg)	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0
Molybdenum, dissolved (µg/L as Mo)	3.6	3.3	8	0.9	0.9	0	3.1	3.3	-6
Nickel, dissolved (µg/L as Ni)	28.7	27.8	3	14.1	16.4	-15	16.9	16.6	2
Selenium, dissolved (µg/L as Se)	17	17	0	<3	E2	42	8	9	-12
Silver, dissolved (µg/L as Ag)	<1	<1	0	<0.4	<0.4	0	<1	<1	0
Strontium, dissolved (µg/L as Sr)	16,800	16,900	-1	5,830	5,830	0	17,100	17,200	-1
Zinc, dissolved (µg/L as Zn)	29	31	-5	5	5	-2	22	23	-4
Uranium, natural, dissolved (U)	198	196	1	36.4	35.9	1	180	180	0
Plutonium-238, whole water (pCi/L as Pu)	0	R	ND	0	0	0	--	--	--
Plutonium-239+240, whole water (pCi/L as Pu)	0	R	ND	0.016	0	200	--	--	--

Table 12. Comparison of water-quality data for ground-water and replicate samples collected near Deer Trail, Colorado, 2002-2003.—Continued

[RPD, relative percent difference, which is defined as [(sample value - replicate value)/[(sample value + replicate value)/2]] x 100, using unrounded laboratory data; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; E, value estimated by laboratory; --, not analyzed; ND, not determined because data were less than the minimum reporting limit; n, below the laboratory reporting level and above the long-term method-detection level; R, no data because sample ruined at laboratory]

