Prepared in cooperation with Routt County, the Colorado Water Conservation Board, and the City of Steamboat Springs

Assessment of Water Quality in the Upper Yampa River Watershed, Colorado, 1975-2009

By Nancy J. Bauch, Jennifer L. Moore, and Keelin R. Schaffrath

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Conversion Factors, Abbreviations, and Datum

Multiply	By	To obtain
acre	0.4047	hectare (ha)
acre	4,047	square meter (m^2)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
foot (ft)	0.3048	meter (m)
inch per year (in/yr)	25.4	millimeter per year (mm/yr)
square mile (mi^2)	2.590	square kilometer (km^2)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:
$°F=(1.8\times°C)+32$

Vertical coordinate information is referenced to the insert datum name (and abbreviation) here for instance, “North American Vertical Datum of 1988 (NAVD 88).”

Horizontal coordinate information is referenced to the insert datum name (and abbreviation) here for instance, “North American Datum of 1983 (NAD 83).”

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

Water year, as used in this report, refers to the period October 1 through September 30 and is designated by the year in which it ends.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L). A value of 1 mg/L equals I part per million; a value of 1 µg/L equals 1 part per billion.

Additional Abbreviations, Acronyms, and Symbols

AMLE	adjusted maximum likelihood estimation
ANC	acid neutralizing capacity
$CaCO_3$	calcium carbonate
CDOA	Colorado Department of Agriculture
CDPHE	Colorado Department of Public Health and Environment
col/100 mL	colonies per 100 milliliters
DM	Daily Maximum
DWS	domestic water supply
E. coli	*Escherichia coli*
HCO_3^-	bicarbonate
HH	Human Health

MCL	Maximum Contaminant Level
MWAT	Maximum Weekly Average Temperature
NH_3	un-ionized ammonia
NH_4^+	ammonium
NO_{23}	nitrate plus nitrite
ROS	regression of ordered statistics
SMCL	Secondary Maximum Contaminant Level
SRM	Southern Rocky Mountains
STORET	STOrage and RETrieval
TDS	total dissolved solids
TVS	table value standard
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UYRW	Upper Yampa River watershed
<	less than
>	greater than

Assessment of Water Quality in the Upper Yampa River Watershed, Colorado, 1975-2009

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Abstract

Around 2006, stakeholders in the Upper Yampa River watershed (UYRW) in northwestern Colorado expressed a need for a compilation and evaluation of the available historic water-quality data in the watershed to assess effects of growth, identify temporal and spatial gaps within available data, and evaluate data for spatial and temporal trends. The U.S. Geological Survey (USGS), in cooperation with Routt County, the Colorado Water Conservation Board, and the City of Steamboat Springs, initiated a study in late 2008 to compile water-quality data and assess water-quality conditions in the watershed. Water-quality data for selected physical properties and chemical constituents collected from streams, lakes and reservoirs, and groundwater wells for various time periods from 1975 through 2009 are summarized, analyzed for spatial and temporal distribution and temporal trends, and compared to State and Federal water-quality standards and recommendations. The availability and characteristics of macroinvertebrate data for the watershed are discussed. The UYRW includes the Elkhead Creek drainage basin and the Yampa River drainage basin upstream from Elkhead Creek.

Water-quality data were compiled for 211 stream sites located throughout much of the watershed. Data for physical properties, total dissolved solids and major ions, nutrients, trace elements,

coliform bacteria, and suspended sediment collected from 1975 through 2009 were analyzed. A statistically significant downward trend in specific conductance was identified for a site on the Yampa River in Steamboat Springs for 1997–2008. Most values of pH, water temperature, and dissolved oxygen met Colorado Department of Public Health and Environment (CDPHE) water-quality standards. The primary water type in many subbasins in the watershed was a calcium bicarbonate type.

Dissolved nitrite in most stream samples were less than laboratory reporting limits. All sites were in attainment of the CDPHE water-quality standard. Dissolved nitrate concentrations in all samples collected after 1988 but one were less than 1 milligram per liter. All sites were in attainment of the CDPHE drinking-water standard of 10 or 100 milligrams per liter, depending on stream segment. Four samples of unfiltered total ammonia collected at three sites during 1975 or 1976 had concentrations greater than the calculated CDPHE standard. Twelve percent of samples with unfiltered total phosphorus data had concentrations greater than U.S. Environmental Protection Agency recommended levels to control eutrophication in downstream waters. A statistically significant upward trend in unfiltered total phosphorus was identified for a site on the Yampa River in Steamboat Springs for 1997–2008. The rate of change was small, 0.001 milligrams per liter per year. The upward trend may reflect population growth and land-use changes that have occurred upstream from the site.

Two-thirds of the concentration data for many trace elements, including dissolved and total recoverable cadmium, chromium, lead, nickel, and silver, dissolved copper and zinc, and total recoverable mercury were less than laboratory reporting levels. Elevated concentrations were detected for total recoverable iron, aluminum, and manganese, and dissolved iron, manganese, and strontium, particularly for stream samples collected in the Yampa River subbasins downstream from the Elk River. CDPHE water-quality standards were met for many trace elements. However, 29 sites were not in attainment of aquatic-life or water-supply standards for dissolved copper, total recoverable iron, dissolved iron and manganese, and(or) dissolved selenium. Many of the sites were in the Yampa River subbasins downstream from the Elk River.

Coliform bacteria data were available for 432 samples collected from 89 stream sites during 1975–76 and 1998–2009. Concentrations of total and fecal coliform were less than 400 or 200 colonies per 100 milliliters, respectively, in 80 percent or more of the samples collected. Concentrations of *Escherichia coli* in five samples collected from 1994 through 2003 were greater than the CDPHE recreation standard of 126 colonies per 100 milliliters. Exceedances could be due to recreational users of the river and wildlife and livestock.

Water-quality data for Lake Elbert, Long Lake Reservoir, Stagecoach Reservoir, Steamboat Lake, and Elkhead Reservoir were summarized or analyzed for this report for various periods of record. Water in Lake Elbert and Long Lake Reservoir from the mid-1980s through 2008 was very dilute; median values for specific conductance were 11.1 and 19.7 microsiemens per centimeter, respectively. The reservoirs have little capacity to neutralize inputs of acidic water. All dissolved sulfate and nitrate concentrations met CDPHE water-quality standards. CDPHE standards for pH and dissolved iron and manganese were not met for 22 samples; most commonly for pH measured at Lake Elbert. Stagecoach Reservoir and Steamboat Lake were vertically stratified during July 2006. Dissolved-oxygen concentrations less than 1 milligram per liter at depth indicated anoxic conditions. Measurements of physical properties in Elkhead Reservoir from July 1995 through August 2001 indicated that the reservoir was stratified during summer and late winter and mixed during spring and fall. Some measurements of dissolved oxygen showed anoxic conditions could be present during stratification. The reservoir trophic status ranged from oligotrophic to eutrophic; phosphorus was the limiting nutrient in more samples (52 percent) than nitrogen (9 percent of samples).

A total of 817 water-quality samples collected from 328 wells in 12 aquifers and one unknown aquifer from 1975 through 1989 and 1998 were analyzed for physical properties, total dissolved solids and major ions, nutrients, and trace elements. The sampled wells were concentrated in the middle two-thirds of the watershed west from the mountains. More samples of groundwater were collected from the unknown aquifer and Mesaverde Group and terrace alluvial aquifers than other aquifers.

Specific conductance as higher in sedimentary rocks aquifers with a marine origin than a nonmarine origin. Most values of pH were within the Colorado Department of Public Health and Environment water-quality standard for groundwater. No one cation was dominant in the watershed. Water type for anions was bicarbonate or bicarbonate and sulfate. About one-half of the samples had dissolved sulfate concentrations that were greater than the Colorado Department of Public Health and Environment standard. Exceedances were most common for samples from wells in the terrace alluvium, Mesaverde Group, and unknown aquifer.

All dissolved nitrite concentrations in groundwater samples were low, well below the Colorado Department of Public Health and Environment standards for drinking water and livestock watering. Median concentrations of dissolved nitrate pus nitrite in sample from all geologic units and the unknown aquifer were 1.5 milligrams per liter or less. The Colorado Department of Public Health and Environment standard was exceeded in around 4 percent of samples collected, primarily from wells in the Yampa coal field. Dissolved and unfiltered total phosphorus concentrations were low; 95 percent were less than 0.1 milligram per liter.

Concentrations of many trace elements in groundwater samples were low; more than 80 percent of the samples collected for dissolved antimony, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, and silver had concentrations less than laboratory reporting levels. The highest concentrations were detected in samples for dissolved aluminum and boron, dissolved and total recoverable iron, and dissolved manganese, strontium, and zinc. Colorado Department of Public Health and Environment water-quality standards were met or rarely exceeded for dissolved antimony, arsenic, beryllium, cadmium, chromium, copper, lead, molybdenum, nickel, and silver. Dissolved iron concentrations were elevated in some samples collected from aquifers in valley-fill deposits, Mancos Shale, Mesaverde Group floodplain alluvial aquifers, and the unknown aquifer. Concentrations in 10 percent of samples did not meet the Colorado Department of Public Health and Environment standard. Median concentrations of dissolved manganese for samples collected from the terrace alluvium, Mesaverde Group, and unknown aquifer were greater than the Colorado Department of Public Health and Environment standard, as were individual samples collected from the Upper Cretaceous series, valley-fill deposits, and Precambrian Erathem. In total, more than one-half of the dissolved manganese samples did not meet the standard. Exceedances of dissolved iron and manganese standards were most common in samples collected from wells in the Yampa coal field. Most dissolved selenium concentrations were less than laboratory reporting levels. Dissolved strontium samples only were collected from the unknown aquifer. Concentrations greater than 1,000 micrograms per liter were typical of samples collected from well in the Yampa coal field. Just over one-quarter of the concentrations of dissolved zinc was less than laboratory reporting levels. The Colorado Department of Public Health and Environment water-quality standard for zinc was not exceeded.

Macroinvertebrate community and population data were available for 66 stream sites in the UYRW for various periods of time between 1975 and 2008. A summary of results from one study of Yampa River sites in Steamboat Springs indicated that changes observed in community characteristics between 2004 and 2008 may be due to natural variation rather than human activities.

Synthesis of water-quality data indicates that the values and concentrations of many physical properties and constituents in stream water samples for the Upper Yampa River watershed were dependant on the geology of the drainage basin of a stream. Many values and concentrations reflected natural conditions. Higher water temperature in the Yampa River in Steamboat Springs and higher total phosphorus concentrations in many streams may result from human activities that include hydrologic and channel modifications and urban and agricultural runoff. Values and concentrations of physical properties and constituents in well-water samples of groundwater were dependant on the depositional environment of the geologic material in the aquifer and various geochemical processes. Higher values and concentrations of many physical properties and constituents in samples from wells in the Yampa coal field were reflected in higher value and concentrations in streams in subbasins of the watershed that included the Yampa coal field.

Introduction

The Yampa River, the largest primarily unregulated tributary to the Colorado River in the Upper Colorado River basin, is a highly valued resource known for its biological diversity, largely unaltered natural condition, and generally high water quality. The Upper Yampa River watershed (UYPW, defined in this report as the Elkhead Creek drainage basin and the Yampa River drainage basin upstream from Elkhead Creek; fig. 1) is undergoing increased land and water development to support growing municipal demands, recreational tourism, and second-home development which presents new, modern-day water-quality challenges. Stakeholders in the UYRW that rely on and manage the water resources of the watershed are interested in the assessment of water quantity and water quality to aid in the preservation and management of the UYRW. A watershed plan for the Yampa River basin was developed in 2002 for the Colorado Department of Public Health and Environment (CDPHE) and the Yampa River Basin Partnership (Montgomery Watson Harza, 2002). The main goals of the plan were to address water quality concerns and provide for the maintenance of high quality water in the Yampa Basin. In 2008, local and state stakeholders including Routt County, the Colorado Water Conservation

Board and the City of Steamboat Springs expressed a need for a compilation and evaluation of the available historic water-quality data in the UYRW, assessing effects of growth and associated land-use change, indentifying temporal and spatial gaps within available data, and evaluating spatial and temporal trends. In 2009 the U.S. Geological Survey (USGS), in cooperation with Routt County, the Colorado Water Conservation Board, and the City of Steamboat Springs, initiated a study to compile water-quality data and assess water-quality conditions in the UYRW. Specific objective of the study were to:

- Develop and maintain a web-accessible water-quality database that provides agencies, researchers, consultants, and interested stakeholders equal access to historic and current water-resources information,
- Evaluate available water-resources data for uniformity and ability to meet the needs of water and land resource managers and decision makers as well as the public and other stakeholders, perform and publish an assessment of water-resource conditions,
- Design and implement regional monitoring strategies to effectively fill identified data gaps by reducing duplication of effort while still meeting a broad base of data collection objectives, and
- Upon implementation of the monitoring program, periodically assess the new data to update what is known about factors affecting water-resource conditions.

Figure 1. Location of the Upper Yampa River watershed, Colorado

Purpose and Scope

This report presents a summary and analysis of water-quality data collected by Federal, State, and local agencies in the UYRW from 1975 through 2009. Data provided in an electronic format were compiled into a web-accessible USGS water-quality database for the UYRW (available at *http://rmgsc.cr.usgs.gov/cwqdr/Yampa/index.shtml*). Water-quality data (physical properties, discharge, dissolved solids, major ions, nutrients, trace elements and uranium, coliform bacteria, and suspended sediment) for streams, lakes, and reservoirs, and groundwater wells were retrieved from this database for analysis in this report. Selected water-quality properties and chemical constituents in the watershed were analyzed to (1) characterize the water quality in the study area, (2) identify spatial and seasonal variability, (3) provide comparisons to Federal and State standards, and (4) identify trends and temporal changes. Macroinvertebrate populations and distributions also are discussed.

Study Area

The UYRW drains approximately 1,800 square miles of the Yampa River watershed west of the Continental Divide in northwestern Colorado (fig. 1) (U.S. Geological Survey, 2010). The boundaries of the watershed extend from the Williams Fork and Flat Top Mountains in the southwestern and southern portions of the watershed, respectively, to the Gore and Park Ranges and the Continental Divide to the east and to the Elk River and Elkhead Creek drainages to the north and west, respectively. Altitudes in the watershed range from over 12,000 feet (ft) in the Flat Top Mountains and Park Range to 6,400 ft near the confluence of the Yampa River with Elkhead Creek west of the town of Hayden. The UYRW is almost entirely contained within Routt County, with small portions in Grand, Garfield, Moffat and Rio Blanco counties.

Human activity in the UYRW began as long as 1,000 years ago when the Native Americans used the Yampa River valley for summer hunting (*http://yampavalley.info/centers/history_%2526_genealogy*, accessed October 2010). Trappers came to the valley around 1820; development of the valley was sparked with the 1861 discovery of gold at Hahn’s Peak in the northern Elk River basin. The vast coal resources in the region and the potential of grazing lands were noted by Ferdinand Hayden during a 1874 survey across northwestern Colorado

(Mehls and Mehls, 1991). Initially, coal was mined for local use; larger-scale production began in 1909 with improved transportation to and from Steamboat Springs. For the greater part of the past century, ranching, including hay and wheat production, and mining were the economic bases of the valley. More recently, recreational-based tourism (skiing, fishing, hunting, rafting, camping, and the like) and second-home development began to play an important economic role. These accounted for approximately 45 percent of the total jobs in the Routt County during 2008 (State Demography Office, 2010a). The Steamboat Springs Ski Resort attracts skiers from around the world. During the 2008-2009 ski season, the number of skier days (skier day is one individual visiting a ski area for skiing or snowboarding for any part of one day) at Steamboat Ski resort was 959,603 (C. Bannister, Colorado Ski Country USA, oral commun., 2010). Agriculture and coal mining each accounted for only about 2.5 percent of the total jobs during 2008.

The population of Routt County during 2008 was estimated at 23,738 (State Demography Office, 2010b). The largest township was Steamboat Springs (11,939), followed by Hayden (1,894) (estimated populations for 2008). About 35 percent of the population in the county lived in unincorporated areas. From 2000 through 2008, the population of Routt County grew by more than 18 percent and was largely driven by recreation-related tourism.

The dominant land cover in the UYRW is forest land, which accounts for about 57 percent of the total land area (fig. 2) (LaMotte, 2008). Other prominent land covers are shrub/scrub land (about 26 percent) and grassland/pasture (about 13 percent). Barren land, developed land and open space, cultivated crops, water, and wetlands are about 4 percent of the land cover. Approximately 49 percent of the land in Routt County is publically owned (Montgomery Watson Harza, 2002). This includes three national forests (Arapaho, Routt, and White River), Bureau of Land Management lands, and lands held by agencies of the State of Colorado (State Land Board, Division of Wildlife, and State Parks).

Vegetation is diverse throughout the watershed. The higher alpine elevations are predominately evergreen and aspen forest while areas around Steamboat Springs are subalpine and generally have Douglas fir, ponderosa pine, aspen, and juniper oak. Areas south from Steamboat Springs, around the Town of Yampa, in the lower Elk River valley, and the lower Yampa River valley are semiarid with shrubs, grassland, and rangeland and are grazed.

Figure 2. Land cover in the Upper Yampa River watershed, Colorado, 2001.

Variation of temperature and precipitation in the UYRW is typical of that found in mountainous and semi-arid regions of Colorado. Annual temperatures in the towns of Steamboat Springs and Hayden range from average minimum temperature of 0.9 and 4.7° Fahrenheit (F), respectively, during January to an average maximum temperature of 82.6 and 85.6°F, respectively, during July (High Plains Regional Climate Center, 2010). Almost 24 inches per year (in/yr) of precipitation fall on average in Steamboat Springs and 17 in/yr fall in Hayden. Much of the precipitation falls as snow throughout the winter months and melts during spring. Snowfall averages 166 in/yr in Steamboat Springs and 107 in/yr in Hayden. Steamboat Springs has an average growing season of 59 days; the growing season at Hayden is approximately 84 days (*http://yampavalley.info.com*, accessed October 2010).

Hydrology and Water Resources

The Yampa River originates in the Flat Top Mountains as the Bear River and flows northward through the Town of Yampa and becomes the Yampa River northeast of the town when Chimney Creek converges with the Bear River (fig. 1). Major tributaries to the Yampa River include Oak Creek, flowing from the southwest upstream from Steamboat Springs, the Elk River, flowing from the north downstream from Steamboat Springs, and Elkhead Creek, flowing from the north downstream from Hayden. Minor tributaries include Fish Creek east of Steamboat Springs, Fish Creek southwest of

Steamboat Springs, Trout Creek, Foidel Creek, and Sage Creek. Streams in the Mount Zirkel, Flat Tops, and Sarvis Creek Wilderness Areas have been classified as outstanding waters by the CDPHE (Colorado Department of Public Health and Environment, 2009aa, 2010c).

The USGS and the Colorado Division of Water Resources operate 13 active (water year 2010) streamflow-gaging stations in the UYRW (fig. 3, table 1). Streamflow measurements began on October 1, 1904, at two sites; measurements have been collected during different periods of record at the 13 sites since 1904. Real-time streamflow data for the USGS stations are available at *http://co.water.usgs.gov/infodata/surfacewater.html*. Real-time data for the Colorado Division of Water Resources stations are available at *http://www.dwr.state.co.us/SurfaceWater/data/division.aspx?div=6*. Historically, the USGS collected streamflow measurements at 36 additional stations for various periods of record between 1913 and 2008. Streamflow in the UYRW is dominated by snowmelt, with increasing flows in April, highest flows in May and June, and decreasing flows in July. Low streamflow at other times of the year is dominated by base flow from groundwater discharge. Mean monthly streamflow for 2005–2008 for two sites on the Yampa River and one site on Elk Creek shows this seasonal pattern to streamflow in the watershed (fig. 4). Mean monthly streamflow was lowest for Yampa River at Steamboat Springs (site 153) and highest at Yampa River above Elkhead Creek (site 145). Low streamflow during August at Yampa River at Steamboat Springs (site 153) can be of concern because of the possible effects of low streamflow on fish (higher water temperature and lower dissolved oxygen and on river rafting.

Figure 3. Location of selected stream sites and active (water year 2010) streamflow-gaging stations, Upper Yampa River watershed, Colorado

Figure 4. Mean monthly discharge for 2005-08 for selected streamflow-gaging stations, Upper Yampa River watershed, Colorado

Table 1. Active streamflow-gaging stations in the Upper Yampa River watershed, Colorado, water year 2010

Development of water resources in the UYRB has focused on irrigation, municipal and industrial diversions, and State-sponsored reservoir development (Colorado Water Conservation Board, 2009). Irrigation has changed little since the late 1800s. There only have been small increases in the amount of acreage irrigated with the construction of new ditches and storage systems. The first significant municipal water system in the UYRW was developed during the 1950s at Steamboat Springs. The City of Steamboat Springs and the Mt. Werner Water and Sanitation District divert the majority of their municipal water supplies directly from Fish Creek east of Steamboat Springs, generally through July, and supplement this flow after July with water released from Fish Creek Reservoir (Colorado Water Conservation Board, 2009). The two entities can also withdraw water from alluvial wells adjacent to the Yampa River. The wells, however, are not a preferred source of municipal water because of the lesser quality of the water compared to the surface water supplies. The primary water source for the Towns of Hayden and Oak Creek is surface water. Groundwater is the primary water source for the Towns of Phippsburg and Yampa and part of the water supply for Hayden (Topper and others, 2003; U.S. Environmental Protection Agency, 2010b).

Six surface-water diversions in the UYPW are used for transbasin and local movement of water for irrigation and industrial purposes. Two small ditches (maximum water right of 43 cubic feet per second, ft^3/s) divert water across the UYRW boundary into the Colorado River basin or the Muddy Creek basin (Colorado Water Conservation Board, 2009). One of these ditches and three other ditches are used to divert water locally in the UYRW from one drainage basin to another for irrigation. A diversion ditch for the Hayden Station power generation facility transports water from the Yampa River to the facility for industrial purposes; the diversion typically ranges from 6 to 10 ft^3/s (Colorado Water Conservation Board, 2009). The Steamboat Springs Ski Area diverts water from an alluvial well near the Yampa River just upstream from Steamboat Springs for making artificial snow (Colorado Water Conservation Board, 2009). During the primary snowmaking diversion months of October through January, the diversions represent 100 percent depletion to the Yampa River streamflows. A portion of the artificial snowpack is consumptively used during the winter and spring months; the remaining portion returns to the stream during spring snowmelt. Concerns about the water supply in the watershed are growing with the possibility of future large-scale diversions and increased water demands.

Eight reservoir and storage facilities in the UYRW can each store 4,000 acre-feet of water or more (table 2). The water is used for irrigation, recreation, and municipal and industrial purposes. The largest reservoirs are Stagecoach Reservoir, Steamboat Lake, and Elkhead Creek Reservoir. Because reservoirs in the watershed are small compared to other reservoirs in the Upper Colorado River basin and primarily located in the headwaters of the Yampa River, streamflow in the Yampa River is largely free-flowing with a natural hydrograph.

Table 2. Reservoir and water-storage facilities in the Upper Yampa River watershed, Colorado, with active storage capacity of 4,000 acre-feet or more

Geology

The UYRW is underlain by rocks of Precambrian age to unconsolidated Quaternary alluvium (fig. 5). The oldest rocks are in the eastern one-third (western side of Gore and Parks Ranges) of the watershed. These mountainous areas are underlain by igneous (granite and gabbro, mafic diorite, and monzonite) and metamorphic (gneiss, schist, and migmatite) rocks. Permian- and Triassic-age sedimentary (sandstone, shale, siltstone) occupy a small portion of the area north from Steamboat

Springs. The western two-thirds of the watershed are underlain by sedimentary rocks of Cretaceous age and sedimentary and igneous rocks of Tertiary age. Dominant rock types of Cretaceous-age include sandstones and shale, and major coals beds comprising the Yampa coal field (fig. 1). Tertiary-age rocks include sandstones and shales. Broad valleys and small rounded hills form in areas with less resistant shales and landscapes of ridges and mesas form in areas with more resistant sandstones. The Tertiary-age basalts and intrusive and volcanic rocks form the Flat Top Mountains in the southern portion of the watershed and the area north from Steamboat Lake. The youngest formations include the unconsolidated surficial deposits and rocks of Quaternary age, including landslide deposits, glacial drift, gravels, and alluvium. Landslide deposits are most common in the Flat Tops Mountains. Glacial drift, primarily from Pinedale and Bull Lake Glaciations, occurs on the western side of the Gore and Park Ranges. The youngest gravels and alluvium primarily are located along the Yampa and Elk River drainages.

Figure 5. Geology of the Upper Yampa River watershed, Colorado

Sedimentary rocks of Cretaceous and Tertiary age are highly soluble and the resulting weathered material contains a large amount of soluble minerals (dissolved solids) and trace elements including arsenic, beryllium, boron, cobalt, manganese, nickel, and selenium (Affolter, 2000). Formations that are seleniferous include the Laramie Formation, Lewis Shale, Williams Fork Formation, Iles Formation, and Mancos Shale (Butler and others, 1996; Colorado Water Quality Control Commission, 2010; Stephens and Waddell, 1998). Major coal deposits in the Yampa coal field occur in the Upper Cretaceous-age Iles and Williams Fork Formations of the Mesaverde Group. (Johnson and others, 2000). In the eastern part of the coal field, the principal coal beds in the middle coal group of the Williams Fork Formation are, in ascending order, the Wolf Creek , Wadge, and Lennox (Bass and others, 1955). The coal deposits were formed in alternating mixed marine and nonmarine environments at the western edge of the Late Cretaceous Western Interior Seaway. Most sulfur in the deposits is in the form of organic sulfur rather than pyritic sulfur and sulfate sulfur (Affolter, 2000). High contents of strontium, barium, and phosphorus are found in the Iles Formation compared to other Cretaceous-age coals in the Colorado Plateau (Arizona, Colorado, New Mexico, and Utah) (Affolter, 2000). Similarly, high contents of arsenic and manganese are found in the Lennox and Wolf Creek coal beds of the Williams Fork Formation. Currently (2010), three underground coal mines are operational in the Yampa coal field south from the Yampa River (fig. 1).

More than 150 hot springs are located in the Steamboat Springs area (Frazier, 2000). Thermal waters for the springs probably are meteoric water that has been heated at depths of 12,000 to 15,000 ft (Lund, 2006). Heated water most likely rises to the surface from a network of faults and fractures that cross the region. Chemical constituents in the springs include sodium, chlorides, sulfates, bicarbonate, and lithium.

Methods of Data Review and Analysis

Methods of data review and analysis of water-quality data for the UYRW included retrieving all water-quality data from the electronic UYRW water-quality database, subsetting the data, performing quality assurance checks, summarizing the data statistically in tables and spatially in figures, analyzing and interpreting analytical data to determine water-quality conditions and characteristics, conducting temporal trend analysis, and comparing data to State of Colorado and Federal water-quality standards and recommendations. The following discussion describes methods used to process, evaluate, and interpret water-quality data for the UYRW.

Data Sources

The dataset used in this study consists of data for the UYRW collected and reported by the U.S. Environmental Protection Agency (USEPA); U.S. Forest Service, USGS, Colorado Department of Agriculture (CDOA), Colorado Department of Public Health and Environment (CDPHE), Colorado Division of Wildlife Riverwatch Program, and the City of Steamboat Springs (data collected by GEI Consultants, Inc.). Data were obtained in an electronic format from the USGS National Water Information System, USEPA STOrage and RETrieval (STORET) Data Warehouse, and GEI Consultants, Inc., and were merged to form the UYRW water-quality database. The database contains water-quality properties and constituents for surface-water (streams, canals, diversions, and lakes and reservoirs), groundwater (wells, springs, and seeps), mining (tunnel, shaft, or mine), and wastewater treatment plants, including effluent, for samples collected for various periods of time for 1901 and 1944 through 2009. Stream data includes population/community data for macroinvertebrates. The data analysis presented in this report is focused on selected physical properties and chemical constituents for stream, lake and reservoir, and groundwater sampling sites for data collected from 1975 through 2009 (table 3). The availability and characteristics of macroinvertebrate data for the watershed are discussed. Instantaneous discharge, daily mean discharge, and stream stage data were compiled for several USGS water-quality stations.

Table 3. Number of sites, period of water-quality record, and number of samples collected at selected site types in the Upper Yampa River watershed, Colorado, for various sources of water-quality data, 1975 through 2009.

Data Quality Assurance

A number of quality-assurance procedures were applied to the water-quality data prior to analysis. The USEPA has established low and high values for 190 common water-quality parameters and properties as an edit-checking procedure for data entered into STORET since November 1993 (National Park Service, 2001). Low and high values for 63 parameters were used for edit-checking of water-quality data for the UYRW (Appendix 1). Using the edit-checking procedures, only a temperature value of –17.8 degrees Celsius (°C) and a dissolved-oxygen concentration of 779 milligrams per liter (mg/L) were deleted. Trace-element data greater than the high values were not deleted. Trace-element data can occur in very high concentrations in areas with historical mining activities or in areas with naturally high mineralization because of geology. For a given sample with filtered- and unfiltered-concentration data for an individual sample, the filtered concentration was checked against the unfiltered concentration. If the filtered concentration was greater than the unfiltered concentration by more than 10 percent, both data values would be deleted. All dissolved and unfiltered data for the UYRW met this edit-check procedure. An ion charge balance was calculated for individual samples with sufficient data (hydrogen ion, calcium, magnesium, sodium, potassium, alkalinity, chloride, and sulfate concentrations) to calculate the balance. All charge balances were within 10 percent, and no data were deleted. Twelve measurements of instantaneous discharge with a value of 0 were deleted. For stream samples, concentration data for 511 individual analyses with a value of 0 were converted to the lowest censored value for the particular constituent of interest. These primarily were for trace elements (491 of 511 analyses) but also included dissolved chloride, fluoride, nitrite and nitrate, total ammonia, and dissolved uranium. The total count for this type of conversion for groundwater samples was 436 individual analyses, primarily for dissolved selenium and orthophosphate and trace elements (422 of 436 analyses) but also for dissolved magnesium, nitrate plus nitrite, and total phosphorus. A total of 801 analyzes for stream-water samples and 620 analyzes for groundwater samples with a data remark code of M (presence of constituent verified but not quantified) were excluded from analysis of data for this report.

For a large portion of the data, limited metadata and(or) quality-assurance data were available. Therefore, it is possible that some data may contain errors that were not detected during the quality-assurance review. Assumptions regarding water-quality collection methods and laboratory-analytical techniques used on data from different data sources were made based on available information. No distinctions between water-quality data collection methods and laboratory analytical techniques were made when metadata were unavailable to support these distinctions. Disparities between data from different sources resulting from differences in water-quality collection methods and laboratory-analytical techniques may affect the precision and accuracy of the statistical results. Although the effect of methodological differences could not be quantified in this analysis, robust statistical methods were used to limit the influence of outliers on statistical results of the analysis. It has been documented for USGS trace-element data that dissolved concentrations of arsenic, boron, beryllium, cadmium, chromium, copper, lead, mercury, and zinc collected before 1992 may have been contaminated during sample collection and field processing ((USGS Office of Water Quality Technical Memorandum 91.10, available at *http://water.usgs.gov/admin/memo/QW/index.html*, accessed September 2010). An in-depth review of these data could not be conducted because field quality-assurance data was not available for analysis.

Data Compilation and Comparison

Data for physical properties and chemical constituents were compiled from the various sources, each with differing laboratory methods and sampling and reporting conventions. For many physical properties and chemical constituents, data were available for one or more parameter codes for the same property or constituent. Equivalent parameter codes for different physical properties and chemical constituent groups were combined for data analysis using the data aggregation methods summarized in table 4. Measurement or concentration data for the first parameter code listed in the table for each constituent were preferred for analysis. If these data were not available, data for the second parameter code listed were used. This aggregation continued for each parameter code in a constituent's group, resulting in a single constituent name with one reporting convention. All of the aggregated nitrate data, for example, is in the form of nitrate as nitrogen instead of nitrate as nitrogen and nitrate as nitrate. Procedures used to aggregate nutrient data follow those used by Mueller and others (1995).

Table 4. Summary of procedures used to aggregate data for select physical properties, discharge, total dissolved solids, major ions, nutrients, trace elements, and coliform bacteria, Upper Yampa River watershed, Colorado.

In natural waters, nitrogen as ammonia can be in the form of aqueous ammonia (un-ionized ammonia, NH_3) or ammonium (NH_4^+). At pH 9.24, the transformation of un-ionized ammonia to ammonium ions is half complete. In most natural waters (pH less than 9.24), nitrogen as ammonia would be in the ammonium form (Hem, 1992). For the USGS and other Federal and State agencies, the sum of un-ionized ammonia concentrations and ammonium ions is reported as “ammonia” or “total ammonia.” In this report, the sum is reported as “total ammonia.”

Censored Values

Computing summary statistics for the water-quality data presented in this report was complicated by the presence of multiple detection or reporting levels for censored data for many chemical constituents. Censored data are data reported as “less-than” a particular laboratory detection level or reporting level. When water-quality results were reported with censored (below laboratory detection or reporting level) values, estimates of percentile values, including the 50th percentile or median, were calculated using the Kaplan-Meier, adjusted maximum likelihood estimation (AMLE), or regression of ordered statistics (ROS) methods following the recommendations of Helsel (2005). The

Kaplan-Meier method was used when less than 50 percent of the data were censored values. When censoring percentages were 50 to 80 percent, the ROS method was used when there were fewer than 50 samples and 50 or more samples when the distribution of data was not normal. For data with 50 or more samples and a normal distribution, the AMLE method was used. When 80 percent or more of the data were censored values, the median value was not computed and only the minimum and maximum values are reported in summary tables.

Water-Quality Standards

In-stream water-quality standards for surface water in the State of Colorado have been established by the CDPHE to protect the beneficial uses of surface water (Colorado Department of Public Health and Environment, 2009a, 2010c). Standards discussed in this report are for protection of cold- and warm-water aquatic life, domestic water supply, and recreational uses. The CDPHE standards are applied on a statewide basis to stream segments and water bodies based on water-use classification (Appendix 2) (Colorado Department of Public Health and Environment, 2009a, 2010c). Stream segments are generally delineated at points of the stream that separate reaches with significant differences in use classification or changes in water quality. Because of this, water-quality standards can vary between stream segments for different streams and can vary for different segments on the same stream. Standards for some segments are not as restrictive as those for other segment because the standard for the current classification is not being attained due to factors such as natural or human-caused conditions, streamflow conditions, and hydrologic modifications (Colorado Department of Public Health and Environment, 2009a). Determination of exceedance of a standard for a site is based on the 15th and 85th percentile of the data for pH, the 15th percentile of the data for dissolved oxygen, the 85th percentile of data for dissolved constituents, and the 50th percentile of the data for total recoverable constituent (Water Quality Control Division, 2004) for samples with more than two data points. Determination of attainment of the water temperature standard is based average and maximum concentrations for sites with continuous (15-minute interval) measurements As required under Section 303(d) of the federal Clean Water Act, the CDPHE has established the 303(d) list of impaired waters (“Water-Quality-Limited Segments Requiring Total Maximum Daily Loads”) and the Colorado Monitoring and Evaluation List (table 5) (Colorado Department of Public Health and Environment, 2010b). For this report, the authors assigned a stream segment to each stream site based on the segment descriptions in the water-quality standards table for the Upper Colorado River basin (Colorado Department of Public Health and Environment, 2010c).

Table 5. Colorado Department of Public Health and Environment section 303(d) list of impaired waters and monitoring and evaluation list for the Upper Yampa River watershed, 2010.

Two types of numeric water-quality standards, fixed values, and table values standards (TVS), have been established by the CDPHE. Fixed value standards have been established for pH, dissolved oxygen, water temperature, un-ionized ammonia, chloride, sulfate, nitrite, nitrate, dissolved and total recoverable arsenic, total recoverable iron, total mercury, and *Escherichia coli* (*E. coli*) and are based on 30-day average values or concentrations. Table value standards are calculated values based on published formulas; this type of standard has been established for water temperature and selected metals (described in this report as trace elements). There are two classifications of TVS—acute and chronic. An acute standard is a value that is not to be exceeded by a concentration for either a single sample or is calculated as an average of all samples collected during a one-day period. A chronic standard is a value not to be exceeded by a concentration for either a single representative sample or calculated as an average of all samples collected during a 30-day period. Water-quality standards have not been established for all physical properties and chemical constituents.

The water-quality standard for pH is an instantaneous minimum (6.5) and maximum (9.0) for all stream segments. The dissolved-oxygen standards for the UYRW are segment specific and are derived as one-day minima. For most stream segments, two dissolved oxygen standards have been established. The less-restrictive standard of 7.0 mg/L is for fish during their spawning season to ensure that the thermal and oxygen requirements for successful migration, spawning, egg incubation, fry rearing, and other reproductive functions are met. The more-restrictive standard of 6.0 mg/L applies to months not related to spawning.

Water temperature standards for the UYRW are based on segment-specific cold- or warm-water aquatic life classifications for biota ("cold stream temperature tier one" ("CS-I"), "cold stream temperature tier two" ("CS-II"), "warm stream temperature tier one " ("WS-I"), and "warm stream temperature tier two" ("WS-II")). Standard are similar for each tier of the cold- or warm-water classification. Water temperature standards are applied to individual segments based on temperature data, fish species, and other available evidence (Colorado Department of Public Health and Environment, 2009a); standards are different depending on seasonal designations as determined by monthly time periods. Two types of temperature criteria were established: the Daily Maximum (DM) and the Maximum Weekly Average Temperature (MWAT). The DM is the highest two-hour average water temperature recorded during a given 24-hour period and is applied as the acute standard. The MWAT is the maximum average of multiple, equally space, daily temperatures over seven consecutive days with a minimum of three data points spaced equally through the day, and is calculated from the optimum and upper temperatures tolerated by a species (Colorado Department of Public Health and Environment, 2009a). For cold-water streams in the UYRW, the temperature standards that are applied will be those for sensitive species (cutthroat trout, brook trout).

The CDPHE water-quality standard for total dissolved solids is a secondary standard (Secondary Maximum Contaminant Level, SMCL) for drinking water of 500 mg/L (Colorado Department of Public Health and Environment, 2010a). A secondary standard is a nonenforceable guideline for contaminants that may have cosmetic (skin or tooth discoloration), esthetic (such as taste, odor, and color), or technical (corrosion and staining) effects. The secondary standard for total dissolved solids will be applied to stream segments that have a standard for chloride and sulfate. The chloride standard has been adopted for most stream segments. The domestic water-supply standard of 250 mg/L for sulfate will be applied to all stream segments that have a water-supply classification. For most stream segments, the aquatic-life standard for selenium applies to dissolved selenium. For three segments, the standard is for total recoverable selenium.

Acute and chronic aquatic-life water-quality standards for total ammonia vary depending on fish species, pH, and water temperature. The aquatic-life standard for nitrite applies to all stream segments. The water-quality standard for nitrate is a Maximum Contaminant Level (MCL) that varies in the UYRW depending on stream segment. The MCL is a legally enforceable standard that applies to drinking water from public water systems. For stream and lakes or reservoirs in the UYRW that are not drinking-water supplies, the MCL is used as a guideline for interpreting water quality. The CDPHE has not established a water-quality standard for total phosphorous. However, the USEPA has recommended that total phosphorous concentrations be less than 0.1 mg/L for streams that do not flow directly into lakes and reservoirs and less than 0.05 mg/L for streams that do flow directly into lakes and reservoirs to control eutrophication of the water bodies (U.S. Environmental Protection Agency, 2000). Total phosphorus data for the UYRW are compared to the USEPA recommended concentrations to provide an environmentally relevant context to concentrations of total phosphorus in steams. Streams used in the comparison are those with standards for other nutrients.

Water-quality standards for trace elements have been established for the protection of aquatic life; standards for many trace elements vary depending on hardness. Hardness-dependent TVS were developed throughout a majority of the watershed for dissolved cadmium, chromium, copper, lead, manganese, nickel, selenium, silver, and zinc. These TVSs were calculated using the mean of available hardness data. If these hardness data were not available, the median hardness value for the site, other sites on the same stream, or nearby streams was used. A majority of the stream segments have fixed numeric standards for dissolved and total recoverable arsenic and iron and total mercury. Most standards for stream segments 4, 11, and 12 are based on total recoverable concentrations rather than dissolved concentrations. For some trace-element data, concentrations were censored at a level greater than the TVS or numeric standard. For these data, it is not possible to determine if a concentration is less than or greater than the standard. These data have been excluded from discuss of exceedences of trace-element standards.

Water-quality standards for *E. coli* are based on recreational use of a stream segment and vary depending on contact use. Standards for *E. coli* are established as indicators of the potential presence of pathogenic organisms. Attainment of the *E. coli* standards are based on the geometric mean of representative stream samples. For this report, an insufficient number of *E. coli* samples was collected to calculate geometric means for comparison to the standards for regulatory purposes. Comparison of *E. coli* data to the standards is a general indication of water quality in streams where the bacteria are present.

Water-quality standards for groundwater in the State of Colorado have been established by the CDPHE to protect the beneficial uses of groundwater (Colorado Department of Public Health and Environment, 2009b), including domestic and agricultural use, surface water-quality protection, and potentially usable and limited use. Water quality data for groundwater in the UYRW will be compared to standards for domestic use and agricultural use for livestock watering. Domestic-use standards include MCLs, SMCLs, and human-health (HH) standards. HH standards have been established to protect the public from acute and long-term chronic effects (Colorado Department of Public Health and Environment, 2009b). Comparison of water-quality data to standards is used as a guideline for interpreting water quality and not for legally0enforceable purposes.

Temporal Trend Analysis

Trend analyses were performed in the TIBCO Spotfire S+® program using the USGS library package ESTREND (Schertz and others, 1991). Analyses were conducted on selected physical properties and constituents for stream sites having at least 10 years of quarterly data with a period of record ending after 2000 and having less than 10 percent censored data. Selected physical properties and constituents were analyzed using the seasonal Kendall test (Hirsch and others, 1982; Helsel and Hirsch, 2002). The seasonal Kendall test, a nonparametric rank-based procedure, was used to analyze water-quality data for monotonic changes in concentrations with time. Seasonality in water-quality data are accounted for by comparing data for different seasons, for example, January–March data are compared only with January–March, April–June with April–June, and so forth. Because of the strong correlation that exists between many water-quality parameters and streamflow, most water-quality data were flow-adjusted prior to testing for trends using streamflow measured at the time of sample collection. Flow adjustment removes that variability in concentration that is related to natural changes in streamflow, allowing for trends caused by others means such as anthropogenic-influenced effects to be more readily identified. When flow-adjustment was applied to the data, the data were regressed against streamflow, and the residuals of the resulting equation were used in the seasonal Kendall test. For water-quality data except pH, the best flow-adjustment most often is to regress the log-transformed constituent data against log-transformed streamflow (D. Mueller, oral comm., 2010). A trend was determined to be present when the p-value of the statistical test was less than 0.05. The smaller the p-value, the stronger the evidence is to reject the null hypothesis that there is no relation between concentration and time, that no trend exists (Helsel and Hirsch, 2002). A trend in an upward direction was identified when a constituent concentration increased more often over time than it decreased. The estimated trend in percent per year is reported from the model calculations. The trend slope is an estimate of the yearly change in value or concentration for the tested time period and is presented as in percentage of median value or concentration per year. Trend results differ depending on the time period used in the trend analysis. Trends that are identified for a particular constituent at a site for one time period may not be identified when another time period is used. A trend also may be statistically significant but not environmentally significant. For example, a statistically significant upward trend with a rate of change of 0.5 mg/L for a constituent may have little environmental relevance if the average concentration is 100 mg/L.

Surface-Water Quality

This section summarizes water-quality data for physical properties and chemical constituents for selected streams in the UYRW. General information on physical properties and chemical constituents are presented first, followed by detailed analyses of data for physical properties, major ions, nutrients, trace elements and uranium, coliform bacteria, and suspended sediment.

Streams

For this report, water-quality data from the UYRW database were compiled for 211 stream sites for January 1975 through September 2009 (fig. 3, Appendix 3). The year 1975 was chosen as the starting year for data analysis because major development of coal resources began in the watershed that year. Site names in Appendix 3 are from the UYRW water-quality database; site names used in the report are nonabbreviated versions of those in Appendix 3. The UYRW has been divided into six subbasins for data analysis: Yampa River upstream from Chuck Lewis State Wildlife Area (henceforth Upstream Lewis SWA), Yampa River downstream from Chuck Lewis State Wildlife Area to Elk River confluence (henceforth, Lewis SWA to Elk River), Elk River, Yampa River downstream from Elk River to Hayden (henceforth, Elk River to Hayden), Yampa River downstream from Hayden to Elkhead Creek confluence (henceforth, Downstream Hayden), and Elkhead Creek (fig. 1). The Elk River, Elk River to Hayden, and Downstream Hayden subbasins include the eastern part of the Yampa coal field

For the UYRW and each subbasin, the number of sites and samples with stream-water quality data for 1975 through 2009 are summarized in table 6. Counts include physical properties and constituents that are discussed in this report. The most sites sampled were in the Upstream Lewis SWA subbasin and the fewest were in the Elkhead Creek subbasin. About 23 percent (49 of 211) sites were mainstem Yampa River sites. Sites were absent from a large area in the northern one-third of the watershed and some areas in the southern part of the watershed (fig. 3). A total of 5,862 samples were collected (table 3). The majority had data for physical properties (97 percent) and discharge (63 percent). Other samples percentages for analyses were total dissolved solids (30 percent), major ions and selenium (36 percent), nutrients (37 percent), and trace elements and uranium (41 percent). The greatest number of samples was collected in the Upstream Lewis SWA subbasin and the fewest in the Downstream Hayden subbasin. Only in the Lewis SWA to Elk River subbasin were samples collected every year (table 7); this occurred at Yampa River at Steamboat Springs (site 153). The largest yearly gaps in data collection occurred in the Downstream Hayden subbasin. For the UYRW and most subbasins, more samples were collected from May through July than other months of the year (table 8). The fewest samples were collected from November through January. About 13 percent (27 of 211) of the sites had data for more than 50 samples; almost one-half (96 of 211) had data for five or fewer samples. The CDPHE has an active sampling program (currently four sites in 2010) but the CDPHE data in STORET, and in the UYRW water-quality database, only were available through 2007. The number of sites sampled by the CDPHE typically increases in the years prior to the triennial review of water-quality standards.

Table 6. Number of stream sites and samples with water-quality data in the Upper Yampa River watershed and subbasins by constituent group, 1975 through 2009.

Table 7. Period of record and number of stream-water samples collected per year by constituent group, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

Table 8. Number of stream-water samples collected per season, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

Physical Properties

Physical properties analyzed for this report included specific conductance, pH, water temperature, dissolved oxygen, hardness, and acid neutralizing capacity (ANC). These data are summarized in table 9. A total of 5,660 samples from 208 sites have data for physical properties for 1975 through 2009 (table 6). The greatest number of physical property samples was collected during the 1990s with a steady decline in sample collection throughout the last decade with an exception during 2001. The Lewis SWA to Elk River subbasin had the greatest number of samples with data for physical properties; the Downstream Hayden subbasin the fewest.

Table 9. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for physical properties in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

Specific conductance is the ability of a substance to conduct an electric current. The presence of charged ionic species in a solution makes the solution conductive. Specific conductance is proportional to the concentration of major dissolved constituents (bicarbonate, calcium, chloride, fluoride, magnesium, potassium, silica, sodium, and sulfate). The weathering of minerals in soil and bedrock contribute as a primary source of major dissolved constituents. Atmospheric deposition can be a substantial source of dissolved chloride and sulfate particularly in areas with crystalline bedrock, which typically has low chlorine and sulfur content (Mast, 2007). Specific conductance in the UYRW was measured for 4,305 samples from 1975 through 2009 and ranged from 50 to 10,000 microsiemens per centimeter at 25° Celsius (µS/cm), with a median of 315 µS/cm (table 9). Low specific conductance values (less than 50 µS/cm) were most common in the headwater tributaries in the Lewis SWA to Elk River subbasin (49 percent of samples) and the Elk River subbasin (27 percent of samples) (fig. 6), including Fish Creek and Granite Creek upstream from Steamboat Springs, the Elk River near Clark, and other tributaries to the Elk River near Clark. Some of the most dilute concentrations were collected during snowmelt runoff (May–June); dilute waters due to snowmelt runoff are common in headwaters of Rocky Mountain watersheds (Mast, 2007). The underlying geology for the Lewis SWA to Elk River and Elk River subbasins mostly is comprised of igneous and metamorphic rocks that are resistant to weathering (fig. 5), which accounts for less major dissolved constituents and lower specific conductance in stream water. Specific conductance values greater than 1,000 µS/cm were most common in the Elk River to Hayden subbasin (62 percent of samples) and the Downstream Hayden subbasin (39 percent of samples) (fig. 6). These subbasins primarily have underlying lithology of Cretaceous-age sedimentary rocks (fig. 5). These rocks are more susceptive to weathering and result in an increase in dissolved constituents and specific conductance in stream water. Throughout the watershed, specific conductance typically was lowest during snowmelt runoff due to dilution and higher during most other times of the year when water in streams primarily was baseflow from groundwater. This is illustrated by the monthly distribution of specific conductance values measured at Yampa River at Milner (site 151) (fig. 7). This pattern is present for many dissolved constituents in water. Specific conductance data for three sites met the statistical requirements for trends testing, as discussed in the “Temporal Trend Analysis” paragraph of the “Methods of Data Review and Analysis” section. A statistically significant (p-value 0.03) trend in a downward direction was identified for Yampa River at Steamboat Springs (site 153) for 1997–2008 (table 10). The rate of change in specific conductance was small; the magnitude was about 6 uS/cm per year.

Figure 6. Distibution of A) specific conductance, B), pH, C) acid neutralizing capacity, D) unfiltered sulfate, E0 unfiltered total phosphorus, and F) dissolved manganese by subbasin for stream water, Upper Yampa River watershed, Colorado, 1975 through 2009.

Figure 7. Distibution of A) specific conductance, B) unfiltered sulfate, C) unfiltered total phosphorus, and D) total recoverable iron at Yampa River at Milner (site 151), Upper Yampa River watershed, Colorado, 1975 through 2007.

Table 10. Results of Seasonal Kendal trend analysis for select physical properties and water-quality constituents in the Upper Yampa River watershed, Colorado.

The pH is the measure of how acidic or alkaline the water is. Pure water has a pH of 7; a value lower than 7 is considered acidic and a value higher than 7 is considered alkaline or basic. The solubility and biological availability of nutrients and trace elements and other chemical processes are pH dependent. A pH less than 4 and greater than 10 can affect the survivability of aquatic organisms (*http://extension.usu.edu/files/publications/publication/nr_wq_2005-19.pdf*). Most streams across the Nation that are not influenced by human activities have pH that ranges from 6.5 to 8.5 (Hem, 1992). The pH of a water quality sample can be affected by biological activity in a stream, geology, precipitation, and human activities. Diurnal fluctuations in pH (lowest in the morning, highest in the late afternoon) result when algae take up dissolved carbon dioxide through photosynthesis during the day, which decreases the concentration of carbonic acid dissolved in water (increasing pH), and release carbon dioxide through respiration at night (Hem, 1992). The pH decreases in the presence of sulfide-bearing minerals (including pyrite) in rocks and soils as water and oxygen react with sulfur to form sulfuric acid. This can occur naturally in areas with mineralized bedrock or in areas with hard-rock mining. Hard-rock and coal mining can result in acidic drainage to a stream.

For the UYRW, pH values were measured in 3,140 samples from 1975 through 2009 at 191 sites. Values ranged from 2.1 to 9.8, and the median was 8.1 (table 9). Median pH was highest in the Upstream Lewis SWA and Elkhead Creek subbasins (8.3 and 8.2, respectively) and was lowest (7.6) in the Elk River subbasin (fig. 6). Most pH values (84 percent) were between 6.5 and 8.5. Individual values not meeting the CDPHE aquatic-life standard of 6.5–9.0 occurred in all subbasins except the Downstream Hayden subbasin (fig. 6). Values greater than the standard maxima of 9.0 were more common than values less than the standard minima of 6.5, primarily in the Lewis SWA to Elk River and Elk River to Hayden subbasins. Most values in the latter subbasin greater than 9.0 were measured during summer. Values less than 6.5 were most common (82 percent) in the Lewis SWA to Elk River and Elk River subbasins. Low pH values in the headwaters of the Yampa River likely occur in waters with naturally-lower alkalinities. Over one-half of the low pH values in these two subbasin were measured during snowmelt in May and June. Measurements of pH indicated diurnal fluctuations. Values of pH at the Yampa River above Elk River (site 145), for example, were 9.07 during the afternoon of August 23, 1999 and 7.92 during the early morning of the next day (Chafin, 2002) because of higher photosynthetic activity during late afternoon. Portions of the Yampa River in and downstream from

Steamboat Springs have algae covering cobbles and rocks in the streambed during summer. Five sites, four in the Lewis SWA to Elk River subbasin and one in the Elk River subbasin, had pH values that were not in attainment of the CDPHE water-quality standard for pH (fig. 8, table 11). Nonattainment of the 6.5 standard should not be a current issue of concern because the samples for all sites with data not in attainment were collected before 1998. Nonattainment of the 9.0 standard for Yampa River above Elk River (site 145) only was based on data for three samples, all collected from 1999 through 2002.

Figure 8. Exceedances of Colorado Department of Public Health and Environment in-stream water quality standards for physical properties and inorganic constituents and U.S. Environmental Protection Agency recommended concentrations for total phosphorus, Upper Yampa River watershed, Colorado, 1975 through 2009.

Table 11. Stream water-quality sites with exceedances of Colorado Department of Public Health and Environment in-stream water-quality standards for select physical properties and water-quality constituents and U.S. Environmental Protection Agency recommended concentrations for total phosphorus, Upper Yampa River watershed, Colorado, 1975 through 2009.

There are fewer occurrences of low pH values in the UYRW in comparison to other mountain watersheds in Colorado where naturally low pH values and acidic drainage from hard-rock mining result from mineralized bedrock. Low pH values associated with coal mining are not an issue of concern in the UYRW compared to coal mining regions in Appalachia. Except for the one pH value of 2.1, streams draining coal-mining areas in the UYRW had pH values greater than 7.1. The absence of acidic coal-mine drainage in Colorado likely is due to the low sulfur content of Colorado coal (Wentz, 1974). With a low amount of sulfur, sulfuric acid is unlikely to form in streams and reservoirs. Streams also have a higher capacity to buffer inputs of acid.

During 1999, the USGS conducted a study of pH tends in the Yampa River from the headwaters of the river to the mouth because of an apparent historical increase in pH at a site in the Yampa River downstream from the UYRW (Chafin, 2002). Conclusions from the pH study indicate that apparent “increasing trends” between 1950s and 1960s to 1980s and 1990s mostly was caused by changes in measurement procedure. Using more recent data, only pH data for the Yampa River at Steamboat Springs (site 153) met the statistical requirements for trends testing, as discussed in the “Temporal Trend Analysis” section. No trend in pH was identified for 1997 through 2008 (p-value 0.41) (table 10).

Water temperature is an important property which controls biological and chemical reaction rates. Temperature often directly influences dissolved oxygen levels and life cycles of aquatic organisms and often reflects seasonality. Water temperature data in the UYRW database are instantaneous measurements made when a water-quality sample was collected. Water temperature was measured for 5,188 samples from 1975 to 2009 and ranged from –3 to 30.4°C with a median of 7.5°C (table 9). Water temperature was lowest in the Elk River subbasin and greatest in the Downstream Hayden subbasin. Temperatures less than 0°C were most common (81 percent) from November through February. All values greater than 25°C were measured from May through July. Water temperatures increased in a downstream direction on the main stem of the Yampa River between Steamboat Springs and Hayden.

Only one site, Yampa River at Steamboat Springs (site 153) had a continuous record of water temperature; measurements were made at 15-minute intervals for most days from July 26, 2002 through April 13, 2005 (http*://waterdata.usgs.gov/co/nwis/nwisman/?site_no=09239500&agency_cd=USGS*). Exceedances of the June–September acute DM and chronic MWAT cold-water standards at this site occurred most often from mid-July through August during 2002–2004; a few exceedences were during early September (fig. 9). The June–September chronic MWAT was exceeded on the most number of sample days (table 12). Because the 7-day average streamflow was much below normal for 2002, below normal or low normal for 2003, and much below normal or below normal for 2004, determination of attainment or not attainment of the June–September standards would be based on the low-flow excursion (acute and chronic critical low flows) (Colorado Department of Public Health and Environment, 2009a). Water temperatures at Yampa River at Steamboat Springs (site 153) also did not meet the October–May acute DM and chronic MWAT cold-water standards, primarily during October fig. 9, table 12). In total, the DM and MWAT standards were exceeded on 16 and 26 percent of sample days, respectively, possibility due to upstream hydrologic modifications and changes in the river channel. Instantaneous water-temperature measurements can be used for a general evaluation of water temperature for sites throughout the watershed. The June–September chronic cold-water MWAT was exceeded in 318 individual measurements made at 20 sites and the October–May MWAT was exceeded in 285 individual measurements made at 19 sites. About 80 percent or more of the exceedences for each time period occurred at sites on the Elk River, Foidel and Middle Creeks, and Yampa River including and upstream from Steamboat Springs. Only one measurement for Elkhead Creek exceeded the March–November chronic MWAT standard for a warm-water stream. The Yampa River from Oak Creek to Elkhead Creek has been included on the CDPHE 2010 Monitoring and Evaluation list for water temperature (Colorado Department of Public Health and Environment, 2010b) (table 5). This includes the Yampa River at Steamboat Springs (site 153). Increases in temperature on the main stem of the Yampa River during summer are of concern for fish in the river. Increases in temperature in combination with low streamflow and low dissolved-oxygen concentration can result in reduced habitat availability for fish species less than optimal resource conditions. High water temperatures are a critical stressor for trout and whitefish. The Yampa River at Steamboat Springs (site 153) was the only site with sufficient water temperature data for temporal trend analysis; a trend was not identified for 1997–2008 (table. 10).

Figure 9. Maximum 2-hour average water temperature (DM), maximum weekly average temperature (MWAT), and daily average discharge with exceedances of Colorado Department of Public Health and Environment (CDPHE) in-stream water-quality standards for water temperature for A) June-September DM, B) June-September MWAT, C) October-May DM, and D) October-May MWAT for Yampa River at Steamboat Springs (site 153), Upper Yampa River watershed, Colorado 2002 though 2005.

Table 12. Number of sample days with water temperature not meeting Colorado Department of Public Health and Environment in-stream water-quality standards, Yampa River at Steamboat Springs, CO (site number 153), July 26, 2002, through April 13, 2005.

Dissolved oxygen is the measurement of the oxygen in water that is available to fish and aquatic life. It varies with temperature, elevation, and depth and is affected by many factors such as photosynthesis and respiration activity and inputs from point and nonpoint sources. Dissolved oxygen often reflects seasonal as well as diurnal variations. Concentrations typically are higher when water temperatures are colder. Dissolved oxygen was measured for 2,803 samples from 1975 to 2009 and ranged from 1.2 to 17.8 mg/L with a median of 9.8 mg/L (table 9). Median dissolved-oxygen concentrations were between 9.8 and 10.1 mg/L for each subbasin except the Downstream Hayden subbasin where the median dissolved oxygen was 9.2 mg/L and the median water temperature was the highest. The lowest dissolved-oxygen concentrations (less than 5.0 mg/L) in the watershed generally occurred during late June through August when streamflows were lower and water temperatures were higher than other times of the year. Diurnal changes in dissolved oxygen are illustrated with sample data for Yampa River above Elk River (site 145) that was discussed for pH. At this site, the dissolved oxygen-concentration was at a maximum saturation of 178 percent of saturation during the afternoon of August 23, 1999 and at a minimum saturation of 66 percent during the early morning of the next day because of photosynthesis (Chafin, 2002). Dissolved oxygen data for two sites, Little White Snake

Creek and Martin Creek, were not in attainment of the CDPHE standard (table 11). Little White Snake Creek is on the CDPHE 2010 Monitoring and Evaluation list for dissolved oxygen (Colorado Department of Public Health and Environment, 2010b). Data for this site were available for 2001 through 2007. Nonattainment of the standard for Martin Creek may not be a current issue of concern because all dissolved oxygen data were collected before 1989.

Hardness generally is measured by the presence of the cations calcium and magnesium in water and is reported in terms of an equivalent concentration of calcium carbonate. Iron and manganese also can contribute to hardness but in small amounts. Hardness can affect the anthropogenic uses of water and the toxicity of metals to aquatic life. Metal toxicity can increase as hardness decreases (Santore and others, 2001). Calcium and magnesium impede the absorption of metals through the gills of fish. The lithology of rocks in the watershed can often affect hardness. Waters draining igneous rocks generally contain little hardness because of the absence of calcium and magnesium cations in the water. Waters draining sandstones and shales as well as other sedimentary formations that contain carbonate have higher hardness. Additionally, additives from municipal water treatment, agricultural fertilizers, and applications for winter road maintenance can all contribute to increased hardness. In the UYRW, hardness was measured for 2,434 samples from 1975 to 2009 and ranged from 10 to 4,000 mg/L with a median of 162 mg/L (table 9). Hardness was lowest in the Elk River and Lewis SWA to Elk River subbasins and highest in the Downstream Hayden and Elk River to Hayden subbasins. Many tributaries in the Elk River and Lewis SWA to Elk River subbasins flow from the mountains, areas that are underlain with igneous and metamorphic rocks. The lithology in Elk River to Hayden and Downstream Hayden subbasins is dominated by sedimentary rocks, including the Lewis and Mancos Shales and the Williams Fork Formation Hardness was lower during May and June in the Upstream Lewis SWA, Lewis SWA to Elk River, Elk River), and Elkhead Creek subbasins when snowmelt runoff occurred than during October–April when streamflow primarily was baseflow from groundwater. In the Elk River to Hayden and Downstream Hayden subbasins, median hardness was slightly higher during October–April than during May and June.

