

Mine Reclamation, Metal Mobilization, and Aquatic Toxicity in the Mancos River Watershed

Prepared for
Ute Mountain Ute Tribe

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Introduction

Objectives and Scope

The Ute Mountain Ute Tribe was awarded funding from the Water Infrastructure Improvements for the Nation Act (WIIN) to implement two projects:

- Mancos River – Thunder Mine remediation implementation and associated Water Quality Assessment
- Mancos River – Assessment of metal sources, mobilization, and potential for downstream toxicity

The implementation of these projects is described in this technical report.

Water quality conditions of portions of the West Mancos River and the East Mancos River are not suitable for aquatic life due to elevated metal concentrations related to legacy mining and natural mineralization. During fall low-flow periods, thick metal precipitates accumulate in the streambed of the East Mancos River and West Mancos River, which are then mobilized and flushed downstream during high-flow scouring events. One of the intentions of this work was to determine how far down the mainstem of the Mancos River these precipitates are mobilized and whether metals persist at ecologically relevant levels during these high-flow spring flushing events. Additionally, a previous investigation into metal sources in the East Mancos River identified the Thunder Mine, located along a lower tributary to the East Mancos River, as a high-priority potential remediation site due to the relatively high copper load from mine drainage and waste rock associated with the site. A component of the work described here was the successful remediation of the Thunder Mine site.

Objectives for both projects included:

- Remediate Thunder Mine site to reduce metal contributions to the East Mancos River.
- Assess the measurable result of Thunder Mine remediation through targeted water-quality sampling before and after remediation, and upstream and downstream of the remediation site.
- Characterize and quantify potential metal contribution and assess potential for unplanned releases from additional mine sites in lower East Mancos and upper West Mancos.
- Assess metal mobilization, suspended sediments, and potential toxicity to aquatic life of metals transported from the East and West Mancos rivers into the mainstem Mancos River during high-flow flushing events.
- Synthesize Mancos River water-quality, stream sediment, and aquatic-life data collected by multiple agencies and organizations over the last decade.

Physical, Geologic, and Hydrologic Setting

Geographic and Historical Setting

The Mancos River originates on the western flanks of the La Plata Mountains, a western subrange of the San Juan Mountains in southwestern Colorado. It then flows southwest through the Mancos Valley, into the Ute Mountain Ute Reservation and Mancos Canyon, until it joins the San Juan River in northwestern New Mexico. The river is 116 miles in length, including major upstream tributaries, and drains an area of approximately 800 square miles. The Mancos River watershed is part of the

Colorado Plateau geologic region, and is often divided into two main parts: an upper watershed of approximately 203 square miles that includes Mancos Valley and the surrounding mountains; and a lower area that begins in Mancos Canyon at the confluence of Weber Creek and drains the mesa and desert lowland country of Mesa Verde National Park, the Ute Mountain Ute Reservation, and the surrounding regions. Four main tributaries originate among the 13-thousand-foot peaks of the upper watershed: the East, Middle, West Mancos Rivers, and Chicken Creek. The East Mancos River has impaired water quality due to elevated metal concentrations and is indicated on the Colorado 303(d) list for impaired water bodies (CDPHE, 2026). In contrast, the West and Middle Mancos Rivers maintain relatively good water quality for the majority of their reaches. However, water quality drastically declines after these two tributaries confluence with the East Mancos River. Dissolved metals from the East Mancos River may affect the Mancos River throughout its entire length.

Early Spanish explorers searched for gold in the upper Mancos River watersheds, and since the late 1800's gold, silver, and other metals have been extracted from mines in the upper Mancos River watershed. Historical mining in the upper Mancos River began between 1897 and 1901, when the low-grade pyritic-gold deposits in Jackson Ridge were discovered at the heads of East, West, and Middle Mancos Rivers. Placer gold deposits were discovered in the East Mancos River valley near the Red Arrow Mine (https://mrdata.usgs.gov/mrds/show-mrds.php?dep_id=10014163). At the turn of the century, hundreds of mine claims had been recorded, and more than 200 claims had been patented. Many of the mines had produced some ore, but the total production of the district up to 1900 was comparatively small. Some of the mines produced intermittently up to 1939, but none of the mines produced even as much as $100,000 (Eckel, 1949). Transportation costs and remote access were described as reasons for mine failures, highlighted during February 1936 when a large avalanche in Rush Basin claimed six lives and destroyed the Doyle-Hesperus Mine boarding house and gold mill (Gulliford, 2010). Mining resumed a few years later at the site with newly constructed buildings and new milling technology such as cyanide leaching for gold extraction (Eckel, 1949). At the ore milling sites for the Doyle mines, mill tailings were dumped directly into the upper East Mancos River, and massive mill tailings deposits can be observed in the stream channel, forming ledges and ironstone dams of tailings cemented by iron and copper mineral precipitates.

At least 70 abandoned historical mines as well as some recently active mines still pockmark the East, Middle, and West Mancos watersheds, and acid-mine drainage and leachate from weathered waste-rock piles likely contribute dissolved-metal loads to streams. However, some component of the dissolved-metal load in the East and West Mancos rivers may be caused by naturally occurring seeps and streams draining mineralized rocks of the upper basin (Neubert, 2000; CDHPE, 2005; CDPHE, 2012). The combination of natural and anthropogenic metal sources in the East Mancos River has created degraded water quality conditions with poor aquatic habitat and a general absence of fish. The effects of impaired water-quality conditions in East Mancos River could be transported downstream, thereby impacting water quality, aquatic habitat, and agricultural irrigation in the lower Mancos River.

Geology

In the upper portions of the Mancos River watershed, the combination of mineralized igneous intrusive rock and altered and metamorphosed sedimentary rocks makes for a unique and complex geological, geochemical, and mineralogical setting (Figure 1). In general, the La Plata Mountains are a laccolithic uplift of Mesozoic sedimentary rocks, intruded by numerous stocks, dikes, and sills

(Eckel, 1949; Mutschler and others, 1998). Injection of great quantities of porphyry magma was largely responsible for forming the La Plata structural dome, a 24-km domal uplift of sedimentary rocks. This domal uplift is the most pronounced structural geology feature of the La Plata Mountains, considerable enough to elevate the Dolores formation nearly 6,000 feet above its normal position (Eckel, 1949). Extensive faulting due to the domal structure resulted in mineralized ore veins, replacement deposits, and breccia zones (Summerlin, 2014). The East Mancos is located along a structural hinge zone along this uplift where the beds generally dip outward at angles of 25° to 60°. In places the rocks are sheared and brecciated along the hinge fold, and many of the ore-bearing vein fractures are concentrated within or near the hinge fold, which is exposed on the ridge between Spiller and Burwell Peaks in upper East Mancos (Eckel, 1949).

The igneous intrusive rocks of the La Plata Mountains are of late Cretaceous or Tertiary age and vary widely in composition and in form. However, all of them can be grouped in two general types: porphyritic and nonporphyritic (Eckel, 1949). Porphyry deposits are high temperature (>700°C), deep-seated (10-20 km) stockwork intrusives within associated sub-volcanic porphyritic intrusive bodies and surrounding country rock. In contrast, epithermal deposits are shallow (<1 km deep) disseminated, stockwork, or vein deposits that were hydrothermally formed. There is evidence that the porphyry bodies of the upper East Mancos (Rush Basin) are surrounded by an aureole of rather intensely altered sedimentary rocks (Eckel, 1949, Summerlin, 2014). The porphyry bodies intruded forcibly between the layers of sedimentary rock which created deposits of metallic mineral ores. The Allard stock, located beneath and between the East Mancos watershed and Bedrock Creek, is a multi-phase syenite stock hosting sub-economic copper deposits that are partly exposed at the surface (Werle et al., 1984). Alteration and pyritization are widespread and extend into sedimentary rocks beyond the stock. Pyrite and chalcopyrite are abundant and are the dominant metallic minerals. Gold, silver, platinum, and palladium also occur in the Allard Stock, primarily as telluride minerals.

The sedimentary rocks exposed in the Mancos watershed range from the Hermosa formation of Pennsylvania age to the Mancos Shale of Upper Cretaceous age. Sedimentary rocks underlying East Mancos include the upper Jurassic Morrison, Junction Creek, Wanakah, Entrada Sandstone, and upper Triassic Dolores and Cutler Formations. The upper Permian Cutler Formation occurs in the central part of the watershed. The Wanakah Formation is comprised of shale, sandstone, and the Pony Express Limestone member. These sedimentary rocks have all been hydrothermally altered in the upper basin due to porphyry intrusives, and many of the limestone beds have been completely silicified (Eckel, 1949).

Three important and distinct classes of metallic ores occur in the East Mancos (Eckel, 1949): (1) porphyry deposits containing metals such as copper, molybdenum, gold, tungsten, and tin; (2) hydrothermal veins containing copper, lead, zinc, silver, and gold; and (3) hydrothermal or metamorphic alteration and replacement of sedimentary rocks. The porphyry deposits also contain platinum-group elements (PGE), including platinum, palladium, rhodium, ruthenium, iridium, and osmium (Summerlin, 2014). Massive veins of pyrite occur as the "Doyle blanket" which are replacement deposits in the Pony Express limestone. While the massively bedded limestone has been completely silicified and replaced by fine grained quartz, several locations within the exposed Pony Express exhibit thick veins of fine to coarsely granular pyrite (Doyle blanket), which also may

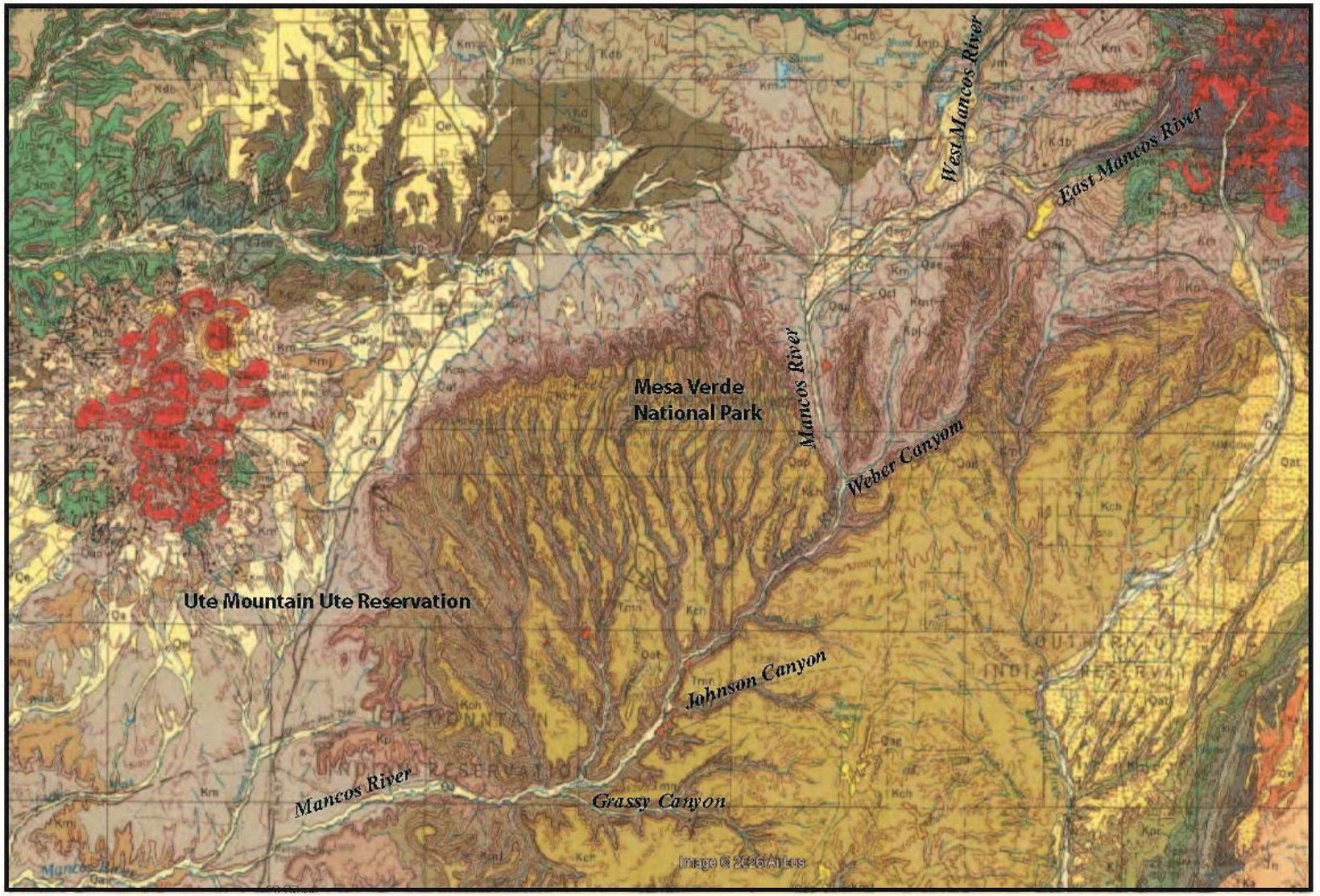


Figure 1. Geologic map of the Mancos River watershed (Haynes et al., 1972).

contain gold and some chalcopyrite.

The Mancos Shale of Upper Cretaceous age underlies most of the Mancos River watershed below confluence with East and West Mancos Rivers, and outcrops in many areas throughout western Colorado and Utah. The formation ranges in thickness from 2,000 to 3,000 ft and consists of massive, fossiliferous marine shale that contains interbedded sandstone, siltstone, and volcanic-ash layers. The Mancos Shale is the lateral equivalent of the Niobrara Formation, Cody Shale, and Pierre Shale in Montana, Nebraska, South Dakota, and Wyoming. The Mancos Shale is a regressive prodeltaplume complex genetically related to the deltaic systems active along the western interior seaway of Cretaceous age and is divided into the lower shale member, the Ferron Sandstone Member (or the Juana Lopez Member), the Mancos B Member, and the Buck Tongue Member (Cashion, 1973; Gill and Hail, 1975; Cole and Young, 1991).

The lower shale member of Mancos Shale contains massive and laminated silty-mudstone and sandy-siltstone parasequences that contain disseminated pyrite, lenticular kerogen and coal, and pyrite minerals associated with ash beds. The Mancos B Member (called the Prairie Canyon Member by Cole and Young, 1991) is characterized by lenticular, cyclic, upward parasequences that range in thickness from 6 to 90 ft and consists of five main lithofacies: silty claystone, sandstone-claystone, sandy siltstone, bioturbated muddy sandstone, and sandy dolomite (as beds and concretions). Volcanic ash layers occur as interbeds throughout the Mancos Shale and range in thickness from less than 1 in. to 2 ft. The ash layers in the study area could have originated from the Sevier Orogeny in central Utah. Volcanic ash could be the source of selenium and other trace constituents in the Mancos Shale. The Mesa Verde Formation of Upper Cretaceous age overlies the Mancos Shale and forms the caprock for the Mesa Verde National Park area. The formation consists of massive sandstone, gray shale, and coal, and ranges in thickness from 60 to about 2,300 ft thick.

Glaciers played a role in the formation of the valleys and canyons of the upper Mancos River watershed. Glacial ice filled the headwater valleys of the Mancos River, and in the East Mancos River, glacial ice occurred at least as far downstream as Gold Run (Atwood and Mather, 1932; Eckel, 1949). Present-day valley floors are likely filled with combinations of glacial till, alluvium, and colluvium; however, little information is available regarding alluvium thicknesses in the valleys of the Mancos watershed. Rock glaciers, masses of rock debris and ice that slowly flow in the same manner that glaciers do, are still present in the East and West Mancos watersheds (Figure 2). These remnants of a colder climate form as the exposed ice from a glacier gets buried beneath thick layers of rock debris. This rocky mantle insulates the remaining ice from rising temperatures, allowing the landform to slowly creep downhill as a debris-covered mass of frozen water and rock. With a warming climate, rock glaciers are exhibiting increased melting, which can dissolve rocks within the rock glacier, mobilizing dissolved metals, thereby increasing dissolved metal concentrations and loads in alpine streams (Thies et al., 2007).

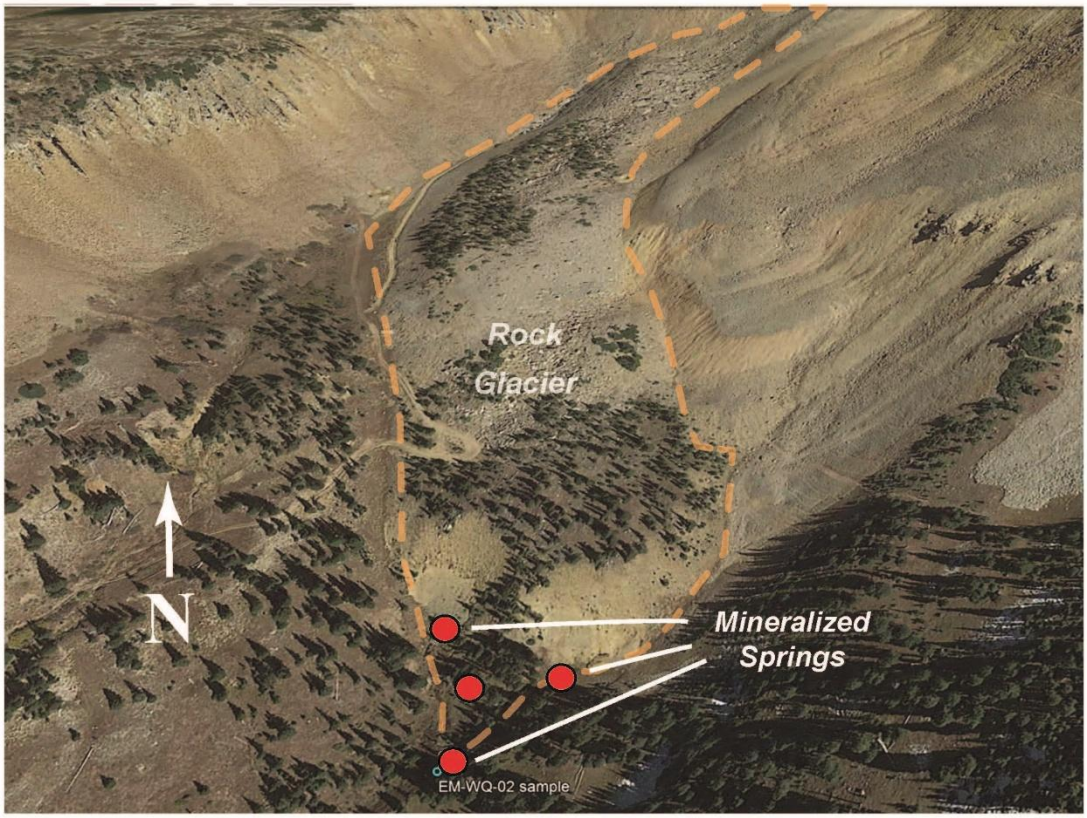


Figure 2. Oblique satellite image of rock glacier in the headwaters of the East Mancos River. Mineralized springs emerge from the base of the rock glacier.

Climate

The Mancos watershed varies in elevation and topography, influencing climate and weather patterns. The headwaters originate above 12,000 feet in elevation, and the mouth of the Mancos River confluences with the San Juan River is below 5,000 feet in elevation. The elevation changes from high mountain environments primarily dominated by snowfall to mesas and desert ecosystems in the lower watershed. The Mancos SNOTEL station is located north of the Middle Mancos watershed at 10,020 feet in elevation. Precipitation varies from year to year, with a range of 15.9 in 2018 to 43.5 inches of precipitation in 1997 (Figure 3).

High-altitude regions like the La Plata Mountains have generally warmed at a greater rate than the global average during the latter half of the 20th century, exhibiting greater increases in daily minimum temperatures than daily maximum temperatures. A climate study of the San Juan Mountains conducted by Rangwala and Miller (2010) suggests that the region has warmed by 1 °C between 1895 and 2005, and that most of the warming occurred between 1990 and 2005.

Air temperature also varies, with an annual average temperature of 37.7 degrees Fahrenheit in 1998 to an annual average temperature of 43.2 degrees Fahrenheit in 2018 (Figure 4). As recorded by the Mancos SNOTEL site since 1995, there has been a trend of decreasing annual precipitation and increasing air temperature within the watershed.

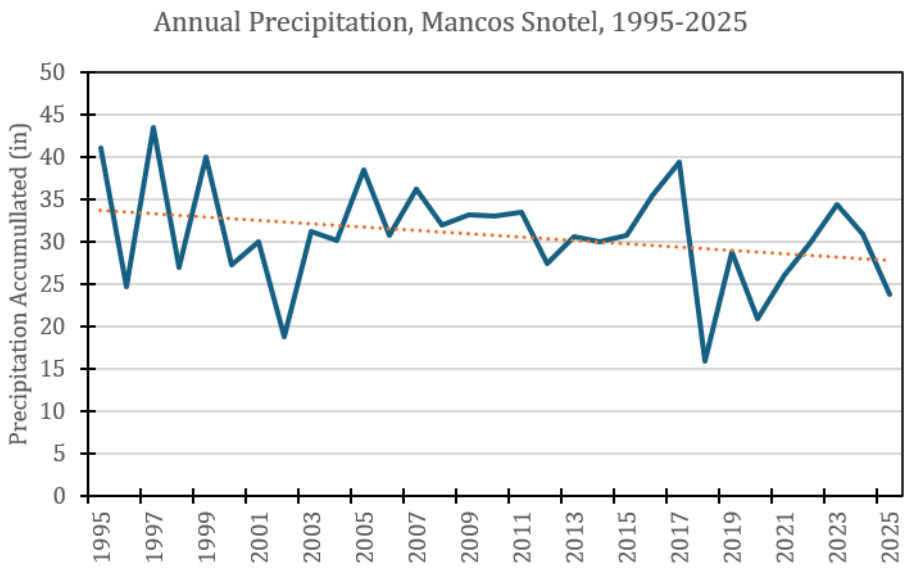


Figure 3. Annual accumulated precipitation measured at the Mancos SNOTEL site from 1995-2025. The orange dotted line is the linear trend line for the plotted precipitation values.

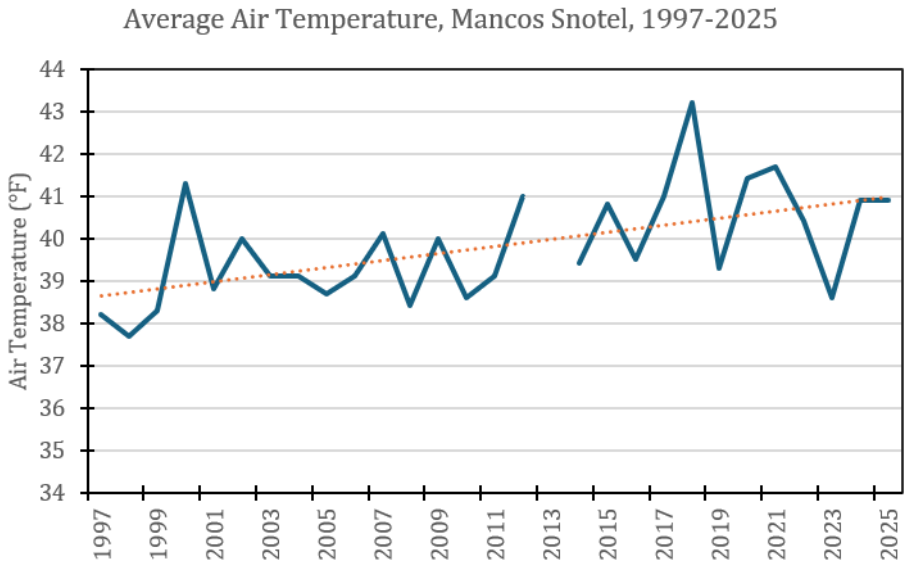


Figure 4. Average air temperature, measured in degrees Fahrenheit, at the Mancos SNOTEL site from 1997-2025.

A weather station in the town of Mancos provides similar temporal availability of air temperature. Maximum daily temperatures and minimum daily temperatures in the town of Mancos are shown in Figure 5 and Figure 6. Both minimum and maximum temperatures have been trending in an increasing manner since 1990. The mean annual precipitation for the Mancos River basin is 16.2 inches (USGS, n.d.). The mean annual precipitation at the Mancos SNOTEL dating back to 1995 is 30.75 inches. This demonstrates variable precipitation regimes in the watershed. In the lower areas of the watershed, conditions are drier and warmer than the mean for the watershed. In upper areas of the watershed, conditions are wetter and colder than the mean.

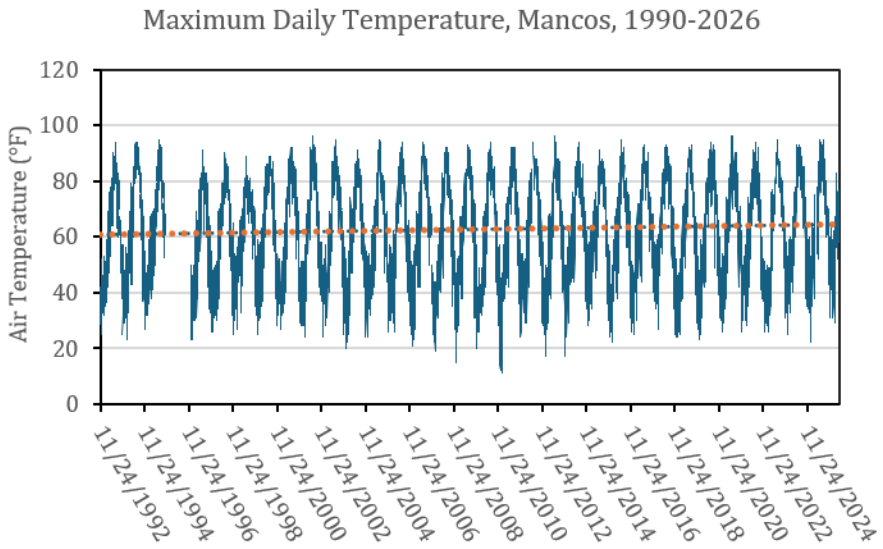


Figure 5. Maximum daily temperatures at a Mancos weather station located in town. Station ID is: USC00055327 sourced from the National Centers for Environmental Information.

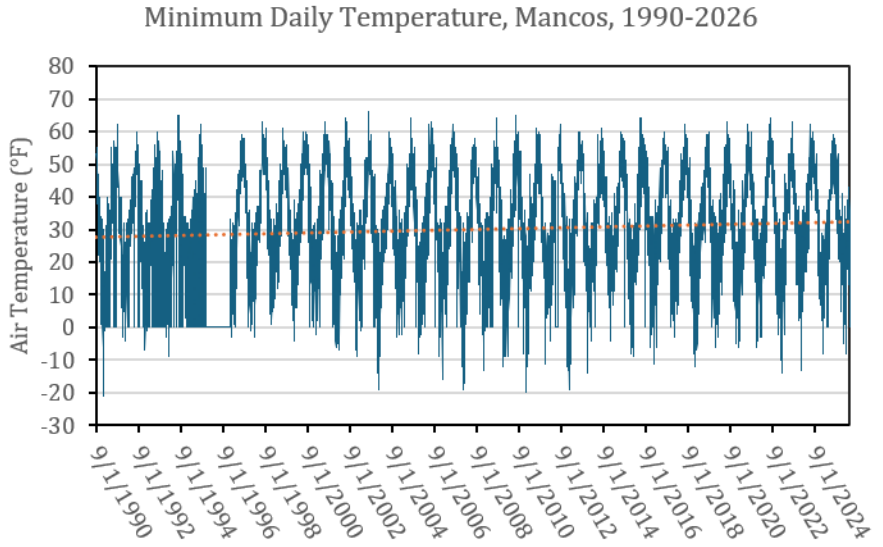


Figure 6. Minimum daily temperatures at a Mancos weather station located in town. Station ID is: USC00055327 sourced from the National Centers for Environmental Information.

Hydrology

The Mancos River begins its course surrounded by 13,000 ft peaks in the La Plata Mountains and flows down steep canyons and waterfalls to the semi-arid desert of the Mancos Valley at 7,475 feet near Mancos, Colorado. The hydrologic setting varies along with the weather patterns detailed above. Elevation profiles of the stream course highlight the steep terrain, with an average stream channel slope of 7 percent per mile, and maximum slope of 32 percent per mile.

The following information is sourced from the U.S. Geological Survey StreamStats program (https://www.usgs.gov/streamstats).

The East Mancos River drains an area of about 12 square miles with an average elevation of 9,691 feet above sea level. The basin receives an average annual precipitation of about 33 inches, with a

maximum annual precipitation of 51 inches. Mean annual streamflow at the mouth of the basin is about 3.5 cfs with maximum flows greater than 250 cfs, and minimum flows ranging from 1 to 1.5 cfs. The Middle Mancos River has a similar drainage area at 12 square miles but has less canyon development and less mineralization than the East Mancos. The Middle Mancos River basin receives an average annual precipitation of about 31 inches. Mean annual streamflow is about 11 cfs.

The West Mancos River drains 43 square miles with an average elevation of 9,550 feet above sea level. The basin receives an average annual precipitation of about 33 inches. Mean annual streamflow at the confluence with the East Mancos River are about 42 cfs with maximum flows greater than 450 cfs, and minimum flows ranging from 2.1 to 2.8 cfs.