	DTX6 04/03/03			D6 07/10/03			DTX4 07/08/03		
Property or constituents	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**	**Sample**	**Replicate**	**RPD**
Specific conductance, lab (µS/cm at 25°C)	4,270	4,240	1	E 16,300	E16,400	-1	2,060	2,050	0
pH, laboratory (standard units)	7.3	7.3	0	7.3	7.3	0	7.1	7.0	1
Calcium, dissolved (mg/L as Ca)	499	503	-1	443	452	-2	390	370	5
Magnesium, dissolved (mg/L as Mg)	274	268	2	2,390	2,150	11	61.7	58.6	5
Sodium, dissolved (mg/L as Na)	337	339	-1	2,180	2,200	-1	107	103	4
Potassium, dissolved (mg/L as K)	14.1	14.3	-1	15.0	13.0	14	8.38	8.04	4
Acid neutralizing capacity, titration to pH 4.5, lab (mg/L as $CaCO_3$)	256	257	0	643	643	0	266	266	0
Sulfate, dissolved (mg/L as SO_4)	2,680	2,680	0	13,000	14,000	-7	1,020	1,020	0
Chloride, dissolved (mg/L as Cl)	18.8	17.7	6	408	407	0	7.24	7.45	-3
Fluoride, dissolved (mg/L as F)	0.49	0.49	0	1.1	1.1	0	0.3	0.3	4
Bromide, dissolved (mg/L as Br)	0.19	0.18	3	4.36	4.17	4	0.07	0.08	-2
Silica, dissolved (mg/L as SiO_2)	11.9	11.8	1	22.5	22.5	0	10.5	10.4	1
Solids, residue on evaporation at 180°C, dissolved (mg/L)	4,510	4,510	0	21,300	21,400	0	1,870	1,840	2
Nitrite plus nitrate, dissolved (mg/L as N)	0.17	0.17	0	20.3	20.2	0	0.15	0.14	5
Nitrogen ammonia, dissolved (mg/L as N)	<0.05	<0.05	0	0.083	0.078	6	<0.05	<0.05	0
Nitrogen ammonia plus organic, total (mg/L as N)	E 0.09	E 0.09	0	[1,2] 0.77	1.5	-64	0.18	0.24	-29
Nitrogen ammonia plus organic, dissolved (mg/L as N)	E 0.06	0.10	-50	0.86	0.75	14	0.14	0.13	7
Phosphorus, total (mg/L as P)	E 0.02	E 0.03	-25	<0.04	<0.04	0	<0.04	<0.04	0
Phosphorus, dissolved (mg/L as P)	<0.05	<0.05	0	E 0.03	E 0.03	0	<0.05	<0.05	0
Aluminum, dissolved (µg/L as Al)	<3	<3	0	<11	<11	2	<2	<2	0
Antimony, dissolved (µg/L as Sb)	<0.60	<0.60	0	<2.10	<2.10	0	<0.30	<0.30	0
Arsenic, dissolved (µg/L as As)	<2	<2	0	<5.7	<5.7	0	<2	<2	0
Barium, dissolved (µg/L as Ba)	8	8	-1	5	4	12	12	12	0
Beryllium, dissolved (µg/L as Be)	<0.12	<0.12	0	<0.42	<0.42	0	<0.06	<0.06	0
Boron, dissolved (µg/L as B)	390	370	5	760	650	16	220	210	5
Cadmium, dissolved (µg/L asCd)	<0.07	0.07	0	E 0.22	E 0.24	-9	E 0.03	E,n 0.04	-12
Chromium, dissolved (µg/L as Cr)	<0.8	<0.8	0	<1.6	<1.6	0	<0.8	<0.8	0
Cobalt, dissolved (µg/L as Co)	1.35	1.35	0	7.45	7.33	2	0.60	0.60	0
Copper, dissolved (µg/L as Cu)	11.5	11.2	3	36.9	34.2	8	3.8	3.6	4
Iron, dissolved (µg/L as Fe)	<30	<10	ND	<80	<200	-86	<8	<8	0
Lead, dissolved (µg/L as Pb)	<0.16	<0.16	0	<0.56	<0.56	0	<0.08	<0.08	0
Manganese, dissolved (µg/L as Mn)	<0.4	<0.4	0	4,350	4,400	-1	E 0.1	<0.2	ND
Mercury, dissolved (µg/L as Hg)	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0
Molybdenum, dissolved (µg/L as Mo)	0.7	0.7	0	3.4	3.5	-4	0.7	0.7	0
Nickel, dissolved (µg/L as Ni)	5.28	5.48	-4	20.5	21.4	-4	9.23	9.12	1
Selenium, dissolved (µg/L as Se)	E 1	<3	ND	10.5	9.6	9	5	6	-9
Silver, dissolved (µg/L as Ag)	<0.4	<0.4	0	<1	<1	0	<0.2	<0.2	0
Strontium, dissolved (µg/L as Sr)	5,880	5,770	2	17,200	17,900	-4	3,140	3,000	5
Zinc, dissolved (µg/L as Zn)	5	5	0	30	28	6	3	3	0
Uranium, natural, dissolved (µg/L as U)	36.7	37.0	-1	161	162	-1	19.0	19.1	-1
Plutonium-238, whole water (pCi/L as Pu)	--	--	--	--	--	--	--	--	--
Plutonium-239+240, whole water (pCi/L as Pu)	--	--	--	--	--	--	--	--	--

Table 12. Comparison of water-quality data for ground-water and replicate samples collected near Deer Trail, Colorado, 2002-2003.—Continued

[RPD, relative percent difference, which is defined as [(sample value - replicate value)/[(sample value + replicate value)/2]] x 100, using unrounded laboratory data; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than; E, value estimated by laboratory; --, not analyzed; ND, not determined because data were less than the minimum reporting limit; n, below the laboratory reporting level and above the long-term method-detection level; R, no data because sample ruined at laboratory]