Acid neutralizing capacity (ANC, determined on a whole-water sample) and alkalinity (determined on a filtered sample) measure the ability of a water sample to neutralize inputs of acid from precipitation, wastewater, or mine drainage (Rounds, 2006). Bicarbonate and carbonate are the main buffering materials. Water with low ANC is susceptible to pH change with the addition of acidic water; water with high ANC resists pH change. Waters with high alkalinity occur in areas with sedimentary rocks and carbonate-rich materials. In the UYRW, contaminants in precipitation, including sulfuric and nitric acids, pose a threat to alpine and subalpine ecosystems in the Rocky Mountains, such as Mount Zirkel and Flat Tops Wilderness areas in the UYRW, because the soil types and bedrock have little capacity to buffer acidic inputs (Turk and Spahr, 1991). As the accumulated snowpack melts, a pulse of strong acids can be released into the aquatic system (Campbell and Turk, 1989).

ANC was measured for 2,244 samples collected at 134 sites in the UYRW; most commonly for the Upstream Lewis SWA and Elk River to Hayden subbasins. Values for ANC ranged from 2 to 660 mg/L with a median of 162 mg/L (table 9). As with hardness, the Elk River and Lewis SWA to Elk River subbasins had the lowest ANC (fig. 6) and the Downstream Hayden and Elk River to Hayden subbasins the highest ANC due to underlying geology. Streams with an ANC of less than 10 that are least likely to resist inputs of acidic water drain mountainous areas in the north and northeast portions of the watershed, including the Mount Zirkel Wilderness, that are susceptible to acidic precipitation. ANC varies seasonally, with lower concentrations during snowmelt runoff and higher concentrations during other times of the year.

Total Dissolved Solids and Major Ions

Total dissolved solids (TDS) in most natural waters are comprised of commonly occurring major ions such as calcium, magnesium, sodium, potassium, bicarbonate, carbonate, sulfate, chloride, fluoride, and silica. TDS are materials dissolved in water that pass through a filter (0.45 micron for this report). Most dissolved ions originate in mineral assemblages in rocks and soils near the land surface (Hem, 1989). In thermal springs, the solute content commonly is higher than that of non-thermal water. The amount and composition of TDS can be used to identify changes in water chemistry at different times of the year. High concentrations of total dissolved solids can degrade the quality of water for municipal and agricultural uses. TDS were measured for 1,743 samples and ranged from 6.5 to 9,280 mg/L with a median of 216 mg/L (table 13). The highest TDS concentrations were in the Downstream Hayden subbasin. Most (77 percent) samples for this subbasin were collected before 1983; samples were not collected from 1983 through 1999. High TDS concentrations also occurred in the Elk River to Hayden subbasin; most (82 percent) samples were collected before 1995. Lowest TDS concentrations occurred in the Elk River and Lewis SWA to Elk River subbasins, areas that drain igneous and metamorphic rocks. This spatial pattern of dissolved solids concentrations is similar to that for specific conductance shown in figure 6. The high TDS concentrations in the Downstream Hayden and Elk River to Hayden subbasins could be attributed to the geology in the region and human influence. The underlying sandstone and shale lithologic units in addition to interaction with weathered rock associated with coal mining in the Elk River to Hayden and Downstream Hayden subbasins may contribute to the increase in TDS. The 85th percentile concentration of TDS data for one site, Trout Creek near mouth (site (115) in the Elk River to Hayden subbasin, was greater than non-enforceable SMCL of 500 mg/L. Comparison to the secondary standard was made for those segments that had standards for chloride and sulfate. For many stream segments in subbasin Elk River to Hayden and Downstream Hayden, TDS data were not compared to the SMCL because chloride or sulfate standards have not been established by the CDPHE. TDS data for one site, Yampa River at Steamboat Springs (site 153) met the statistical requirements for trends testing, as discussed in the "Temporal Trend Analysis" section. A statistically significant (p-value 0.03) trend in a downward direction was identified for 1997 through 2008 (table 10). This is similar to the downward trend identified for specific conductance. Many natural or human-influenced factors can cause changes in dissolved solids concentrations, thus causing changes in specific conductance. The rate of change in dissolved solids concentrations was small at 3.9 mg/L per year.

Table 13. Summary statistics of the number of steam sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for total dissolved solids and major ions in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

Major ions in water are a product of interaction with groundwater and aquifer materials, lithology, soils, and human activity. Major ions in this section refer to dissolved concentrations unless stated otherwise. Concentrations of major ions in the UYRW show an annual pattern related to snowmelt. With the onset of snowmelt during May and June and subsequent runoff, major ion concentrations in streams across the watershed typically are lower during runoff than other times of the year because of the increased volume of streamflow Because of the strong influence of snowmelt on water quality, other natural and human factors that may affect major ion concentrations cannot be identified during snowmelt runoff. In general, major ion concentrations increase steadily through the summer and fall as streamflow decreases and the dilution affect from runoff is reduced. As with specific conductance and dissolved solids, major ion concentrations typically were highest in areas underlain by sedimentary rocks and lowest in areas that drain igneous and metamorphic rocks.

A total of 2,098 samples for major ions were collected from 1975 through 2009 at 146 stream sites (table 6). More than 100 samples per year were collected during 1976, 1980–81, 1997, and 2001; less than 20 samples per year were collected during 1993–94, 2005, and 2009 (table 7). The most sites sampled and the most samples collected were in the Upstream Lewis SWA and Elk River to Hayden subbasins; sampling occurred during most years from 1975 through 2009. The fewest sites and samples were recorded for the Elkhead Creek and Downstream Hayden subbasins, respectively.

A total of 172 samples had sufficient data for calcium, magnesium, potassium, sodium, bicarbonate, chloride, and sulfate to determine water type. For all subbasins except the Downstream Hayden subbasin, the primary ions in solution in most or all streams throughout the year were the cation calcium and the anion bicarbonate. Streams in the Elk River to Hayden subbasin also had a mixture of anions (bicarbonate-sulfate, sulfate, and sulfate-bicarbonate) in 25 percent of the samples from July through April. A few samples in the Elk River to Hayden and Elkhead Creek subbasins had cation mixtures of calcium-magnesium, calcium-magnesium with sodium plus potassium, calcium with sodium plus potassium, and magnesium-calcium. Anion mixtures in a few samples in the Upstream Lewis SWA and Elkhead Creek subbasins included bicarbonate-sulfate, sulfate, and sulfate-bicarbonate. No one water type was dominant in the Downstream Hayden subbasin; water types include the cations calcium, calcium-magnesium, magnesium-calcium, and sodium plus potassium with magnesium and the anions bicarbonate, bicarbonate-sulfate, sulfate, sulfate-bicarbonate. The type of water represents the weathering of underlying lithology and soil materials. Piper diagrams for five streams in the UYRW were constructed to analyze the ionic composition of stream water and show similarities and differences in water types between sites in the Lewis SWA to Elk River, Elk River, and Downstream Hayden subbasins (fig. 10). The dominant ions in the Yampa River at Steamboat Springs (site 153) were calcium and bicarbonate. These two ions also were dominant in Middle Creek but some samples showed the influence of sulfate, most likely resulting from sedimentary rocks in the drainage area. The three streams the Downstream Hayden subbasin had the most diverse water types, especially the cations sodium plus potassium with magnesium and the anion sulfate for Stokes Gulch near Hayden (site 112) and sulfate for Hubberson Gulch near Hayden (site 61), streams that drain areas of Mancos Shale and the Williams Fork Formation.

Figure 10. Cation and anion percentiles and water type for water-quality samples collected from selected stream sites in the Upper Yampa River watershed, Colorado, 1975 through 2009.

Dissolved sulfate concentrations were highest in the Elk River to Hayden and Downstream Hayden subbasin (fig. 6) because of the prevalence of sedimentary rocks in the subbasins. A seasonal pattern to unfiltered sulfate concentrations was evident for unfiltered sulfate at Yampa River at Milner (fig. 7). Unfiltered sulfate data for one site on Little White Snake Creek and one site on Trout Creek were not in attainment of the water-supply standard of 250 mg/L (fig. 8, table 11). Sample collection at these sites began in 2001 and 1996, respectively. Both sites have drainage basins that are underlain by sedimentary rocks. The CDPHE has not established a sulfate standard for many stream segments in the Elk River to Hayden subbasin and a few segments in the Upstream Lewis SWA and Downstream Hayden subbasins because of naturally high concentrations of sulfate. All chloride concentrations in the UYRW were 76 mg/L or less, well below the CDPHE water-quality standard of 250 mg/L (table 13).

Only one site, Yampa River at Steamboat Springs (site 153), had sufficient data for TDS and major ions for temporal trend analysis. A statistically significant (p-value 0.03) trend in a downward direction was identified for TDS for 1997 through 2008 (table 10). This is similar to the downward trend identified for specific conductance. Many natural or human-influenced factors can cause changes in dissolved solids concentrations, thus causing changes in specific conductance. The rate of change in dissolved solids concentrations was small at 3.9 mg/L per year. No trends were identified for calcium, magnesium, sodium, potassium, sulfate, chloride, and silica.

Nutrients

Nutrients (nitrite, nitrate, ammonia, phosphorus, and orthophosphate) in stream water provide essential food for plants and animals; however, excessive concentrations can reduce water quality and have adverse effects on aquatic life and human health. Nutrients occur naturally in streams and from anthropogenic sources. In the UYRW, natural sources of nutrients include the weathering and erosion of phosphorus-bearing rocks and soils, breakdown of organic matter, and atmospheric deposition. Human activities include applications of fertilizers, runoff from urban areas, soil erosion, effluent from the wastewater treatment process, seepage from septic tanks, detergents, animal waste, and atmospheric deposition. Nitrogen is released to the atmosphere by fossil fuel combustion and agricultural activities (Mast, 2007). Nitrite typically is found in low concentrations in streams because it is unstable in aerated water; high levels of nitrite generally indicate pollution through disposal of sewage or organic waste (Hem,1992). Nitrate is a more stable species of nitrogen over a range of conditions. Excessive concentrations of nitrate in drinking water may cause methemoglobinemia, commonly known as blue baby syndrome, in small children (Hem, 1992). The ammonium (NH_4+) ion is the ammonia fraction that is the available nutrient; un-ionized ammonia (NH_3) is the fraction that can be toxic to fish in excessive concentrations. Toxic levels are pH and temperature dependent (toxicity increases as temperature and especially pH increase) and vary depending on species. Phosphorous often adsorbs to the surface of sediment and organic particles and when found in waterways, can indicate that erosion and sediment transport is occurring (Mueller and others, 1995). Eutrophication is the process of excessive nutrient concentrations leading to increased algae growth and decomposition that eventually affect the availability of dissolved oxygen for aquatic life. Eutrophication can cause problems such as habitat loss, toxic algal blooms, reduction in biodiversity, taste and odor issues, pH fluctuations, and clogged municipal water intake pipes. Nutrient species in this study include nitrite, nitrate, ammonia, and total phosphorous.

Nutrient (nitrogen and phosphorus) were collected at 2,163 from 164 stream sites in the UYRW (table 6). The spatial and temporal distribution of sample collection was similar to that for physical properties and major ions. More than 100 samples per year were collected during 1975–1976, 1980–81, 1997, and 2001; less than 20 samples per year were collected during 1993–94, 2005, and 2009 (table 7). More sites were sampled and more samples were collected in the Upstream Lewis SWA and Elk River to Hayden subbasins than other subbasins; the fewest sites sampled and samples collected were in the Elkhead Creek and Downstream Hayden subbasins, respectively.

Dissolved nitrite was measured for 628 samples from 1981 to 2009 and ranged from less than 0.001 to 0.39 mg/L with a median of 0.002 mg/L (table 14). Concentrations in 85 percent of samples, and all samples collected in the last 10 years, were 0.01 mg/L or less. Although there were nine samples collected from 1981 through 1988 with nitrite concentrations greater than the CDPHE aquatic-life standard of 0.05 mg/L, all sites were in attainment of the standard. Temporal trends testing could not be performed using nitrite data. More than 10 percent of the nitrite data was censored and did not meet the statistical requirements for trends testing.

Table 14. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for nutrients in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

Dissolved nitrate was measured for 1,096 samples from 1975 to 2009 and ranged from less than 0.005 to 90 mg/L with a median of 0.07 mg/L (table 14). Many sites had more than 50 percent censored data. All samples collected after 1988 except one had dissolved nitrate concentrations of 1 mg/L or less.

The concentration in one sample collected from Elkhead Creek above Long Gulch (site 40) in 2003 was 1.5 mg/L. Dissolved nitrate concentrations were greatest in the Elk River to Hayden and Downstream Hayden subbasins. All concentrations greater than 5 mg/L were detected in samples from these two subbasins. The Elk River to Hayden and Downstream Hayden subbasins have higher percentages of grassland, pasture, and rangeland in comparison to other subbasins, and livestock could contribute to nitrate in streams. Increases in nitrate also can be caused by wastewater treatment plant effluent and wildlife. All sites in the UYRW were in attainment of the CDPHE MCL for nitrate of 10 or 100 mg/L, depending on stream segment (Appendix 2). Samples with concentrations greater than 10 mg/L were collected in stream segments in the Elk River to Hayden and Downstream Hayden subbasins that have a standard of 100 mg/L because of natural conditions. Concentrations of unfiltered nitrate were similar to those for dissolved nitrate (table 14). More than 10 percent of the nitrate data were censored and did not meet the statistical requirements for trends testing.

The median dissolved nitrate concentration of 0.05 mg/L for high-elevation streams in the UYRW that would be representative of reference conditions was greater than the median concentration of approximately 0.005 mg/L for reference streams in the Southern Rocky Mountains (SRM) (U.S. Environmental Protection Agency, 2000). Calculation of the nitrate reference median for the UYRW was based on data for 1975–76 and for a few years in each decade since. The median nitrate concentration for reference streams in the SRM was calculated as the median concentration of seasonal data for 1990–99. Reference values represent conditions minimally affected by human activities and protective of aquatic life and recreational uses.

Unfiltered total ammonia was analyzed for 1,027 samples from 1975 to 2009 and ranged from less than 0.01 to 2.3 mg/L with a median of 0.02 mg/L (table 14). More than 60 percent of the data were censored values. Higher (greater than 0.2 mg/L) concentrations only were detected in 10 percent of the samples; most (84 percent) of these were collected before 1996. From 1996 through 2009, about 71 percent of the concentrations greater than 0.1 mg/L were detected in the Yampa River just downstream from Stagecoach Reservoir, all from October through February. The maximum total ammonia concentration of 2.3 mg/L also was detected at this location. Conditions within the reservoir could be contributing to the increase in ammonia downstream from the reservoir outlet. Other sources of ammonia to stream in the UYRW could include fertilizers, seepage from septic tanks, livestock and wildlife, and effluent from the wastewater treatment process. Total ammonia concentrations in four samples collected during 1975 or 1976 at three sites exceeded the calculated CDPHE standard for the sample. No comparison was made to the 85th percentile concentration; the standard varies depending on the pH and water temperature of the sample. Total ammonia data could not be tested for temporal trends because most of the data was censored.

Unfiltered total phosphorous was measured for 1,583 samples at 144 sites; concentrations ranged from less than 0.0037 to 3.9 mg/L, and the median was 0.044 mg/L (table 14). Median concentrations were 0.06 mg/L or more in the Upstream Lewis SWA, Elk River to Hayden, and Downstream Hayden subbasins. The highest concentrations were in the Elk River to Hayden and Downstream Hayden subbasins (fig. 6). High concentrations of total phosphorus throughout the UYRW could result from naturally-high concentrations in some sedimentary rocks and from urban and agricultural runoff, wastewater treatment plant effluent, and animal waste. The Wadge and Wolf Creek coal beds in the Yampa Coal field have very high contents of phosphorus (30 times greater than the average value for Cretaceous-age coal because of ash deposits (Affolter, 2000). A seasonal pattern to total phosphorus concentrations was evident for Yampa River at Milner (site 151). Concentrations were highest during the initial flush of snowmelt during April when phosphorus is bound to sediments and lowest during snowmelt runoff with dilution (fig. 7). Concentrations in 12 percent (193 of 1,583) of samples were greater than USEPA recommended concentrations to control downstream eutrophication. A total of 59 samples from seven sites were greater than 0.05 mg/L, the recommended concentration for streams that directly flow into lakes and reservoirs, and concentrations in 134 samples from 32 sites were greater than the recommended concentration of 0.1 mg/L for streams that do not directly flow into lakes and reservoirs. As a percentage of samples collected per year, concentrations greater than the recommendations occurred in more than 10 percent of samples collected during 1975–1982, 1988–1992, 1997–2000, 2002, and 2007. The most (50 percent) was during 1990. Temporally, concentrations greater the recommendations occurred most frequently (greater than 25 percent of samples) during March, April, and May before and at the beginning of snowmelt runoff because phosphorus sorbs to particulate material. The 85th percentile concentration of total phosphorus data for 19 sites exceeded the recommended concentrations; five streams flow directly into reservoirs (fig. 10, table 11). Data for 8 of the sites were collected after 1994. Some stream segments in the Upstream Lewis SWA, Elk River to Hayden, and Downstream Hayden subbasins were excluded from the tabulation and calculation of exceedences because of naturally-occurring high concentrations of phosphorus. Total phosphorus data for one site, Yampa River at Steamboat Springs (site 153) met the statistical requirements for trends testing. A statistically significant (p-value 0.038) trend in an upward direction of 0.001 mg/L per year was identified for 1997–2008 (fig. 11, table 11). This may reflect population growth and land-use changes that have occurred upstream from the Steamboat Springs site.

Figure 11. Flow-adjusted unfiltered total phosphorus concentration at Yampa River at Steamboat Springs (site 153), Upper Yampa River watershed, Colorado, 1997 through 2008.

Total phosphorus concentrations in high-elevation streams in the UYRW that would be representative of reference conditions were compared to concentration in reference streams in the

Southern Rocky Mountains. The 25th percentile and median concentrations of total phosphorus in the UYRW were 0.006 and 0.009 mg/L (calculated from data for 1975–76 and after 1998), respectively, and were similar to or much lower than the regional reference concentration for the Southern Rockies (Ecoregion 21) of 0.00635 mg/L (25th percentile concentration) and the regional median concentration of 0.02 mg/L (both calculated from seasonal summaries of data for 1990–99) (U.S. Environmental Protection Agency, 2000).

Trace Elements and Uranium

For this report, trace elements are metal and nonmetallic elements that generally occur in small (less than 1 mg/L) concentrations. Many trace elements are essential nutrients required by biota in small amounts, but substantial concentrations of trace elements can be toxic to aquatic life. Some trace elements can bioaccumulate in biota and bioconcentrate in the food chain. Trace-element type and concentration in water often are directly related to the bedrock geology and natural geochemical conditions in an area and the presence of thermal springs. Streams in mineralized areas naturally can contain high background concentrations of dissolved metals from the oxidation and weathering of minerals in rocks and soils. Common anthropogenic sources of trace elements are atmospheric deposition, industrial water releases (particularly acidic mine drainage), and urban runoff. The radiochemical uranium is an important indicator of radon gas, a human carcinogen. The potential for radon in indoor air increases with higher concentrations of uranium in rocks. The USEPA has assigned Garfied, Moffat, and Rio Blanco Counties to the radon-potential category of 1, signifying a high potential for elevated indoor radon levels (U.S. Environmental Protection Agency, 2010a). Routt County is in the radon-potential category of 2 and has a moderate potential for elevated indoor radon levels. Uranium in drinking water may be harmful to kidneys.

Trace-element and uranium data were available for 2,425 samples collected from 1975 through 2009 at 145 sites in the UYRW (table 6). Sample were collected most frequently (over 100 samples per year) during 1976, 1980, 1992–1997, and 2001 (table 7). Samples were collected almost every year in the Upstream Lewis SWA and Elk River to Hayden subbasins. The fewest trace-element samples were collected in the Elkhead Creek subbasin.

Concentration data for 23 trace elements in the dissolved form and 20 trace elements in the unfiltered form, including total recoverable, were available in the UYRW database for 145 stream sites. ‘Total recoverable’ means that the portion of a water and suspended-sediment sample measured by the total recoverable analysis procedure. Data for 15 trace elements are discussed in this report; summary statistics are presented in table 15. More than two-thirds of the concentrations for dissolved and total recoverable cadmium, chromium, lead, nickel, and silver, dissolved copper and zinc, and total recoverable mercury were less than laboratory reporting levels. Concentrations were highest for total recoverable iron, aluminum, and manganese, and dissolved iron, manganese, and strontium. The Elk River to Hayden and Downstream Hayden had the maximum detected concentrations of total recoverable aluminum, cadmium, nickel, and iron, dissolved and total recoverable copper, lead, and manganese, and dissolved arsenic, boron, chromium, strontium, and zinc. This likely is attributed to lithologic conditions in these subareas. Iron can be associated sedimentary and iron-rich igneous intrusive rocks (Colorado Department of Public Health and Environment, 2008). Data collected by the Seneca Coal Company indicate that the weathering and erosion of iron-containing lithologic formations and related soils contributes to elevated total recoverable iron concentrations in the Grassy Creek area. The mean content of manganese in the Wolf Creek coal bed in the eastern portion of the Yampa coal field was almost three-times higher than the mean content in other Cretaceous coal beds in the Yampa coal field (Brownfield and others, 1999). There was no spatial pattern to dissolved aluminum, copper, iron, and zinc concentrations, but dissolved manganese concentrations were highest in the Elk to Hayden and downstream from Hayden subareas (fig. 6). Over one-half of the strontium samples had concentrations that were greater than the median concentration of 60 micrograms per liter (µg/L) for major rivers in North American (Hem, 1985). This occurred in the Upstream Lewis SWA, Elk River, Elk River to Hayden, and Elkhead Creek subbasins; no data were available for the Downstream Hayden subbasin (tables 15). The Wadge and Wolf Creek coal beds in the Yampa Coal field have high contents of strontium (30 times greater than the average value for Cretaceous-age coal) (Affolter, 2000).

Table 15. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for trace elements in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

Yearly variation in trace element concentrations of total recoverable aluminum, copper, iron, manganese, and zinc showed that higher concentrations typically occurred in 1980 and 1982 and typically were much lower in other years. There was no pattern to dissolved concentrations of these trace elements. Seasonal variation is trace element concentrations was evident for total recoverable concentrations of aluminum, copper, iron, and zinc, as shown for total recoverable iron at Yampa River at Milner (site 151) (fig. 7). Total recoverable aluminum, copper, iron, and zinc concentrations were highest in April; aluminum and iron concentrations also were elevated in May. Concentrations were higher during the initial pulse of snowmelt runoff due to particulate-phase trace elements binding to sediment during the first flush of material off of the land surface. The seasonal variation in total recoverable manganese concentrations was less evident. Dissolved iron concentrations had a similar seasonal pattern as total recoverable iron. For other dissolved trace elements, including manganese, a seasonal pattern of concentrations were not discernable. Sufficient data for trend testing only were available for total recoverable iron and dissolved and total recoverable manganese for Yampa River at

Steamboat Springs (site 153). A trend in a downward direction was identified for 1997–2008 for total recoverable manganese (table 10); the magnitude of change was 2.6 slope was µg/L per year.

Dissolved copper collected at four sites and total recoverable iron collected at five sites were not in attainment of the CDPHE standard for the protection of aquatic life (fig. 12, table 11). Only one of four sites with an exceedence of the copper standard included data collected after 1998. Mean hardness for the four sites was 15 mg/L or less. Extremely low values for hardness greatly lowers the copper standard compared to sites with higher mean hardness. The four sites are in the Lewis SWA to Elk River and Elk River subbasins that naturally have low hardness values. Determination of nonattainment of the copper standard was based on small sample sizes, seven samples or less. Exceedances of the total recoverable iron standard all were based on data collected before 1998. Exceedences of the standard should not be a current issue of concern because of the age of the data. No stream had an exceedence of both the dissolved copper standard and the total recoverable iron standard. There were individual samples with concentrations of total recoverable arsenic, iron, and manganese and dissolved cadmium, chromium, lead, silver, and zinc that were greater than the standard values but attainment of the standards was met because the 85th percentile concentration of the data collected at a particular site for a particular trace element was less than the standard. Individual exceedences were most common for total recoverable iron, particularly from March through June when increased sediment load would be carried in streams with the flush of snowmelt runoff. Four sites in the Upstream Lewis SWA and Lewis SWA to Elk River subbasins were not in attainment of the water-supply standard for dissolved iron (fig. 12, table 11). All but one site not in attainment had data that were collected in the last decade. Nonattainment of the water-supply standard for dissolved manganese occurred at 18 sites (fig. 12, table 11); all data for six sites were collected before 1993. Nonattainment was most common in the Upstream Lewis SWA and Lewis SWA to Elk River subbasins. Higher dissolved manganese concentrations could be the result of the lithologic conditions or possible oxidation-reduction processes that may occur in the water. Only one stream segment in the UYRW is on the State of Colorado 2008 303(d) list of impaired waters for non-attainment of aquatic-life use standards because of metal contamination (table 5) (Colorado Department of Public Health and 2010b); Dry Creek and its tributaries and wetlands are listed for total recoverable iron. Five streams and six trace elements are on the State of Colorado Monitoring and Evaluation list for metals (table 5) (Colorado Department of Public Health and 2010b).

Figure 12. Exceedances of Colorado Department of Public Health and Environment in-stream water-quality standards for trace elements, Upper Yampa River watershed, Colorado, 1975 through 2009.

Selenium is a trace element that occurs naturally in Cretaceous-age sedimentary rocks in western Colorado, especially in the Lewis and Mancos Shales (Butler and others, 1996; Colorado Water Quality Control Commission, 2010). Human activities such as mining and irrigated agriculture potentially can mobilize selenium in rock and soil. In water, selenium can bioaccumulate in aquatic organisms. Overexposure to selenium can be toxic to macroinvertebrates, fish, and birds. Selenium was measured for 846 samples collected at 108 sites primarily from 1975 through 1983 and after 1990. Concentrations ranged from a minimum noncensored value of 0.07 to 300 µg/L (table 13); 81 percent of samples were censored at reporting levels that ranged from 0.2 to 6 µg/L. Samples with detected concentrations of 3 µg/L or greater were collected from streams that drained areas with underlying Lewis and Mancos Shales, geologic formations that are seleniferous. Aquatic-life standards for dissolved selenium have been adopted for most stream segments; three segments have a standard for total recoverable selenium (Appendix 2). The chronic standard of 4.6 µg/L for dissolved selenium was not met for seven sites; the acute standard of 18.4 also was not met for six of the seven sites (fig. 8, table 11). The sites are in the Upstream Lewis SWA, Elk River to Hayden, and Downstream Hayden subbasins. The site in the

Upstream Lewis SWA subbasin is near Stagecoach Reservoir in an area underlain by Mancos Shale. Sites with exceedences in the Elk River to Hayden and Downstream Hayden subbasins are underlain by Lewis Shale. One stream segment for Dry Creek and one for Sage Creek are on the CDPHE 2010 303(d) list for impaired waters for selenium, and one stream segment for the Yampa River downstream from Stagecoach Reservoir is on the 2010 Monitoring and Evaluation list for selenium (table 5) (Colorado Department of Public Health and Environment, 2010b). No data were available for comparison to the aquatic-life standard for total recoverable selenium.

Dissolved uranium data for the UYRW only were available for 51 samples; one-half were collected during 1979 and 1981-1983 and one-half were collected during 2003, 2004, and 2006. Detected concentrations ranged from less than 0.059 to 170 µg/L (table 15). The maximum concentration, collected during 1983, was an outlier; the next highest concentration in the watershed was 6 µg/L. About 33 percent of the data were censored at concentrations less than 1 µg/L. Most of the data were collected in the Upstream Lewis SWA, Elk River, and Elk River to Hayden subbasins. Except for one sample with a concentration of 170 µg/L collected at Yampa River above Oak Creek confluence (site 129), all dissolved uranium concentrations were much lower than the USEPA drinking-water standard of 30 µg/L. The CDPHE has not established uranium standard for the UYRW.

Coliform Bacteria

Coliforms are bacteria present in the digestive tracts of warm-blooded animals and in soil and vegetation. The bacteria are not likely to cause illness themselves but their presence in water indicates that disease-causing pathogens also could be in the water. Total coliform consists of a large group of different types of bacteria. Fecal coliforms are bacteria that are present in the feces and intestines of warm-blooded animals. Their presence in water indicates recent contamination by animal waste or sewage. *E.coli* is a subgroup of fecal coliform bacteria. The USEPA recommends that *E.coli* is best suited for predicting the presence of gastrointestinal illness-causing pathogens in fresh water; the recommended steady-state geometric mean value for recreational bathing use is 126 *E.coli* colonies per 100 milliliters (col/100 mL) and is based on a specific level of risk of no more than ten illnesses per 1,000 swimmers for fresh water. Sources of bacteria include animal and wildlife (including birds) wastes that are typically deposited directly in a water body, runoff from feedlots, pastures, and woods, and sewage plants and septic systems. Concentrations of fecal coliforms are typically influenced by but not limited to temperature, salinity, light intensity, rainfall, and streamflow.

In the UYRW, data for coliform bacteria were available for 432 samples collected from 89 stream sites (table 6) during 1975–76 and 1998–2009 Table 7). More than 44 samples per year were collected during 1975, 1976, 2001, and 2002. Samples were collected most frequently and from the greatest number stream sites in the Lewis SWA to Elk River subbasin than other subbasins; the fewest samples and sites were in the Downstream Hayden subbasin.

Total coliform data were available for 119 samples collected during 1975 and 1976 at 43 sites, primarily in the Lewis SWA to Elk River subbasin. Concentrations ranged from no detection to 18,000 col/100 mL; about 80 percent (95 of 119) of the concentrations were less than 400 col/100 mL. Most (20 of 24) concentrations of 400 col/100 mL or more were detected in samples from the Lewis SWA to Elk River subbasin. *E.coli* was measured for 123 samples collected from 1991 through 2009. Concentrations ranged from less than 1 to 733 col/100 mL, and the median was 18 col/100 mL (table 16). Recent (2000–2009) *E. coli* data are from samples collected at Elk River near Milner (site 33), Fish Creek at Upper Station (site 149),Yampa River at Steamboat Springs (site 153) and three Elkhead Creek sites (sites 40 and 42). The CDPHE recreation standard for *E. coli* of 126 col/100 mL was exceeded in five samples collected from 1994 through 2003. Two samples were from Yampa River at Steamboat Springs (site 153) and three samples were from two Elkhead Creek sites (sites 40, 44). No sites with an

E coli standard of 205 or 630 col/100 mL were sampled. Three stream segments are on the CDPHE 303(d) list of impaired waters or monitoring and evaluation list for *E. coli* (table 5). The most robust set of data for bacteria in the UYRW was available for fecal coliform. Data for 399 samples were collected at 88 sites in multiple subbasins during 1975–1976 and 1989–2007. About 95 percent (381 of 399) of the concentrations were less than 200 col/100 mL, the maximum concentratation was 2,100 col/100 mL (table 16). Potential sources of *E.coli* and fecal coliform in the UYRW include but are not limited to recreational water users, wildlife, and livestock. The Yampa River in the vicinity of Steamboat Springs is heavily used for recreation during summer; the Elkhead Creek subbasin has a high percentage of rangeland and pasture.

Table 16. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for coliform bacteria in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

Suspended Sediment

Suspended sediment or suspended solids are very fine particles suspended in water for a significant time period without settling. This includes silt and soil from erosion and storm and urban runoff, remains from the breakdown of terrestrial and aquatic biota, and wastes from industry and water treatment plants. The amount and size of suspended sediment in water are affected by streamflow; higher streamflows can carry more and larger suspended material than lower streamflows (fig. 13). Because phosphorus adsorbs to the surface of sediment, phosphorus concentrations are higher when suspended-sediment concentrations are higher. Suspended-sediment samples were collected in the less frequently and in the fewest years compared to other constituent groups (table 6 and 7). In all subbasins except the Elk River and Elkhead Creek subbasin, sample collection only occurred before 1993;

samples were collected in the Elk River and Elkhead Creek subbasins through 2003. Concentrations typically were lowest from August through February when streamflow was lowest. Concentrations were highest during May in the Elk River and Elkhead Creek subbasins and during April in other subbasins. The highest concentrations were in streams in areas with sedimentary rocks, especially the Elk River to Hayden and Downstream Hayden subbasins (table 17). Bushy Creek is the only stream segment on the State of Colorado 2008 303(d) list of impaired waters for nonattainment of the sediment standard (table 5) (Colorado Department of Public Health and 2010b).

Figure 13. Discharge and suspended-sediment and total phosphorus concentrations in Elkhead Creek above Long Gulch (site 40), Upper Yampa River watershed, Colorado, July 1995 through September 2003.

Table 17. Summary statistics of the number of stream sites and samples and minimum, median, and maximum values for suspended sediment in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2003.

Lakes and Reservoirs

The UYRW water-quality database contains data for 42 lake and reservoir sites in 30 bodies of water and 369 samples days beginning in 1975 (table 6). Sites with different site names and identifiers in the database but with the same latitude and longitude are counted as one site. Samples collected at multiple depths on the same day are counted as one sample day. For 26 lake and reservoir sites in 16 bodies of water, data were collected for a maximum of four samples days, all before 1986. About one-half of these sites were potholes or ponds. Data also were available for 16 sites and 327 samples collected on 180 sample days from five lakes and reservoirs beginning in 1983 (Appendix 4). Lake Elbert and Long Lake Reservoir, high-elevation lakes in and near the Mount Zirkel Wilderness Area north and east of Steamboat Springs, are long-term data-collection sites with samples collected on 139 days between the mid-1980s and 2008. Samples were collected in Stagecoach Reservoir on 43 days at five sites during 1990–1992 and July 2006. Data for Steamboat Lake only were available for one day in July 2006. Elkhead Reservoir had one-half of the sites and 44 percent of the samples with water-quality data; data were collected between July 1995 and August 2001.

Analysis of lake and reservoir data is restricted to those sites with long-term data collection and(or) recent (after 1994) data. Sites are grouped for analysis based on site and data similarities. Data for Lake Elbert and Long Lake are analyzed together. Analysis of data for Stagecoach Reservoir is limited to samples collected on July 25, 2006. These data are compared to data collected in Steamboat Lake on the same day. Water quality of Elkhead Reservoir was analyzed in detail by Kuhn and others (2003) and is summarized here.

Lake Elbert and Long Lake Reservoir were sampled 2–5 times per year during the open-water season (July-October) (Mast and others, 2005). Grab samples were collected manually from the shore at locations with little or no vegetation. Both lakes were very dilute, with median specific conductance concentrations were 11.1 and 19.7 uS/cm (table 18). Conductance typically was lower during snowmelt runoff when lake water was diluted than later during summer when groundwater discharge had a larger effect on water chemistry. Values of pH were similar for the two reservoirs, ranging from 6.2 or 6.3 to 8.2 or 8.4. Median pH was slightly more acidic in Lake Elbert. Values of pH in 17 samples from Lake Elbert and one sample from Long Lake Reservoir were less than the CDPHE water-quality minimum standard of 6.5 for aquatic-life protection; these occurred during July or August. Hardness and ANC reflected the lakes' location in areas with Precambrian igneous rocks that react slowly to weathering. Low ANC (17.9 mg/L or less) indicates that both lakes are sensitive to acidic deposition. Hardness, ANC, and sulfate concentrations were higher in Long Lake Reservoir, reflecting a greater influence of groundwater on water quality and differences in biogeochemistry (Mast and others, 2005). Little or no decrease in sulfate concentrations was detected with a decrease in sulfate emissions from a nearby upwind powerplant and a related decrease in atmospheric deposition of sulfate. However, there should be a decrease in lake sulfate at some time in the future because of the reduction in atmospheric deposition (Mast and others, 2005). Most (119 of 135) nitrate concentrations were less than detection levels of 0.01 and 0.007 mg/L. Mast and others (2005) report that the Lake Elbert and Long Lake Reservoir watersheds are less sensitive to atmospheric deposition of nitrogen than reservoirs in the Front Range of Colorado because of a greater capacity for nitrogen assimilation. Unfiltered total phosphorus concentrations were 0.02 mg/L or lower. All dissolved manganese concentrations were less than the aquatic-life standard. Water-supply standards for dissolved iron and manganese rarely were exceeded. Concentrations in one sample from Lake Elbert and two samples from Long Lake Reservoir collected before 1989 exceeded the dissolved iron standard. The standard for dissolved manganese was exceeded in one sample collected from Long Lake Reservoir during 1987.

Table 18. Summary statistics of the number of sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for select physical properties, sulfate, and select nutrients and trace elements in Lake Elbert and Long Lake Reservoir, Upper Yampa River watershed, Colorado, 1983 through 2009.

Depth-profile measurements for July 26, 2006 for one site near the dam in Stagecoach Reservoir and Steamboat Lake were compiled for water temperature, specific conductance, pH, and dissolved oxygen (fig. 14). Samples also were collected near the water surface and near the bottom of the water column for analysis of physical properties, major ions and selenium, nutrients, trace elements, and chlorophyll *a*. Values for selected physical properties and constituents in the near surface and near bottom samples are shown in table 19.

Figure 14. Water temperature, specific conductance, pH, and dissolved-oxygen profiles for A) Stagecoach Reservoir and B) Steamboat Lake, Upper Yampa River watershed, Colorado, April 25, 2006.

Table 19. Concentrations of select physical properties, sulfate, select nutrients and trace elements, and chlorophyll *a* in near-surface and near-bottom water-quality samples, Stagecoach Reservoir and Steamboat Lake, Upper Yampa River watershed, Colorado, July 25, 2006.

Vertical stratification within the water column was evident for water temperature, specific conductance, pH, and dissolved oxygen (fig. 14). Water temperature at the site near the dam in each reservoir was similar at the surface, around 22°C, and lower (less than 6°C) at depth in Stagecoach Reservoir than in Steamboat Lake (8.4°C or greater). Specific conductance was much higher for Stagecoach Reservoir. The Yampa River and other tributaries to the reservoir drain areas overlying sedimentary rocks. Tributaries to Steamboat Lake primarily drain areas with more resistant igneous and metamorphic rocks. Water clarity, as measured by Secchi depth transparency, was less in Stagecoach Reservoir. This is probably due to an increased amount of dissolved constituents in the reservoir water as compared to Steamboat Lake. Water column pH was lower (around 7.2–7.5) in Steamboat Lake. There were no exceedences of the CDPHE water-quality standard for pH of 6.5–9.0. Anoxic conditions at depth were indicated for both bodies of water; dissolved-oxygen concentrations were less than 1 mg/L starting around 19 ft below the water surface in Stagecoach Reservoir and around 22 ft below the water surface in Steamboat Lake. Loss of oxygen primarily is due to oxygen consumption at the sediment-water interface where bacterial decomposition of sediment organic matter is greatest and use of oxygen by aquatic organisms in the water column (Wetzel, 1983). Stagecoach Reservoir is on the State of Colorado Monitoring and Evaluation list for dissolved oxygen (table 5) (Colorado Department of Public Health, 2010b).

Concentrations of chemical constituents in both bodies of water were lower near the water surface than near the bottom of the water column except for total phosphorus in Stagecoach Reservoir (table 19). Concentrations of nitrate less than the detection limit in near-surface samples probably indicates biological uptake of the nutrient. Hardness, ANC, sulfate, and total phosphorus in near-surface and near-bottom samples were higher in Stagecoach Reservoir because of sedimentary rocks in the drainage basin for the reservoir. Dissolved and total recoverable iron and dissolved manganese were higher in Steamboat Lake, probably because of the composition of igneous and metamorphic rocks in the reservoir drainage basin. Chlorophyll *a* was an order of magnitude higher in Stagecoach Reservoir than Steamboat Lake. With only one sample, it is not possible to explain this difference in chlorophyll *a* concentration.

The study of water-quality in Elkhead Reservoir from July 1995 through August 2001 indicated seasonal changes in water quality for many physical properties and chemical constituents (Kuhn and others, 2003). Depth-profile measurements showed that the lake stratified during summer and late winter and mixed during spring and fall. Temperature ranged from about 0°C during winter to about 20°C during summer. Specific conductance was lowest (138 µS/cm) during snowmelt runoff and highest (610 µS/cm) during early spring when streamflow was low. Values of pH indicated neutral to slightly alkaline conditions; median pH near the water surface ranged from 7.2 to 8.0. Median dissolved-oxygen concentrations were around 7.1 and 7.2 in near-surface samples and from 4.8 to 5.6 mg/L at depth during stratification. Some measurements of dissolved oxygen showed anoxic conditions during stratification; concentrations at depth were around 1.0 mg/L or less. The range in median water clarity was 3.0 to 4.3 ft. Median dissolved nitrate plus nitrite concentrations ranged from 0.006 to 0.020 mg/L in near-surface samples and from 0.005 to 0.172 mg/L in near-bottom samples. Median phosphorus concentrations were slightly lower (0.018 to 0.0128 mg/L) in near-surface samples than near-bottom samples (0.028 to 0.058 mg/L). Median concentrations of chlorophyll a were 1.1 µ/L or less at all sites. The trophic state of the reservoir ranged from oligotrophic (nutrient poor) to eutrophic (nutrient rich). More (52 percent) samples indicated that phosphorus was the limiting nutrient rather than nitrogen (9 percent of samples). Elkhead Reservoir and Lake Catamount, south from Steamboat Springs, have fish consumption advisories for mercury (*http://www.cdphe.state.co.us/wq/FishCon/*, accessed October 2010) (table 5).

Groundwater

Water-quality data for groundwater in the UYRW were available for 328 wells. Six wells were sampled by the CDOA during 1998, and 322 wells were sampled by the USGS from 1975 through 1989 (fig. 15, table 3, Appendix 5). Wells were concentrated in the middle two-thirds of the watershed west from the mountains. A total of 1,590 samples were collected–six by the CDOA and 1,584 by the USGS. For the USGS wells, 817 samples had water-quality data and 767 samples only had data for water-level measurements. This count of water-quality data for the USGS does not include multiple water-quality samples collected on the same day at a site or 219 water-level measurements collected on the same day at a site as the water-quality sample but at a different time. Almost 66 percent (214 of 322) of the USGS wells with water-quality data only were sampled once. Each CDOA well was sampled once in 1998. Samples with water-quality data most commonly were collected during 1975, 1978, and 1988 (table 20). The fewest samples were collected during 1984, 1986, and 1998; no samples were collecting during 1985 and 1990 through 1997. All water-quality samples for groundwater but one had data for physical properties; the fewest data were available for organic carbon, stable isotopes, and radiochemical constituents. Analysis of water-quality data for groundwater will focus on one sample per day for physical properties, TDS, major ions, nutrients, and trace elements.

Figure 15. Location of groundwater wells with water-quality data, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.

Table 20. Period of record and number of groundwater water-quality samples collected per year by constituent group, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.

For all CDOA wells and about 29 percent of the USGS wells, no aquifer description was provided with the well-construction data. Wells with an aquifer description were located in 12 geologic units, most commonly the floodplain alluvium and Mesaverde Group (table 21). Water-quality samples most often were collected from the unknown aquifer and Mesaverde Group, and terrace alluvial aquifers. In ascending order, the stratigraphy of the Upper Cretaceous and Tertiary formations with aquifers discussed in this report are Mancos Shale, Mesaverde Group, Lewis Shale, and Browns Park Formation. The alluvial aquifer occurs along the stream valleys and is Quaternary in age. The Mancos Shale predominately is mudrock that formed in the marine environment of the Western Interior Seaway. It grades into the Mesaverde Group which consists of marine and nonmarine deposits of sandstone, shale, and coal beds that formed with the regression and transgression of the Western Interior Seaway. The Lewis Shale is composed of shale, siltstone, and smaller amounts of sandstone that formed in an offshore marine environment. The Tertiary Browns Park Formation includes riverine sandstone, conglomerates, and siltstone that eroded from nearby mountains and volcanic ash. The alluvium is unconsolidated gravel, sand, silt, and clay derived from rock and soil erosion. The quality of groundwater in the aquifers is a function the depositional environment and of various geochemical processes that include dissolution of soluble minerals in the aquifers and related soil and ion exchange and oxidation-reduction processes. Published information on groundwater quality that includes areas within the UYRW is available from the Ground Water Atlas of Colorado for alluvial aquifers in the Yampa River basin, Precambrian crystalline and tertiary igneous rock aquifers, and sedimentary rock aquifers of the Sand Wash basin (Topper and others, 2003). Groundwater quality for the upper part of the Mesaverde Group (Twentymile aquifer and the Williams Fork aquifer) in the Yampa coal field is discussed in Robson and Stewart (1990).

Table 21. Number of groundwater wells and samples by sample type and geologic unit, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.

Physical Properties

Data for physical properties for groundwater were available for 816 water-quality samples collected from 328 wells. Water temperature and specific conductance data were most common; dissolved-oxygen concentrations were the least common (table 22). Specific conductance ranged from 50 to 15,900 µS/cm, with a median of 1,170 µS/cm (table 22). No aquifer description was available for the sample with the maximum conductance. Conductance typically was lower in the Browns Park Formation than in the alluvium, Lewis and Mancos Shales, and Mesaverde Group (fig. 16), probably reflecting the nonmarine depositional environment of the Browns Park Formation and the marine depositional environment of the latter three geologic units. Values of pH ranged 5.3 to 12.3, and the median was 7.6. About 6 percent (42 of 667) pH values did not meet the CDPHE SMCL of 6.5–9.0 (table 23) (Colorado Department of Public Health and Environment, 2009b). Values less than 6.5 were measured in 14 samples from 13 wells, most commonly in samples from wells in the unknown aquifer and Mesaverde Group. Values greater than 9.0 were measured in 28 samples from 17 wells, most commonly in alluvium and the Mesaverde Group. Water temperature ranged from 2 to 95°C, with a median of 10.5°C. The maximum value was measured in the Mesaverde Group and probably represents water heated at depth. About 31 percent (36 of 116) of samples from 16 wells in the unknown aquifer and Mesaverde Group aquifer had a dissolved-oxygen concentration of less than 1 mg/L, indicating anoxic conditions.

Figure 16. Specific conductance in well-water samples by geologic unit, Upper Yampa River watershed, Colorado, 1975 through 1986.

Table 22. Summary statistics of the number of wells and samples, minimum, median, and maximum values and Colorado Department of Public Health and Environment water-quality standards and number of exceedances for selected physical properties and water-quality constituents in groundwater, Upper Yampa River watershed, Colorado, 1975 though 1989 and 1998.

Table 23. Geologic units with exceedances of Colorado Department of Public Health and Environment water-quality standards for groundwater for selected physical properties and water-quality constituents, Upper Yampa River watershed, Colorado, 1975 through 1989.

Total Dissolved Solids and Majors ions

Data for total dissolved solids was available for 564 samples collected from 179 wells (table 22). Concentrations ranged from 46 to 8,490 mg/L, with a median of 812 mg/L. Among the geologic units, the median concentration was lowest (289 and 329 mg/L) in the floodplain alluvial and Browns Park Formation aquifers, respectively, and highest (894 mg/L) in the Mesaverde Group aquifers.

Major ion data typically were available for 554 or more samples (table 22) collected from 186 wells. A total of 185 samples with data for the cations calcium, magnesium, sodium, and potassium and the anions bicarbonate, chloride, fluoride, and sulfate were used to calculate water type. Calcium was the dominant cation in the Browns Park Formation aquifer, and calcium and magnesium were the dominant cations in the floodplain alluvial and Lewis Shale aquifers (fig. 17). All three geologic units had one or two samples with sodium plus potassium as the dominant cation. For the other geologic units shown in fig. 17, no one cation was dominant in the aquifers, and the water type for cations mostly was mixed between calcium, magnesium, and sodium plus potassium. In the Williams Fork aquifer of the Mesaverde Group, the dissolution of calcite and dolomite from limey shales, limestones, and dolomitic limestones is a source of calcium and magnesium (Robson and Stewart, 1990). In areas with marine shales, the exchange of calcium and magnesium ions in solution with sodium ions on the clay minerals in sodium-rich marine shales is the principal source of sodium in the groundwater (Robson and Stewart, 1990). Bicarbonate was the dominant anion in the floodplain alluvium, Browns Park Formation, and Lewis and Mancos Shale aquifers; bicarbonate and sulfate were dominant in the terrace alluvium and Mesaverde Group. Dissolution of carbonate minerals likely is the source of bicarbonate; sulfate may occur because of the dissolution of gypsum and oxidation of the minerals pyrite and marcasite (Robson and Stewart, 1990). Insufficient leaching of materials in soil from the lack of precipitation in a semiarid climate may cause sulfate to remain near the land surface (Hem, 1992), possibly accounting for higher sulfate concentrations in the terrace alluvial aquifer.

Figure 17. Cation and anion percentiles and water type by geologic unit for groundwater samples, Upper Yampa River watershed, Colorado, 1975 through 1986

Dissolved sulfate concentrations ranged from less than 1 to 4,000 mg/L, with a median of 220 mg/L (table 22). For the geologic units, the median sulfate concentration was lowest (5.9 mg/L) in the Browns Park Formation aquifer and highest (330 mg/L) in the terrace alluvial aquifer; the median ranged from 49 to 140 mg/L for the floodplain alluvial, Lewis and Mancos Shale, and Mesaverde Group aquifers. Concentrations in about one-half (250 of 554) of the well-water samples for sulfate were greater than the CDPHE SMCL of 250 mg/L for groundwater (table 23) (Colorado Department of Public Health and Environment, 2009b). About 51 and 57 percent of the samples collected from the terrace alluvial and Mesaverde Group aquifers did not meet the standard; 47 percent of samples from wells with no aquifer description also did not meet the standard.

Most (539 of 554) dissolved chloride concentrations were less than the SMCL of 250 mg/L (Colorado Department of Public Health and Environment, 2009b). Concentration ranged from 0.5 to 5,000 mg/L, and the median was 10 mg/L (table 22). For the geologic units, median concentrations were 8.3 mg/L or less in the floodplain alluvial, Browns Park, and Mesaverde aquifers and in wells without an aquifer description. Median concentrations of 12 and 21 mg/L in the Mancos and Lewis Shales, respectively, probably reflect the marine origin of the formations. The highest (46 mg/L) median concentration was in the terrace alluvial aquifer. About 2.7 percent (15 of 554) of samples collected between 1975 and 1982 had chloride concentrations that did not meet the CDPHE SMCL (table 23). Most (9 of 15) exceedences were in samples with no aquifer description; three exceedances each were in samples from the Mancos Shale and Mesaverde Group aquifers.

Dissolved fluoride concentrations in well-water samples ranged from 0.1 to 15 mg/L, with a median of 0.4 mg/L (table 22). All geologic units except the terrace alluvium had a median concentration of 0.4 mg/L or less, the terrace alluvium median was 0.7 mg/L. Five of 557 dissolved fluoride concentrations did not meet the CDPHE MCL of 4 mg/L for groundwater (Colorado Department of Public Health and Environment, 2009b). One exceedance, the maximum concentration of 15 mg/L, was in a sample from the Browns Park Formation aquifer, and two were in samples from the Mancos Shale aquifer. Well-completion data were not available for two other samples exceeding the fluoride standard.

Nutrients

Nutrient data were available for 508 samples (table 20) collected from 189 wells. Dissolved nitrate plus nitrite samples were most common (473 samples); total unfiltered phosphorus samples were least common (42 samples) (table 22). Most (139 of 142) samples for dissolved nitrite were from wells with no aquifer description; three samples were from the Mesaverde Group. All dissolved nitrite concentrations were 0.26 mg/L or less, well below the CDPHE MCL for drinking water of 1 mg/L and the agricultural-use standard for livestock watering of 10 mg/L (Colorado Department of Public Health and Environment, 2009b). Data for dissolved nitrate plus nitrite (NO_{23}) were available for all geologic units listed in table 21, most commonly for samples from wells with no aquifer description (254 samples) and the Mesaverde Group (122 samples). Median concentrations were less than 1 mg/L for all geologic units except for the terrace alluvium (1.5 mg/L) and Lewis Shale (1.1 mg/L). About 4.4 percent (21 of 473) of the NO_{23} samples has concentrations that exceeded the CDPHE HH standard of 10 mg/L (table 22). Exceedances occurred in samples from eight geologic units (table 23) that were collected before 1980 and during 1988 and 1989 and were most common in samples collected from wells in the Yampa coal field. One exceedance occurred in a sample from a well (site 197) just upstream from Stagecoach Reservoir and one from a well (site 482) upstream from Elkhead Reservoir. No NO_{23} concentrations exceeded the agricultural-use standard for livestock watering of 100 mg/L Data for dissolved total phosphorus were available for well samples with no aquifer description (189 samples), terrace alluvium and Mesaverde Group (44 samples each), and Lewis Shale (1 sample). Unfiltered total phosphorus data only were available for 42 samples (table 22) from the floodplain alluvium, Eocene series, Lewis and Mancos Shales, Mesaverde Group, unknown aquifer, and valley-fill deposits. Concentrations of dissolved and unfiltered total phosphorus were 0. 33 mg/L or less except for a concentration of 0.76 from a well (site 355) with no aquifer description. About 95 percent of the concentrations were less than 0.1 mg/L. Concentrations greater than 0.1 mg/L were detected in samples from wells in the terrace alluvium (5 samples), unknown aquifer (4 samples), Mesaverde Group (2 samples), and one sample from the Lewis and Mancos Shales in the Yampa coal field. The CDPHE has not established water-quality standards for dissolved and unfiltered total phosphorus in groundwater.

Trace Elements

Trace-element data were available for 609 samples from 190 wells. Samples included data for the dissolved constituents and total recoverable iron listed in table 22 that are discussed in this report and also for total recoverable copper, dissolved lithium and vanadium, and unfiltered and total recoverable manganese. More than 500 samples had concentration data for dissolved boron, iron, manganese, and zinc; the fewest samples (22) were available for dissolved antimony (table 22). More than 80 percent of the data for dissolved antimony, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, and silver were less than laboratory reporting levels. The highest concentrations (3,600 µg/L or more) detected were for dissolved aluminum and boron, dissolved and total recoverable iron, and dissolved manganese, strontium, and zinc. All concentrations of dissolved antimony, chromium, copper, nickel, and silver met CDPHE MCLs or SMCLs for groundwater. The HH standard for dissolved lead was exceeded in one sample from the Mesaverde Group aquifer at site 286 near the mouth of Middle Creek (table 23); no samples had concentration greater than the agricultural-use standard for livestock watering of 1,000 µg/L. The HH standard for dissolved molybdenum was exceeded in one sample from the Mancos Shale aquifer at site 467 just northwest of Steamboat Springs (table 23). The MCL for dissolved beryllium was exceeded in two samples (site 329) from the unknown aquifer. The MCL for dissolved cadmium was exceeded in less than 4 percent (13 of 329) of samples (table 23), three samples from the Mesaverde Group aquifer near Foidel Creek and ten samples from unknown aquifer near Fish Creek and between Grassy and Sage Creeks in the Yampa coal field. No standard has been established for cobalt.

Data for dissolved aluminum were available for wells with no aquifer description (268 samples), Mesaverde Group aquifer (58 samples) and floodplain alluvial aquifer (1 sample). The median concentration was 10 µg/L for the Mesaverde Group and unknown aquifer; the maximum concentration was detected in a well sample from the unknown aquifer. No domestic water-quality standard has been established by the CDPHE for dissolved aluminum. All aluminum concentrations were less than the agricultural-use standard for livestock watering of 5,000 µg/L. Arsenic data primarily were available for wells in the unknown aquifer (291 samples) and the Mesaverde Group (82 samples); 22 or fewer samples were available from the alluviums, Browns Park Formation, and Lewis and Mancos Shales. All dissolved arsenic concentrations but one were 8 µg/L or less, most (365 of 446) were 1 µg/L or less. Only one sample collected during 1975 from the floodplain alluvial aquifer at site 238 had a concentration (160 µg/L) that did not meet the CDPHE MCL of 10 µg/L for dissolved arsenic (table 23). Data for dissolved barium only were available for samples from the unknown aquifer. All seven dissolved barium concentrations of 200 µg/L or more were detected in samples from one well (site 312) located near an unnamed tributary to Fish Creek in the Yampa coal field. Dissolved boron data most commonly were available for the unknown aquifer (309 samples), the Mesaverde Group (119 samples), and the terrace alluvium (88 samples). The median concentration in the terrace alluvial aquifer of 1,300 µg/L was greater than all concentrations in other aquifers except one value of 1,400 µg/L for a sample from the unknown aquifer. The highest concentrations (2,000 µg/L or more) were detected in samples from wells in the vicinity of the mouth of Sage Creek near Hayden. Water-quality standards for barium and boron have not been established by the CDPHE.

Dissolved iron data were available for 574 samples from every lithology listed in table 21. Most samples were collected from the unknown lithology (329 samples), Mesaverde Group (127 samples) and terrace alluvium (65 samples). The highest median concentrations were for samples from the valley-fill deposits (115 µg/L), Mancos Shale (80 µg/L), and Mesaverde Group (50 µg/L) and lowest (less than 10 µg/L) for the Browns Park Formation. Individual samples with concentrations greater than 2,000 µg/L were collected from the unknown aquifer (5 samples), Mesaverde Group (3 samples), and one sample each from the floodplain alluvium, Mancos Shale, and valley-fill deposits. The CDPHE SMCL for dissolved iron was exceeded in 10 percent (60 of 574) samples collected between 1975 and 1989, most commonly for the unknown aquifer (table 23). Exceedances were concentrated in the Yampa coal field. Data for total recoverable iron only were available for 109 samples; 55 and 53 samples from the unknown lithology and the Mesaverde Group aquifers, respectively, and one sample from the floodplain alluvial aquifer. The median concentration for the first two aquifers was 3,700 and 1,400 µg/L, respectively. Concentrations greater than 10,000 µg/L were detected in samples from wells near Fish, Trout, and Grassy Creeks in the Yampa coal field. All three aquifers had one or more samples with a concentration greater than 79,000 µg/L.

Dissolved manganese data were available for all geologic units, especially the unknown aquifer (318 samples), Mesaverde Group (110 samples), and terrace alluvium (67 samples). Median concentrations were 30 µg/L or less for aquifer samples from the floodplain alluvium, Browns Park Formation, and Lewis and Mancos Shales; the median for the Browns Park Formation was the lowest at less than 10 µg/L. Median concentrations for the terrace alluvium (70 µg/L) and Mesaverde Group and unknown aquifer (60 µg/L each) were greater than the CDPHE SMCL for manganese of 50 µg/L, as were single concentrations for the Upper Cretaceous series (60 µg/L), valley-fill deposits (70 µg/L), and Precambrian Erathem (110 µg/L). In total, the CDPHE SMCL for dissolved manganese was exceeded in more than one-half (284 of 548) of the samples; most commonly for the unknown aquifer (table 23). Exceedances were concentrated in the Yampa coal field; a few (7) exceedances were just downstream from Steamboat Springs (site 440), just north and northwest from Steamboat Springs (sites 443, 464, 467), the Elk River valley (sites 480, 501), and the Elkhead Creek basin (site 475).

Data for dissolved selenium were available for all geologic units, primarily for the unknown aquifer (332 samples), Mesaverde Group (128 samples), and terrace alluvium (81 samples). Most (439 of 594) concentrations were less than reporting limit of 1 µg/L (table 22). The median concentration of 4 µg/L for the terrace alluvial aquifer was the only median greater than 1 mg/L; the maximum concentration of 27 µg/L was detected in a sample from this aquifer. There were no exceedences of the CDPHE MCL for selenium of 50 µg/L (Colorado Department of Public Health and Environment, 2009b). Except for 217 samples from wells with no aquifer description, data for dissolved strontium were available for nine or fewer samples from the alluvial floodplain, Browns Park and Curtis Formations, Mancos Shale, Mesaverde Group, and Precambrian Erathem aquifers. Median concentrations were the highest (680 µg/L) in the unknown aquifer and higher (495 and 330 µg/L) in the Mesaverde Group and Mancos Shale, respectively. Concentrations greater than 1,000 µg/L typically were detected in samples from multiple wells in the unknown aquifer near an unnamed tributary to Fish Creek and between Grassy and Sage Creeks in the Yampa coal field and one well each in the Mancos Shale and unknown aquifer near Mad Creek northwest from Steamboat Springs. The CDPHE has not established a water-quality standard for strontium in groundwater. Data for zinc were available for all geologic units except the Eocene and Upper Cretaceous series and the Fort Union Formation; data were most common for the unknown aquifer (316 samples), Mesaverde Group (102 samples), and terrace alluvium (66 samples). About 27 percent (138 of 514) of the samples had concentrations less than laboratory reporting levels. The highest median concentrations were for samples from the Browns Park Formation and Mancos Shale aquifers, 265 and 220 µg/L, respectively. Concentration greater than 1,000 µg/L were detected in well-water samples from aquifers in the floodplain alluvium, Lewis Shale, Mancos Shale, and Mesaverde Group, and the unknown aquifer; the wells were located throughout the UYRW. The CDPHE SMCL for zinc of 5,000 µg/L was not exceeded.