There is a Colorado Division of Water Resources (DWR) gage upstream of the town of Mancos called Mancos River Near Mancos (MRNM). This gage provides a reference for hydrologic conditions in the upper watershed, but it is important to note that the gage is located below several major irrigation diversions. Data from this gage was utilized between 2000 and 2025 to provide a contemporary hydrologic reference below the confluence of the East, West and Middle Mancos Rivers. Between 2000 and 2025, the minimum acre feet in a water year was 3,346 in 2002. The maximum acre feet in a water year was 54,291 in 2023. Figure 7 shows the annual yield at MRNM between 2000 and 2025. As with gages lower in the watershed, there is great variability in annual yields between water years. Moving downstream, the USGS gage Mancos River Near Towaoc (MRNT) provides a long-running hydrologic dataset dating back to 1921. The minimum acre feet of water (ACFT) per year between 1921 and 2023 was 1,251. The maximum acre feet of water at MRNT was 100,204. This range of total flows implies a highly variable flow regime dependent on upstream precipitation, snowpack, and water usage. The average acre feet per year at MRNT from 1921-2023 is 34,020. The average acre feet from 2000-2023 was 21,335. Three of the five lowest yearly outputs in this dataset were in recent years: 2018, 2020, and 2021.

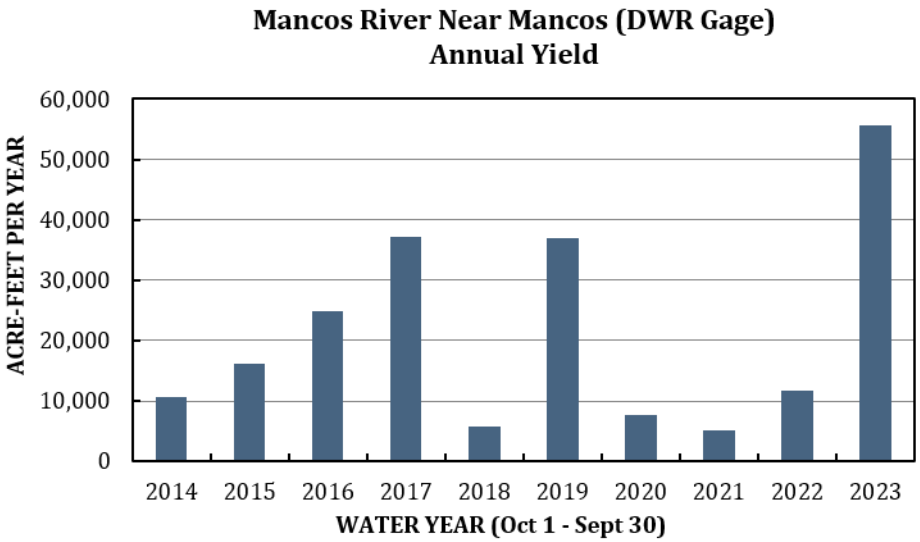


Figure 7. Annual yield at MRNM between 2014 and 2023.

A USGS gage was operated on the Mancos River near the confluence with the San Juan River between 2023 and 2026 (Figure 8) at the terminus of the Mancos watershed. The maximum mean

daily flow during this period was 686 cubic feet per second (cfs) in October 2024. During the operation of this site, the mean daily discharge measured zero 257 days out of 933.

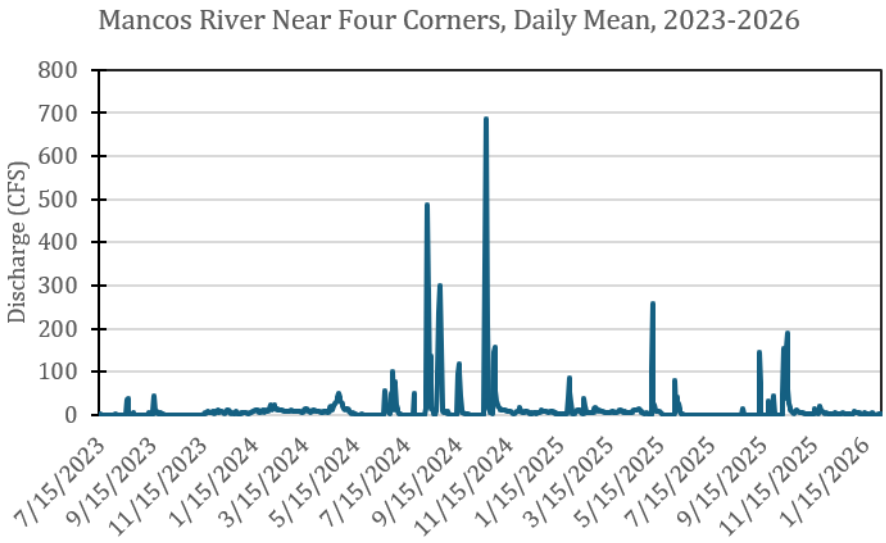


Figure 8. Mean daily discharge at Mancos River Near Four Corners (USGS) station.

When comparing water years, there are instances where the annual yield was greater at MRNM upstream than at MRNT downstream. Figure 9 compares annual yields at the two stations between 2000 and 2025. During the variability of annual yields in the watershed overall, the yields at MRNM are periodically greater than MRNT. 12 water years in this dataset had greater yields at MRNM upstream than at MRNT. Hydrologically, flows in the Mancos River do not always increase from upstream to downstream. This is potentially due to evapotranspiration into the atmosphere, infiltration into the ground, lower flows from tributaries downstream, and water usage.

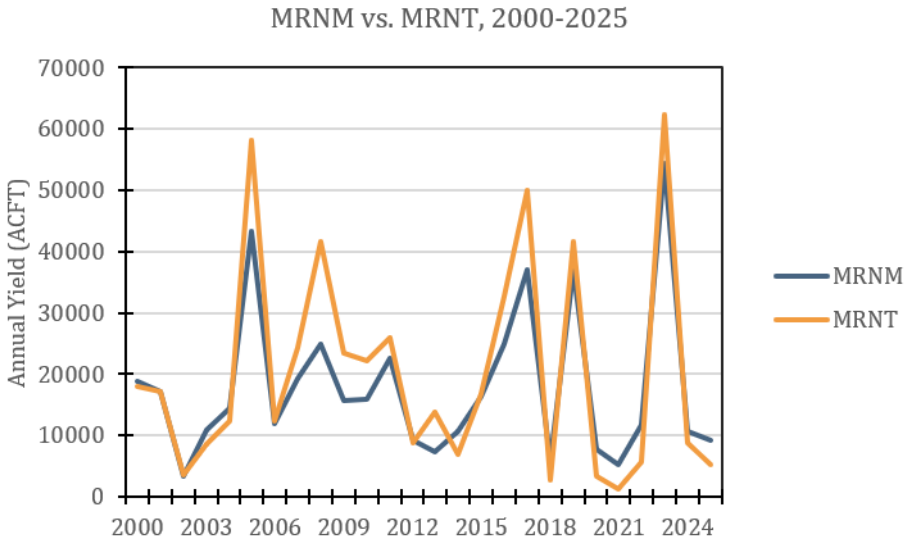


Figure 9. Annual yields, in acre feet, for MRNM and MRNT between 2000 and 2025.

Previous Studies and Historical Data

We evaluated numerous available datasets detailing water quality conditions in the Mancos River watershed and identified high concentrations of copper in some portions of the upper Mancos watershed particularly from the East Mancos watershed (CDPHE, 2012; Wright et al, 2020). The following discussion of historical data will focus on the initial impetus for this report—that metals, copper in particular, may be transported from the East Mancos watershed downstream to the confluence with the San Juan River.

Water quality data have been collected intermittently in the Mancos River watershed beginning in the 1970's with the Atomic Energy Commission (AEC) program called the National Uranium Resource Evaluation (NURE) (Smith, 2006). The sampling program included streambed sediment samples and field filtered and acidified water samples (Table H1 and Table H2). Samples collected in headwater streams during spring runoff in May 1976 show relatively low dissolved copper concentrations. However, these low concentrations were likely due to snowmelt runoff dilution. In contrast, samples collected from mainstem Mancos River on Ute Mountain Ute Reservation during September 1977 show relatively high dissolved copper concentrations ranging from 15 to 29 μg/L (micrograms per liter, or ppb). Streambed sediment samples, which are less subject to snowmelt dilutions, tell the opposite story and largely show high copper concentration in the headwaters and lower copper concentrations in the mainstem Mancos River (See Appendix H).

East Mancos Watershed

A 1993 study describing natural geochemical processes of acid rock drainage in the East Mancos River watershed provided important dissolved-metal concentration profiles for the East Mancos (Meyer, 1993). These water quality samples are in addition to intermittent East Mancos water quality samples collected by the Colorado Department of Public Health and Environment (CDPHE); U.S. Environmental Protection Agency (USEPA); River Watch of Colorado; the Mancos Conservation District (MCD); Mountain Studies Institute (MSI); Colorado Division of Reclamation, Mining, and Safety (DRMS); and the U.S. Geological Survey (USGS). Data from these combined sources show fluctuations in aluminum, copper, manganese, and zinc concentrations at the mouth of the East Mancos River from 1992 to 2024. Concentrations generally increase over time with several samples showing elevated concentrations in 2023 and 2024 (Figure 10 and Figure 11). For example, dissolved copper concentrations at the mouth of the East Mancos historically ranged from 7 to 50 ug/L, with an occasional spike up to 140 ug/L. In late 2024, dissolved copper concentrations increased to 1,400 and later 1,600 ug/L before decreasing to 500 ug/L. These fluctuating increases over time may be attributable to a warming climate, with possible melting of ice cores within alpine rock glaciers and possible melting of perma-frost in (Manning et al., 2024). However, the elevated concentrations observed in 2023 and 2024 are not so easily explained. Some of the water quality samples were collected after substantial rainstorms and may represent storm runoff events. Another explanation could be sediment mobilization in 2023 due to an above average runoff. Mineral exploration in Bedrock Creek on the La Plata River started in 2023, but it is unclear if or how these activities could have affected water quality in the East Mancos River. Sources and causes of the dissolved metal concentration spikes in the East Mancos remain uncertain.

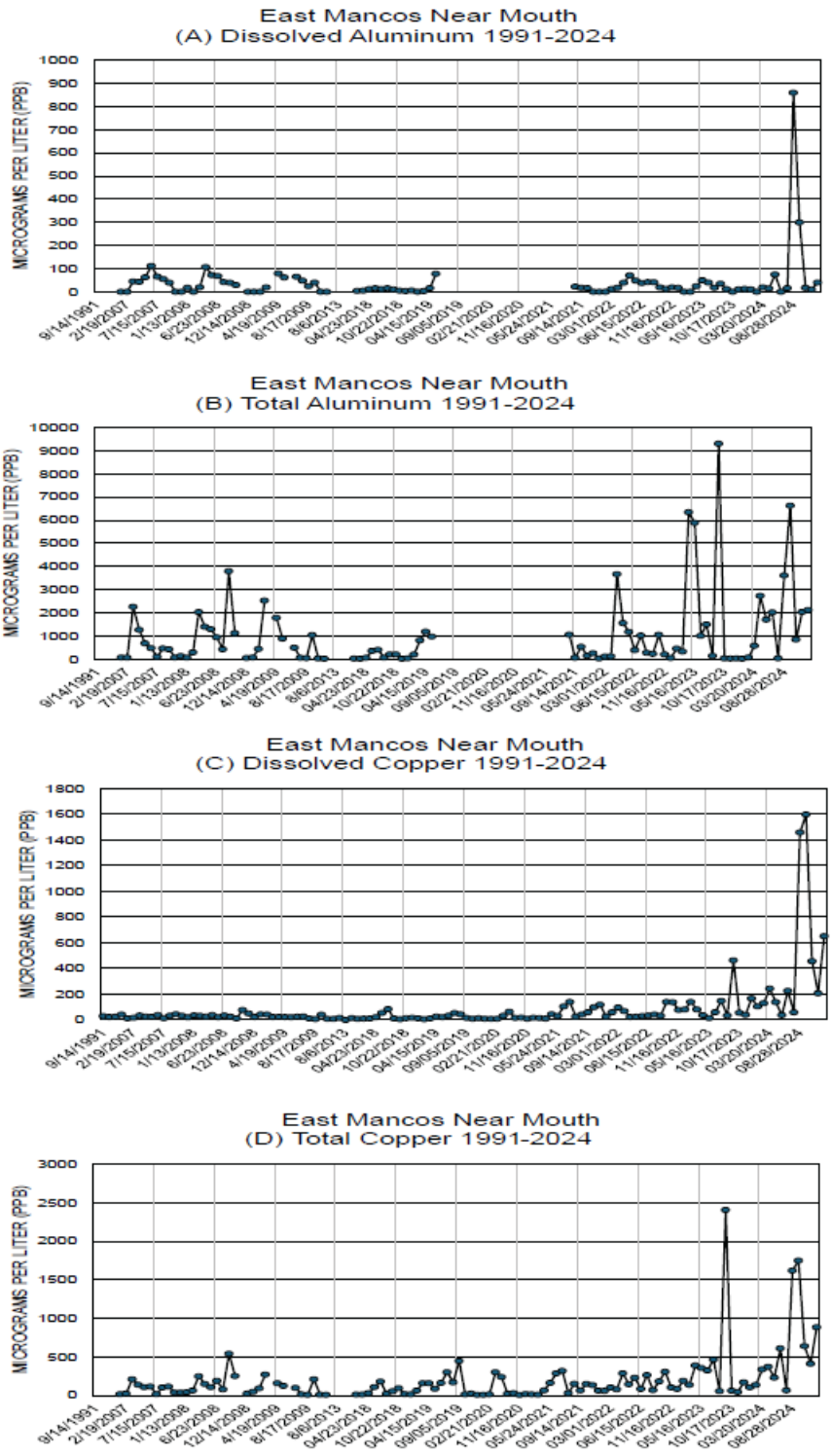


Figure 10. Historical concentrations of aluminum and copper in water from East Mancos River. Data from Meyer (1993), Colorado Department of Public Health and Environment (CDPHE), U.S. Environmental Protection Agency (EPA), Colorado River Watch, and Mountain Studies Institute.

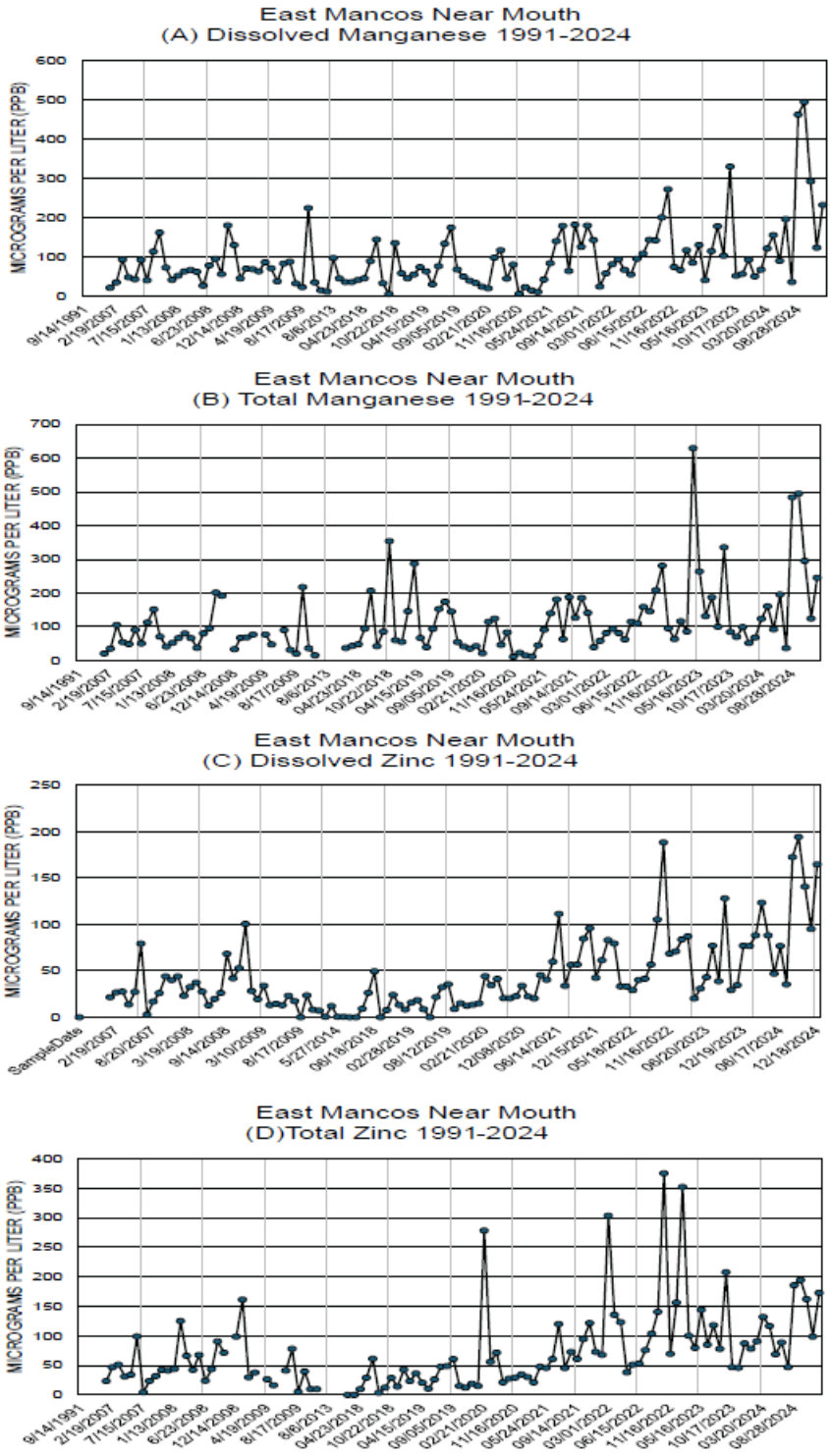


Figure 11. Historical concentrations of manganese and zinc in water from East Mancos River. Data from Meyer (1993), Colorado Department of Public Health and Environment (CDPHE), U.S. Environmental Protection Agency (EPA), Colorado River Watch, and Mountain Studies Institute.

Mass loads were calculated by multiplying metal concentration and streamflow discharge, resulting in pounds per day (lb/d) of metal loading for each sample event. Mass loading profile data were reported by Meyer (1993), Wright et al., (2020), and USGS (2026) for the East Mancos River (Figure 12). Calculating mass load removes the variability in concentration caused by different discharge values and allows for both comparison between low-flow and high-flow sample periods and evaluation of potential metal sources. Samples collected during dry or drought years generally produce lower mass loading results, while samples from the snowmelt-runoff period produce higher mass loading results. Consistent with observed patterns in concentration, dissolved copper loads in August 2023 are greater than loads from 3 previous low-flow sample events (1991, 1992, and 2018).

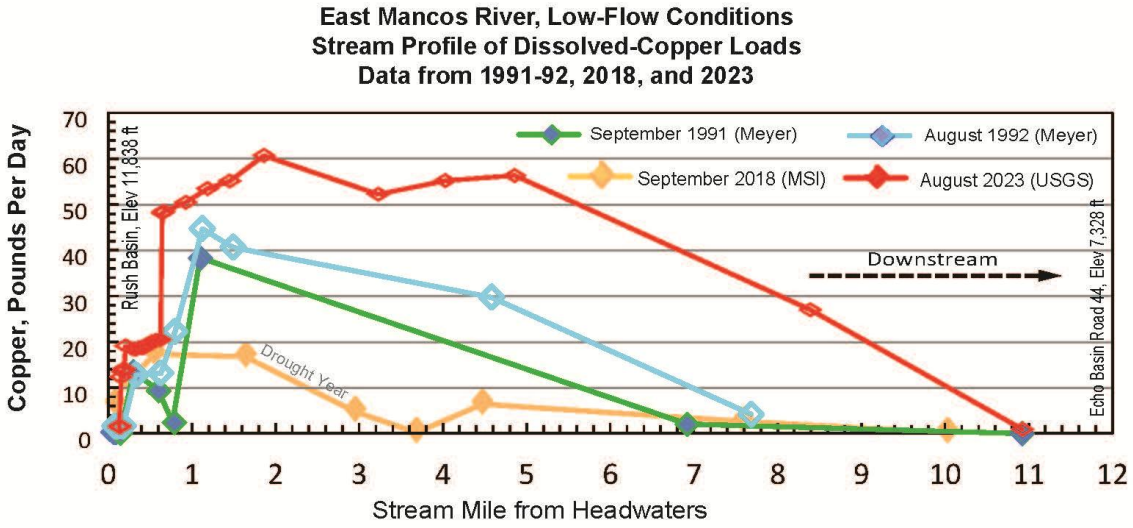


Figure 12. Mass loading stream profiles of dissolved copper during low-flow conditions. Data from Meyer (1993), Wright et al., (2020), and Manning et al. 2026).

As part of a state-wide effort to describe naturally occurring degraded waters, the Colorado Geological Survey collected water-quality samples from upper East Mancos River near Rush Basin (Neubert, 2000). From collection of samples on September 18, 1999 (late-summer low flow conditions), the report describes extensive bog-iron deposits and acidic stream waters with high concentrations of dissolved metals, concluding (p. 63):

> *"Past mining activities between this test site and the upper sample sites may affect water quality, but the effects are apparently dwarfed by the degraded runoff from the large exposures of altered bedrock and talus further upstream."*

In 2005, the Colorado Department of Public Health and Environment Hazardous Materials and Waste Management Division (CDPHE, 2005) conducted a reconnaissance study of the East Mancos watershed to examine impacts of historical mining on human health and the environment. The report describes elevated concentrations of cadmium, copper, iron, manganese, nickel, and zinc in stream water and bed sediments, concluding (p. 22):

> *"Based on the available data, it is apparent that impacts to water quality in the drainage originate from naturally occurring source areas in the headwaters and attenuate prior to the confluence with the main fork of the Mancos River. While mining activity has occurred in the*

drainage, ongoing impairments to surface water quality do not appear to be attributable to historic mineral extraction activities."

However, a 2012 re-evaluation of historical data by CDPHE to address copper and manganese impairment and to establish Total Maximum Daily Load (TMDL) for the East Mancos watershed concluded that metal sources in the East Mancos were predominantly related to mining activities (CDPHE, 2012). The report attributed 85% of copper and manganese to historical mining sources and set a maximum range of dissolved copper concentrations at 5-15 ug/L. Previous publications regarding natural background metals in the upper East Mancos and our own water quality data collected over multiple years do not support the TMDL report's finding that most of the copper and manganese loads are related to mining activities. Rather, most data suggest that water quality impairment is due primarily to natural background and augmented by historic mining impacts. Thus, the copper and manganese TMDL values for the East Mancos River likely warrant re-evaluation.

The most recent 303(d) list of impaired waters expanded the list of impairments on the East Mancos to include total arsenic, dissolved cadmium, total copper, total and dissolved iron, dissolved nickel, dissolved selenium, sulfate, and dissolved zinc. It also includes dissolved oxygen and pH on the monitoring and evaluation list. Dissolved copper and dissolved manganese remain the only analytes with a completed TMDL (CDPHE, 2026).

During 2018-2019, through grant funding provided by CDPHE to Mancos Conservation District (MCD), a detailed study of the East Mancos watershed was conducted by a collaborative group including the Division of Mine Reclamation and Safety (DMRS), Mountain Studies Institute (MSI), Southwest Hydro-Logic (SWHL), and MCD. Water-quality samples were collected from springs, streams, and draining mines and waste-rock samples from abandoned mine sites (Wright et al., 2020). Results demonstrated extremely high concentrations of dissolved copper in the upper East Mancos watershed with concentrations attenuating towards the mouth of the watershed (removed from dissolved phase due to natural geochemical processes of mixing and precipitation). Samples collected high-flow conditions in May-July of 2019 showed decreased dissolved copper concentrations, likely due to dilution from snowmelt runoff, but increased mobilization throughout the watershed. Waste-rock leachate extractions from abandoned mine sites showed a wide range of low, medium, and high concentrations of copper with potential for leaching into streams caused by snowmelt or rainfall on the waste rock piles (Appendix H).

Weekly water quality samples and discharge measurements at the mouth of the East Mancos River (EM-25A) during March- July 2019 showed increasing discharges during March-July, with the discharge peak occurring on June 12 (Appendix H6). Time series of metal mass loading indicates that the loads for many constituents peaked before peak streamflow. Other constituent loads, such as dissolved copper and dissolved zinc, peaked with discharge and continued to increase after peak streamflow. Dissolved copper concentrations at the East Mancos mouth during the 2019 snowmelt runoff period ranged from 6 to 52 ug/L, while total copper concentrations ranged from 52 to 1,070 ug/L (Appendix H7). During fall and winter low-flow periods, metal solids accumulate on the streambed throughout the upper and middle reaches due to mineral supersaturation and precipitation. Then, during runoff, these metal solids are flushed from the streambed (Figure 13), causing increased metal concentrations and loads at the mouth of the watershed.

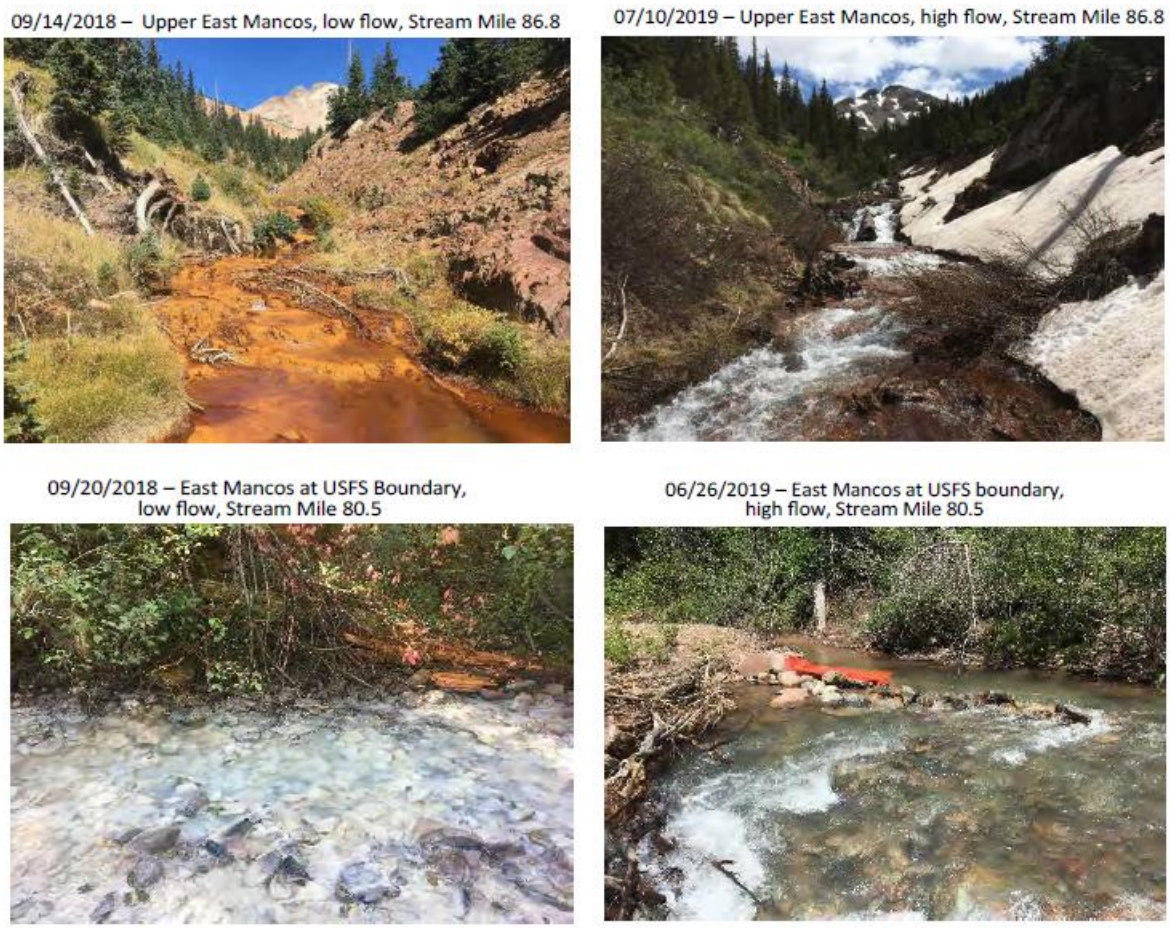


Figure 13. Photo comparison of the East Mancos River during low-flow conditions showing mineral precipitates, before and after snowmelt runoff during high-flow conditions showing that mineral precipitates had been scoured from the streambed. Mineral solids were transported out of the basin by snowmelt runoff (Wright et al., 2020).

These results prompted the current investigation (this report) into whether aqueous metals from the East Mancos watershed are transported downstream into and through the Ute Mountain Ute Reservation.

Lower Mancos Watershed

Samples collected by UMUT staff in the Mancos River above Weber Canyon Creek from 1995 to 2020 show total copper concentrations ranging from below detection to 70 ug/L, with a copper spike occurring on April 10, 2012 (Figure 14). Samples collected in the Mancos River below Weber Creek from 1994 to 2020 show total copper concentrations ranging from below detection to 233 ug/L, with a copper spike occurring on August 6, 2012 (Figure 14). The high April 2012 result occurred prior to the irrigation season, whereas the high August 2012 result occurred during irrigation season, possibly following a rainstorm. Since Weber Canyon Creek drains farmland irrigated by East Mancos water (East Mancos Highline Pipeline), Weber Canyon Creek likely contributes copper and other metals to the Mancos River on Ute Mountain Ute tribal land. The mainstem of the Mancos River before if confluences with Weber Canyon Creek is on the 303(d) list of impaired waters for Colorado for total arsenic, dissolved manganese, and macroinvertebrates, as well as an M&E for sulfate. Weber Canyon Creek is impaired for macroinvertebrates (CDPHE, 2026).