Property or constituents	DTX8A 10/06/03 Sample	DTX8A 10/06/03 Replicate	RPD
Specific conductance, lab (µS/cm at 25°C)	1,840	1,840	0
pH, laboratory (standard units)	7.6	7.6	0
Calcium, dissolved (mg/L as Ca)	151	150	1
Magnesium, dissolved (mg/L as Mg)	32.7	32.1	2
Sodium, dissolved (mg/L as Na)	241	239	1
Potassium, dissolved (mg/L as K)	6.6	6.4	3
Acid neutralizing capacity, titration to pH 4.5, lab (mg/L as $CaCO_3$)	212	213	0
Sulfate, dissolved (mg/L as SO_4)	748	753	-1
Chloride, dissolved (mg/L as Cl)	27.8	28.2	-1
Fluoride, dissolved (mg/L as F)	0.3	0.3	0
Bromide, dissolved (mg/L as Br)	0.31	0.31	0
Silica, dissolved (mg/L as SiO_2)	14.1	13.9	0
Solids, residue on evaporation at 180°C, dissolved (mg/L)	1,400	1,400	0
Nitrite plus nitrate, dissolved (mg/L as N)	<0.04	<0.04	0
Nitrogen ammonia, dissolved (mg/L as N)	1.44	1.47	-2
Nitrogen ammonia plus organic, total (mg/L as N)	1.5	1.5	0
Nitrogen ammonia plus organic, dissolved (mg/L as N)	1.6	1.6	0
Phosphorus, total (mg/L as P)	<0.04	<0.04	0
Phosphorus, dissolved (mg/L as P)	<0.04	<0.04	0
Aluminum, dissolved (µg/L as Al)	E 2	1.6	22
Antimony, dissolved (µg/L as Sb)	<0.20	<0.20	0
Arsenic, dissolved (µg/L as As)	0.3	0.2	40
Barium, dissolved (µg/L as Ba)	13	13	0
Beryllium, dissolved (µg/L as Be)	<0.06	<0.06	0
Boron, dissolved (µg/L as B)	250	250	0
Cadmium, dissolved (µg/L as Cd)	<0.04	<0.04	0
Chromium, dissolved (µg/L as Cr)	<0.8	<0.8	0
Cobalt, dissolved (µg/L as Co)	0.62	0.62	0
Copper, dissolved (µg/L as Cu)	1.9	2.0	-5
Iron, dissolved (µg/L as Fe)	612	601	2
Lead, dissolved (µg/L as Pb)	<0.08	<0.08	0
Manganese, dissolved (µg/L as Mn)	115	126	-9
Mercury, dissolved (µg/L as Hg)	<0.02	<0.02	0
Molybdenum, dissolved (µg/L as Mo)	0.6	0.6	0
Nickel, dissolved (µg/L as Ni)	1.60	1.81	-12
Selenium, dissolved (µg/L as Se)	0.5	0.4	22
Silver, dissolved (µg/L as Ag)	<0.20	<0.20	0
Strontium, dissolved (µg/L as Sr)	2,650	2,620	1
Zinc, dissolved (µg/L as Zn)	1	1	0
Uranium, natural, dissolved (µg/L as U)	0.19	0.20	-5
Plutonium-238, whole water (pCi/L as Pu)	--	--	--
Plutonium-239+240, whole water (pCi/L as Pu)	--	--	--

[1] Value is significantly different from historical or subsequent data at the same site, and analytical bias is suspected. However, insufficient evidence from laboratory to reject or change value.

[2] Value for dissolved is at least 0.05 mg/L greater than value for total; difference is not from rounding the values. The value likely is affected by some analytical bias.

Table 13. Methods used to analyze streambed-sediment samples collected near Deer Trail, Colorado, 2002-2003.

[MRL, minimum reporting level; MDC, minimum detectable concentration (radiochemical samples); reporting limits varied for each parameter so MRL and MDC provided below are examples only; ICP, inductively coupled plasma; MS, mass spectrometry; AA, atomic absorption; ASF, automated segmented-flow spectrophotometry; mg/kg, milligrams per kilogram; µg/g, micrograms per gram; g/kg, grams per kilogram; pCi/g, picocuries per gram]