Macroinvertebrates

Data on macroinvertebrate communities and population were available for 66 stream sites in the UYRW for various periods of time between 1975 and 2008 (fig. 18, Appendix 6). Data consists of counts of the number of individuals within a given taxa. About 38 percent (25 of 66) of sites were sampled once by the USGS during August and September 1975. The CDPHE collected macroinvertebrate data at 37 sites during most years from 1997 through 2008. Sample collection occurred during April and July through October; three or fewer samples were collected at each site. Data were made available from the State of Colorado Ecological Data Application System (Chris Theel, written commun., 2009). These data are included in an Ecological Monitoring and Assessment Program report (Colorado Department of Public Health and Environment, 2007). Data on macroinvertebrate communities and population also have been collected by GEI Consultants, Inc., for the City of Steamboat Springs; population data for various taxa were available for four sites on the Yampa River within the city limits for one day during the middle of September 2005 and 2007 and late August 2008 (GEI Consultants, Inc., 2007, 2008). Data were collected to determine if changes in the macroinvertebrate community occurred throughout the study reach or through time. USGS macroinvertebrate data are available at *http://rmgsc.cr.usgs.gov/cwqdr/Yampa/index.shtml*). CDPHE and GEI Consultants, Inc., macroinvertebrate data are available at the Colorado Division of Wildlife Data Sharing Network [get address from Barb Horn (CDOW) when data upload is finally complete].

Figure 18. Location of stream sites with macroinvertebrate data, Upper Yampa River watershed, Colorado, 1975 through 2008.

Detailed analysis of the macroinvertebrate data is beyond the scope of this report. However, results of macroinvertebrate sampling at the four Yampa River sites within the Steamboat Springs city limits can be summarized from the 2008 GEI Consultants, Inc., report (GEI Consultants, Inc., 2008). For the 2008 sampling, density (number of individuals per square meter) was the highest at the most downstream site. Insects were the most commonly collected taxa throughout the study reach; crustaceans, and snails and clams occurred in small numbers in the reach. Segmented worms increased in density from upstream to downstream and represented a significant part of the aquatic community at the most downstream site. The macroinvertebrate community at the most downstream site was more tolerant of poor water quality than the communities upstream. This may indicate that macroinvertebrates in the river were affected by water quality; however, other characteristics of the macroinvertebrate community such as species richness did not indicate that a problem exists because of water quality. Many of the changes in community characteristics during the years from 2004 through 2008 occurred throughout the study reach, and no negative changes were unique to downstream sites. This may indicate that changes in community characteristics are due to natural variation rather than human activities.

Synthesis of Water-Quality Data in the Upper Yampa River watershed

Water-quality data for 5,862 samples collected from 1975 through 2009 at 211 stream sites in the UYRW were analyzed for this report. Samples were collected from streams throughout much of the watershed except for a large area in the northern one-third of the watershed and some areas in the southern part of the watershed. Long-term data collection was limited. Only one site, Yampa River at Steamboat Springs, was sampled every year during the study period. However, data for sites sampled by the CDPHE only were available through 2007. About one-half of the sites had data for five or fewer samples.

Analysis of stream data for specific conductance illustrates many of the findings that also were identified for others physical properties and constituents. Specific conductance of a stream sample depended in large part on the underlying geology of the stream's drainage basin. Low (less than 50 µS/cm) specific conductance values were most common in streams in the subbasin Yampa River from the Chuck Lewis State Wildlife Area to the Elk River and the Elk River subbasin. The geology in these subbasins mostly is comprised of igneous and metamorphic rocks that are resistant to weathering. With less weathering, streams contain fewer dissolved constituents and have lower specific conductance. Streams in the Yampa River subbasins downstream from the Elk River, in contrast, commonly had specific conductance values greater than 1,000 µs/cm. Streams in these areas primarily have drainage basins that are underlain by Cretaceous-age sedimentary rocks, particularly those of marine origin. Sedimentary rocks, including shales and sandstones, are more susceptive to weathering. The weathering results in an increase in dissolved constituents in streams and higher specific conductance. Higher values or concentrations can occur naturally in a stream because of natural conditions. Another finding illustrated by specific conductance in streams is the seasonal variability in value or concentration of many constituents due to streamflow. Throughout the watershed, specific conductance was lowest during snowmelt runoff when there was increased dilution and higher during most other times of the year with lower streamflow and more baseflow from groundwater. Only three sites had sufficient (10 years or more of at least quarterly data collection ending after 2000 and less than 10 percent censored data) long-term data that could be tested for temporal trends. Trend analysis of data for other constituents, including other physical properties, dissolved solids, selected major ions, total phosphorus, and some trace elements, could only be conducted for one site. Few stream sites had data collection for 10 years or more. For many sites, there was a gap in yearly data collection or sample collection was concentrated during the warmer months of the year rather than at least quarterly sampling during a year.

This demonstrates the need for consistent (throughout a year and for many years) long-term data collection at a site for temporal trend analysis of water-quality data and also to identify emerging changes in water quality.

Values of pH and dissolved oxygen for many samples were within CDPHE water-quality standards. However, five sites with pH data and two sites with dissolved oxygen data were not in attainment of CDPHE standards. Four sites with pH less than the standard of 6.5 were in the subbasins Yampa River from the Chuck Lewis State Wildlife Area to the Elk River and the Elk River with naturally lower pH due to geology and lower steam alkalinity (lower capacity to buffer inputs of acidic water). Acidic drainage is not a water quality issue of concern in the Yampa coal field because of the lack of sulfuric acid formation and higher buffering capacity. Values of PH greater than the maxima standard were more common than those less the standard minima. Many higher values occurred during summer afternoons when photosynthesis activity was higher than others times of the day. One issue of water-quality concern in the UYRW is water temperature, particularly in the Yampa River in Steamboat Springs. Many values measured in the Yampa River in Steamboat Springs, particularly those during late July and early August were not in attainment of the CDPHE standard for cold water. Higher water temperatures can stress aquatic life.

Concentrations of total dissolved solids, major ions, nitrate, and many trace elements tended to be higher in the subbasins downstream from the Elk River than in other subbasins because of the prevalence of sedimentary rocks in these areas. Materials weathered from the sedimentary rocks contain a large amount soluble minerals and trace elements. Exceedance or non-attainment of CDPHE water-quality standards based on the 85th percentile of data were recorded for total dissolved solids, total recoverable iron, unfiltered sulfate, and dissolved, copper, iron, manganese, and selenium, especially for manganese. Concentration greater than standards were most common in the Upstream Lewis and Lewis

SWA to Elk River subbasins. Standards have not been established for many stream segments in the Elk River to Hayden, and Downstream Hayden subbasins because of naturally-high concentrations for many constituents. Another issue of water-quality concern in the UYRW is total phosphorus in streams. High concentrations were detected throughout the watershed and could result from naturally-high concentrations in some sedimentary rocks, urban and agricultural runoff, wastewater treatment plant effluent, and animal waste. Elevated concentrations can result in excessive amounts of algae. A statistically significant upward trend in flow-adjusted concentrations of unfiltered total phosphorus of 0.001 mg/L per year was identified Yampa River at Steamboat Springs for 1997-2008. The 85th percentile of data for total phosphorus was greater than USEPA recommended concentrations in every subbasin except the Elk River and Downstream Hayden subbasins. The *E. coli* standard for recreation was exceeded in five samples. Three stream segments are on the CDPHE list of impaired waters or monitoring and evaluation list for *E. coli*.

Long-term data collection only occurred for two lakes and reservoirs; samples were collected in Lake Elbert and Long Lake Reservoir from the mid-1980s and 2008. Recent data (data collected after 1994) were available for Stagecoach Reservoir, Steamboat Lake, and Elkhead Reservoir. Values of pH in less than the CDPHE minima were more common in Lake Elbert than Long Lake Reservoir. Both bodies of water are sensitive to acidic deposition from precipitation because of a very low buffering capacity. Stagecoach Reservoir, Steamboat Lake, and Elkhead Reservoir thermally stratified during summer. Each body of water exhibited anoxic conditions during summer; dissolved-oxygen concentrations at depth were less than 1 mg/L. Low dissolved oxygen is an issue of concern for Stagecoach Reservoir; the reservoir is on the CDPHE monitoring and evaluation list for dissolved oxygen. Many physical properties and constituents for Elkhead Reservoir exhibited seasonal changes in water quality. The reservoir's trophic state was oligotrophic to eutrophic, and phosphorus was the limited nutrient in more samples than nitrogen. Elkhead Reservoir and Lake Catamount, south from Steamboat Springs, have fish consumption advisories for mercury.

Groundwater data from 1975 through 1989 and for 1998 were analyzed. No data were in the UYRW water-quality database for 1990 through 1997 and there was no recent data (data collected after 1989). A total of 328 wells and 1,590 samples were collected. Except for six CDOA wells and samples, all wells and samples were for the USGS. Wells were concentrated in the middle two-thirds of the watershed west from the mountains. Extensive data collection was limited; almost 66 percent of wells sampled only had data for one sample. No aquifer description was available for about 29 percent of the wells. The remaining wells were completed in 12 geologic units, primarily the Mesaverde Group and the floodplain alluvium. Eight of 12 geologic units and the unknown aquifer had more than three samples; most commonly the unknown aquifer. Mesaverde Group, and terrace alluvium. Groundwater quality depended on the depositional environment of the geologic material and various geochemical processes.

Specific conductance typically was lower in the Browns Park Formation than other geologic units and the unknown aquifer, as were median concentrations of total dissolved solids, and dissolved sulfate and chloride. This most likely is due to the riverine depositional environment of the formation rather than a marine environment and the presence of sandstones and conglomerates rather than shale. The highest median concentrations of dissolved sulfate and chloride were in samples from the terrace alluvium. This could reflect insufficient leaching of material from the alluvium because of the semi-arid climate. Higher concentrations of sulfate may occur naturally because geochemical process involving gypsum and minerals containing sulfur. In the marine Lewis and Mancos Shales, chloride could result from ion exchange in clays. The CDPHE standard in sulfate was exceeded in about one-half of the samples collected. The chloride standard was exceeded in less than 3 percent of samples.

Other CDPHE standards that rarely (less than 6 percent of samples) were exceeded were those for pH, and dissolved fluoride and NO_{23}. Except for 5 samples of NO_{23} collected during 1988 and 1989, all exceedances occurred before 1980. Exceedances of the NO_{23} standard were most common in samples from wells in the Yampa coal field.

Many trace elements in groundwater would not be issues of concern because of low concentrations; 80 percent of more of the concentrations for many trace elements were less than laboratory reporting levels. CDPHE water-quality standards were exceeded in one or two samples for dissolved arsenic, lead, molybdenum, and beryllium, and in less than 4 percent of samples for dissolved cadmium. Trace elements with higher concentrations in groundwater samples were dissolved aluminum, and boron, dissolved and total recoverable iron, and dissolved manganese, strontium, and zinc. Of these, the most important for water quality were dissolved iron and manganese. The CDPHE standard for dissolved iron was exceeded in 10 percent of samples, and the standard for dissolved manganese was exceeded in more than one-half of the samples collected. Exceedances for dissolved iron and manganese were common for samples collected from wells in the Yampa coal field. High concentration of these trace elements and other properties and constituents, including specific conductance, hardness, alkalinity, total dissolved solids, sulfate, NO_{23}, and other trace elements, in samples from wells in the Yampa coal field are reflected in higher concentrations of these properties and constituents in stream water samples from sites in the Elk River to Hayden and Downstream Hayden subbasins that include the Yampa coal field.

Summary

Around 2006, stakeholders in the UYRW in northwestern Colorado expressed a need for a compilation and evaluation of the available historic water-quality data in the watershed to assess effects of growth, identify temporal and spatial gaps within available data, and evaluate data for spatial and temporal trends. The U.S. Geological Survey (USGS), in cooperation with Routt County, the Colorado Water Conservation Board, and the City of Steamboat Springs, initiated a study in late 2008 to compile water-quality data and assess water-quality conditions in the watershed. This assessment of water quality in the UYRW includes surface water and groundwater data collected from 1975 through 2009 that were available in an electronic UYRW water-quality database. Water-quality data were compiled from the USGS National Water Information System, the USEPA Storage and Retrieval database, and City of Steamboat Springs (data collected by GEI Consultants, Inc.) This report presents summary, spatial and temporal distribution, temporal trend analysis, and comparison to State and Federal water-quality standards and recommendations of data for selected physical properties and chemical constituents collected from streams, lakes and reservoirs, and groundwater wells from 1975 through 2009. The availability and characteristics of macroinvertebrate data for the watershed are discussed. The UYRW includes the Elkhead Creek drainage basin and the Yampa River drainage basin upstream from Elkhead Creek.

Data for physical properties, total dissolved solids and major ions, nutrients, trace elements and uranium, suspended sediment, and coliform bacteria collected from 211 stream sites throughout most of the watershed were analyzed. More sites were sampled in the subbasin Yampa River upstream from the Chuck Lewis State Wildlife than other subbasins in the watershed; more samples also were collected in this subbasin than other subbasins. A total of 5,862 samples were collected. Physical properties (specific conductance, pH, water temperature, dissolved oxygen, hardness, and acid neutralizing capacity) were collected at nearly all stream sites and in the greatest number of samples. Suspended-sediment data were collected at the fewest number of sites and in the fewest number of samples. For all physical properties and chemical constituents, five or fewer samples were collected at almost one-half of the stream sites.

Low (less than 50 µS/cm) specific conductance values were most common in headwater tributaries with drainage basins that are underlain with igneous and metamorphic rocks are resistant to weathering; higher (greater than 1,000 µS/cm) specific conductance values were more common in areas with sedimentary rocks that are more susceptive to weathering. A statistically significant (p-value 0.03) trend in a downward direction was identified for 1997 through 2008 for specific conductance measured at the Yampa River at Steamboat Springs site; the rate of change was about 6 µS/cm/year. Most values of pH, water temperature, and dissolved oxygen met CDPHE water-quality standards. However, five sites had pH values that were not in attainment of the CDPHE aquatic-life standard of 6.5–9.0; four less than 6.5 were sampled before 1988 and one greater than 9.0 was sampled from 1999 through 2002. Sites not in attainment were in the Yampa River from Chuck Lewis State Wildlife Area to Elk River subbasin (four sites) and the Elk River subbasin (one site). Water temperature measured at the Yampa River at Steamboat Springs site from July 2002 through December 2004 did not meet the CDPHE aquatic-life standards for cold water for 16 percent of samples days for the DM and 26 percent for the MWAT. One Little White Snake Creek site and one Martin Creek site were not in attainment of the dissolved-oxygen aquatic-life standard of 6.0 mg/L. Only the Little White Snake Creek site was sampled after 2000. This stream is on the CDPHE Monitoring and Evaluation list for 2010. Streams with a lower capacity to neutralize inputs of acidic water were more common in the Yampa River from Chuck Lewis State Wildlife Area to Elk River subbasin and the Elk River subbasin than other subbasins in the watershed. Streams least likely to neutralize acidic inputs drain mountainous areas that are susceptible to acidic precipitation.

The 85th percentile concentration of TDS at one site on Trout Creek site was greater than the non-enforceable SMCL of 500 mg/L. This site in the subbasin Yampa River from Elk River to Hayden has a drainage basin that is underlain by sedimentary rocks that likely contribute to increased concentrations of TDS. The primary water type throughout the watershed except for the Yampa River downstream from Hayden subbasin was calcium bicarbonate. No water type was dominant in the Yampa River downstream from Hayden subbasin. Unfiltered sulfate data for one Little White Snake Creek site and one Trout Creek site were not in attainment of the CDPHE water-quality standard of 250 mg/L. Both sites have drainage basins that are underlain by sedimentary rocks. All dissolved and unfiltered chloride concentrations met the CDPHE water-quality standard of 250 mg/L. Standards for sulfate and chloride have not been established for some stream segments because of naturally high concentrations in the streams. Data for TDS, calcium, magnesium, sodium, potassium, sulfate, chloride, and silica collected at the Yampa River at Steamboat Springs site from 1997 through 2008 were tested for temporal trends. The only statistically significant trend identified was a downward trend in TDS; the p-value and rate of change were 0.03 and 3.9 mg/L/yr, respectively.

Concentrations of dissolved nitrite were 0.01 mg/L or less in 85 percent of samples collected and all samples collected in the last 10 years. All stream sites were in attainment of the CDPHE aquatic-life standard of 0.05 mg/L for nitrite. More than 50 percent of dissolved nitrate data for many stream sites in the UYRW were reported as less than detection levels. Only one sample collected after 1988 had a dissolved nitrate concentration that was greater than 1 mg/L. Among all samples, concentrations were highest in the Yampa River subbasins downstream from the Elk River. All sites in the UYRW were in attainment of the CDPHE drinking-water MCL for nitrate of 10 or 100 mg/L. The standard of 100 mg/L was established for some stream segments because of naturally high concentrations of nitrate. Unfiltered total ammonia concentrations in four samples collected at three sites during 1975 or 1976 were greater than the calculated CDPHE standard for each sample. Median unfiltered total phosphorus concentrations were 0.06 mg/L or more in the subbasin upstream from the Chuck Lewis State Wildlife Area and Yampa River subbasins downstream from the Elk River. Concentrations greater than USEPA recommended levels of 0.5 or 0.1 mg/L to control downstream eutrophication were detected in 12 percent (193 of 1,583) of individual samples collected from more than 32 sites, most commonly during some years before 1993 and 1997–2002, 2002, 2007. A statistically significant (p-value=0.038) trend in an upward direction for flow-adjusted concentrations of unfiltered total phosphorus of 0.001 mg/L/year was identified for 1997–2008 for the Yampa River at Steamboat Springs site (site 153). This may reflect population growth and land-use changes that have occurred upstream from the site.

Two-thirds or more of the concentration data for dissolved and total recoverable cadmium, chromium, lead, nickel, and silver, dissolved copper and zinc, and total recoverable mercury were less than laboratory reporting levels. Elevated concentrations were highest for total recoverable iron, aluminum, and manganese, and dissolved iron, manganese, and strontium. Many of the maximum detected concentrations for these and other trace elements were in samples collected in the Yampa River subbasins downstream from the Elk River. CDPHE water-quality standards were met for many trace elements. However, four and five stream sites with dissolved copper and total recoverable iron data, respectively, were not in attainment of the CDPHE standards for the protection of aquatic life. All data except that for one dissolved copper site were collected before 1998. Four stream sites were not in attainment of the water-supply standard for dissolved iron; data primarily were collected during the last 10 years. Nonattainment of the water-supply standard for dissolved manganese occurred at 18 stream sites. Sites not in attainment of the aquatic-life and water-supply standards were most common in the Yampa River subbasins downstream from the Elk River. Aquatic-life standards for dissolved selenium were not met at seven sites in the subbasin upstream from Chuck Lewis State Wildlife Area and the Yampa River subbasins downstream from the Elk River. The sites not in attainment are in areas underlain by Lewis and Mancos Shales, lithologic formations that are seleniferous. Dissolved uranium data only were available for 51 samples. One sample collected during 1983 had a concentration that was greater than the USEPA drinking-water standard of 30 µg/L.

Coliform bacteria data were available for 432 samples collected from 89 stream sites during 1975–76 and 1998–2009, most commonly from sites in the Lewis SWA to Elk River subbasin and during 1975, 1976, 2001, and 2002. Concentrations of total coliform were less than 400 col/100 mL in 80 percent of samples collected; all samples were collected during 1975 and 1976. Samples for E. coli were collected as late 2009. Concentrations of E. coli in five samples collected from 1994 through 2003 were greater than the CDPHE recreation standard of 126 col/mL. The two exceedances for the Yampa River at Steamboat Springs site and three exceedances for two Elkhead Creek sites could be due to recreational users of the river and wildlife and livestock. Concentrations of fecal coliform less than 200 col/100 ml in about 95 percent of the samples collected.

Water-quality data for five lakes and reservoirs in the UYRW were summarized or analyzed for this report. Data collected between the mid-1980s and 2008 were summarized for Lake Elbert and Long Lake Reservoir. Data collected in Stagecoach Reservoir and Steamboat Lake on one day in July 2006 were analyzed, and data collected from July 1995 through August 2001 were summarized for Elkhead Reservoir. Water in Lake Elbert and Long Lake Reservoir was very dilute; median specific conductance concentrations were 11.1 and 19.7 uS, respectively. The CDPHE minimum water-quality standard for pH of 6.5 was not met in 17 samples from Lake Elbert and one sample from Long Lake Reservoir. Low concentrations of ANC (17.9 mg/L or less) indicated that the reservoirs are sensitive to acidic deposition. Dissolved nitrate concentrations in 119 of 135 samples were less than reporting levels. Water-supply standards for dissolved iron and manganese rarely were exceeded. Concentrations in one Lake Elbert sample and two Long Lake Reservoir samples were greater than the dissolved iron standard. One Long Lake Reservoir sample had a concentration greater than the dissolved manganese standard.

All samples with exceedances were collected before 1989. Measurements of water temperature, specific conductance, pH, and dissolved oxygen in Stagecoach Reservoir and Steamboat Lake made on July 26, 2006, showed vertical stratification within the water column. Water clarity was less in Stagecoach Reservoir than Steamboat Lake. This probably is due to an increased amount of dissolved constituents in Stagecoach Reservoir as compared to Steamboat Lake. Dissolved-oxygen concentrations of less than 1 mg/L at depth in both bodies of water indicated anoxic conditions. Stagecoach Reservoir is on the State of Colorado Monitoring and Evaluation list for dissolved oxygen. Data collected in Elkhead Reservoir from July 1995 through August 2001 exhibited seasonal changes in the water quality of many physical properties and chemical constituents. The reservoir was stratified during summer and late winter and mixed during spring and fall. Dissolved-oxygen concentrations at depth of around 1.0 mg/L or less during stratification indicated anoxic conditions. The reservoir trophic state ranged from oligotrophic (nutrient poor) to eutrophic (nutrient rich). More (52 percent) samples indicated that phosphorus was the limiting nutrient rather than nitrogen (9 percent of samples).

Water-quality data for groundwater were available for 817 samples collected from 328 wells from 1975 through 1989 and 1998. About 66 percent of the wells only were sampled once. Wells were concentrated in the middle two-thirds of the watershed west from the mountains. No aquifer description was available for about 29 percent of the wells. Wells with an aquifer description most commonly were located in 12 geologic units, especially the floodplain alluvium and Mesaverde Group. Water-quality samples most often were collected from the unknown aquifer and Mesaverde Group and terrace alluvial aquifers. Three aquifers were marine in origin.

Specific conductance was higher in sedimentary rock aquifers of marine origin rather than the nonmarine sedimentary rock aquifer. About 6 percent of pH values did not meet the CDPHE SMCL of

6.5–9.0, most commonly in the unknown aquifer and the Mesaverde Group aquifer. These two aquifers were the only aquifers with dissolved-oxygen concentrations less than 1 mg/L.

Median total dissolved solids concentrations were highest in the Mesaverde Group and lowest in the floodplain alluvium and Browns Park Formation. The dominant cations were calcium and calcium-magnesium in some aquifers and mixed between calcium, magnesium, and sodium plus potassium in other aquifers. Bicarbonate or bicarbonate and sulfate were the dominant anions. Dissolved sulfate concentrations in about one-half of the samples were greater than the CDPHE SMCL of 250 mg/L, most commonly for samples from the terrace alluvium, Mesaverde Group, and unknown aquifer. The chloride SMCL of 250 mg/L and the fluoride MCL of 4 mg/L rarely were exceeded.

All dissolved nitrite concentrations were below the CDPHE standards for drinking water and livestock watering. Median dissolved NO_{23} concentrations were less than 1 mg/L in all geologic units except the terrace alluvium and Lewis Shale; the median concentrations for these aquifers was 1.5 and 1.1 mg/L, respectively. The CDPHE HH for dissolved NO_{23} was not met in 4.4 percent of samples, primarily in samples collected from wells in the Yampa coal field. Dissolved and unfiltered total phosphorus concentrations were less than 0.1 mg/L in 95 percent of all wells sampled.

Concentrations of dissolved antimony, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, and silver were low in the watershed; more than 80 percent of the samples collected for these trace elements had concentrations less than laboratory reporting levels. The highest concentrations (3,600 µg/L or more) were detected in samples for dissolved aluminum and boron, dissolved and total recoverable iron, and dissolved manganese, strontium, and zinc. CDPHE MCLs or SMCLs for groundwater were met for dissolved antimony, chromium, copper, nickel, and silver. The HH standard for dissolved lead and molybdenum and the MCL for dissolved arsenic, beryllium, and cadmium rarely were exceeded. These standards were exceeded in a total of 18 samples.

Dissolved iron concentrations were elevated in some samples; median concentrations were 50 µg/L or more for samples collected from aquifers in valley-fill deposits, Mancos Shale, and Mesaverde Group. Individual concentrations greater than 2,000 µg/L were detected in samples from these three aquifers and also from the unknown aquifer and floodplain alluvial aquifer. Dissolved iron concentrations in 10 percent of samples did not met the CDPHE SMCL of 300 µg/L, most commonly for samples from the unknown aquifer. Exceedances were concentrated in the Yampa coal field. Dissolved manganese concentrations also were elevated in some samples. Median concentrations were greater than the CDPHE SMCL of 50 µg/L in samples collected from the terrace alluvium, Mesaverde Group, and unknown aquifer and individual samples collected from the Upper Cretaceous series, valley-fill deposits, and Precambrian Erathem. In total, the CDPHE SMCL for dissolved manganese was not met for more than one-half of the samples collected, most commonly in samples from the unknown aquifer. were concentrated in the Yampa coal field.

Concentrations of dissolved selenium were less than laboratory reporting levels in about 74 percent of the samples collected. Only the median concentration of 4 µg/L for the terrace alluvium was greater than 1 µg/L. The CDPHE SMCL for dissolved selenium was not exceeded. Dissolved strontium data primarily were available for the unknown aquifer. Concentrations greater than 1,000 µg/L typically were detected in samples from multiple wells in the unknown aquifer in the Yampa coal field. About 27 percent of the data for dissolved zinc were less than laboratory reporting levels. The highest (220 µg/L or more) median concentrations of dissolved zinc were for samples collected from the Browns Park Formation and Mancos Shale aquifers. The CDPHE SMCL for zinc of 5,000 µg/L was not exceeded.

Macroinvertebrate community and population data were available for 66 stream sites in the UYRW for various periods of time between 1975 and 2008. Data were collected by the CDPHE, GEI Consultants, Inc., and the USGS. Detailed analysis of the macroinvertebrate data is beyond the scope of this report. A summary of community and population data collected once a year by GEI Consultants, Inc., at four Yampa River sites in Steamboat Springs between 2004 and 2008 did indicate that many changes in community characteristics during the study period occurred throughout the study reach, and no negative changes were unique to downstream sites. This may indicate that changes in community characteristics are due to natural variation rather than human activities.

Synthesis of water-quality data indicates that the values and concentrations of many physical properties and constituents in stream water samples were dependant on the geology of the drainage basin of a stream. Concentrations of many properties and constituents were lower in areas with less reactive igneous and metamorphic rocks and higher in areas with more sedimentary rocks, particularly in subbasins downstream from the Elk River. Many values and concentrations reflected natural conditions, including many higher concentrations. Analysis of data for changes in stream-water-quality over time was limited because of the absence of consistent long-term data collection in the watershed. Attainment of CDPHE water-quality standards for many constituents in stream water was met. Nonattainment of the standard for water temperature at one site and total phosphorus concentrations greater than USEPA recommended limits at many sites probably were the most important water-quality issues of concern for streams. An upward trend in total phosphorus concentrations was identified for one stream site. Hydrologic and channel modifications may be the cause of higher water temperatures in the Yampa River in Steamboat Springs. Some concentrations of total phosphorus are high because of geology; others could result from urban and agricultural runoff, treatment plant effluent, and animal waste.

Recent (collected after 1998) groundwater data were not available for analysis. Data collected from 1975 through 1989 and during 1998 indicated that values and concentrations of physical properties and constituents in groundwater samples were dependant on the depositional environment of the geologic material in the aquifer and various geochemical processes. Attainment of CDPHE water-quality standards were met and rarely exceeded for many constituents. However, the standards for dissolved sulfate and manganese were exceeded in about one-half or more of the samples collected. Higher values and concentrations of many physical properties and constituents in samples from wells in the Yampa coal field were reflected in higher concentrations in streams in subbasins that included the Yampa coal field.

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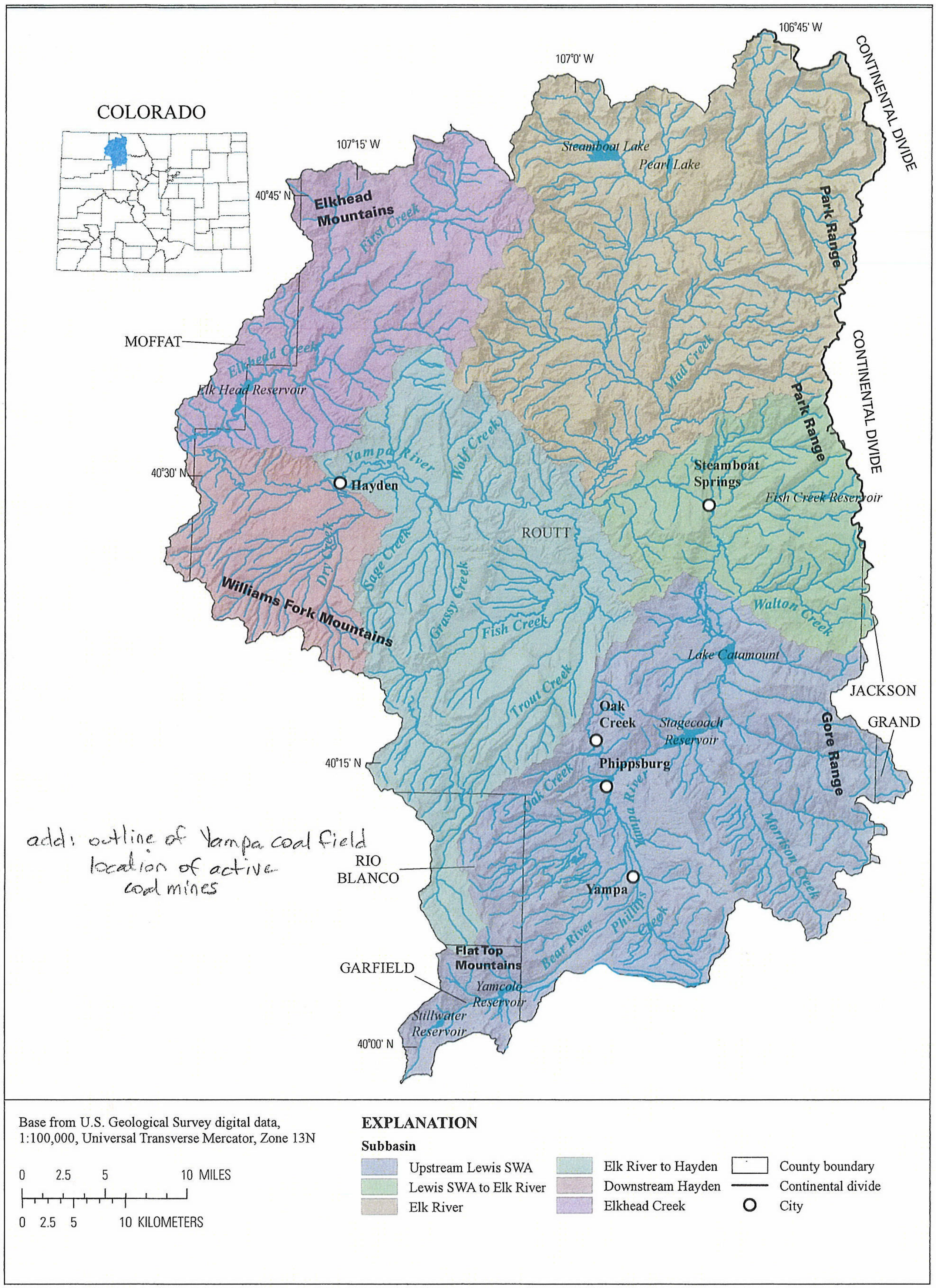


add: outline of Yampa coal field
location of active
coal mines

Figure 1. Location of the Upper Yampa River watershed, Colorado

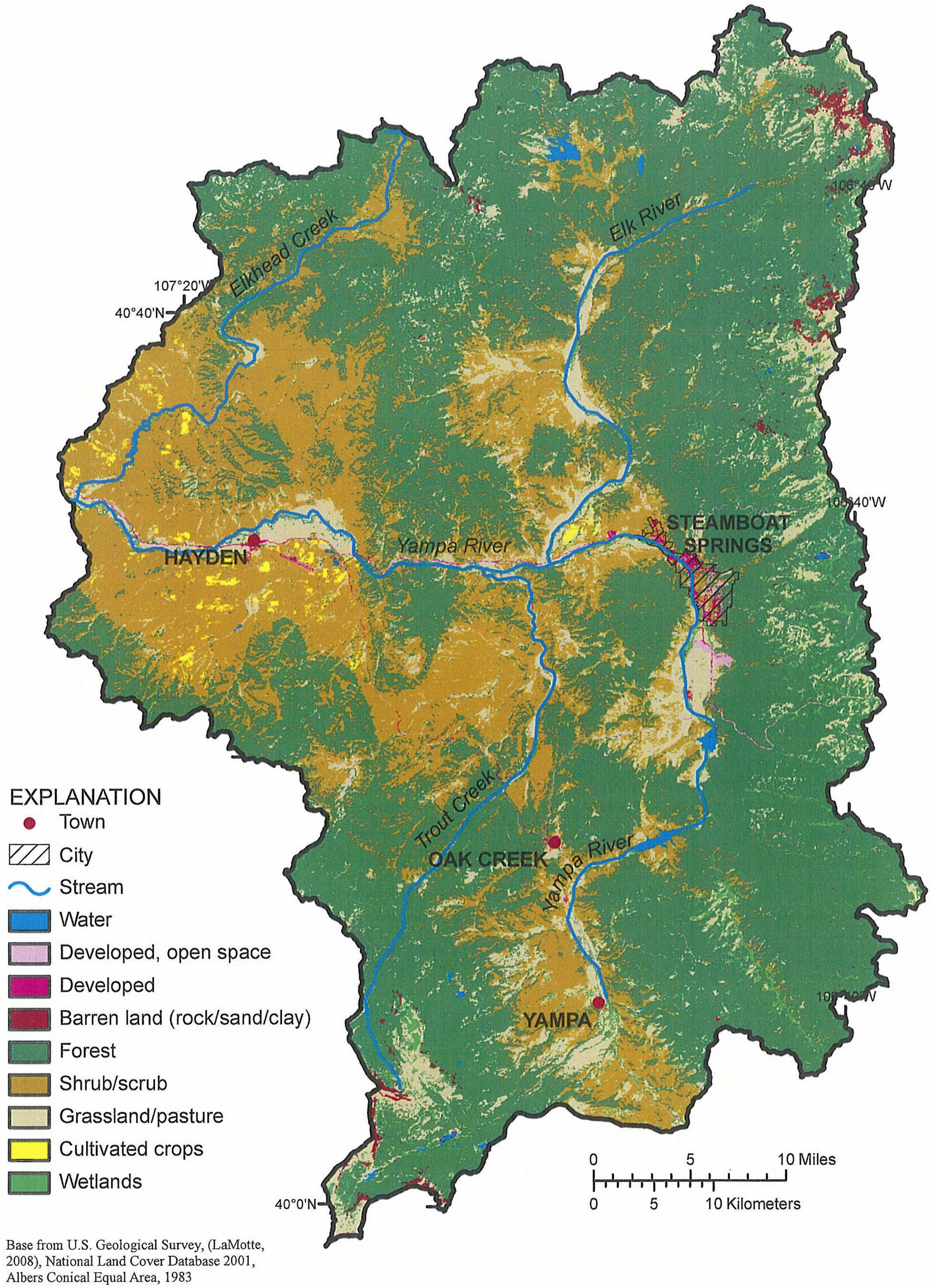
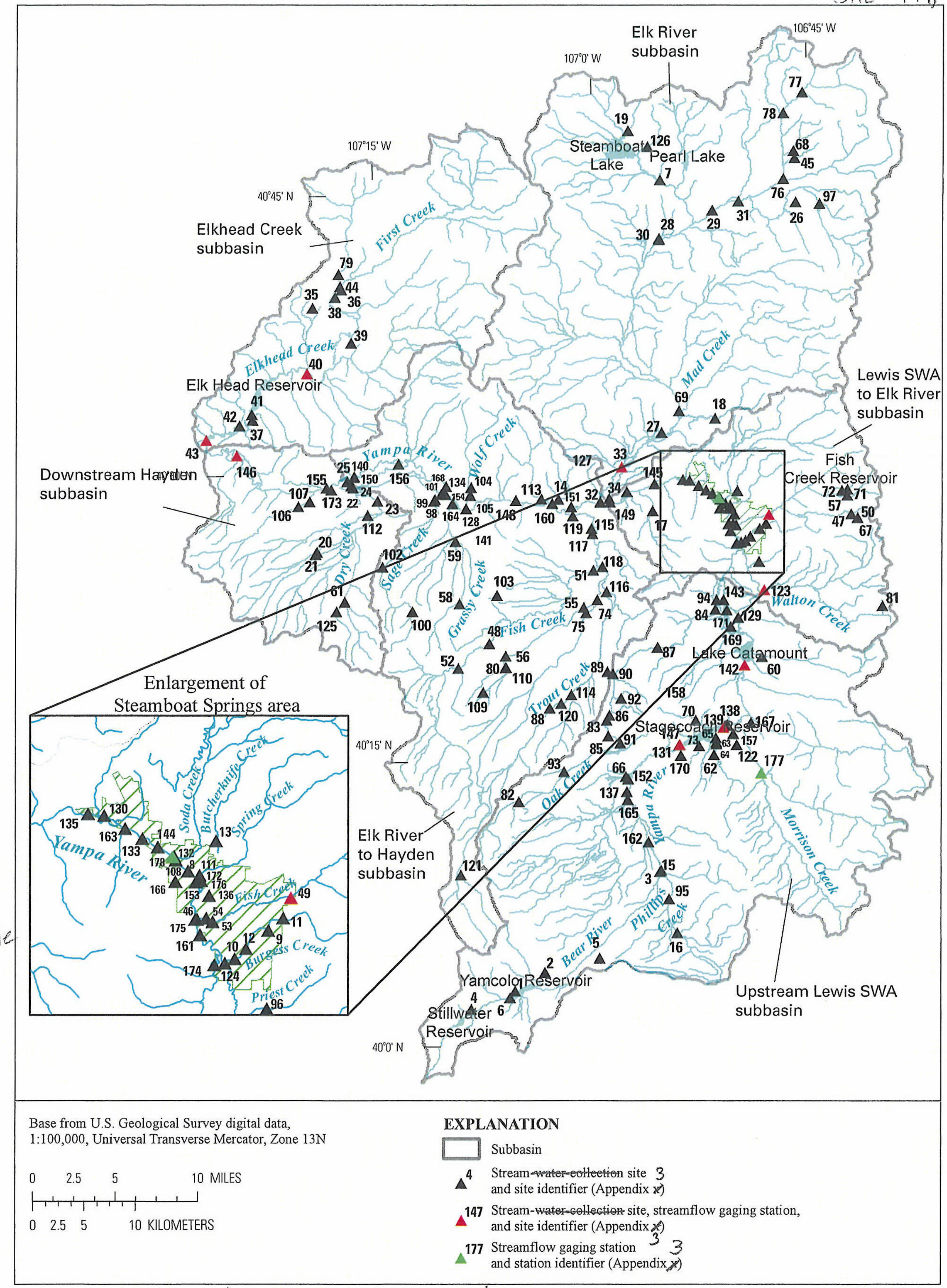


Figure 2. Landcover in the Upper Yampa River watershed, Colorado, 2001.

add gage: Willow Creek below Steamboat Lake (site #179, triangle in red)



need line from 158 to red triangle

change 53 triangle to red

Figure 3. Location of selected stream sites and active (water year 2010) streamflow-gaging stations, Upper Yampa River watershed, Colorado

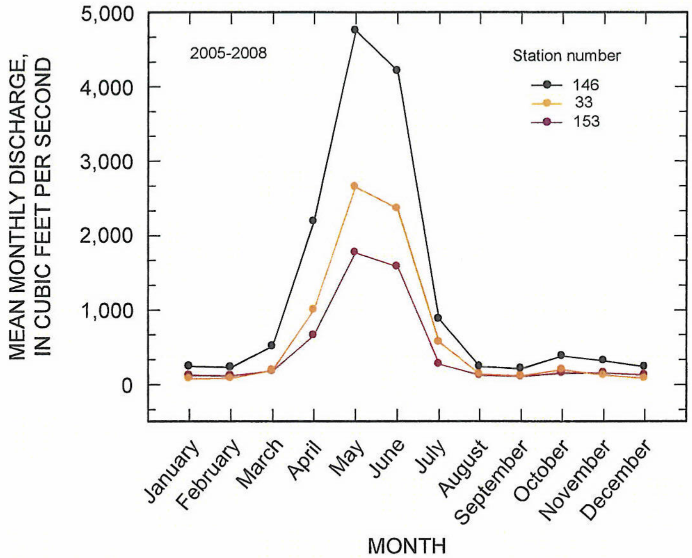
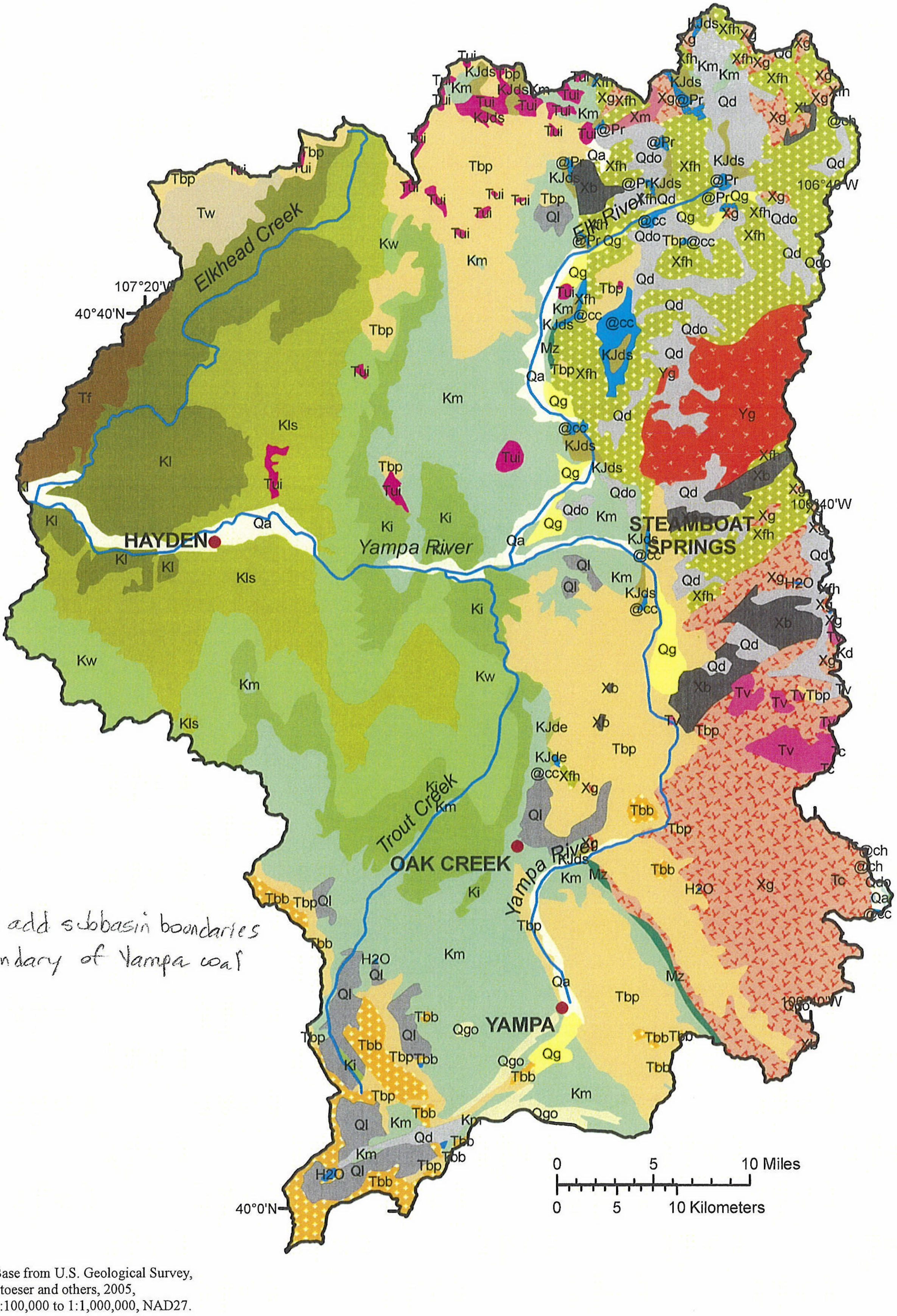


Figure 4. Mean monthly discharge for 2005-2008 for selected stations in the Upper Yampa River watershed, Colorado. See figure 3 for location of gaging stations and table 1 for station information.



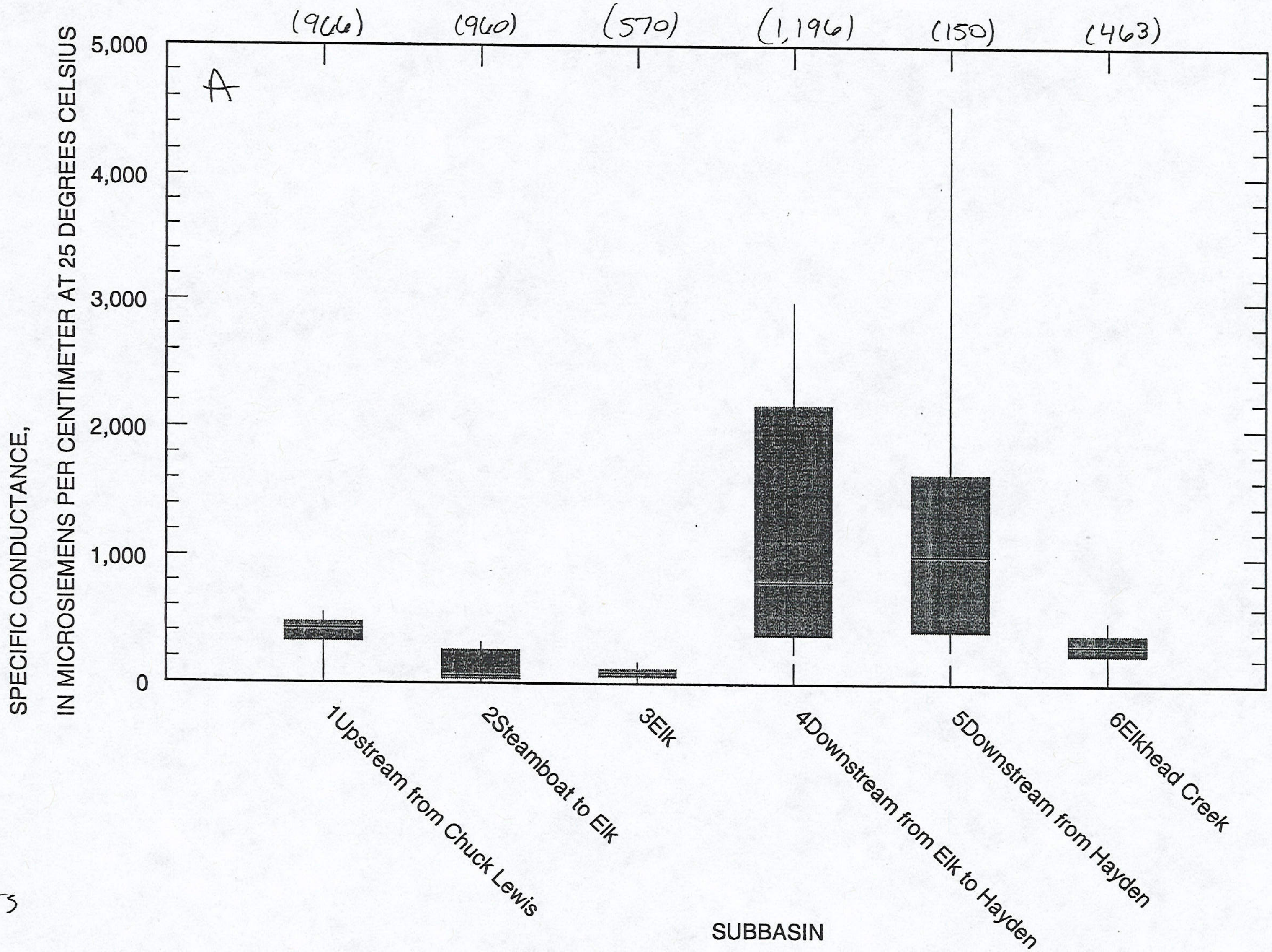
Need to add subbasin boundaries and boundary of Yampa coal field

Figure 5. Geology of the Upper Yampa River watershed, Colorado.

EXPLANATION

- Town
- City
- Stream
- Qa, Quaternary modern alluvium
- Qg, Quaternary gravels and alluvium
- Qgo, Quaternary older gravels and alluviums
- Qd, Quaternary glacial drift of Pinedale and Bull Lake Glaciations
- Qdo, Quaternary older glacial drifts
- Ql, Quaternary landslide deposits
- Tbp, Tertiary Browns Park Formation
- Tw, Tertiary Wasatch Formation
- Tc, Tertiary Coalmont Formation
- Tf, Tertiary Fort Union Formation
- Tbb, Tertiary basalt flows and tuff, breccia, and conglomerate of late-volcanic bimodal suite
- Tv, Tertiary volcanic rocks
- Tui, Upper Tertiary intrusive rocks of 20 Ma
- Kl, Cretaceous Laramie Formation-shales, claystone, sandstone, and major coal beds
- Kls, Cretaceoius Lewis Shale
- Kw, Cretaceous Williams Fork Formation-sandstone, shale, and major coal beds
- Kd, Createaceous Dakaota Sandstone
- Ki, Cretaceous Iles Formation-sandstone and shale.
- Km, Cretaceous Mancos Shale
- KJde, Cretaceous and Jurassic Dakota, Burro Canyon, Morrison, Wanakah, and Entrada formations
- KJds, Createaceous and Jurassic Dakota, Morrison, and Sundance formations
- Jms, Jurassic Morrison Formation and Sundance Formation (shale and siltstone), and Entrada Sandstone
- TRch, Triassic Chugwater Formation
- TRcc, Triassic Chinle and Chugwaters Formations
- TRPr, Triassic and Permian rocks
- Mz, Mesozoic rocks
- Xb, Precambrian bioitite gneiss, schist, and migmatite
- Xfh, Precambrian felsic and hornblende gneisses
- Yg, Precambrian granic rocks of 1,400 Ma
- Xg, Precambrian granitic rocks of 1,700 Ma
- Xm, Precambrian mafic rocks of 1,700 Ma
- Water

Figure 5. Geology of the Upper Yampa River watershed, Colorado--Continued.

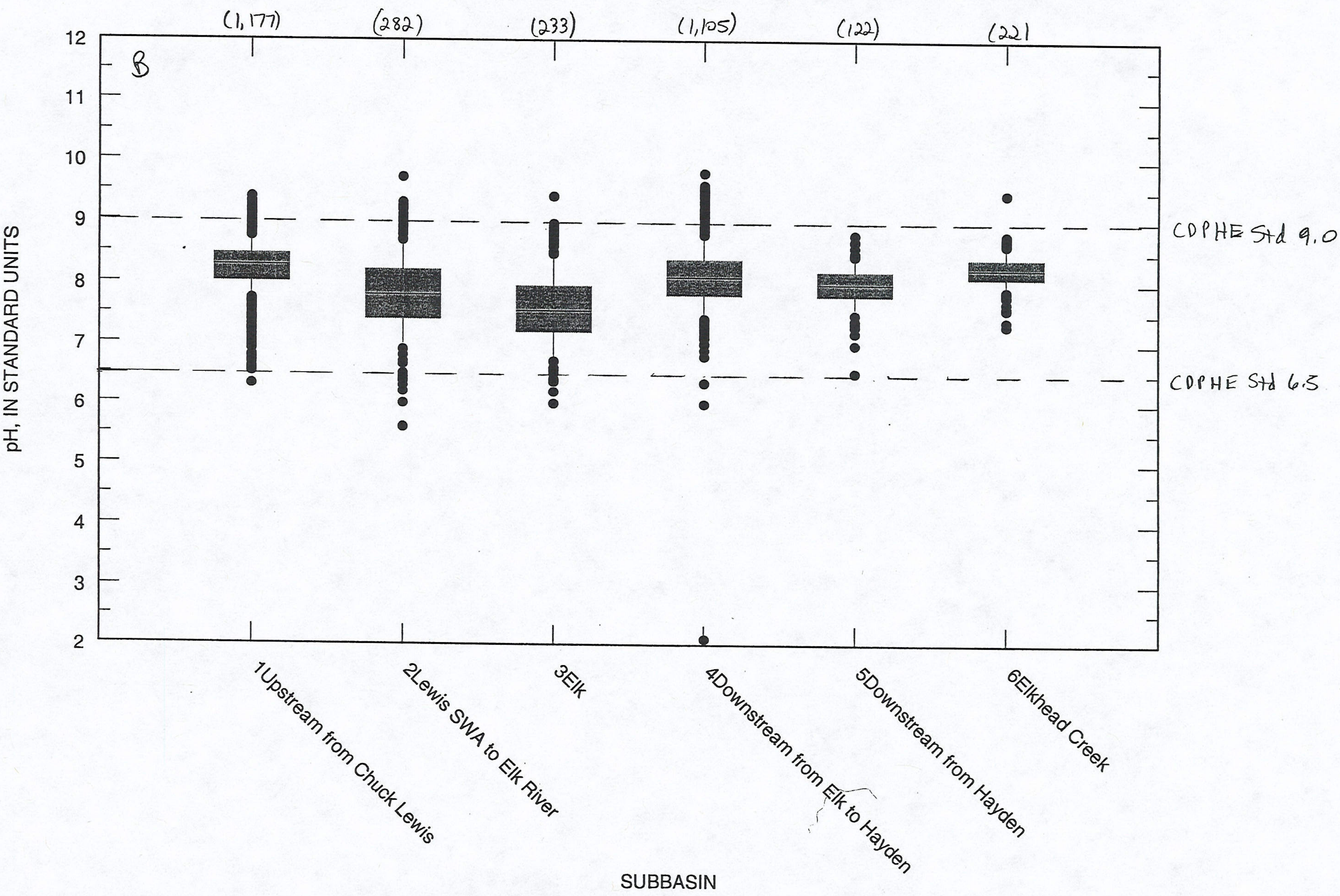


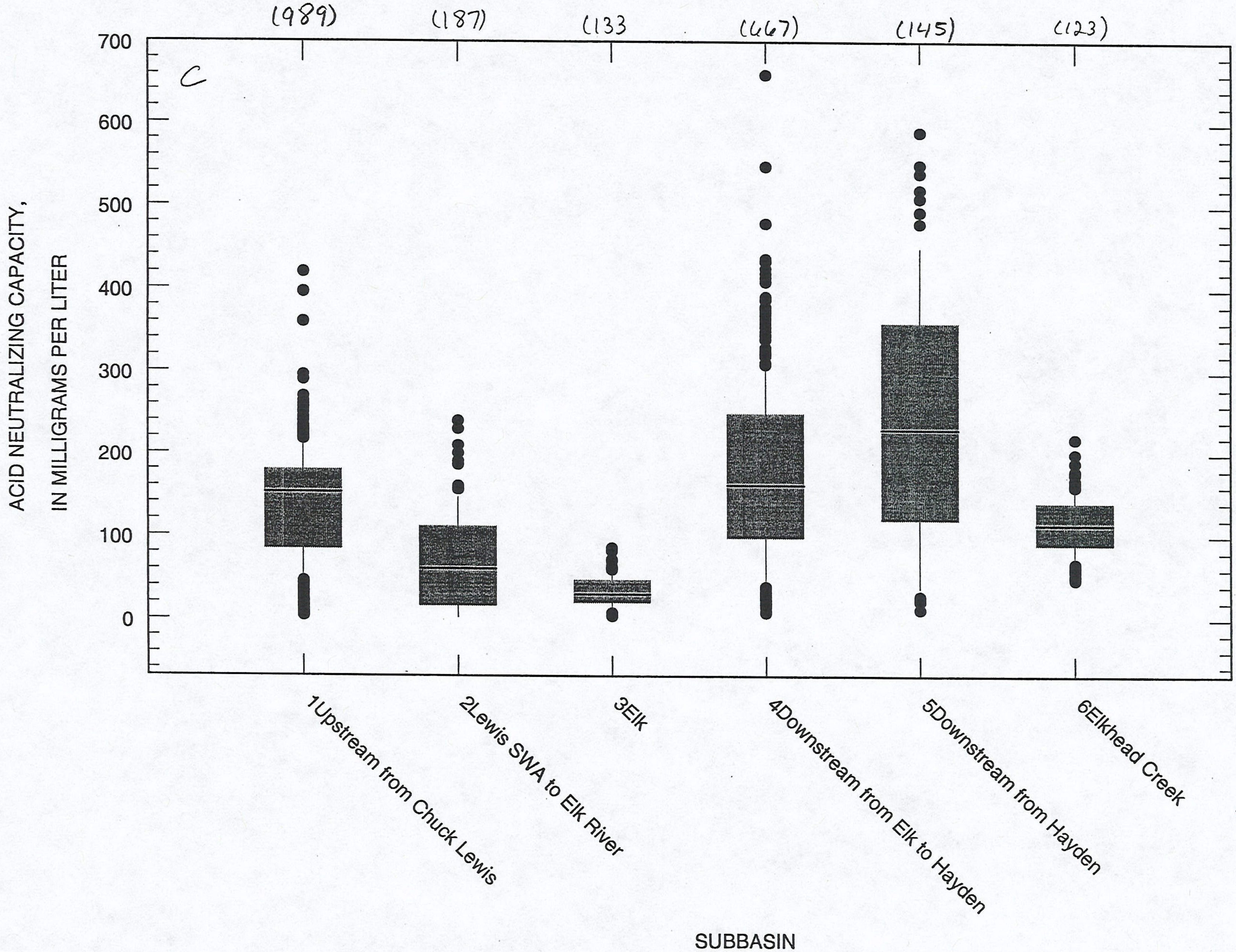
EXPLANATION
add

outliers not shown

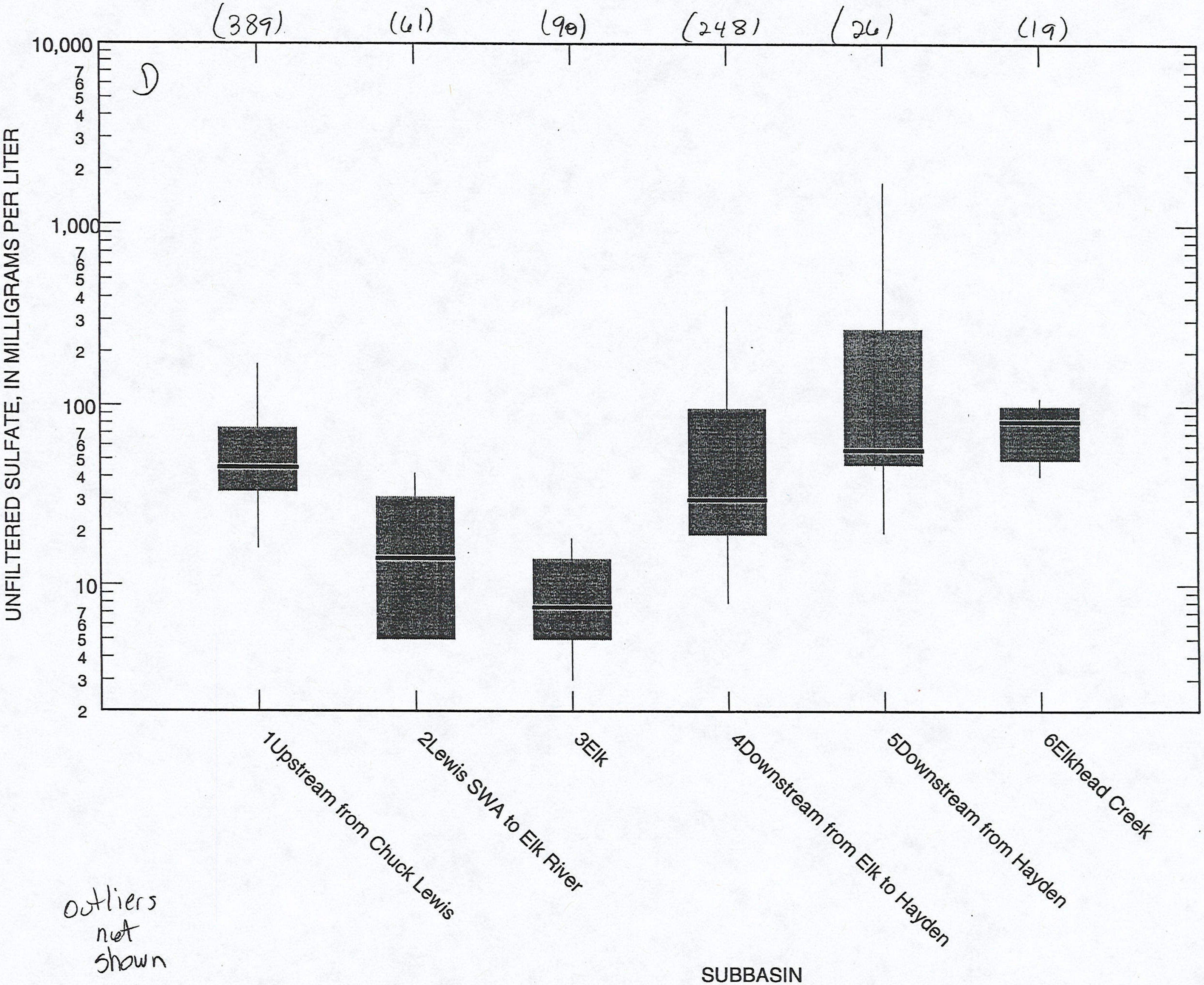
maybe cut bottom of boxes off at 50-censoring leve or add dashed box below 50 and add 'some values within dashed box were censored at 50 uS/cm'.