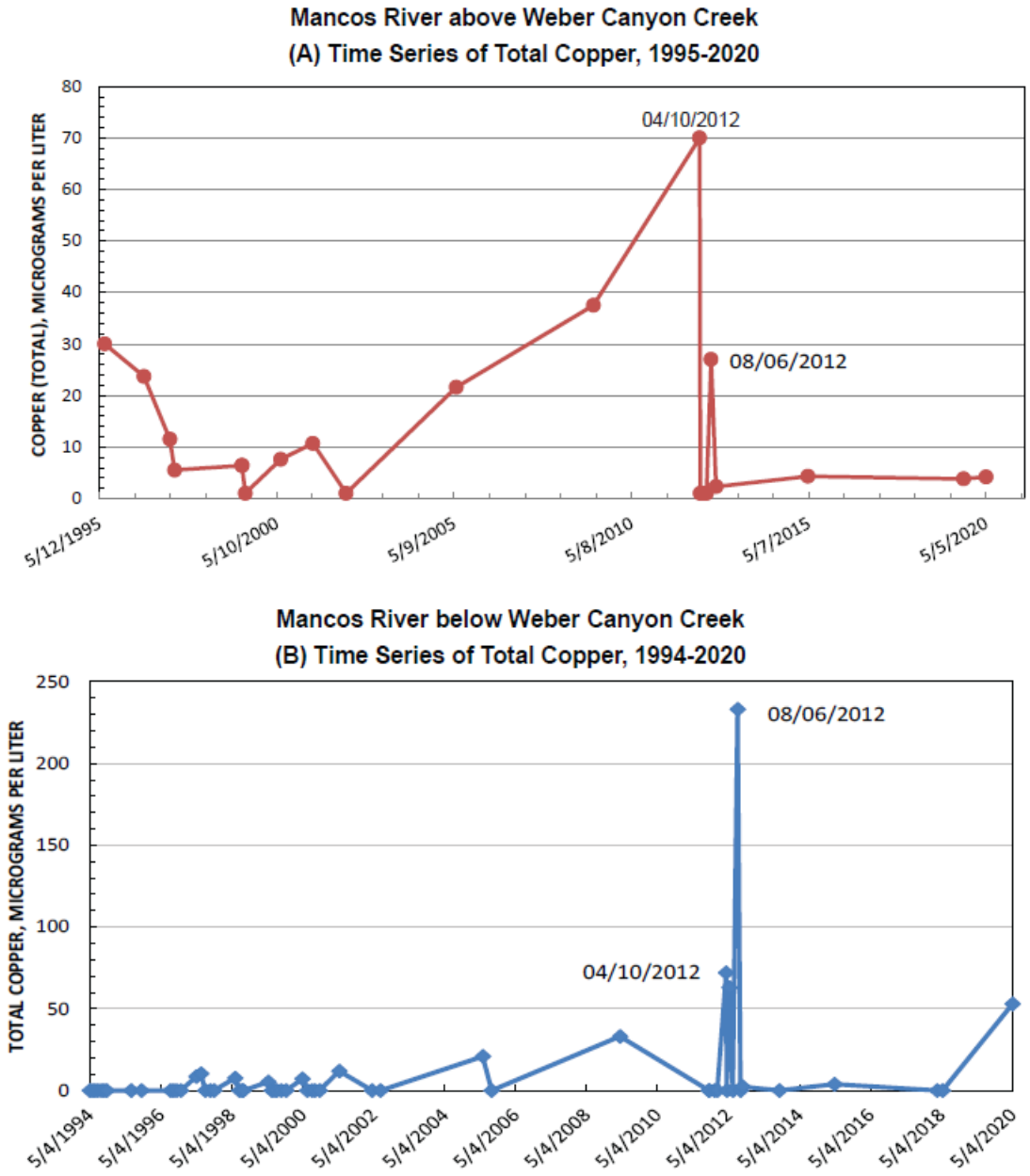


Figure 14. Concentrations of total copper in water samples collected by the Ute Mountain Ute Tribe, at Mancos River above Weber Canyon Creek, just after entering Tribal land, and Mancos River below Weber Canyon Creek. Data from USEPA WQX Data Base.

As the Mancos River flows through the Ute Mountain Ute property, several tributaries enter the canyon, where intermittent water quality samples have been collected below the confluences. Metal concentrations decrease through the Mancos Canyon due to attenuation and dilution by less mineralized tributary inflows. The Mancos River crosses U.S. Highway 491 south of Towaoc, where the USGS has operated a streamflow gaging station since 1986. Water quality samples have been collected intermittently at the gaging site since 2004 (Figure 15). Whereas dissolved copper

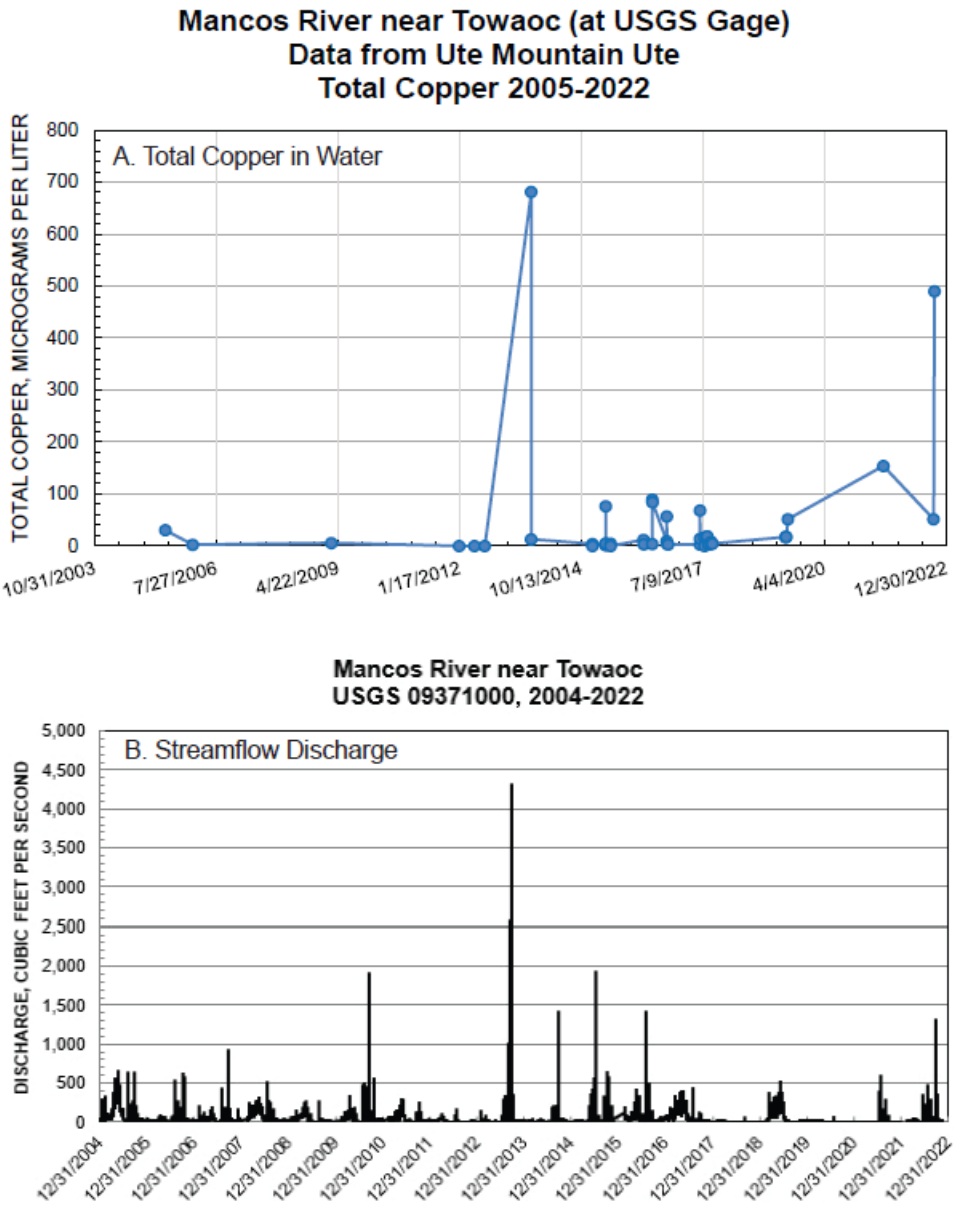


Figure 15. Total copper concentrations in water from the Mancos River near Towaoc (a); streamflow discharge at the USGS streamflow gaging station 2004-2022 (b).

concentrations are typically low at the site, total copper concentrations show an occasional spike, likely caused by late summer thunderstorms and transport of copper-laden streambed sediments.

The Mancos River frequently dries up through lower reaches of the watershed. When it's not dry, the Mancos River continues below Highway 491 through Ute Mountain Ute lands where other tributaries enter the stream, including Navajo Wash and Ute Canyon. From intermittent samples from these tributaries in the lower reach, aqueous metals have been occasionally documented in water samples collected by the tribe. As the river leaves Ute Mountain Ute tribal lands, it flows for a short reach through the Navajo Nation towards the confluence with the San Juan River. Occasional spikes of dissolved and total copper concentrations have been documented by samples collected by

the Navajo Nation Environmental Protection Agency (Figure 16). However, these spikes may not necessarily be related to copper from the East Mancos or West Mancos headwaters.

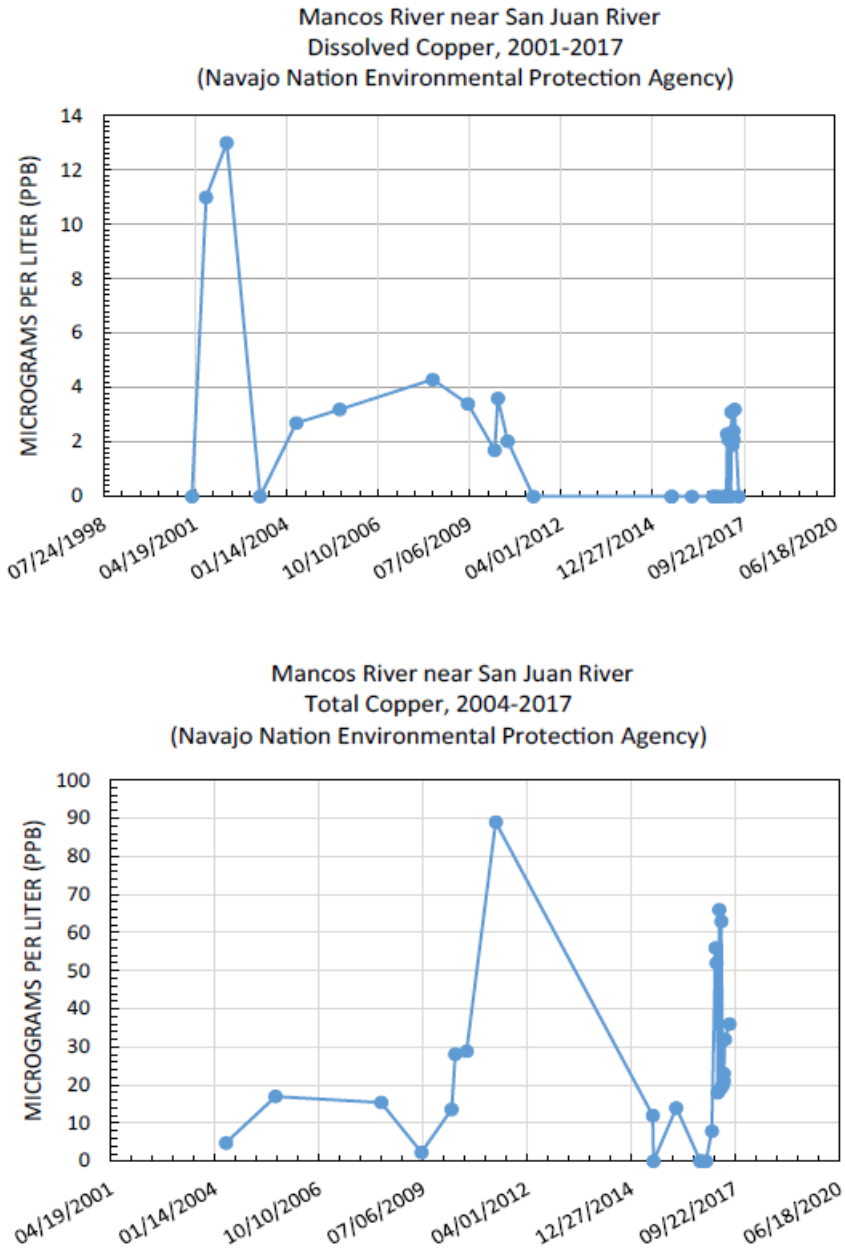


Figure 16. Time series of dissolved and total copper concentrations for the Mancos River near the San Juan River (data provided by Navajo Nation Environmental Protection Agency.

The USGS has operated a streamflow gaging station at the Mancos River near San Juan River from 2023-2026. However, the gaging station will be discontinued starting in October 2026. The stream is frequently dry at the site, with an occasional discharge spike due to thunderstorms. Causes of the dry lower Mancos River (zero flows) are primarily related to irrigation diversions in the Mancos Valley upstream from the Ute Mountain Ute Nation, where the river is often completely diverted for agricultural uses. Additionally, there are numerous reaches of the Mancos watershed where the

water sinks into the streambed (called a losing stream). These reaches include the East Mancos River above the USFS boundary, Mancos River through the Mancos Valley, and Mancos River from Grassy Canyon to Highway 491. It is uncertain where the water goes through these losing reaches but is assumed that it is lost to the regional groundwater system.

During August 2023, the USGS conducted a hydrogeochemical investigation of the upper East Mancos watershed, applying stream tracer-dilution testing combined with intense water-quality sampling. The work by Manning and others (2026) included the placement of shallow hand-installed piezometers on the left and right banks of selected reaches in the upper basin to describe groundwater inflows and chemistry. The study concluded that most dissolved metals were sourced in the very upper portions of the basin where mineralized springs emerge, forming massive quantities of iron and copper stream deposits, also described by Wright and others' (2020) report (Appendix H8). The Manning report concluded that more than 80 percent of the copper and other metals in the East Mancos River are sourced from the upper mineralized springs while only 15 percent of the metals may be sourced from mines and waste-rock piles. However, the study was conducted during low flow conditions in 2023, and authors note that contributions from mining sources may be greater during snowmelt runoff and high-flow conditions (Manning et al, 2026). The report also makes an effort to assign mining-related metal loads to waste-rock piles but did not mention the possible effects of groundwater flow paths through subsurface mining features.

Methods

For consistent and reliable surface-water and water-quality results, the field work performed as part of this report followed established protocols for streamflow gaging stations, streamflow discharge measurements, and water-quality sampling. Team members were provided with field equipment and accessories to ensure consistent execution of protocols between the numerous sites and field conditions, including health and safety considerations.

Stream Flow Discharge Measurements

Discharge measurements made by team members were performed by wading across a stream with a point velocity meter using the mid-section method. A measuring tape is stretched across the stream, perpendicular to the flow, subdividing the stream into sections. At each section, the stream depth is read from the wading rod, and a water velocity reading is made at numerous points across the stream (up to 20 or more) depending on the stream width. This is a standardized method that has been by the USGS for over one hundred years (Rantz, 1982). Stream velocity can be measured by mechanical meters spinning vanes or cups to obtain a velocity, in feet per second (ft/sec). For this project, mechanical meters included the pygmy and AA-Price current meters. Electromagnetic meters, such as the Hach FH950.1 used on the project, measure an electrical signal generated in response to relative motion between the velocity meter and water to provide a velocity. The cross-sectional area of each section is multiplied by the stream velocity to obtain discharge, where summing all sections together results in streamflow discharge, in cubic feet per second (cfs).

In the case of high-flow events, the streams are frequently too deep and fast to wade across the stream. For this project, a mechanical boom was constructed to be used at bridge crossings over the Mancos River where the AA-Price current meter was lowered into the water, suspended by a cable and reel (Figure 17). Stream depths are read from a counter on the reel, and discharge is calculated for sections across the stream, similar to a wading measurement.



Figure 17. Examples of water quality and streamflow sampling methods: trailer-mounted mechanical boom for measuring streamflow discharge during high-flow events when too deep/fast to wade (top left), turbid snowmelt runoff water in East Mancos River at the staff gage (top right), and portable glove box for sampling and filtration of water quality samples (bottom).

Streamflow Gaging Station

Streamflow gaging stations consist of a stream-site installation where depth-sensing (stream stage) instrumentation is installed at a deep point in the stream, and the site is operated such that a continuous record of stage and discharge can be obtained. As part of this project, multi-sensing continuous data loggers were installed (In-Situ Aqua Troll 200), which contain a pressure transducer to measure stage, a temperature sensor to measure stream water temperature, and a conductivity sensor to measure and record specific conductance. As part of this project, a gaging station was established at the mouth of the East Mancos (site EM-25A) during September 2023, and a second gage was installed during March 2026 in the Mancos River above Weber Creek (site MRAW), within the Ute Mountain Ute boundary.

Over the period of record, streamflow discharge measurements were made at each site (up to 20 measurements), with corresponding stage readings recorded by the data logger (intervals of 15 minutes to 1 hour). Graphical relationships were established for stage versus discharge (called the rating), and equations were developed to represent a continuous record of streamflow discharge.

A staff gage was installed at the East Mancos gaging site, and a trail camera was set up on a tripod, and pointed at the staff gage. Still photos of snowmelt, high-flow runoff showed the increased stream stage, but also the colors and turbidity of the stream water. Capturing an image from the day of synoptic sampling on May 30, 2023, the photo in Figure 17 shows the milky copper-colored stream water representing aluminum, copper, iron, and manganese suspended in the stream water.

Collection and Processing of Water-Quality Samples

As part of this study, water-quality samples were collected from springs, streams, and mines and analyzed for major ions, total and dissolved metals, and dissolved organic carbon. Waste-rock soil samples were collected and analyzed for leachate potential using SPLP leachate extractions analyzed for dissolved metals. Water-quality and leachate samples were analyzed by Green Analytical Laboratories (GAL) in Durango, Colorado.

Field data collection included measurement of the field water-quality parameters temperature, pH, specific conductance, and dissolved oxygen. Data collection included discharge measurements at each water-quality site, performed by flow anemometer (pygmy or AA), velocity sensor (e.g. Hach FS950), portable flume, or volumetric method. Field laboratory data included analytical determinations for turbidity. Field methods included sample filtration and treatment within portable glove boxes to isolate the samples from interference (Figure 17).

Geographic coordinates of water-quality sampling sites were determined using the Global Positioning System (GPS) referenced to latitude and longitude (in decimal degrees) within the World Geodetic System of 1984 (WGS 84). Altitudes of sampling sites, in feet above mean sea level, were determined through a combination of topographic maps and GPS. Tools used to collect site coordinate data included the navigation software Gaia GPS™ operating on smart-phone platform, where multi-layered maps display the topography and aerial photography, and where site photographs can be acquired and stored.

Laboratory analytical determinations included major ions and trace metals. Concentrations of major ions and trace constituents were determined through a combination of inductively-coupled plasma optical emission spectroscopy (EPA 200.7), inductively-coupled plasma mass spectrometry (EPA 200.8), ion chromatography (EPA 300.0), and ultraviolet infrared analyzer (Standard Methods 5310C).

To gain a better understanding of the fraction of aluminum that is bioavailable and could pose risk to aquatic life, we used a relatively new sampling and analytical method developed by Rodriguez et al, 2019. Current water quality standards assess potential aluminum toxicity using total recoverable sample preparation, but recent research suggests that total recoverable sample preparation may overestimate toxicity to aquatic life especially in locations with naturally occurring aluminosilicates (Ryan et al. 2019). In order to differentiates nonbioavailable from bioavailable forms of aluminum, we collected unfiltered, unpreserved surface water samples, added sodium acetate buffer solution to obtain a pH of 4.0–4.2, agitated for three hours at 100 rpm, filtered through 0.45-µm filter, and analyzed for aluminum using ICP-OES (Rodriguez et al. 2019). These processing steps were conducted by GAL.

Field analytical methods include analysis of turbidity by field spectrophotometry. Field meters were calibrated in the morning on the day of water-quality sample collection. Field meter calibrations, measurements, sample filtration, and sample preservation were done according to

water-quality field methods developed by the USGS (Horowitz, 1994; Wilde, 2014). Methods and reporting limits for water-quality field parameters are shown in the Appendix M. Water-quality samples were filtered and processed using a peristaltic pump, positive-displacement sample pump, and(or) 60-mL syringe. Site waters were passed through a 0.45 um (micrometer) capsule filter into sample bottles within a portable glove box, where samples were acidified and preserved within the glove box. Unfiltered samples were placed directly into the sample bottles. Quality-assurance samples were collected, equaling approximately 10 percent of all samples collected during this investigation.

Collection and Processing of Mine Waste Rock Leachate Samples

Historical waste-rock piles were sampled for potential to leach metals into the West Mancos River. Waste rock and soil samples were collected from a minimum of ten to thirty locations at each site. Leachate samples of waste rock were extracted using the SPLP method (Synthetic Precipitation Leaching Procedure, EPA SW-846 Method 1312), which is a laboratory test used to determine if contaminants in soil or waste can leach out and potentially contaminate groundwater. It simulates the natural weathering process of acid rain or snow seeping through contaminated soil. Leachate water samples from the SPLP extractions were analyzed for the same parameters as water samples.

Collection and Processing of Benthic Macroinvertebrates

We collected benthic macroinvertebrate samples using a modified rectangular dip net coupled with a dolphin bucket and implemented the following protocols similar to methodology outlined by CDPHE (2010). At each site we collected ten samples at equal intervals along a 100-meter-long stream reach. We collected each sample by placing the net securely on the bottom of the river with the net opening facing upstream. Standing downstream of the net, we disturbed the substrate on the river bottom that is immediately upstream of the net. We lifted and scrubbed rocks and gravel by hand for approximately 30 seconds to ensure that BMIs were dislodged and drifted downstream into the net opening. For each sample, we disturbed an area of approximately 0.115 m^2 of substrate, which was estimated in the field by using the size of the net opening as a guide (*net opening is 46 cm by 25 cm; area of 0.115 m^2*). We then composited the ten samples into a single sample container representing 1.15 m^2 (1782 in^2) of habitat at each site. We followed this protocol to collect samples at WMAGB, WMAT, MRBW, MRJC, and MRBG.

Samples collected by MCD at WMAE, EM-25E, and MANMANCO followed River Watch protocols (Colorado River Watch, 2023).

Samples collected by MCD were processed and identified through the Colorado River Watch program. All other samples were processed and identified in the Mountain Studies Institute benthic macroinvertebrate laboratory in Durango, Colorado. Identifications were completed by Mountain Studies Institute and Dr. Michael Bogan (University of Arizona). We sub-sampled each field sample using a rotating drum splitter until a minimum of 500 organisms was obtained. Using a 10x microscope, we identified organisms to the lowest practical taxonomic level based on Merritt, Cummins, and Berg (2019). Dr. Bogan identified all Chironomidae and Acari taxa and served as a second taxonomist for our quality assurance program by independently verifying at least 10% of all taxa. After obtaining an acceptable subsample, we scanned the entire sample for and included all large and/or rare taxa that were found. We archived the remaining sample remnant in 80% ethanol.

Geochemical Modeling

Results from geochemical models provide an understanding of the dissolved metal species present in water samples. While water-quality standards address concentration of a dissolved element (for example, copper, symbol Cu), there are many forms of dissolved copper such as copper carbonate (CuCO3), copper hydroxide (CuOH+), copper phosphate (CuPO4-), copper sulfate (CuSO4), copper silicate (CuSiO2), copper chloride (CuCl), and cupric or "free" copper (Cu+2) (Stumm and Morgan, 1981). Copper readily complexes with organic carbon (Nordstrom and Munoz, 1994), and these metal-organic complexes affect aquatic toxicity (USEPA, 2007). Supersaturation of dissolved metal species occurs with just the right combination of dissolved metal cations and complexing anions to form solid precipitates on the stream bottom (for example, cuprous ferrite, symbol CuFeO2). In order to describe the distribution of dissolved-metal species and solid phases, the Wateq4f and Phreeqc geochemical models were implemented, which are computer programs written by the U.S. Geological Survey describing multicomponent, multiphase equilibrium and geochemical processes (Parkhurst and Appelo, 1999; Ball and Nordstrom, 1991; Nordstrom and Munoz, 1994).

Streamflow Discharge Data and Gages

In general, the Mancos River is one of the most diverted and controlled rivers in southwestern Colorado. Irrigation diversions begin high in the headwaters; for example, the Gold Run Ditch in the upper East Mancos diverts water out of the basin into the La Plata River basin; and the Summit Canal in the upper West Mancos diverts water out of the basin for Summit Reservoir. With 124 ditches and canals throughout the tributaries and mainstem Mancos River, ditch and canal diversions typically occur during irrigation season, April 15 to October 15 of each year; however, there are also many other diversions that occur out of season (free water conditions), with continuous diversions for municipal water systems. These diversions make it difficult to account for streamflow gains and losses, and excessive diversions cause streams to become dry. This is particularly a problem for the Mancos River through the Ute Mountain Ute Reservation, where the stream frequently has no flow below Mancos River at Grassy Canyon. Water rights for the ditches, canals, ponds, lakes, and wells are held according to the prior appropriation system of water law in Colorado.

Streamflow discharge data were important for this study to plan for water-quality sampling through observation of precipitation and snowmelt events, and to calculate constituent mass loading from sampling results. Continuous streamflow data were recorded by the following temporary or permanently installed streamflow gaging stations, in a downstream direction (Figure 18):

- East Mancos River at Mouth, site EM-25A, temporary station, data September 2023 to present, operated as part of this study. Data include water temperature and specific conductance.
- Mancos River near Mancos, site MANMANCO, permanent station, data August 1985 to present, operated by the Colorado Division of Water Resources.
- Mancos River Above Weber Canyon, site MRAW, temporary station, data April 2026 to present, operated as part of this study. Data include water temperature and specific conductance.
- Mancos River near Towaoc, USGS site 09371000, permanent station, data April 1921 to present, operated by the U.S. Geological Survey Water Resources Division.

- Mancos River Near Four Corners, USGS site 093710009, discontinued, data January 2023 through February 2026, operated by the U.S. Geological Survey Water Resources Division.

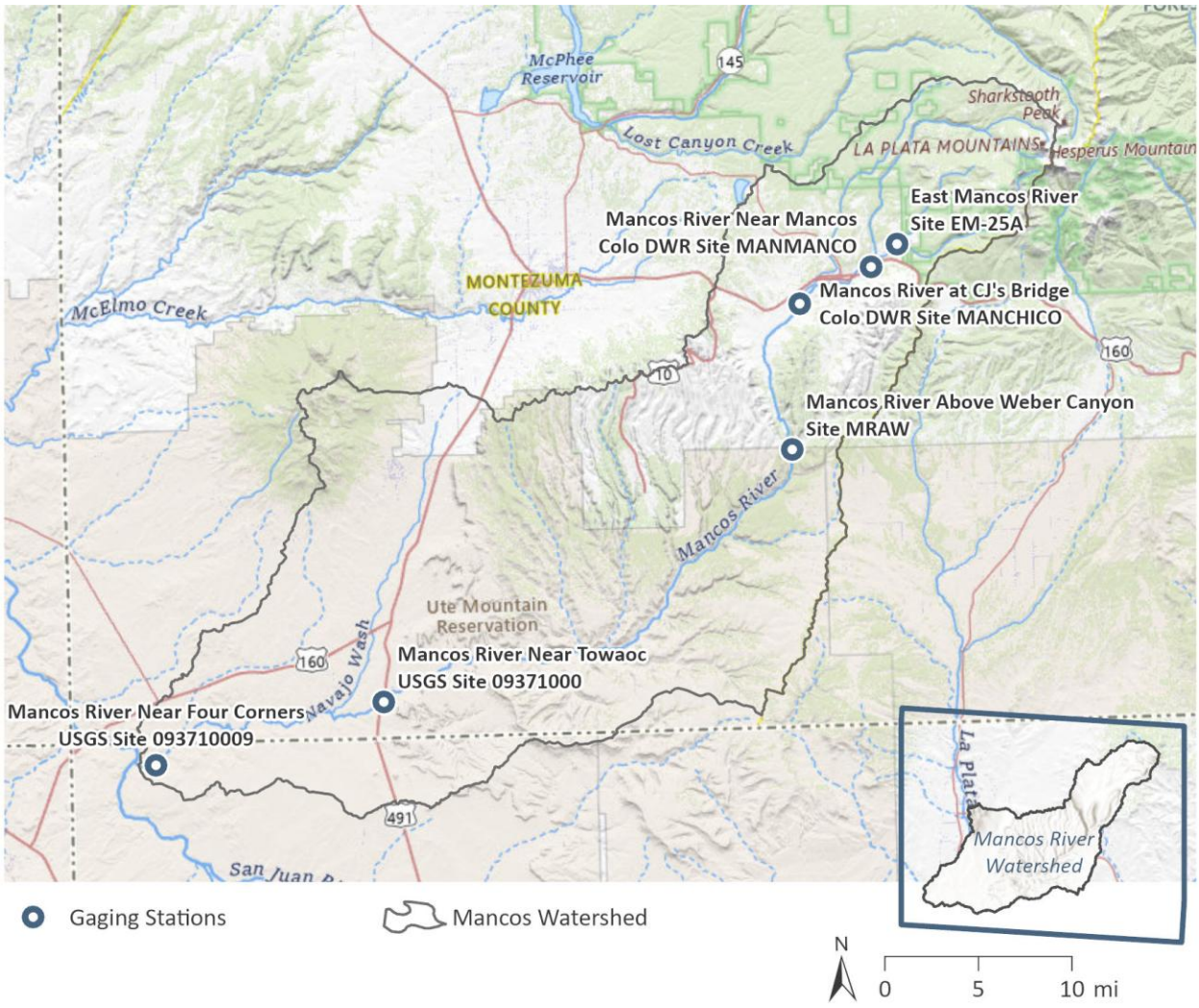


Figure 18. Temporary and permanently installed streamflow gaging stations in the Mancos watershed.