Property or constituent	Units	Analytical method	MRL or MDC	Method reference
		Nutrients[1]		
Nitrogen, ammonia plus organic	mg/kg	Colorimetry, ASF, salicylate-hypochlorite	72-408	U.S. Environmental Protection Agency (1983, Method 351.2)
Phosphorus, total as P	mg/kg	Colorimetry, ASF, phosphomolybdate	7.0-160	U.S. Environmental Protection Agency (1983, Method 365.3)
		Trace elements[1]		
Aluminum	µg/g	ICP	15-40	U.S. Environmental Protection Agency (1986, Method 6010B)
Antimony	µg/g	ICP-MS	0.29-1.8	U.S. Environmental Protection Agency (1986, Method 6020)
Arsenic	µg/g	ICP-MS	0.73-4.5	U.S. Environmental Protection Agency (1986, Method 6020)
Barium	µg/g	ICP-MS	0.15-0.90	U.S. Environmental Protection Agency (1986, Method 6020)
Beryllium	µg/g	ICP-MS	0.15-2.0	U.S. Environmental Protection Agency (1986, Method 6020)
Cadmium	µg/g	ICP-MS	0.15-0.90	U.S. Environmental Protection Agency (1986, Method 6020)
Chromium	µg/g	ICP-MS	0.29-1.8	U.S. Environmental Protection Agency (1986, Method 6020)
Cobalt	µg/g	ICP-MS	0.15-0.90	U.S. Environmental Protection Agency (1986, Method 6020)
Copper	µg/g	ICP-MS	0.29-1.8	U.S. Environmental Protection Agency (1986, Method 6020)
Lead	µg/g	ICP-MS	0.15-0.90	U.S. Environmental Protection Agency (1986, Method 6020)
Manganese	µg/g	ICP-MS	0.15-0.90	U.S. Environmental Protection Agency (1986, Method 6020)
Mercury	µg/g	AA manual cold vapor	0.048-0.13	U.S. Environmental Protection Agency (1986, Method 7471A)
Molybdenum	µg/g	ICP-MS	0.29-1.8	U.S. Environmental Protection Agency (1986, Method 6020)
Nickel	µg/g	ICP-MS	0.15-0.90	U.S. Environmental Protection Agency (1986, Method 6020)
Selenium	µg/g	ICP-MS	0.73-4.5	U.S. Environmental Protection Agency (1986, Method 6020)
Silver	µg/g	ICP-MS	0.15-0.90	U.S. Environmental Protection Agency (1986, Method 6020)
Thallium	µg/g	ICP-MS	0.15-0.90	U.S. Environmental Protection Agency (1986, Method 6020)

Table 13. Methods used to analyze streambed-sediment samples collected near Deer Trail, Colorado, 2002-2003.–Continued

[MRL, minimum reporting level; MDC, minimum detectable concentration (radiochemical samples); reporting limits varied for each parameter so MRL and MDC provided below are examples only; ICP, inductively coupled plasma; MS, mass spectrometry; AA, atomic absorption; ASF, automated segmented-flow spectrophotometry; mg/kg, milligrams per kilogram; µg/g, micrograms per gram; g/kg, grams per kilogram; pCi/g, picocuries per gram]

Property or constituent	Units	Analytical method	MRL or MDC	Method reference
		Trace elements[1]		
Tin	µg/g	ICP-MS	1.5-9.0	U.S. Environmental Protection Agency (1986, Method 6020)
Uranium	µg/g	ICP-MS	0.15-0.90	U.S. Environmental Protection Agency (1986, Method 6020)
Zinc	µg/g	ICP-MS	1.5-9.0	U.S. Environmental Protection Agency (1986, Method 6020)
		Carbons[2]		
Inorganic carbon	g/kg	Coulimetric	0.2	Not available
Organic carbon	g/kg	Wet oxidation	0.2	Not available
Total carbon	g/kg	Induction furnace (Leco)	0.1	Not available
		Radioactivity[3]		
Gross alpha	pCi/g	Thorium-230	6	Not available
Gross beta	pCi/g	Cesium-137	3	Not available
Plutonium-238	pCi/g	Alpha spectrometry	0.1	Not available
Plutonium-239+240	pCi/g	Alpha spectrometry	0.1	Not available

[1] Analyses done by Severn Trent Laboratory in Arvada, Colorado. MRL calculated for each sample.

[2] Analyses in 2002 done by the USGS National Water Quality Laboratory using methods shown. Analyses in 2003 done by Severn Trent Laboratory in Chicago, Illinois, using furance combustion and nondispersive infrared detection (Lloyd Kahn Method) for inorganic and total carbon with organic carbon value by subtraction; MRL was 1.3 for each parameter.