Figure 6. Distribution of A) specific conductance, B) pH, C) acid neutralizing capacity, D) unfiltered sulfate, E) unfiltered total phosphorus, and F) dissolved manganese by subbasin for stream water, Upper Yampa River watershed, Colorado, 1975 through 2009. Values less than and greater than the 10th percentile and 90th percentile of data, respectively, for specific conductance, unfiltered sulfate and dissolved manganese are not shown.


B
(1,177)
(282)
(233)
(1,105)
(122)
(221)
pH, IN STANDARD UNITS
12
11
10
9
8
7
6
5
4
3
2
CDPHE Std 9.0
CDPHE Std 6.5
1Upstream from Chuck Lewis
2Lewis SWA to Elk River
3Elk
4Downstream from Elk to Hayden
5Downstream from Hayden
6Elkhead Creek
SUBBASIN



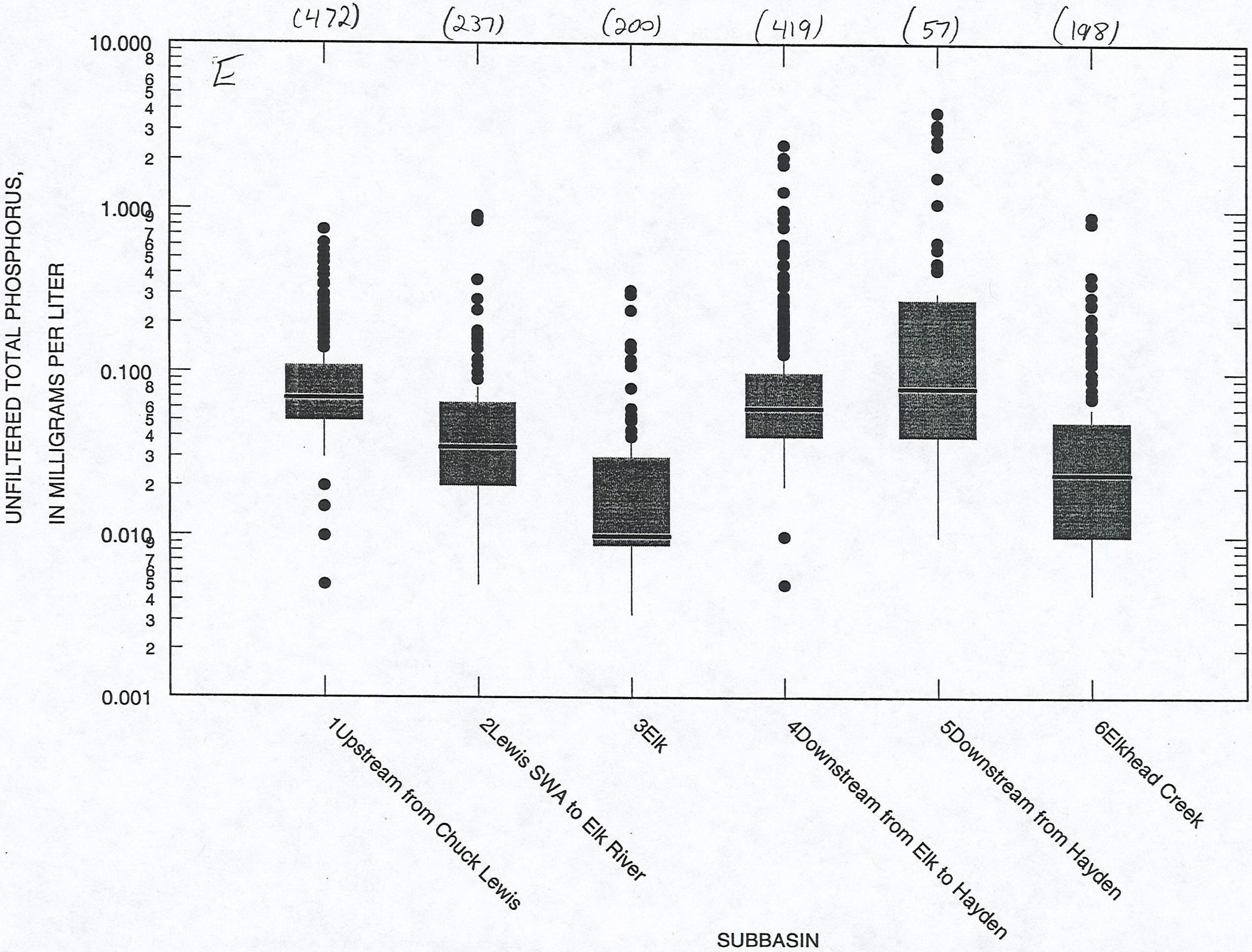
(989)
(187)
(133
(467)
(145)
(123)
C
ACID NEUTRALIZING CAPACITY,
IN MILLIGRAMS PER LITER
0
100
200
300
400
500
600
700
1Upstream from Chuck Lewis
2Lewis SWA to Elk River
3Elk
4Downstream from Elk to Hayden
5Downstream from Hayden
6Elkhead Creek
SUBBASIN



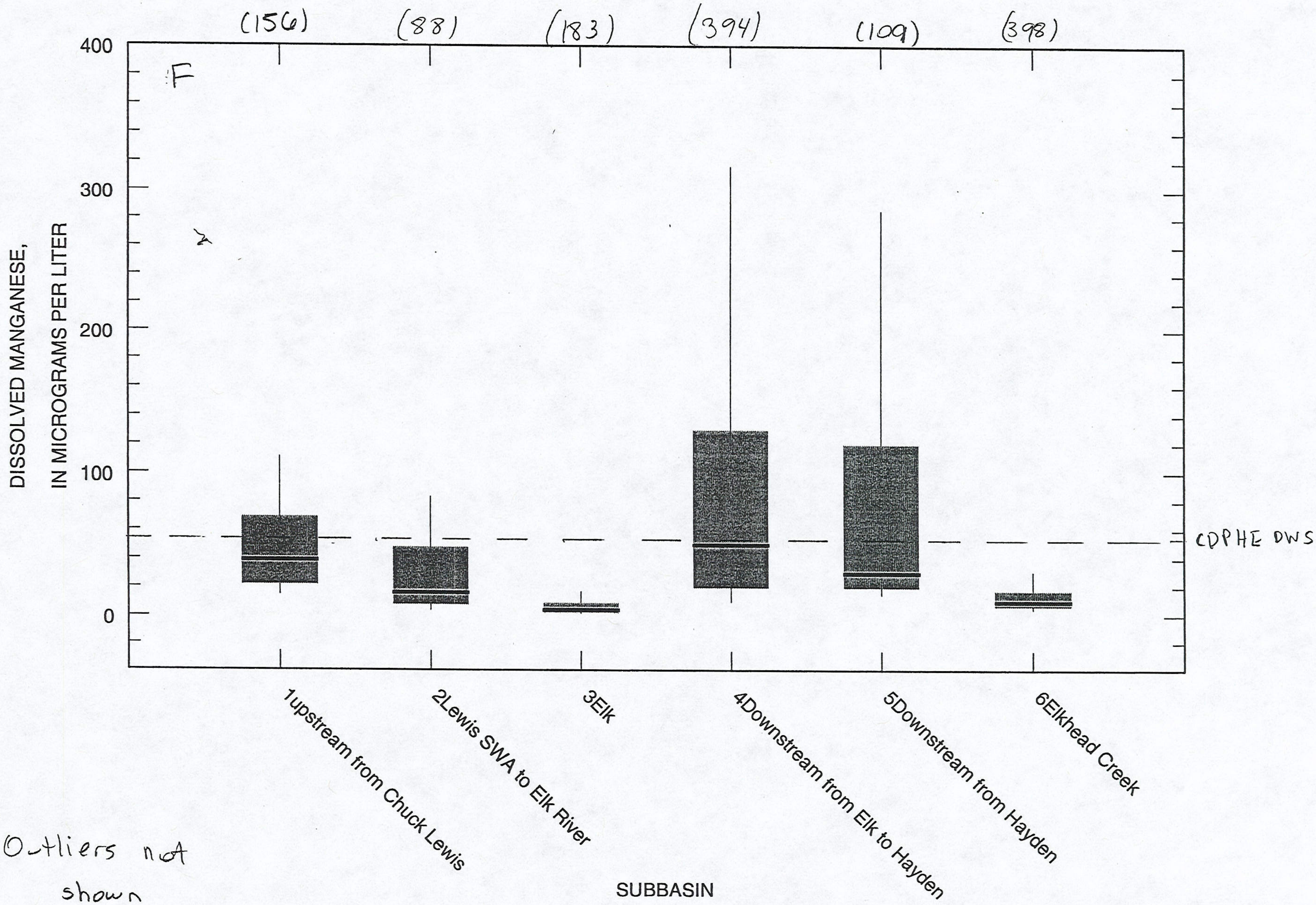
Show SMCL?

outliers not shown

104



will need to
adjust for
censored values



Outliers not shown

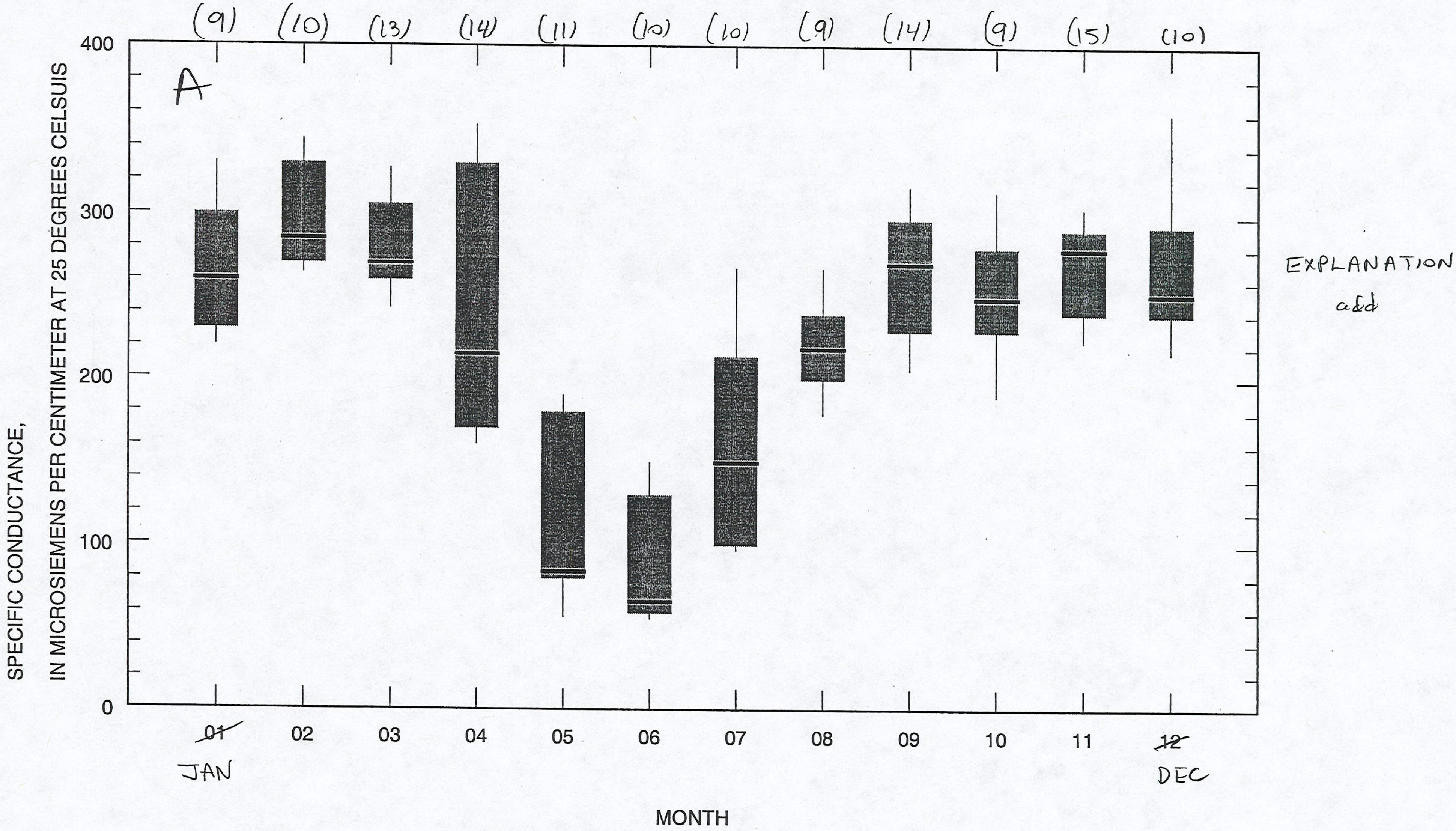
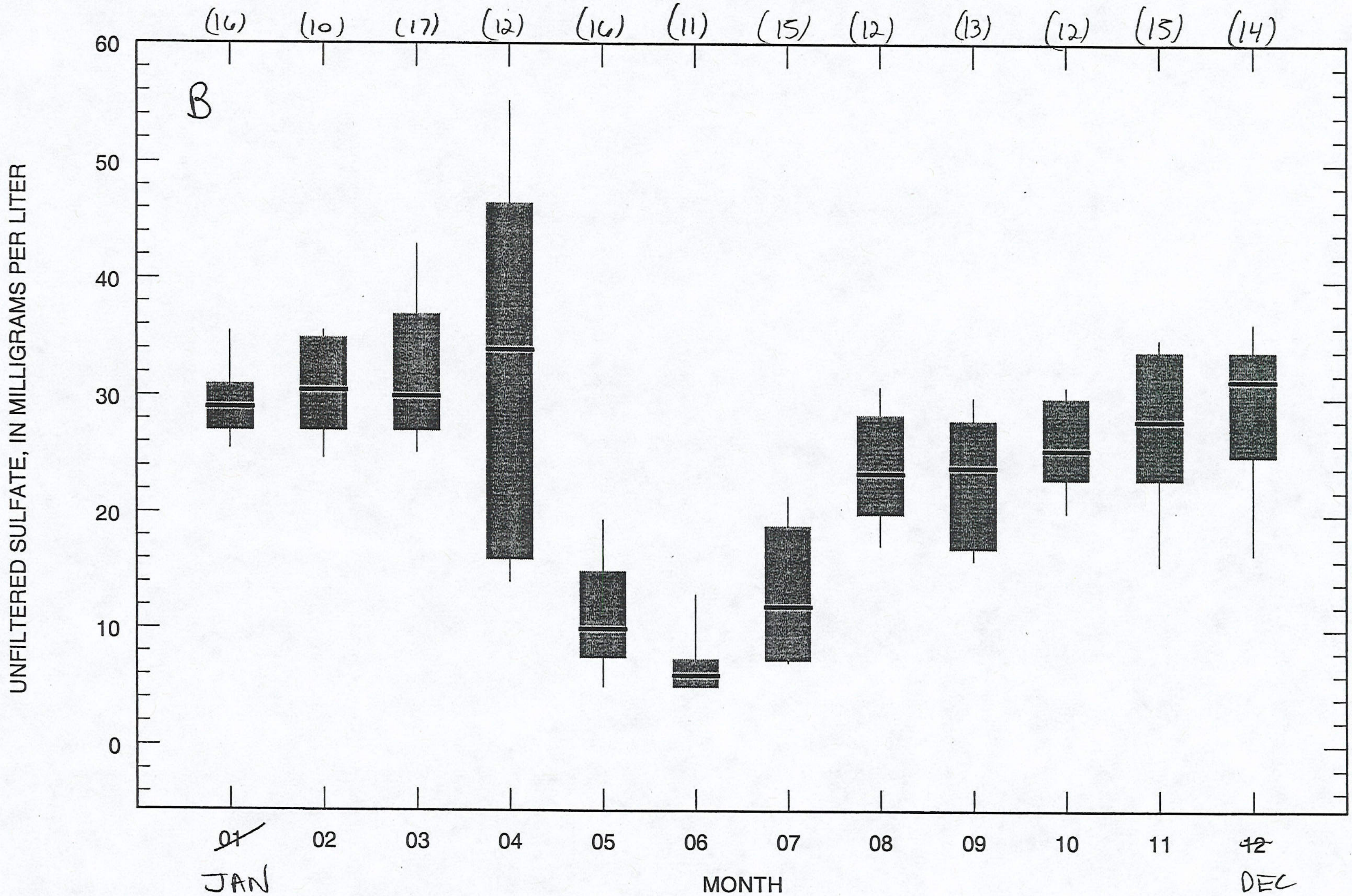
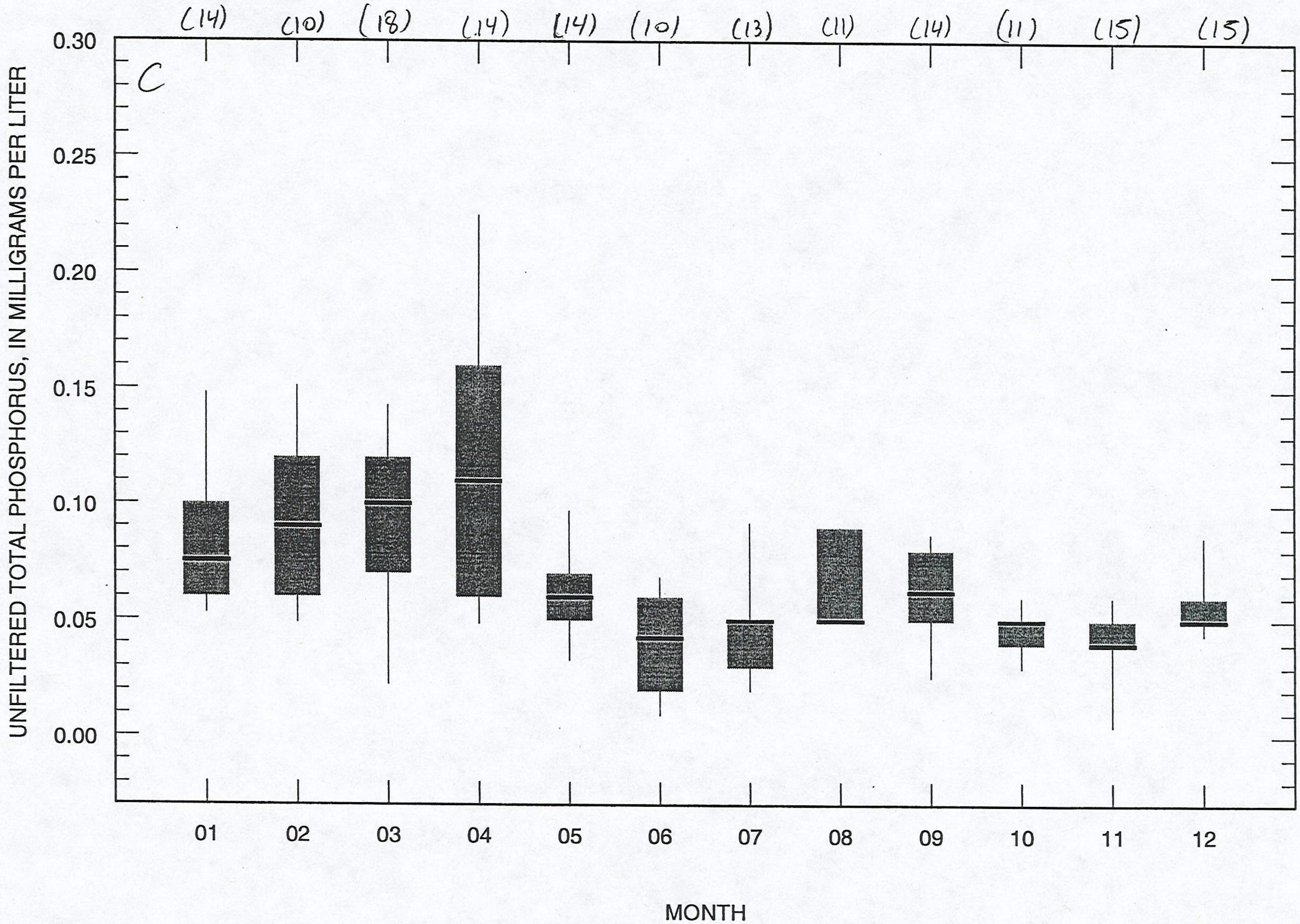
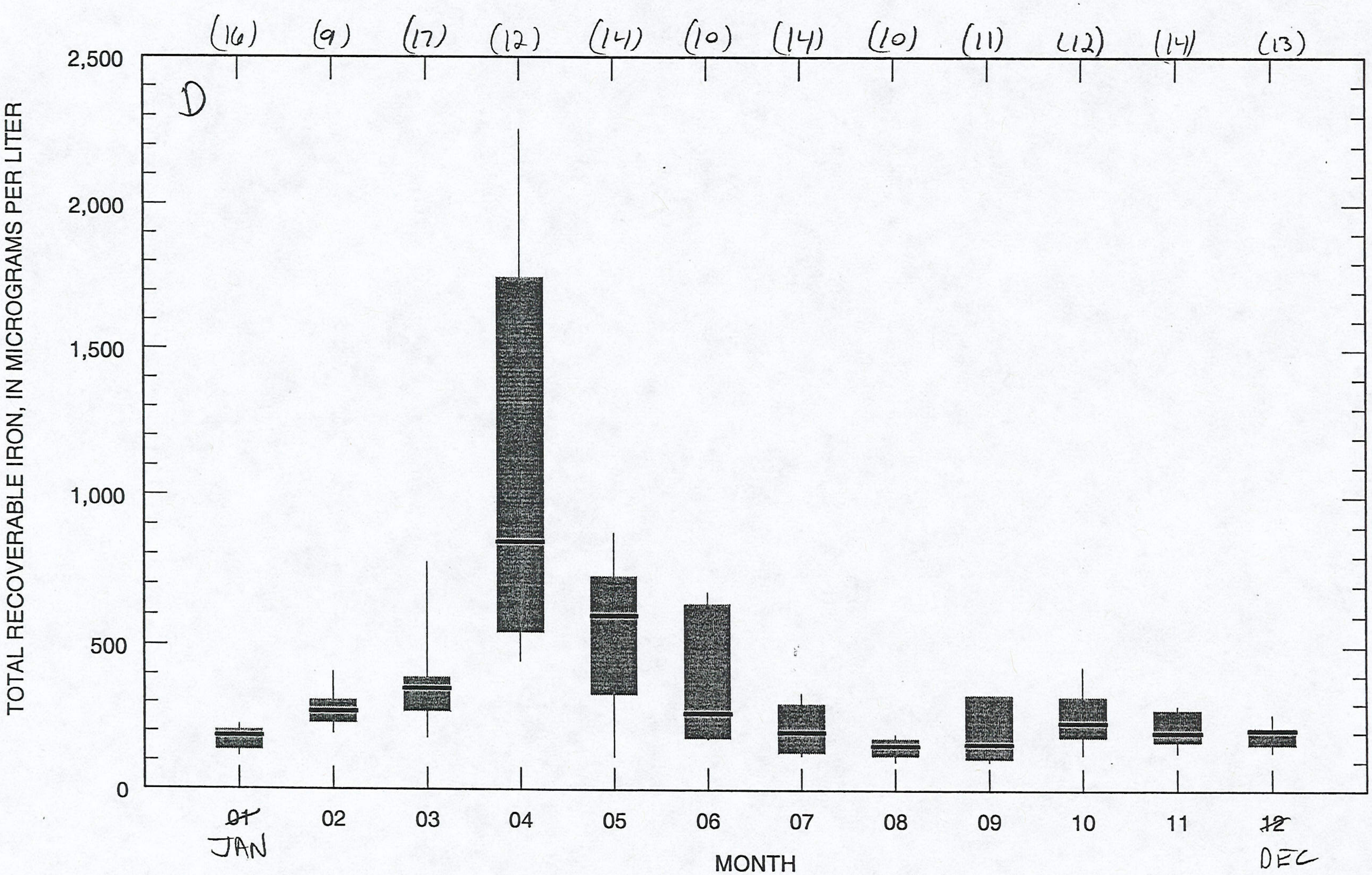


Figure 7. Distribution of A) specific conductance, B) unfiltered sulfate, C) unfiltered total phosphorus, and D) total recoverable iron at Yampa River at Milner (site 151) by month, Upper Yampa River watershed, Colorado, 1975 through 2007.


B
(16) (10) (17) (12) (16) (11) (15) (12) (13) (12) (15) (14)
UNFILTERED SULFATE, IN MILLIGRAMS PER LITER
0
10
20
30
40
50
60
~~01~~ 02 03 04 05 06 07 08 09 10 11 ~~12~~
JAN
MONTH
DEC

109


C
(14)
(10)
(18)
(14)
(14)
(10)
(13)
(11)
(14)
(11)
(15)
(15)
UNFILTERED TOTAL PHOSPHORUS, IN MILLIGRAMS PER LITER
0.30
0.25
0.20
0.15
0.10
0.05
0.00
01
02
03
04
05
06
07
08
09
10
11
12
MONTH



TOTAL RECOVERABLE IRON, IN MICROGRAMS PER LITER
0
500
1,000
1,500
2,000
2,500
D
(16)
(9)
(17)
(12)
(14)
(10)
(14)
(10)
(11)
(12)
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~~01~~ JAN
02
03
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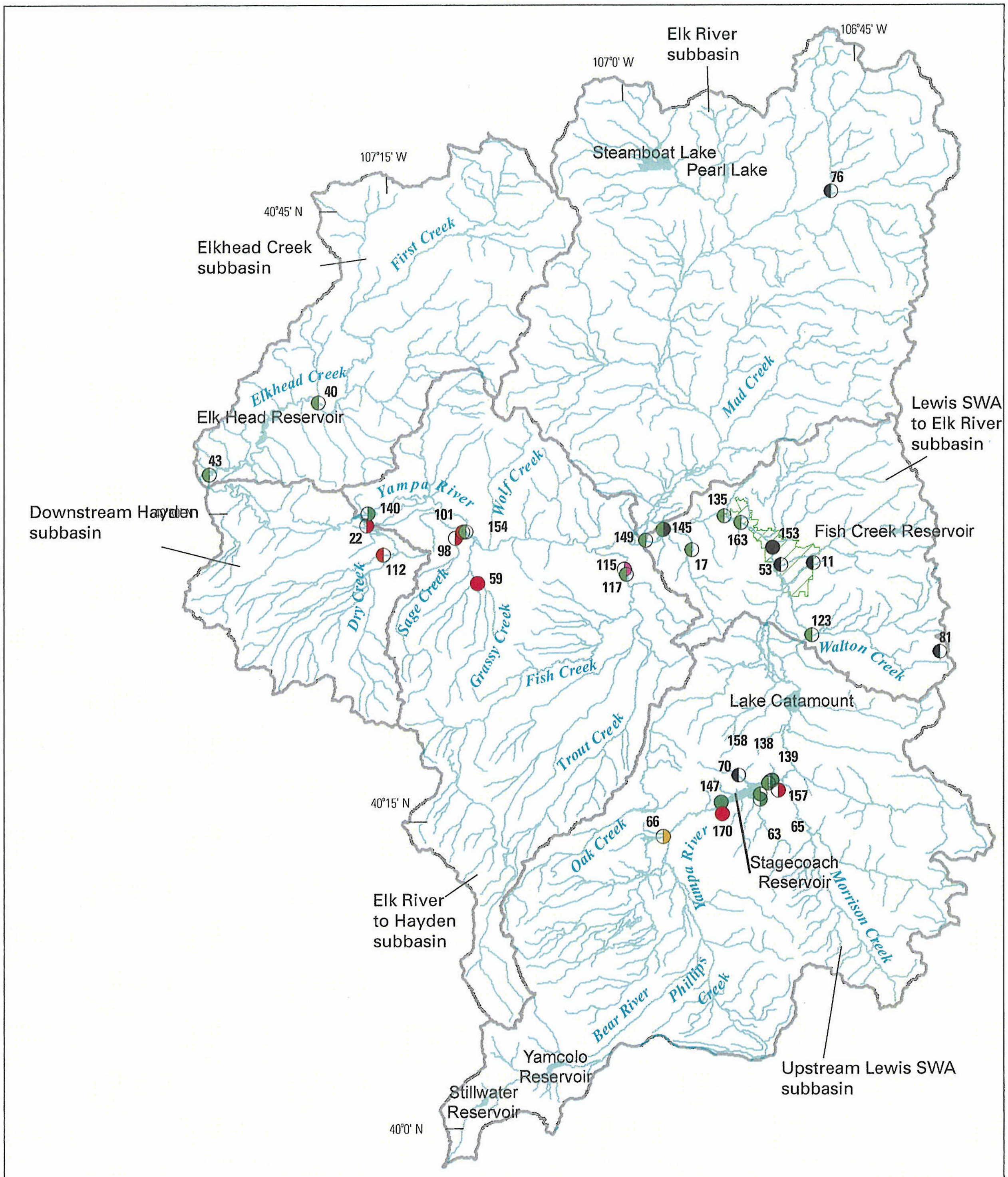
11
~~12~~ DEC
MONTH



Base from U.S. Geological Survey digital data, 1:100,000, Universal Transverse Mercator, Zone 13N

0 2.5 5 10 MILES

0 2.5 5 10 KILOMETERS

EXPLANATION

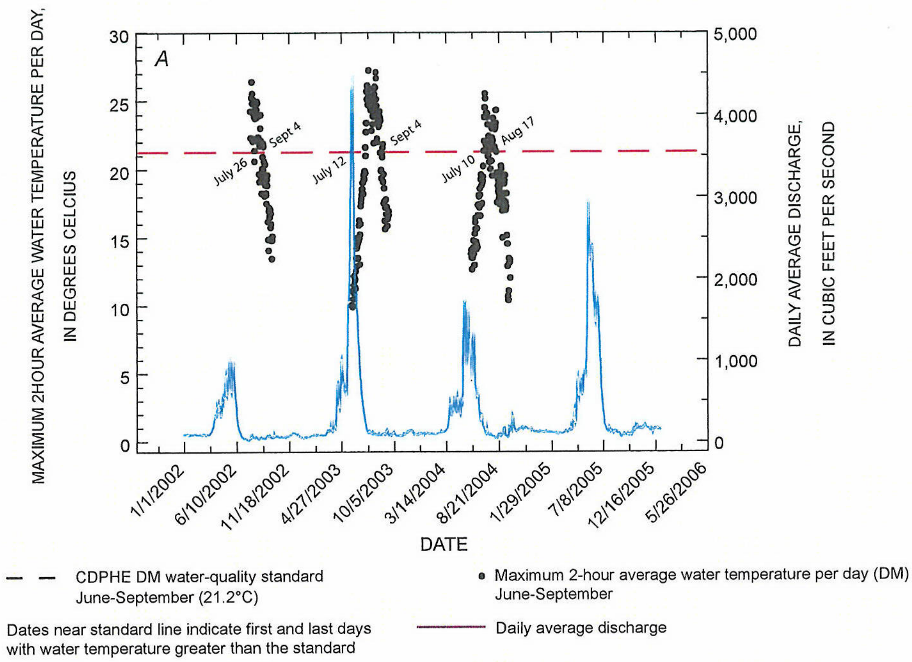
Subbasin

Sample collected before1996 ◑ Sample collected after 1996

Water-Quality Standard

- Physical property (pH, water temperature, dissolved oxygen)
- ~~Inorganics~~ (total dissolved solids, sulfate, selenium) need to take this out and add to figure 10
- Total phosphorus
- Physical property, inorganics, total phosphorus
- Inorganics, total phosphorus

Figure 8. Exceedances of Colorado Department of Public Health and Environment in-stream water-quality standards for physical properties, total dissolved solids, and sulfate and U.S. Enviromental Protection Agency recommended concentrations for total phosphorus, Upper Yampa River watershed, Colorado, 1975 through 2009. See table 10 — for additional information on exceedances



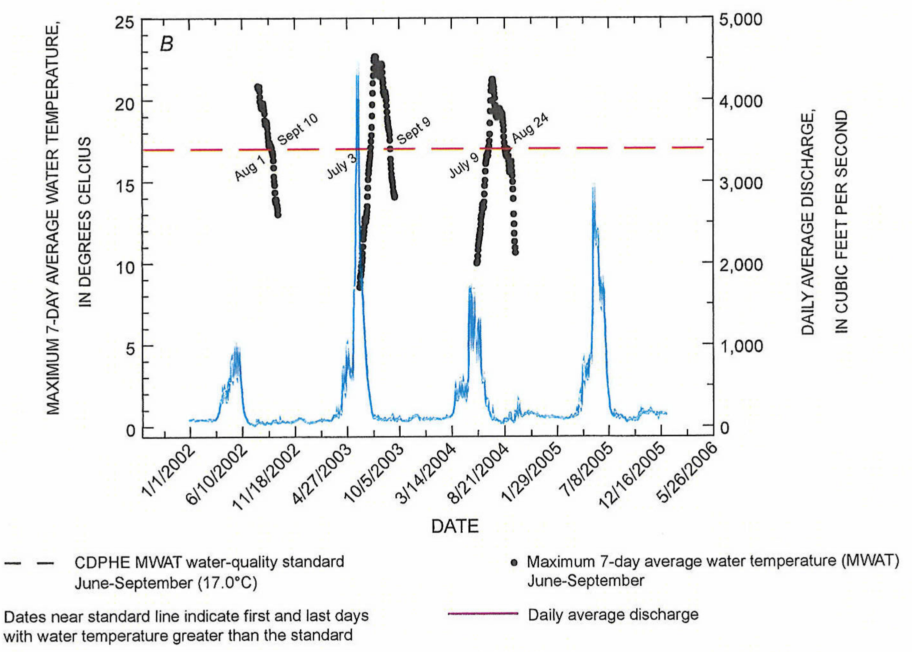
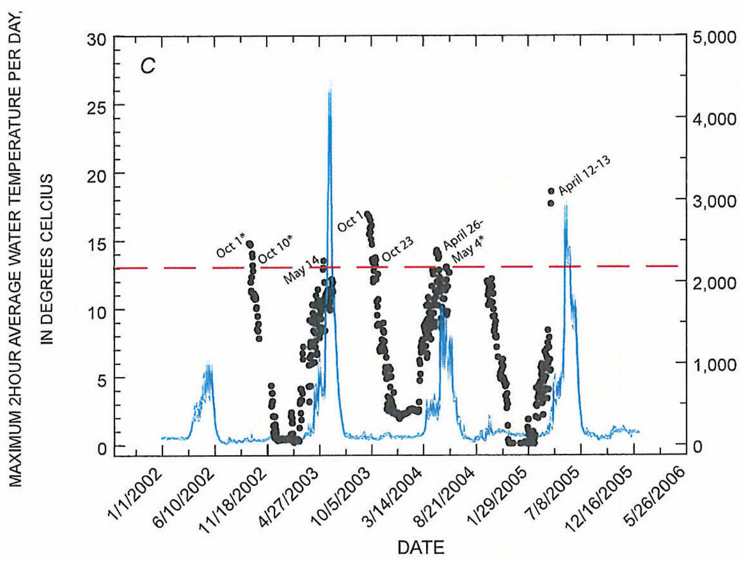


Figure 9. Maximum 2-hour average water temperature (DM), maximum weekly average temperature (MWAT), and daily average discharge with exceedances of Colorado Department of Public Health and Environment (CDPHE) in-stream water quality standards for water temperature for A) June-September DM, B) June-September MWAT, C) October-May DM, and D) October-May MWAT for Yampa River at Steamboat Springs (site 153), Upper Yampa River watershed, Colorado, 2002 through 2005.

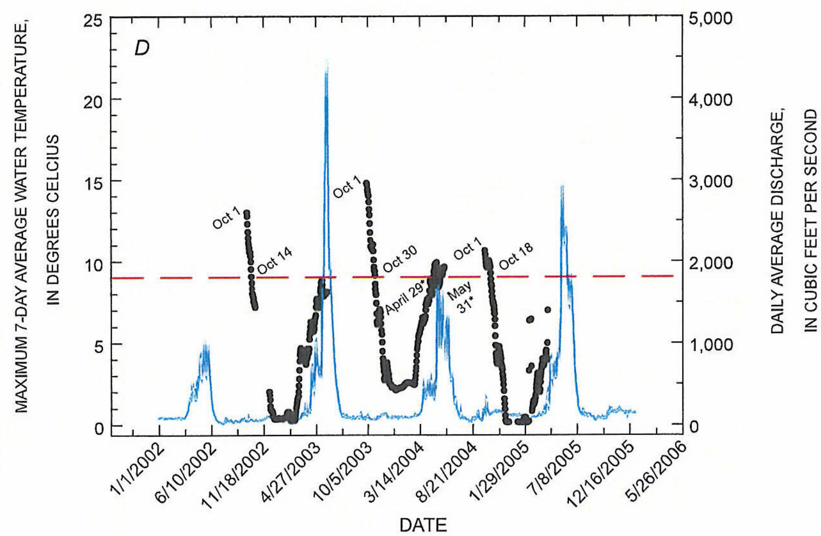


— — CDPHE DM water-quality standard October-May (13.0°C)

Dates near standard line indicate first and last days with water temperature greater than the standard. *Exceedance did not iccur every day between the dates.

• Maximum 2-hour average water temperature per day (DM) October-May

——— Daily average discharge



— — CDPHE MWAT water-quality standard October-May (9.0°C)

Dates near standard line indicate first and last days with water temperature greater than the standard. *Exceedance did not occur every day from April 29 through May 31.

• Maximum 7-day average water temperature (MWAT) October-May

——— Daily average discharge

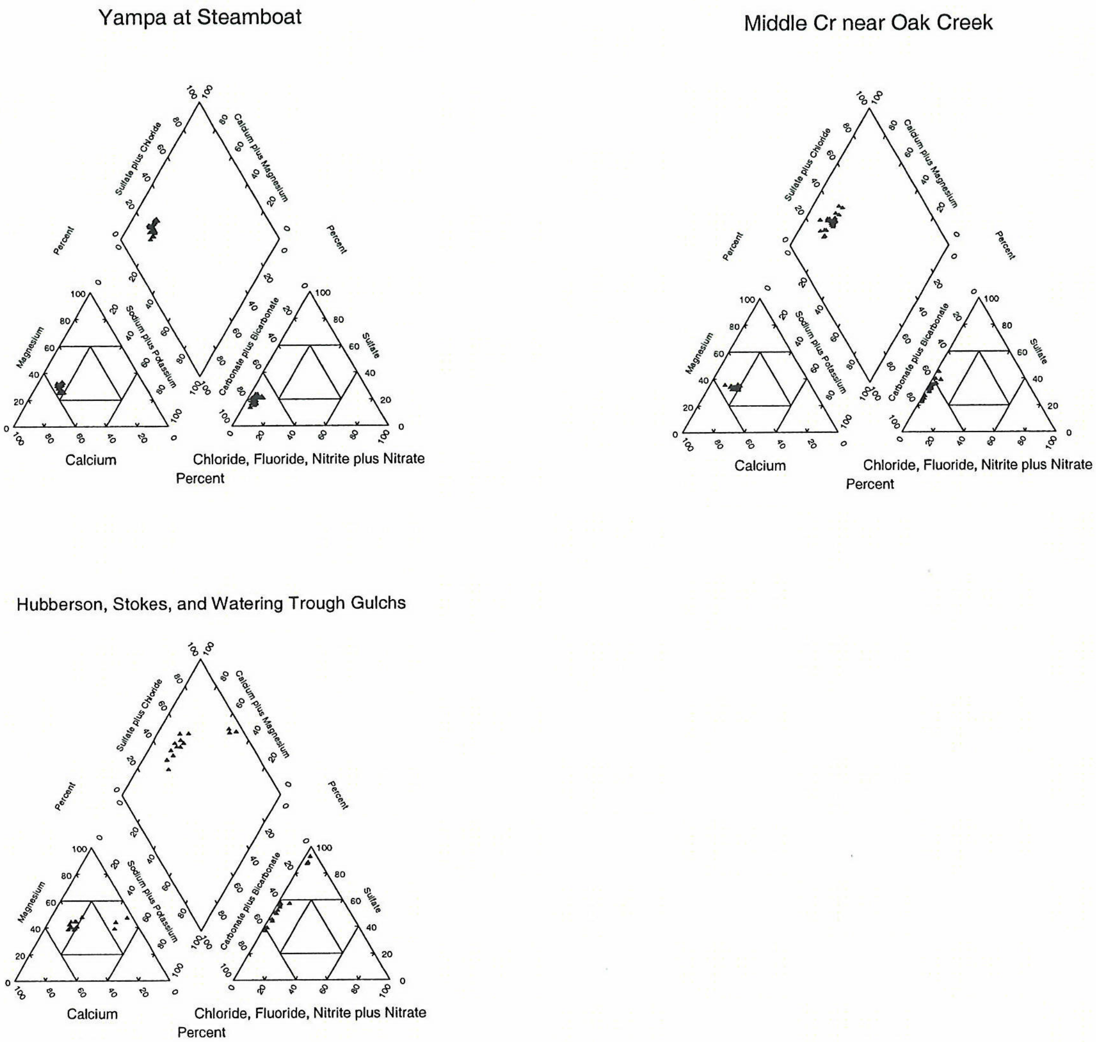


Figure 10. Cation and anion percentiles and water type for water-quality samples collected from selected stream sites in the Upper Yampa River watershed, Colorado, 1975 through 2009. See figure 3 for locations of sites and Appendix 2 for site information.

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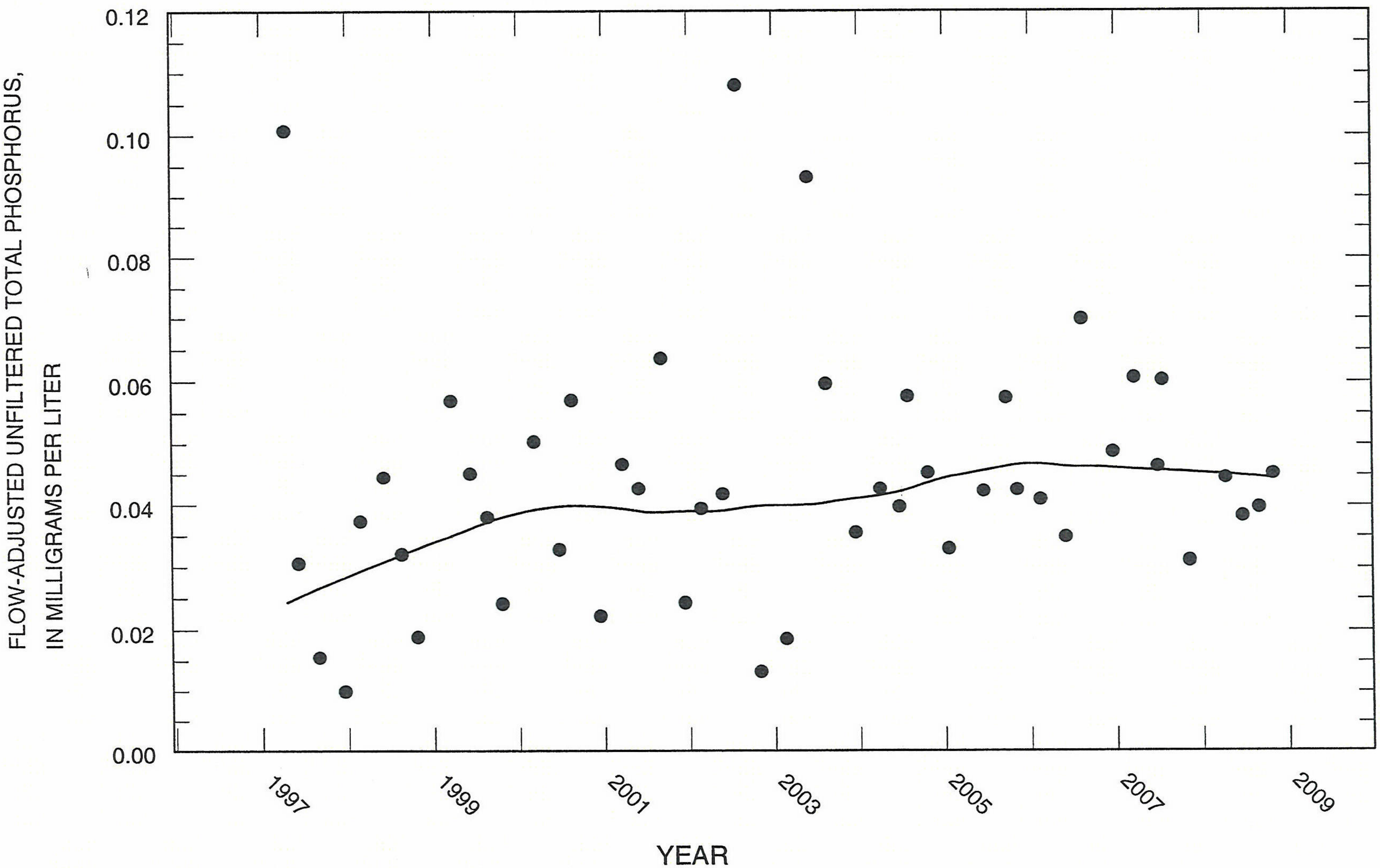
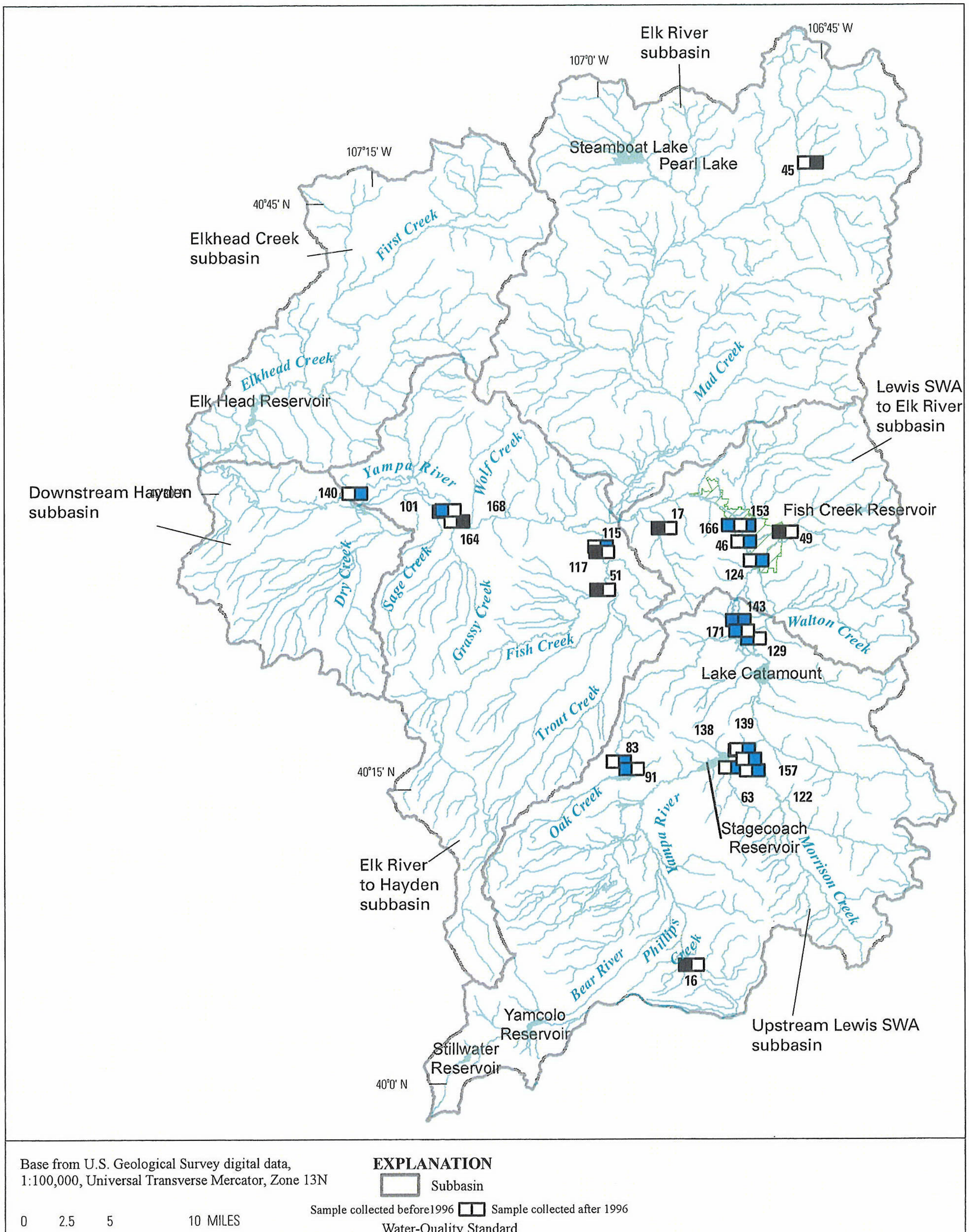


Fig. 11. Flow-adjusted unfiltered total phosphorus concentration at Yampa River at Steamboat Springs (site 153), Upper Yampa River watershed, Colorado, 1997 through 2008.



Base from U.S. Geological Survey digital data, 1:100,000, Universal Transverse Mercator, Zone 13N

0 2.5 5 10 MILES

0 2.5 5 10 KILOMETERS

EXPLANATION

Subbasin

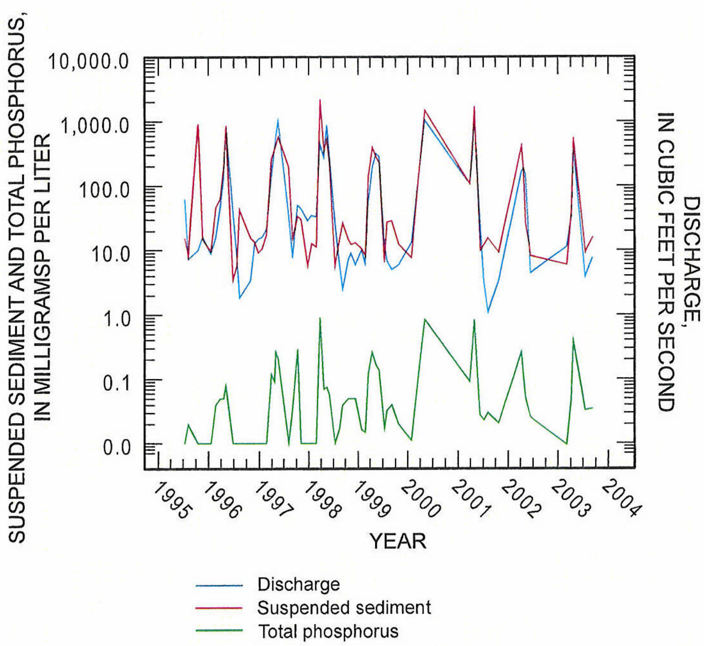
Sample collected before1996 Sample collected after 1996

Water-Quality Standard

Aquatic life standard

Water-supply standard

Figure 12. Exceedances of Colorado Department of Public Health and Environment instream water-quality standards for trace elements, Upper Yampa River watershed, Colorado, 1975 through 2009.



13

Figure . Discharge and suspended-sediment and total phosphorus concentrations in Elkhead Creek above Long Gulch (site 40), Upper Yampa River watershed, Colorado. See figure 3 for location of site and Appendix 3 for site infomation.

811

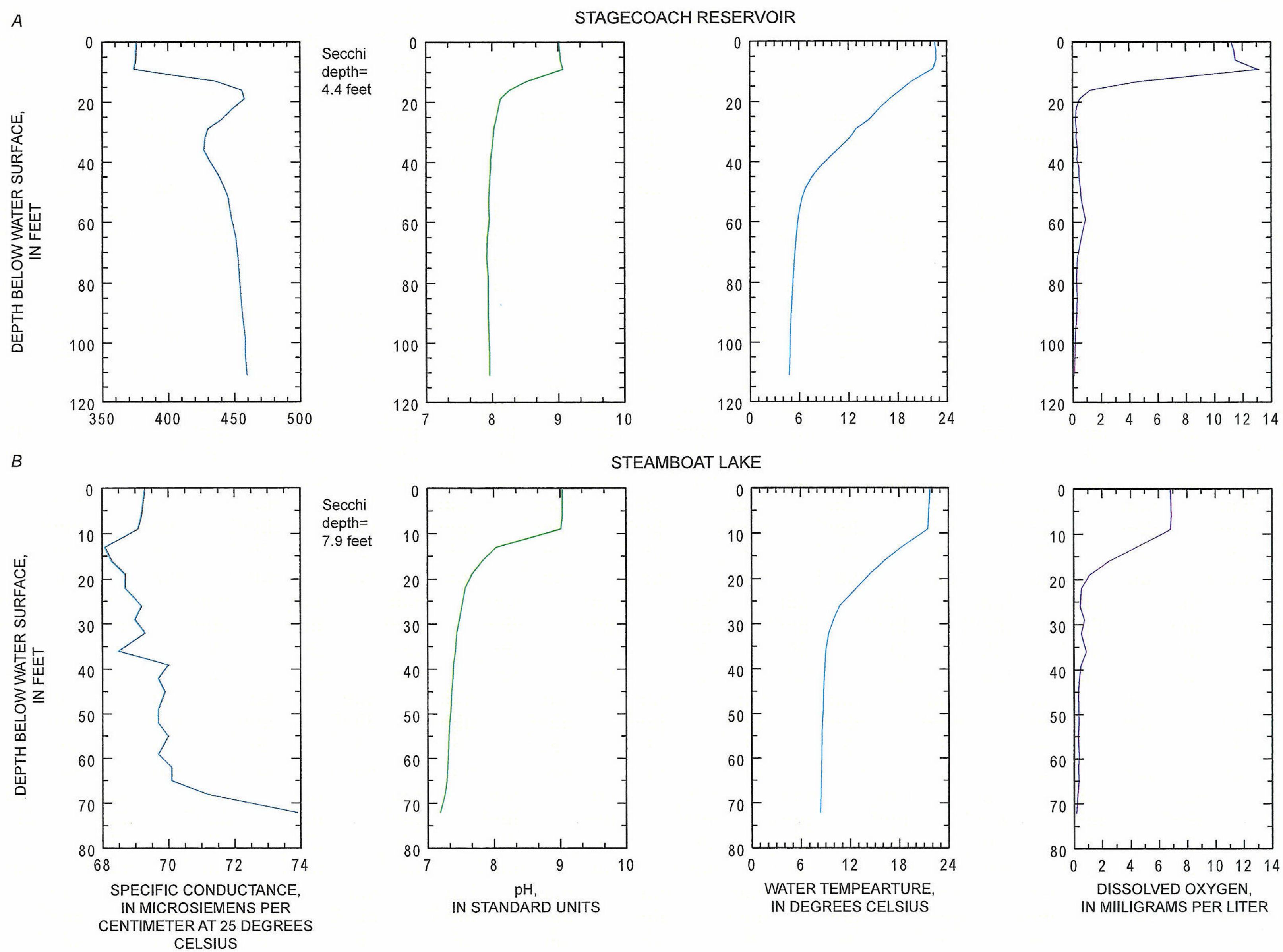
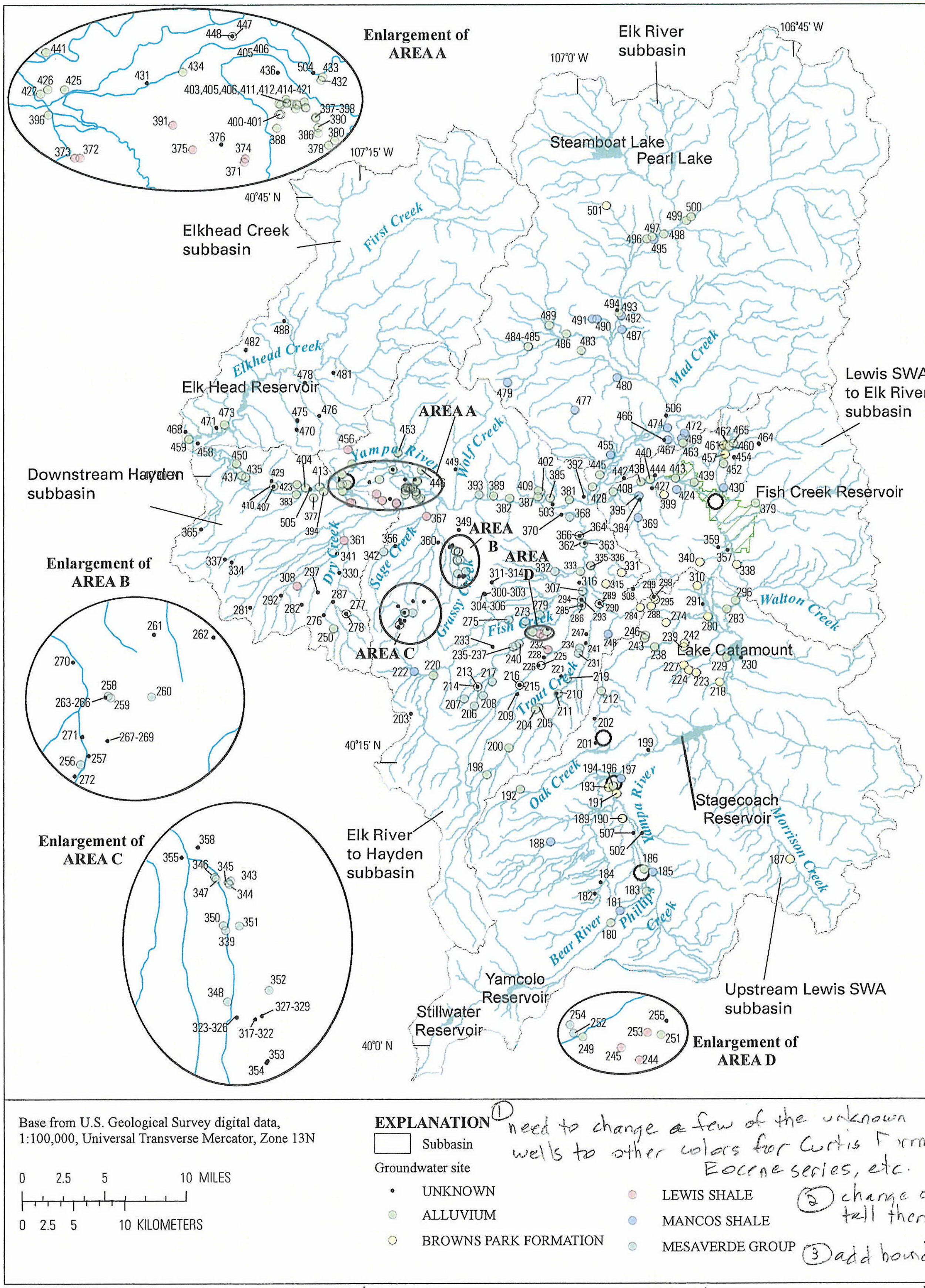


Figure 14. Depth profiles of specific conductance, pH, water temperature, and dissolved-oxygen for *A)* Stagecoach Reservoir and *B)* Steamboat Lake, Upper Yampa River watershed, Colorado, April 25, 2006. (Note different scale for specific conductance).



(1) need to change a few of the unknown wells to other colors for Curtis Formation, Eocene series, etc.