In addition to the streamflow gaging stations, a temporary staff gage was installed at the sampling location East Mancos near Mouth (downstream from EM-25A) where the USGS placed the mini-sipper automatic sampler, and a trail camera was set up to photograph the staff gage on an hourly basis.

There are other streamflow gaging stations along the Mancos River; for example, Mancos River near CJ's Bridge (site MANCHICO), operated by the Colorado DWR, and other stations that have been discontinued over time. The MANCHICO site is located downstream from Chicken Creek and is heavily influenced by numerous irrigation canals and withdrawals throughout the Mancos Valley. Water-quality samples were collected at MANCHICO, but the streamflow data are not included as part of this report. Another Colorado DWR site (MANJACCO) is located upstream from the Jackson Gulch Reservoir inlet canal, and this gage has operated since January 2000, with another DWR gage

(site JACCANCO) located on the inlet canal. Other gages have operated intermittently throughout the past, such as Mancos River Near Anitas Flat (USGS site 371508108212801); however, data availability are limited.

For the East Mancos site EM-25A, starting on September 23, 2023, streamflow discharge ranged from 1.28 to 227.9 cfs (cubic feet per second), with an average of 6.21 cfs (Figure 19). The discharge peak occurred on October 14, 2025 during a rain event. Stream water temperature at EM-25A ranged from -0.10 to 21.8°C (degrees Celsius), with an average of 5.54°C. Specific conductance of stream water ranged from 130.0 to 532.3 uS/cm (microsiemens per centimeter), with an average of 362.7 us/cm (Appendix S2).

For the Mancos River Above Weber Canyon site MRAW, starting on March 13, 2026, streamflow discharge ranged from 1.31 to 34.5 cfs, with an average of 6.6 cfs (Figure 19). The discharge peak occurred on April 1, 2026, where the cause cannot be easily explained, except for the possibility of breach and release of stream debris dam or earlier than seasonally anticipated snowmelt. Stream water temperature at MRAW ranged from 2.75 to 16.9°C, with an average of 10.3°C. Specific conductance of stream water ranged from 1,019 to 1,783 us/cm, with an average of 1,374 us/cm (Appendix S3).

For the Mancos River near Mancos site MANMANCO, during the period of this study starting in 2023, streamflow discharge ranged from 0.61 to 596 cfs (Figure 19). The discharge peak occurred on May 17, 2023, during the snowmelt runoff period of an above average snowpack in the La Plata Mountains. For the Mancos River near Towaoc USGS site 09371000, during the period of this study, streamflow discharge ranged from zero to 640 cfs, with an average of 31.8 cfs. The peak occurred during snowmelt runoff of May 2023. For the Mancos River near Four Corners site USGS 093710009, starting in June 2023, streamflow discharge ranged from zero to 686 cfs, with an average of 14.7 cfs (Figure S4). The peak occurred during the monsoon rains of October 2024 (Appendix S4C). Notice that the monsoon high flows of 2024 did not affect the upper basin sites EM-25A and MANMANCO, indicating localized thunderstorms impacting streams in the lower basin.

In an unaltered watershed, stream discharge typically increases as the river moves downstream and collects additional flow from tributaries. However, due to significant diversions on the Mancos River and the location of agricultural return flows, this pattern does not necessarily hold true for the Mancos River. Between the impetus of snowmelt runoff and before irrigation season begins, discharge on the Mancos follows a more typical pattern: the Mancos River at Towac (MRNT) as a downstream site below all major tributaries has the highest discharge and the East Mancos River (EM-25A) as a tributary to the Mancos River has the lowest (Figure 19). However after irrigation season begins in early to mid-June, the pattern generally flips. For example, in 2023, the Mancos River at Mancos (MANMANCO) has higher discharge values for the duration of irrigation season than the Mancos River near Towac (Figure 19). Similarly, in 2024, the Mancos River near Mancos had higher discharge than the Mancos River at CJ's bridge (MANCHICO) just on the other side of Mancos and downstream of a major tributary. During this same period, the Mancos River near Towac was lower than both upstream sites.

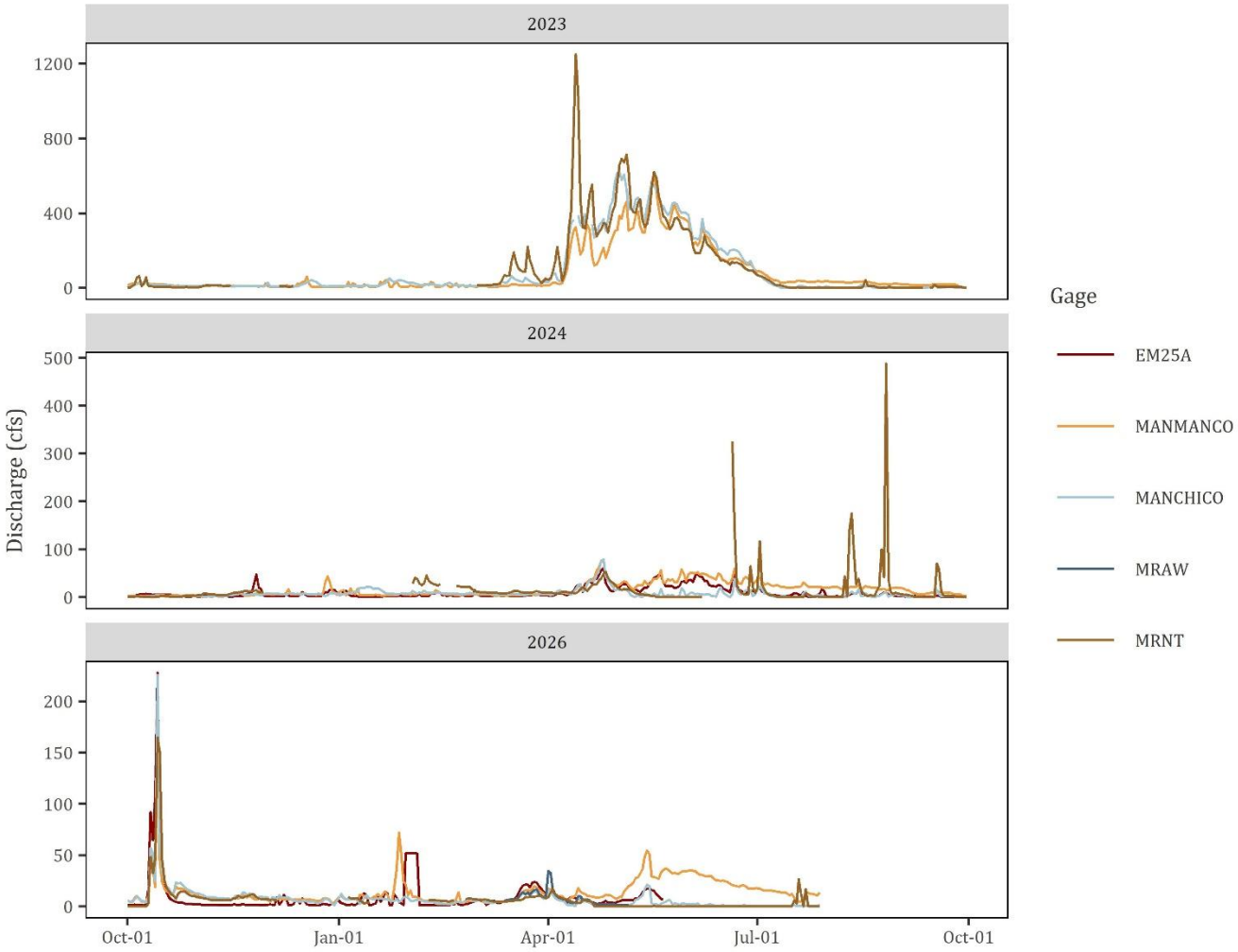


Figure 19. Discharge (cfs) at two temporary gaging stations (EM-25A and MRAW) and three permanent streamflow gaging stations (MANMANCO, MANCHICO, and MRNT) in the Mancos River Watershed for water years 2023, 2024, and 2026.

Thunder Mine Remediation, Implementation, and Associated Water Quality Assessment

Study Design and Site Background

Water-quality conditions of the East Fork Mancos River do not meet established standards for dissolved copper and manganese due to the combination of drainage from historical mines and natural background metal concentrations. A recent investigation into metal sources in the East Mancos River identified the Thunder Mine as a high priority potential remediation site due to its potential contribution of copper, arsenic, and lead to the East Mancos River (Wright et al., 2020). The Thunder Mine is located in the East Mancos Watershed and consists of a waste rock pile and a draining adit. An ephemeral drainage runs directly beside and underneath the site, dropping approximately 2,000 vertical feet over 0.4 miles to the East Mancos River. A long kill zone is located below the Thunder Mine waste rock extending approximately 2,000 feet downslope. Reclamation

recommendations consisted of consolidation and capping of the waste rock pile outside of the ephemeral drainage coupled with rerouting the adit drainage away from the waste rock.

The objectives related to the Thunder Mine reported here were:

- Remediate Thunder Mine site to reduce potential metal contributions to the East Mancos River.
- Assess the measurable result of Thunder Mine remediation through targeted water-quality sampling before and after remediation, and upstream and downstream of the remediation site.

The remediation of Thunder Mine is described in the DRMS Closeout report in Appendix TM.

Remediation of the Thunder Mine site was completed in summer 2024. Targeted water quality sampling occurred during a pre-remediation period from November 2022 to June 2024 and during a post-remediation period from September 2024 to April 2026. Water quality sampling locations targeted the Thunder Mine adit drainage, a location on the East Mancos River upstream of any potential influence from the Thunder Mine, and a location on the East Mancos River downstream of any potential influence from the Thunder Mine. Bracketing sampling locations upstream and downstream of where the Thunder Mine influences the East Mancos River was intended to capture any potential water quality impacts from the Thunder Mine pre- and post-remediation.

It is not readily apparent where water interacting with the Thunder Mine reaches the East Mancos River. In all site visits, water flowing from the Thunder Mine site disappeared from the surface a short distance below FS Road 567 and we never observed water draining from the Thunder Mine adit or Thunder Mine waste rock flowing as surface water all the way to the East Mancos River. However, site scouting suggested a direct surface flow path from the Thunder Mine portal to the East Mancos River confluence. This connectivity was evidenced by a continuous orange precipitate path extending from the base of the waste rock pile to the river. To allow a wide path of potential Thunder Mine influence on the East Mancos River we initially established bracketing sites accordingly. However, after visiting this reach of the East Mancos River during a variety of flow conditions, we found that there were numerous mineralized inputs along the south bank of the river (opposite side as the Thunder Mine, and unrelated to the Thunder Mine) that were flowing into the East Mancos River between our two sampling locations and thus potentially obscuring any signal of water quality influence from the Thunder Mine. Therefore, to more closely bracket the influence of the Thunder Mine we moved the downstream “below Thunder” sampling location approximately 1,900 feet further upstream to just below the ephemeral drainage where water originating from the Thunder Mine would most likely reach the East Mancos River (Figure 20). For site consistency, we focus our analysis on samples collected from this tighter bracketing of the Thunder Mine. Thunder Mine remediation in summer of 2024 successfully rerouted the adit drainage toward a new flow path to the northeast of the pre-remediation flow path. To ensure that our upstream monitoring site on the East Mancos River was still located upstream of any Thunder Mine influence we shifted the monitoring site upstream approximately 300 feet (Figure 20). There are no other notable inflows between these two locations.

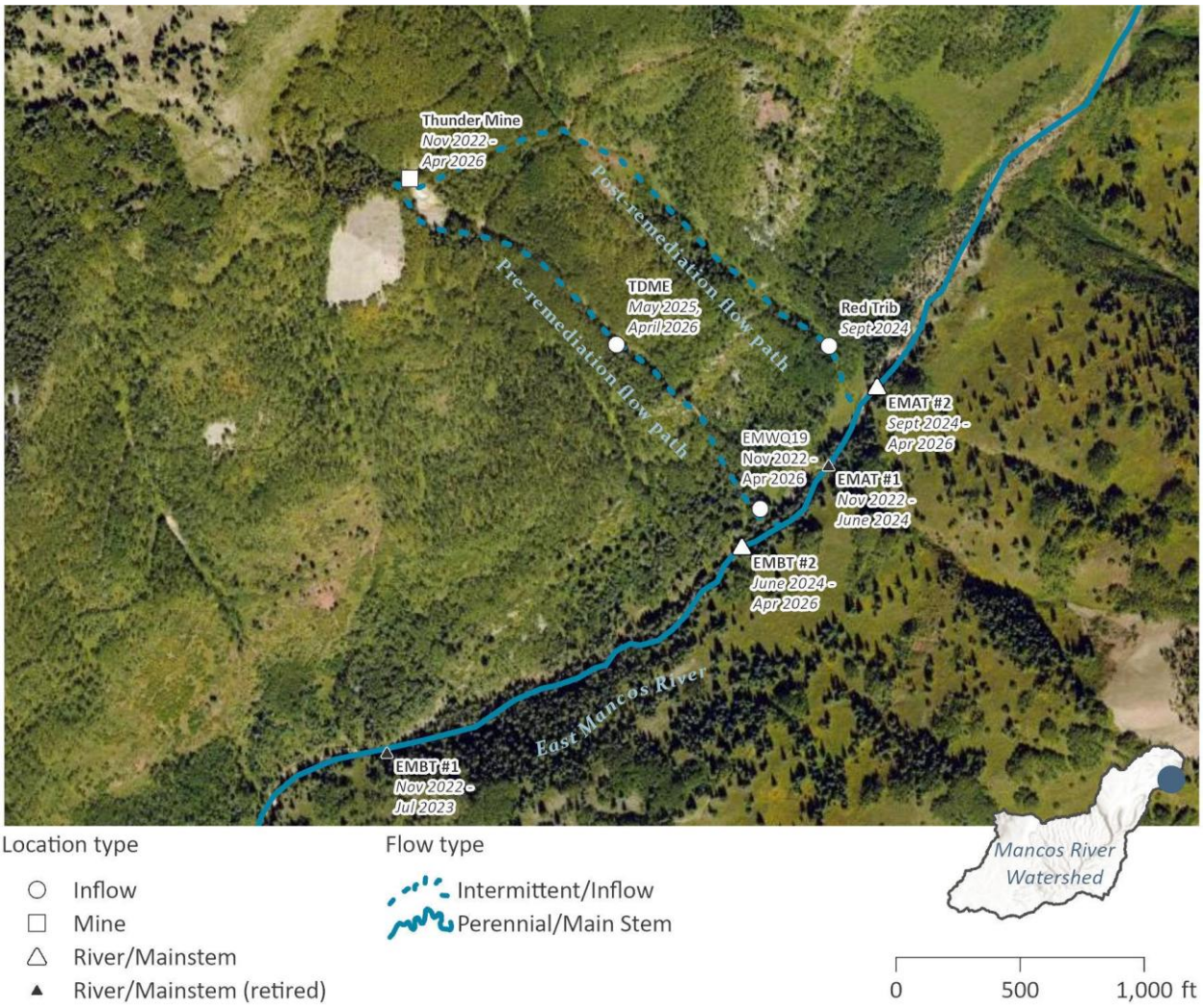


Figure 20. East Mancos water quality monitoring sites upstream (EMAT) and downstream (EMBT) of the Thunder Mine. Upstream and downstream sites were moved in 2024 to better bracket inflow from the Thunder Mine.

Since water did not continuously flow at the surface between the Thunder Mine and the East Mancos River (Figure 20, Figure 21), we tried to characterize the potential influence of the Thunder Mine on water quality by collecting water quality samples anytime we encountered surface water emergences along the theoretical flow path between the Thunder Mine and the East Mancos River. As our pre- and post-remediation sampling occurred across various water years and hydrologic periods, surface water emergences between the Thunder Mine and the East Mancos River were inconsistently present. We found the most consistent surface water emergence point potentially related to the Thunder Mine located at the downstream end of the ephemeral drainage below Thunder Mine (EMWQ19). During springtime conditions of 2025 and 2026 we found and sampled a surface water emergence about halfway down the ephemeral drainage below Thunder Mine (TDME).



Figure 21. Photo of slope with Thunder Mine and hypothetical flow paths down to the East Mancos River.

We also collected a sample during the post-remediation period from the post-remediation flow path in September of 2024 (RedTrib). Additionally, we sampled a blue colored spring likely unrelated to the Thunder Mine due to its topographical position upstream of EMAT#2 (EMBS). Numerous ephemeral drainages, complex groundwater flow paths, and emerging seeps and springs surround the Thunder Mine area. These opportunistic sampling sites were added to the study design to better understand surface water conditions in the area and potentially pinpoint where, if anywhere, Thunder adit water is reemerging before entering the East Mancos River.

Water Quality

Metal Concentrations

Metal concentrations and loads from the Thunder Mine adit vary across seasons and years. The sample from November 2022 had relatively high concentrations and loads of most metals. The July 2023 sample, taken as soon as the road into the site was passable, showed the lowest metal concentrations as well as the lowest metal loading. In 2024 and 2025, where we have both spring and fall samples within the same year, concentrations in the fall were generally higher than in the spring while loads during the spring were generally higher than during the fall (Figure 22).

The timing of our spring high-flow sample events was dictated by site access as to when the road was passable and steep slopes were snow-free enough to be safely navigate off-trail down to the

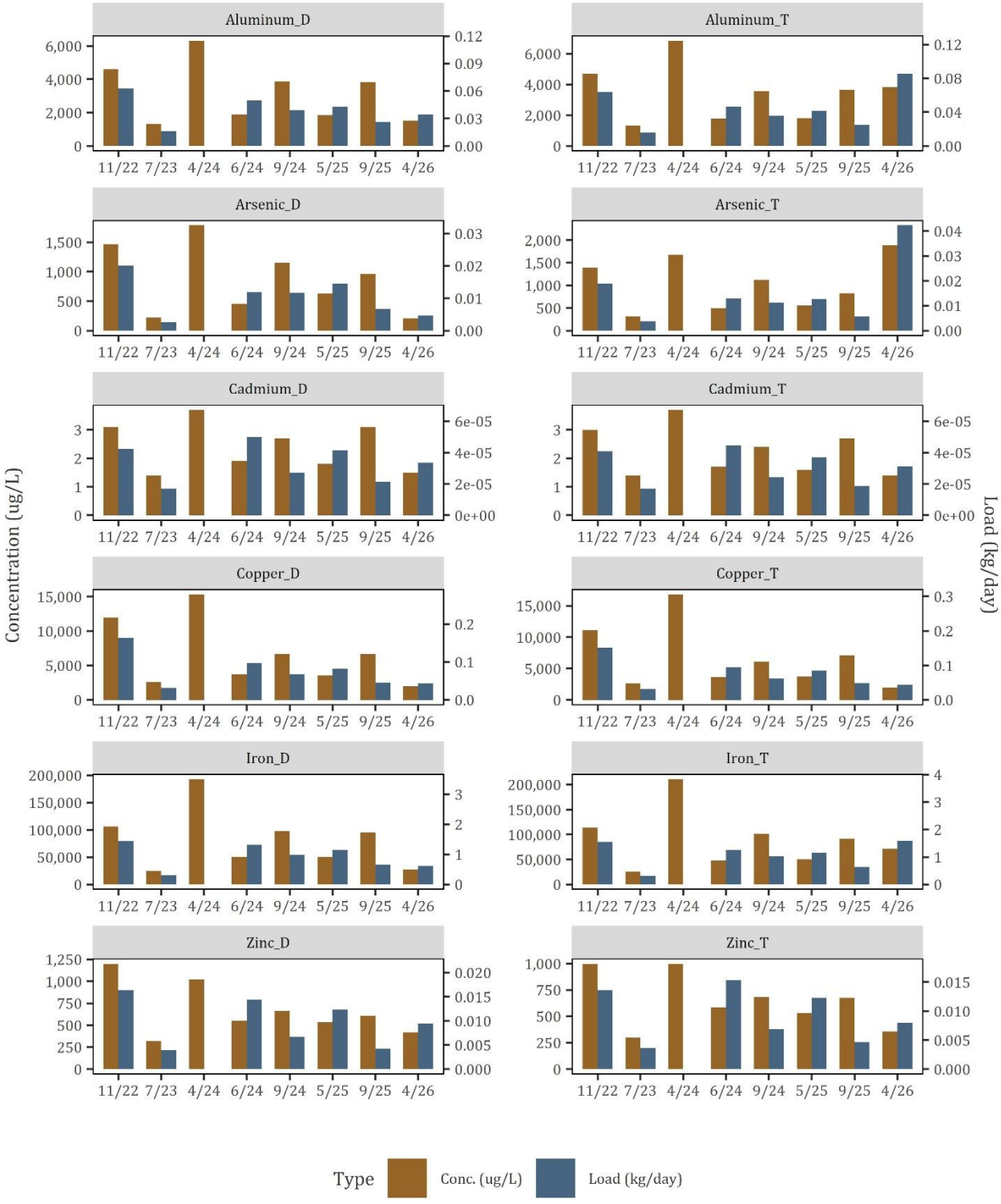


Figure 22. Metal concentrations (ug/L) and loads (kg/day) in water draining from the Thunder Mine adit. Discharge could not be measured in April 2024 due to snow coverage, so we do not present load for that sample event.

East Mancos River. We were however interested in what water quality conditions were like during peak snowmelt period when snowmelt water would be actively flowing through Thunder Mine waste rock. Therefore, we accessed the Thunder Mine site via skis in April 2024 while there was still widespread snow cover. Due to snow coverage on the steep slopes below the Thunder Mine, we still could not access the East Mancos River sites on this date but were able to collect a water quality sample from the Thunder Mine adit. This April 2024 Thunder Mine adit drainage sample had the highest concentration of most metals across all sample dates (Figure 22).

The low-snow coverage and accessible road conditions in the spring of 2026 allowed us to visit the Thunder Mine and East Mancos River sample locations earlier than usual in April of 2026. During this sample event, the Thunder Mine drainage had the highest concentration and load of total arsenic, but somewhat lower concentration and loads of copper and zinc compared to other sample events (Figure 22).

The high metal concentrations measured in the April 2024 Thunder Mine adit sample suggests that water quality conditions draining the Thunder Mine site may be poorest during the peak snowmelt period when unfortunately, there is typically too much snow to safely access our sampling sites on this remote reach of the East Mancos River.

To investigate how similar the water quality of sampled surface water emergence points downslope from the Thunder Mine was from the water quality of the Thunder Mine adit, we used Principal Component Analysis (PCA).

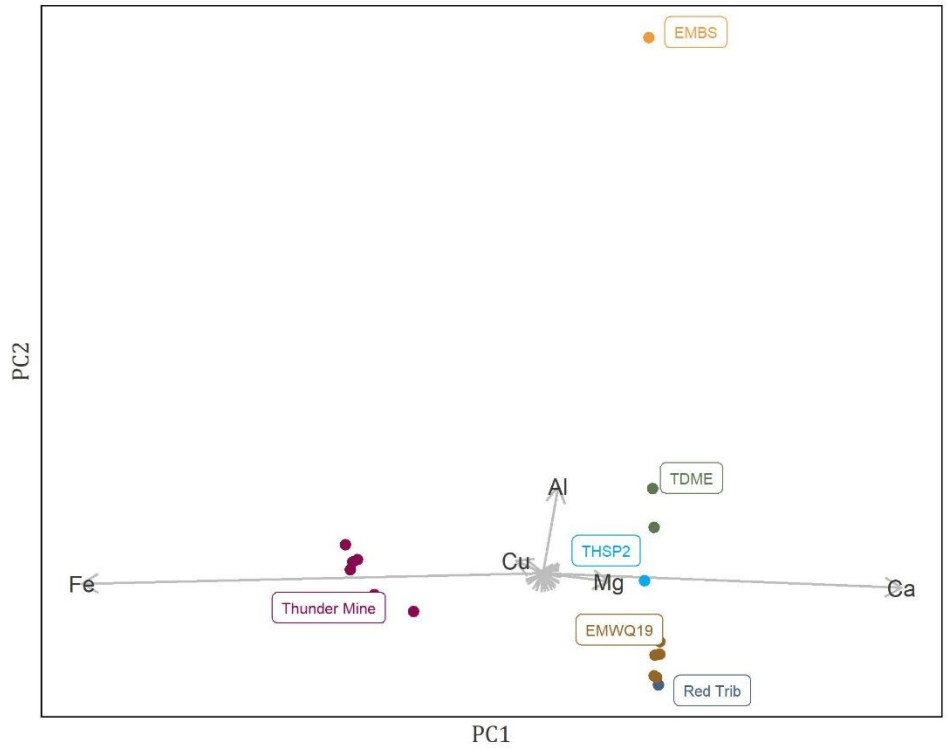


Figure 23. Principal component analysis of metal concentrations at water quality sampling locations adjacent to the Thunder Mine and the East Mancos River. Only the three primary vectors (aluminum, calcium, and iron) are displayed.

The PCA plot depicts samples from different sites across different sample events. Samples with more similar water quality are plotted more closely together while samples with less similar water

quality are plotted further apart from one another. Increased iron concentrations and decreased calcium concentrations primarily drive the separation of the Thunder Mine drainage water quality from other sampling locations while variations in aluminum concentrations differentiate EMWQ19 and the Red Trib from the Thunder Mine drainage mid-elevation emergence (TDME) site. EMBS, the blue spring located upstream of EMAT#2, had a water quality signature that differed from all other inflows. The water quality of samples from the Thunder Mine adit appear clustered together and isolated from other sites in the PCA plot, which suggests that the adit water quality differs substantially from the other sampled sites (Figure 23).

Evaluating a measurable response in East Mancos River water quality following remediation is made difficult by the fact that our surface water quality samples collected prior to remediation did not demonstrate an influence of the Thunder Mine on East Mancos River water quality. Most metals of concern decreased in concentration and decreased in hazard quotient (HQ) values in the East Mancos River as water flowed past the potential zone of influence of the Thunder Mine (Table 1, Figure 24, Figure 25).

Table 1. Metal concentration and hazard quotients (HQ) both before and after restoration at the East Mancos above the Thunder Mine (EMAT) and the East Mancos below the Thunder Mine (EMBT).

	Concentration fraction or Hazard Quotient type	Pre-remediation (June 2024)			Post-remediation (May 2025)			Post-remediation (Apr 2026)		
		EMAT #1	EMBT #2	Difference (EMBT- EMAT)	EMAT #2	EMBT #2	Difference (EMBT- EMAT)	EMAT #2	EMBT #2	Difference (EMBT- EMAT)
Aluminum	Dissolved (ug/L)	2650	2610	-40	4190	4000	-190	11900	10100	-1800
	Total (ug/L)	2910	2850	-60	4460	4360	-100	12200	9900	-2300
	Chronic HQ	354.9	203.6	-151.3	619.4	605.6	-13.8	1386.4	1650.0	263.6
	Acute HQ	223.8	123.9	-99.9	405.5	396.4	-9.1	871.4	1031.3	159.9
Arsenic	Dissolved (ug/L)	ND	ND	0.0	ND	ND	0.0	0.5	0.0	-0.5
	Total (ug/L)	2.1	1.3	-0.8	1.1	0.8	-0.3	1.0	0.9	-0.1
	Chronic HQ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Acute HQ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cadmium	Dissolved (ug/L)	0.8	0.7	-0.1	0.9	0.9	0.0	1.1	1.0	-0.1
	Total (ug/L)	0.7	0.7	0.0	0.8	0.8	0.0	1.0	0.9	-0.1
	Chronic HQ	2.7	2.3	-0.4	2.5	2.4	-0.1	2.4	2.2	-0.3
	Acute HQ	1.3	1.2	-0.2	1.2	1.1	0.0	1.1	1.0	-0.1
Copper	Dissolved (ug/L)	824.0	820.0	-4.0	1110.0	1070.0	-40.0	1530.0	1300.0	-230.0
	Total (ug/L)	785.0	785.0	0.0	1190.0	1140.0	-50.0	1500.0	1270.0	-230.0
	Chronic HQ	251.0	246.4	-4.6	265.7	250.1	-15.6	291.1	241.0	-50.1
	Acute HQ	185.4	181.7	-3.7	191.5	179.8	-11.7	204.9	169.2	-35.7
Iron	Dissolved (ug/L)	922.0	904.0	-18.0	1400.0	1300.0	-100.0	1220.0	752.0	-468.0
	Total (ug/L)	2830.0	2080.0	-750.0	1600.0	1570.0	-30.0	1850.0	1380.0	-470.0
	Chronic HQ	2.8	2.1	-0.8	1.6	1.6	0.0	1.9	1.4	-0.5
Zinc	Dissolved (ug/L)	78.4	78.9	0.5	94.5	92.4	-2.1	173.0	150.0	-23.0
	Total (ug/L)	66.3	65.2	-1.1	90.6	86.8	-3.8	145.0	127.0	-18.0
	Chronic HQ	8.2	8.0	-0.2	5.4	5.0	-0.4	5.6	4.5	-1.0
	Acute HQ	1.4	1.4	0.0	1.3	1.3	-0.1	1.9	1.6	-0.3

This remained true in the post-remediation period as well; most metals of concern decreased in concentration and HQ values from EMAT to EMBT. We calculated Hazard Quotients (HQs) that reflect potential toxicity for metals and, as described previously in Wright and others (2020), the

water quality of the reach of the East Mancos upstream of the Thunder Mine is not suitable for aquatic life, which indicates it has a diminished capacity for aquatic life to either respond favorably or negatively to remediation efforts. Following remediation, potential toxicity to aquatic life in the East Mancos downstream of the Thunder Mine did not demonstrate any evidence of substantial improvement.