[3] Analyses of 2002 samples done by Severn Trent Laboratory in Richland, Washington. Analyses of 2003 samples done by Eberline Services in Richmond, California. MDC calculated for each sample.

Table 14. Comparison of chemical and radioactivity data for streambed-sediment and replicate samples collected near Deer Trail, Colorado, 2002-2003.

[RPD, relative percent difference, which is defined for sample-replicate pairs as [(sample value - replicate value)/((sample value + replicate value)/2)] x 100, and for basin pairs as [(biosolids value - no biosolids value)/((biosolids value + no biosolids value)/2)] x 100; mg/kg, milligrams per kilogram; g/kg, grams per kilogram; µg/g, micrograms per gram ; pCi/g, picocuries per gram; E, estimated because less than reporting level; J, method blank contamination--the associated method blank contains the target constituent at a reportable level; +/-, plus or minus the analytical uncertainty followed in parentheses by the minimum detectable concentration calculated for that sample; <, less than; --, not analyzed; ND, not determined because data were less than the minimum reporting limit]

Property or constituents	Biosolids-applied site 06/04/02 Sample	No-biosolids-applied site 06/04/02 Sample	RPD between environmental sample and replicate
Total nitrogen (mg/kg)	1,500	710	71
Phosphorus (mg/kg)	880	680	26
Carbon, inorganic (g/kg)	4.6	5.4	-16
Carbon, total (g/kg)	19	13	38
Carbon, organic (g/kg)	14	7	63
Aluminum (µg/g)	21,500	20,500	5
Antimony (µg/g)	E,J 0.04	E,J 0.08	-67
Arsenic (µg/g)	7	6	15
Barium (µg/g)	J 133	J 130	2
Beryllium (µg/g)	0.9	0.9	-2
Cadmium (µg/g)	0.2	E 0.1	67
Chromium (µg/g)	J 21	J 21	0
Cobalt (µg/g)	7.2	7.0	3
Copper (µg/g)	J 17	J 11	43
Lead (µg/g)	J 18	J 15	18
Manganese (µg/g)	J 220	J 220	0
Mercury (µg/g)	E 0.04	E 0.01	120
Molybdenum (µg/g)	J 0.5	J 0.4	22
Nickel (µg/g)	J 16	J 15	6
Selenium (µg/g)	0.9	E 0.6	40
Silver (µg/g)	J 0.6	E,J 0.1	143
Thallium (µg/g)	0.3	0.3	0
Tin (µg/g)	E,J 0.4	E,J 0.5	-22
Uranium (µg/g)	2.0	1.5	29
Zinc (µg/g)	66	57	15
Gross Alpha radioactivity (pCi/g)	12.2 +/- 4.0 (1.3)	10.0 +/- 3.2 (1.6)	20
Gross Beta radioactivity (pCi/g)	15.9 +/- 3.1 (2.5)	12.9 +/- 2.7 (2.4)	21
Plutonium-238 (pCi/g)	-0.00069 +/- 0.00099 (0.01980)	0 +/- 0.0096 (0.0106)	ND
Plutonium-239+240 (pCi/g)	0.013 +/- 0.015 (0.012)	0.012 +/- 0.014 (0.011)	11

Table 14. Comparison of chemical and radioactivity data for streambed-sediment and replicate samples collected near Deer Trail, Colorado, 2002-2003.—Continued

[RPD, relative percent difference, which is defined for sample-replicate pairs as [(sample value - replicate value)/((sample value + replicate value)/2)] x 100, and for basin pairs as [(biosolids value - no biosolids value)/((biosolids value + no biosolids value)/2)] x 100; mg/kg, milligrams per kilogram; g/kg, grams per kilogram; µg/g, micrograms per gram ; pCi/g, picocuries per gram; E, estimated because less than reporting level; J, method blank contamination--the associated method blank contains the target constituent at a reportable level; +/-, plus or minus the analytical uncertainty followed in parentheses by the minimum detectable concentration calculated for that sample; <, less than; --, not analyzed; ND, not determined because data were less than the minimum reporting limit]