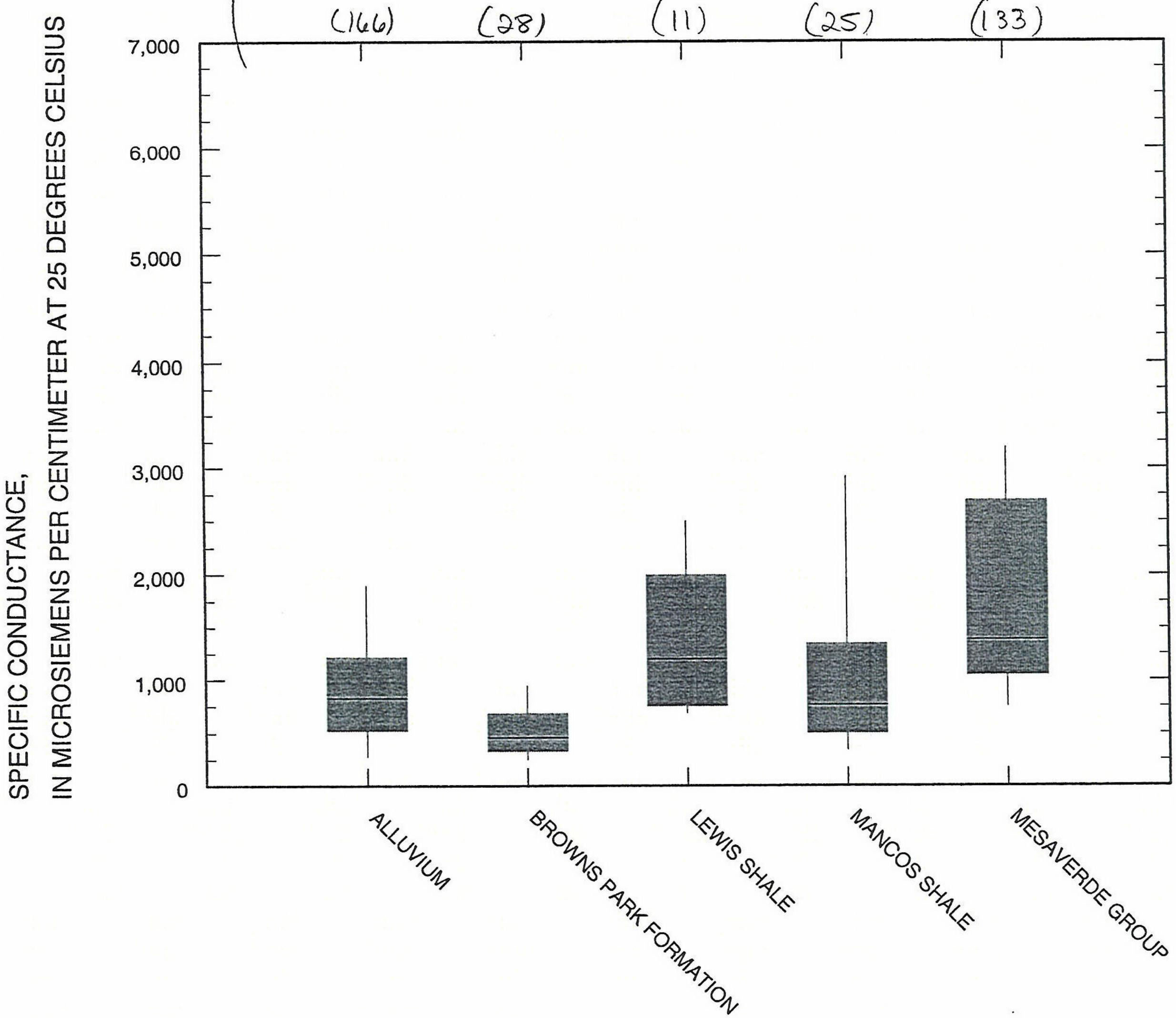
(2) change colors to tell them apart

(3) add boundary for Yampa coal field

Figure 15. Location of groundwater wells in the Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.

center justify

will add outliers



will add:
EXPLANATION

Fig. 16. Specific conductance in well-water samples by geologic unit, Upper Yampa River watershed, Colorado, 1975 through 1986.

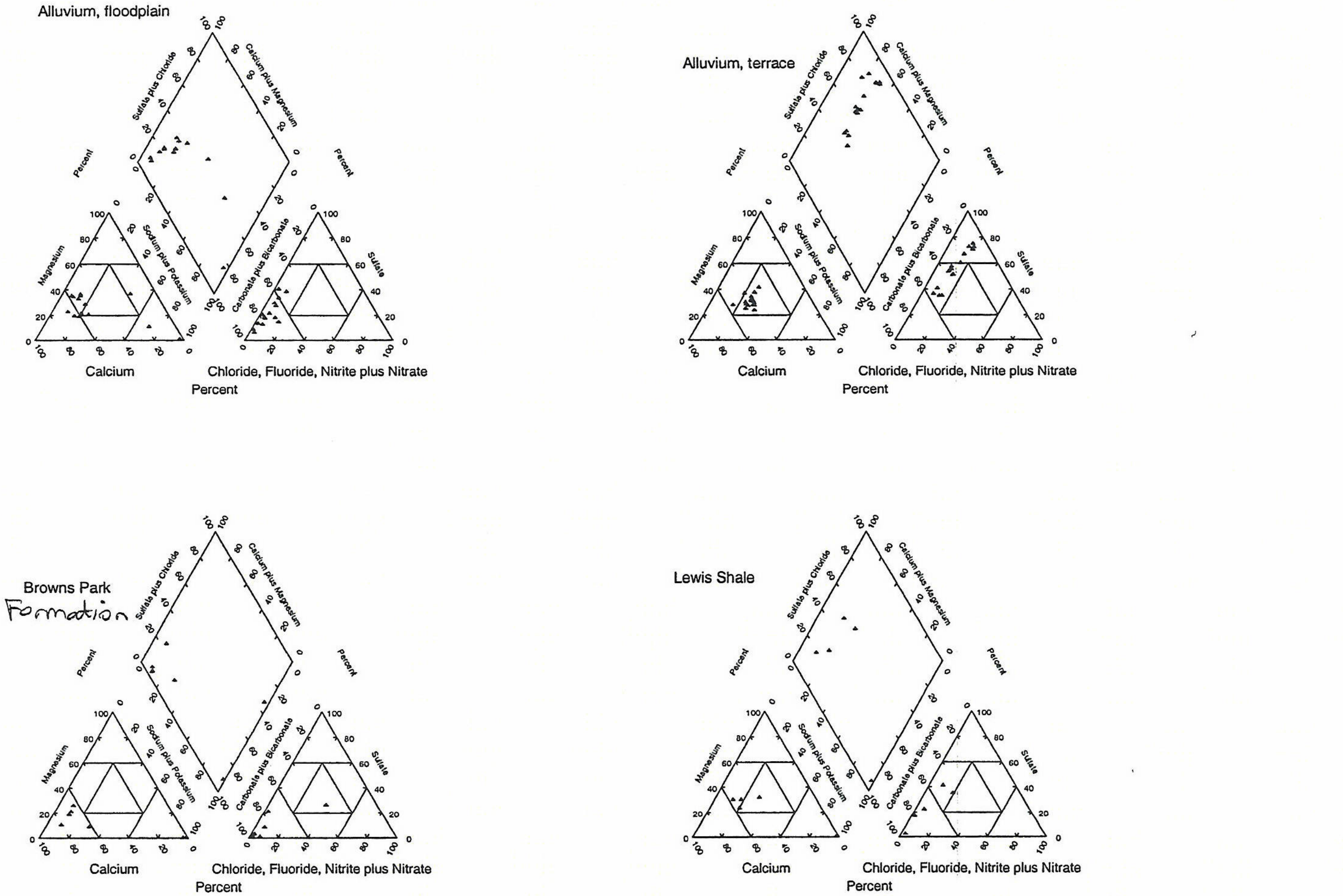


Fig. 17. Cation and anion percentiles and water type by geologic unit for groundwater samples, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.

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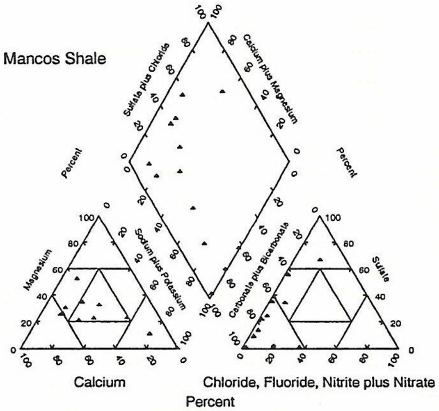
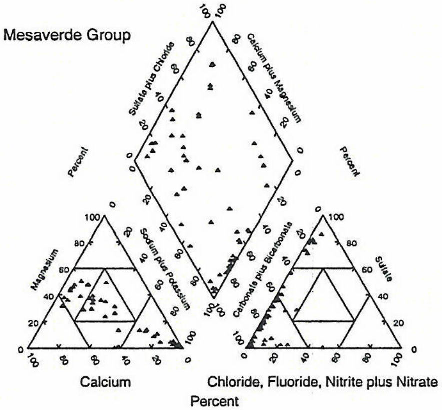
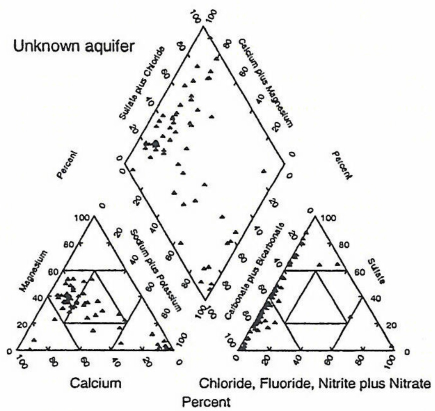
Mancos Shale



Mesaverde Group



Unknown aquifer



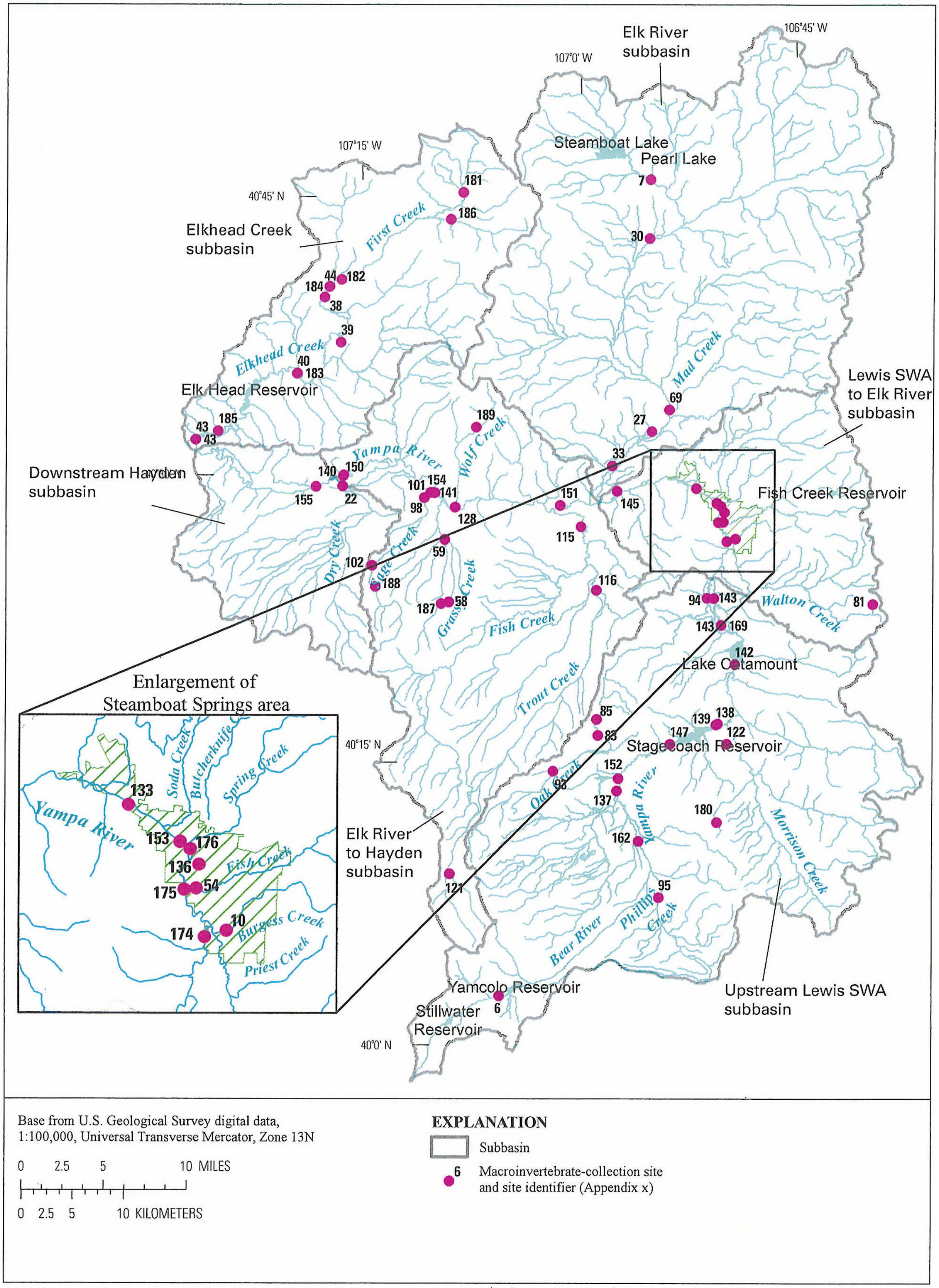


Figure 18. Stream sites with macroinvertebrate data, Upper Yampa River watershed, Colorado, 1975 through 2008. See Appendix 5 for additional site information.

Table 1. Active streamflow-gaging stations in the Upper Yampa River watershed, Colorado, water year 2010.
[USGS, U.S. Geological Survey; CODWR, Colorado Division of Water Resources. USGS information from the USGS National Water Information System (NWIS). CODWR information from *http://www.dwr.state.co.us/SurfaceWater/data/division.aspx?div=6*. A water year is defined as a 12-month period beginning October 1 and ending September 30 of the following year. A water year is designated as the year in which it ends]

Site number (fig. 3)	USGS or CODWR site identifer	USGS or CODWR site name	Agency	Period of record
177	MORBSCCO	Morrison Creek below Silver Creek	CODWR	4/22/2009–present, seasonal[1]
147	09237450	Yampa River above Stagecoach Reservoir, CO	USGS	10/1/1988–present
158	09237500	Yampa River below Stagecoach Reservoir, CO	USGS	10/1/1939–9/30/1944, 10/1/1956–9/30/1972, 10/1/1984–present
142	YAMABVCO[2]	Yampa River above Lake Catamount near Steamboat Springs	CODWR	10/1/2003–present
49	09238900	Fish Creek at Upper Sta near Steamboat Springs, CO	USGS	10/1/1966–9/30/1972, 5/1/1982–present
123	WLTNCKCO[3]	Walton Creek near Steamboat Springs, CO	CODWR	10/1/1965–present
153	09239500	Yampa River at Steamboat Springs, CO	USGS	10/1/1904–9/30/1906, 3/1/1910–present
178	09240020	Yampa River below Soda Creek at Steamboat Springs, CO	USGS	6/25/2008–present, seasonal[4]
179	WILBSLCO	Willow Creek below Steamboat Lake	CODWR	10/1/1978–present
33	09242500	Elk River near Milner, CO	USGS	10/1/1904–9/30/1906, 10/1/1909–9/30/1927, 4/1/1990–present
146	09244490	Yampa River above Elkhead Creek near Hayden, CO	USGS	3/16/2004–present
40	09246200	Elkhead Creek above Long Gulch, near Hayden, CO	USGS	8/10/1995–present
43	09246500	Elkhead Creek near Craig, CO	USGS	1/1/1910-12/31/1918, 7/11/2008-present

[1]Site is operated seasonally from late April through October.

[2]Site is located at or near Colorado Department of Public Health and Environment site 12807.

[3]Site also is USGS site 09238500.

[4]Site is operated seasonally from May through August.

Table 2. Reservoir and water-storage facilities in the Upper Yampa River watershed, Colorado, with active storage capacity of 4,000 acre-feet or more. [ac-ft, acre feet, No, number. Multiple purpose is irrigation, recreation and municipal and industrial uses. Data from Colorado Water Conservation Board (2009)]

Resource or storage facility	Active storage capacity (ac-ft)	Purpose
Stillwater Reservoir No. 1	5,175	Irrigation
Fish Creek Reservoir	4,042	Municipal
Pearl Lake	5,657	Fishery and recreation
Steamboat Lake	23,064	Fishery and recreation
Elkhead Creek Reservoir	10,422	Multiple
Lake Catamount	7,422	Fishery and recreation
Yamcolo Reservoir	8,028	Irrigation
Stagecoach Reservoir	30,000	Multiple

Table 3. Number of sites, period of water-quality record, and number of samples collected at selected site types in the Upper Yampa River watershed, Colorado, for various sources of water-quality data, 1975 through 2009.
[No., number; --, no data]

Data source	Site type											
	Streams			Lakes and reservoirs			Groundwater wells			Macroinvertebrates		
	No. of sites	Period of water-quality record	No. of samples	No. of sites	Period of water-quality record	No. of sample days[1]	No. of sites	Period of water-quality record	No. of samples	No. of sites	Period of water-quality record	No. of samples
City of Steamboat Springs (GEI Consultants, Inc)	8	2007–2008	32	--	--	--	--	--	--	4	2005–2008	12
Colorado Department of Agriculture	--	--	--	--	--	--	6	1998	6	--	--	--
Colorado Department of Public Health and Environment	56	1975–2007	868	[2]4	1990, 2006	4	--	--	--	37	[3]1997–2008	62
Colorado Division of Wildlife Riverwatch Program	14	1990–2004	1,045	--	--	--	--	--	--	--	--	--
U.S. Environmental Protection Agency	2	2000–2001	4	1	1985	1	--	--	--	--	--	--
U.S. Forest Service	3	1974–75, 1978–99	35	--	--	--	--	--	--	--	--	--
U.S. Geological Survey	128	1975–2009	3,878	37	1975–76, 1978–79, 1983, 1985–2009	364	322	[4]1975–1989	[5]1,584	25	1975	25

[1]Samples collected at multiple depths on the same day are counted as one sample day.

[2]Two sites in Stagecoach Reservoir are co-located and counted as one site, as are two sites in Steamboat Lake. For each body of water, samples collected near the top and bottom of the water column at the same location have different site identification numbers in the UYRW data repository but are counted as one site in this table.

[3]No data for 1999, 2002, 2004, and 2007.

[4]No data for 1985.

[5]Count consists of 817 samples with water-quality data and 767 samples with water-level data only. Count of water-quality samples does not include multiple (14) water-quality samples collected on a day or 219 water-level measurements collected on the same day but at a different time than the water-quality sample.

Table 4. Summary of procedures used to aggregate data for selected physical properties, discharge, total dissolved solids, major ions, nutrients, trace elements, and coliform bacteria, Upper Yampa River watershed, Colorado.
[μS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; Ca, calcium; Mg, magnesium; ft^3/s, cubic feet per second; S, sulfur; N, nitrogen; NO_2, nitrite; *, constituent computed from procedure listed for nitrite, as N; NO_3, nitrate; NH_3, un-ionized ammonia; NH_4^+, ammonium; **, constituent computed from procedure listed for nitrate, as N; P phosphorus; PO_4, phosphate; μg/L; micrograms per liter; Fe, iron; col/100 mL; colonies per 100 milliliters; *E. coli*, *Escherichia coli*. Procedures used to aggregate nutrient data follow those used by Mueller and others (1995)]

Physical property or constituent (reporting units)	Physical property or constituent name	Parameter code[1]	No. of samples
	Physical properties and discharge		
Specific conductance (μS/cm)	Specific conductance, water, unfiltered, μS/cm at 25°C	00095	3,890
	Specific conductance, water, unfiltered, field, μS/cm at 25°C	00094	415
pH (standard units)	pH, water, unfiltered, field, standard units	00400	3,104
	pH, water, unfiltered, laboratory, standard units	00403	36
Hardness (mg/L)	Hardness, water, mg/L as $CaCO_3$	00900	1,615
	Hardness,water, total, Ca Mg calculated, mg/L as $CaCO_3$	46570	787
	Hardness, water, filtered, calculated, mg/L as $CaCO_3$	00906	32
Acid neutralizing capacity (mg/L as $CaCO_3$)	Acid neutralizing capacity, water, unfiltered, fixed endpoint (pH 4.5) titration, field, mg/L as $CaCO_3$	00410	476
	Acid neutralizing capacity, water, unfiltered, fixed endpoint (pH 4.5) titration, laboratory, mg/L as $CaCO_3$	90410	716
	Acid neutralizing capacity, water, unfiltered, mg/L as $CaCO_3$	00431	1,052
Discharge (ft^3/s)	Discharge, instantaneous, ft^3/s	00061	3,665
	Discharge, ft^3/s	00060	18
	Flow, estimated, stream, ft^3/s	74069	1
	Total dissolved solids		
Dissolved solids, total (mg/L)	Residue, water, filtered, sum of constituents, mg/L	70301	989
	Residue on evaporation, dried at 180°C, water, filtered, mg/L	70300	754
	Major ions		
Bicarbonate, dissolved (mg/L)	Bicarbonate, water, unfiltered, fixed endpoint (pH 4.5) titration, field, mg/L	P00440	160
	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field, mg/L	P00453	24
Sulfate, dissolved (mg/L)	Sulfate, water, filtered, mg/L	00945	1,019
	Sulfate, water, dissolved, as S, mg/L	78462 (multiplied by 3.0)	2
Chloride, dissolved (mg/L)	Chloride, water, filtered, mg/L	00940	1,015

Table 4. Summary of procedures used to aggregate data for selected physical properties, discharge, total dissolved solids, major ions, nutrients, trace elements, and coliform bacteria, Upper Yampa River watershed, Colorado.
[μS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; Ca, calcium; Mg, magnesium; ft^3/s, cubic feet per second; S, sulfur; N, nitrogen; NO_2, nitrite; *, constituent computed from procedure listed for nitrite, as N; NO_3, nitrate; NH_3, un-ionized ammonia; NH_4^+, ammonium; **, constituent computed from procedure listed for nitrate, as N; P phosphorus; PO_4, phosphate; μg/L; micrograms per liter; Fe, iron; col/100 mL; colonies per 100 milliliters; *E. coli*, *Escherichia coli*. Procedures used to aggregate nutrient data follow those used by Mueller and others (1995)]

Physical property or constituent (reporting units)	Physical property or constituent name	Parameter code[1]	No. of samples
Chloride, dissolved (mg/L)	Chloride, dissolved in water, mg/L	00941	2
	Nutrients		
Nitrite, unfiltered (mg/L as N)	Nitrite, water, unfiltered, mg/L as N	00615	34
	Nitrite, water, unfiltered, mg/L as NO_2	71855 (multiplied by 0.30446)	61
Nitrate, dissolved (mg/L as N)	Nitrate plus nitrite, water, filtered, mg/L as N,	00631	1,092
	minus [2]nitrite, filtered, mg/L as N	00613	628
	Nitrate, water, filtered, mg/L as N	00618	4
Nitrate, unfiltered (mg/L as N)	Nitrate plus nitrite, water, unfiltered, mg/L as N,	00630	1,155
	minus [2]nitrite, unfiltered, mg/L as N	*	95
	Nitrate, water, unfiltered, mg/L as NO_3	71850 (multiplied by 0.2259)	62
Total ammonia, unfiltered (mg/L as N)	Ammonia, water, unfiltered, mg/L as N	00610	184
	Ammonia + Ammonium as N, total NH_3 + NH_4^+ in water, mg/L	82230	843
Total nitrogen, unfiltered (mg/L)	Total nitrogen, water, unfiltered, mg/L	00600	511
	[3]Ammonia plus organic nitrogen, water, unfiltered, mg/L as N,	00625	358
	plus [2]nitrate, as N,	**	98
	plus [2]nitrite, as N	*	11
Orthophosphate (mg/L as P)	Orthophosphate, water, filtered, mg/L as P	00671	836
	Orthophosphate, water, unfiltered, mg/L as P	70507	16
	Phosphate, water, unfiltered, mg/L as PO_4	00650 (multiplied by 0.3261)	2
	Trace elements		
Aluminum, total recoverable (μg/L)	Aluminum, water, unfiltered, recoverable, μg/L	01104	51
	Aluminum, water, unfiltered, recoverable, μg/L	01105	304
Beryllium, total recoverable (μg/L)	Beryllium, water, unfiltered, recoverable, μg/L	00998	24
	Beryllium, water, unfiltered, recoverable, μg/L	01012	82
Chromium, total recoverable	Chromium, water, unfiltered, recoverable, μg/L	01034	172

Table 4. Summary of procedures used to aggregate data for selected physical properties, discharge, total dissolved solids, major ions, nutrients, trace elements, and coliform bacteria, Upper Yampa River watershed, Colorado.
[μS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; Ca, calcium; Mg, magnesium; ft^3/s, cubic feet per second; S, sulfur; N, nitrogen; NO_2, nitrite; *, constituent computed from procedure listed for nitrite, as N; NO_3, nitrate; NH_3, un-ionized ammonia; NH_4^+, ammonium; **, constituent computed from procedure listed for nitrate, as N; P phosphorus; PO_4, phosphate; μg/L; micrograms per liter; Fe, iron; col/100 mL; colonies per 100 milliliters; *E. coli*, *Escherichia coli*. Procedures used to aggregate nutrient data follow those used by Mueller and others (1995)]

Physical property or constituent (reporting units)	Physical property or constituent name	Parameter code[1]	No. of samples
(μg/L)	Chromium, water, unfiltered, recoverable, μg/L	01118	59
Chromium, dissolved (μg/L)	Chromium(VI), water, filtered, μg/L	01032	21
	Chromium, water, filtered, μg/L	01030	133
Copper, total recoverable (μg/L)	Copper, water, unfiltered, recoverable, μg/L	01042	724
	Copper, water, unfiltered, recoverable, μg/L	01119	253
Iron, total recoverable (μg/L)	Iron,total recoverable in water as Fe μg/L	00980	690
	Iron, water, unfiltered, recoverable, μg/L	01045	1,339
Lead, total recoverable (μg/L)	Lead, water, unfiltered, recoverable, μg/L	01051	281
	Lead, water, unfiltered, recoverable, μg/L	01114	264
Manganese, total recoverable (μg/L)	Manganese, water, unfiltered, recoverable, μg/L	01055	1,228
	Manganese, water, unfiltered, recoverable, μg/L	01123	265
Molybdenum, total recoverable (μg/L)	Molybdenum, water, unfiltered, recoverable, μg/L	01062	172
	Molybdenum, water, unfiltered, recoverable, μg/L	01129	35
Nickel, total recoverable (μg/L)	Nickel, water, unfiltered, recoverable, μg/L	01067	186
	Nickel, water, unfiltered, recoverable, μg/L	01074	26
Silver, total recoverable (μg/L)	Silver, water, unfiltered, recoverable, μg/L	01077	88
	Silver, water, unfiltered, recoverable, μg/L	01079	84
Zinc, total recoverable (μg/L)	Zinc, water, unfiltered, recoverable, μg/L	01092	651
	Zinc, water, unfiltered, recoverable,μg/L	01094	32
Coliform bacteria			
Fecal coliform (col/100 mL)	Fecal coliform, M-FC MF (0.7 micron) method, water, col/100 mL	31613	127
	Fecal coliform, M-FC MF (0.7 micron) method, water, col/100 mL	31625	153
	Fecal coliform, M-FC MF (0.45 micron) method, water, col/100 mL	31616	119
E. coli (col/100 mL)	*Escherichia coli*, modified m-TEC MF method, water, col/100 mL	90902	22
	Escherichia coli, m-TEC MF method, water, col/100 mL	31633	101

Table 4. Summary of procedures used to aggregate data for selected physical properties, discharge, total dissolved solids, major ions, nutrients, trace elements, and coliform bacteria, Upper Yampa River watershed, Colorado.

[μS/cm, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; Ca, calcium; Mg, magnesium; ft^3/s, cubic feet per second; S, sulfur; N, nitrogen; NO_2, nitrite; *, constituent computed from procedure listed for nitrite, as N; NO_3, nitrate; NH_3, un-ionized ammonia; NH_4^+, ammonium; **, constituent computed from procedure listed for nitrate, as N; P phosphorus; PO_4, phosphate; μg/L; micrograms per liter; Fe, iron; col/100 mL; colonies per 100 milliliters; *E. coli*, *Escherichia coli*. Procedures used to aggregate nutrient data follow those used by Mueller and others (1995)]

Physical property or constituent (reporting units)	Physical property or constituent name	Parameter code[1]	No. of samples

[1]Parameter codes from the U.S. Geological Survey National Water Information System and the U.S. Environmental Protection Agency Data Storage and Retrieval System (STORET).

[2]Values less than detection and missing values are not included in the calculation.

[3]Total kjeldahl nitrogen. If any values for the parameters used in the calculation are less than detection or missing, total nitrogen is not computed.

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Table 5. Colorado Department of Public Health and Environment section 303(d) list of impaired waters and monitoring and evaluation list for the Upper Yampa River watershed, 2010.
[--, no listing; Mn, manganese; Se, selenium; Hg, mercury; FCA, fish consumption advisory; DO, dissolved oxygen; USFS, U.S. Forest Service; Fe, iron; dis, dissolved; Zn, zinc; *E. coli*, *Escherichia coli*; trec, total recoverable; Pb, lead. Data from Colorado Department of Public Health and Environment (2010b)]

Segment	Segment description	Segment portion	Clean Water Act Section 303(d) impairment	Monitoring and Evaluation list parameter
2a	Mainstem of the Yampa River from Wheeler Creek to Oak Creek	Yampa River below Stagecoach Reservoir	--	Mn, Se
2b	All lakes and reservoir tributary to the Yampa River, Elkhead Creek, and the Little Snake River	Elkhead Reservoir, Lake Catamount	Aquatic life use (Hg FCA)	--
2b	All lakes and reservoir tributary to the Yampa River, Elkhead Creek, and the Little Snake River	Stagecoach Reservoir	--	DO
2c	Yampa River, from Oak Creek to Elkhead Creek	All	--	Water temperature
3	All tributaries to Yampa River, except for specific listings on USFS land	Bushy Creek	Sediment	--
3	All tributaries to Yampa River, except for specific listings on USFS land	Walton Creek	--	Mn
3	All tributaries to Yampa River, except for specific listings on USFS land	Little Morrisonn Creek	--	Fe (dis), Zn
4	Little White Snake Creek, source to Yampa River	All	--	DO
8	Elk River including tributaries and wetlands from the source to Yampa River	Elk River below Morin Ditch	*E. coli*	--
8	Elk River including tributaries and wetlands from the source to Yampa River	Lost Dog Creek	--	Hg
13b	Foidel Creek and tributaries, Fish Creek, Middle Creek and tributaries	Fish Creek	--	*E. coli*
13d	Dry Creek including all tributaries and wetlands from the source to the Yampa River	Below Seneca sample location 8 (WSD5)	Se	--
13d	Dry Creek including all tributaries and wetlands from the source to the Yampa River	All	Fe (trec)	--
13d	Dry Creek including all tributaries and wetlands from the source to the Yampa River	Dry Creek below Routt County Road 53	--	*E. coli*, Pb
13e	Sage Creek, Grassy Creek and tributaries	Sage Creek below Routt County Road 51D	Se	--

Table 6. Number of stream sites and samples with water-quality data in the Upper Yampa River watershed and subbasins by constitutent group,1975 through 2009.
[No., number]

Constitutent group	Upper Yampa River Watershed		Subbasin											
			Yampa River upstream from Chuck Lewis State Wildlife Area		Yampa River downstream from Chuck Lewis State Wildlife Area to confluence with Elk River		Elk River		Yampa River downstream from Elk River confluence to Hayden		Yampa River downstream Hayden to confluence with Elkhead Creek		Elkhead Creek	
	No. of sites	No. of samples	No. of sites	No. of samples	No. of sites	No. of samples	No. of sites	No. of samples	No. of sites	No. of samples	No. of sites	No. of samples	No. of sites	No. of samples
Physical properties	208	5,660	56	1,940	51	1,055	23	620	49	1,358	16	204	13	483
Discharge (instantaneous)	139	3,684	36	807	34	789	15	467	35	1,060	11	137	8	424
Dissolved solids	110	1,743	28	429	13	166	17	200	33	647	10	101	9	200
Major ions	146	2,098	36	509	27	242	20	225	44	774	11	131	8	217
Nutrients	164	2,163	34	543	43	297	21	222	46	756	12	129	8	216
Trace elements and uranium	145	2,424	43	1,024	24	246	19	194	39	709	11	156	9	95
DOC	54	342	10	26	4	20	11	38	4	28	18	149	7	81
Coliform bacteria	89	432	21	112	32	171	8	36	18	32	4	12	6	69
Suspended sediment	65	1,079	18	265	13	62	10	101	12	399	5	92	7	160
Total unique sites and samples	211	5,862	56	1,981	51	1,088	23	629	51	1,452	16	225	14	487

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Table 7. Period of record and number of stream-water samples collected per year by constituent group, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.
[Value in cell is number of samples analyzed in each constituent group for the year. --, no data]

Constituent group	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Upper Yampa River watershed																																			
Physical properties	194	231	76	63	103	137	177	145	125	47	93	169	159	137	186	170	280	360	285	296	262	242	263	182	219	176	298	159	118	97	70	55	63	20	3
Discharge, instantaneous	118	193	26	49	59	103	133	77	63	29	73	149	145	123	171	143	162	233	150	140	161	126	132	137	187	155	119	90	91	76	56	4	4	4	3
Dissolved solids, total	45	52	37	44	67	88	146	60	76	37	62	63	41	36	28	17	33	25	14	9	18	69	124	41	88	52	198	88	46	19	3	7	4	4	2
Major ions	87	102	37	46	70	110	148	95	77	38	63	64	41	36	32	15	34	25	15	13	20	69	126	53	90	61	199	93	59	31	8	55	63	20	3
Nutrients	137	156	36	46	64	109	146	80	76	38	63	64	41	35	46	27	37	31	11	13	19	69	126	41	89	61	199	89	42	23	8	55	63	20	3
Trace elements and uranium	82	101	36	47	76	109	92	95	59	37	51	52	33	32	22	22	79	122	106	124	108	127	139	59	61	47	184	87	56	31	8	55	63	20	2
Dissolved organic carbon	59	64	9	18	24	29	18	12	5	--	--	--	--	--	--	--	--	--	--	--	5	7	6	9	14	14	11	10	23	--	--	5	--	--	--
Coliform bacteria	56	69	--	--	--	--	--	--	--	--	--	--	--	--	18	8	19	18	4	4	2	7	10	9	22	14	63	45	10	3	4	4	20	20	3
Suspended sediment	42	137	23	45	57	98	69	65	37	13	29	69	42	39	34	19	32	19	--	--	8	22	28	24	54	23	14	12	25	--	--	--	--	--	--
Yampa River upstream from Chuck Lewis State Wildlife Area subbasin																																			
Physical properties	50	43	16	10	27	14	22	14	14	14	22	54	49	48	47	55	124	202	173	184	142	101	102	54	51	38	93	60	36	31	17	18	15	--	--
Discharge, instantaneous	26	26	--	1	2	7	--	--	--	2	9	45	41	41	38	38	49	102	50	37	49	30	30	29	33	27	19	21	19	22	14	--	--	--	--
Dissolved solids, total	10	9	6	3	13	12	19	11	11	14	19	20	22	20	16	8	17	10	2	--	--	12	33	3	11	12	74	35	2	5	--	--	--	--	--
Major ions	20	18	6	4	11	12	20	11	11	14	19	21	22	20	16	7	17	10	2	--	--	12	34	3	12	12	74	39	14	15	--	18	15	--	--
Nutrients	23	30	6	4	10	12	20	11	12	14	19	21	22	19	30	18	25	20	2	--	--	12	34	3	11	12	74	35	4	7	--	18	15	--	--
Trace elements and uranium	20	18	6	4	13	11	15	11	11	13	14	16	15	16	16	17	44	99	93	109	87	61	70	22	22	16	74	43	20	15	--	18	15	--	--
Dissolved organic carbon	12	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--	--	--	--	--	--	--	--	--
Coliform bacteria	17	17	--	--	--	--	--	--	--	--	--	--	--	--	18	8	14	14	--	--	--	--	--	--	8	--	7	9	--	--	--	--	--	--	--
Suspended sediment	18	24	--	6	13	--	--	--	--	--	--	42	39	39	28	16	25	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Yampa River downstream from Chuck Lewis State Wildlife Area to confluence with Elk River subbasin																																			
Physical properties	44	72	9	6	5	7	10	31	42	10	20	55	49	26	59	31	56	60	32	49	42	42	38	38	31	26	31	25	17	19	18	8	24	20	3
Discharge, instantaneous	27	43	--	--	--	--	5	6	19	10	19	52	49	26	59	32	46	57	32	49	42	18	22	27	29	24	17	17	16	16	15	4	4	4	3
Dissolved solids, total	2	--	--	--	--	--	5	3	15	5	10	8	1	--	1	--	5	4	3	--	--	6	21	5	9	7	18	12	5	5	3	3	4	4	2
Major ions	6	10	--	--	--	--	5	6	16	6	11	8	1	--	5	--	5	4	3	--	--	6	21	11	9	7	18	13	5	7	4	8	24	20	3
Nutrients	29	51	--	--	--	--	5	5	14	6	11	8	1	--	5	--	5	4	3	--	--	6	21	5	9	7	18	13	5	7	4	8	24	20	3
Trace elements and uranium	6	10	--	--	--	--	--	6	12	6	4	1	--	--	--	--	13	8	3	--	--	28	20	15	8	5	18	13	5	7	4	8	24	20	2
Dissolved organic carbon	6	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	2	--	1	--	--	--	--	--	--	--
Coliform bacteria	19	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	4	3		--	1	4	4	7	4	15	11	4	3	4	4	20	20	3
Suspended sediment	7	19	--	--	--	--	--	6	12	3	5	1	--	--	5	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Elk River subbasin																																			
Physical properties	16	23	10	2	7	11	13	12	9	1	2	6	8	15	29	36	30	28	23	14	11	17	31	20	63	44	46	29	38	12	1	9	4	--	--
Discharge, instantaneous	11	17	1	--	--	--	--	--	4	1	2	6	8	15	29	36	31	28	23	14	11	11	15	19	62	44	19	20	30	9	1	--	--	--	--
Dissolved solids, total	4	6	--	--	4	6	6	3	4	--	--	--	--	--	--	3	3	5	4	4	2	11	18	1	36	13	27	11	22	3	--	4	--	--	--
Major ions	8	6	--	--	4	6	6	3	4	--	--	--	--	--	--	3	4	5	4	4	2	11	19	1	37	21	27	11	23	3	--	9	4	--	--
Nutrients	10	9	--	--	4	6	6	3	4	--	--	--	--	--	--	3	4	5	4	4	1	11	19	1	37	21	27	11	16	3	--	9	4	--	--

Table 7. Period of record and number of stream-water samples collected per year by constituent group, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.
[Value in cell is number of samples analyzed in each constituent group for the year. --, no data]

Constituent group	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Trace elements and uranium	8	6	--	--	4	6	7	3	--	--	--	--	--	--	--	2	2	2	3	4	2	11	19	1	17	15	27	11	28	3	--	9	4	--	--
Dissolved organic carbon	8	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--	--	17	--	--	5	--	--	--
Coliform bacteria	5	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	3	--	--	--	10	6	--	--	--	--	--	--	--
Suspended sediment	6	17	1	--	--	--	--	--	--	--	--	--	--	--	--	3	3	4	--	--	--	--	--	--	35	19	--	--	13	--	--	--	--	--	--
Yampa River downstream from Elk River to Hayden subbasin																																			
Physical properties	68	72	36	35	48	68	90	65	52	21	47	46	43	41	40	35	44	49	43	35	36	38	59	46	45	32	55	5	1	5	24	18	16	--	--
Discharge, instantaneous	43	91	25	32	47	66	83	57	37	15	41	38	37	34	34	28	26	36	36	28	29	24	31	38	36	29	22	--	--	--	17	--	--	--	--
Dissolved solids, total	25	34	31	32	39	46	81	42	42	18	33	35	18	16	11	6	8	6	5	5	6	13	28	8	11	4	33	5	1	5	--	--	--	--	--
Major ions	46	58	31	32	45	58	82	63	42	18	33	35	18	16	11	5	8	6	5	5	6	13	28	14	11	4	33	5	1	5	3	18	16	--	--
Nutrients	64	57	30	32	40	58	80	54	42	18	33	35	18	16	11	6	3	2	1	5	6	13	28	8	11	4	33	5	1	5	3	18	16	--	--
Trace elements and uranium	41	57	30	33	47	58	48	63	36	18	33	35	18	16	6	3	3	2	1	5	6	13	28	16	9	3	33	5	1	5	3	18	16	--	--
Dissolved organic carbon	26	29	9	16	19	19	11	12	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	1	--	--	--	--	--	--	--	--	--
Coliform bacteria	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	3	2	12	3	--	--	--	--	--	--	--
Suspended sediment	7	64	22	29	34	64	44	46	25	10	24	26	3	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Yampa River downstream from Hayden to confluence with Elkhead Creek subbasin																																			
Physical properties	8	3	--	9	11	35	38	13	--	--	--	--	--	--	--	4	17	11	5	2	1	1	--	--	--	2	18	6	--	12	6	--	2	--	--
Discharge, instantaneous	4	3	--	15	10	37	38	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11	5	--	--	--	--
Dissolved solids, total	1	--	--	8	9	24	35	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	15	--	6	1	--	--	--	--	--
Major ions	2	3	--	9	11	34	35	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	15	6	--	1	1	--	2	--	--
Nutrients	6	3	--	9	10	33	35	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	15	6	--	1	--	1	2	--	--
Trace elements and uranium	2	3	--	9	10	34	22	12	--	--	--	--	--	--	--	--	17	11	5	2	1	1	--	--	--	1	16	6	--	1	1	--	2	--	--
Dissolved organic carbon	2	3		1	5	10	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Coliform bacteria	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	5	--	--	--	--	--	--	--
Suspended sediment	--	--	--	10	10	34	25	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Elkhead Creek subbasin																																			
Physical properties	8	18	5	1	5	2	4	10	8	1	2	8	10	7	11	9	9	10	9	12	30	43	33	24	29	34	55	34	26	18	4	2	2	--	--
Discharge (instantaneous)	7	13	--	1	--	--	--	--	3	1	2	8	10	7	11	9	10	10	9	12	30	43	34	24	27	31	42	32	26	18	4	--	--	--	--
Dissolved solids	3	3	--	1	2	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	10	27	24	24	21	15	31	19	16	--	--	--	--	--	--
Major ions	5	7	--	1	--	--	--	--	4	--	--	--	--	--	--	--	--	--	1	4	12	27	24	24	21	16	32	19	16	--	--	2	2	--	--
Nutrients	5	6	--	1	--	--	--	--	4	--	--	--	--	--	--	--	--	--	1	4	12	27	24	24	21	16	32	19	16	--	--	2	2	--	--
Trace elements and uranium	5	7	--	1	2	--	--	--	--	--	--	--	--	--	--	--	--	--	1	4	12	13	2	5	5	7	16	9	2	--	--	2	2	--	--
Dissolved organic carbon	5	5	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	7	6	9	8	9	11	9	6	--	--	--	--	--	--
Coliform bacteria	2	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	4	2	5	3	4	4	8	14	11	6	--	--	--	--	--	--
Suspended sediment	4	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	22	28	24	19	4	14	12	12	--	--	--	--	--	--

Table 8. Number of stream-water-quality samples collected per season, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

Watershed or subbasin	Number of samples per season			
	Nov-Jan	Feb-April	May-July	Aug-Oct
Upper Yampa River watershed	975	1,441	1,954	1,492
Subbasin				
Yampa River upstream from Chuck Lewis State Wildlife Area	349	479	712	441
Yampa River downstream from Chuck Lewis State Wildlife Area to confluence with Elk River	175	206	361	346
Elk River	94	133	223	179
Yampa River downstream from Elk River confluence to Hayden	250	413	437	352
Yampa River downstream from Hayden to confluence with Elkhead Creek	26	91	64	44
Elkhead Creek	81	119	157	130

Table 9. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected physical properties in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; μS/cm; microsiemens per centimeter at 25 degrees Celsius; --, no water-quality standard; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; >, greater than. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c). Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Physical property (reporting units)	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
Upper Yampa River watershed							
Specific conductance (μS/cm)	191	4,305	33	2	315	10,000	--
pH (standard units)	184	3,140	0	2.1	8.1	9.8	6.5–9.0
Water temperature (°C)	191	5,188	0	–3	7.5	30.4	Footnote 2
Oxygen, dissolved (mg/L)	171	2,803	0	1.2	9.8	17.8	[3]5.0, 6.0
Hardness, total (mg/L as $CaCO_3$)	142	2,434	2	4	162	4,000	--
Acid neutralizing capacity (mg/L as $CaCO_3$)	134	2,244	1	2	136	660	--
Yampa River upstream from Chuck Lewis State Wildlife Area subbasin (stream segments 2a, 2c, 3, 4, 5, 6, 7)							
Specific conductance (μS/cm)	47	966	0	29	424	1,179	--
pH (standard units)	52	1,177	0	6.3	8.3	9.4	6.5–9.0
Water temperature (°C)	51	1,589	0	–3	8	28	Footnote 2
Oxygen, dissolved (mg/L)	52	1,300	0	1.2	9.8	>15	6.0
Hardness, total (mg/L as $CaCO_3$)	41	1,018	0	25	190	580	--
Acid neutralizing capacity (mg/L as $CaCO_3$)	41	989	0	4	152	420	--
Yampa River downstream from Chuck Lewis State Wildlife Area to confluence with Elk River subbasin (stream segments 2c, 3, 20a)							
Specific conductance (μS/cm)	47	960	30	2	55	750	--
pH (standard units)	38	282	0	5.6	7.8	9.7	6.5–9.0
Water temperature (°C)	41	997	0	–0.15	6	26.6	Footnote 2
Oxygen, dissolved (mg/L)	37	293	0	4	10	17.8	6.0
Hardness, total (mg/L as $CaCO_3$)	26	218	1	4.3	48	320	--
Acid neutralizing capacity (mg/L as $CaCO_3$)	21	187	0	2	60	240	--
Elk River subbasin(stream segments 8, 20a)							
Specific conductance (μS/cm)	22	570	3	16	80.5	750	--
pH (standard units)	22	233	0	6	7.55	9.4	6.5–9.0
Water temperature (°C)	23	613	0	–0.26	5.7	25.5	Footnote 2
Oxygen, dissolved (mg/L)	22	200	0	6.9	9.905	13.8	6.0
Hardness, total (mg/L as $CaCO_3$)	17	209	1	4	21	120	--
Acid neutralizing capacity (mg/L as $CaCO_3$)	15	133	1	4	30	86	--
Yampa River downstream from Elk River confluence to Hayden subbasin (stream segments 2c, 11, 12, 13a, 13b, 13c, 13e, 13f, 20a)							
Specific conductance (μS/cm)	48	1,196	0	49	806	6,360	--
pH (standard units)	48	1,105	0	2.1	8.1	9.8	6.5–9.0
Water temperature (°C)	48	1,314	0	–0.25	9	28.6	Footnote 2
Oxygen, dissolved (mg/L)	38	671	0	3	9.8	16	[3]5.0, 6.0
Hardness, total (mg/L as $CaCO_3$)	37	679	0	20	260	3,000	--
Acid neutralizing capacity (mg/L as $CaCO_3$)	37	667	0	8.2	162	660	--
Yampa River downstream from Hayden to confluence with Elkhead Creek subbasin (stream segments 2c, 12, 13d)							
Specific conductance (μS/cm)	15	150	0	72.2	1,008	10,000	--

Table 9. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected physical properties in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; μS/cm; microsiemens per centimeter at 25 degrees Celsius; --, no water-quality standard; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; >, greater than. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c). Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Physical property (reporting units)	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
pH (standard units)	13	122	0	6.5	8	8.8	6.5–9.0
Water temperature (°C)	16	200	0	–0.33	9.5	25.2	Footnote 2
Oxygen, dissolved (mg/L)	11	125	0	4.5	9.2	13.1	[3]5.0, 6.0
Hardness, total (mg/L as $CaCO_3$)	11	104	0	23	540	4,000	--
Acid neutralizing capacity (mg/L as $CaCO_3$)	12	145	0	12	230	590	--
Elkhead Creek subbasin (stream segments 14, 15, 20b)							
Specific conductance (μS/cm)	12	463	0	100	305	912	--
pH (standard units)	11	221	0	7.3	8.25	9.47	6.5–9.0
Water temperature (°C)	12	475	0	–0.12	8.7	30.4	Footnote 4
Oxygen, dissolved (mg/L)	11	214	0	4.7	10.1	14.5	[3]5.0, 6.0
Hardness, total (mg/L as $CaCO_3$)	10	206	0	47.4	128.5	331	--
Acid neutralizing capacity (mg/L as $CaCO_3$)	8	123	0	48.6	114	219	--

[1]Censored values can be expressed as values less than the laboratory reporting level or values greater than the maximum value reported.

[2]Temperature standards for cold-water streams—acute (Daily Maximum): June–September, 21.2°C; October–May, 13.0°C; chronic (Maximum Weekly Average Temperature): June–September, 17.0°C; October–May, 9.0°C (Colorado Department of Public Health and Environment, 2009, 2010c).

[3]Standard varies by stream segment. See Colorado Department of Public Health and Environment (2010c).

[4]Temperature standards for warm-water streams—acute (Daily Maximum): March–November, 31.3°C; December–February, 15.2°C; chronic (Maximum Weekly Average Temperature): March–November, 28.7°C; December–February, 14.3°C (Colorado Department of Public Health and Environment, 2009, 2010c).

Table 10. Results of Seasonal Kendall trend analysis for selected physical properties and water-quality constituents in the Upper Yampa River watershed, Colorado.

[No., number; p-vlaue, significance of trend; μS/cm; microsiemens per centimeter at 25 degrees Celsius; --, data not reported; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; P, phosphorus; μg/L, micrograms per liter; col/100 mL, colonies per 100 milliliters. See figure 3 and Appendix 3 for location of sites and additional site information]

Physical property of constituent (reporting units)	Period of record	No. of samples/No. of censored values	Flow adjustment	p-Value	Trend direction	Trend slope	Magnitude of trend slope (percent/year)	Magnitude of trend slope (units/year)	Median value
Yampa River above Stagecoach Reservoir (site 147)									
Specific conductance (μS/cm)	1990–2003	167/0	Yes	0.77	None	--	--	--	452
Elk River near Milner, CO (site 33)									
Specific conductance (μS/cm)	1990–2003	162/0	Yes	0.08	None	--	--	--	122
Yampa River at Steamboat Springs (site 153)									
Specific conductance (μS/cm)	1997–2008	127/0	Yes	0.03	Down	-0.028	-2.7	-6.0	264
pH (standard units)	1997–2008	55/0	No	0.41	None	--	--	--	8.2
Water temperature (°C)	1997–2008	125/0	Yes	0.17	None	--	--	--	6.0
Hardness, total (mg/L as $CaCO_3$)	1997–2008	49/0	Yes	0.09	None	--	--	--	116
Dissolved solids, total (mg/L)	1997–2008	44/0	Yes	0.03	Down	-0.030	-3.0	-3.9	153
Calcium, dissolved (mg/L)	1997–2008	49/0	Yes	0.07	None	--	--	--	30.0
Magnesium, dissolved (mg/L)	1997–2008	49/0	Yes	0.08	None	--	--	--	9.84
Sodium, dissolved (mg/L)	1997–2008	49/0	Yes	0.40	None	--	--	--	8.20
Potassium, dissolved (mg/L)	1997–2008	49/0	Yes	0.26	None	--	--	--	1.74
Sulfate, dissolved (mg/L)	1997–2008	48/0	Yes	0.06	None	--	--	--	27.4
Chloride, dissolved (mg/L)	1997–2008	48/0	Yes	0.06	None	--	--	--	3.64
Silica, dissolved (mg/L)	1997–2008	48/0	Yes	0.77	None	--	--	--	9.72
Phosphorous, total (mg/L as P)	1997–2008	48/3	Yes	0.04	Up	0.031	3.1	0.001	0.036
Iron, total recoverable (μg/L)	1997–2008	48/0	Yes	0.53	None	--	--	--	255
Manganese, dissolved (μg/L)	1997–2008	48/0	Yes	0.17	None	--	--	--	17.4
Manganese, total recoverable (μg/L)	1997–2008	48/0	Yes	0.03	Down	-0.047	-4.6	-2.6	45.6
Escherichia coli (col/100 mL)	1997–2008	47/4	No	0.06	None	--	--	--	2.7

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Table 11. Stream water-quality sites with exceedances of Colorado Department of Public Health and Environment in-stream water-quality standards constituents and U.S. Environmental Protection Agency recommended concentrations for total phosphorus, Upper Yampa River watershed, Coloradc [no., number; Min., minimum; Max., maximum; SMCL, Secondary Maximum Contaminant Level; DWS, domestic water supply; <, less than; >, greate Yampa River upstream from Chuck Lewis State Wildlife Area, Lewis SWA to Elk River=Yampa River downstream from Chuck Lewis State Wildlife Ar Hayden=Yampa River downstream from Elk River to Hayden, Downstream Hayden=Yampa River downstream from Hayden to confluence with Elkhe Department of Public Health and Environment (2009a, 2010b); standards are for protection of aquatic life, unless otherwise stated. Recommended cc Environmental Protection Agency (2000). See Appendix 3 for additional site information]

Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Site identifier	Stream segment	Subbasin	Period of water-quality record (calendar year)[1]	No. of samples	No. of censored values[2]
				pH (standard units)			
11	BURGESS CREEK AB SKI AREA NR STEAMBOAT SPGS,	402802106471000	3	Lewis SWA to Elk River	1975–76	6	0
53	FISH CREEK NEAR STEAMBOAT SPRINGS, CO	09239000	3	Lewis SWA to Elk River	1975–76	6	0
76	NORTH FORK ELK RIVER NEAR HINMAN PARK, CO.	404620106462200	20a	Elk River	1975–76	3	0
81	NORTH FORK WALTON CREEK NR RABBIT EARS PASS,	09238300	3	Lewis SWA to Elk River	1975–87	10	0
145	YAMPA RIVER ABV ELK RIVER	402936106565000	2c	Lewis SWA to Elk River	1999–2002	3	0
				Dissolved oxygen (milligrams per liter)			
66	LITTLE WHITE SNAKE CK @ HWY 131	12897	4	Upstream Lewis SWA	2001–07	4	0
70	MARTIN C AB DAM SITE NR OAK CREEK, CO	401729106514601	3	Upstream Lewis SWA	1986–88	14	0
				Dissolved solids, total (milligrams per liter)			
115	TROUT CK NR. MOUTH	12876	13f	Elk River to Hayden	1996–2004	17	0
				Sulfate, unfiltered (milligrams per liter)			
66	LITTLE WHITE SNAKE CK @ HWY 131	12897	4	Upstream Lewis SWA	2001–07	4	0
115	TROUT CK NR. MOUTH	12876	13f	Elk River to Hayden	1996–2007	22	0
				Phosphorus, total (milligrams per liter)			
17	COW CR. NR. STEAMBOAT SPRINGS,CO.	402836106550100	3	Lewis SWA to Elk River	1982	3	0
40	ELKHEAD CREEK ABOVE LONG GULCH, NEAR HAYDEN	09246200	15	Elkhead Creek	1995–2003	83	20
43	ELKHEAD CREEK NEAR CRAIG, CO	09246500	15	Elkhead Creek	1975–78	6	1
63	LITTLE MORRISON CK @ RD 18A	12896	3	Upstream Lewis SWA	2001–07	7	0
65	LITTLE MORRISON CREEK NEAR STAGECOACH, CO.	401634106502200	3	Upstream Lewis SWA	1975–76	4	0
66	LITTLE WHITE SNAKE CK @ HWY 131	12897	4	Upstream Lewis SWA	2001–07	4	0
115	TROUT CK NR. MOUTH	12876	13f	Elk River to Hayden	1996–07	22	0
117	TROUT CREEK ABOVE MILNER, CO.	402720106591200	13f	Elk River to Hayden	1982	3	1

Table 11. Stream water-quality sites with exceedances of Colorado Department of Public Health and Environment in-stream water-quality standards · constituents and U.S. Environmental Protection Agency recommended concentrations for total phosphorus, Upper Yampa River watershed, Coloradc [no., number; Min., minimum; Max., maximum; SMCL, Secondary Maximum Contaminant Level; DWS, domestic water supply; <, less than; >, greate Yampa River upstream from Chuck Lewis State Wildlife Area, Lewis SWA to Elk River=Yampa River downstream from Chuck Lewis State Wildlife Ai Hayden=Yampa River downstream from Elk River to Hayden, Downstream Hayden=Yampa River downstream from Hayden to confluence with Elkhe Department of Public Health and Environment (2009a, 2010b); standards are for protection of aquatic life, unless otherwise stated. Recommended cc Environmental Protection Agency (2000). See Appendix 3 for additional site information]

Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Site identifier	Stream segment	Subbasin	Period of water-quality record (calendar year)[1]	No. of samples	No. of censored values[2]
147	YAMPA R. U/S STAGECOACH RES @ CR16	12809	2a	Upstream Lewis SWA	1999–07	22	1
135	YAMPA R BL KOA CAMPGROUNDS NR STEAMBOAT SPC	403017106525800	2c	Lewis SWA to Elk River	1975–76	4	0
138	YAMPA R. BLW STAGECOACH RES.	12808	2a	Upstream Lewis SWA	1996–99	14	0
139	YAMPA R. D/S STAGECOACH RES. DAM	12808P	2a	Upstream Lewis SWA	2000–07	21	0
140	YAMPA R. N. OF HAYDEN @ CALIFORNIA PARK RD	12802	2c	Elk River to Hayden	1996–99	13	0
147	YAMPA RIVER ABOVE STAGECOACH RESERVOIR, CO	09237450	2a	Upstream Lewis SWA	1988–92	24	0
145	YAMPA RIVER ABOVE ELK RIVER NEAR MILNER, CO.	402932106564900	2c	Lewis SWA to Elk River	1975–76	9	0
149	YAMPA RIVER AT ELK RIVER JUNCTION NR MILNER, CC	402902106580000	2c	Lewis SWA to Elk River	1975–76	4	0
154	YAMPA RIVER BELOW DIVERSION, NEAR HAYDEN, CO.	09244410	2c	Elk River to Hayden	1975–82	81	0
158	YAMPA RIVER BELOW STAGECOACH RESERVOIR, CO	09237500	2a	Upstream Lewis SWA	1988–92	24	0
163	YAMPA RIVER BELOW STEAMBOAT II SEWAGE PLANT,	403002106545500	2c	Lewis SWA to Elk River	1975–76	4	0
			Copper, dissolved (micrograms per liter)				
45	ENGLISH CREEK ABOVE MOUTH, NEAR CLARK, CO	404727106453700	20a	Elk River	1999–2003	7	4
49	FISH CR AT UPPER STA NR STEAMBOAT SPRINGS, CO	09238900	3	Lewis SWA to Elk River	1984–85	3	1
101	SAGE CREEK NEAR HAYDEN, CO.	402918107094400	13e	Elk River to Hayden	1975–76	3	1
123	WALTON CREEK NEAR STEAMBOAT SPRINGS, CO.	09238500	3	Lewis SWA to Elk River	1984–85	3	1
			Iron, dissolved (micrograms per liter)				
46	FISH	FISH	3	Lewis SWA to Elk River	2007–08	4	1
63	LITTLE MORRISON CK @ RD 18A	12896	3	Upstream Lewis SWA	2001–07	7	0
166	Yampa River Library	CDOWRW-12	2c	Lewis SWA to Elk River	1991–92	4	0
170	Yampa River Stagecoach Res	CDOWRW-8	2a	Upstream Lewis SWA	1990–2004	16	0
			Iron, total recoverable (micrograms per liter)				
16	CHIMNEY CREEK AT TRAPPER, CO.	400612106524800	5	Upstream Lewis SWA	1975–76	4	0

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Table 11. Stream water-quality sites with exceedances of Colorado Department of Public Health and Environment in-stream water-quality standards · constituents and U.S. Environmental Protection Agency recommended concentrations for total phosphorus, Upper Yampa River watershed, Coloradc [no., number; Min., minimum; Max., maximum; SMCL, Secondary Maximum Contaminant Level; DWS, domestic water supply; <, less than; >, greate Yampa River upstream from Chuck Lewis State Wildlife Area, Lewis SWA to Elk River=Yampa River downstream from Chuck Lewis State Wildlife Ai Hayden=Yampa River downstream from Elk River to Hayden, Downstream Hayden=Yampa River downstream from Hayden to confluence with Elkhe Department of Public Health and Environment (2009a, 2010b); standards are for protection of aquatic life, unless otherwise stated. Recommended cc Environmental Protection Agency (2000). See Appendix 3 for additional site information]

Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Site identifier	Stream segment	Subbasin	Period of water-quality record (calendar year)[1]	No. of samples	No. of censored values[2]
17	COW CR. NR. STEAMBOAT SPRINGS,CO.	402836106550100	3	Lewis SWA to Elk River	1982	4	0
51	FISH CREEK AT MOUTH NEAR MILNER, CO.	402530106585700	13b	Elk River to Hayden	1975–82	10	0
117	TROUT CREEK ABOVE MILNER, CO.	402720106591200	13f	Elk River to Hayden	1982	4	0
164	Yampa River East Br	CDOWRW-13	2c	Elk River to Hayden	1998	7	0
			Manganese, dissolved (micrograms per liter)				
63	LITTLE MORRISON CK @ RD 18A	12896	3	Upstream Lewis SWA	2001–07	7	0
83	OAK CK D/S TOWN OF OAK CREEK @ CR 27	12892	6	Upstream Lewis SWA	1999–2007	14	0
91	Oak Creek Decker Pk	CDOWRW-80	6	Upstream Lewis SWA	1991–92	13	0
115	TROUT CK NR. MOUTH	12876	13f	Elk River to Hayden	1996–2007	22	0
124	WALT	WALT	3	Lewis SWA to Elk River	2007–08	4	0
122	WALTON CR. NEAR MOUTH @ HWY 40	12894	3	Lewis SWA to Elk River	1999–2007	5	0
129	YAMPA ABOVE OAK CREEK CONFLUENCE	000088	2a	Upstream Lewis SWA	1988–93	22	4
153	YAMPA R. @ 5TH ST. BRIDGE IN STEAMBOAT	12806	2c	Lewis SWA to Elk River	1996–2007	37	1
143	YAMPA R. ABV OAK CREEK	12811	2a	Upstream Lewis SWA	1996–2002	30	0
138	YAMPA R. BLW STAGECOACH RES.	12808	2a	Upstream Lewis SWA	1996–99	14	1
139	YAMPA R. D/S STAGECOACH RES. DAM	12808P	2a	Upstream Lewis SWA	2000–07	21	5
140	YAMPA R. N. OF HAYDEN @ CALIFORNIA PARK RD	12802	2c	Elk River to Hayden	1996–99	13	1
143	YAMPA RIVER AB OAK CREEK NR STEAMBOAT SPGS, C	402356106500000	2a	Upstream Lewis SWA	1975–76	4	1
153	YAMPA RIVER AT STEAMBOAT SPRINGS, CO	09239500	2c	Lewis SWA to Elk River	1975–2009	68	2
157	Yampa River Below Stagecoach	CDOWRW-81	2a	Upstream Lewis SWA	2004	5	0
166	Yampa River Library	CDOWRW-12	2c	Lewis SWA to Elk River	1991–92	8	0
168	YAMPA RIVER NEAR HAYDEN, CO.	09244400	2c	Elk River to Hayden	1979	3	0
171	Yampa River SWA Br	CDOWRW-10	2a	Upstream Lewis SWA	1991–92	15	0

Table 11. Stream water-quality sites with exceedances of Colorado Department of Public Health and Environment in-stream water-quality standards
constituents and U.S. Environmental Protection Agency recommended concentrations for total phosphorus, Upper Yampa River watershed, Coloradc
[no., number; Min., minimum; Max., maximum; SMCL, Secondary Maximum Contaminant Level; DWS, domestic water supply; <, less than; >, greate
Yampa River upstream from Chuck Lewis State Wildlife Area, Lewis SWA to Elk River=Yampa River downstream from Chuck Lewis State Wildlife A
Hayden=Yampa River downstream from Elk River to Hayden, Downstream Hayden=Yampa River downstream from Hayden to confluence with Elkhe
Department of Public Health and Environment (2009a, 2010b); standards are for protection of aquatic life, unless otherwise stated. Recommended cc
Environmental Protection Agency (2000). See Appendix 3 for additional site information]

Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Site identifier	Stream segment	Subbasin	Period of water-quality record (calendar year)[1]	No. of samples	No. of censored values[2]
			Selenium, dissolved (micrograms per liter)				
22	DRY CK @ HAYDEN	12852	13d	Downstream Hayden	2001–05	7	2
59	GRASSY CK @ RD. 27A	12853	13e	Elk River to Hayden	2001–07	7	1
59	GRASSY CREEK NEAR MOUNT HARRIS, CO.	09244300	13e	Elk River to Hayden	1975–82	5	3
98	SAGE CK @ RD. 27	12851	13e	Elk River to Hayden	2001–07	7	1
101	SAGE CREEK NEAR HAYDEN, CO.	402918107094400	13e	Elk River to Hayden	1975–76	5	1
112	STOKES GULCH NEAR HAYDEN, CO.	09244470	13d	Downstream Hayden	1978–81	5	0
157	Yampa River Below Stagecoach	CDOWRW-81	2a	Upstream Lewis SWA	2004	3	0

[1]Sample collection may not have occurred during every year in the period of record.