Post-remediation Site Improvements

While neither pre- nor post-remediation impacts from the Thunder Mine were detected in the East Mancos River, the on-site improvements are substantial. Previously, the site's ephemeral drainage was filled with waste rock. During remediation, this waste rock was relocated out of the drainage channel, capped on-site, and covered with talus rock. This new flow path is entirely devoid of waste rock, significantly reducing erosion and preventing human contact with high-arsenic material. Although these distinct localized improvements are difficult to quantify in the East Mancos River—largely due to the difficulty in accessing the area during critical times of snowmelt infiltration and storm events—they provide clear, long-term water quality benefits to the greater Thunder Mine area.

Summary

Water quality improvements from the remediation of the Thunder mine could not be detected in the mainstem of the East Fork Mancos River due to several factors.

- Water from the Thunder Mine adit may not have reached the East Mancos River during our sampling events; or if it did, it traveled subsurface and likely mixed with other subsurface waters prior to reaching the East Mancos River, thus obscuring a signal of influence in the East Mancos River from the Thunder Mine site.
- Several surface water emergence points downslope of the Thunder Mine including TDME and EMWQ19 exhibited low pH and high metal concentrations but had water quality characteristics that were distinct from the Thunder Mine adit drainage (Figure 3), further suggesting subsurface groundwater mixing.
- If the measured discharge from the Thunder Mine adit did reach the East Mancos River, it would account for less than 1% of the East Mancos River discharge measured at EMAT during all sample events.
- Metal concentrations from the Thunder Mine adit appear to be the highest in the early spring during the peak snow-melt period (Figure 2). It is possible that the Thunder Mine site has a greater influence on East Mancos River water quality during early spring when widespread snow cover prevents safe access of East Mancos River sampling locations.

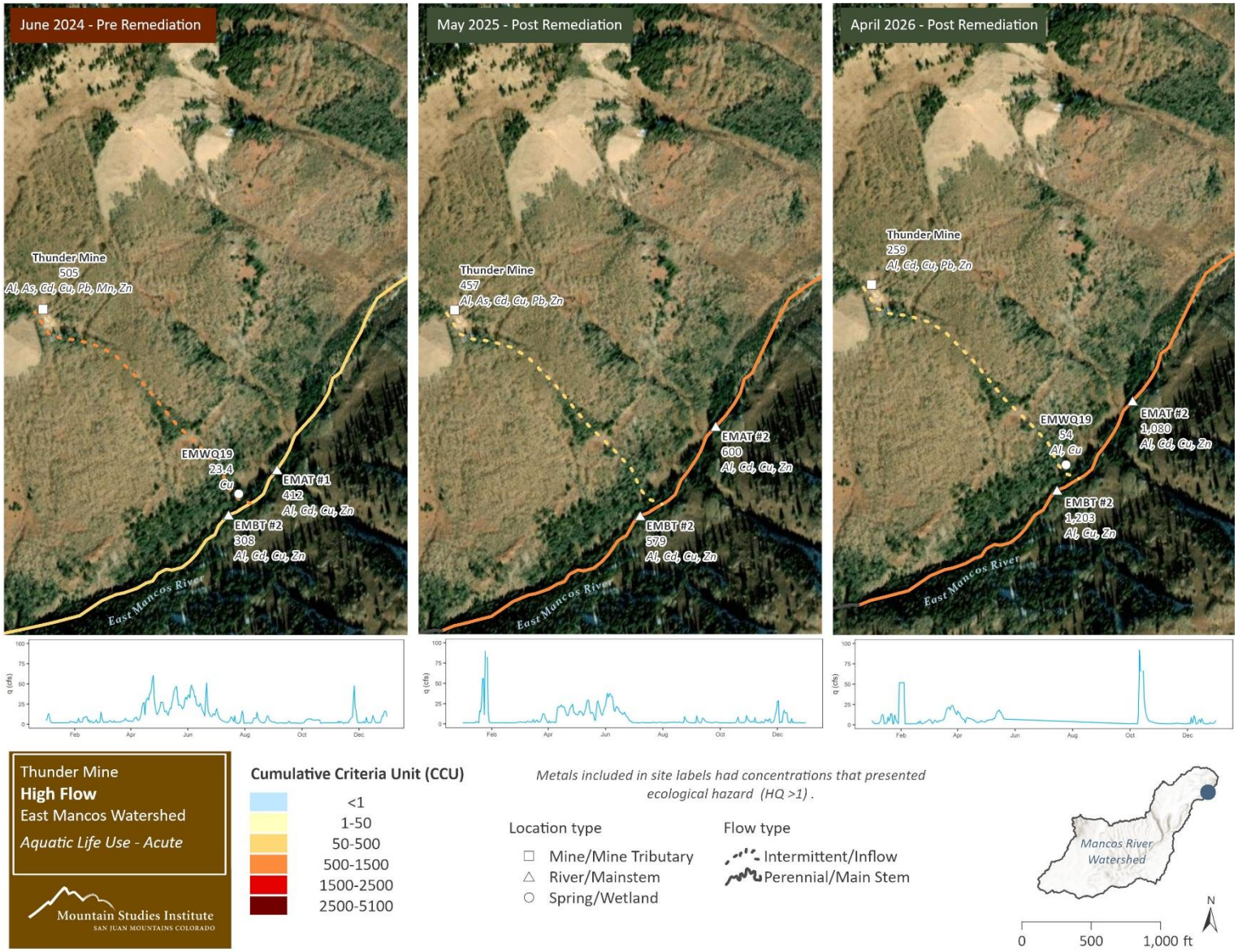


Figure 24. Acute aquatic life cumulative criteria units (CCU) and metals that exceeded acute water quality standards during high flow at and around Thunder Mine.

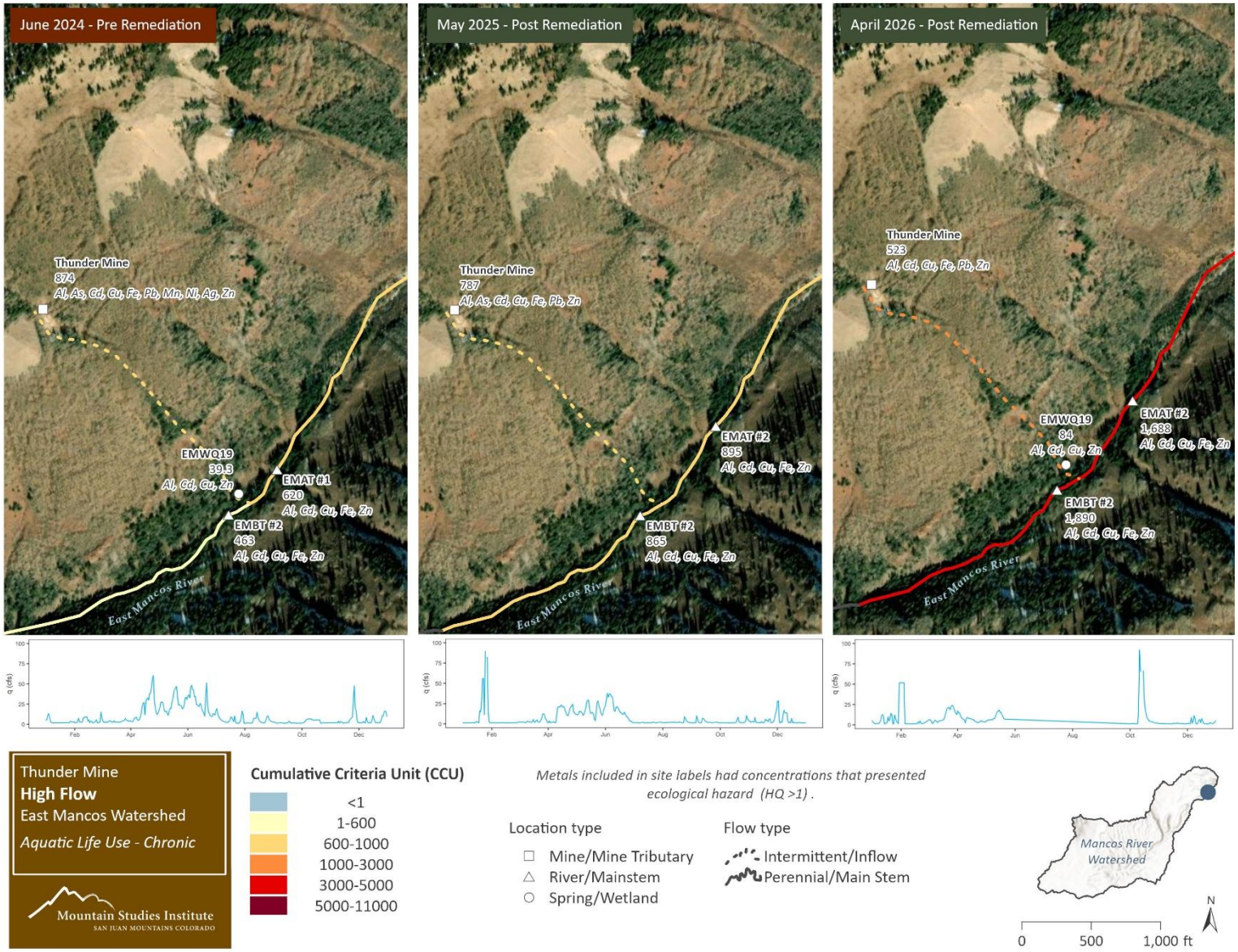


Figure 25. Chronic aquatic life cumulative criteria units (CCU) and metals that exceeded chronic water quality standards during high flow at and around Thunder Mine.

South Fork West Mancos River Mines Characterization

Prepared by Kirstin Brown, Colorado Division of Reclamation, Mining, and Safety
In cooperation with Mountain Studies Institute and Southwest Hydrologic
April 2026

This report is intended to be a guidance document in understanding the impact of the major mines on water quality in the South Fork West Mancos River in Owens Basin and the potential for reclamation projects to improve water quality. Interest in Owens Basin water quality piqued in 2020 when a local hiker noted orange precipitates on the riverbed in the upper part of Owens Basin and a Durango Herald article reported on the discoloration.

In September 2020, the Colorado Division of Reclamation, Mining, and Safety (DRMS), the Mountain Studies Institute (MSI), and Southwest Hydrologic completed the East Mancos River Watershed Report. Focusing on the basin directly south of Owens Basin, the report detailed major mining impacts by sampling instream water quality, three flowing mine drainages, and 31 mine waste rock piles. The three organizations partnered again to assess water quality in the West Mancos River and evaluate mines in Owens Basin, where the stream bed was reported to be orange.

MSI and DRMS completed reconnaissance of the watershed on July 25, 2023 and August 10, 2023 to sample the stream and any potential mines. The goal of the reconnaissance was to collect water samples where the stream water quality exhibited an abrupt change as evidenced by pH, conductivity, large inflows, mining drainage inflows, and stream bed precipitate color changes that would indicate metals loading and shifting in-stream chemical conditions.

Major Target Areas for Investigation

Four major target investigation areas were identified through inspection of aerial photos where the riverbed changed color (listed in order starting at the headwaters and going downstream):

- Headwaters just below treeline at an elevation of approximately 11,000 feet.
- Gold Bed Mine (Mine 1) - where the riverbed turns white
- Peerless Mine (Mine 2) - where the riverbed turns white, orange, and red.
- Area where the riverbed turns to orange above and at a trail crossing.
- Blue streamside ponds lower in the watershed, located near the Owens Basin Trailhead.

These areas were the focus of the investigations and sampling that took place. A map of these locations is provided in Figure 26 below.

Sampled Mines

Only two (2) mines were sampled as part of this study. It should be noted that there are numerous small prospects, other mines more distant from the river, a historic mill, and a history of placer mining in the South Fork West Mancos River in addition to the two (2) sampled mines. Another mine above Fluffhead Iron Fen was investigated on June 15, 2026 and was found to have less than 1 gallons per minute of mine drainage but did have a flowing spring coming past the mine through the talus, which was initially thought to be mine drainage, but upon further investigation you can hear the flow path coming from the talus to the east of the mine. The water from the talus source above and to the east of the site was flowing into the Iron Fen area on June 15, 2026, but was not flowing on July 25 and August 10 of 2023.

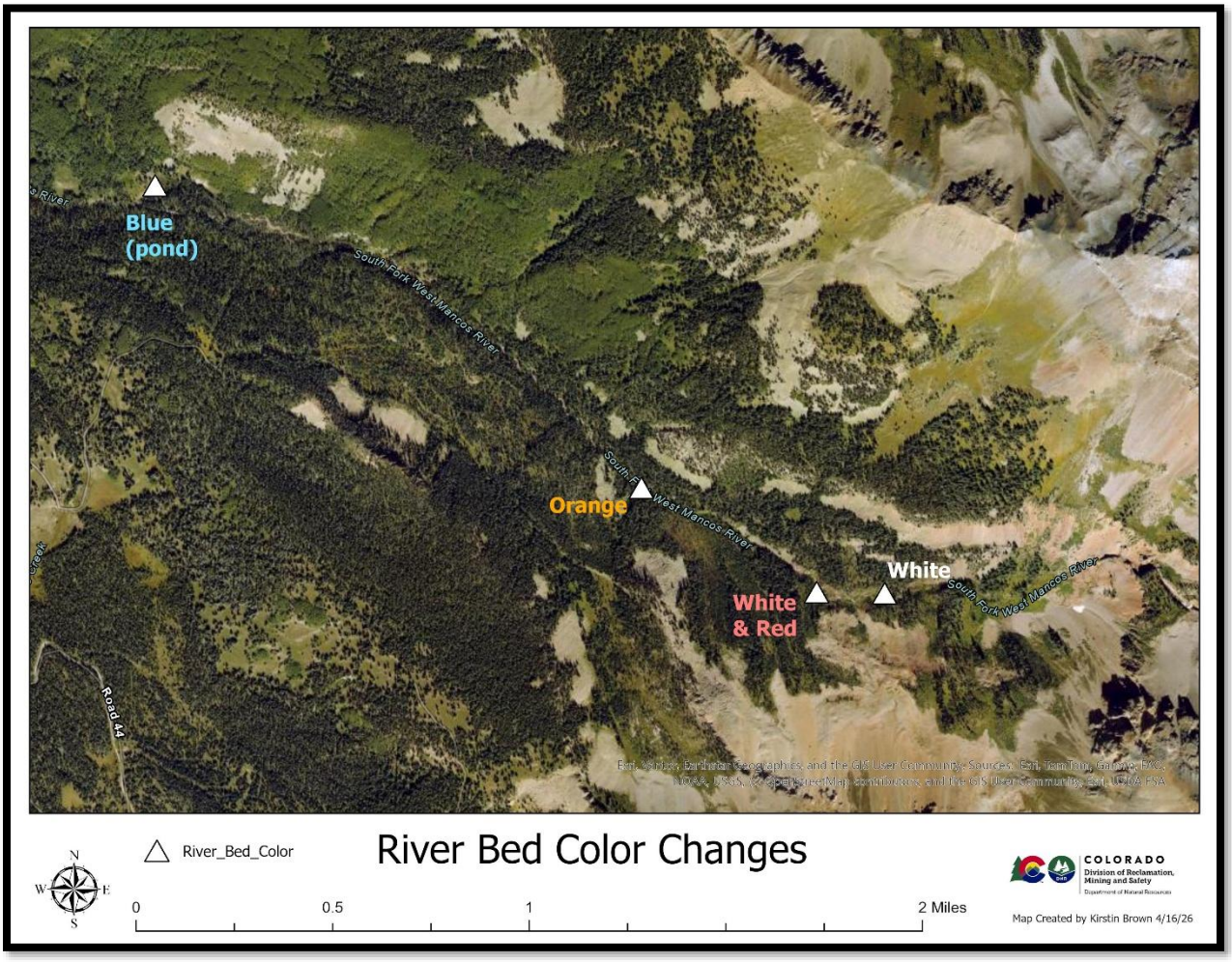


Figure 26. River bed color changes on the South Fork West Mancos River

Of the mines investigated, there were only two (2) mines that had visible effects on instream water quality because their perennially flowing mine drainage is directly connected to the South Fork West Mancos River via mine drainage tributary inputs, the **Gold Bed Mine (#1) (Mineral Survey #9814)** and **the Peerless Mine (#2) (Mineral Survey # 9812).** The mines in the database are labeled as Mine #1 and Mine #2, numbered and named in the order that they were sampled, then later research identified the mine names.

Gold Bed Mine (Mine #1)

The Gold Bed mine location is mapped on Plate 14 in USGS PP219 (Eckel et al, 1959), showing where the Gold Bed mineral survey/claim is located and it is referenced in the discussion of the Peerless Mine in the same report as being nearby. The mine location does correlate with the approximate location of the Gold Bed mineral survey #9814 shown on the Montezuma County Assessor's GIS website, which gives additional confidence that this mine is named the Gold Bed. This site has two cables adjacent that come from above the site and past the portal to the east. The two cables lead towards Jackson Ridge and towards the South of the West Mancos River. In USGS

PP219 (page 160) it says that ore from the Doyle Group was processed at the Peerless Mill, which may explain the location of the cables that lead towards the ridge (Eckel et al, 1959). In the future, if historians are interested, the cables could be traced to see where they originate from.

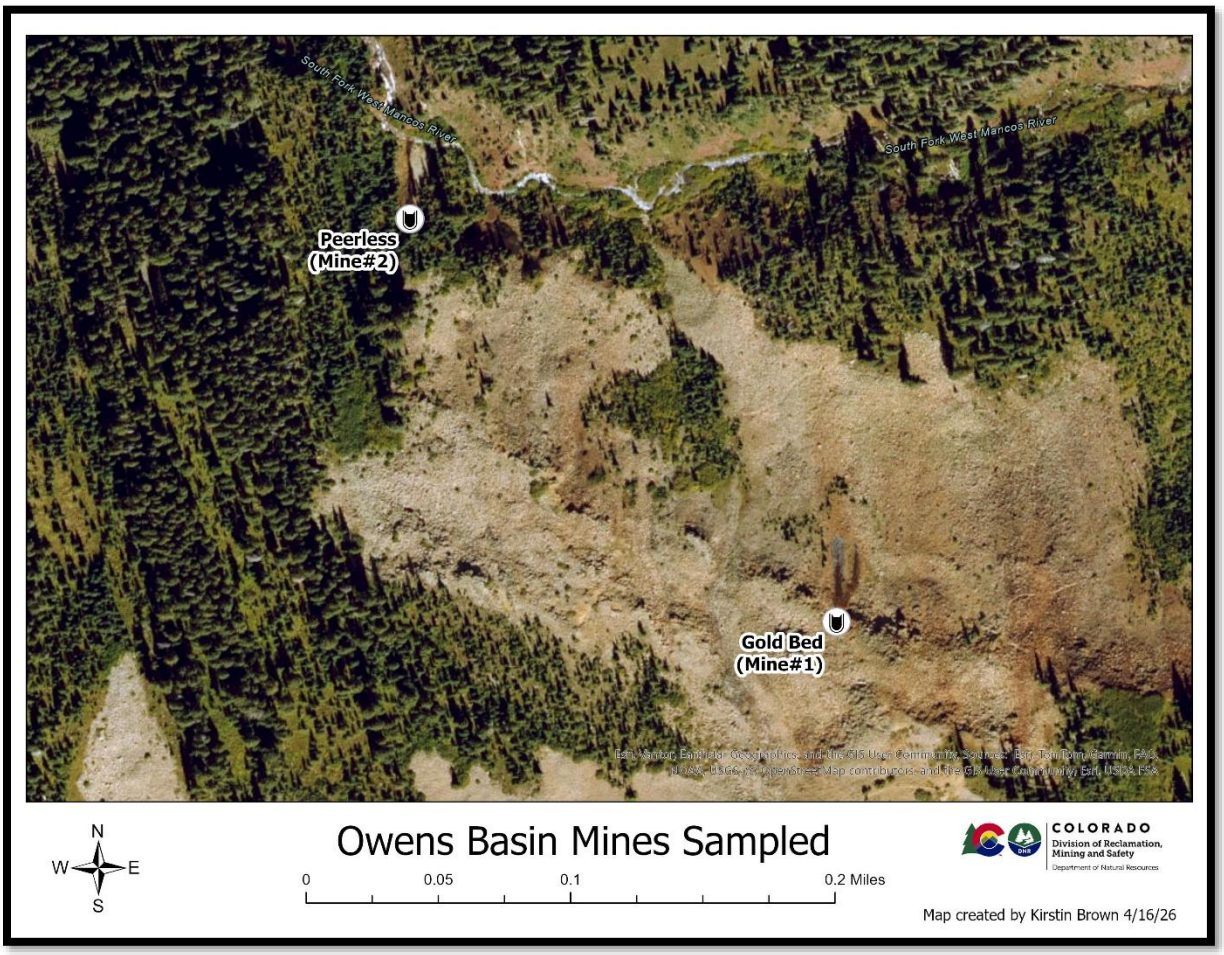


Figure 27. Mines sampled in Owen's Basin

Geology

The geology of the Gold Bed mine was gathered from PP219 and field investigations. The mine is mapped on Plate 19 but not called out by name. The mine is mapped as being located on the same contact as the Northstar and Sundown Doyle Group mines, which are in Rush Basin, one basin to the south from Owens Basin, at the contact of the Wanakah and the Entrada formations. The stratigraphic location of the Gold Bed Mine is dissimilar from the Peerless Mine (Mine #2) which is located at contact between the Entrada and the Dolores (Figure 28).

The Gold Bed Mine is driven into a bedrock outcrop, but quaternary talus fields surround the mine. There is talus above and below the Gold Bed mine that is generated from the steep slopes of Jackson Ridge above. The underground mine workings exhibit turquoise colored copper mineralization on the walls inside the mine. Because the mine is mapped on the same contact as the many of the Doyle Group mines it is postulated that the ore body is tabular and nearly horizontal, with potentially a dip towards the West Mancos River (and away from the East Mancos River). The ore body is likely similar to the Doyle Group mines as a pyritic replacement of a limestone bed.

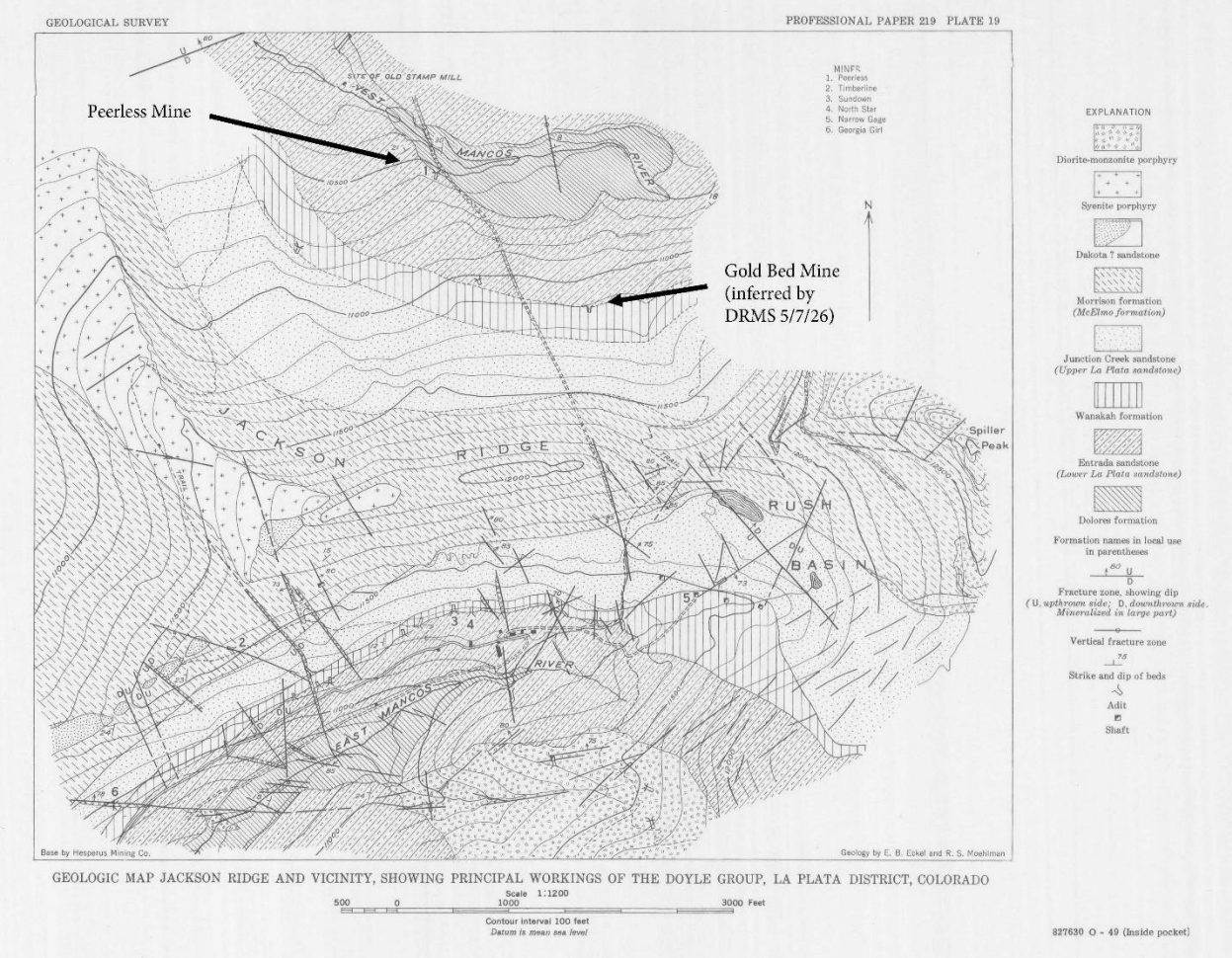


Figure 28. Geologic map of Jackson Ridge and the Doyle Group mine workings.

Mine Workings

The Gold Bed Mine adit is open and intact (Figure 29). The adit invert trends generally to the south into Jackson Ridge. The visible mine workings are open 9 feet by 8 feet at the portal and extend at least 100 feet or more in a southern direction with no visible evidence of rooms or drifts within the mine seen at surface. The adit has impounded water on the floor of the mine, which is measured at approximately 2.5 feet deep. The water is impounded by rock fall and talus at the portal.

Based on the waste rock pile square footage of approximately 5,000 square feet and potential waste rock volume (370 CY) and using the mine opening dimension measured in the field of 9 feet X 8 feet, the total depth of potential horizontal mine workings may have been around 150 feet deep.

Mine Waste

The mine waste pile at the site encompasses approximately 5,000 square feet and has steep slopes of around 35 degrees (Figure 30). The waste rock pile is completely surrounded by quaternary talus. Mine drainage flows over the waste rock pile and has moss growing in places along the flow path and on top of the waste rock. Some evergreen trees are also growing within the waste rock. No erosive features, such as rills or gulleys were noted on the waste rock pile, but the mine drainage



Figure 29. Gold Bed Mine with impounded water 2.5 feet deep.



Figure 30. Gold Bed Mine waste rock pile and mine drainage.

does flow over and potentially saturate the waste rock pile. The Gold Bed mine waste rock was sampled in a 30 point composite across the pile and analyzed for leaching potential by the Synthetic Precipitation Leaching Procedure and Inductively Coupled Plasma Mass Spectr30-pointEPA Method 1312). The Gold Bed and Peerless Mine waste rock is discussed together below.

Reclamation Options

The Gold Bed Mine is extremely remote, there is no road or even in-use trail access to the site. The waste rock at the site is small in area and lower in metals than a lot of other waste rock piles in southwest Colorado. It is not technically feasible to bring equipment to this site to move or cap the waste rock. No reclamation is warranted for this site at this time.

Peerless Mine (Mine #2)

The Peerless Mine (Mine #2) was correlated with the mine described for this location in United States Geological Survey (USGS) Professional Paper 219 (PP219). The correlation is based on the location on the PP219 maps, the elevation of 10,525 feet above sea level, and the description of a tram leading to the mill site farther downstream. The remnants of the cable leading to the mill can be found on the southern streambank above the South Fork West Mancos River leading from this site towards the mill. The location also correlates relatively closely with the Montezuma County GIS and the mine locations shows on the Peerless Mineral Survey #9812. The Peerless is described by PP219 as follows *(Page 159 – 160, USGS PP219, Geology and Ore Deposits of the La Plata District, Eckel, 1949*):

PEERLESS (2b)

The Peerless mine is near the south bank of the West Mancos River, north of Jackson Ridge, at an altitude of 10,525 feet (pl. 19). Little is known of this or the nearby Gold Bed mine (pl. 14), but they are believed to have been part of the "Jackson contact" development, begun by George A. Jackson in 1890. There is no record of production from any of the workings. The Peerless mine was worked through an adit trending S. 15° E., which was caved in 1935; the size of the dump indicates that there are several hundred feet of workings. The ruins of an old tram show that the mine was once connected with a small stamp mill, whose site is indicated in plate 19. Most of the ore put through this mill, however, is said to have come from the Doyle mine.

The adit was driven at the contact between the Dolores formation and the Entrada sandstone, which here dip 20° to 30° W. A 20-foot dike of coarse-grained diorite-monzonite porphyry trending southeast is exposed near the portal. The dump contains much pyrite and relatively abundant masses of bladed arsenopyrite intergrown with a little dull-green chlorite. A few poor exposures, supplemented by hazy information from local sources, indicate that the sulfide ore occurred in a bed-replacement deposit about 5 feet thick. The ore is said to have contained about 0.25 ounce of gold to the ton.