Property or constituents	Biosolids-applied site 07/07/02 Sample	No-biosolids-applied site 07/07/02 Sample	Biosolids-applied site 07/07/02 Replicate	RPD between sites	RPD between environmental sample and replicate
Total nitrogen (mg/kg)	1,500	790	1,400	62	7
Phosphorus (mg/kg)	J 620	J 590	590	5	5
Carbon, inorganic (g/kg)	3.6	4.7	3.6	-27	0
Carbon, total (g/kg)	15	11	15	31	0
Carbon, organic (g/kg)	11	6.2	12	56	-9
Aluminum (µg/g)	J 25,000	J 26,000	28,000	-4	-11
Antimony (µg/g)	< 0.3	E 0.1	< 0.3	ND	ND
Arsenic (µg/g)	J 7	J 8	J 7	-13	0
Barium (µg/g)	J 152	J 131	J 142	15	7
Beryllium (µg/g)	1.1	1.1	1.0	0	10
Cadmium (µg/g)	0.2	E 0.1	0.2	67	0
Chromium (µg/g)	J 24	J 26	J 22	-8	9
Cobalt (µg/g)	7.9	8.2	7.4	-4	7
Copper (µg/g)	J 16	J 14	J 15	13	6
Lead (µg/g)	J 16	J 16	J 15	0	6
Manganese (µg/g)	J 250	J 230	J 230	8	8
Mercury (µg/g)	E 0.02	E 0.02	E 0.02	0	0
Molybdenum (µg/g)	0.3	E 0.2	E 0.2	40	40
Nickel (µg/g)	17	18	16	-6	6
Selenium (µg/g)	J 1	J 1	J 1	0	0
Silver (µg/g)	0.4	E 0.1	0.3	120	29
Thallium (µg/g)	0.3	0.3	0.3	0	0
Tin (µg/g)	E,J 0.3	E,J 0.4	E,J 0.2	-29	40
Uranium (µg/g)	J 1.7	J 1.6	J 1.5	6	13
Zinc (µg/g)	J 70	J 72	J 69	-3	1
Gross Alpha radioactivity (pCi/g)	--	--	--	--	--
Gross Beta radioactivity (pCi/g)	--	--	--	--	--
Plutonium-238 (pCi/g)	--	--	--	--	--
Plutonium-239+240 (pCi/g)	--	--	--	--	--

Table 14. Comparison of chemical and radioactivity data for streambed-sediment and replicate samples collected near Deer Trail, Colorado, 2002-2003.—Continued

[RPD, relative percent difference, which is defined for sample-replicate pairs as [(sample value - replicate value)/((sample value + replicate value)/2)] x 100, and for basin pairs as [(biosolids value - no biosolids value)/((biosolids value + no biosolids value)/2)] x 100; mg/kg, milligrams per kilogram; g/kg, grams per kilogram; µg/g, micrograms per gram ; pCi/g, picocuries per gram; E, estimated because less than reporting level; J, method blank contamination--the associated method blank contains the target constituent at a reportable level; +/-, plus or minus the analytical uncertainty followed in parentheses by the minimum detectable concentration calculated for that sample; <, less than; --, not analyzed; ND, not determined because data were less than the minimum reporting limit]