[2]Censored values can be expressed as values less than the laboratory reporting level or values greater than the maximum value reported.

[3]Minimum censored value is greater than minimum detected value.

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Table 12. Number of sample days with water temperature not meeting Colorado Department of Public Health and Environment in-stream water-quality standards, Yampa River at Steamboat Springs, CO (site number 153), July 26, 2002, through April 13, 2005.
[°C, degrees Celsius; DM, Daily Maximum; MWAT, Maximum Weekly Average Temperature. Water-quality standards are from Colorado Department of Public Health and Environment (2009, 2010b). Continuous (15-minute interval) temparature data were available for July 26, 2002 through April 13, 2005. See figure 3 for location of site]

In-stream water-quality standard (°C)	Number of sample days not meeting standard	Percentage of days not meeting standard (percent)
21.2 (cold, acute DM, June–September)	113	36
17.0 (cold, chronic MWAT, June–September)	151	49
13.0 (cold, acute DM, October–May)	32	5.5
9.0 (cold, chronic MWAT, October–May)	88	14.5

Table 13. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for total dissolved soilds and selected major ions in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; --, no water-quality standard; <, less than; DWS, domestic water supply. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c). Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent (reporting units)	No. of sites	No. of samples	No. of censored values[1]	Minimum value (milligrams per liter)	Median value (milligrams per liter)	Maximum vale (milligrams per liter)	In-stream water-quality standard (milligrams per liter)
Upper Yampa River watershed							
Dissolved solids, total	110	1,743	1	[2]6.5	216	9,280	--
Calcium, dissolved	75	1,064	0	1.4	39.5	480	--
Magnesium, dissolved	75	1,066	0	0.2	15.1	810	--
Sodium, dissolved	65	1,022	0	0.58	18	1,400	--
Potassium, dissolved	65	1,019	0	0.20	2.2	19	--
Bicarbonate, dissolved	28	304	0	14	146	550	--
Sulfate, dissolved	69	1,021	16	[2]0.65	64.5	6,200	--
Sulfate, unfiltered	52	833	67	<3	36	4,300	[3]250 DWS or none
Chloride, dissolved	66	1,017	18	0.1	3.9	240	--
Chloride, unfiltered	16	101	5	<0.002	6	76	[3]250 DWS or none
Fluoride, dissolved	68	992	172	<0.0001	0.2	1	--
Silica, dissolved	66	1,012	0	0.009	8.8	28	--
Yampa River upstream from Chuck Lewis State Wildlife Area subbasin (stream segments 2a, 2c, 3, 4, 5, 6, 7)							
Dissolved solids, total	28	429	0	43	260	1,130	--
Calcium, dissolved	8	84	0	21	53.7	130	--
Magnesium, dissolved	8	84	0	7.1	19.7	36	--
Sodium, dissolved	6	74	0	3.5	12	32	--
Potassium, dissolved	6	74	0	0.4	2.23	4.5	--
Bicarbonate, dissolved	3	7	0	160	211	257	--
Sulfate, dissolved	6	73	6	<5	55	250	--
Sulfate, unfiltered	22	389	3	<3	45	340	[3]250 DWS or none
Chloride, dissolved	6	74	0	0.4	2.35	14	--
Chloride, unfiltered	10	46	2	<1	4	70	[3]250 DWS or none
Fluoride, dissolved	6	74	5	<0.001	0.2	0.6	--
Silica, dissolved	6	74	0	6.9	19	28	--
Yampa River downstream from Chuck Lewis State Wildlife Area to confluence with Elk River subbasin (stream segments 2c, 3, 20a)							
Dissolved solids, total	13	166	1	[2]6.5	90	471	--
Calcium, dissolved	19	157	0	1.4	12.1	100	--
Magnesium, dissolved	19	157	0	0.2	2.7	18	--
Sodium, dissolved	11	125	0	0.7	2.63	30	--
Potassium, dissolved	11	125	0	0.2	0.9	4.9	--
Bicarbonate, dissolved	3	26	0	15	111	157	--
Sulfate, dissolved	12	125	4	[2]0.65	5	160	--
Sulfate, unfiltered	6	61	17	<3	14	54	250 DWS
Chloride, dissolved	12	125	3	<0.1	1.1	12	--
Fluoride, dissolved	12	123	61	[2]0.03	0.08	0.9	--

Table 13. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for total dissolved soilds and selected major ions in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.
[No., number; --, no water-quality standard; <, less than; DWS, domestic water supply. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c). Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent (reporting units)	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum vale	In-stream water-quality standard
				(milligrams per liter)			
Silica, dissolved	12	120	0	2.4	8.9	18	--
Elk River subbasin(stream segments 8, 20a)							
Dissolved solids, total	17	200	0	12.7	29.9	180	--
Calcium, dissolved	10	130	0	1.9	5.9	29	--
Magnesium, dissolved	10	130	0	0.3	1.2	10.6	--
Sodium, dissolved	10	130	0	0.6	1.61	9.15	--
Potassium, dissolved	10	130	0	0.2	0.8	4.7	--
Bicarbonate, dissolved	3	130	0	14	39	78	--
Sulfate, dissolved	10	129	0	0.7	3.2	53	--
Sulfate, unfiltered	7	90	38	<3	7	50	250 DWS
Chloride, dissolved	10	129	15	<0.1	0.3	4.6	--
Chloride, unfiltered	1	7	1	[2]2	4	4	[3]250 DWS or none
Fluoride, dissolved	9	101	60	<0.1	0.1	0.4	--
Silica, dissolved	10	129	0	1.74	7	15	--
Yampa River downstream from Elk River confluence to Hayden subbasin (stream segments 2c, 11, 12, 13a, 13b, 13c, 13e, 13f, 20a)							
Dissolved solids, total	33	647	0	10	321	5,650	--
Calcium, dissolved	23	429	0	6.6	78	480	--
Magnesium, dissolved	23	431	0	1.5	37	310	--
Sodium, dissolved	23	429	0	1.9	32	540	--
Potassium, dissolved	23	425	0	0.5	3.4	19	--
Bicarbonate, dissolved	11	116	0	21	160	510	--
Sulfate, dissolved	26	429	6	1.8	170	2,300	--
Sulfate, unfiltered	13	248	9	<3	30	4,300	[3]250 DWS or none
Chloride, dissolved	23	424	0	0.3	6.5	59	--
Chloride, unfiltered	4	47	2	<0.002	12	53	[3]250 DWS or none
Fluoride, dissolved	26	430	10	<0.001	0.2	1	--
Silica, dissolved	23	423	0	0.2	8	18	--
Yampa River downstream from Hayden to confluence with Elkhead Creek subbasin (stream segments 2c, 12, 13d)							
Dissolved solids, total	10	101	0	60	709	9,280	--
Calcium, dissolved	8	78	0	33	110	280	--
Magnesium, dissolved	8	78	0	13	71.5	810	--
Sodium, dissolved	8	78	0	11	54	1,400	--
Potassium, dissolved	8	79	0	2.1	5	12	--
Bicarbonate, dissolved	4	17	0	144	360	550	--
Sulfate, dissolved	8	80	0	46	360	6,200	--
Sulfate, unfiltered	3	26	0	8	57	3,800	[3]250 DWS or none
Chloride, dissolved	8	80	0	3.4	12.5	240	--

Table 13. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for total dissolved soilds and selected major ions in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; --, no water-quality standard; <, less than; DWS, domestic water supply. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c). Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent (reporting units)	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum vale	In-stream water-quality standard
				(milligrams per liter)			
Chloride, unfiltered	1	1	0	13	13	13	[3]250 DWS or none
Fluoride, dissolved	9	81	1	<0.001	0.3	0.6	--
Silica, dissolved	8	80	0	0.1	8.1	19	--
Elkhead Creek subbasin (stream segments 14, 15, 20b)							
Dissolved solids, total	9	200	0	68	202	635	--
Calcium, dissolved	7	186	0	13	31	71	--
Magnesium, dissolved	7	186	0	3.8	12	39	--
Sodium, dissolved	7	186	0	3.6	19	78	--
Potassium, dissolved	7	186	0	0.76	1.6	4.5	--
Bicarbonate, dissolved	4	8	0	72	167	232	--
Sulfate, dissolved	7	185	0	11	52	347	--
Sulfate, unfiltered	1	19	0	17	83	130	250 DWS
Chloride, dissolved	7	185	0	0.3	3	12	250 DWS
Fluoride, dissolved	6	183	35	[2]0.081	0.13	0.3	--
Silica, dissolved	7	186	0	0.0094	9.9	16	--

[1]Censored values can be expressed as values less than the laboratory reporting level.

[2]Minimum censored value is greater than minimum detected value.

[3]Water-quality standards vary by stream segment. See Colorado Department of Public Health and Environment (2010c).

Table 14. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected nutrients in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009. [No., number; mg/L, milligrams per liter; N, nitrogen; <, less than; --, no water-quality standard; MCL, Maximum Contaminant Level; TVS, table value standard; P, phosphorus; nc,not computed; E, estimated. Water-quality standards are from Colorado Department of Public Health and Environment (2010c); standards are for aquatic-life protection, unless otherwise stated. Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent (reporting units)	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
Upper Yampa River watershed							
Nitrite, dissolved (mg/L as N)	42	628	457	<0.001	0.002	0.39	--
Nitrite, unfiltered (mg/L as N)	9	95	36	<0.0009	0.002	0.4	0.05
Nitrate, dissolved (mg/L as N)	93	1,096	360	<0.005	0.07	90	--
Nitrate, unfiltered (mg/L as N)	120	1,217	701	[2]0.007	0.06	47.6	[3]10, 100 (MCL)
Ammonia, total, unfiltered (mg/L as	39	1,027	635	<0.01	0.02	2.3	[3]TVS or none
Phosphorus, total, unfiltered (mg/L a	144	1,583	243	[2]0.003	0.044	3.9	[3,4]0.05, 0.1
Orthophosphate, dissolved (mg/L as	53	854	367	<0.001	0.01	0.22	--
Yampa River upstream from Chuck Lewis State Wildlife Area subbasin (stream segments 2a, 2c, 3, 4, 5, 6, 7)							
Nitrite, dissolved (mg/L as N)	2	101	83	<0.01	nc	0.04	--
Nitrite, unfiltered (mg/L as N)	4	41	16	<0.0009	0.002	0.04	0.05
Nitrate, dissolved (mg/L as N)	12	147	83	0.01	0.04	5	--
Nitrate, unfiltered (mg/L as N)	34	482	330	[2]0.0071	0.07	1.4	[3]10, 100 (MCL)
Ammonia, total, unfiltered (mg/L as	2	407	250	<0.01	0.03	2.3	[3]TVS or none
Phosphorus, total, unfiltered (mg/L a	34	472	51	<0.005	0.07	0.75	[3,4]0.05, 0.1
Orthophosphate, dissolved (mg/L as	5	107	25	<0.01	0.02	0.21	--
Yampa River downstream from Chuck Lewis State Wildlife Area to confluence with Elk River subbasin (stream segments 2c, 3, 20a)							
Nitrite, dissolved (mg/L as N)	17	130	101	<0.001	0.002	0.02	--
Nitrite, unfiltered (mg/L as N)	1	9	5	<0.01	0.01	0.02	0.05
Nitrate, dissolved (mg/L as N)	25	177	89	<0.005	0.05	0.9	--
Nitrate, unfiltered (mg/L as N)	26	150	66	[2]0.01	0.08	0.68	10 (DWS)
Ammonia, total, unfiltered (mg/L as	9	115	69	<0.01	0.01	1.9	TVS
Phosphorus, total, unfiltered (mg/L a	36	237	21	<0.005	0.034	0.921	[3,4]0.05, 0.1
Orthophosphate, dissolved (mg/L as	10	107	45	<0.001	0.009	0.07	--
Elk River subbasin(stream segments 8, 20a)							
Nitrite, dissolved (mg/L as N)	8	93	63	<0.001	<0.001	0.03	--
Nitrite, unfiltered (mg/L as N)	2	9	6	[2]0.001	<0.01	0.01	0.05
Nitrate, dissolved (mg/L)	13	121	23	<0.005	0.05	0.946	--
Nitrate, unfiltered (mg/L)	15	118	80	[2]0.01	0.05	0.88	10 (MCL)
Ammonia, total, unfiltered (mg/L as	8	98	78	<0.01	nc	<1	TVS
Phosphorous, total, unfiltered (mg/L	20	200	76	[2]0.003	0.009	0.32	[3,4]0.05, 0.1
Orthophosphate, dissolved (mg/L as	10	112	55	<0.001	0.001	0.031	--
Yampa River downstream from Elk River confluence to Hayden subbasin (stream segments 2c, 11, 12, 13a, 13b, 13c, 13e, 13f, 20a)							
Nitrite, dissolved (mg/L as N)	8	122	62	<0.001	0.01	0.14	--
Nitrite, unfiltered (mg/L as N)	1	35	9	<0.0009	0.003	0.017	0.05
Nitrate, dissolved (mg/L as N)	29	373	76	<0.005	0.2	32	--

Table 14. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected nutrients in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009. [No., number; mg/L, milligrams per liter; N, nitrogen; <, less than; --, no water-quality standard; MCL, Maximum Contaminant Level; TVS, table value standard; P, phosphorus; nc,not computed; E, estimated. Water-quality standards are from Colorado Department of Public Health and Environment (2010c); standards are for aquatic-life protection, unless otherwise stated. Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent (reporting units)	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
Nitrate, unfiltered (mg/L as N)	35	401	199	[2]0.01	0.07	17	[3]10, 100 (MCL)
Ammonia, total, unfiltered (mg/L as	9	356	213	<0.01	0.02	0.83	[3]TVS or none
Phosphorus, total, unfiltered (mg/L a	37	419	41	<0.005	0.06	2.5	[3,4]0.05, 0.1
Orthophosphate, dissolved (mg/L as	18	278	82	<0.001	0.01	0.2	--
Yampa River downstream from Hayden to confluence with Elkhead Creek subbasin (stream segments 2c, 12, 13d)							
Nitrite, dissolved (mg/L as N)	3	3	2	<0.001	<0.001	0.39	--
Nitrite, unfiltered (mg/L as N)	1	1	0	0.4	0.4	0.4	0.05
Nitrate, dissolved (mg/L as N)	7	83	6	<0.005	0.18	90	--
Nitrate, unfiltered (mg/L as N)	6	36	11	[2]0.01	0.07	47.6	[3]10, 100 (MCL)
Ammonia, total, unfiltered (mg/L as	6	31	19	<0.01	0.02	0.31	[3]TVS or none
Phosphorus, total, unfiltered (mg/L a	11	57	3	<0.01	0.08	3.9	[3,4]0.05, 0.1
Orthophosphate, dissolved (mg/L as	4	66	24	<0.001	0.01	0.22	--
Elkhead Creek subbasin (stream segments 14, 15, 20b)							
Nitrite, dissolved (mg/L as N)	4	179	146	[2]0.003	nc	0.032	0.05
Nitrate, dissolved (mg/L as N)	7	195	83	<0.005	0.06	1.534	--
Nitrate, unfiltered (mg/L as N)	4	30	15	[2]0.01	E 0.05	0.52	10 (MCL)
Ammonia, total, unfiltered (mg/L as	5	20	16	<0.01	nc	0.1	TVS
Phosphorus, total, unfiltered (mg/L a	6	198	44	0.0044	0.02	0.923	[3,4]0.05, 0.1
Orthophosphate, dissolved (mg/L as	6	184	136	0.009	<0.01	<0.018	--

[1]Censored values can be expressed as values less than the laboratory reporting level.

[2]Minimum censored value is greater than minimum detected value.

[3]Water-quality standards vary by stream segment. See Colorado Department of Public Health and Environment (2010c).

[4]Recommened concentration. See U.S. Environmental Protection Agency (2000).

Table 15. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected trace elements and uranium in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; --, no water-quality standard; <, less than; E, estimated; nc, not computed; TVS, table value standard; tr, trout; DWS, domestic water supply; sc, sculpin. Table value standards vary with stream hardness. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c); standards are for aquatic-life protection, unless otherwise stated. Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
				(micrograms per liter)			
			Upper Yampa River watershed				
Aluminum, dissolved	70	588	368	6	21	570	--
Aluminum, total recoverable	57	355	34	<1	310	83,000	--
Arsenic, dissolved	86	602	362	0.133	0.69	13	340 (acute)
Arsenic, total recoverable	25	31	17	<1	<1	3	[2]0.02, 0.02–10, 7.6, 100 (chronic)
Boron, dissolved	25	459	35	<10	60	630	750 DWS
Cadmium, dissolved	113	1,006	957	E 0.013	nc	<3	[2]TVS(tr) (acute), TVS (acute, chronic), none
Cadmium, total recoverable	33	262	208	<0.02	nc	9.2	[2]5 (acute), 10 (chronic), none
Chromium, dissolved	36	154	144	<0.1	nc	50	[2]TVS (16 acute, 11 chronic), none
Chromium, total recoverable	37	231	127	0.568	1.5	400	[2]50 (acute), 100 (chronic), none
Copper, dissolved	108	960	711	0.175	1.0	550	[2]TVS (acute, chronic) or none
Copper,total recoverable	102	977	337	E 0.403	2	510	[2]200 (acute, chronic) or none
Iron, dissolved	125	1,183	89	4	59	6,020	[2]300 DWS (chronic) or none
Iron, total recoverable	123	2,029	13	<10	420	190,000	[2]1,000, 1,035, existing quality (chronic) or none
Lead, dissolved	108	925	866	0.04	nc	290	[2]TVS (acute, chronic) or none
Lead, total recoverable	96	545	432	E 0.03	0.5	300	[2]50 (acute), 100 (chronic), none
Manganese, dissolved	128	1,328	137	0.348	28	2,100	[2]TVS (acute, chronic), 50 DWS (chronic), none
Manganese, total recoverable	102	1,496	143	E 2.18	70	4,100	[2]TVS (acute, chronic), 200 (chronic), none
Mercury, total recoverable	93	657	554	<0.0005	nc	2.1	[2]2.0 (acute) or none
Nickel, dissolved	45	135	108	<1	nc	<30	[2]TVS (acute, chronic) or none
Nickel, total recoverable	51	212	154	<1	2.4	280	[2]100 or 200 (chronic) or none
Selenium, dissolved (μg/L)	64	547	466	[3]E 0.07	nc	300	[2]18.4 (acute), 4.6 (chronic), or none
Silver, dissolved	62	636	633	<0.008	nc	<3	[2]TVS (acute, chronic), TVS(tr) (chronic), none
Silver, total recoverable	39	172	166	<0.2	nc	<50	[2]100 (acute) or none
Strontium, dissolved	9	90	0	13	305	5,500	--

Table 15. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected trace elements and uranium in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; --, no water-quality standard; <, less than; E, estimated; nc, not computed; TVS, table value standard; tr, trout; DWS, domestic water supply; sc, sculpin. Table value standards vary with stream hardness. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c); standards are for aquatic-life protection, unless otherwise stated. Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
				(micrograms per liter)			
Strontium, total recoverable	3	28	0	30	300	400	--
Zinc, dissolved	122	1,036	708	E 0.546	1.8	960	[2]TVS (acute, chronic), TVS(sc) (chronic), none
Zinc, total recoverable	96	683	359	1.2	8.5	1,430	[2]2,000 (acute, chronic) or none
Uranium, natural, dissolved	14	51	18	0.059	1	170	--
Yampa River upstream from Chuck Lewis State Wildlife Area subbasin (stream segments 2a, 2c, 3, 4, 5, 6, 7)							
Aluminum, dissolved	19	196	156	6	nc	570	--
Aluminum, total recoverable	18	81	17	<1	105	2,500	--
Arsenic, dissolved	23	19	8	<1	1	3	340 (acute)
Arsenic, total recoverable	14	72	41	<0.5	1	<10	[2]0.02, 0.02–10, 7.6 (chronic)
Boron, dissolved	1	10	0	10	25	30	750 DWS
Cadmium, dissolved	36	308	282	0.15	nc	2	[2]TVS(tr) (acute), TVS (chronic), none
Cadmium, total recoverable	19	152	124	<0.02	nc	7.4	[2]5 (acute) or none
Chromium, dissolved	8	28	27	<1	nc	<20	[2]TVS (16 acute, 11 chronic), none
Chromium, total recoverable	11	57	50	<1	nc	400	[2]50 (acute) or none
Copper, dissolved	33	330	258	1	1.5	<20	[2]TVS (acute, chronic) or none
Copper,total recoverable	39	535	141	<0.6	1.9	32	[2]200 (chronic) or none
Iron, dissolved	37	322	22	<10	71	950	[2]300 DWS (chronic) or none
Iron, total recoverable	42	916	2	10	480	5,900	[2]1,000 or none
Lead, dissolved	32	283	275	<1	nc	17	[2]TVS (acute, chronic) or none
Lead, total recoverable	35	203	162	<1	nc	<200	[2]50 (acute) or none
Manganese, dissolved	38	398	15	<1	37	450	[2]TVS (acute, chronic), 50 DWS (chronic), none
Manganese, total recoverable	39	747	35	<2.8	76	410	[2]TVS (acute, chronic) or none
Mercury, total recoverable	31	185	184	<0.0005	nc	<0.5	[2]2.0 (acute) or none
Nickel, dissolved	9	25	15	<1	<1	9	[2]TVS (acute, chronic) or none
Nickel, total recoverable	15	58	40	<1	2	<100	[2]100 (chronic) or none

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Table 15. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected trace elements and uranium in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; --, no water-quality standard; <, less than; E, estimated; nc, not computed; TVS, table value standard; tr, trout; DWS, domestic water supply; sc, sculpin. Table value standards vary with stream hardness. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c); standards are for aquatic-life protection, unless otherwise stated. Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
				(micrograms per liter)			
Selenium, dissolved (μg/L)	32	237	207	<0.2	nc	7.9	[2]18.4 (acute), 4.6 (chronic), or none
Silver, dissolved	20	208	207	<0.2	nc	2	[2]TVS (acute), TVS(tr) (chronic), none
Silver, total recoverable	21	67	57	<0.2	nc	<50	[2]100 (acute) or none
Strontium, dissolved	1	12	0	240	285	400	--
Strontium, total recoverable	2	20	0	280	315	400	--
Zinc, dissolved	32	291	197	<0.6	3.1	700	[2]TVS (acute, chronic), TVS(sc) (chronic), none
Zinc, total recoverable	36	202	138	<10	5.2	1,430	[2]2,000 (acute, chronic) or none
Uranium, natural, dissolved	4	21	7	0.88	1	170	--
Yampa River downstream from Chuck Lewis State Wildlife Area to confluence with Elk River subbasin (stream segments 2c, 3, 20a)							
Aluminum, dissolved	8	47	24	<30	34	170	--
Aluminum, total recoverable	6	10		56	5.5	2,600	--
Arsenic, dissolved	12	66	56	<1	nc	2	340 (acute)
Arsenic, total recoverable	4	5	4	<1	nc	1	0.02 (chronic)
Boron, dissolved	3	25	24	<10	nc	40	750 DWS
Cadmium, dissolved	12	151	141	0.013	nc	<2	TVS(tr) (acute), TVS (chronic)
Cadmium, total recoverable	4	5	5	<0.3	nc	<0.3	--
Chromium, dissolved	11	45	43	<0.1	nc	<10	TVS (16 acute, 11 chronic)
Chromium, total recoverable	2	5	1	3	5.5	<10	--
Copper, dissolved	12	143	85	0.26	1.1	45.8	TVS (acute, chronic)
Copper,total recoverable	12	59	20	1.1	2.8	<20	--
Iron, dissolved	20	105	1	17	80	6,020	300 DWS (chronic)
Iron, total recoverable	14	186	0	20	304	3,700	1,000 (chronic)
Lead, dissolved	11	138	118	0.04	nc	17	TVS (acute, chronic)
Lead, total recoverable	11	25	22	<1	nc	<200	--
Manganese, dissolved	21	183	22	1.3	16	133	TVS, 50 DWS (chronic)

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Table 15. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected trace elements and uranium in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; --, no water-quality standard; <, less than; E, estimated; nc, not computed; TVS, table value standard; tr, trout; DWS, domestic water supply; sc, sculpin. Table value standards vary with stream hardness. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c); standards are for aquatic-life protection, unless otherwise stated. Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
				(micrograms per liter)			
Manganese, total recoverable	12	130	5	5	60	170	--
Nickel, dissolved	5	19	15	<1	<1	6	TVS (acute, chronic)
Nickel, total recoverable	4	15	14	3	nc	<50	--
Selenium, dissolved (μg/L)	12	145	121	[3]0.07	nc	<6	18.4 (acute), 4.6 (chronic)
Silver, dissolved	9	119	118	<0.008	nc	1	TVS (acute), TVS(tr) (chronic)
Silver, total recoverable	4	5	5	<0.2	nc	<0.2	--
Strontium, dissolved	2	24	0	13	23.5	43	--
Zinc, dissolved	20	173	101	0.799	2.1	587	[2]TVS (acute, chronic), TVS(sc) (chronic)
Zinc, total recoverable	9	24	13	<10	13.2	40	--
Uranium, natural, dissolved	1	4	3	<1	<1	1	--
Elk River subbasin(stream segments 8, 20a)							
Aluminum, dissolved	12	107	40	11.1	34	260	--
Aluminum, total recoverable	10	67	8	19.0	112	6,612	--
Arsenic, dissolved	13	83	64	<1	nc	1	340 (acute)
Arsenic, total recoverable	2	2	2	0.133	0.22	2	0.02 (chronic)
Boron, dissolved	1	1	1	<16	nc	<16	750 DWS
Cadmium, dissolved	18	155	152	0.025	nc	<2	TVS(tr) (acute), TVS (chronic)
Cadmium, total recoverable	3	21	18	<0.3	nc	2.9	--
Chromium, total recoverable	2	24	23	<1	nc	<20	--
Copper, dissolved	18	154	108	0.175	0.71	5.3	TVS (acute, chronic)
Copper,total recoverable	15	98	46	0.403	1	20	--
Iron, dissolved	17	127	1	6.4	54	420	300 DWS (chronic)
Iron, total recoverable	19	182	3	14	150	10,030	1000 (chronic)
Lead, dissolved	18	152	143	0.04	nc	13	TVS (acute, chronic)
Lead, total recoverable	15	98	65	0.03	0.31	<200	--

Table 15. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected trace elements and uranium in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

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Constituent	No. of sites	No. of samples	No. of censored values[1]	Minimum value (micrograms per liter)	Median value (micrograms per liter)	Maximum value (micrograms per liter)	In-stream water-quality standard (micrograms per liter)
Manganese, dissolved	18	156	55	0.348	2.8	650	TVS, 50 DWS (chronic)
Manganese, total recoverable	15	110	26	2.2	10	960	--
Nickel, dissolved	4	10	10	<2	nc	<2	TVS (acute, chronic)
Nickel, total recoverable	7	27	23	<1	nc	<100	--
Selenium, dissolved (μg/L)	12	88	86	<1	nc	<5	18.4 (acute), 4.6 (chronic)
Silver, dissolved	12	105	105	<0.2	nc	<1	TVS (acute), TVS(tr) (chronic)
Silver, total recoverable	4	17	17	<0.2	nc	<50	--
Strontium, dissolved	1	1	0	20.1	20.1	20.1	--
Strontium, total recoverable	1	8	0	30	65	110	--
Zinc, dissolved	18	158	120	0.546	1.05	52	[2]TVS (acute, chronic), TVS(sc) (chronic)
Zinc, total recoverable	15	98	66	1.20	3.62	100	--
Uranium, natural, dissolved	4	12	4	0.059	<1	6	--
Yampa River downstream from Elk River confluence to Hayden subbasin (stream segments 2c, 11, 12, 13a, 13b, 13c, 13e, 13f, 20a)							
Aluminum, dissolved	23	172	111	8	18	<250	--
Aluminum, total recoverable	15	119	9	<1	1,500	68,000	--
Arsenic, dissolved	26	162	78	0.4	1	13	340 (acute)
Arsenic, total recoverable	4	4	2	<1	<1	2	[2]0.02, 7.6, 100 (chronic)
Boron, dissolved	12	345	8	<10	60	630	750 DWS
Cadmium, dissolved	33	265	260	<0.18	nc	3	[2]TVS(tr) (acute), TVS (acute, chronic), none
Cadmium, total recoverable	4	81	58	<0.02	0.03	9.2	[2]10 (chronic) or none
Chromium, dissolved	14	44	39	<0.8	nc	50	[2]TVS (16 acute, 11 chronic), none
Chromium, total recoverable	14	80	30	<0.8	6	54	[2]100 (chronic) or none
Copper, dissolved	32	218	199	<1	nc	550	[2]TVS (acute, chronic) or none
Copper,total recoverable	23	182	110	<0.6	3.0	510	[2]200 (acute) or none
Iron, dissolved	37	446	45	4	50	2,300	[2]300 DWS (chronic) or none

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Table 15. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected trace elements and uranium in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; --, no water-quality standard; <, less than; E, estimated; nc, not computed; TVS, table value standard; tr, trout; DWS, domestic water supply; sc, sculpin. Table value standards vary with stream hardness. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c); standards are for aquatic-life protection, unless otherwise stated. Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
				(micrograms per liter)			
Iron, total recoverable	32	522	8	<10	460	190,000	[2]1,000, 1,035, existing quality (chronic)
Lead, dissolved	34	237	234	<0.08	nc	<30	[2]TVS (acute, chronic) or none
Lead, total recoverable	22	158	139	<1	nc	300	[2]100 (chronic) or none
Manganese, dissolved	37	394	29	<4	50	1,500	[2]TVS (acute, chronic), 50 DWS (chronic), none
Manganese, total recoverable	23	331	71	<2.8	120	4,100	[2]200 (chronic) or none
Nickel, dissolved	19	51	51	<1	nc	<30	[2]TVS (acute, chronic) or none
Nickel, total recoverable	18	62	62	<1	nc	<100	[2]200 (chronic) or none
Selenium, dissolved (µg/L)	38	247	178	<0.4	<0.4	290	[2]18.4 (acute), 4.6 (chronic), or none
Silver, dissolved	14	119	118	<0.06	nc	<3	[2]TVS (acute, chronic), TVS(tr) (chronic), none
Strontium, dissolved	3	38	0	290	1,020	5,500	--
Zinc, dissolved	38	289	208	2.7	1.1	280	[2]TVS (acute, chronic), TVS(sc) (chronic), none
Zinc, total recoverable	22	261	103	<2	20	1,000	[2]2,000 (chronic) or none
Uranium, natural, dissolved	4	13	4	<1	1	4	--
Yampa River downstream from Hayden to confluence with Elkhead Creek subbasin (stream segments 2c, 12, 13d)							
Aluminum, dissolved	6	47	23	8	10	<250	--
Aluminum, total recoverable	5	41	0	130	2,200	83,000	--
Arsenic, dissolved	6	43	18	<1	1	4	340 (acute)
Arsenic, total recoverable	6	41	1	<1	2	36	[2]0.02, 7.6, 100 (chronic)
Boron, dissolved	4	66	0	50	80	590	750 DWS
Cadmium, dissolved	8	47	43	<0.02	nc	<2	[2]TVS(tr) (acute), TVS (acute, chronic), none
Chromium, dissolved	1	1	1	<0.8	<0.8	<0.8	[2]TVS (16 acute, 11 chronic), none
Chromium, total recoverable	6	29	<3	0.8	4	30	[2]100 (chronic) or none
Copper, dissolved	7	42	27	<2	1.9	60	[2]TVS (acute, chronic) or none
Copper,total recoverable	5	55	6	<0.6	5.9	250	--
Iron, dissolved	8	107	14	<10	40	430	[2]300 DWS (chronic) or none

Table 15. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected trace elements and uranium in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; --, no water-quality standard; <, less than; E, estimated; nc, not computed; TVS, table value standard; tr, trout; DWS, domestic water supply; sc, sculpin. Table value standards vary with stream hardness. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c); standards are for aquatic-life protection, unless otherwise stated. Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
				(micrograms per liter)			
Iron, total recoverable	10	145	0	50	690	190,000	[2]1,000, existing quality (chronic) or none
Lead, dissolved	7	38	37	<0.08	nc	290	[2]TVS (acute, chronic) or none
Lead, total recoverable	5	12	11	<1	nc	<200	--
Manganese, dissolved	8	109	2	5	30	2,100	[2]TVS (acute, chronic), 50 DWS (chronic), none
Manganese, total recoverable	7	119	0	20	80	3,300	[2]200 (chronic) or none
Nickel, dissolved	3	10	10	<1	nc	<2	[2]TVS (acute, chronic) or none
Nickel, total recoverable	2	6	5	<50	nc	280	--
Selenium, dissolved (μg/L)	7	47	23	<0.4	1	300	[2]18.4 (acute), 4.6 (chronic), or none
Silver, dissolved	3	26	26	<0.2	nc	<0.5	[2]TVS (acute, chronic), TVS(tr) (chronic), none
Zinc, dissolved	7	43	18	<3	10	960	[2]TVS (acute, chronic), TVS(sc), none
Zinc, total recoverable	6	50	6	<2	40	890	[2]2,000 (chronic) or none
Uranium, natural, dissolved	1	1	0	4	4	4	--
Elkhead Creek subbasin (stream segments 14, 15, 20b)							
Aluminum, dissolved	2	19	10	<15	E 46	190	--
Aluminum, total recoverable	3	37	0	50.5	390	9,063	--
Arsenic, dissolved	6	59	47	<1	nc	<5	340 (acute)
Arsenic, total recoverable	1	1	1	<1	nc	<1	0.02 (chronic)
Boron, dissolved	3	12	2	<10	20	60	750
Cadmium, dissolved	6	80	79	<0.04	nc	<2	TVS(tr) (acute), TVS (chronic)
Cadmium, total recoverable	3	3	3	<0.3	nc	<0.3	--
Chromium, dissolved	2	36	34	0.507	nc	5.5	TVS (16 acute, 11 chronic)
Chromium, total recoverable	2	36	20	0.568	E 1.32	10.0	--
Copper, dissolved	6	73	26	0.856	E 1.7	<5	TVS (acute, chronic)
Copper,total recoverable	8	48	14	<1	E 2.23	23.1	--
Iron, dissolved	6	76	6	6	E 30.5	620	300 DWS (chronic)

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Table 15. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected trace elements and uranium in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; --, no water-quality standard; <, less than; E, estimated; nc, not computed; TVS, table value standard; tr, trout; DWS, domestic water supply; sc, sculpin. Table value standards vary with stream hardness. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c); standards are for aquatic-life protection, unless otherwise stated. Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Constituent	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
				(micrograms per liter)			
Iron, total recoverable	6	78	0	30	428	17,690	1,000 (chronic)
Lead, dissolved	6	77	76	0.048	nc	<5	TVS (acute, chronic)
Lead, total recoverable	8	49	33	0.539	E 1.09	<200	--
Manganese, dissolved	6	88	14	<1	E 10	100	TVS, 50 DWS (chronic)
Manganese, total recoverable	6	59	6	8.46	37	523	--
Nickel, dissolved	5	20	7	<1	E 2	3	TVS (acute, chronic)
Nickel, total recoverable	5	44	10	1.31	E 2.85	3	--
Selenium, dissolved (μg/L)	7	82	74	<0.4	nc	<5	18.4 (acute), 4.6 (chronic)
Silver, dissolved	4	59	59	<0.1	nc	<2	TVS (acute), TVS(tr) (chronic)
Silver, total recoverable	3	37	37	<0.2	nc	<1	--
Strontium, dissolved	2	15	0	130	270	503	--
Zinc, dissolved	7	82	64	<1	E 2.1	28	TVS (acute, chronic)
Zinc, total recoverable	8	48	33	2.721	E 9.5	68.8	--

[1]Censored values can be expressed as values less than the laboratory reporting level.

[2]Water-quality standards vary by stream segment. See Colorado Department of Public Health and Environment (2010c).

[3]For some constituents, the minimum censored value is greater than the minumum detected value.

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Table 16. Summary statistics of the number of stream sites and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected coliform bacteria in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2009.

[No., number; --, no standard; <, less than. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c). Descriptions of stream segments are in Colorado Department of Public Health and Environment (2010c)]

Coliform bacteria	No. of sites	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
				(colonies per 100 milliliters)			
Upper Yampa River watershed							
Total coliform	43	119	12	0	60	18,000	--
Escherichia coli	6	123	6	<1	18	733	126/100
Fecal coliform	88	399	52	0	14	2,100	--
Yampa River upstream from Chuck Lewis State Wildlife Area subbasin (stream segments 2a, 2c, 3, 4, 5, 6, 7)							
Total coliform	10	33	2	<1	30	750	--
Fecal coliform	21	106	29	<1	5.5	560	--
Yampa River downstream from Chuck Lewis State Wildlife Area to confluence with Elk River subbasin (stream segments 2c, 3, 20a)							
Total coliform	18	55	4	<1	140	18,000	--
Escherichia coli	2	64	6	<1	12	177	126/100
Fecal coliform	31	146	11	0	15	1,800	--
Elk River subbasin(stream segments 8, 20a)							
Total coliform	5	16	5	<1	3.5	1,700	--
Escherichia coli	1	6	0	7	22.5	108	126/100
Fecal coliform	8	34	7	<1	2.5	1,200	--
Yampa River downstream from Elk River confluence to Hayden subbasin (stream segments 2c, 11, 12, 13a, 13b, 13c, 13e, 13f, 20a)							
Total coliform	7	7	0	0	96	200	--
Fecal coliform	18	32	2	0	13	133	--
Yampa River downstream from Hayden to confluence with Elkhead Creek subbasin (stream segments 2c, 12, 13d)							
Total coliform	1	1	0	210	210	210	--
Fecal coliform	4	12	0	2	14.5	261	--
Elkhead Creek subbasin (stream segments 14, 15, 20b)							
Total coliform	2	7	1	<1	24	190	--
Escherichia coli	3	53	1	1	21	733	126/100
Fecal coliform	6	69	3	<1	29	2,100	--

[1]Censored values can be expressed as values less than the laboratory reporting level.

Table 17. Summary statistics of the number of stream sites and samples and minimum, median, and maximum values for suspended sediment in stream-water samples, Upper Yampa River watershed and subbasins, Colorado, 1975 through 2003.
[No., number]

Watershed or subbasin	No. of sites	No. of samples	No. of censored values[1]	Minimum value (milligrams per liter)	Median value (milligrams per liter)	Maximum value (milligrams per liter)
Upper Yampa River watershed	65	1,079	11	0	40	11,300
Subbasin						
Yampa River upstream from Chuck Lewis State Wildlife Area	18	265	0	0	33	2,340
Yampa River downstream from Chuck Lewis State Wildlife Area to confluence with Elk River	13	62	0	0	7.5	676
Elk River	10	101	11	0	4	565
Yampa River downstream from Elk River to Hayden	12	399	0	0	85	11,300
Yampa River downstream from Hayden to confluence with Elkhead Creek	5	92	0	8.3	90	10,200
Elkhead Creek	7	160	0	1	16.4	2,197

[1]Censored values can be expressed as values less than the laboratory reporting level.

Table 18. Summary statistics of the number of samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment in-stream water-quality standards for selected physical properties and constituents in Lake Elbert and Long Lake Reservoir, Upper Yampa River watershed, Colorado, 1983 through 2009.

[No., number; µS/cm; microsiemens per centimeter at 25 degrees Celsius; --, no water-quality standard; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; N, nitrogen; <, less than; nc, not computed; E, estimated; P, phosphorus; µg/L, micrograms per liter; DWS, domestic water supply; TVS, table value standard. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c); standards are for aquatic-life protection, unless otherwise stated. Descriptions of segments are in Colorado Department of Public Health and Environment (2010c)]

Physical property and constituent (reporting units)	No. of samples	No. of censored values[1]	Minimum value	Median value	Maximum value	In-stream water-quality standard
Lake Elbert (stream segment 1b)						
Specific conductance (µS/cm)	72	0	7.0	11.1	17.5	--
pH (standard units)	72	0	6.3	6.8	8.2	6.5–9.0
Hardness, total (mg/L as $CaCO_3$)	72	0	2.6	3.5	5.1	--
Acid neutralizing capacity (mg/L as $CaCO_3$)	29	0	3.0	3.7	4.3	--
Sulfate, dissolved (mg/L)	72	0	0.307	0.516	0.690	250
Nitrate, dissolved (mg/L as N)	72	66	<0.006	nc	E 0.02	10
Phosphorus, total, unfiltered (mg/L as P)	35	3	[2]0.001	0.005	0.011	--
Iron, dissolved (µg/L)	31	0	E 5	28.5	560	300 (DWS)
Iron, total recoverable (µg/L)	30	0	30	140	720	1,000
Manganese, dissolved (µg/L)	31	9	<1	2	15	TVS, 50 (DWS)
Long Lake Reservoir (stream segment 2b)						
Specific conductance (µS/cm)	63	0	14.2	19.7	73.7	--
pH (standard units)	63	0	6.2	7	8.4	6.5–9.0
Hardness, total (mg/L as $CaCO_3$)	63	0	5.4	7.5	15.8	--
Acid neutralizing capacity (mg/L as $CaCO_3$)	39	0	2.1	6.1	17.9	--
Sulfate, dissolved (mg/L)	63	0	0.892	1.3	2.5	250
Nitrate, dissolved (mg/L as N)	63	53	<0.007	nc	0.11	10
Phosphorus, total, unfiltered (mg/L as P)	2	0	0.017	0.018	0.02	--
Iron, dissolved (µg/L)	42	0	44	140	400	300 (DWS)
Manganese, dissolved (µg/L)	42	3	<1	4	150	TVS, 50 (DWS)

[1]Censored values can be expressed as values less than the laboratory reporting level .

[2]The minimum censored value is greater than the minumum detected value.

Table 19. Concentrations of selected physical propertiesand constituents in near-surface and near-bottom water-quality samples, Stagecoach Reservoir and Steamboat Lake, Upper Yampa River watershed, Colorado, July 25, 2006.
[mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; N, nitrogen; <, less than; P, phosphorus; µg/L micrograms per liter]

Physical property or constituent (reporting units)	Stagecoach Reservoir		Steamboat Lake	
	Sample depth (feet)	Value[1]	Sample depth (feet)	Value[1]
Hardness, total (mg/L as $CaCO_3$)	0	170	3	29
	104	200	68	30
Acid neutralizing capacity (mg/L as $CaCO_3$)	0	150	3	34
	104	180	68	35
Sulfate, unfiltered (mg/L)	0	46	3	<3
	104	62	68	4
Selenium, dissolved (µg/L)	0	<1	3	<1
	104	1.1	68	<1
Nitrate, unfiltered (mg/L as N)	0	<0.02	3	<0.02
	104	0.35	68	0.08
Phosphorus, total, unfiltered (mg/L as P)	0	0.4	3	0.02
	104	0.14	68	0.09
Iron, dissolved (µg/L)	0	<10	3	140
	104	17	68	540
Iron, total recoverable (µg/L)	0	28	3	230
	104	37	68	810
Manganese, dissolved (µg/L)	0	<2	3	2
	104	160	68	110
Chlorophyll *a* (µg/L)	0	8,200	3	800

[1]Censored values can be expressed as values less than the laboratory reporting level.

Table 20. Period of record and number of groundwater water-quality samples collected per year by constituent group, Upper Yampa River watershed Colorado, 1975 through 1989 and 1998.
[Value in cell is number of samples analyzed in each constituent group for the year. --, no data]

Constituent group	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1998	Total
							Upper Yampa River watershed										
Physical properties	145	11	19	146	91	45	57	47	29	2	--	3	22	121	72	6	830
Dissolved solids, total	56	5	18	45	39	42	57	47	29	2	--	3	22	121	72	6	578
Major ions	56	5	18	45	81	43	57	47	29	2	--	3	22	121	72	6	621
Nutrients	56	5	18	45	35	43	55	47	29	--	--	3	22	120	10	6	508
Organic carbon	--	--	--	--	1	--	--	--	--	--	--	--	--	--	4	--	5
Radiochemcial	--	--	--	--	--	9	35	18	--	--	--	--	--	22	4	--	88
Stable isotopes	--	--	--	--	--	--	--	--	--	--	--	--	--	23	4	--	27
Trace elements	56	5	18	46	84	43	57	47	29	2	--	3	22	121	72	4	609
Total number of samples	145	11	19	147	91	45	57	47	29	2	--	3	22	121	72	6	

Table 21. Number of groundwater wells and samples by geologic unit and sample type, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[no, number; --, no data]

Geologic unit near well screen	Approximate age	Number of wells and samples			
		Wells	Water quality[1]	Wells	Water level only
Alluvium, flood plain	Quaternary	75	85	27	31
Alluvuim, terrace	Quaternary	23	122	23	270
Browns Park Formation	Tertiary	29	29	20	20
Curtis Fromation of San Rafael Group	Jurassic	1	1	--	--
Eocece series	Tertiary	1	2	--	--
Fort Union Formation	Tertiary	1	1	--	--
Lewis Shale	Cretaceous	14	19	3	3
Mancos Shale	Cretaceous	23	26	15	15
Mesaverde Group	Cretaceous	46	143	36	200
Precambrian Erathem	Precambrian	2	2	2	2
Upper Ctetaceous series	Cretaceous	3	3	1	1
Valley-fill deposits	Quaternary	7	10	--	--
Unknown	--	103	374	21	225
Total wells and samples		328	817	148	767

[1]Count does not include multiple (14) water-quality samples collected on a day or 219 water-level measurements collected on the same day but at a different time than the water-quality sample.

Table 22. Summary statistics of the number of wells and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment water-quality standards for groundwater and number of exceedances for selected physical properties and water-quality constituents, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; Min., minimum; Max., maximum; µS/cm; microsiemens per centimeter at 25 degrees Celsius; --, no water-quality standard; SMCL, Secondary Maximum Contaminant Level; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; <, less than; MCL, Maximum Contaminant Level; N, nitrogen; ne, no exceedance; E, estimated; HH, Human Health; P, phosphorus; µg/L, micrograms per liter; nc, not computed. Water-quality standards are from Colorado Department of Public Health and Environment (2009b]

Physical property or constituent (reporting units)	No. of wells	No. of samples	No. of censored values[1]	Min. value	Median value	Max. value	Water-quality standard	No. of exceedances of water-quality standard
			Physical properties					
Specific conductance (µS/cm)	257	715	0	50	1,170	15,900	--	--
pH (standard units)	264	677	[2]1	5.3	7.6	12.3	6.5–9.0 (SMCL)	42
Water temperature (°C)	327	732	0	2	10.5	95	--	--
Dissolved oxygen (mg/L)	33	116	0	0	1.4	10	--	--
Hardness, total (mg/L as $CaCO_3$)	201	574	0	4.9	330	7,000	--	--
Acid neutralizing capacity (mg/L as $CaCO_3$)	165	264	0	19	260	2,760	--	--
			Total dissolved solids and major ions					
Dissolved solids, total (mg/L)	179	564	0	46	812	8,490	--	--
Calcium, dissolved (mg/L)	186	559	0	1.3	73	2,800	--	--
Magnesium, dissolved (mg/L)	186	559	2	<0.1	33	470	--	--
Sodium, dissolved (mg/L)	185	558	0	2.2	150	1,300	--	--
Potassium, dissolved (mg/L)	186	559	0	0.3	3.8	1,500	--	--
Bicarbonate, dissolved (mg/L)	158	208	0	0	372	3,360	--	--
Sulfate, dissolved (mg/L)	185	554	1	<1	220	4,000	250 (SMCL)	250
Chloride, dissolved (mg/L)	185	554	0	0.5	10	5,000	250 (SMCL)	15
Fluoride, dissolved (mg/L)	184	557	0	0.1	0.4	15	4 (MCL)	5
Silica, dissolved (mg/L)	184	557	1	[3]0.3	11	150	--	--
			Nutrients					
Nitrite, dissolved (mg/L as N)	27	142	112	<0.01	<0.01	0.26	1 (MCL)	ne
Nitrate plus nitrite, dissolved (mg/L as N)	182	473	128	<0.01	E 0.11	37	10 (HH)	21
Ammonia, total, dissolved (mg/L as N)	29	144	0	0.03	0.45	5.6	--	--
Phosphorus, total, dissolved (mg/L as P)	68	278	54	<0.01	0.02	0.76	--	--
Phosphorus, total, unfiltered (mg/L as P)	42	42	10	<0.01	0.02	0.33	--	--
Orthophosphate, dissolved (mg/L as P)	180	375	134	<0.01	0.03	2.4	--	--
			Trace elements					
Aluminum, dissolved (µg/L)	68	327	166	<5	10	4,500	--	--
Antimony, dissolved (µg/L)	22	22	18	<1	nc	1	6 (MCL)	ne
Arsenic, dissolved (µg/L)	176	446	248	<1	<1	160	10 (MCL)	1

Table 22. Summary statistics of the number of wells and samples, minimum, median, and maximum values, and Colorado Department of Public Health and Environment water-quality standards for groundwater and number of exceedances for selected physical properties and water-quality constituents, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.

[No., number; Min., minimum; Max., maximum; μS/cm; microsiemens per centimeter at 25 degrees Celsius; --, no water-quality standard; SMCL, Secondary Maximum Contaminant Level; °C, degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; <, less than; MCL, Maximum Contaminant Level; N, nitrogen; ne, no exceedance; E, estimated; HH, Human Health; P, phosphorus; μg/L, micrograms per liter; nc, not computed. Water-quality standards are from Colorado Department of Public Health and Environment (2009b)]

Physical property or constituent (reporting units)	No. of wells	No. of samples	No. of censored values[1]	Min. value	Median value	Max. value	Water-quality standard	No. of exceedances of water-quality standard
Barium, dissolved (μg/L)	24	215	0	14	68	680	2,000 (MCL)	ne
Beryllium, dissolved (μg/L)	24	215	207	<0.5	nc	6	4 (MCL)	2
Boron, dissolved (μg/L)	128	539	4	<10	190	4,700	--	--
Cadmium, dissolved (μg/L)	96	329	284	<1	nc	23	5 (MCL)	13
Chromium, dissolved (μg/L)	48	251	234	<5	nc	<25	100 (MCL)	ne
Cobalt, dissolved (μg/L)	33	224	209	<2	nc	23	--	--
Copper, dissolved (μg/L)	78	273	241	<2	nc	300	1,000 (SMCL)	ne
Iron, dissolved (μg/L)	186	574	69	<3	40	39,000	300 (SMCL)	60
Iron, total recoverable (μg/L)	46	109	0	20	2,300	590,000	--	--
Lead, dissolved (μg/L)	71	313	296	<1	nc	120	50 (HH)	1
Manganese, dissolved (μg/L)	183	548	57	<1	60	3,600	50 (SMCL)	284
Mercury, dissolved (μg/L)	140	215	201	<0.1	nc	2	--	--
Molybdenum (μg/L)	135	395	328	<1	nc	74	35 (HH)	1
Nickel, dissolved (μg/L)	49	242	230	<2	nc	50	100 (HH)	ne
Selenium, dissolved (μg/L)	183	594	439	<1	<1	27	50 (MCL)	ne
Silver, dissolved (μg/L)	25	216	189	<1	nc	<30	50 (HH)	ne
Strontium, dissolved (μg/L)	50	241	0	7	560	10,000	--	--
Zinc, dissolved (μg/L)	156	514	138	<3	20	4,500	5,000 (SMCL)	ne

[1]Censored values can be expressed as values less than the laboratory reporting level.

[2]One value is censored at greater than 9.0 standard units.

[3]For some constituents, the minimum censored value is greater than the minumum detected value.

Table 23. Geologic units with exceedances of Colorado Department of Public Health and Environment water-quality standards for groundwater for selected physical properties and water-quality constituents, Upper Yampa River watershed, Colorado, 1975 through 1989.
[no., number; SMCL, Secondary Maximum Contaminant Level; HH, Human Health; MCL, Maximum Contaminant Level. Parenthesis following physical property or constituent name includes value of water-quality standard and reporting unit, and type of standard. Water-quality standards are from Colorado Department of Public Health and Environment (2009b)]

Geologic unit	Total no. of wells	Total no. of samples	Exceedance of water-quality standard			
			No. of wells	No. of samples[1]	Year(s)	Range of values
pH (< 6.5 standard units, SMCL)						
Alluvium, flood plain	40	42	5	6	1978	5.8–6.4
Browns Park Formation	27	27	1	1	1978	6.4
Mancos Shale	23	24	1	1	1978	6.1
Mesaverde Group	42	129	5	5	[2]1977–84	5.3–6.4
Valley-fill deposits	7	8	1	1	1975	6.1
pH (> 9.0 standard units, SMCL)						
Alluvium, flood plain	40	42	3	3	1978	9.2–9.4
Browns Park Formation	27	27	1	1	1978	9.2
Mesaverde Group	42	129	7	10	[2]1977–83	9.1–11.5
Unknown	77	340	6	14	[2]1975–89	9.1–12.3
Sulfate (250 milligrams per liter, SMCL)						
Alluvium, flood plain	14	15	1	1	1975	370
Alluvium, terrace	22	44	14	25	1978–79	290–1,200
Lewis Shale	6	6	1	1	1975	290
Mancos Shale	12	13	1	2	1975, 1978	420, 1,700
Mesaverde Group	41	126	15	64	[2]1975–86	260–2,900
Unknown	71	331	38	156	[2]1975–89	510–2,300
Valley-fill deposits	7	7	1	1	1975	420
Chloride (250 milligrams per liter, SMCL)						
Mancos Shale	12	13	3	3	1975–78	300–350
Mesaverde Group	41	129	2	3	1976–80	280-1,900
Unknown	72	333	3	9	1975–82	350-5,000
Fluoride (4 milligrams per liter, SMCL)						
Browns Park Formation	7	7	1	1	1978	15
Mancos Shale	12	13	2	2	1975	4.8–5.1
Unknown	72	332	1	2	1988–89	4.1–4.3
Nitrate plus nitrite, dissolved (10 milligrams per liter, HH)						
Alluvium, flood plain	14	15	1	1	1976	18
Alluvium, terrace	22	45	1	3	1979	18–20
Browns Park Formation	7	7	1	1	1978	13
Fort Union Formation	1	1	1	1	1975	37
Lewis Shale	5	5	2	2	1975	12–15
Mancos Shale	12	13	1	1	1978	17
Mesaverde Group	40	122	1	1	1978	14
Unknown	70	254	5	11	1988–89	13–27
Arsenic, dissolved (10 micrograms per liter, MCL)						

Table 23. Geologic units with exceedances of Colorado Department of Public Health and Environment water-quality standards for groundwater for selected physical properties and water-quality constituents, Upper Yampa River watershed, Colorado, 1975 through 1989.
[no., number; SMCL, Secondary Maximum Contaminant Level; HH, Human Health; MCL, Maximum Contaminant Level. Parenthesis following physical property or constituent name includes value of water-quality standard and reporting unit, and type of standard. Water-quality standards are from Colorado Department of Public Health and Environment (2009b)]

Geologic unit	Total no. of wells	Total no. of samples	Exceedance of water-quality standard			
			No. of wells	No. of samples[1]	Year(s)	Range of values
Alluvium, flood plain	13	14	1	1	1975	160
Beryllium, dissolved (4 micrograms per liter, MCL)						
Unknown	24	215	1	2	1988–89	4.5–6
Cadmium, dissolved (5 micrograms per liter, MCL)						
Mesaverde Group	22	45	3	3	1977	11–13
Unknown	45	225	10	10	1988–89	6–23
Iron, dissolved (300 micrograms per liter, SMCL)						
Alluvium, flood plain	14	15	3	3	[2]1975–80	340–2,500
Alluvium, terrace	22	65	2	2	1979	360–1,700
Fort Union Formation	1	1	1	1	1975	830
Lewis Shale	6	6	1	1	1975	1600
Mancos Shale	12	13	4	4	1978	360–3,100
Mesaverde Group	41	127	8	11	1975–82	460–39,000
Unknown	62	329	22	34	[2]1975–89	340–5,100
Precambrian Erathem	1	1	1	1	1978	660
Valley-fill deposits	7	7	3	3	1975	1,300–3,100
Lead, dissolved (50 micrograms per liter, HH)						
Mesaverde Group	18	45	1	1	1977	120
Manganese, dissolved (50 micrograms per liter, SMCL)						
Alluvium, flood plain	14	15	6	7	[2]1975–80	60–620
Alluvium, terrace	22	67	19	38	1978–79	60–3,600
Browns Park Formation	7	7	1	1	1978	110
Lewis Shale	6	6	2	2	1975	60–310
Mancos Shale	12	13	3	3	1978	80–230
Mesaverde Group	38	110	14	56	[2]1977–86	60–3,000
Unknown	72	318	42	174	[2]1975–89	55–2,600
Precambrian Erathem	1	1	1	1	1978	110
Upper Cretaceous	1	1	1	1	1975	60
Valley-fill deposits	7	7	1	1	1975	70
Molybdenum, dissolved (35 micrograms per liter, HH)						
Mancos Shale	10	11	1	1	1978	74

[1]Count does not include samples with concentrations reported at the value of the water-quality standard or samples with concentrations censored at values equal to or greater than the value of the standard.

[2]Exceedances did not occur in every year of the year range.