This bed of ore is unique in the district, in that it lies at the Dolores-Entrada contact; the cause of its localization at that horizon is unknown. Burbank [25] has noted thin discontinuous lenses of limestone at and near this contact along the San Miguel River, and it seems possible that the Peerless deposit represents a similar lens.

Geology

The geology of the Peerless Mine was gathered from USGS PP219 and on-site observations. USGS PP219 reports that arsenopyrite is present at the Peerless Mine (page 57, PP219). During field investigations it was noted that there was a lack of large visible crystalline sulfides in the mine waste pile. While sulfides were not directly observed, they may still be present as finer-grained crystals that were not easily visible. Chlorite was also noted as present at the Peerless Mine in USGS PP219. PP219 also reported that the Peerless Mine, "consisted of a nearly horizontal tabular body of pyrite, arsenopyrite, and chlorite at the contact between the Dolores formation and the Entrada sandstone. This body probably replaced a lens of limestone such as those that occur at or near this horizon in other parts of southwestern Colorado." (page 68, PP219). The professional paper (PP219) also discusses and maps a near vertical diorite-monzonite porphyry dike that outcrops near the portal.

Mine Workings

The Peerless adit was reported as collapsed in 1935 in USGS PP219 (page 160) and the adit remains collapsed as of 2023 (Figure 31). At the top of the waste rock pile there is a slope break and flat bench area that extends across the entire top of the waste rock pile. The exact location within the slope break of the mine opening is not obvious but it is assumed to be somewhere near one of the mine drainage seep locations along the cut bank. By using the waste rock pile's approximate 5,000 square foot area and potential waste rock volume (370 CY) and estimating that the mine opening dimension could have been 5ft by 7ft, the total depth of potential horizontal mine workings may have been around 250 feet deep. Very little is known about the underground mine workings.

The strike of the mine workings according to PP 219 was S15E, which correlates well with the approximate portal location within the slope break observed in the field in 2023. Some of the mapping in PP219 and the Peerless mine discussion also indicates a diorite-monzonite porphyry dike outcropping near the portal, so the mine workings may have been concentrated along the contact on the strike of the dike at a strike of S15E.



Figure 31. Peerless Mine waste rock pile and mine drainage.

Mine Waste

The mine waste pile encompasses approximately 5,000 square feet of area. The average thickness of the waste rock pile is estimated at 2 feet thick, for a potential mine waste volume of approximately 370 cubic yards. The waste rock pile has some evergreen trees and grasses growing in it, which is a good indication that the waste rock chemical characteristics are at least good enough to support plant life. The Peerless Mine waste rock pile is very steep (over 30 degrees) and the toe of the waste rock sits on the banks of the South Fork West Mancos River, which undercuts the waste rock pile and causes erosion. The mine drainage flows over the middle of the waste rock pile, saturating the waste rock and potentially contributing to additional slope instability that could allow waste rock to easily be eroded into the river.

The stability of the waste rock pile has characteristics of both instability and stability. The pile is unstable due to the steepness and the mine drainage saturation as well as the undercutting of the toe of the waste rock into the river. The pile shows signs of stability with the vegetation growing within the waste rock pile, which can help minimize erosion.

Reclamation Options

The Peerless Mine is extremely remote, there is no road or even in-use trail access to the site. The waste rock at the site is small in are and lower in metals than a lot of other waste rock piles in southwest Colorado. It is not technically feasible to bring equipment to this site to move or cap the waste rock. It may be possible to route the mine water away from the waste rock through hand labor. But, in general, no reclamation is warranted for this site at this time.

Gold Bed and Peerless Mine Waste Rock Discussion

The waste rock leachate results clearly show that the Gold Bed Mine (Mine 1) waste rock is higher in metals than the Peerless Mine (Mine 2) for every analyte except Cadmium, where it is almost equal, and for chromium, selenium and silver where both waste rock piles were not detectable for those analytes (Table 2).

Table 2. Waste Rock Leachate Results from July 25th, 2023 Sampling

Site Number	Aluminum, SPLP diss, ug/L	Antimony, SPLP diss, ug/L	Arsenic, SPLP diss, ug/L	Cadmium, SPLP diss, ug/L	Chromium, SPLP diss, ug/L	Cobalt, SPLP diss, ug/L	Copper, SPLP diss, ug/L	Iron, SPLP diss, ug/L	Lead, SPLP diss, ug/L
Mine 1 - Gold Bed Mine	3,740	3.2	21	0.8	< 1.0	8.0	213.0	1,840	3
Mine 2 - Peerless Mine	534	0.8	< 0.4	0.9	< 1.0	3	29.4	< 39.0	< 0.4

Site Number	Manganese, SPLP diss, ug/L	Mercury, SPLP diss, ng/L	Molyb-denum, SPLP diss, ug/L	Nickel, SPLP diss, ug/L	Selenium, SPLP diss ug/L	Silver, SPLP diss, ug/L	Uranium, SPLP diss, ug/L	Vanadium, SPLP diss, ug/L	Zinc, SPLP diss, ug/L
Mine 1 - Gold Bed Mine	363	45.4	0.9	13	< 0.4	< 0.2	2.4	16.8	109
Mine 2 - Peerless Mine	224	< 24.8	< 0.3	4.2	< 0.4	< 0.2	0.5	3.6	37

The Gold Bed Mine waste rock pile is high in aluminum and iron, which could suggest that this waste rock is influenced by the same pyrite rich deposits as the Doyle Group in the headwaters of the East Mancos River over the ridge, as is suggested by its stratigraphic location at the contact between the Wanakah and the Entrada. The waste rock's high aluminum and iron could be indicative of pyrite weathering and dissolution of host rock by acid formed by the pyrite.

The Gold Bed Mine waste rock is moderately high in arsenic in comparison to other waste rock piles in Colorado and when compared to the Bonita Peak Mining District (BPMD) 30 plus waste rock piles in Silverton, Colorado, where the Gold Bed Mine's arsenic concentration would have ranked 11th out of all the sampled waste rock.

The lead and zinc concentrations for both mines are specifically low when compared to other mine waste rock across the state of Colorado and within the Bonita Peak Mining District. A characteristic of both waste rock piles is that mine drainage is perennially flowing over them, which is a constant source of lower pH water interacting with the waste rock. Both waste rock piles are leaching metals above water quality standards set for the West Mancos River.

Lower East Mancos River Mines Characterization

Study Design

Mine locations were compiled for the Lower East Mancos watershed from the Mineral Resources Database (USGS, 2011). Mines in the lower watershed, generally south of Fall Creek, have been uncharacterized in the past. The intention of this characterization is to better understand the historic mining conditions that may or may not be influencing surface water in the lower reaches of the East Mancos watershed.

Mine locations were compiled into KMZ format from the MRDS. Prior to visiting each site, a hill shade was generated in ArcGIS Pro to verify or correct points from the MRDS. Both uncorrected and corrected mine locations were visited during this survey. If surface water was found draining from a mine location, field parameters were collected. These included pH, water temperature, specific conductance, and dissolved oxygen. A raw water sample was collected if there was presence of surface water, and a sample of waste rock was collected if there was waste rock present. These samples were collected as archive and were not analyzed in the scope of this report, but remain available for future analysis if necessary.

Mine locations visited (Figure 32) ranged in the MRDS database from B to E records, and were identified in the database as “Mine, past or present producer” or “Prospect or occurrence”. The MRDS database describes their records as, “In this map interface, records are separated by completeness, consistency, and quality of reference sources. Records are graded A through E with A indicating most complete and consistent, to E indicating records lacking information we consider important.” Of the mines characterized in this report, only Charlene is identified as a B record, and Billings is a C record. All other sites are D or E records, indicating they lack site information and verification. The summary of each site is intended to provide better understanding of abandoned mine locations in the East Mancos watershed.

Charlene

Charlene Mine is a B-record mine, past or present producer in the MRDS. The site is in Twin Canyon Basin downslope from Caviness Mountain. This mine site is the only B-record that we visited and has the most established remnants of mining infrastructure. There is a large, open adit/tunnel that may be upwards of ten feet tall. Old roads of varying condition cross the slope extensively throughout the site. There were no major waste rock piles to archive. There is a draining spring emerging through a small pipe (less than 2 inches diameter) downslope of the tunnel that was identified as CM_UP for the purposes of this report. The purpose of the pipe is unknown (draining mine tunnel, water source for cattle). We collected a raw grab sample from the pipe and measured parameters in the small channel created by the spring. The pH was 7.66 and the specific conductance was 362.8 uS/cm (Table 3). These parameters do not indicate the presence of acid-mine drainage. There is another spring emergence down slope. This spring did not have enough flow to measure parameters or take a raw water archive sample. This relationship between this emerging spring and the Charlene Mine is unknown.

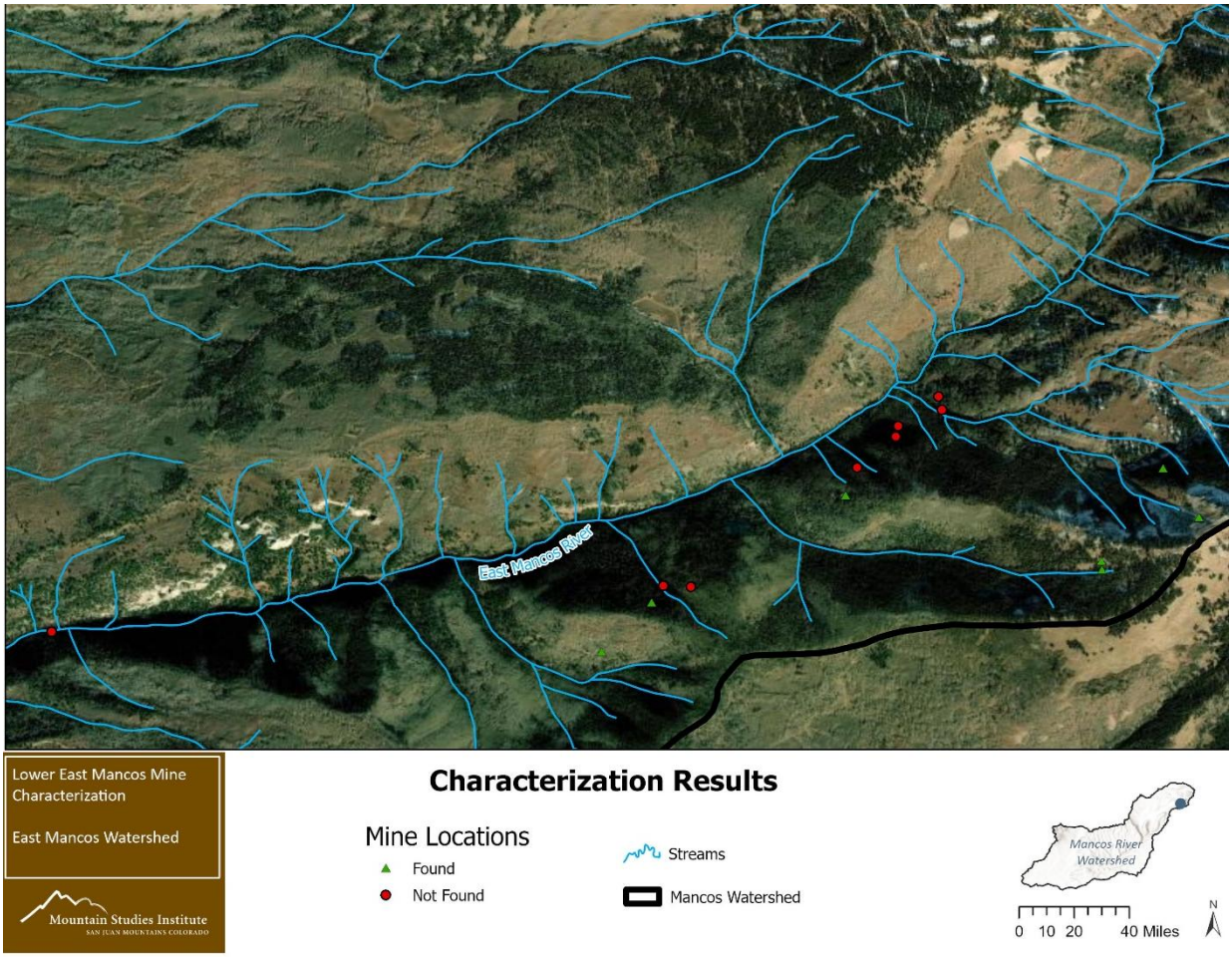


Figure 32. Locations of mine sites visited during the characterization visits. The map contains both corrected locations and original points from the MRDS.

Table 3. Sites where parameters were collected during the mine characterization. Dissolved oxygen readings were inaccurate for EM01 and EG01 due to barometer calibration errors and values were excluded from this table. Locations here are not mine outflow.

Site	Field Parameters			
	pH	SPC (uS/cm)	Temperature (°C)	Dissolved oxygen (mg/L)
EM01	4.25	285.9	10.0	NA
EG01	6.85	244.3	11.4	NA
EG02	6.71	388.4	8.5	6.64
CM_UP	7.66	362.8	15.8	6.88

Billings

Billings is a C-record prospect or occurrence in the MRDS. It is located in a basin on the northwest side of the Madden Peak ridge at approximately 11,000 feet in elevation. We visited both an MRDS location and a corrected point from the hill shade. The sites were called B01 and B02. B01 was near the top of an ephemeral drainage. It appeared to be a collapsed adit/tunnel with rock

reinforcement structures on one side of the depression. There was no water emerging from the depression, and there was no water flowing in the ephemeral drainage below B01. A waste rock pile was present at the toe of the depression. We collected an archive waste rock sample at B01. B02 was accessed by traversing across the basin to another visible waste rock pile. The waste rock pile is compiled at the top of the north fork of the ephemeral drainage basin and appears to wash down the drainage in storm events. At the site, we collected an archive waste rock sample from the dominant waste rock pile at the top of the drainage. The prospect pit at B02 was in large talus but appeared as a noticeable depression. There was no emerging water at the prospect pit, and there was no surface water flowing in the ephemeral drainage through the waste rock stripe. It appears that the drainage would contain storm flow, but the influence of this land surface flow on water quality is unknown.

Belle Placer

The Belle Placer is characterized by the MRDS as a D-record mine, past or present producer. It is located on the east side of an ephemeral drainage 1500 feet above the East Mancos River. The site is co-located with the Rowena Tunnel. There was no evidence of mining disturbance or surface water at the uncorrected Belle Placer site. We visited a corrected point on the west side of the drainage. Here we found what is likely to be a prospect pit or a collapsed adit. There was no surface water exiting the depression.

Silver Nugget, Lion's Den

Silver Nugget, Lion's Den is a D-record prospect or occurrence in the MRDS. It is located southwest of Fall Creek Mine between two ephemeral drainages. These drainages did not have surface flow during our site visit. The MRDS location for Silver Nugget is approximately 900 feet above the East Mancos River. There was no evidence of mining infrastructure or ground disturbance at the MRDS location. We visited a corrected location from the hill shade that is likely to be the prospect pit for Silver Nugget, Lion's Den. The corrected point is approximately 600 feet upslope from the original point in the southwest direction. Here, we found a prospect pit that was about 50 feet wide and 100 feet upslope. There was a waste rock pile at the toe of the prospect pit. There was no surface water draining from the depression of the pit, or downslope below the prospect pit. We collected a waste rock sample for archive.

Fall Creek

Fall Creek Mine is a D-record located to the south of the confluence between Fall Creek and the East Mancos River. Its location is approximately 600 feet upslope of the East Mancos River. The MRDS identified Fall Creek Mine as a mine, past or present producer. We visited both the original location and a corrected location from identified from the hill shade. There was no evidence of mining disturbance or surface water at either Fall Creek Mine location.

Unk

Unk is classified as a D-record on the MRDS as a prospect pit. It is located on the north side of the Fall Creek drainage and is approximately 200 feet from the drainage. We visited the MRDS location and a corrected point from the hill shade. There were no signs of mining disturbance or surface water on the hillside at the site location.

Gold Run Tunnel

Gold Run Tunnel is a D-record mine, past or present producer in the MRDS. It is located near tree line at the top of East Gulch. We visited the original and a corrected point from the hill shade. At both points, we found what appeared to be present of past mining activity. Both locations were larger depressions, that may be either collapsed adits or prospect pits. There were multiple small waste rocks piles in the areas near the depressions, and an old roadbed is just below both depressions. Waste rock samples were collected to archive from the waste rock piles. There is a small, ephemeral channel downslope of the larger depression that begins at the roadbed cut, but there is currently no surface water. In addition, no surface water is emerging from either depression we found at Gold Run Tunnel. The site location is at the top of an intermittent or ephemeral drainage that flows to the East Mancos River 1.25 miles below. On base maps, this drainage is called East Gulch. From the Gold Run Tunnel site, we walked down the drainage to search for emerging surface water. Throughout the drainage, we found evidence of human disturbance (old barrels, water tanks, pipes, cement blocks, structural wood, machinery). We found surface water emerge approximately 600 feet from Gold Run Tunnel. It appeared to be a spring that may have been bombed for cattle in the past. We measured parameters here and they can be found in Table 3. This site, EG02, has a neutral pH of 6.71 and a specific conductance of 388.4 uS/cm. These parameters indicate that emerging surface water closest in proximity to Gold Run Tunnel is not influenced by the mining history in the drainage. Without lab analysis, we can only hypothesize that this emerging water is not affected by the mine site. In addition to parameters here, we crossed East Gulch lower down on the Old Gold Run trail as we traveled to other mine sites in this report. We measured parameters at this site, EG01, located approximately 0.5 miles above the East Mancos River. This surface flow appeared to be perennial or intermittent, and did not appear to be negatively affected by any mining history. We found presence of an aquatic community in East Gulch (mayflies, stoneflies and caddisflies) that also indicate water quality suitable to support aquatic life. These parameters can be seen Table 3.

Red Arrow Extension

Red Arrow Extension is a D-record identified on the MRDS as a mine, past or present producer. It is located at the East Mancos River approximately 2 miles downstream from the Red Arrow Mine and Mill. This site is the farthest downstream mining site we visited. There were no signs of a mine around the location on the MRDS. The main Red Arrow Mine ceased production in 2013 (*Red Arrow Mine and Mill*, n.d.). It is likely the Red Arrow Extension existed in the past, but we did not find signs of mining presence at the site. There were groundwater seeps around the banks of the river but there was no surface water sources draining down the hillside on either side of the river at the site location. There is potential that any mining infrastructure collapsed at this site. We measured parameters in the East Mancos River (EM01) at the general site location, which are shown in Table 3.

Rowena Tunnel

The Rowena Tunnel is an E record located on the east side of an ephemeral drainage 1500 feet above the East Mancos River. The site is co-located with the uncorrected Belle Placer mine location. The MRDS defined the Rowena Tunnel is a mine, past or present producer. At and around this site, there was no evidence of mining that is affecting the East Mancos River. No surface water is currently flowing in the ephemeral drainage, and the site contained no remnants of mining (machinery, wood structures, etc.). There was no evidence of ground disturbance.

Discussion

Historic mining in this portion of the East Mancos River watershed does not appear to present further investigation of water quality. No mine sites listed above had water emerging from an adit or tunnel, collapsed or not. Charlene Mine and Gold Run Tunnel were the only sites that had surface water emerging to collect a raw, archived water sample. We cannot attribute the source of this surface water to those mine locations without further investigation. Mine sites visited in this characterization do not appear to be impacting water quality in a qualitative manner. Throughout the investigation, East Gulch and Fall Creek are the only sources of surface flow that was found to reach the East Mancos River. In both locations, aquatic insect communities were found. This indicates water quality draining the basins with historic mine locations is suitable to support aquatic life. We were able to walk on the Old Gold Run trail crossing under terrain that drains five of the nine mine locations in this study (Fall Creek, Billings, Gold Run Tunnel, Unk, and Silver Nugget). Aside from East Gulch and Fall Creek as surface water sources, there was no other surface water flowing into the East Mancos River in this reach.

Minimizing Unplanned Mine Releases

The goal of this document is to inform about the current mine conditions as they relate to the potential for unplanned mine releases in the East Mancos and South Fork West Mancos (SFWM) Rivers. Unplanned mine releases in this report refers to the unintended discharge of acid mine water into the environment. Unplanned releases typically involve the loss of containment of impounded mine water from underground mine workings.

Unplanned mine releases have two general categories of release, (1) caused by human disturbance and (2) caused by natural geohazard conditions. Both types will be discussed in this report. Human disturbance of impounded mine water can cause the loss of containment of impounded water through the physical disturbance of natural mine collapse features. Natural geohazard conditions, such as changing flow conditions, precipitation of metals, ice conditions, and rock falls near surface and underground can also cause the release of impounded mine water through degradation of natural conditions that can lead to the release of impounded mine water without direct human disturbance of the site recently.

The goal of this report is to minimize the potential for unplanned mine releases to the environment.

Study Design

In 2008 and 2018 the Colorado Division of Reclamation, Mining and Safety (CODRMS) inspected the mines in the East Mancos River watershed for safety closures and waste rock and acid mine drainage sampling. In 2023 and 2026, CODRMS inspected the mines in the West Mancos watershed for the same. These mining related sources were assessed in the field for potential risk for an uncontrolled fluid release. Attention was paid to the mine drainage flows, the portal condition, the visible height of impounded water on a collapsed adit, the potential lateral extent of mine workings via the estimated waste rock volume and historical research, and how much precipitate is formed by the mine drainage.

The criteria to evaluate an unplanned release are listed below:

- Is there mine drainage?
- Is the flow perennial or intermittent?

- What is the flow rate?
- What is the condition of the portal?
- Is the visible height of impounded water at the portal greater than 5ft high?
- How extensive are the mine workings?
- How much precipitate is formed by the mine drainage?

Mines with Flowing Water

Only the mines with flowing and impounded water will be analyzed for minimizing unplanned releases. The mines are listed below and a map is shown on the next pages:

East Mancos River Mines with Mine Drainage:

DRMS Safety Closure #20
DRMS Safety Closure #21
Doyle 9
Georgia Girl Upper
Georgia Girl Lower
Waste Rock 6 (DRMS 30)
Thunder
Gold Dollar
Red Arrow Gold Run Portal
Kentucky (Lower)

South Fork West Mancos River Mines with Mine Drainage:
Gold Bed
Peerless
Mine above Fluffhead Iron Fen (WMIF)

Key Observations

The mines with the greatest potential for an unplanned release are sites where there is perennial mine drainage, a potentially small collapse feature impounding water, visible height of water is greater than 5ft high off the floor of the mine (indicating a larger volume of impounded water), mines with larger lateral workings, higher flows, and greater amount of precipitate formation that can impound more water.

Table 4 captures the site characteristics for each mine investigated for unplanned releases. The table does include a ranking TOTAL score that indicates that the Thunder, Gold Dollar, and Gold Bed are the sites of highest concern.

Table 4. Unplanned mine releases key observations

	Is the mine drainage perennial (Y=1, N=0)		Is there a very small total portal collapse that could be destabilized easily or is in flux (i.e., roof of mine visible or can see into mine)? (Y=1, N=0)		At the time of inspection, was height of impounded water at the portal greater than 5 ft (pressure at the collapsed portal)? (Y=1, N=0)		Extent of lateral mine workings (based on waste rock volume & USGS PP219). [Small (under 500ft) = 0; Medium (500ft-2,000ft) = 1; Large (+2,000ft) = 2]	Extent of Workings score	Flow? [Low (under 5 gpm) = 0; Medium (5 gpm to 100 gpm) = 1; High (above 100 gpm) = 2]		How much precipitate is formed from the mine drainage? (High = 1, Low = 0)		TOTAL	Notes/Professional Judgment
East Mancos Draining Mine Sites														
Doyle 5	N	0	N	0	N	0	Small	0	Low	0	Low	0	0	Rock wall and concrete safety closure
DRMS Safety Closure #20	N	0	N	0	N	0	Small	0	Low	0	Low	0	0	Rock wall and concrete safety closure
DRMS Safety Closure #21	N	0	N	0	N	0	Small	0	Low	0	Low	0	0	Rock wall and concrete safety closure
Doyle 9	N	0	N	0	N	0	Medium	1	Low	0	Low	0	1	Rock wall and concrete safety closure with pipe on the floor of the mine conveying drainage
Georgia Girl Upper	N	0	N	0	N	0	Small	0	Low	0	Low	0	0	Collapsed adit
Georgia Girl Lower	N	0	N	0	N	0	Medium	1	Low	0	Low	0	1	Collapsed adit
Waste Rock 6	N	0	N	0	N	0	Small	0	Low	0	Low	0	0	Backfilled adit
Thunder	Y	1	N	0	Y	1	Large	2	Low	0	High	1	5	Collapsed adit with 5ft or higher water
Gold Dollar	Y	1	N	0	Y	1	Medium	1	Low	0	Low	0	3	Collapsed adit, but this mine was breached with a backhoe in 1986 and caused an unplanned release from human disturbance
Red Arrow Gold Run Portal	N	0	N	0	N	0	Large	2	Low	0	Low	0	2	Open adit that drains in higher water years along the floor of the mine to a small evaporation pond at surface
Kentucky Lower	N	0	N	0	N	0	Medium	1	Low	0	Low	0	1	Collapsed adit
South Fork West Mancos River Draining Mines														
Gold Bed	Y	1	Y	1	N	0	Small	0	Medium	1	Low	0	3	Open adit with a small pile of talus backing water up at the portal
Peerless	Y	1	N	0	Y	1	Small	0	Low	0	Low	0	2	Collapsed adit with 5ft or higher water
Mine above Iron Seep	N	0	N	0	N	0	Medium	1	Low	0	Low	0	1	Collapsed adit with water emanating near the floor of the mine

Please see Appendix A for the Photographic Log of the site and the Site Map at the end of this report.

Natural Unplanned Releases

Natural unplanned releases can occur when natural conditions reach a tipping point and water is released by some failure mechanism. CODRMS has collected information on mines across the State and at the Bonita Peak Superfund site in an effort to understand unplanned releases. The potential natural failure mechanisms appear to consist of the following:

- Clogging of mine openings and underground infrastructure with mine drainage precipitates. The precipitates eventually reach a point where they are no longer strong enough to hold water pressure back. This typically happens when mines are open at the surface, but it can also be related to clogging piping, coffers dams, collapse features at the portal, and other infrastructure. This release mechanism appears to be related to precipitate particle stability failure.

- Ice damming appears to be related to some unplanned releases, where ice temporarily raises the pressure of the impounded water, and as ice begins to melt or fails, water is released.

- Although it is less noted on the mines studied across Colorado, there appears to be a component of slope failure around the portal, whether due to slope wash, small landslides, or avalanche activity that could cause natural unplanned releases.

The mines in this report lack the characteristics of other sites across Colorado that have natural unplanned releases. Most of the mines in this report have closed, backfilled, or naturally collapsed portals, which are more stable and less likely to have a natural release. But, the Gold Bed mine is open along the South Fork West Mancos River and does have a relatively small collapse that is impounding a small mine pool (2.5 feet high) with a relatively larger flow of perennial water, that could be easily disturbed by the steep talus slopes or winter avalanche activity. While the Gold Bed is a higher natural release concern than the other sites, it should be noted that the mine pool in the

tunnel is estimated to be on the small side because the workings are estimated to be less than 500 feet deep.

Human – Caused Unplanned Releases

Human – caused unplanned releases are due to human disturbance of impounded mine water at a site. Usually the disturbance is related to opening or modifying the portal.

The Gold Dollar mine was the site of an unplanned mine release into the East Mancos River in 1986 when the mine was opened with a backhoe and the mine water rushed down into the East Mancos River. The Gold Dollar is of specific interest and noted for gold prospecting, as mentioned in the USGS Professional Paper 219, which may be one reason that it was reopened in 1986. Anecdotal eyewitness accounts report that there was a potential fish kill associated with the Gold Dollar release. The effects of the Gold Dollar release were investigated by DRMS in 2009, and the conclusion of the investigation is that the water in the East Mancos River was being affected by sources further upstream than the Gold Dollar in 2009.