Property or constituents	Biosolids-applied site 08/05/02 Sample	No-biosolids-applied site 08/05/02 Sample	No-biosolids-applied site 08/05/02 Replicate	RPD between sites	RPD between environmental sample and replicate
Total nitrogen (mg/kg)	1,900	440	1,300	125	-99
Phosphorus (mg/kg)	700	400	30	55	172
Carbon, inorganic (g/kg)	1.9	4.5	4.5	-81	0
Carbon, total (g/kg)	22	11	11	67	0
Carbon, organic (g/kg)	20	6.6	6.8	101	-3
Aluminum (µg/g)	23,000	17,000	20,000	30	-16
Antimony (µg/g)	E 0.02	E 0.01	E 0.01	67	0
Arsenic (µg/g)	6	5	5	18	0
Barium (µg/g)	J 100	J 110	J 110	-10	0
Beryllium (µg/g)	1.1	0.9	1.0	20	-11
Cadmium (µg/g)	0.2	E 0.1	E 0.1	67	0
Chromium (µg/g)	J 23	J 19	J 19	19	0
Cobalt (µg/g)	7.4	6.2	6.2	18	0
Copper (µg/g)	J 15	J 10	J 10	40	0
Lead (µg/g)	J 20	J 14	J 13	35	7
Manganese (µg/g)	J 280	J 200	J 200	33	0
Mercury (µg/g)	E 0.04	E 0.01	E 0.01	120	0
Molybdenum (µg/g)	J 0.3	J 0.3	E,J 0.2	0	40
Nickel (µg/g)	15	13	13	14	0
Selenium (µg/g)	E 0.6	E 0.6	E 0.6	0	0
Silver (µg/g)	J 0.2	E,J 0.1	E,J 0.1	67	0
Thallium (µg/g)	0.3	0.3	0.3	0	0
Tin (µg/g)	< 1.6	< 1.5	< 1.5	ND	0
Uranium (µg/g)	1.9	1.5	1.5	24	0
Zinc (µg/g)	65	48	48	30	0
Gross Alpha radioactivity (pCi/g)	--	--	--	--	--
Gross Beta radioactivity (pCi/g)	--	--	--	--	--
Plutonium-238 (pCi/g)	--	--	--	--	--
Plutonium-239+240 (pCi/g)	--	--	--	--	--

Table 14. Comparison of chemical and radioactivity data for streambed-sediment and replicate samples collected near Deer Trail, Colorado, 2002-2003.—Continued

[RPD, relative percent difference, which is defined for sample-replicate pairs as [(sample value - replicate value)/((sample value + replicate value)/2)] x 100, and for basin pairs as [(biosolids value - no biosolids value)/((biosolids value + no biosolids value)/2)] x 100; mg/kg, milligrams per kilogram; g/kg, grams per kilogram; µg/g, micrograms per gram ; pCi/g, picocuries per gram; E, estimated because less than reporting level; J, method blank contamination--the associated method blank contains the target constituent at a reportable level; +/-, plus or minus the analytical uncertainty followed in parentheses by the minimum detectable concentration calculated for that sample; <, less than; --, not analyzed; ND, not determined because data were less than the minimum reporting limit]

Property or constituents	Biosolids-applied site 06/01/03 Sample	No-biosolids-applied site 06/01/03 Sample	No-biosolids-applied site 06/01/03 Replicate	RPD between sites	RPD between environmental sample and replicate
Total nitrogen (mg/kg)	990	600	610	49	-2
Phosphorus (mg/kg)	J 14	E,J 2.9	E,J 4.9	131	-51
Carbon, inorganic (g/kg)	5.6	7	6.8	-22	3
Carbon, total (g/kg)	15	12	13	22	-8
Carbon, organic (g/kg)	9.1	5	6.1	58	-20
Aluminum (µg/g)	36,000	26,000	41,000	32	-45
Antimony (µg/g)	E,J 0.14	E,J 0.03	E,J 0.07	126	-75
Arsenic (µg/g)	13	8.9	13	37	-37
Barium (µg/g)	200	190	270	5	-35
Beryllium (µg/g)	E 1.1	E 0.79	E 1.7	33	-73
Cadmium (µg/g)	E 0.35	E 0.26	E 0.38	30	-38
Chromium (µg/g)	J 42	J 31	J 45	30	-37
Cobalt (µg/g)	14	10	14	33	-33
Copper (µg/g)	22	16	22	32	-32
Lead (µg/g)	29	18	27	47	-40
Manganese (µg/g)	430	370	520	15	-34
Mercury (µg/g)	E 0.03	< 0.09	< 0.13	ND	ND
Molybdenum (µg/g)	E 0.6	E 0.4	E 0.7	40	-55
Nickel (µg/g)	27	20	28	30	-33
Selenium (µg/g)	E 2	E 1	2	67	-67
Silver (µg/g)	E 0.3	E 0.2	E 0.3	40	-40
Thallium (µg/g)	0.4	0.4	0.5	0	-22
Tin (µg/g)	E 0.6	E 0.2	E 0.4	100	-67
Uranium (µg/g)	3.6	2.3	4.3	44	-61
Zinc (µg/g)	120	79	110	41	-33
Gross Alpha radioactivity (pCi/g)	16.0 +/- 2.3 (2.7)	20.5 +/- 2.8 (3.2)	17.6 +/- 2.5 (2.9)	-25	15
Gross Beta radioactivity (pCi/g)	24.8 +/- 2.9 (4.2)	30.2 +/- 3.4 (3.4)	19.7 +/- 2.5 (4.2)	-20	42
Plutonium-238 (pCi/g)	0.0075 +/- 0.0038 (0.0280)	0.0036 +/- 0.0036 (0.0260)	0.0041 +/- 0.0021 (0.0150)	70	-13
Plutonium-239+240 (pCi/g)	0.0075 +/- 0.0038 (0.0280)	0.0071 +/- 0.0036 (0.0260)	0.0021 +/- 0.0041 (0.0150)	5	112