Appendix 1. U.S. Environmental Protection Agency STORET edit-checking procedure of low and high values for selected water-quality parameters from the Upper Yampa River watershed water-quality database.
[STORET, STOrage and RETrieval; °C, degrees Celsius; μS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; $HCO3^-$, bicarbonate; N, nitrogen; PO_4, phosphate; P, phosphorus; μg/L, micrograms per liter; col/100 mL, colonies per 100 milliliters, NO_3, nitrate. Parameter codes are from the USEPA STORET Data Warehouse. Data are from National Park Service (2001)]

[1]Parameter code	[1]Parameter code name	Low value	High value
P00010	Water temperature (°C)	–2	37.0
P00094	Specific conductance (μS/cm)	1.0	60,000.0
P00095	Specific conductance (μS/cm)	1.0	60,000.0
P00300	Oxygen, dissolved (mg/L)	0.0	30.0
P00400	pH (standard units)	0.9	12.0
P00403	pH, lab (standard units)	0.9	12.0
P00410	Alkalinity, total (mg/L as $CaCO_3$)	0.0	1,000.0
P00440	Bicarbonate (mg/L as $HCO3^-$)	0.0	450.0
P00600	Nitrogen, total (mg/L as N)	0.0	100.0
P00610	Ammonia, total (mg/L as N)	0.0	20.0
P00615	Nitrite, total (mg/L as N)	0.0	5.0
P00625	Ammonia plus organic nitrogen, total (mg/L as N)	0.0	50.0
P00630	Nitrite plus nitrate, total (mg/L as N)	0.0	55.0
P00650	Phosphate, total (mg/L as PO_4)	0.0	30.0
P00665	Phosphorus, total (mg/L as P)	0.0	10.0
P00900	Hardness, total (mg/L as CaCO3)	0.0	5,000.0
P00915	Calcium, dissolved (mg/L)	0.0	1,000.0
P00925	Magnesium, dissolved (mg/L)	0.0	1,000.0
P00930	Sodium, dissolved (mg/L)	0.0	5,000.0
P00935	Potassium, dissolved (mg/L)	0.0	1,000.0
P00940	Chloride, total (mg/L)	0.0	22,000.0
P00945	Sulfate, total (mg/L)	0.0	2,500.0
P00946	Sulfate, dissolved (mg/L)	0.0	2,500.0
P00950	Fluoride, dissolved (mg/L)	0.0	15.0
P00955	Silica, dissolved (mg/L)	0.0	2,000.0
P01000	Arsenic, dissolved (μg/L)	0.0	5,000.0
P01002	Arsenic, total (μg/L)	0.0	5,000.0
P01005	Barium, dissolved (μg/L)	0.0	2,000.0
P01007	Barium, total (μg/L)	0.0	2,000.0
P01010	Beryllium, dissolved (μg/L)	0.0	2,000.0
P01012	Beryllium, total (μg/L)	0.0	2,000.0
P01020	Boron, dissolved (μg/L)	0.0	5,000.0
P01022	Boron, total (μg/L)	0.0	5,000.0
P01025	Cadmium, dissolved (μg/L)	0.0	500.0
P01027	Cadmium, total (μg/L)	0.0	500.0
P01030	Chromium, dissolved (μg/L)	0.0	2,000.0
P01032	Chromium, hexavalent (μg/L)	0.0	2,000.0
P01034	Chromium, total (μg/L)	0.0	2,000.0

Appendix 1. U.S. Environmental Protection Agency STORET edit-checking procedure of low and high values for selected water-quality parameters from the Upper Yampa River watershed water-quality database.
[STORET, STOrage and RETrieval; °C, degrees Celsius; μS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; $HCO3^-$, bicarbonate; N, nitrogen; PO_4, phosphate; P, phosphorus; μg/L, micrograms per liter; col/100 mL, colonies per 100 milliliters, NO_3, nitrate. Parameter codes are from the USEPA STORET Data Warehouse. Data are from National Park Service (2001)]

[1]Parameter code	[1]Parameter code name	Low value	High value
P01040	Copper, dissolved (μg/L)	0.0	2,000.0
P01042	Copper, total (μg/L)	0.0	5,000.0
P01045	Iron, total (μg/L)	0.0	56,000.0
P01046	Iron, dissolved (μg/L)	0.0	56,000.0
P01049	Lead, dissolved (μg/L)	0.0	1,000.0
P01051	Lead, total (μg/L)	0.0	1,000.0
P01055	Manganese, total (μg/L)	0.0	5,000.0
P01056	Manganese, dissolved (μg/L)	0.0	5,000.0
P01065	Nickel, dissolved (μg/L)	0.0	2,000.0
P01067	Nickel, total (μg/L)	0.0	2,000.0
P01075	Silver, dissolved (μg/L)	0.0	5,000.0
P01077	Silver, total (μg/L)	0.0	5,000.0
P01090	Zinc, dissolved (μg/L)	0.0	25,000.0
P01092	Zinc, total (μg/L)	0.0	25,000.0
P01105	Aluminum, total (μg/L)	0.0	20,000.0
P01106	Aluminum, dissolved (μg/L)	0.0	20,000.0
P01145	Selenium, dissolved (μg/L)	0.0	100.0
P22703	Uranium, natural, dissolved (μg/L)	0.0	500.0
P31613	Fecal coliform, membrane filter, m-FC agar, 44.5C, 24 hour (col/100 mL)	0.0	10,000,000.0
P31616	Fecal coliform, membrane filter, m-FC broth (col/100 mL)	0.0	10,000,000.0
P70300	Residue, total filtrable, dried at 180°C (mg/L)	0.0	4,000.0
P70507	Phosphorus, orthophosphate, total (mg/L as P)	0.0	10.0
P71850	Nitrate nitrogen, total (mg/L as NO_3)	0.0	65.0
P71890	Mercury, dissolved (μg/L)	0.0	10.0
P71900	Mercury, total (μg/L)	0.0	10.0

[1]Parameter code numbers and names from the USGS National Water Information System and the USEPA Data Storage and Retrieval System (STORET) Data Warehouse.

Appendix 2. Selected Colorado Department of Public Health and Environment in-stream water-quality standards for stream segments in the Upper Yampa River watershed, Colorado.

[mg/L, milligrams per liter, °C, degrees Celsius; DM, Daily Maximum; MWAT, Maximum Weekly Average Temperature; SMCL, Secondary Maximum Contaminant Level; TVS, Table Value Standard; MCL; Maximum Contaminant Level; μg/L, milligrams per liter; tr, trout; sc, sculpin; col/mL, colonies per 100 milliliters. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c), unless otherwise stated. Descriptions of segments are in Colorado Department of Public Health and Environment (2010b). Recommended total phosphorus levels are from U.S. Environmental Protection Agency (2000). Stream segments with no water-quality data in the Upper Yampa River watershed database or outside of the Upper Yampa River watershed boundary as defined for this report are not included in this table]

Physical property or constituent (units)	In-stream water-quality standard		Stream segment
	Type	Value[1]	
Physical properties			
pH (standard units)	Aquatic life	6.5–9.0	all
Dissolved oxygen (mg/L)	Aquatic life	6.0	1b, 2a–2c, 3, 4, 5, 6, 7, 8, 11, 12, 13a–13c, 13f, 14, 20a
Dissolved oxygen (mg/L)	Aquatic life	5.0	13d, 13e, 15
Water temperature (°C)	Aquatic life cold (June–Sept)	21.2 (acute, DM)	1b, [2]2a–2c, 3, 4, 5, 6, 7, 8, 11, 12, 13a–13c, 13f, 14, 20a
		17.0 (chronic, MWAT)	
	Aquatic life cold (Oct–May)	13.0 (acute, DM)	
		9.0 (chronic, MWAT)	
	Aquatic life warm (March–Nov)	31.3 (acute, DM)	13d, 13e, 15
		28.7 (chronic, MWAT)	
	Aquatic life warm (Dec–Feb)	15.2 (acute, DM)	
		14.3 (chronic), MWAT	
Total dissolved solids and major ions			
Dissolved solids, total (mg/L)	SMCL	500	2a, 2c, 3, 4, 6, 8, 13a, 13c (June–Feb), 13f, 14, 15, 20a
Sulfate, unfiltered (mg/L)	Domestic water supply	250	1b, 2a–2c, 3, 4, 6, 8, 13a, 13c (June–Feb), 13f, 14, 15, 20a
Chloride, unfiltered (mg/L)	Domestic water supply	250	1b, 2a– 2c, 3, 4, 6, 8, 13a, 13c (June–Feb), 13f, 14, 15, 20a
Nutrients			
Ammonia, total (mg/L)	Aquatic life	TVS (acute, chronic) or none	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13c, 13e, 13f, 14, 15, 20a
Nitrite, unfiltered (mg/L)	Aquatic life	0.05	all
Nitrate, unfiltered (mg/L)	MCL	10	1b, 2a–2c, 3, 4, 6, 8, 13a, 13c (June–Feb), 13f, 14, 15, 20a
Nitrate, unfiltered (mg/L)	Domestic water supply	100	5, 7, 11, 12, 13b, 13c (March–May), 13d, 13e
Phosphorus, total (mg/L)	Recommended	0.05	2a, 3, 15 (Streams that flow directly into lake or reservoir)
Phosphorus, total (mg/L)	Recommended	0.1	2a, 2c, 3, 4, 6, 8, 13a, 13c (June–Feb), 13f, 14, 15, 20a (Streams that do not flow directly into lake or reservoir)
Trace elements			

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Appendix 2. Selected Colorado Department of Public Health and Environment in-stream water-quality standards for stream segments in the Upper Yampa River watershed, Colorado.

[mg/L, milligrams per liter, °C, degrees Celsius; DM, Daily Maximum; MWAT, Maximum Weekly Average Temperature; SMCL, Secondary Maximum Contaminant Level; TVS, Table Value Standard; MCL; Maximum Contaminant Level; µg/L, milligrams per liter; tr, trout; sc, sculpin; col/mL, colonies per 100 milliliters. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c), unless otherwise stated. Descriptions of segments are in Colorado Department of Public Health and Environment (2010b). Recommended total phosphorus levels are from U.S. Environmental Protection Agency (2000). Stream segments with no water-quality data in the Upper Yampa River watershed database or outside of the Upper Yampa River watershed boundary as defined for this report are not included in this table]

Physical property or constituent (units)	In-stream water-quality standard		Stream segment
	Type	Value[1]	
Arsenic, dissolved (µg/L)	Aquatic life	340 (acute)	all
Arsenic, total recoverable (µg/L)	Aquatic life	0.02 (chronic)	1b, 2a–2c, 3, 6, 8, 13a, 13c (June–Feb), 13f, 14, 15, 20a
		0.02–10 (chronic)	4
		7.6 (chronic)	5, 7, 13b, 13c (March–May), 13d, 13e
		100 (chronic)	11, 12
Boron, dissolved (µg/L)	Domestic water supply	750	all
Cadmium, dissolved (µg/L)	Aquatic life	TVS(tr) (acute)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–3c, 13f, 14, 15, 20a
Cadmium, dissolved (µg/L)		TVS (acute)	13d, 13e
		TVS (chronic)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13f, 14, 15, 20a
Cadmium, total recoverable (µg/L)	Aquatic life	5 (acute)	4
		10 (chronic)	11, 12
Chromium, dissolved (µg/L)	Aquatic life	TVS (16 acute, 11 chronic)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13e, 14, 15, 20a
Chromium, total recoverable (µg/L)	Aquatic life	50 (acute)	4
		100 (chronic)	11, 12
Copper, dissolved (µg/L)	Aquatic life	TVS (acute, chronic)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13e, 14, 15, 20a
Copper,total recoverable (µg/L)	Aquatic life	200 (chronic)	4
		200 (acute)	11, 12
Iron, dissolved (µg/L)	Domestic water supply	300 (chronic)	1b, 2a–2c, 3, 4, 6, 8, 13a, 13c (June–Feb), 13f, 14, 15, 20a
Iron, total recoverable (µg/L)	Aquatic life	1,000 (chronic)	b, 2a–2c, 3, 5, 6, 7, 8, 13a, 13b (not Middle Creek), 13c, 13f, 14, 15, 2
		1,035 (chronic)	13b (Middle Creek)
		existing quality (chronic)	13d, 13e
Lead, dissolved (µg/L)	Aquatic life	TVS (acute, chronic)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13e, 14, 15, 20a
Lead, total recoverable (µg/L)	Aquatic life	50 (acute)	4
		100 (chronic)	11, 12
Manganese, dissolved (µg/L)	Domestic water supply	50 (chronic)	1b, 2a–2c, 3, 4, 6, 8, 13a, 13c (June–Feb), 13f, 14, 15, 20a

Appendix 2. Selected Colorado Department of Public Health and Environment in-stream water-quality standards for stream segments in the Upper Yampa River watershed, Colorado.

[mg/L, milligrams per liter, °C, degrees Celsius; DM, Daily Maximum; MWAT, Maximum Weekly Average Temperature; SMCL, Secondary Maximum Contaminant Level; TVS, Table Value Standard; MCL; Maximum Contaminant Level; µg/L, milligrams per liter; tr, trout; sc, sculpin; col/mL, colonies per 100 milliliters. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c), unless otherwise stated. Descriptions of segments are in Colorado Department of Public Health and Environment (2010b). Recommended total phosphorus levels are from U.S. Environmental Protection Agency (2000). Stream segments with no water-quality data in the Upper Yampa River watershed database or outside of the Upper Yampa River watershed boundary as defined for this report are not included in this table]

Physical property or constituent (units)	In-stream water-quality standard		Stream segment
	Type	Value[1]	
Manganese, dissolved (µg/L)	Aquatic life	TVS (acute, chronic)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13e, 14, 15, 20a
Manganese, total recoverable (µg/L)	Aquatic life	TVS (acute, chronic)	4
		200 (chronic)	11, 12
Mercury, total (µg/L)	Aquatic life	0.01 (chronic)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13e, 14, 15, 20a
Mercury, total recoverable (µg/L)	Aquatic life	2.0 (acute)	4
Nickel, dissolved (µg/L)	Aquatic life	TVS (acute, chronic)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13e, 14, 15, 20a
Nickel, total recoverable (µg/L)	Aquatic life	100 (chronic)	4
		200 (chronic)	11, 12
Selenium, dissolved (µg/L)	Aquatic life	18.4 (acute), 4.6 (chronic)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13e, 14, 15, 20a
Selenium, total recoverable (µg/L)	Aquatic life	20 (chronic)	4, 11, 12
Silver, dissolved (µg/L)	Aquatic life	TVS (acute)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13e, 14, 15, 20a
		TVS(tr) (chronic)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13c, 13f, 14, 15, 20a
		TVS (chronic)	13d, 13e
Silver, total recoverable (µg/L)	Aquatic life	100 (acute)	4
Zinc, dissolved (µg/L)	Aquatic life	TVS (acute)	1b, 2a–2c, 3, 5, 6, 7, 8, 13a–13f, 14, 15, 20a
		TVS(sc) (chronic)	2a, 2c, 3, 8, 13a (hardness less than 113 mg/L CaCO3)
		TVS (chronic)	1b, 2b, 5, 6, 7, 13b-13f, 14, 15, 20a; 2a, 2c, 3, 8, 13a (hardness >= than 113 mg/L CaCO3)
Zinc, total recoverable (µg/L)	Aquatic life	2,000 (acute)	4
		2,000 (chronic)	4, 11, 12
Coliform bacteria			
Escherichia coli (col/100 mL)	Recreation	126/100	1b, 2a–2c, 3, 6, 8, 13a–13d, 13f, 14, 15, 20a
		205/100	5, 7
		630/100	4, 11, 12, 13e

[1]Table value standards for trace elements vary with hardness. See Colorado Department of Public Health and Environment (2009, 2010c).

Appendix 2. Selected Colorado Department of Public Health and Environment in-stream water-quality standards for stream segments in the Upper Yampa River watershed, Colorado.

[mg/L, milligrams per liter, °C, degrees Celsius; DM, Daily Maximum; MWAT, Maximum Weekly Average Temperature; SMCL, Secondary Maximum Contaminant Level; TVS, Table Value Standard; MCL; Maximum Contaminant Level; μg/L, milligrams per liter; tr, trout; sc, sculpin; col/mL, colonies per 100 milliliters. Water-quality standards are from Colorado Department of Public Health and Environment (2009a, 2010c), unless otherwise stated. Descriptions of segments are in Colorado Department of Public Health and Environment (2010b). Recommended total phosphorus levels are from U.S. Environmental Protection Agency (2000). Stream segments with no water-quality data in the Upper Yampa River watershed database or outside of the Upper Yampa River watershed boundary as defined for this report are not included in this table]

Physical property or constituent (units)	In-stream water-quality standard		Stream segment
	Type	Value[1]	

[2]April–December temperature WAT (Weekly Average Temperature) for stream segment 2b: Stagecoach Reservoir 21.40 degrees Celsius, Steamboat Lake 21.60 degrees Celsuis.

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Appendix 3. Selected stream sites in the Upper Yampa River watershed, Colorado, and type of water-quality data collected, period of water-quality record, and number of samples collected from 1975 through 2009.

[No., number; USFS, U.S. Forest Service; PP, physical properties; D, discharge; CB, coliform bacteria; SS, suspended sediment; CDPHE, Colorado Department of Public Health and Environment; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; CODOW, Colorado Division of Wildlife Riverwatch Program; USGS, U.S. Geological Survey; CSS, City of Steamboat Springs; TE, trace elements; TE_U, trace elements and uranium; USEPA, U.S. Environmental Protection Agency. Subbasin definitions: Upstream Lewis SWA= Yampa River upstream from Chuck Lewis State Wildlife Area, Lewis SWA to Elk River=Yampa River downstream from Chuck Lewis State Wildlife Area to Elk River confluence, Elk River to Hayden=Yampa River downstream from Elk River to Hayden, Downstream Hayden=Yampa River downstream from Hayden to confluence with Elkhead Creek. Sites with the same site number are considered to be at the same location. Sites with name in **bold** are streamflow gaging stations; see table 1 for additional information on these sites]

Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record (calendar year)	No. of samples
1	BEAR R. #2 13 MI SW YAMPA	USFS	11057702	40.05	-107.066667	Upstream Lewis SWA	PP,D,CB	1975	6
2	BEAR R. #3 10MI SW YAMPA	USFS	11057703	40.066667	-107.033333	Upstream Lewis SWA	PP,D,CB,SS	[1]1975–79	24
3	BEAR R. @ RD. 8	CDPHE	12898	40.1570878	-106.9016075	Upstream Lewis SWA	PP,D,TDS,MI,N,TE	[1]2000–07	9
4	BEAR RIVER #1	USFS	11057701	40.033333	-107.116667	Upstream Lewis SWA	PP,D,SS	1975	5
5	Bear River Miller	CODOW	CDOWRW-6	40.08	-106.97	Upstream Lewis SWA	PP,D,TE	1990–99	131
6	BEAR RIVER NEAR TOPONAS, CO	USGS	09236000	40.04387328	-107.0722729	Upstream Lewis SWA	PP,D,MI,N,TE	1975–86, 2005	46
7	BEAVER CREEK NEAR HAHNS PEAK, CO.	USGS	404610106545600	40.76941619	-106.9161606	Elk River	PP,D,MI,N,TE	1975	1
8	BTKN-DWN [Butcherknife Creek 15m above Yampa St]	CSS	BTKN-DWN	40.484	-106.834	Lewis SWA to Elk River	PP,MI,N,TE,CB	2007–08	4
9	BURGESS C TRIB BL SKI AREA NR STEAMBOAT SPGS, CO	USGS	402745106473600	40.46247777	-106.793937	Lewis SWA to Elk River	PP,D,MI,N	1976	3
10	BURGESS CK NEAR MOUTH @ HWY 40	CDPHE	12893	40.45166	-106.81016	Lewis SWA to Elk River	PP,D,TDS,MI,N,TE,CB	1999	1
11	BURGESS CREEK AB SKI AREA NR STEAMBOAT SPGS, CO.	USGS	402802106471000	40.46719994	-106.7867147	Lewis SWA to Elk River	PP,D,N,CB,SS	1975–76	8
12	BURGESS CREEK BL SKI AREA NR STEAMBOAT SPGS, CO.	USGS	402720106481500	40.45553339	-106.8047705	Lewis SWA to Elk River	PP,D,CB,SS	1975–76	5
13	BUTCHERKNIFE CREEK NR MOUTH AT STEAMBOAT SPG,CO.	USGS	402944106495900	40.4955323	-106.8206047	Lewis SWA to Elk River	PP,D,N,CB	1975–76	5
14	CHENEY CREEK NEAR MILNER,CO.	USGS	402908107014000	40.4855308	-107.0283866	Elk River to Hayden	D,CB	1975	1
15	CHIMNEY CK @ RD. 8	CDPHE	12899	40.158	-106.9	Upstream Lewis SWA	PP,D,MI,N,TE	[1]2001–07	17
16	CHIMNEY CREEK AT TRAPPER, CO.	USGS	400612106524800	40.10331818	-106.8806012	Upstream Lewis SWA	PP,D,TDS,MI,N,TE,CB	1975–76	6
17	COW CR. NR. STEAMBOAT SPRINGS,CO.	USGS	402836106550100	40.476643	-106.9175508	Lewis SWA to Elk River	PP,D,TDS,MI,N,TE,SS	1981–82, 2005	10
18	CREEK ROUTT	USGS	403333106504900	40.5591422	-106.8475491	Lewis SWA to Elk River	PP,MI,TE	1976	1
19	DEEP CREEK AT HAHNS PEAK, CO.	USGS	404845106571400	40.81247064	-106.9544949	Elk River	PP,D,MI,N,TE	1975	1
20	DILL GULCH NEAR HAYDEN, CO	USGS	402605107181500	40.4346968	-107.304781	Downstream Hayden	PP,D,TDS,MI,N,TE,SS	1981–82	4
21	DILL GULCH TRIBUTARY 0.2MI AB MOUTH -S132	USGS	402558107182101	40.4327524	-107.3064476	Downstream Hayden	PP,D,TDS,MI,N,TE	1982	1

Appendix 3. Selected stream sites in the Upper Yampa River watershed, Colorado, and type of water-quality data collected, period of water-quality record, and number of samples collected from 1975 through 2009.

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Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record (calendar year)	No. of samples
22	DRY CK @ HAYDEN	CDPHE	12852	40.49233	-107.26466	Downstream Hayden	PP,TDS,MI,N,TE_U,CB	[1]2001–05	7
23	DRY CK AT HAYDEN NR YAMPA VALLEY AIRPORT	CDPHE	12852A	40.481	-107.23613	Downstream Hayden	PP,MI,N,TE	2007	2
24	DRY CREEK AT HWY 40 AT HAYDEN, CO	USGS	402939107160100	40.4941403	-107.2675586	Downstream Hayden	PP,D	1975	2
24	DRY CREEK ABOVE SEWAGE PLANT AT HAYDEN, CO.	USGS	402938107160101	40.4939722	-107.2669722	Downstream Hayden	PP	2005	2
25	DRY CREEK BELOW SEWAGE PLANT AT HAYDEN, CO.	USGS	402952107161600	40.4977513	-107.2717254	Downstream Hayden	PP,D,N,CB	1975	4
26	ELK R.@ RD. 64A	CDPHE	12868	40.75166	-106.7586633	Elk River	PP,TDS,MI,N,TE,CB	2001–02	13
27	ELK R. NEAR MOUTH @ CR44	CDPHE	12860	40.54583	-106.90883	Elk River	PP,TDS,MI,N,TE,CB	1999	1
28	ELK RIVER AB. GLEN EDEN	CDPHE	12865	40.7163889	-106.9155556	Elk River	PP,TDS,MI,N,TE,CB	1996–97	11
29	ELK RIVER ABOVE CLARK, CO	USGS	09240900	40.743306	-106.8553254	Elk River	PP,D	[1]1987–2003	99
30	ELK RIVER AT CLARK, CO.	USGS	09241000	40.7174726	-106.9158832	Elk River	PP,D,TDS,MI,N,TE,SS	[1]1975–2003	148
31	ELK RIVER BELOW SOUTH FORK AT HINMAN PARK, CO.	USGS	404506106492800	40.7516394	-106.8250465	Elk River	PP,D,TDS,MI,N,TE,CB,SS	1975–76	6
32	ELK RIVER NEAR MILNER	CDPHE	000154	40.4833333	-106.9788889	Elk River	PP,TDS,MI,N,TE_U,CB	1979–82	21
33	**ELK RIVER NEAR MILNER, CO.**	USGS	09242500	40.5146975	-106.9539407	Elk River	PP,D,TDS,MI,N,TE,CB,SS	[1]1975–2005	180
33	ELK R. @ RD. 42	CDPHE	12861	40.51483	-106.954	Elk River	PP,TDS,MI,N,TE_U,CB	[1]2001–07	25
34	ELK RIVER NEAR MOUTH	USGS	402914106580400	40.4871979	-106.9683853	Elk River	PP,D,TDS,MI,N	1999–2000	2
34	ELK RIVER NEAR MOUTH AT US 40 BRIDGE, CO.	USGS	402913106580400	40.4869201	-106.9683853	Elk River	PP,N,CB	1975	2
35	ELKHEAD CR 1.5 MILES BELOW NORTH FORK	CDPHE	ELKHEAD03	40.65	-107.3166667	Elkhead Creek	PP,TDS	1979	1
36	ELKHEAD CR AT HWY 40 BRIDGE	CDPHE	ELKHEAD01	40.6666667	-107.2833333	Elkhead Creek	PP,TDS,TE	1979	1
37	ELKHEAD CR BELOW ELKHEAD RES	CDPHE	ELKHEAD02	40.55	-107.3833333	Elkhead Creek	PP,TE	1979	1
38	ELKHEAD CREEK	USEPA	WCOP99-0512	40.6599679	-107.2906527	Elkhead Creek	PP,MI,N,TE	2000	2
39	ELKHEAD CREEK	USEPA	WCOP99-0565	40.6199685	-107.2706516	Elkhead Creek	PP,MI,N,TE	2001	2

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Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record (calendar year)	No. of samples
40	**ELKHEAD CREEK ABOVE LONG GULCH, NEAR HAYDEN, CO**	USGS	09246200	40.59163879	-107.3208933	Elkhead Creek	PP,D,TDS,MI,N,TE,CB,SS	1995–2004	143
40	ELKHEAD CREEK ABOVE ELKHEAD RESERVOIR, CO.	USGS	403530107191300	40.59163879	-107.3208933	Elkhead Creek	PP,D,TDS,MI,N,TE,CB,SS	[1]1975–83	10
41	ELKHEAD CREEK BELOW ELKHEAD RESERVOIR, CO	USGS	403318107230100	40.554972	-107.384228	Elkhead Creek	PP,D,SS	[1]1997–2003	10
42	ELKHEAD CREEK BELOW MAYNARD GULCH, NEAR CRAIG, CO	USGS	09246400	40.5447222	-107.3980556	Elkhead Creek	PP,D,TDS,MI,N,TE,CB,SS	1995–2005	143
43	**ELKHEAD CREEK NEAR CRAIG, CO**	USGS	09246500	40.5310829	-107.4361735	Elkhead Creek	PP,D,TDS,MI,N,TE,SS	[1]1975–83, 2005	9
43	ELKHEAD CK NR CRAIG @ HWY 40	CDPHE	12840	40.531	-107.43633	Elkhead Creek	PP,TDS,MI,N,TE,CB	[1]1999–2007	19
43	ELKHEAD CREEK NEAR MOUTH	USGS	403152107260700	40.5310829	-107.4358957	Elkhead Creek	PP,D,TDS,MI,N	1999	1
44	ELKHEAD CREEK NEAR ELKHEAD, CO.	USGS	09245000	40.6696938	-107.2850592	Elkhead Creek	PP,D,TDS,MI,N,TE,CB,SS	[2]1975–96	141
45	ENGLISH CREEK ABOVE MOUTH, NEAR CLARK, CO	USGS	404727106453700	40.7908059	-106.7608772	Elk River	PP,D,TDS,MI,N,TE,SS	[1]1999–2003	14
46	FISH [Fish Creek below Hwy 40 and 10m above pedestrian bridge]	CSS	FISH	40.466	-106.829	Lewis SWA to Elk River	PP,MI,N,TE,CB	2007–08	4
47	FISH C TRIB BL LONG LK, NR BUFFLAO PASS, CO.	USGS	09238710	40.4766454	-106.6875442	Lewis SWA to Elk River	PP,D,TDS,MI,N,SS	1985–95	40
48	FISH CK @ RD. 27	CDPHE	12854	40.35633	-107.104	Elk River to Hayden	PP,TDS,MI,N,TE,CB	2001	4
49	**FISH CR AT UPPER STA NR STEAMBOAT SPRINGS, CO**	USGS	09238900	40.4749775	-106.7869926	Lewis SWA to Elk River	PP,D,TDS,MI,N,TE,CB,SS	1982–2004	166
49	FISH CK AT STEAMBOAT	CDPHE	12874	40.4747222	-106.7830556	Lewis SWA to Elk River	PP,TDS,MI,N,TE,CB	1996–97	11
50	FISH CR TRIB AB LONG LK, NR BUFFALO PASS, CO.	USGS	09238700	40.47331224	-106.6800438	Lewis SWA to Elk River	PP,D	1985–87	8
51	FISH CREEK AT MOUTH NEAR MILNER, CO.	USGS	402530106585700	40.42497698	-106.9831072	Elk River to Hayden	PP,D,TDS,MI,N,TE,SS	[1]1975–82, 2005	16
51	FISH CREEK AT ROAD 179	CDPHE	12854A	40.42344	-106.9856	Elk River to Hayden	PP,MI,N,TE	2006–07	4
52	FISH CREEK NEAR MILNER, CO.	USGS	09244100	40.33414469	-107.1392207	Elk River to Hayden	PP,D,TDS,MI,N,TE,SS	[1]1975–82, 2005	18
53	FISH CREEK NEAR STEAMBOAT SPRINGS, CO	USGS	09239000	40.46525524	-106.8214376	Lewis SWA to Elk River	PP,D,MI,N,CB,SS	1975–76	8
54	FISH CREEK NR MOUTH AT STEAMBOAT SPRINGS, CO.	USGS	402759106493100	40.46636629	-106.8258822	Lewis SWA to Elk River	PP,D,CB	1975, 2005	4
54	FISH CK NEAR MOUTH @ HWY 40	CDPHE	12870	40.4665	-106.82467	Lewis SWA to Elk River	PP,D,TDS,MI,N,TE,CB	[1]1999–2002	5

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Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record (calendar year)	No. of samples
55	FOIDEL CREEK AT MOUTH NEAR OAK CREEK, CO	USGS	09243900	40.39025545	-106.9947738	Elk River to Hayden	PP,D,TDS,MI,N,TE,SS	1975–2001, 2005	290
55	FOIDEL CK @ RD. 33	CDPHE	12856	40.39033	-106.996	Elk River to Hayden	PP,TDS,MI,N,TE,CB	[1]2001–07	7
56	FOIDEL CREEK NEAR OAK CREEK, CO	USGS	09243800	40.34581144	-107.085053	Elk River to Hayden	PP,D,TDS,MI,N,TE,SS	[3]1975–2001	226
57	GRANITE C NR BUFFALO PASS, CO.	USGS	09238770	40.49303389	-106.6925446	Lewis SWA to Elk River	PP,D,SS	1985–95	65
58	GRASSY CREEK AT GRASSY GAP, CO.	USGS	402330107082000	40.3916434	-107.139499	Elk River to Hayden	PP,D,TDS,MI,N,TE,SS	[1]1975–82	22
59	GRASSY CREEK NEAR MOUNT HARRIS, CO.	USGS	09244300	40.4469199	-107.1456109	Elk River to Hayden	PP,D,TDS,MI,N,TE,SS	[1]1975–82	21
59	GRASSY CK @ RD. 27A	CDPHE	12853	40.44666	-107.14583	Elk River to Hayden	PP,TDS,MI,N,TE_U,CB	[1]2001–07	7
60	HARRISON CREEK AT MOUTH NR BLACKTAIL MTN, CO.	USGS	402056106471600	40.3488693	-106.7883797	Upstream Lewis SWA	PP,D,CB,SS	1975–76	4
61	HUBBERSON GULCH NEAR HAYDEN, CO.	USGS	09244464	40.39108697	-107.2714464	Downstream Hayden	PP,D,TDS,MI,N,TE,SS	[1]1978–82	41
62	L. MORRISON C AB DAM SITE NR OAK CREEK, CO	USGS	401540106502801	40.26109309	-106.8417132	Upstream Lewis SWA	PP,D,SS	1986–88	17
63	LITTLE MORRISON CK @ RD 18A	CDPHE	12896	40.2725	-106.83933	Upstream Lewis SWA	PP,TDS,MI,N,TE	[1]2001–07	7
64	LITTLE MORRISON CREEK @ CR 16	CDPHE	12896A	40.2708	-106.8393333	Upstream Lewis SWA	PP,D,TDS,MI,N,TE	2000	1
65	LITTLE MORRISON CREEK NEAR STAGECOACH, CO.	USGS	401634106502200	40.27609276	-106.8400466	Upstream Lewis SWA	PP,D,N,CB,SS	1975–76	5
66	LITTLE WHITE SNAKE CK @ HWY 131	CDPHE	12897	40.24066	-106.94266	Upstream Lewis SWA	PP,TDS,MI,N,TE	[1]2001–07	4
67	LONG LAKE INLET NEAR BUFFALO PASS, CO.	USGS	09238705	40.47359	-106.6800438	Lewis SWA to Elk River	PP,D,N,SS	1986–95	51
68	LOST DOG CREEK ABOVE MOUTH, NEAR CLARK, CO	USGS	404750106454200	40.79719468	-106.762266	Elk River	PP,D,TDS,MI,N,TE_U,SS	[1]1999–2006	21
69	MAD CREEK NEAR STEAMBOAT SPRINGS, CO.	USGS	09242000	40.56553065	-106.8892167	Elk River	PP,D,TDS,MI,N,TE,CB,SS	1975–76, 2003	12
69	MAD CK @ CHRISTINA SWA	CDPHE	12863	40.5652778	-106.8891667	Elk River	PP,TDS,MI,N,TE,CB	1996–98, 2007	16
70	MARTIN C AB DAM SITE NR OAK CREEK, CO	USGS	401729106514601	40.29136998	-106.8633807	Upstream Lewis SWA	PP,D,SS	1986–88	17
71	MD FK FISH C NR BUFFALO PASS, CO.	USGS	09238750	40.49831156	-106.6922668	Lewis SWA to Elk River	PP,D,MI,N,SS	1985–95	61
72	MID FK FISH CR TRIB BL FISH CR RESERVOIR, CO	USGS	09238800	40.49720037	-106.6989339	Lewis SWA to Elk River	PP,D,MI,N,SS	[1]1985–94	15

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Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record (calendar year)	No. of samples
73	MIDDLE C AB DAM SITE NR OAK CREEK, CO	USGS	401608106513001	40.2688705	-106.8589359	Upstream Lewis SWA	PP,D,SS	1986–88	16
73	MIDDLE CREEK @ CR 16	CDPHE	12809B	40.2687833	-106.8589333	Upstream Lewis SWA	PP,D,TDS,MI,N,TE	2000	1
74	MIDDLE CK., SAMPLE #7	USGS	402354106584400	40.39831096	-106.9794957	Elk River to Hayden	PP,D	2005	1
74	MIDDLE CK @ 33 RD.	CDPHE	12855	40.39716	-106.98033	Elk River to Hayden	PP,TDS,MI,N,TE,CB	[1]2001–07	8
75	MIDDLE CREEK NEAR OAK CREEK, CO	USGS	09243700	40.38553335	-106.993107	Elk River to Hayden	PP,D,TDS,MI,N,TE,SS	1975–2001	243
76	NORTH FORK ELK RIVER ABOVE MOUTH, NEAR CLARK, CO	USGS	404620106461900	40.772195	-106.7725445	Elk River	PP,D,TDS,MI,N,TE_U,SS	[1]1999–2006	23
76	NORTH FORK ELK RIVER NEAR HINMAN PARK, CO.	USGS	404620106462200	40.772195	-106.7733778	Elk River	PP,D,CB,SS	1975–76	4
77	NORTH FORK ELK RIVER ABV AGNES CREEK, NR CLARK, CO	USGS	405057106451000	40.8491383	-106.7533763	Elk River	PP,D,TDS,MI,N,TE,SS	1999–2000	11
78	NORTH FORK ELK RIVER ABV TRAIL CREEK, NR CLARK, CO	USGS	404950106462700	40.83052734	-106.7747661	Elk River	PP,D,TDS,MI,N,TE,SS	1999–2000	11
79	NORTH FORK ELKHEAD CREEK NEAR ELKHEAD, CO.	USGS	09245500	40.680527	-107.2872814	Elkhead Creek	PP,D,CB,SS	1975–76	4
80	NORTH FORK OF FOIDEL CREEK AT MOUTH, CO	USGS	402007107050400	40.3352561	-107.0850529	Elk River to Hayden	PP,D,TDS,MI,N	1983	2
81	NORTH FORK WALTON CREEK NR RABBIT EARS PASS, CO.	USGS	09238300	40.3955363	-106.649764	Lewis SWA to Elk River	PP,D,TDS,MI,N,TE	[1]1975–87	10
82	OAK CR AT NAT FOREST BOUNDARY ABOVE TOWN	CDPHE	OAK01	40.2166667	-107.0666667	Upstream Lewis SWA	PP,TDS,TE	1979	1
83	OAK CK D/S TOWN OF OAK CREEK @ CR 27	CDPHE	12892	40.27616	-106.96416	Upstream Lewis SWA	PP,D,TDS,MI,N,TE,CB	[1]1999–2007	14
84	OAK CK NEAR MOUTH @ CR 14 @ SYDNEY PEAK HORSE RANCH	CDPHE	12891A	40.39035	-106.8432	Upstream Lewis SWA	PP,MI,N,TE	2006–07	4
85	OAK CREEK AB OAK CREEK DRAIN NEAR OAK CREEK, CO.	USGS	401725106575600	40.29025799	-106.966161	Upstream Lewis SWA	PP,D,MI,N,TE,CB,SS	1975–76, 2005	7
86	OAK CREEK ABOVE ROUTT, CO.	USGS	401741106574600	40.29470236	-106.9633832	Upstream Lewis SWA	PP,D,TDS,MI,N,TE,SS	1975–76	5
87	OAK CREEK AT CR 35 BELOW HAYBRO, CO	USGS	402121106543201	40.3556972	-106.9089694	Upstream Lewis SWA	PP,D	2005	2
88	OAK CREEK AT P AND M COAL MINE OAK CREEK COLO	CDPHE	OAK02	40.3	-107.0333333	Upstream Lewis SWA	PP,TDS,TE	1979	1
89	OAK CREEK AT WHITECOTTON RD	CDPHE	OAK03	40.3333333	-106.9666667	Upstream Lewis SWA	PP,TDS,TE	1979	1
90	OAK CREEK BELOW TOWN OF OAK CREEK	CDPHE	000153	40.3316667	-106.96	Upstream Lewis SWA	PP,TDS,MI,N,TE_U,CB	1979–92	74

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Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record (calendar year)	No. of samples
91	Oak Creek Decker Pk	CODOW	CDOWRW-80	40.27	-106.95	Upstream Lewis SWA	PP,TE	[4]1991–2000	92
92	Oak Creek Habro Br	CODOW	CDOWRW-9	40.31	-106.95	Upstream Lewis SWA	PP,MI,TE	[4]1991–99	109
93	OAK CREEK NEAR OAK CREEK, CO.	USGS	09238000	40.24386976	-107.0153283	Upstream Lewis SWA	PP,D,TDS,MI,N,TE,SS	[1]1975–81, 2005	13
94	OAK CREEK NEAR STEAMBOAT SPRINGS, CO.	USGS	402356106503000	40.3988677	-106.8422705	Upstream Lewis SWA	PP,D,MI,N,TE	1975, 2005	2
94	OAK CK @ 22 RD ABV YAMPA R	CDPHE	12891	40.3988889	-106.8419444	Upstream Lewis SWA	PP,D,TDS,MI,N,TE_U,CB	[1]1996–2004	26
95	PHILLIPS CREEK NEAR YAMPA, CO.	USGS	400759106532500	40.1330397	-106.8908796	Upstream Lewis SWA	PP,D,MI,TE	1975, 2005	2
96	PRIEST C BL SKI AREA NR STEAMBOAT SPRINGS, CO.	USGS	402600106473600	40.43331177	-106.7939366	Lewis SWA to Elk River	PP,D,N	1976	3
97	S. FORK ELK R. @ TRAIL 1169 NR FR 443	CDPHE	12869	40.75066	-106.73066	Elk River	PP,TDS,MI,N,TE,CB	2001	6
98	SAGE CK @ RD. 27	CDPHE	12851	40.4835	-107.17016	Elk River to Hayden	PP,TDS,MI,N,TE_U,CB	[1]2001–07	7
99	SAGE CR AB HADEN STATION	USGS	402855107101501	40.48191898	-107.1714452	Elk River to Hayden	PP,D,TDS ,MI,N,TE	1979	2
100	SAGE CREEK ABOVE SAGE CREEK RES, NR HAYDEN, CO.	USGS	09244415	40.3835877	-107.193389	Elk River to Hayden	PP,D,TDS,MI,N,TE,SS	1981–83	28
101	SAGE CREEK NEAR HAYDEN, CO.	USGS	402918107094400	40.48830777	-107.162834	Elk River to Hayden	PP,D,MI,N,TE,CB,SS	1975–76, 2005	20
101	SAGE CR @ HWY 40	USGS	402917107094501	40.48803	-107.1631118	Elk River to Hayden	PP,D,TDS,MI,N,TE	1975–76	3
102	SAGE CREEK NEAR MOUNT HARRIS, CO.	USGS	402522107134100	40.42275328	-107.228668	Elk River to Hayden	PP,D,MI,N,TE	1975–76	5
103	SCC87-CREEK	USGS	402358107054601	40.39942127	-107.0967205	Elk River to Hayden	PP,TDS,MI,N,TE	1988	3
104	SENECA NORTH	USGS	402940107074200	40.49441894	-107.1289444	Elk River to Hayden	PP,TDS,MI,N,TE	1986	1
105	SENECA NORTHEAST	USGS	402915107074500	40.48747465	-107.1297777	Elk River to Hayden	PP,TDS,MI,N,TE	1986	1
106	SMUIN GULCH NEAR HAYDEN, CO	USGS	402829107193700	40.47469578	-107.3275597	Downstream Hayden	PP,D,TDS,MI,N,TE,SS	1981–82	6
107	SMUIN TRIB. CREEK NEAR HAYDEN, CO	USGS	402845107185100	40.47914025	-107.3147817	Downstream Hayden	PP,D,TDS,MI,N	1981	6
108	SODA CREEK NR MOUTH AT STEAMBOAT SPRINGS,CO.	USGS	402920106501900	40.48886566	-106.839216	Lewis SWA to Elk River	PP,D,N,CB	1975–76, 2005	6

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Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record (calendar year)	No. of samples
108	SODA [Soda Creek abv second pedestrian bridge from confl with Yampa R in Little Toots Park	CSS	SODA	40.488	-106.84	Lewis SWA to Elk River	PP,MI,N,TE,CB	2007–08	4
109	SOUTH FORK OF FOIDEL CREEK ABOVE MINE, CO	USGS	401847107063400	40.31303424	-107.1100532	Elk River to Hayden	PP,D,TDS,MI,N	1983	2
110	SOUTH FORK OF FOIDEL CREEK AT MOUTH, CO	USGS	402008107050200	40.3355339	-107.0844973	Elk River to Hayden	PP,D,TDS,MI,N	1983	1
111	SPRING CREEK NR MOUTH AT STEAMBOAT SPRINGS, CO.	USGS	402857106494000	40.482477	-106.8283824	Lewis SWA to Elk River	PP,D,N,CB	1975–76, 2005	6
112	STOKES GULCH NEAR HAYDEN, CO.	USGS	09244470	40.4683077	-107.2470023	Downstream Hayden	PP,D,TDS,MI,N,TE,SS	1978–82	39
113	TOW CREEK NEAR MOUTH AT US 40 BRIDGE, CO.	USGS	402908107025100	40.4855307	-107.0481092	Elk River to Hayden	D,CB	1975	1
114	TROUT CK @ RD. 27	CDPHE	12876H	40.31233	-107.00866	Elk River to Hayden	PP,TDS,MI,N,TE	2001	4
115	TROUT CK NR. MOUTH	CDPHE	12876	40.4602778	-106.9886111	Elk River to Hayden	PP,TDS,MI,N,TE_U,CB	[1]1996–2007	22
116	TROUT CREEK ABOVE FOIDEL CREEK NEAR MILNER, CO.	USGS	402416106580800	40.404422	-106.9694956	Elk River to Hayden	PP,D,MI,N,TE	1975, 2005	2
117	TROUT CREEK ABOVE MILNER, CO.	USGS	402720106591200	40.4555318	-106.9872743	Elk River to Hayden	PP,D,TDS,MI,N,TE,SS	1981–82	11
118	TROUT CREEK BELOW FOIDEL CREEK NEAR MILNER, CO.	USGS	402536106582700	40.42664368	-106.9747737	Elk River to Hayden	PP,D,TDS,MI,N,TE,SS	1975, 2005	2
119	TROUT CREEK NEAR MILNER, CO.	USGS	402816107003800	40.4710868	-107.0111638	Elk River to Hayden	PP,D,TDS,MI,N,CB	[1]1975–2005	6
120	TROUT CREEK NEAR OAK CREEK, CO	USGS	401816107011000	40.3044239	-107.0200512	Elk River to Hayden	PP,D,TDS,MI,N	1981	7
121	TROUT CREEK NEAR PHIPPSBURG, CO.	USGS	09243000	40.15109279	-107.1317192	Elk River to Hayden	PP,D,TDS,MI,N,TE	1975	1
122	WALTON CR. NEAR MOUTH @ HWY 40	CDPHE	12894	40.2702728	-106.816	Lewis SWA to Elk River	PP,D,TDS,MI,N,TE,CB	1999, 2006–07	5
123	**WALTON CREEK NEAR STEAMBOAT SPRINGS, CO.**[5]	USGS	09238500	40.4080346	-106.7869917	Lewis SWA to Elk River	PP,D,TDS,MI,N,TE,SS	1982–87	45
124	WALTON CREEK NR MOUTH AT US 40 BRIDGE, CO.	USGS	402700106485400	40.44997787	-106.8156039	Lewis SWA to Elk River	PP,D,N,CB	1975, 2005	4
124	WALTON CREEK @ HWY 40	CDPHE	12894A	40.4499813	-106.8159692	Lewis SWA to Elk River	PP,TDS,MI,N,TE,CB	2001–02	3
124	WALT [Walton Creek 10m above Hwy 40 bridge]	CSS	WALT	40.45	-106.815	Lewis SWA to Elk River	PP,MI,N,TE,CB	2007–08	4
125	WATERING TROUGH GULCH NEAR HAYDEN, CO.	USGS	09244460	40.38247595	-107.2808909	Downstream Hayden	PP,D,TDS,MI,N,TE,SS	1978–81	27

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Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record (calendar year)	No. of samples
126	WAYS GULCH AT HAHNS PEAK, CO SITE 1A	USGS	404756106555100	40.79885997	-106.9314387	Elk River	PP,D,MI,N,TE	1975	1
127	WEST FORK ELK RIVER NR MOUTH AT US 40 BRIDGE,CO.	USGS	402903106584100	40.4841423	-106.9786633	Elk River to Hayden	PP,D,N,CB	1975, 2005	5
128	WOLF CREEK NEAR HAYDEN, CO.	USGS	402832107080200	40.47553045	-107.1344999	Downstream Hayden	PP,D,MI,N,TE	1975	3
128	WOLF CREEK AT HWY 40	CDPHE	12802C	40.47575	-107.1344	Downstream Hayden	PP,MI,N,TE	2006–07	4
129	YAMPA ABOVE OAK CREEK CONFLUENCE	CDPHE	000088	40.3833333	-106.8166667	Upstream Lewis SWA	PP,TDS,MI,N,TE_U,CB	[1]1975-93	101
130	YAMPA R 0.5 MI DSTRM STP BELOW STMBT SPRGS.	USGS	403015106523000	40.5041428	-106.8756058	Lewis SWA to Elk River	PP,N,CB	1976	2
131	YAMPA R AB DAM SITE NR OAK CREEK, CO	USGS	401609106525201	40.2691481	-106.8817142	Upstream Lewis SWA	PP,D,SS	1986–88	17
132	YAMPA R AT 13TH ST BRIDGE AT STEAMBOAT SPRINGS, CO	USGS	402922106502701	40.48944444	-106.8408389	Lewis SWA to Elk River	PP	2005	1
133	YAMPA R AT JAMES BRN BR BLW STEAMBOAT SPRINGS, CO	USGS	402946106512601	40.49624444	-106.8571861	Lewis SWA to Elk River	PP	2005	1
133	YMP-7 [Yampa River 100m above James Brown Bridge]	CSS	YMP-7	40.495833	-106.85655	Lewis SWA to Elk River	PP,MI,N,TE,CB	2007–08	4
134	YAMPA R AT US HWY 40	CDPHE	12802B	40.495	-107.15797	Elk River to Hayden	PP,MI,N,TE	2006–07	4
135	YAMPA R BL KOA CAMPGROUNDS NR STEAMBOAT SPG, CO.	USGS	403017106525800	40.50469828	-106.8833837	Lewis SWA to Elk River	PP,D,N,CB	1975–76	5
136	YAMPA R. @ CR 14 FISHING ACCESS	CDPHE	12806D	40.475	-106.8235	Upstream Lewis SWA	PP,TDS,MI,N,TE,CB	1999	1
137	YAMPA R. ABV. PHIPPSBURG	CDPHE	12814	40.2272222	-106.9413889	Upstream Lewis SWA	PP,D,TDS,MI,N,TE_U,CB	1996–2004	34
138	YAMPA R. BLW STAGECOACH RES.	CDPHE	12808	40.2872222	-106.8288889	Upstream Lewis SWA	PP,D,TDS,MI,N,TE,CB	1996–99	14
139	YAMPA R. D/S STAGECOACH RES. DAM	CDPHE	12808P	40.288	-106.827	Upstream Lewis SWA	PP,TDS,MI,N,TE,CB	[1]2000–07	21
140	YAMPA R. N. OF HAYDEN @ CALIFORNIA PARK RD	CDPHE	12802	40.5022222	-107.2636111	Elk River to Hayden	PP,TDS,MI,N,TE,CB	[1]1996–99	13
141	YAMPA R. NR MOUNT HARRIS BLW HWY 40 BRIDGE	CDPHE	12805	40.488	-107.15833	Elk River to Hayden	PP,TDS,MI,N,TE,CB	1999	1
142	**YAMPA R. U/S LAKE CATAMOUNT @ CR18**[6]	CDPHE	12807	40.34083	-106.80833	Upstream Lewis SWA	PP,TDS,MI,N,TE,CB	1999	1
143	YAMPA RIVER AB OAK CREEK NR STEAMBOAT SPGS, CO.	USGS	402356106500000	40.39886777	-106.833937	Upstream Lewis SWA	PP,D,TDS,MI,N,TE,CB,SS	1975–76, 2005	6
143	YAMPA R. ABV OAK CREEK	CDPHE	12811	40.3988889	-106.8341667	Upstream Lewis SWA	PP,D,TDS,MI,N,TE,CB	1996–2002	30

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Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record (calendar year)	No. of samples
144	YAMPA RIVER AB SEWAGE PLANT BL STEAMBOAT SPG,CO.	USGS	402934106505400	40.49275437	-106.8489385	Lewis SWA to Elk River	PP,D,N,CB,SS	1975–76, 2005	11
145	YAMPA RIVER ABOVE ELK RIVER NEAR MILNER, CO.	USGS	402932106564900	40.49219797	-106.9475516	Lewis SWA to Elk River	PP,D,MI,N,TE,CB	1975–76	10
145	YAMPA RIVER ABV ELK RIVER	USGS	402936106565000	40.49330906	-106.9478294	Lewis SWA to Elk River	PP,D,TDS,MI,N	[1]1999–2005	5
146	**YAMPA RIVER ABOVE ELKHEAD CREEK NEAR HAYDEN, CO**	USGS	09244490	40.5180278	-107.3997838	Downstream Hayden	PP,D	2004–05	13
147	**YAMPA RIVER ABOVE STAGECOACH RESERVOIR, CO**	USGS	09237450	40.26925	-106.88125	Upstream Lewis SWA	PP,D,TDS,MI,N,TE,CB,SS	1988–2005	202
147	YAMPA R. U/S STAGECOACH RES @ CR16	CDPHE	12809	40.26933	-106.88116	Upstream Lewis SWA	PP,TDS,MI,N,TE,CB	[1]1999–2007	22
148	YAMPA RIVER ABOVE TOW CREEK OIL FIELD, CO.	USGS	402902107043600	40.4838639	-107.0772765	Elk River to Hayden	PP,D,N,CB	1975	3
149	YAMPA RIVER AT ELK RIVER JUNCTION NR MILNER, CO.	USGS	402902106580000	40.48386466	-106.9672741	Lewis SWA to Elk River	PP,D,N,CB	1975–76	5
150	YAMPA RIVER AT HAYDEN	USGS	403007107155001	40.50191798	-107.264503	Elk River to Hayden	PP,D,MI,TE	1979	1
150	YAMPA RIVER AT HAYDEN, CO.	USGS	403006107154800	40.5016402	-107.2639475	Elk River to Hayden	PP,D,MI,N,TE,CB	1975–76, 2005	10
151	YAMPA RIVER AT MILNER, CO.	USGS	402840107004200	40.4777533	-107.012275	Elk River to Hayden	PP,D,N,CB	1975, 2005	5
151	YAMPA RIVER AT MILNER	CDPHE	000038	40.4788889	-107.0133333	Elk River to Hayden	PP,TDS,MI,N,TE_U,CB	[7]1975-2007	179
152	YAMPA RIVER AT PHIPPSBURG, CO.	USGS	401418106562200	40.23831495	-106.9400487	Upstream Lewis SWA	PP,D,MI,N,TE,CB,SS	1975–76, 2005	7
153	**YAMPA RIVER AT STEAMBOAT SPRINGS, CO**	USGS	09239500	40.4829861	-106.8324306	Lewis SWA to Elk River	PP,D,TDS,MI,N,TE,CB,SS	1975–2009	358
153	YAMPA R. @ 5TH ST. BRIDGE IN STEAMBOAT	CDPHE	12806	40.48316	-106.83233	Lewis SWA to Elk River	PP,TDS,MI,N,TE_U,CB	[7]1996–2007	38
153	Yampa River 5th St Br	CODOW	CDOWRW-607	40.48	-106.83	Lewis SWA to Elk River	PP,D,TE	1998–2000	17
154	YAMPA RIVER BELOW DIVERSION, NEAR HAYDEN, CO.	USGS	09244410	40.48830779	-107.1597784	Elk River to Hayden	PP,D,TDS,MI,N,TE,CB,SS	[1]1975–2005	158
155	YAMPA RIVER BELOW HAYDEN, CO.	USGS	402930107174200	40.49164014	-107.2956148	Elk River to Hayden	PP,D,TDS,MI,N,TE,CB	1975–76, 2005	8
155	YAMPA R. WEST OF HAYDEN @ HWY 40	CDPHE	12802A	40.49166	-107.29566	Elk River to Hayden	PP,TDS,MI,N,TE,CB	2000–02	18
156	YAMPA RIVER BELOW MORGAN CREEK NEAR HAYDEN, CO.	USGS	403051107124500	40.5141404	-107.213113	Elk River to Hayden	PP,D,N,CB	1975	3
157	YAMPA RIVER BELOW OAK CREEK NR STEAMBOAT SPG,CO.	USGS	402544106493600	40.4288671	-106.8272706	Lewis SWA to Elk River	PP,D,MI,N,TE,CB,SS	1975–76, 2005	10

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157	Yampa River Below Stagecoach	CODOW	CDOWRW-81	40.28	-106.82	Upstream Lewis SWA	PP,D,MI,N,TE	[8]1991–2004	134
158	**YAMPA RIVER BELOW STAGECOACH RESERVOIR, CO**	USGS	09237500	40.28525929	-106.8314354	Upstream Lewis SWA	PP,D,TDS,MI,N,TE,CB,SS	1984–2005	263
159	YAMPA RIVER BELOW STEAMBOAT II SEWAGE PLANT, CO.	USGS	403002106545500	40.5005314	-106.9158844	Lewis SWA to Elk River	PP,D,N,CB	1975–76	5
160	YAMPA RIVER BELOW TROUT CREEK AT MILNER, CO.	USGS	402854107020500	40.481642	-107.0353311	Elk River to Hayden	PP,D,MI,N,TE,CB	1975–76, 2005	9
161	YAMPA RIVER BELOW WALTON CREEK, CO.	USGS	402737106493700	40.4602553	-106.8275488	Lewis SWA to Elk River	PP,N,CB	1975–76	6
162	YAMPA RIVER BELOW YAMPA, CO.	USGS	401048106544800	40.17998305	-106.9139363	Upstream Lewis SWA	PP,D,MI,TE	1975, 2005	3
162	Yampa River Willow Cabin Br	CODOW	CDOWRW-7	40.18	-106.91	Upstream Lewis SWA	PP,D	1990–99	131
162	YAMPA R. BLW YAMPA @ CR21	CDPHE	12815	40.183	-106.91533	Upstream Lewis SWA	PP,D,TDS,MI,N,TE,CB	1999–2002	14
163	YAMPA RIVER BL SEWAGE PLANT BL STEAMBOAT SPG,CO.	USGS	402958106515200	40.49942075	-106.86505	Lewis SWA to Elk River	PP,D,N,CB	1975	3
163	YAMPA R 0.2 MI BL STP BL STEAMBOAT SPRINGS, CO.	USGS	402958106515201	40.49942075	-106.86505	Lewis SWA to Elk River	PP,D,N,CB	1976	2
164	Yampa River East Br	CODOW	CDOWRW-13	40.48	-107.15	Elk River to Hayden	PP,D,MI,TE	1990–98	49
165	Yampa River Hunt Creek	CODOW	CDOWRW-3260	40.22	-106.94	Upstream Lewis SWA	PP,TE	1993	1
166	Yampa River Library	CODOW	CDOWRW-12	40.48	-106.84	Lewis SWA to Elk River	PP,TE	[1]1991–96	23
167	Yampa River N of Stagecoach	CODOW	CDOWRW-3476	40.29	-106.8	Upstream Lewis SWA	PP	1993	1
168	YAMPA RIVER NEAR HAYDEN, CO.	USGS	09244400	40.4891411	-107.1597784	Elk River to Hayden	PP,D,TDS,MI,N,TE	[1]1975–2005	6
169	YAMPA RIVER NR SIDNEY, COLO.	USGS	402230106493000	40.3749795	-106.8256032	Upstream Lewis SWA	PP	2005	1
169	YAMPA R. D/S LAKE CATAMOUNT @ HWY 131	CDPHE	12806F	40.37533	-106.825	Upstream Lewis SWA	PP,TDS,MI,N,TE,CB	1999	1
170	Yampa River Stagecoach Res	CODOW	CDOWRW-8	40.26	-106.88	Upstream Lewis SWA	PP,D,MI,N,TE	[8]1990–2004	150
171	Yampa River SWA Br	CODOW	CDOWRW-10	40.39	-106.83	Upstream Lewis SWA	PP,D,TE	1991–98	147
172	Yampa River Treehouse	CODOW	CDOWRW-11	40.48	-106.83	Lewis SWA to Elk River	PP,D,TE	[1]1991–96	15
173	Yampa River West Br	CODOW	CDOWRW-14	40.49	-107.29	Downstream Hayden	PP,TE	[1]1990–2001	45

Appendix 3. Selected stream sites in the Upper Yampa River watershed, Colorado, and type of water-quality data collected, period of water-quality record, and number of samples collected from 1975 through 2009.

[No., number; USFS, U.S. Forest Service; PP, physical properties; D, discharge; CB, coliform bacteria; SS, suspended sediment; CDPHE, Colorado Department of Public Health and Environment; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; CODOW, Colorado Division of Wildlife Riverwatch Program; USGS, U.S. Geological Survey; CSS, City of Steamboat Springs; TE, trace elements; TE_U, trace elements and uranium; USEPA, U.S. Environmental Protection Agency. Subbasin definitions: Upstream Lewis SWA= Yampa River upstream from Chuck Lewis State Wildlife Area, Lewis SWA to Elk River=Yampa River downstream from Chuck Lewis State Wildlife Area to Elk River confluence, Elk River to Hayden=Yampa River downstream from Elk River to Hayden, Downstream Hayden=Yampa River downstream from Hayden to confluence with Elkhead Creek. Sites with the same site number are considered to be at the same location. Sites with name in **bold** are streamflow gaging stations; see table 1 for additional information on these sites]

Site no. (fig. 3)	Site name in Upper Yampa River watershed water-quality database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record (calendar year)	No. of samples
174	YMP-1 [Yampa River 200m above confl Walton Creek]	CSS	YMP-1	40.449233	-106.82025	Lewis SWA to Elk River	PP,MI,N,TE,CB	2007–08	4
175	YMP-2 [Yampa River 35 m above confl Fish Creek]	CSS	YMP-2	40.466017	-106.83003	Lewis SWA to Elk River	PP,MI,N,TE,CB	2007–08	4
176	YMP-3A [Yampa River 70m above pedestrian bridge and hot spring outflow in Weiss Park]	CSS	YMP-3A	40.480517	-106.82763	Lewis SWA to Elk River	PP,MI,N,TE,CB	2007–08	4

[1]Samples were not collected every year in the period of record.

[2]Samples were not collected in 1978.

[3]Samples were not collected in 1984.

[4]Samples were not collected in 1997.

[5]Site also is Colorado Division of Water Resources streamflow gage WLTNCKCO. See table 1 for additional information.

[6]Site also is Colorado Division of Water Resources streamflow gage YAMABVCO. See table xx for additional information.

[7]Samples were not collected in 2005.

[8]Samples were not collected in 2001.

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Appendix 4. Selected lake and reservoir sites in the Upper Yampa River watershed, Colorado, and type of water-quality data collected, period of water-quality record, and number of sample days, 1983 through 2009.