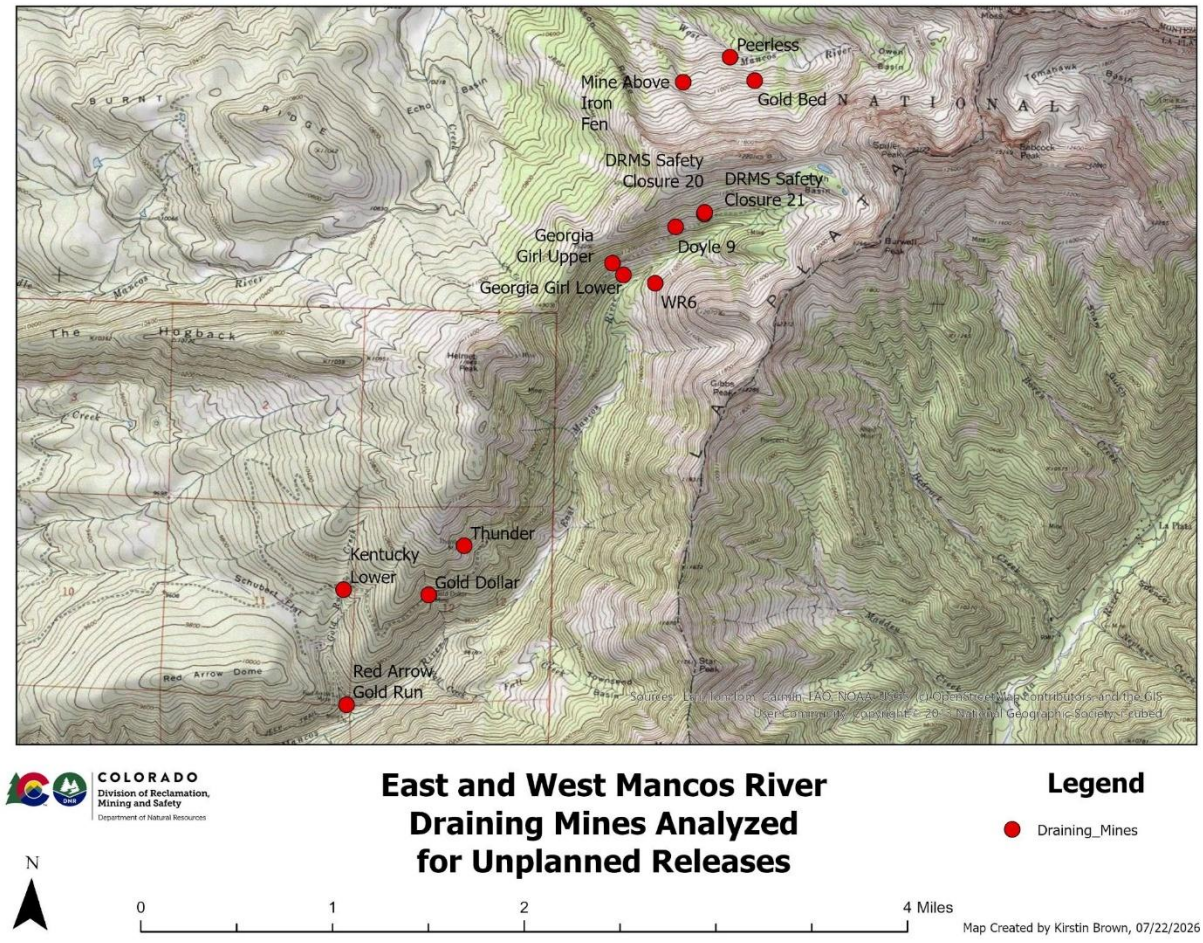


Figure 33. Draining mines in the East and West Mancos River watersheds analyzed for unplanned releases.

One project goal that CODRMS had was to limit access to the Gold Dollar portal along the site access road. During the implementation of the Thunder project, the Gold Dollar property was sold and the new landowner installed a locking access gate to the mine. The administrative access control on the

Gold Dollar road will help prevent unwanted access to the portal that has water backed over 5 feet or higher off the floor of the mine.

The Thunder mine is another mine site that has water backed up behind a collapsed portal that is 5 feet or higher off the floor of the mine with a large amount of lateral workings. The Thunder access road is now impassable after the reclamation of the waste rock pile because the entire 1,000 foot access road was turned into a mine drainage diversion channel, which is completely impassable to vehicles. The administrative control that blocks off vehicle access to the Thunder portal will minimize human disturbance of the Thunder portal, especially due to vehicles and heavy equipment.

Two of the sites with the greatest potential for human-caused unplanned releases (Gold Dollar and Thunder) have been addressed through administrative access control to the portals, thereby minimizing the potential for human-caused unplanned releases from these sites.

West Mancos Watershed

Study Design

The West Mancos River begins in its headwaters on the west side of the La Plata Mountains and reaches its confluence with the East Mancos River to form the main stem of the Mancos River. Previous studies characterized water quality in the East Mancos River and the Mancos River, but less is known about conditions in the headwaters of the West Mancos River. We sought to identify and quantify contaminant sources from legacy mines in the upper reaches of the watershed, and to assess the downstream extent of their influence.

In 2023, we collected samples from the South Fork West Mancos River, nearby mine sites, and notable inflows to characterize conditions for water quality and aquatic life (Table 5).

Table 5. Sampling locations, sample dates, and sample types on the West Mancos River.

Site ID	Site Description	Sample Dates	Collection Type
WMAGB	South Fork West Mancos River above Gold Bed	7/25/2023 & 8/23/2023	Surface Water and Benthic
Gold Bed Mine	Gold Bed Mine (aka Mine 1)	7/25/2023	Solid and Surface Water
Trib 1	Trib to South Fork West Mancos River	7/25/2023	Surface Water
WMBGB	South Fork West Mancos River below Gold Bed and above Peerless	7/25/2023	Surface Water
Peerless Mine	Peerless Mine (aka Mine 2)	7/25/2023	Solid and Surface Water
WMBPL	South Fork West Mancos River below Peerless	7/25/2023	Surface Water
WMIS	West Mancos – Iron Spring	8/23/2023	Surface Water
WMIF	West Mancos – Iron Fen	8/10/2023	Surface Water
WMAT	South Fork West Mancos River at Trail Crossing	8/10/2023	Surface Water and Benthic
WMAB	South Fork West Mancos River above Beaver Pond	8/10/2023	Surface Water

We collected surface water samples and waste rock samples following methods described in the Methods section of this report. Samples were analyzed by Green Analytical Laboratories. We collected BMI samples in 2023 to understand benthic abundance and community composition as well as overall condition of aquatic life habitat. Benthic results are discussed in the Benthic Macroinvertebrate Community section later in this report.

Metal Concentrations, Mass Loading, and Aqueous Geochemistry

We located and collected samples from two draining mines in Owens Basin within the South Fork West Mancos River watershed. Drainage from the Gold Bed Mine and the Peerless Mine had high concentrations of aluminum, cadmium, copper, iron, nickel and zinc. The Gold Bed Mine drains along an extended flow path before reaching the South Fork West Mancos River. We sampled the downstream terminus of this flow path as Trib 1 where it enters the South Fork West Mancos River. We collected a sample upstream of Trib 1 as WMAGB and a sample downstream of Trib 1 as WMBGB, effectively bracketing the influence of the Gold Bed Mine on the South Fork West Mancos River. At WMBGB, upstream of Trib 1, the only analyte that occurred at high enough concentration to cause risk to aquatic life was dissolved zinc. Downstream of Trib 1, at WMBGB, metal concentrations and loads increased substantially. For example, from WMAGB to WMBGB the dissolved aluminum concentration increased by 904% and dissolved zinc increased by 59%. Further downstream from Trib 1, the Peerless Mine drainage enters the South Fork West Mancos River. We collected a sample downstream of the Peerless Mine drainage at WMBPL, which effectively brackets the influence of the Peerless Mine between WMBGB and WMBPL. From WMBGB to WMBPL, there was a 163% increase in dissolved aluminum, 263% increase in dissolved copper, 131% increase in dissolved zinc, and 200% increase in dissolved cadmium. Downstream of the Gold Bed Mine and the Peerless Mine, we did not find additional major draining mines, but we did locate and sample two mineralized inputs; an iron spring (WMIS) and outflow from an iron fen (WMIF). We collected two additional samples on the South Fork West Mancos intending to characterize conditions downstream of the two draining mines and the two mineralized inflows. These two locations were South Fork West Mancos at trail crossing (WMAT) and South Fork West Mancos above beaver pond (WMAB). Elevated metal concentrations persisted in the South Fork West Mancos through WMAB.

For the five sampled inflows to the South Fork West Mancos River (Gold Bed Mine, Peerless Mine, Trib 1, WMIF and WMIS), we calculated metal loads based on field measured discharge measurements and lab metal concentration results (Table 6).

WMIF contributed the highest load of several metals including dissolved and total copper, manganese, and zinc. The Gold Bed Mine contributed the highest load of total aluminum and dissolved and total iron. Notably, the measured load at Trib 1 at the end of the Gold Bed Mine flow path was much lower for most analytes than the load measured at the Gold Bed Mine adit at the beginning of the flow path. The measured discharge of Trib 1 was 33% less than the discharge measured at the Gold Bed Mine adit. This indicates that along the flow path below the Gold Bed Mine, flows may infiltrate into sub-surface flow paths and/or metals may be attenuating between the adit and the inflow to the South Fork West Mancos River.

Table 6. Loads (kg/day) for analytes at five inflows. Parameter suffixes are "_T" is total, "D" is dissolved, and "_B" is bioavailable. Green highlighted cells are the highest value for each analyte among inflows.

	Parameters and Loads	Site				
		Gold Bed	Trib 1	Peerless	WMIF	WMIS
Parameters	Discharge (CFS)	0.06	0.04	0.01	0.22	0.02
	pH	3.72	3.60	3.41	3.76	3.84
	Conductivity (uS/cm)	442.90	220.50	789.50	190.60	433.70
Loads (kg/day)	Al_T	3.083	0.750	0.524	1.356	1.238
	Al_B	3.009	1.092	2.965	0.355	3.318
	As_D	0.001	0.000	0.000	0.000	0.003
	As_T	0.001	0.000	0.000	0.000	0.003
	Cd_D	0.000	0.000	0.000	0.001	0.000
	Cd_T	0.000	0.000	0.000	0.001	0.000
	Chloride	0.0001	0.0000	0.0000	0.0000	0.0000
	Cu_D	0.147	0.037	0.030	0.411	0.059
	Cu_T	0.142	0.038	0.029	0.363	0.070
	Flouride	0.000	0.000	0.000	0.000	0.000
	Fe_D	1.629	0.013	0.257	0.380	0.947
	Fe_T	1.717	0.013	0.272	0.390	0.963
	Pb_D	0.00001	0.00002	0.00002	0.00000	0.00000
	Pb_T	0.00000	0.00000	0.00002	0.00000	0.00000
	Mn_D	0.112	0.049	0.023	0.161	0.041
	Mn_T	0.116	0.051	0.023	0.161	0.049
	Mb_T	0.0001	0.0000	0.0000	0.0000	0.0002
	Ni_D	0.004	0.001	0.001	0.005	0.001
	Ni_T	0.004	0.001	0.001	0.005	0.002
	Se_D	0.0000	0.0000	0.0000	0.0000	0.0000
	Se_T	0.0000	0.0000	0.0000	0.0000	0.0001
	Ag_D	0.0000	0.0000	0.0000	0.0000	0.0000
	Ag_T	0.0000	0.0000	0.0000	0.0000	0.0000
	U_T	0.002	0.000	0.000	0.001	0.001
	Zn_D	0.043	0.017	0.009	0.087	0.017
	Zn_T	0.040	0.015	0.009	0.072	0.018
	Sulfate	36.992	12.830	39.928	11.010	38.607

Comparing loads of the five inputs, and the load of the South Fork West Mancos River upstream of these inputs (WMAGB), to the load measured at the most proximate downstream sampled site (WMAT) provides a different perspective (Table 7). WMIF contributed the greatest percentage of metal loading in cadmium, copper, manganese, nickel, and zinc. Gold Bed Mine contributes the highest percentage of aluminum, iron and uranium. WMAGB, above the five measured inflows, contributed the highest percentage of sulfate and fluoride. The load at WMAGB, upstream of all measured inflows, contributed a range of 2-40% of the load for the analytes that are present at both WMAGB and WMAT. The percent total of metals contributed by the source of the four inflows

(excluding Trib 1) ranged from 41-61% of the load at WMAT for this list of analytes, indicating that there are additional sources or processes occurring in this reach.

Table 7. The percentage of load for the select list of analytes that contributed to total load at WMAT by measured inflows.. The percent load was calculated by dividing the load at the input or WMAGB by the load at WMAT.

Analyte	Percent Loads at WMAT					
	Site					
	Gold Bed	**Trib 1**	**Peerless**	**WMIF**	**WMIS**	**WMAGB**
Aluminum, bioavailable	37.5	13.6	37.0	4.4	41.4	1.6
Aluminum, total	30.1	7.3	5.1	13.3	12.1	3.5
Arsenic, dissolved	28.1	0.0	0.0	0.0	81.9	0.0
Cadmium, dissolved	7.5	2.2	11.6	17.8	4.0	0.0
Cadmium, total	8.1	2.3	12.1	18.8	4.5	0.0
Copper, dissolved	12.6	3.2	2.6	35.4	5.1	0.0
Copper, total	13.3	3.6	2.7	33.9	6.5	0.0
Iron, dissolved	85.8	0.7	13.5	20.0	49.9	0.0
Iron, total	82.2	0.6	13.0	18.7	46.1	0.0
Flouride	0.0	0.0	0.0	0.0	0.0	50.5
Manganese, dissolved	13.2	5.7	2.7	19.0	4.9	2.7
Manganese, total	13.6	5.9	2.7	18.8	5.7	3.2
Nickel, dissolved	16.6	4.8	3.0	20.3	5.4	18.2
Nickel, total	15.6	5.0	2.8	20.1	6.9	12.4
Sulfate	14.7	5.1	15.9	4.4	15.4	39.9
Uranium, total	21.5	5.6	4.9	9.5	13.7	0.0
Zinc, dissolved	12.5	5.0	2.7	25.3	4.9	17.7
Zinc, total	13.2	5.0	2.9	23.7	5.9	8.4

Water Quality Standards and Aquatic Toxicity

Aquatic Toxicity

We assessed water quality conditions for aquatic life in context of water quality standards (CDPHE, 2024a), EPA criteria (EPA 2018), and toxicity estimates. We summarize risk to aquatic life from metals as a cumulative criteria unit (CCU). CCUs are the sum of calculated hazard quotients across multiple analytes. Hazard Quotients (HQs) are calculated as the concentration of an analyte divided by the corresponding water quality standard or toxicity estimate. When this ratio produces values greater than 1.0, this indicates that the concentration of the analyte is greater than the water quality standard and there is elevated risk to aquatic life. Sites with a greater CCU are composed of higher hazard quotients and therefore a higher risk to aquatic life.

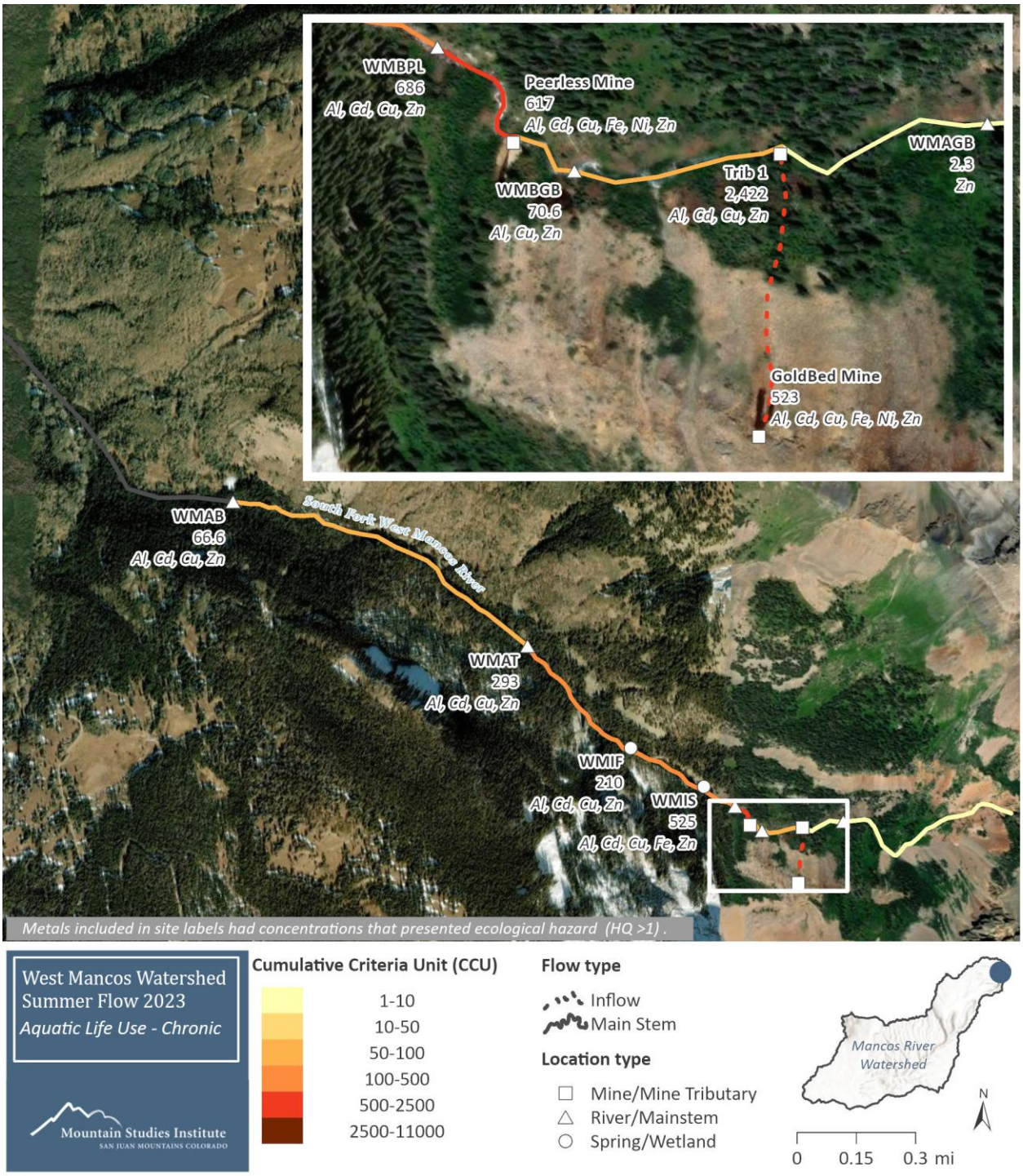


Figure 34. Chronic aquatic life CCU's for West Mancos River main stem sites and inflows.

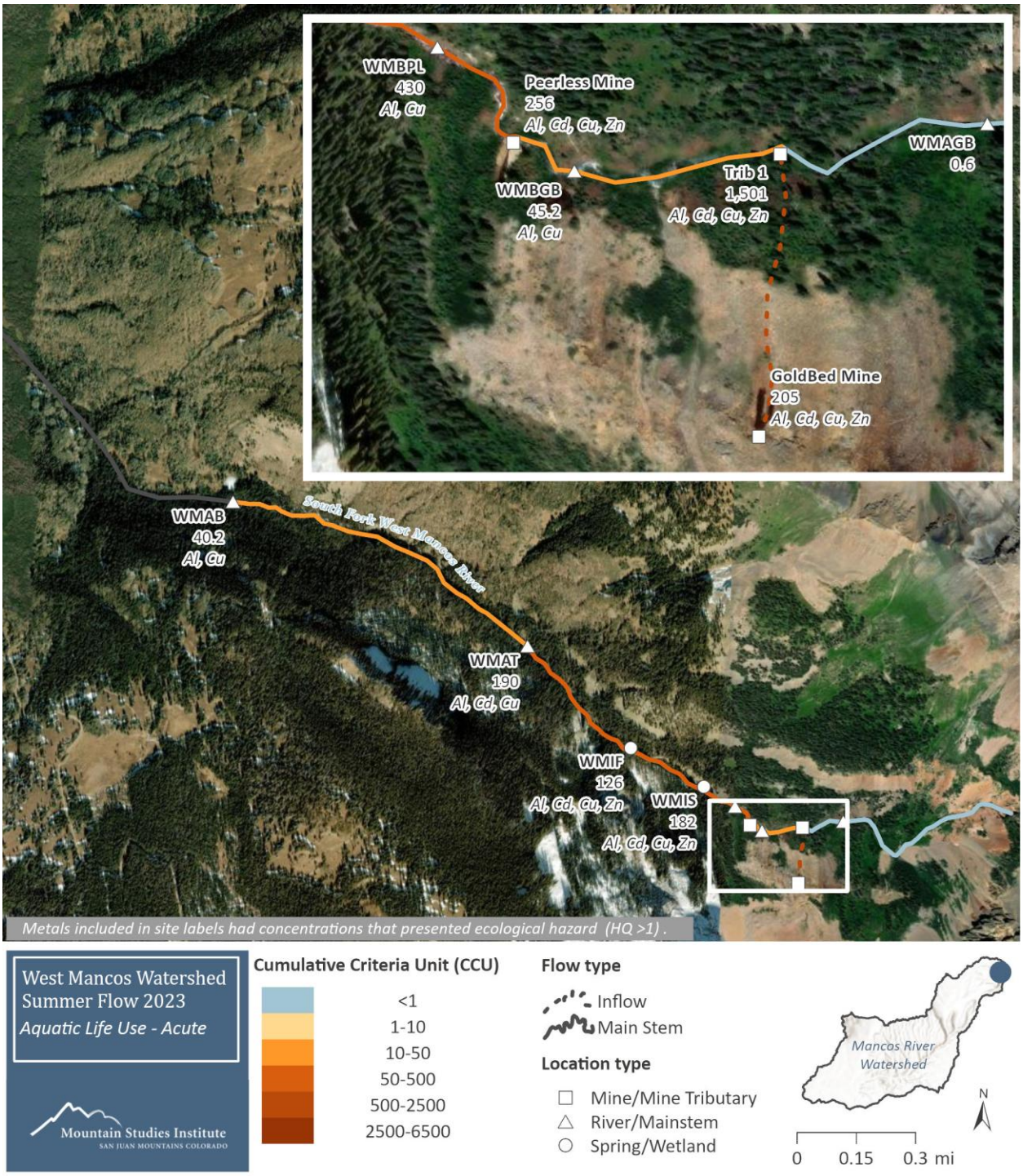


Figure 35. Acute aquatic life CCU's for West Mancos River main stem sites and inflows.

WMAGB, upstream of the measured inflows, had the lowest CCU value among sampled sites on the South Fork West Mancos River (Figure 34 and Figure 35). The only analyte at WMAGB that had a HQ greater than 1.0, and thus surpassed its standard, was zinc. Chronic CCUs increase incrementally in a downstream direction from a CCU of 2.3 at WMAGB to a CCU of 686 at WMBPL as

discharges from the Gold Bed Mine and Peerless Mine enter the South Fork West Mancos River. Downstream of WMBPL, chronic CCUs decrease to a low of 66.6 at WMAB.

Several metals surpassed chronic water quality standards in the South Fork West Mancos River, posing a threat to aquatic life. At WMBGB, aluminum, copper and zinc surpassed chronic water quality standards. Further downstream at WMBPL, aluminum, cadmium, copper, and zinc surpassed chronic standards. Although CCUs decrease at the downstream end of the sampled reach, aluminum, cadmium, copper, and zinc still pose a risk to aquatic life at WMAB.

The West Mancos River is approximately 17.2 miles long from the headwaters to the mouth. Our sampling reach on the South Fork West Mancos River from WMAGB to WMAB is located between stream miles 0.4 and 2.4 (from the headwaters). To better understand the water quality conditions in the lower reach of the West Mancos River, we utilized data from an existing River Watch site located 15.8 miles downstream from the headwaters. The River Watch site was sampled on August 8th, 2023, which is between the range of our South Fork West Mancos River sampling dates (Table 5), providing a viable temporal comparison.

HQs at the West Mancos River Watch site were lower than HQs in the most downstream sampling site on the South Fork West Mancos River. Metals that surpassed chronic or acute standards on the South Fork West Mancos River (aluminum, cadmium, copper, and zinc) did not surpass standards at the River Watch site on the lower West Mancos. This indicates that, at least during the August 2023 sampling period, the poor water quality conditions exhibited in the South Fork West Mancos River do not extend all the way to the lower reach of the West Mancos River.

Using analytes measured on the South Fork West Mancos River as well as the River Watch site on the lower West Mancos River, we plotted concentrations of each analyte along stream mile locations for each site (Figure 36, Figure 37; and Figures WM1-WM15). Analytes that were included at all sites including the River Watch site includes: aluminum, arsenic, cadmium, copper, iron, manganese, lead, selenium, zinc, and sulfate. Excluding total iron, all analytes peaked in concentration at WMAT, and decreased in concentration to the River Watch site downstream (e.g., total aluminum in Figure 36). Concentrations of most analytes at the River Watch site are equal to or less than concentrations at the WMAGB site, which is upstream of the sampled draining mines and mineralized inflows. pH follows a similar pattern with the lowest pH occurring in the South Fork West Mancos at WMBPL (5.0), and the pH returning to more neutral at the River Watch site (Figure 37).

Between WMAB and the River Watch site, there are several inflows that may dilute or help to attenuate the metals originating in the South Fork West Mancos River. For example, the confluence with the North Fork West Mancos River occurs downstream of WMAB but upstream of the River Watch site. Trout were found in tributaries to the North Fork Mancos River by CPW in 2022 and the Mineral Resources Database shows only one historic prospect pit in that watershed. With little mining influence and presence of trout, the North Fork Mancos River likely contributes better water quality than the South Fork Mancos River.

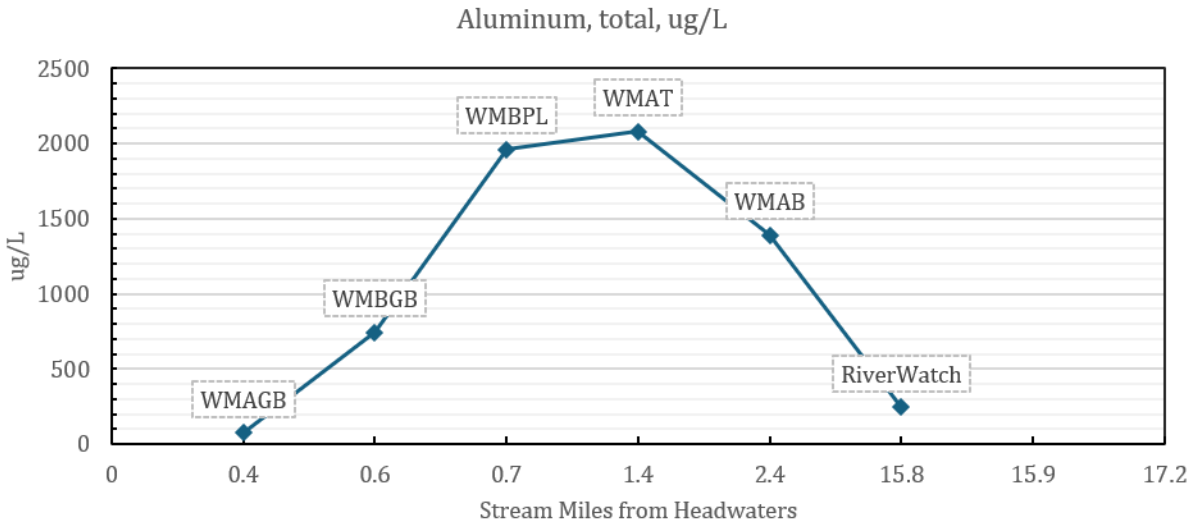


Figure 36. Total aluminum concentration at sampled locations on the West Mancos River in summer 2023.

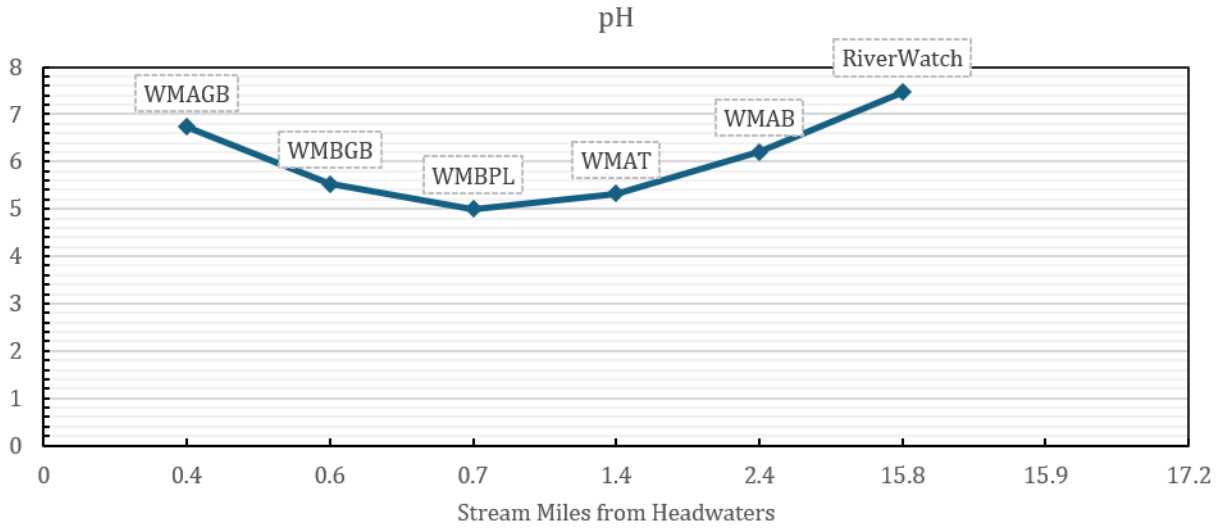


Figure 37. pH at sampled locations on the West Mancos River in summer 2023.

West Mancos Iron Fen – WMIF (Fluffhead Fen)

Although other fens exist in Owens Basin, only one (WMIF) appears to contribute significant surface water to the South Fork West Mancos River. Fens, groundwater-fed wetlands that accumulate peat due to stable anoxic conditions, play key roles in carbon and water storage, as well as water filtration and wildlife habitat. Early fen characterization efforts in the San Juan Mountains identified a subset of peatlands characterized by *Spaghnum* spp., *Betula glandulosa*, *Polytrichastrum longisetum*, *Carex aquatalis*, a pH less than 4.5, and high electroconductivity (Chimner et al. 2010; Harbert and Cooper 2017). These systems were described as iron fens and have typically been found in watersheds containing volcanic bedrock and metal-rich source water such as the South Fork West Mancos River. Some studies postulate that the iron oxide associated with metal-rich groundwater binds strongly with lead, zinc, manganese and copper (Syrovetnik et al. 2007). Others

have demonstrated similar mechanisms in peat (Brown et al. 2000). Thus, iron fens may play an important role in metal retention in addition to storing carbon and water. Researchers are actively exploring this concept.

Fluffhead Fen (WMIF) is a roughly 5-acre forested iron fen complex fed by at least ten springs ranging in pH from 3.5 to 5.7 in addition to other groundwater sources (Figure 38).