Table 14. Comparison of chemical and radioactivity data for streambed-sediment and replicate samples collected near Deer Trail, Colorado, 2002-2003.—Continued

[RPD, relative percent difference, which is defined for sample-replicate pairs as [(sample value - replicate value)/((sample value + replicate value)/2)] x 100, and for basin pairs as [(biosolids value - no biosolids value)/((biosolids value + no biosolids value)/2)] x 100; mg/kg, milligrams per kilogram; g/kg, grams per kilogram; µg/g, micrograms per gram ; pCi/g, picocuries per gram; E, estimated because less than reporting level; J, method blank contamination--the associated method blank contains the target constituent at a reportable level; +/-, plus or minus the analytical uncertainty followed in parentheses by the minimum detectable concentration calculated for that sample; <, less than; --, not analyzed; ND, not determined because data were less than the minimum reporting limit]

Property or constituents	Biosolids-applied site 08/08/03 Sample	No-biosolids-applied site 08/08/03 Sample	Biosolids-applied site 08/08/03 Replicate	RPD between sites	RPD between environmental sample and replicate
Total nitrogen (mg/kg)	1,500	530	1,500	96	0
Phosphorus (mg/kg)	J 200	J 520	J 11	-89	179
Carbon, inorganic (g/kg)	8.3	6.6	7.1	23	16
Carbon, total (g/kg)	16	12	17	29	-6
Carbon, organic (g/kg)	7.8	5.4	9.7	36	-22
Aluminum (µg/g)	28,000	22,000	28,000	24	0
Antimony (µg/g)	E,J 0.20	E,J 0.04	E,J 0.08	133	86
Arsenic (µg/g)	7.5	6.7	7.7	11	-3
Barium (µg/g)	150	140	150	7	0
Beryllium (µg/g)	1.0	1.1	1.1	-10	-10
Cadmium (µg/g)	E 0.20	E 0.15	E 0.21	29	-5
Chromium (µg/g)	J 29	J 25	J 29	15	0
Cobalt (µg/g)	9.1	8.0	9.3	13	-2
Copper (µg/g)	J 15	J 13	J 16	14	-6
Lead (µg/g)	J 18	J 15	J 18	18	0
Manganese (µg/g)	J 280	J 250	J 300	11	-7
Mercury (µg/g)	E 0.03	E 0.01	E 0.02	100	40
Molybdenum (µg/g)	E,J 0.4	E,J 0.3	E,J 0.4	29	0
Nickel (µg/g)	17	16	18	6	-6
Selenium (µg/g)	E 0.9	E 0.6	E 0.7	40	25
Silver (µg/g)	E,J 0.2	E,J 0.1	E,J 0.2	67	0
Thallium (µg/g)	E 0.4	E 0.29	E 0.3	32	29
Tin (µg/g)	<8.6	<9.0	<9.0	-5	-5
Uranium (µg/g)	1.6	1.4	1.6	13	0
Zinc (µg/g)	77	65	79	17	-3
Gross Alpha radioactivity (pCi/g)	--	--	--	--	--
Gross Beta radioactivity (pCi/g)	--	--	--	--	--
Plutonium-238 (pCi/g)	--	--	--	--	--
Plutonium-239+240 (pCi/g)	--	--	--	--	--