[No., number; USGS, U.S. Geological Survey; PP, physical properties; N, nutrients; CHL, chlorophyll; MI, major ions; N, nutrients; TE, trace elements; OC, organic carbon; SI, stable isotopes; CDPHE, Colorado Department of Public Health and Environment; CB, coliform bacteria. Subbasin definitions: Upstream Lewis SWA=Yampa River upstream from Chuck Lewis State Wildlife Area, Lewis SWA to Elk River=Yampa River downstream from Chuck Lewis State Wildlife Area to Elk River confluence]

Site name in Upper Yampa River watershed database	Source of data	Site identifier	Latitude	Longitude	Subbasin	Type of water-quality data	Period of water-quality record	No. of sample days
ELKHEAD RESERVOIR SITE 1A	USGS	403507107214900	40.5852496	-107.3642276	Elkhead Creek	PP	7/12/1995–8/2/2001	[1]18
ELKHEAD RESERVOIR SITE 1B	USGS	403506107214500	40.58497186	-107.3631165	Elkhead Creek	PP,N,CHL	7/12/1995–8/2/2001	[1]18
ELKHEAD RESERVOIR SITE 2A	USGS	403439107223800	40.5774718	-107.377839	Elkhead Creek	PP	7/12/1995–8/2/2001	[1]18
ELKHEAD RESERVOIR SITE 2B	USGS	403437107223300	40.57691628	-107.37645	Elkhead Creek	PP,N,CHL	7/12/1995–8/2/2001	[1]18
ELKHEAD RESERVOIR SITE 2C	USGS	403435107222900	40.5763607	-107.375339	Elkhead Creek	PP	7/12/1995–8/2/2001	[1]18
ELKHEAD RESERVOIR SITE 3A	USGS	403336107230700	40.5599719	-107.3858947	Elkhead Creek	PP	7/12/1995–8/2/2001	[1]18
ELKHEAD RESERVOIR SITE 3B	USGS	403333107230100	40.5591386	-107.384228	Elkhead Creek	PP,N,CHL	7/12/1995–8/2/2001	[1]18
ELKHEAD RESERVOIR SITE 3C	USGS	403331107225500	40.55858308	-107.3825613	Elkhead Creek	PP	7/12/1995–8/2/2001	[1]18
LAKE ELBERT	USGS	403803106422500	40.6341423	-106.7075437	Lewis SWA to Elk River	PP,MI,N,TE,OC,CHL,SI	8/24/1993–9/9/2009	75
LONG LAKE RESERVOIR	USGS	402833106412400	40.47581204	-106.6905999	Lewis SWA to Elk River	PP,MI,N,TE,OC,CHL,SI	7/16/1985–8/11/2005	64
STAGECOACH RES, NR PHIPPSBURGH, 250M W OF DAM	CDPHE	STAGE01	40.2847222	-106.8347222	Upstream Lewis SWA	PP,MI,N,TE,CHL	10/10/1990	[1]1
STAGECOACH RESERVOIR,NR PHIPPSBURGH,INLET SIDE	CDPHE	STAGE02	40.2763889	-106.8597222	Upstream Lewis SWA	PP,MI,N,TE,CHL	10/10/1990	1
STAGECOACH RESERVOIR AT DAM, COLORADO	USGS	401707106495800	40.28525927	-106.8333799	Upstream Lewis SWA	PP,TDS,MI,N,TE,OC,CB	4/26/1990–11/7/1992	[1]20
STAGECOACH RESERVOIR NEAR INLET,NR OAK CREEK, CO.	USGS	401628106515500	40.2744259	-106.8658806	Upstream Lewis SWA	PP,TDS,MI,N,TE,OC,CB	4/26/1990–11/7/1992	20
STAGECOACH RESERVOIR NR DAM [UPPER and LOWER]	CDPHE	12812A, 12812B	40.28509	-106.83545	Upstream Lewis SWA	PP,MI,N,TE,CHL	7/25/2006	1
STEAMBOAT LAKE NR DAM [UPPER and LOWER]	CDPHE	12866A, 12866B	40.79327	-106.9485	Elk River	PP,MI,N,TE,CHL	7/25/2006	1

[1]Ssamples were collected on the day day for each site within a reservoir.

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Appendix 5. Groundwater sites and aquifer description, type of water-quality data collected, period of water-quality record, number of samples, and water-quality standard exceeded, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. ~~14~~ 15)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
180	400637106563601	USGS	40.11026208	-106.9439366	Alluvium, flood plain	PP	1978	1	2	--
181	400716106555901	USGS	40.12109525	-106.9336586	Mancos Shale	PP, TDS, MI, N, TE	1978	1	1	--
182	400809106574301	USGS	40.13581696	-106.9625485	Curtis Formation of San Rafael Group	PP, TDS, MI, N, TE	1978	1	1	--
183	400819106541001	USGS	40.13859509	-106.90338	Alluvium, flood plain	PP	1978	1	2	--
184	400845106572001	USGS	40.14581679	-106.9561595	Unknown	PP, TDS, MI, TE	1981	1	1	--
185	400921106534601	USGS	40.155817	-106.8967134	Mancos Shale	PP, TDS, MI, N, TE	1978	1	2	fe, mn
186	400930106542101	USGS	40.15831689	-106.9064359	Alluvium, flood plain	PP, TDS, MI, N, TE	1978	1	2	--
187	401007106442101	USGS	40.1685956	-106.7397647	Browns Park Formation	PP	1978	1	2	--
188	401053107005201	USGS	40.1813711	-107.0150502	Mancos Shale	PP, TDS, MI, N, TE	1978	1	2	--
189	401210106555401	USGS	40.2027602	-106.9322704	Browns Park Formation	PP	1978	1	2	--
190	401210106555601	USGS	40.2027602	-106.932826	Browns Park Formation	PP	1978	1	2	--
191	401330106562001	USGS	40.2249819	-106.939493	Browns Park Formation	PP, TDS, MI, N, TE	1978	1	2	--
192	401340107030201	USGS	40.2277587	-107.0511623	Alluvium, flood plain	PP, TDS, MI, N, TE	1975	1	1	--
193	401349106565501	USGS	40.23025948	-106.9492155	Browns Park Formation	PP	1978	1	2	--
194	401352106564201	USGS	40.23109284	-106.9439376	Browns Park Formation	PP	1978	1	2	--
195	401355106563501	USGS	40.23192616	-106.9436598	Browns Park Formation	PP	1978	1	1	--
196	401355106563601	USGS	40.23192616	-106.9439376	Alluvium, flood plain	PP	1978	1	2	--
197	401418106560301	USGS	40.23831499	-106.9347708	Mancos Shale	PP, TDS, MI, N, TE	1978	1	1	no23
198	401425107052301	USGS	40.2402582	-107.0903298	Alluvium, flood plain	PP	1978	1	2	pH
199	401551106541201	USGS	40.264148	-106.9039369	Unknown	PP	1975	1	1	--
200	401552107035301	USGS	40.2644245	-107.0653295	Alluvium, flood plain	PP	1975	1	1	--
201	401611106575001	USGS	40.2697029	-106.964494	Unknown	PP, TDS, MI, N, TE	1975, 1978	2	2	--
202	401729106575701	USGS	40.29136907	-106.9664388	Unknown	PP, TDS, MI, N, TE	1975	2	2	sul, fe, mn
203	401735107104201	USGS	40.29303424	-107.1789432	Unknown	PP	1975	1	1	--
204	401754107020501	USGS	40.2983128	-107.0353292	Alluvium, flood plain	PP	1975	1	1	--
205	401801107015101	USGS	40.30025726	-107.0314403	Mesaverde Group	PP, TDS, MI, N, TE	1978	1	2	--

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Appendix 5. Groundwater sites and aquifer description, type of water-quality data collected, period of water-quality record, number of samples, and water-quality standard exceeded, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
206	401804107062101	USGS	40.30109009	-107.1064418	Mesaverde Group	PP, TDS, MI, N, TE	1977, 1980	2	3	sul, mn (2)
207	401826107070401	USGS	40.30720099	-107.1183866	Mesaverde Group	PP, TDS, MI, N, TE	1977, 1980	2	3	fe, mn
208	401837107054501	USGS	40.3102566	-107.0964417	Mesaverde Group	PP, TDS, MI, N, TE	1977, 1980	3	4	mn (2)
209	401842107032201	USGS	40.3116457	-107.0567187	Unknown	PP	1975	1	1	--
210	401847107003101	USGS	40.31303489	-107.0092177	Mesaverde Group	PP, TDS, MI, N, TE	1977	1	2	mn
211	401847107003301	USGS	40.31303488	-107.0108844	Unknown	PP, TDS, MI, N, TE	1975	1	1	pH
212	401857106573101	USGS	40.315813	-106.9592166	Alluvium, flood plain	PP	1975	1	1	--
213	401904107060800	USGS	40.3177564	-107.1028308	Unknown	PP, TDS, MI, N, TE	1975–76	2	2	sul (2), fe (2), mn
214	401904107060801	USGS	40.3177564	-107.1028308	Mesaverde Group	PP, TDS, MI, N, TE	1977, 1980	2	3	sul (2), cd, mn
215	401912107031300	USGS	40.31997889	-107.0542187	Unknown	PP, TDS, MI, N, TE	1975	1	1	--
216	401912107031301	USGS	40.31997889	-107.0542187	Mesaverde Group	PP, TDS, MI, N, TE	1977	1	2	--
217	401922107050701	USGS	40.3227564	-107.085886	Mesaverde Group	PP, TDS, MI, N, TE	1977	1	2	pH, mn
218	401931106492301	USGS	40.3252584	-106.823658	Browns Park Formation	PP	1978	1	2	--
219	401935106595401	USGS	40.32636799	-106.9989399	Mesaverde Group	PP, TDS, MI, N, TE	1980	1	1	--
220	401939107091201	USGS	40.32747808	-107.1539431	Alluvium, flood plain	PP	1975	1	1	--
221	401941107002001	USGS	40.32803457	-107.0061623	Unknown	PP, TDS, MI, N, TE	1980	1	1	mn
222	401950107103300	USGS	40.3305334	-107.1764436	Mancos Shale	PP, TDS, MI, N, TE	1975	1	1	sul
223	401959106510101	USGS	40.3330358	-106.850881	Browns Park Formation	PP, TDS, MI, N, TE	1978	1	2	--
224	402007106513001	USGS	40.3352579	-106.8592145	Browns Park Formation	PP	1978	1	1	--
225	402015107014501	USGS	40.33747865	-107.029774	Mesaverde Group	PP, TDS, MI, N, TE	1977	1	2	mn
226	402015107015500	USGS	40.3374786	-107.0325518	Valley-fill deposits	PP, TDS, MI, N, TE	1975	1	1	fe, mn
227	402023106515201	USGS	40.33970219	-106.865048	Browns Park Formation	PP	1978	1	1	--
228	402041107013301	USGS	40.3447007	-107.0264406	Unknown	PP, TDS, MI, N, TE	1975	2	2	mn
229	402049106485501	USGS	40.34692467	-106.8158803	Alluvium, flood plain	PP	1978	1	2	--
230	402050106475500	USGS	40.34720259	-106.7992133	Unknown	PP, TDS, MI, N, TE	1975	1	1	--
231	402056106590901	USGS	40.34886758	-106.9864398	Mesaverde Group	PP, TDS, MI, N, TE	1975, 1978	3	3	--

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Appendix 5. Groundwater sites and aquifer description, type of water-quality data collected, period of water-quality record, number of samples, and water-quality standard exceeded, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
232	402106107011801	USGS	40.351645	-107.022274	Lewis Shale	PP	1975	1	1	--
233	402112107050801	USGS	40.35331126	-107.0861642	Unknown	PP, TDS, MI, N, TE	1975	2	2	--
234	402113106590501	USGS	40.3535897	-106.9853287	Mesaverde Group	PP, TDS, MI, N, TE	1980	1	1	--
235	402114107034300	USGS	40.35386696	-107.0625526	Mesaverde Group	PP, TDS, MI, N, TE	1975	1	2	--
236	402114107034301	USGS	40.35386696	-107.0625526	Mesaverde Group	PP, TDS, MI, N, TE	1975, 1977	2	4	cd
237	402118107033101	USGS	40.35497806	-107.0592192	Mesaverde Group	PP, TDS, MI, N, TE	1975	2	2	--
238	402120106535201	USGS	40.35553487	-106.8983823	Alluvium, flood plain	PP, TDS, MI, N, TE	1975	2	2	ar
239	402121106515301	USGS	40.3558129	-106.865326	Browns Park Formation	PP	1978	1	2	--
240	402124107031801	USGS	40.3566447	-107.055608	Mesaverde Group	PP, TDS, MI, N, TE	1975	2	2	sul
241	402128106583901	USGS	40.35775634	-106.9781064	Unknown	PP	1975	1	1	--
242	402132106515001	USGS	40.3588684	-106.8644927	Browns Park Formation	PP	1978	1	2	--
243	402146106543401	USGS	40.3627568	-106.9100493	Alluvium, flood plain	PP	1978	1	2	--
244	402149107013801	USGS	40.36358918	-107.0278298	Lewis Shale	PP	1975	1	1	--
245	402156107015201	USGS	40.36553355	-107.0317187	Lewis Shale	PP, TDS, MI, N, TE	1975	2	2	fe, mn
246	402157106543101	USGS	40.3658123	-106.909216	Alluvium, flood plain	PP	1975	1	1	--
247	402157106583801	USGS	40.3658117	-106.9778287	Unknown	PP	1975	1	1	--
248	402158106570701	USGS	40.3660897	-106.9525503	Mancos Shale	PP	1978	1	1	--
249	402202107022101	USGS	40.3672001	-107.0397745	Alluvium, flood plain	PP, TDS, MI, N, TE	1975	2	2	mn
250	402202107160801	USGS	40.3671986	-107.2695016	Alluvium, flood plain	PP	1975	1	1	--
251	402204107012201	USGS	40.36775577	-107.0233853	Alluvium, flood plain	PP, TDS, MI, N, TE	1976, 1980	3	5	no23, fe, mn (2)
252	402204107022801	USGS	40.36775566	-107.041719	Mesaverde Group	PP, TDS, MI, N, TE	1975	1	1	--
253	402205107013201	USGS	40.3680335	-107.026163	Lewis Shale	PP, TDS, MI, N, TE	1975	2	2	mn
254	402209107023101	USGS	40.3691445	-107.0425523	Mesaverde Group	PP, TDS, MI, N, TE	1976–77, 1980	3	4	cd
255	402212107011801	USGS	40.36997795	-107.0222741	Valley-fill deposits	PP, TDS, MI, N, TE	1975	1	1	--
256	402217107113601	USGS	40.37136574	-107.1939445	Mesaverde Group	PP	1978	1	1	--
257	402222107113001	USGS	40.3727546	-107.1922778	Unknown	PP, TDS, MI, N, TE	1975	2	2	sul, fe, mn

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Appendix 5. Groundwater sites and aquifer description, type of water-quality data collected, period of water-quality record, number of samples, and water-quality standard exceeded, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
258	402231107111601	USGS	40.3824766	-107.1883889	Mesaverde Group	PP, TDS, MI, N, TE	1980–81	4	7	sul (4), fe (2), mn (3)
259	402231107111602	USGS	40.38219887	-107.1878333	Mesaverde Group	PP, TDS, MI, N, TE	1980–83	9	9	sul (2)
260	402231107111612	USGS	40.3824767	-107.179222	Mesaverde Group	PP, TDS, MI, N, TE	1980–83	9	14	pH (2), mn (6)
261	402231107111616	USGS	40.39247648	-107.1789444	Unknown	PP, TDS, MI, N, TE	1980–82	7	10	mn (6)
262	402231107111617	USGS	40.39219878	-107.1664441	Unknown	PP, TDS, MI, N, TE	1980–82	5	8	fe (2), mn (5)
263	402231107111630	USGS	40.38219886	-107.1889445	Unknown	PP, TDS, MI, N, TE	1981	1	2	sul, mn
264	402231107111631	USGS	40.38219886	-107.1889445	Unknown	PP, TDS, MI, N, TE	1981	1	2	sul, mn
265	402231107111632	USGS	40.38219886	-107.1889445	Unknown	PP, TDS, MI, N, TE	1981	1	2	sul, mn
266	402231107111633	USGS	40.38219886	-107.1889445	Unknown	PP, TDS, MI, N, TE	1981	1	1	sul, mn
267	402231107111634	USGS	40.37525458	-107.1883888	Unknown	PP, TDS, MI, N, TE	1980–83	9	15	sul (4), fe (2), mn (8)
268	402231107111636	USGS	40.37525458	-107.1883888	Unknown	PP, TDS, MI, N, TE	1980–82	6	11	pH (4), chl (6), fe, mn
269	402231107111637	USGS	40.37525458	-107.1883888	Unknown	PP, TDS, MI, N, TE	1982–83	7	11	pH (3), sul (5), chl (2)
270	402231107111646	USGS	40.38775425	-107.1958891	Unknown	PP, TDS, MI, N, TE	1980–83	12	17	sul (4), mn (2)
271	402231107111653	USGS	40.37581009	-107.1936667	Unknown	PP, TDS, MI, N, TE	1981–82	6	8	sul (6), fe, mn (6)
272	402231107111657	USGS	40.3694213	-107.1950556	Unknown	PP, TDS, MI, N, TE	1980–82	6	9	fe (2), mn (4)
273	402236107025301	USGS	40.3766443	-107.0486637	Mesaverde Group	PP, TDS, MI, N, TE	1976–77, 1980	4	7	sul, chl (2)
274	402237106530701	USGS	40.37692337	-106.8858823	Browns Park Formation	PP	1978	1	1	--
275	402239107040301	USGS	40.3774775	-107.0681085	Mesaverde Group	PP, TDS, MI, N, TE	1976–77	2	4	--
276	402244107165001	USGS	40.3788649	-107.2811687	Unknown	PP, TDS, MI, N, TE	1980–81	4	4	fe, mn (3)
277	402250107151801	USGS	40.3805318	-107.2556125	Mesaverde Group	PP, TDS, MI, N, TE	1975	1	1	fe
278	402250107151802	USGS	40.3805318	-107.2556125	Unknown	PP	1975	1	1	--
279	402257107015301	USGS	40.3824776	-107.0319967	Mesaverde Group	PP, TDS, MI, N, TE	1976–77, 1980	3	5	pH (2)
280	402259106501501	USGS	40.38303476	-106.8381035	Browns Park Formation	PP	1978	1	1	--
281	402303107215701	USGS	40.3841417	-107.3664484	Unknown	PP, TDS, MI, N, TE	1980	1	1	sul, fe
282	402316107182301	USGS	40.38775335	-107.3070027	Unknown	PP, TDS, MI, N, TE	1980	1	1	--
283	402324106485701	USGS	40.3899792	-106.8164365	Alluvium, flood plain	PP	1978	1	1	--

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Appendix 5. Groundwater sites and aquifer description, type of water-quality data collected, period of water-quality record, number of samples, and water-quality standard exceeded, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
284	402324106545501	USGS	40.38997837	-106.9158831	Browns Park Formation	PP	1978	1	1	--
285	402327106590000	USGS	40.39081109	-106.9839402	Unknown	PP, TDS, MI, N, TE	1975	1	1	fe
286	402327106590001	USGS	40.39081109	-106.9839402	Mesaverde Group	PP, TDS, MI, N, TE	1977	1	1	chl, pb
287	402327107161301	USGS	40.3908092	-107.2708908	Unknown	PP, TDS, MI, N, TE	1980–81	4	4	sul (4), fe (4), mn (4)
288	402329106541001	USGS	40.3913673	-106.9033829	Browns Park Formation	PP	1978	1	2	--
289	402334106574601	USGS	40.39275567	-106.9633842	Mesaverde Group	PP	1978	1	2	--
290	402336106574400	USGS	40.3933112	-106.9628286	Unknown	PP, TDS, MI, N, TE	1975	1	1	--
291	402338106503600	USGS	40.3938678	-106.8439371	Unknown	PP, TDS, MI, N, TE	1975	1	1	chl
292	402344107195001	USGS	40.3955307	-107.33117	Unknown	PP	1975	1	1	--
293	402346106590000	USGS	40.39608875	-106.9839402	Unknown	PP, TDS, MI, N, TE	1975	1	1	sul, mn
294	402346106590001	USGS	40.39608875	-106.9839402	Mesaverde Group	PP, TDS, MI, N, TE	1977	1	2	pH, sul
295	402349106535201	USGS	40.3969228	-106.8983828	Browns Park Formation	PP	1978	1	1	--
296	402351106482201	USGS	40.39747915	-106.8067142	Alluvium, flood plain	PP	1978	1	1	--
297	402356107171701	USGS	40.3988644	-107.288669	Unknown	PP, TDS, MI, N, TE	1976–77	2	4	sul (2), fe
298	402357106535801	USGS	40.39914496	-106.9000496	Browns Park Formation	PP	1978	1	2	--
299	402358106535900	USGS	40.3994227	-106.9003273	Unknown	PP, TDS, MI, N, TE	1975	1	1	--
300	402359107054401	USGS	40.39969905	-107.0961649	Unknown	PP, TDS, MI, N, TE	1987–89	9	9	sul (9), fe (3), mn (9)
301	402359107054402	USGS	40.39969905	-107.0961649	Unknown	PP, TDS, MI, N, TE	1987–89	9	9	sul (7), mn (2)
302	402359107054403	USGS	40.39969905	-107.0961649	Unknown	PP, TDS, MI, N, TE	1987–89	9	9	sul (8), mn (2)
303	402359107054404	USGS	40.39969905	-107.0961649	Unknown	PP, TDS, MI, N, TE	1987–89	10	11	sul
304	402401107054701	USGS	40.40025458	-107.0969983	Unknown	PP, TDS, MI, N, TE	1988–89	9	11	sul (9), no23, cd, mn (9)
305	402401107054702	USGS	40.40025458	-107.0969983	Unknown	PP, TDS, MI, N, TE	1988	4	4	sul (4), cd, mn (4)
306	402401107054703	USGS	40.40025458	-107.0969983	Unknown	PP, TDS, MI, N, TE	1987–88	5	5	sul (5), mn (5)
307	402414106585701	USGS	40.40386635	-106.983107	Mesaverde Group	PP, TDS, MI, N, TE	1975	1	1	fe
308	402415107184401	USGS	40.4041418	-107.3128363	Lewis Shale	PP	1978	1	2	--
309	402423106552500	USGS	40.4063668	-106.9242168	Unknown	PP, TDS, MI, N, TE	1975	1	1	--

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[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
310	402436106510101	USGS	40.40997848	-106.850882	Browns Park Formation	PP	1978	1	1	--
311	402437107051701	USGS	40.4102544	-107.0886649	Unknown	PP, TDS, MI, N, TE	1987–89	12	12	cd, fe, mn (8)
312	402437107051702	USGS	40.4102544	-107.0886649	Unknown	PP, TDS, MI, N, TE	1987–89	13	15	sul (3), no23, cd, mn (13)
313	402437107051703	USGS	40.4102544	-107.0886649	Unknown	PP, TDS, MI, N, TE	1987–89	14	15	mn (10)
314	402437107051704	USGS	40.4102544	-107.0886649	Unknown	PP, TDS, MI, N, TE	1987–89	12	12	sul, mn (8)
315	402438106572001	USGS	40.4105331	-106.956162	Browns Park Formation	PP	1975	1	1	--
316	402440106591001	USGS	40.41108838	-106.9867182	Unknown	PP, TDS, MI, N, TE	1980	1	1	--
317	402454107071601	USGS	40.4149763	-107.1217212	Unknown	PP, TDS, MI, N, TE	1987–89	10	12	sul (10), fe (2), mn (10)
318	402454107071602	USGS	40.4149763	-107.1217212	Unknown	PP, TDS, MI, N, TE	1987–89	9	9	sul (9), cd
319	402454107071603	USGS	40.4149763	-107.1217212	Unknown	PP, TDS, MI, N, TE	1987–89	9	9	sul (9), fe (2), mn (9)
320	402454107071604	USGS	40.4149763	-107.1217212	Unknown	PP, TDS, MI, N, TE	1987–89	10	12	sul (10), cd, mn (2)
321	402454107071605	USGS	40.4149763	-107.1217212	Unknown	PP, TDS, MI, N, TE	1987–89	9	9	pH, sul (5)
322	402454107071606	USGS	40.4149763	-107.1217212	Unknown	PP, TDS, MI, N, TE	1987–89	9	9	pH (4)
323	402455107073001	USGS	40.41525407	-107.1256102	Unknown	PP, TDS, MI, N, TE	1987–89	9	9	cd
324	402455107073002	USGS	40.41525407	-107.1256102	Unknown	PP, TDS, MI, N, TE	1987–89	10	12	--
325	402455107073003	USGS	40.41525407	-107.1256102	Unknown	PP, TDS, MI, N, TE	1987–89	6	6	sul (2), fe, mn (2)
326	402455107073004	USGS	40.41525407	-107.1256102	Unknown	PP, TDS, MI, N, TE	1987–89	9	9	fl (2)
327	402456107071101	USGS	40.41553188	-107.1203323	Unknown	PP, TDS, MI, N, TE	1987–88	4	4	sul (4), no23, cd, mn (4)
328	402456107071102	USGS	40.41553188	-107.1203323	Unknown	PP, TDS, MI, N, TE	1987–88	5	5	ul (5), no23 (3), cd, mn (5)
329	402456107071103	USGS	40.41553188	-107.1203323	Unknown	PP, TDS, MI, N, TE	1987–89	10	12	), no23 (5), be (2), cd, mn (10)
330	402459107154901	USGS	40.41636427	-107.2642243	Unknown	PP, TDS, MI, N, TE	1975	2	2	sul, mn
331	402514106561501	USGS	40.420533	-106.9381062	Browns Park Formation	PP, TDS, MI, N, TE	1978	1	1	no23
332	402515107005401	USGS	40.42081017	-107.0156078	Mesaverde Group	PP, MI, N, TE	1980	1	1	--
333	402517106590701	USGS	40.4213659	-106.985885	Alluvium, flood plain	PP	1978	1	1	mn
334	402526107231601	USGS	40.4238629	-107.3883938	Unknown	PP, TDS, MI, N, TE	1975	2	2	sul, fe
335	402535106582301	USGS	40.4263659	-106.9736626	Alluvium, flood plain	PP	1978	1	2	--

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Appendix 5. Groundwater sites and aquifer description, type of water-quality data collected, period of water-quality record, number of samples, and water-quality standard exceeded, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
336	402535106582501	USGS	40.4263659	-106.9742181	Alluvium, flood plain	PP	1978	1	2	--
337	402535107234401	USGS	40.4263628	-107.3961718	Unknown	PP	1975	1	1	--
338	402545106481901	USGS	40.4291451	-106.8058812	Browns Park Formation	PP	1978	1	2	pH
339	402545107073901	USGS	40.4291426	-107.1281104	Mesaverde Group	PP, TDS, MI, N, TE	1977	1	1	pH, sul
340	402551106505201	USGS	40.43081135	-106.8483822	Browns Park Formation	PP	1977	1	1	--
341	402600107160001	USGS	40.4333083	-107.2672801	Unknown	PP, TDS, MI, N, TE	1976–77	3	4	fe
342	402609107124801	USGS	40.4358086	-107.2139456	Mesaverde Group	PP, TDS, MI, N, TE	1978	1	2	no23
343	402620107072928	USGS	40.437198	-107.127277	Mesaverde Group	PP, TDS, MI, N, TE	1980–81, 1983	6	6	sul (6), fe, mn (5)
344	402620107072929	USGS	40.43664247	-107.1275549	Mesaverde Group	PP, TDS, MI, N, TE	[3]1980–86	12	12	sul (12), mn (11)
345	402620107072930	USGS	40.4369202	-107.1278327	Mesaverde Group	PP, TDS, MI, N, TE	[3]1980–86	13	13	pH, sul (13), mn (12)
346	402620107072932	USGS	40.4377535	-107.1306105	Mesaverde Group	PP, TDS, MI, TE	1984	1	1	sul
347	402620107072933	USGS	40.43747577	-107.1303327	Mesaverde Group	PP, TDS, MI, N, TE	[3]1979–86	14	15	pH (2), sul (14), mn (5)
348	402620107072935	USGS	40.417754	-107.1275547	Mesaverde Group	PP, TDS, MI, N, TE	1979–80	2	2	pH (2)
349	402620107072939	USGS	40.45608648	-107.127555	Unknown	PP, TDS, MI, N, TE	1980	1	1	mn
350	402620107072950	USGS	40.42997595	-107.1286659	Mesaverde Group	PP, TDS, MI, N, TE	1979–82	6	8	sul
351	402620107072951	USGS	40.42997597	-107.1253325	Mesaverde Group	PP, TDS, MI, N, TE	1979–82	5	7	pH, sul (4), fe (2), mn (5)
352	402620107072952	USGS	40.41969846	-107.1189434	Mesaverde Group	PP, TDS, MI, N, TE	1979–83	10	10	pH
353	402620107072953	USGS	40.4083098	-107.1189433	Unknown	PP, TDS, MI, N, TE	1979–82	6	8	--
354	402620107072955	USGS	40.40803205	-107.119221	Unknown	PP, TDS, MI, TE	1979	1	2	pH
355	402620107072956	USGS	40.44080898	-107.1375551	Unknown	PP, TDS, MI, N, TE	1980–83	8	8	sul (6), fe (4), mn (8)
356	402627107115900	USGS	40.4408086	-107.2003343	Unknown	PP, TDS, MI, N, TE	1975	1	1	mn
357	402631106485700	USGS	40.44192249	-106.8164372	Valley-fill deposits	PP, TDS, MI, N, TE	1975	1	1	--
358	402633107080101	USGS	40.4424756	-107.1342218	Valley-fill deposits	PP, TDS, MI, N, TE	1975	2	2	sul
359	402639106493600	USGS	40.44414456	-106.8272708	Valley-fill deposits	PP, TDS, MI, N, TE	1975	1	1	--
360	402641107090201	USGS	40.4446977	-107.1511666	Unknown	PP	1975	1	1	--
361	402643107153301	USGS	40.44525257	-107.25978	Lewis Shale	PP, TDS, MI, N, TE	1975	2	2	--

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[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
362	402646106585501	USGS	40.4460876	-106.9825518	Alluvium, flood plain	PP	1975	1	1	--
363	402647106585000	USGS	40.4463654	-106.9811629	Unknown	PP, TDS, MI, N, TE	1975	1	1	fe, mn
364	402709106591201	USGS	40.4524763	-106.9872742	Unknown	PP, TDS, MI, N, TE	1975	2	2	--
365	402709107252501	USGS	40.45247315	-107.4242282	Unknown	PP, TDS, MI, N, TE	1975	1	1	--
366	402710106591401	USGS	40.45275408	-106.9878298	Mesaverde Group	PP	1978	1	2	--
367	402804107095201	USGS	40.46775266	-107.165056	Lewis Shale	PP	1975	1	1	--
368	402809106595501	USGS	40.4691425	-106.999219	Mesaverde Group	PP	1978	1	2	--
369	402810106551001	USGS	40.46942096	-106.9200508	Mancos Shale	PP, TDS, MI, N, TE	1978	1	2	fe
370	402815107003001	USGS	40.47080907	-107.0089415	Unknown	PP	1975	1	1	--
371	402842107120001	USGS	40.47830777	-107.2006125	Lewis Shale	PP, TDS, MI, N, TE	1978–79	3	3	--
372	402843107150601	USGS	40.4785852	-107.2522803	Lewis Shale	PP	1979	1	1	--
373	402843107151201	USGS	40.4785852	-107.253947	Lewis Shale	PP	1975	1	1	--
374	402845107115901	USGS	40.47914109	-107.2003347	Lewis Shale	PP	1975	1	1	--
375	402852107125801	USGS	40.4810854	-107.216724	Lewis Shale	PP, TDS, MI, N, TE	1975	1	1	no23
376	402857107122601	USGS	40.4824743	-107.2078349	Unknown	PP	1975	1	1	--
377	402857107174201	USGS	40.48247367	-107.2956146	Alluvium, flood plain	PP	1975	1	1	--
378	402858107102501	USGS	40.48275227	-107.174223	Alluvium, terrace	PP, TDS, MI, N, TE	1979	5	8	mn (2)
379	402902106470401	USGS	40.48386624	-106.7850482	Alluvium, terrace	PP	1978	1	2	--
380	402902107101801	USGS	40.48386337	-107.1722786	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	6	11	sul (2), fe, mn (3)
381	402904106595701	USGS	40.4844199	-106.9997748	Alluvium, flood plain	PP	1978	1	1	pH
382	402906107040801	USGS	40.48497506	-107.0694986	Alluvium, flood plain	PP	1975	1	1	--
383	402906107185401	USGS	40.48497345	-107.315615	Alluvium, flood plain	PP	1975	1	1	--
384	402907106550300	USGS	40.48525394	-106.9181065	Unknown	PP	1975	1	1	--
385	402908107011901	USGS	40.48553087	-107.022553	Alluvium, flood plain	PP	1975	1	1	--
386	402908107103701	USGS	40.48552997	-107.1775565	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	8	13	mn
387	402912107020901	USGS	40.48664188	-107.0364423	Alluvium, flood plain	PP	1978	1	2	pH

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[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
388	402912107112401	USGS	40.48664098	-107.1906124	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	6	12	no23 (3), mn
389	402913107051501	USGS	40.48691935	-107.0881101	Alluvium, flood plain	PP	1975	1	1	--
390	402913107103701	USGS	40.4869188	-107.1775566	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	6	11	mn (2)
391	402913107132101	USGS	40.48691856	-107.2231131	Lewis Shale	PP	1978	1	2	--
392	402914106585701	USGS	40.48719778	-106.9831078	Unknown	PP	1975	1	1	--
393	402916107061601	USGS	40.48775257	-107.1050549	Mesaverde Group	PP, TDS, MI, N, TE	1975	1	1	--
394	402917107170101	USGS	40.4880292	-107.2842256	Alluvium, flood plain	PP	1975	1	1	--
395	402920106550701	USGS	40.48886496	-106.9192177	Mancos Shale	PP	1978	1	2	--
396	402920107154301	USGS	40.4888627	-107.2625585	Alluvium, flood plain	PP	1978	1	2	--
397	402921107104001	USGS	40.489141	-107.1783899	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	6	10	sul, mn
398	402922107104001	USGS	40.48941877	-107.1783899	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	5	9	sul, mn (3)
399	402924106532301	USGS	40.4899763	-106.8903282	Browns Park Formation	PP, TDS, MI, N, TE	1978	1	2	--
400	402924107112001	USGS	40.48997425	-107.1895013	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	5	7	mn (2)
401	402924107112201	USGS	40.48997424	-107.1900569	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	6	10	sul, mn
402	402929107015901	USGS	40.491364	-107.0336645	Mesaverde Group	PP	1978	1	2	pH
403	402929107110301	USGS	40.4913631	-107.184779	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	4	7	sul (2), mn (2)
404	402929107181701	USGS	40.49136229	-107.3053372	Alluvium, flood plain	PP	1975	1	1	--
405	402930107105101	USGS	40.4916409	-107.1814456	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	5	9	sul (2), mn (3)
406	402930107105201	USGS	40.4916409	-107.1817234	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	6	10	sul (2), mn
407	402930107203001	USGS	40.49163975	-107.3422824	Upper Cretaceous series	PP	1978	1	2	--
408	402931106565501	USGS	40.49192019	-106.9492183	Alluvium, flood plain	PP	1975	1	1	--
409	402931107020901	USGS	40.4919195	-107.0364424	Alluvium, flood plain	PP	1975	1	1	--
410	402931107203001	USGS	40.4919175	-107.3422824	Alluvium, flood plain	PP	1975	1	1	--
411	402932107110101	USGS	40.49219645	-107.1842234	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	5	9	mn (2)
412	402932107112001	USGS	40.4921964	-107.1895013	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	5	8	sul (2)
413	402932107171801	USGS	40.49219574	-107.288948	Alluvium, flood plain	PP, TDS, MI, N, TE	1975	2	2	sul, fe, mn

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Appendix 5. Groundwater sites and aquifer description, type of water-quality data collected, period of water-quality record, number of samples, and water-quality standard exceeded, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
414	402933107110201	USGS	40.4924742	-107.1845012	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	5	9	mn (2)
415	402933107110701	USGS	40.4924742	-107.1858901	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	5	8	sul (2), mn (3)
416	402933107110702	USGS	40.4924742	-107.1858901	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	[4]5	7	sul (2), fe, mn (4)
417	402933107111301	USGS	40.4924742	-107.1875568	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	5	8	sul (2), mn (2)
418	402933107112201	USGS	40.49247419	-107.1900569	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	6	10	sul (2)
419	402934107111301	USGS	40.49275197	-107.1875568	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	6	10	sul (2), mn (2)
420	402935107105301	USGS	40.49302978	-107.1820012	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	6	9	--
421	402937107111401	USGS	40.49358529	-107.1878346	Alluvium, terrace	PP, TDS, MI, N, TE	1978–79	5	8	sul (2), mn
422	402938107155201	USGS	40.49386257	-107.2650586	Alluvium, flood plain	PP	1978	1	1	--
423	402938107185201	USGS	40.49386216	-107.3150596	Alluvium, flood plain	PP	1975	1	1	--
424	402941106523101	USGS	40.4946985	-106.8758835	Mancos Shale	PP	1978	1	2	--
425	402942107152501	USGS	40.4949737	-107.2575584	Alluvium, flood plain	PP	1978	1	1	--
426	402942107154401	USGS	40.49497368	-107.2628363	Alluvium, flood plain	PP	1978	1	1	--
427	402944106541301	USGS	40.4955316	-106.9042174	Unknown	PP	1975	1	1	--
428	402946106582101	USGS	40.49608655	-106.9731077	Alluvium, flood plain	PP	1975	1	1	--
429	402948107203801	USGS	40.4966396	-107.3445047	Unknown	PP	1975	1	1	--
430	402949106491801	USGS	40.49692117	-106.8222714	Mancos Shale	PP	1978	1	1	--
431	402949107135201	USGS	40.49691829	-107.2317245	Unknown	PP	1975	1	1	--
432	402954107103501	USGS	40.49830747	-107.1770011	Alluvium, flood plain	PP	1975	1	1	--
433	402957107103301	USGS	40.49914079	-107.1764456	Alluvium, flood plain	PP, TDS, MI, N, TE	1978	1	2	fe, mn
434	402959107131101	USGS	40.49969608	-107.2203354	Alluvium, flood plain	PP	1975	1	1	--
435	402959107222701	USGS	40.49969487	-107.3747832	Alluvium, flood plain	PP	1975	1	1	--
436	402960107112401	USGS	40.499974	-107.1906125	Unknown	PP, TDS, MI, N, TE	1978	1	1	--
437	403003107224201	USGS	40.5008059	-107.37895	Alluvium, flood plain	PP	1975	1	1	--
438	403004106550001	USGS	40.5010869	-106.9172733	Alluvium, flood plain	PP	1975	2	2	--
439	403005106512101	USGS	40.5013652	-106.8564388	Alluvium, flood plain	PP	1978	1	1	--

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Appendix 5. Groundwater sites and aquifer description, type of water-quality data collected, period of water-quality record, number of samples, and water-quality standard exceeded, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
440	403012106542201	USGS	40.5033092	-106.9067175	Alluvium, flood plain	PP, TDS, MI, N, TE	1975	2	2	mn
441	403014107154701	USGS	40.5038624	-107.2636697	Alluvium, flood plain	PP	1975	1	1	--
442	403015106561001	USGS	40.50414227	-106.9367181	Unknown	PP	1975	1	1	--
443	403017106523701	USGS	40.5046983	-106.8775503	Alluvium, flood plain	PP, TDS, MI, N, TE	1975	1	1	mn
444	403025106540101	USGS	40.5069203	-106.900884	Unknown	PP	1975	1	1	--
445	403025106575201	USGS	40.50691977	-106.965052	Alluvium, flood plain	PP, TDS, MI, N, TE	1975	2	2	--
446	403031107101701	USGS	40.5085851	-107.172001	Alluvium, flood plain	PP	1975	1	2	--
447	403031107121601	USGS	40.50858495	-107.2050573	Alluvium, flood plain	PP	1978	1	1	--
448	403032107115701	USGS	40.50858495	-107.2050573	Valley-fill deposits	PP, TDS, MI, N, TE	1975, 1978	3	3	fe
449	403035107075401	USGS	40.50969646	-107.1322779	Unknown	PP	1975	1	1	--
450	403041107230601	USGS	40.5113613	-107.3856168	Alluvium, flood plain	PP	1975	1	1	--
451	403047107150701	USGS	40.51302907	-107.2525584	Alluvium, flood plain	PP	1975	1	1	--
452	403106106492001	USGS	40.5183097	-106.8228268	Alluvium, flood plain	PP, TDS, MI, N, TE	1978	1	2	pH
453	403125107115701	USGS	40.5235848	-107.1997794	Alluvium, flood plain	PP	1975	1	1	--
454	403127106483501	USGS	40.52414306	-106.8103265	Precambrian Erathem	PP	1978	1	2	--
455	403129106570801	USGS	40.52469739	-106.9528295	Mancos Shale	PP, TDS, MI, N, TE	1975	2	2	chl, fl
456	403132107152501	USGS	40.5255289	-107.2575585	Lewis Shale	PP, TDS, MI, N, TE	1975	1	1	sul, no23
457	403136106491401	USGS	40.5266429	-106.82116	Browns Park Formation	PP	1978	1	2	--
458	403143107254501	USGS	40.528583	-107.4297845	Unknown	PP	1975	1	1	--
459	403156107262501	USGS	40.53219399	-107.4408958	Alluvium, flood plain	PP	1975	1	1	--
460	403202106485601	USGS	40.53386508	-106.8161598	Alluvium, flood plain	PP	1978	1	1	--
461	403205106492001	USGS	40.53469834	-106.8228266	Browns Park Formation	PP, TDS, MI, N, TE	1978	1	2	--
462	403207106490601	USGS	40.5352539	-106.8189376	Browns Park Formation	PP, TDS, MI, N, TE	1978	1	2	fl
463	403210106520801	USGS	40.5360868	-106.8694943	Alluvium, flood plain	PP	1978	1	2	--
464	403211106465401	USGS	40.5363653	-106.7822701	Precambrian Erathem	PP, TDS, MI, N, TE	1978	1	2	fe, mn
465	403211106484001	USGS	40.53636508	-106.8117152	Alluvium, flood plain	PP	1978	1	2	--

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Appendix 5. Groundwater sites and aquifer description, type of water-quality data collected, period of water-quality record, number of samples, and water-quality standard exceeded, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
466	403218106532601	USGS	40.5383088	-106.8911614	Unknown	PP, TDS, MI, N, TE	1978	1	1	sul
467	403219106531101	USGS	40.5385866	-106.8869946	Mancos Shale	PP, TDS, MI, N, TE	1978	1	2	mo, fe, mn
468	403219107263800	USGS	40.53858278	-107.444507	Unknown	PP	1975	1	1	--
469	403224106521501	USGS	40.5399756	-106.8714387	Mancos Shale	PP	1978	1	2	--
470	403233107185801	USGS	40.54247268	-107.3167265	Upper Cretaceous series	PP	1978	1	1	--
471	403235107243001	USGS	40.54302747	-107.4089507	Eocene series	PP, TDS, MI, N, TE	1975	2	2	--
472	403242106520301	USGS	40.54497558	-106.8681053	Mancos Shale	PP	1978	1	2	--
473	403245107235801	USGS	40.54580529	-107.4000617	Alluvium, flood plain	PP	1975	1	1	--
474	403258106531300	USGS	40.54941979	-106.8875501	Mancos Shale	PP, TDS, MI, N, TE	1975	1	1	chl, fl
475	403303107185600	USGS	40.5508059	-107.3161709	Upper Cretaceous series	PP, TDS, MI, N, TE	1975	1	1	mn
476	403318107172501	USGS	40.55497276	-107.2908926	Unknown	PP	1975	1	1	--
477	403351106594201	USGS	40.56414089	-106.9956082	Mancos Shale	PP	1978	1	2	--
478	403504107182701	USGS	40.58441675	-107.3081152	Unknown	PP	1975	1	1	--
479	403516107042501	USGS	40.58775129	-107.074221	Mancos Shale	PP, TDS, MI, N, TE	1975, 1978	3	3	--
480	403536106564701	USGS	40.5933075	-106.9469958	Mancos Shale	PP, TDS, MI, N, TE	1978	1	2	sul, chl, fe, mn
481	403537107162901	USGS	40.59358359	-107.2753367	Unknown	PP	1975	1	1	--
482	403646107223700	USGS	40.6127492	-107.3775613	Fort Union Formation	PP, TDS, MI, N, TE	1975	1	1	fe, no23
483	403702106591901	USGS	40.6171957	-106.989219	Alluvium, flood plain	PP	1978	1	2	--
484	403711107030101	USGS	40.6196954	-107.0508872	Alluvium, flood plain	PP	1975	1	2	--
485	403712107030201	USGS	40.61997317	-107.0511649	Alluvium, flood plain	PP, TDS, MI, N, TE	1978	1	2	--
486	403754107002301	USGS	40.63163984	-107.0069973	Alluvium, flood plain	PP, TDS, MI, N, TE	1975	2	2	--
487	403810106563001	USGS	40.6360847	-106.9422733	Mancos Shale	PP, TDS, MI, N, TE	1978	1	2	--
488	403820107200001	USGS	40.6388604	-107.3339492	Unknown	PP	1975	1	2	--
489	403821107013501	USGS	40.63913966	-107.0269977	Alluvium, flood plain	PP	1975	1	1	--
490	403843106581501	USGS	40.645251	-106.9714407	Mancos Shale	PP	1978	1	1	--
491	403843106583501	USGS	40.64525097	-106.9769964	Mancos Shale	PP	1978	1	2	--

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Appendix 5. Groundwater sites and aquifer description, type of water-quality data collected, period of water-quality record, number of samples, and water-quality standard exceeded, Upper Yampa River watershed, Colorado, 1975 through 1989 and 1998.
[No., number; USGS, U.S. Geological Survey; PP, physical properties; --, water-quality standard not exceeded; TDS, total dissolved solids; MI, major ions; N, nutrients, TE, trace elements; fe, iron; mn, manganese; NO23, nitrate plus nitrite; sul, sulfate; cd, cadmium; ar, arsenic; chl, chloride; pb, lead; fl, fluoride; mo, molybdenum; CDOA, Colorado Department of Agriculture]

Site no (fig. 14)	Site Identifier	Source of data	Latitude	Longitude	Aquifer description	Type of data	Period of water-quality record	No. of sample days	No. of samples[1]	Water-quality standard exceeded[2]
492	403855106563401	USGS	40.6485845	-106.9433844	Mancos Shale	PP	1978	1	2	--
493	403903106564301	USGS	40.65080669	-106.9458844	Alluvium, flood plain	PP	1978	1	2	pH
494	403912106565000	USGS	40.6533066	-106.9478289	Valley-fill deposits	PP, TDS, MI, N, TE	1975	1	1	pH, fe
495	404259106542301	USGS	40.71636157	-106.906994	Mancos Shale	PP	1978	1	2	pH
496	404302106545201	USGS	40.7171948	-106.9150498	Alluvium, flood plain	PP	1978	1	2	pH
497	404309106543001	USGS	40.71913929	-106.9089385	Alluvium, flood plain	PP	1978	1	1	--
498	404318106534201	USGS	40.72163936	-106.8956047	Alluvium, flood plain	PP, TDS, MI, N, TE	1978	2	3	pH (2)
499	404402106521001	USGS	40.73386159	-106.8700482	Alluvium, flood plain	PP	1978	1	1	pH
500	404414106515101	USGS	40.7371949	-106.8647702	Alluvium, flood plain	PP	1978	1	2	--
501	404446106574501	USGS	40.7460829	-106.9631069	Browns Park Formation	PP, TDS, MI, N, TE	1978	1	2	mn
502	WS-027	CDOA	40.19	-106.91	Unknown	PP, TDS, MI, N	1998	1	1	--
503	WS-029	CDOA	40.48	-107.02	Unknown	PP, TDS, MI, N, TE	1998	1	1	--
504	WS-031	CDOA	40.5	-107.18	Unknown	PP, TDS, MI, N, TE	1998	1	1	--
505	WS-032	CDOA	40.49	-107.3	Unknown	PP, TDS, MI, N, TE	1998	1	1	--
506	WS-033	CDOA	40.56	-106.89	Unknown	PP, TDS, MI, N, TE	1998	1	1	--
507	WS-034	CDOA	40.19	-106.92	Unknown	PP, TDS, MI, N	1998	1	1	--

[1]For some samples, count includes one water-quality sample and one water-level measurement collected on the same day but at different times.

[2]Number in parenthesis is count of exceedances. Except for pH, all standards are for dissolved water samples.

[3]Sample collection did not occur in every year of the year range.

[4]One sampe day only includes data for trace elements.

Appendix 6. Stream sites in the Upper Yampa River watershed, Colorado, with macroinvertebrate data, and period of record and number of sample days, 1975 through 2008.

[No., number; USGS, U.S. Geological Survey; CDPHE, Colorado Department of Public Health and Environment; USFS, U.S. Forest Service; CSS, City of Steamboat Springs. Subbasin definitions: Upstream Lewis SWA=Yampa River upstream from Chuck Lewis State Wildlife Area, Lewis SWA to Elk River=Yampa River downstream from Chuck Lewis State Wildlife Area to Elk River confluence, Elk River to Hayden=Yampa River downstream from Elk River to Hayden, Downstream Hayden=Yampa River downstream from Hayden to confluence with Elkhead Creek. Sites with the same site number are considered to be at the same location]

Site no. (fig ~~17~~ 18)	Site name	Source of data	Site identifier	Latitude	Longitude	Subbasin	Period of water-quality record (month/year)	No. of sample days
6	BEAR RIVER NEAR TOPONAS, CO	USGS	09236000	40.043873	-107.0722729	Upstream Lewis SWA	8/1975	1
7	BEAVER CREEK NEAR HAHNS PEAK, CO.	USGS	404610106545600	40.769416	-106.9161606	Elk River	9/1975	1
10	BURGESS CK NEAR MOUTH @ HWY 40	CDPHE	12893	40.45166	-106.81016	Lewis SWA to Elk River	4/2001	1
180	Bushy Creek above Cty Rd 16	CDPHE	12885	40.2008	-106.8259	Lewis SWA to Elk River	9/2006	1
22	DRY CK @ HAYDEN	CDPHE	12852	40.49233	-107.26466	Downstream Hayden	8/2001	1
27	ELK R. NEAR MOUTH @ CR44	CDPHE	12860	40.54583	-106.90883	Elk River	8/2001	1
30	ELK RIVER AT CLARK, CO.	USGS	09241000	40.717473	-106.9158832	Elk River	8/1975	1
33	ELK RIVER NEAR MILNER, CO.	USGS	09242500	40.514698	-106.9539407	Elk River	8/1975	1
38	ELKHEAD CREEK	CDPHE	WCOP99-0512	40.659968	-107.2906527	Elkhead Creek	8/2001	1
39	ELKHEAD CREEK	CDPHE	WCOP99-0565	40.619969	-107.2706516	Elkhead Creek	8/2001, 7/2008	2
40	ELKHEAD CREEK ABOVE ELKHEAD RESERVOIR, CO.	USGS	403530107191300	40.591639	-107.3208933	Elkhead Creek	9/1975	1
181	Elkhead Creek above First Creek	CDPHE	12849A	40.75513	-107.13307	Elkhead Creek	7/2008	1
182	Elkhead Creek above Rippy property	CDPHE	12846A	40.67624	-107.27145	Elkhead Creek	7/2008	1
183	Elkhead Creek at County Rd. 76	CDPHE	12843	40.59181	-107.32057	Elkhead Creek	7/2008	1
184	Elkhead Creek at Rippy property	CDPHE	12846	40.66944	-107.28547	Elkhead Creek	7/2008	1
185	Elkhead Creek below Elkhead Reservoir	CDPHE	12843A	40.53901	-107.4106	Elkhead Creek	8/2001	1
43	ELKHEAD CREEK NEAR CRAIG, CO	USGS	09246500	40.531083	-107.4361735	Elkhead Creek	9/1975	1
43	ELKHEAD CK NR CRAIG @ HWY 40	CDPHE	12840	40.531	-107.43633	Elkhead Creek	8/2001	1
44	ELKHEAD CREEK NEAR ELKHEAD, CO.	USGS	09245000	40.669694	-107.2850592	Elkhead Creek	9/1975	1
186	First Creek east of USFS/State boundary	CDPHE	12849	40.7312	-107.14705	Elkhead Creek	8/2005	1
54	FISH CK NEAR MOUTH @ HWY 40	CDPHE	12870	40.4665	-106.82467	Lewis SWA to Elk River	4/2001, 8/2001	2
58	GRASSY CREEK AT GRASSY GAP, CO.	USGS	402330107082000	40.391643	-107.139499	Elk River to Hayden	9/1975	1
59	GRASSY CREEK NEAR MOUNT HARRIS, CO.	USGS	09244300	40.44692	-107.1456109	Elk River to Hayden	9/1975	1
59	GRASSY CK @ RD. 27A	CDPHE	12853	40.44666	-107.14583	Elk River to Hayden	4/2003	1

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Appendix 6. Stream sites in the Upper Yampa River watershed, Colorado, with macroinvertebrate data, and period of record and number of sample days, 1975 through 2008.

[No., number; USGS, U.S. Geological Survey; CDPHE, Colorado Department of Public Health and Environment; USFS, U.S. Forest Service; CSS, City of Steamboat Springs. Subbasin definitions: Upstream Lewis SWA=Yampa River upstream from Chuck Lewis State Wildlife Area, Lewis SWA to Elk River=Yampa River downstream from Chuck Lewis State Wildlife Area to Elk River confluence, Elk River to Hayden=Yampa River downstream from Elk River to Hayden, Downstream Hayden=Yampa River downstream from Hayden to confluence with Elkhead Creek. Sites with the same site number are considered to be at the same location]

Site no. (fig 17)	Site name	Source of data	Site identifier	Latitude	Longitude	Subbasin	Period of water-quality record (month/year)	No. of sample days
187	Grassy Creek at Rd 27 STL	CDPHE	12853A	40.3901	-107.14825	Elk River to Hayden	4/2003	1
69	MAD CK @ CHRISTINA SWA	CDPHE	12863	40.565278	-106.8891667	Elk River	10/1997, 9/1998	2
81	NORTH FORK WALTON CREEK NR RABBIT EARS PASS, CO.	USGS	09238300	40.395536	-106.649764	Lewis SWA to Elk River	8/1975	1
83	OAK CK D/S TOWN OF OAK CREEK @ CR 27	CDPHE	12892	40.27616	-106.96416	Upstream Lewis SWA	4/2001, 8/2001	2
85	OAK CREEK AB OAK CREEK DRAIN NEAR OAK CREEK, CO.	USGS	401725106575600	40.290258	-106.966161	Upstream Lewis SWA	8/1975	1
93	OAK CREEK NEAR OAK CREEK, CO.	USGS	09238000	40.24387	-107.0153283	Upstream Lewis SWA	8/1975	1
94	OAK CK @ 22 RD ABV YAMPA R	CDPHE	12891	40.398889	-106.8419444	Upstream Lewis SWA	4/2001, 8/2001	2
95	PHILLIPS CREEK NEAR YAMPA, CO.	USGS	400759106532500	40.13304	-106.8908796	Upstream Lewis SWA	8/1975	1
98	SAGE CK @ RD. 27	CDPHE	12851	40.4835	-107.17016	Elk River to Hayden	4/2003	1
188	Sage Creek in canyon on Rd 37	CDPHE	12851B	40.4041	-107.2242	Elk River to Hayden	7/2008	1
101	SAGE CREEK NEAR HAYDEN, CO.	USGS	402918107094400	40.488308	-107.162834	Elk River to Hayden	9/1975	1
102	SAGE CREEK NEAR MOUNT HARRIS, CO.	USGS	402522107134100	40.422753	-107.228668	Elk River to Hayden	9/1975	1
115	TROUT CK NR. MOUTH	CDPHE	12876	40.460278	-106.9886111	Elk River to Hayden	9/2008	1
116	TROUT CREEK ABOVE FOIDEL CREEK NEAR MILNER, CO.	USGS	402416106580800	40.404422	-106.9694956	Elk River to Hayden	8/1975	1
121	TROUT CREEK NEAR PHIPPSBURG, CO.	USGS	09243000	40.151093	-107.1317192	Elk River to Hayden	8/1975	1
122	WALTON CR. NEAR MOUTH @ HWY 40	CDPHE	12894	40.270273	-106.816	Lewis SWA to Elk River	4/2001, 8/2001	2
189	Wolf Creek at 52 Rd	CDPHE	12855	40.5469	-107.1125167	Downstream Hayden	4/2003	1
128	WOLF CREEK NEAR HAYDEN, CO.	USGS	402832107080200	40.47553	-107.1344999	Downstream Hayden	9/1975	1
133	YMP-7 [Yampa River 100m above James Brown Bridge]	CSS	YMP-7	40.495833	-106.85655	Lewis SWA to Elk River	9/2005-08	3
136	YAMPA R. @ CR 14 FISHING ACCESS	CDPHE	12806D	40.475	-106.8235	Upstream Lewis SWA	4/2001, 8/2001	2
137	YAMPA R. ABV. PHIPPSBURG	CDPHE	12814	40.227222	-106.9413889	Upstream Lewis SWA	9/1998, 8/2001	3

Appendix 6. Stream sites in the Upper Yampa River watershed, Colorado, with macroinvertebrate data, and period of record and number of sample days, 1975 through 2008.

[No., number; USGS, U.S. Geological Survey; CDPHE, Colorado Department of Public Health and Environment; USFS, U.S. Forest Service; CSS, City of Steamboat Springs. Subbasin definitions: Upstream Lewis SWA=Yampa River upstream from Chuck Lewis State Wildlife Area, Lewis SWA to Elk River=Yampa River downstream from Chuck Lewis State Wildlife Area to Elk River confluence, Elk River to Hayden=Yampa River downstream from Elk River to Hayden, Downstream Hayden=Yampa River downstream from Hayden to confluence with Elkhead Creek. Sites with the same site number are considered to be at the same location]

Site no. (fig 17)	Site name	Source of data	Site identifier	Latitude	Longitude	Subbasin	Period of water-quality record (month/year)	No. of sample days
138	YAMPA R. BLW STAGECOACH RES.	CDPHE	12808	40.287222	-106.8288889	Upstream Lewis SWA	8/1998	1
139	YAMPA R. D/S STAGECOACH RES. DAM	CDPHE	12808P	40.288	-106.827	Upstream Lewis SWA	4/2001, 8/2001	2
140	YAMPA R. N. OF HAYDEN @ CALIFORNIA PARK RD	CDPHE	12802	40.502222	-107.2636111	Elk River to Hayden	4/2001, 8/2001	2
141	YAMPA R. NR MOUNT HARRIS BLW HWY 40 BRIDGE	CDPHE	12805	40.488	-107.15833	Elk River to Hayden	4/2001, 8/2001	2
142	YAMPA R. U/S LAKE CATAMOUNT @ CR18	CDPHE	12807	40.34083	-106.80833	Upstream Lewis SWA	4/2001, 8/2001	2
143	YAMPA R. ABV OAK CREEK	CDPHE	12811	40.398889	-106.8341667	Upstream Lewis SWA	4/2001, 8/2001	3
143	YAMPA RIVER AB OAK CREEK NR STEAMBOAT SPGS, CO.	USGS	402356106500000	40.398868	-106.833937	Upstream Lewis SWA	8/1975	1
145	YAMPA RIVER ABOVE ELK RIVER NEAR MILNER, CO.	USGS	402932106564900	40.492198	-106.9475516	Lewis SWA to Elk River	8/1975	1
147	YAMPA R. U/S STAGECOACH RES @ CR16	CDPHE	12809	40.26933	-106.88116	Lewis SWA to Elk River	4/2001, 8/2001	2
150	YAMPA RIVER AT HAYDEN, CO.	USGS	403006107154800	40.50164	-107.2639475	Elk River to Hayden	9/1975	1
151	YAMPA RIVER AT MILNER	CDPHE	000038	40.478889	-107.0133333	Elk River to Hayden	4/2001, 8/2001	2
152	YAMPA RIVER AT PHIPPSBURG, CO.	USGS	401418106562200	40.238315	-106.9400487	Upstream Lewis SWA	8/1975	1
153	YAMPA RIVER AT STEAMBOAT SPRINGS, CO	USGS	09239500	40.482986	-106.8324306	Lewis SWA to Elk River	8/1975	1
153	YAMPA R. @ 5TH ST. BRIDGE IN STEAMBOAT	CDPHE	12806	40.48316	-106.83233	Lewis SWA to Elk River	9/1998, 4/2001	2
154	YAMPA RIVER BELOW DIVERSION, NEAR HAYDEN, CO.	USGS	09244410	40.488308	-107.1597784	Elk River to Hayden	9/1975	1
155	YAMPA RIVER BELOW HAYDEN, CO.	USGS	402930107174200	40.49164	-107.2956148	Elk River to Hayden	9/1975	1
162	YAMPA R. BLW YAMPA @ CR21	CDPHE	12815	40.183	-106.91533	Upstream Lewis SWA	4/2001, 8/2001	2
169	YAMPA R. D/S LAKE CATAMOUNT @ HWY 131	CDPHE	12806F	40.37533	-106.825	Upstream Lewis SWA	4/2001, 8/2001	2
174	YMP-1 [Yampa River 200m above confl Walton Creek]	CSS	YMP-1	40.449233	-106.82025	Lewis SWA to Elk River	9/2005-08	3
175	YMP-2 [Yampa River 35 m above confl Fish Creek]	CSS	YMP-2	40.466017	-106.83003	Lewis SWA to Elk River	9/2005-08	3
176	YMP-3A [Yampa River 70m above pedestrian bridge and hot spring outflow in Weiss Park]	CSS	YMP-3A	40.480517	-106.82763	Lewis SWA to Elk River	9/2005-08	3

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