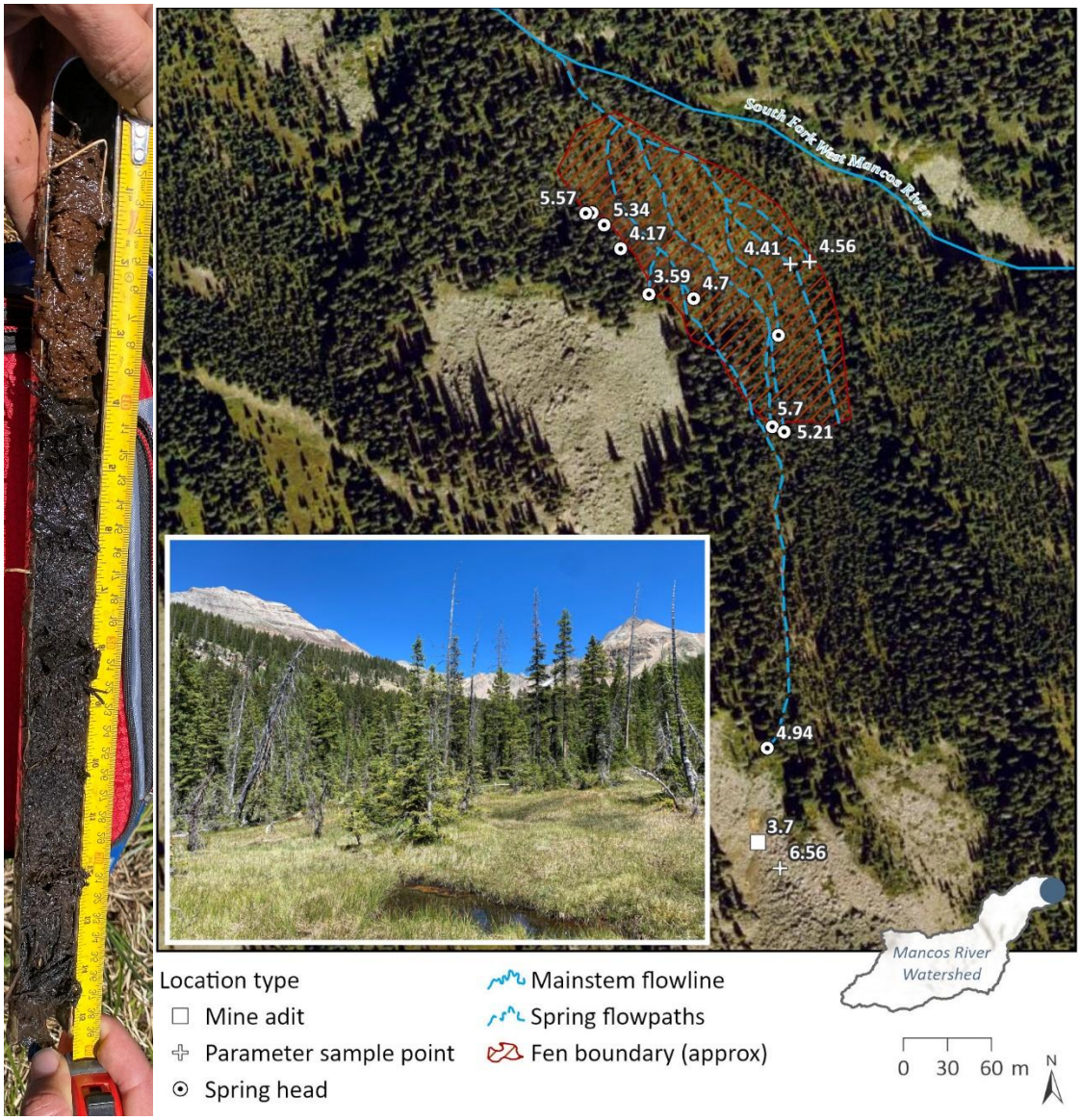


Figure 38. Map of Fluffhead Fen (WMIF, right) showing the distribution of pH across the site at both spring heads and at opportunistic points in flow paths (marked as parameter sample points) and a photo showing the top 40cm of soil (left). The soil color contrast is typical of iron fens: the top 10 cm demonstrates organic soil turned orange by oxidized iron while the rest of the core demonstrates organic soil turned almost coal black by reduced iron. The photo of the fen contained within the map was taken from the same location as the core.

Sphagnum mosses, several species of sedge, and *Eriophorum angustifolium* (cotton grass) dominate the site accompanied by *Picea engelmanii* (Engleman spruce) and *Vaccinium* spp. growing on small hummocks typical of forested fens. Several brown moss species can also be found in isolated patches where the pH is higher. Three primary channels armored with ferricrete (iron precipitate

that forms a crumbly rock as iron re-oxides) move water from spring heads to the West Mancos River. One spring originates roughly 1,000 vertical feet above the fen within a talus slope that also contains a draining adit. The channel carrying water from the springhead to the fen does not begin to develop ferricrete until it enters the fen. As stated above, the outflow of Fluffhead Fen contributes to the metal load of the South Fork West Mancos River. With many of the spring flowpaths being lined with ferricrete, this may prevent interaction with the surrounding peat and reduce the peat's potential to sequester metals. Additional surface water and soil samples could help further understand the potential metal sequestration of the Fluffhead Fen. An initial soil core taken from near the center of the complex shows classic iron fen peat: a shallow bright rusty orange layer over a layer that is deep black. Typically, the bright rusty orange layer is soil rich in oxidized iron while the black layer is rich in reduced iron (Figure 38). Other reduced metals can produce a near black color as well (eg. zinc and manganese), however only iron oxidizes to a bright, rusty orange.

Mancos Watershed Metals Mobilization

Study Design

One primary objective of this work was to collect water-quality samples during high-flow events to assess whether metals from the mineralized upper watershed are mobilized onto the UMUT reach of the Mancos River. If metals are mobilized and present downstream on UMUT, another objective was to assess whether they exist at concentrations that pose a threat aquatic life. We conducted synoptic-style sampling events during the spring runoff period of 2023, 2024, and 2026.

The magnitude of snowpack and snowmelt runoff varies from year to year. Whereas spring high-flow conditions of May 2023 were above average, spring high flow of 2024 occurred early and was well below average. 2026 was a record drought year with abnormally low streamflow conditions throughout the western US. During the 2023 high flow year, the Mancos River ran full for the entire length, discharging robustly into the confluence with the San Juan River. During runoff of 2024, by mid-May, water no longer reached the Mancos River near Towaoc, and did not make it to the San Juan River (dry streambed). When flows are low, residence time of surface water is much slower through the Mancos Valley and Mancos Canyon (within the UMUT), giving the opportunity for chemical reactions and warming temperatures within the stream that could remove or attenuate metals in water. When flows are high, travel times of the stream are rapid, which transports metals from the headwaters to downstream reaches with less time for chemical reactions and temperature change.

During the 2018-19 investigation of the East Mancos River (Wright et al., 2020), weekly sampling was done at the mouth of the watershed during snowmelt runoff (previous site EM-25A). Much information was gleaned from the weekly sampling; for example, the peak metal concentrations and mass loading occurred before the peak streamflow. These peak metal concentrations were the manifestation of the scouring of metal-rich streambed precipitates during high-flow conditions. Some metals peaked later than others, yet these data indicated that metals were being transported out of the East Mancos watershed.

To characterize the mobilization of metals during high-flow periods, we established fifteen sampling sites from the headwaters to the San Juan River (Figure 39). Site descriptions and locations are described in Appendix HF1, and all water-quality data are tabulated in Appendix DB.

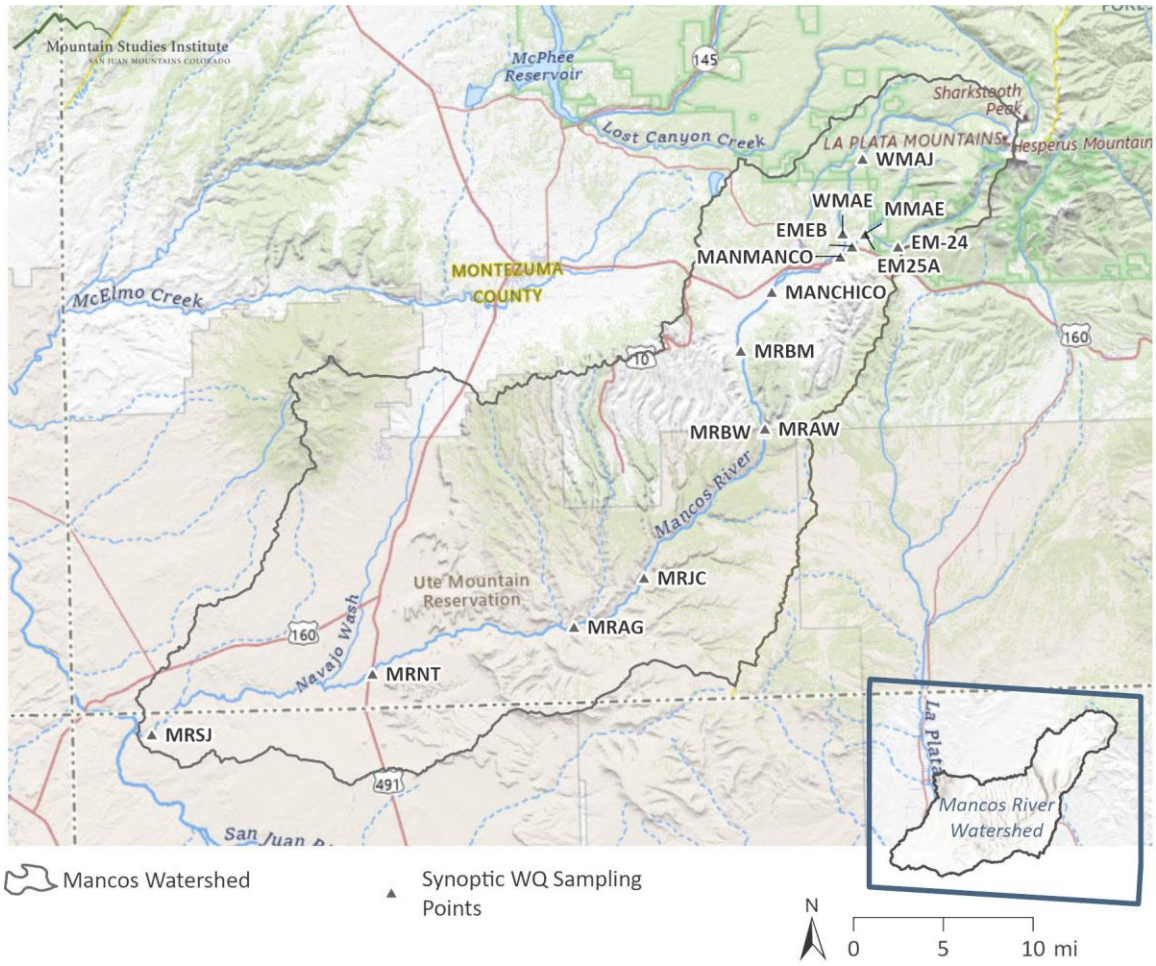


Figure 39. Synoptic sampling locations from headwaters to the confluence with the San Juan River.

Metal Concentrations, Mass Loading, and Aqueous Geochemistry

Distribution of Selected Metals During High Flow

Water-quality samples were analyzed for more than 50 different constituents and water properties, including parameters measured in the field. The distribution of metals of concern are presented as graduated circles based on the magnitude of concentration for total aluminum, dissolved copper, dissolved manganese, dissolved zinc, pH, and dissolved organic carbon (DOC) in Appendix HF, Figures HF1-HF18.

The presence of aluminum in stream water can be related to acid rock drainage in the upper portions of the Mancos River watershed, and aluminum can be present in water due to the weathering of Mancos Shale in the lower portions of the basin. During the robust high-flow sampling of 2023, water from historical mines in the upper West Mancos River had total aluminum concentrations greater than 20,000 ug/L, and the East Mancos River had total aluminum concentrations ranging from 700 to 17,000 ug/L (Appendix HF1). With increasing pH and other inflows near the town of Mancos, aluminum drops out (precipitates) to relatively low concentrations, then total aluminum concentrations increase as the Mancos River traverses the Mancos Canyon through UMUT property to the San Juan River. During high flow of 2024, with less water in the stream, total aluminum concentrations were high in the East Mancos River but

decreased downstream due to mixing. There was no water present during the 2024 sampling event below Mancos River at Grassy Canyon (Appendix HF2). During high flow of 2026, with less water in the streams than 2023, total aluminum concentrations were high in the East Mancos River, decreasing in the canyon at Johnson and Grassy Canyons, but increased at Mancos at Towaoc (site

MRNT) and Mancos at San Juan River (site MRSJ), illustrating aluminum contributions to the system by the Mancos Shale in the lower basin (Appendix HF3).

The presence of copper in streams of the Mancos River watershed largely originates from acid rock drainage and legacy mine sites in the upper portions of the East and West Mancos Rivers, particularly the upper East Mancos. While copper can be transported in acidic (low pH) waters of the East Mancos, mixing with circumneutral inflows in a downstream direction removes the copper from the water column (attenuates), whereby the copper becomes part of the streambed sediment load. As an example, in the lower East Mancos River, an apparent landslide feature occurs where diffuse groundwater inflows enter the stream. Mixing of the circumneutral groundwater with the acidic copper and aluminum-rich stream water causes turquoise-colored colloids in the stream (Figure 40).



Figure 40. Blue pool in lower East Mancos River where diffuse groundwater inflows mix with copper and aluminum-rich stream water to precipitate turquoise-colored colloids.

During high flow of 2023, attenuation was illustrated by high dissolved-copper concentrations in the East Mancos, with decreasing concentrations in a downstream direction (Figure 41). Given that the main copper source is the East Mancos, the Mancos Shale contributes little to no copper, and with robust high flows in the Mancos River, it appears as though the copper from East Mancos does, indeed, make it to the San Juan River during some conditions (Figure 41). During high flow of 2024, with less water in the Mancos River, slower velocities, and warmer temperatures, dissolved copper concentrations decreased in a downstream direction (Figure 42). During high flow of 2026, with less water in streams (record drought), dissolved copper concentrations are attenuated by slower

velocities, mixing with inflows (irrigation return flows from Mancos Shale), and warmer water temperatures (Figure 43).

The presence of manganese in streams of the Mancos River watershed can be attributed to acid rock drainage in the upper portions of the watershed, and manganese can be produced from weathering of the Mancos Shale. During high flow of 2023, high dissolved-manganese concentrations are shown in the upper East and West Mancos River drainages (Appendix HF7), decreasing through lower reaches of the watershed. During high flow of 2024, dissolved-manganese concentrations were not nearly as high as 2023, but still showed elevated manganese concentrations in the upper East Mancos (Appendix HF8), with increased manganese concentration between Johnson and Grassy Canyons, indicating a possible source of manganese in the lower reaches of the watershed. During high flow of 2026, the pattern from 2024 seems repeated (Appendix HF9).

The presence of zinc in streams of the Mancos River watershed can be attributed to acid rock drainage and legacy mine sites in the upper portions of the watershed, and zinc can be produced from weathering of the Mancos Shale. During high flow of 2023, high dissolved-zinc concentrations are shown in the upper East and West Mancos River drainages (Appendix HF10), decreasing through lower reaches of the watershed. During high flow of 2024, dissolved-zinc concentrations were not nearly as high as 2023, but still had elevated dissolved-zinc concentrations in the upper East Mancos (Appendix HF11). Zinc concentrations during high flow of 2026 had a similar pattern as observed in 2024 (Appendix HF12).

To determine whether water is acidic, neutral, or basic, the pH of stream water is measured in the stream or within a container of depth-integrated samples and also was measured in the laboratory for verification of field pH measurements. As a property of water, low pH values are caused by acidic weathering of sulfide-bearing minerals such as pyrite (fool's gold) and chalcopyrite (copper sulfide). Low pH values tend to keep metals dissolved in stream water whereby metals can be readily transported downstream. Higher pH values are caused by weathering of carbonate minerals, such as calcite and dolomite, in the Mancos Shale, which then "buffers" the low pH waters. During high flow of 2023, very low pH values were measured (ranging from 3.6 to 5.4 standard units) in the East and West Mancos Rivers. After crossing the UMUT boundary, the Mancos River above Weber Canyon showed pH value of 7.86, which decreased to 6.88 in the Mancos River below Johnson Canyon (Appendix HF13). The causes of this pH decrease are uncertain, but the chemical mechanisms behind the pH decrease contributes to the transport of metals through the Mancos Canyon within the UMUT Reservation. For example, during high flow 2023 the dissolved-copper concentration in Mancos River above Weber Canyon was 8.0 ug/L, increasing to 17.3 ug/L in the Mancos River below Johnson Canyon (Figure 41). Decreased pH might have been mobilizing copper from stream bed sediments into stream water. During high flow of 2024 with less water in streams, pH of water in streams of the Mancos watershed were a little higher, with the lowest pH values in the upper East Mancos (Appendix HF14). Once again, a slight pH decrease was noticed between Weber and Johnson Canyon. During high flow of 2026 with much less water in streams, pH values were generally lower throughout the upper watershed compared with 2024 (Appendix HF15).

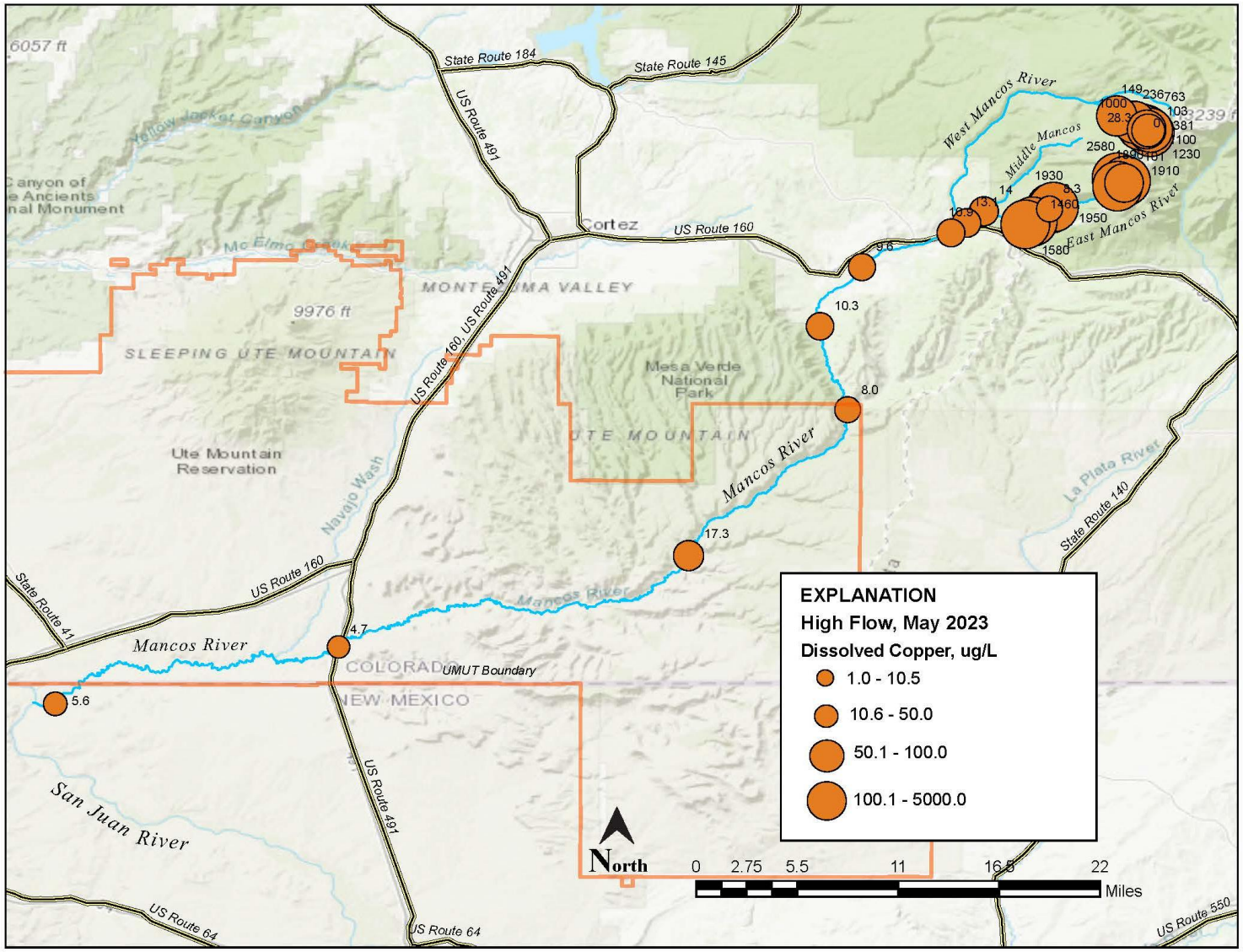


Figure 41. Distribution of dissolved copper in the Mancos River watershed during high-flow May 2023.

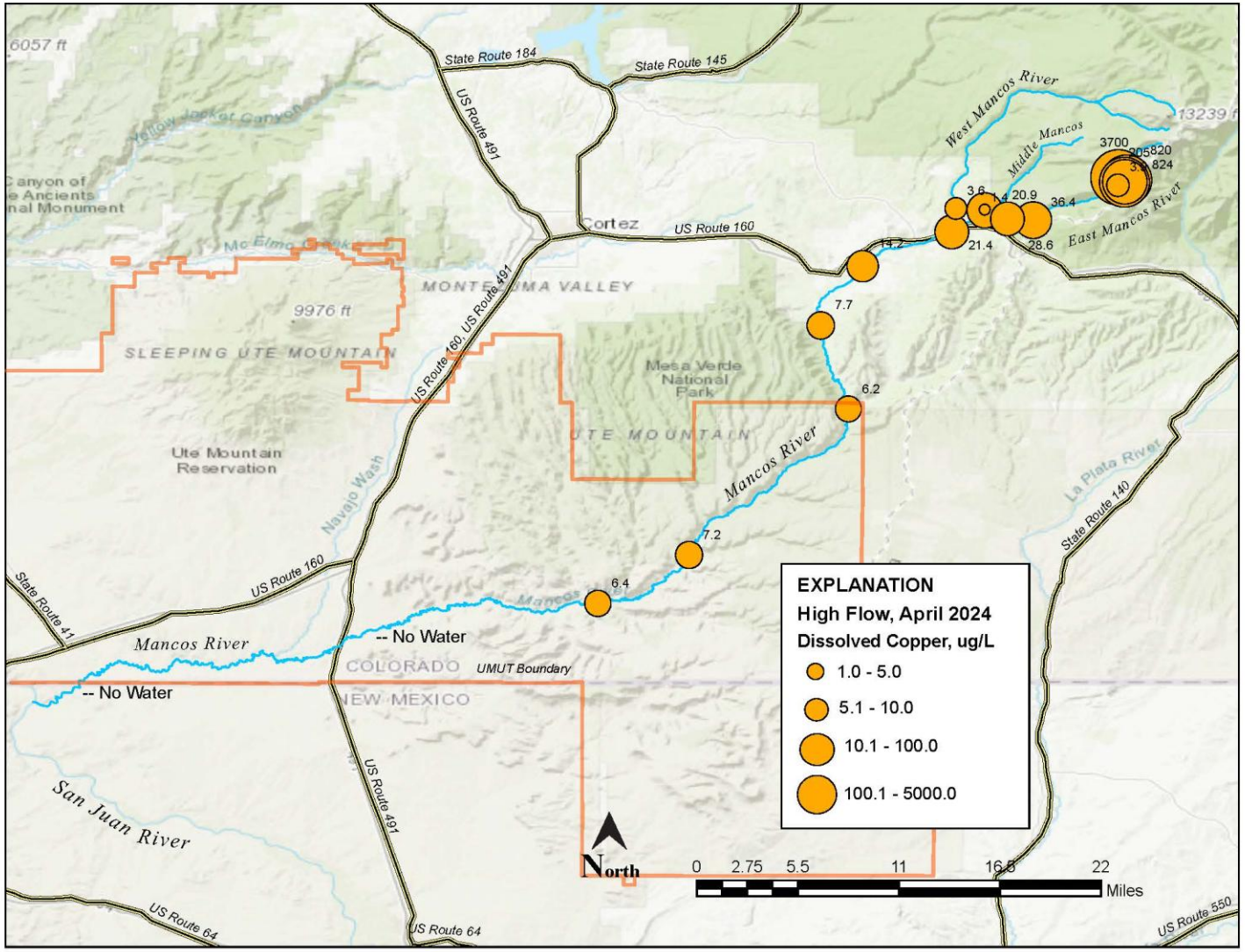


Figure 42. Distribution of dissolved copper in the Mancos River watershed during high-flow April 2024.

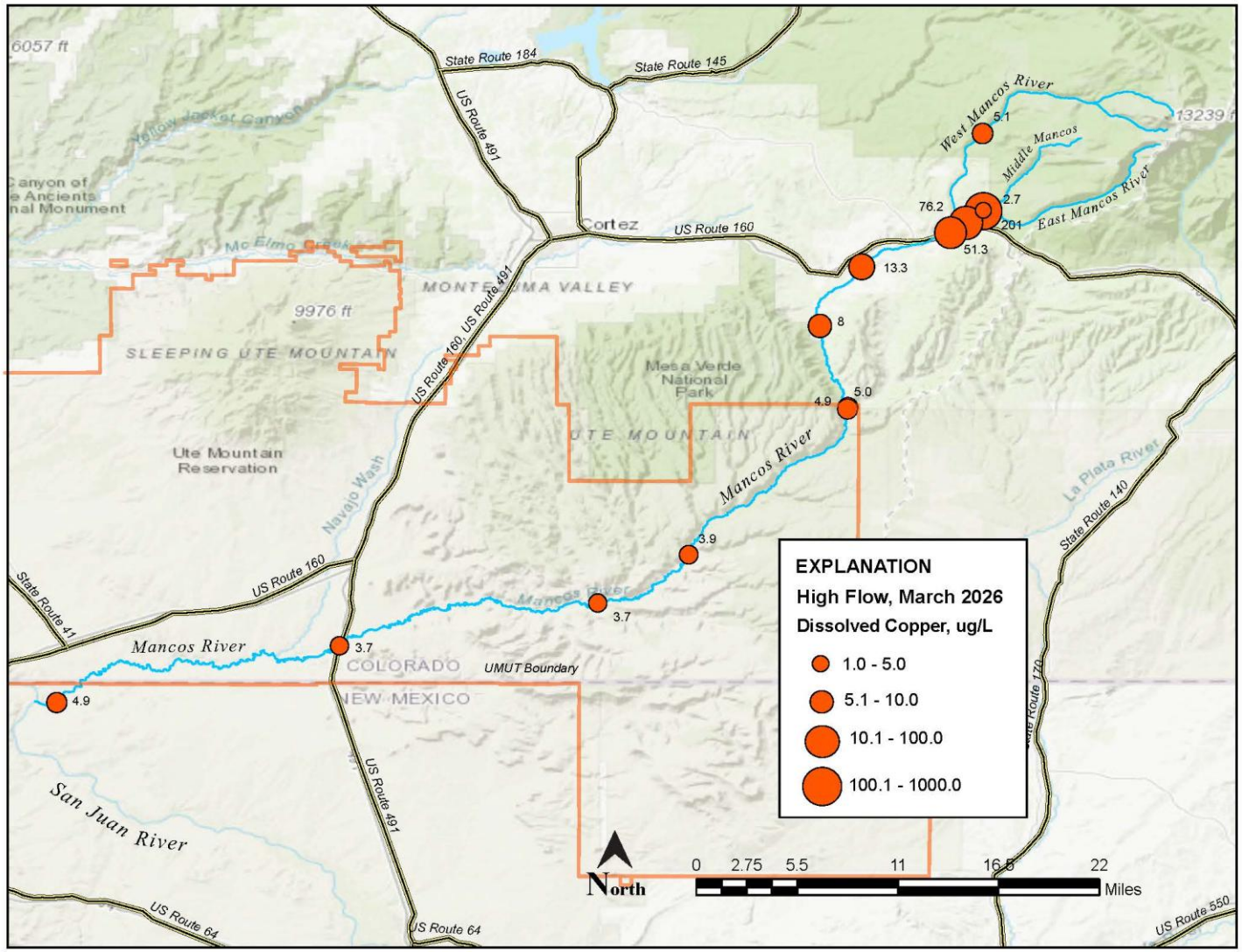


Figure 43. Distribution of dissolved copper in the Mancos River watershed during high-flow March 2026.

The presence of dissolved organic carbon (DOC) in streams can be caused by weathering of organic matter in soils and forested landscapes. Weathering of organic-rich rocks and shales can produce elevated DOC concentrations in streams. Agricultural runoff can produce DOC in water due to cattle or livestock operations, and DOC can be produced by on-site septic systems and municipal sewage outfall. High DOC concentrations can be problematic for public water systems because the DOC can react with chlorine to create carcinogens (trihalomethanes) in drinking water. In contrast, natural DOC concentrations in streams can lower the toxicity of dissolved metals for fish and aquatic ecosystems. In forested areas with deep snowpack, carbon can be stored in the soil through the winter, then flushed out of the soil during snowmelt, creating elevated DOC concentrations in streams during high-flow runoff conditions. With high dissolved-metal concentrations such as the East Mancos, the DOC can be sequestered by the metals, removing DOC from the stream water. On the other hand, elevated DOC concentrations of tributaries entering a stream can then react with metals such as copper in streambed sediments, mobilizing and transporting metals that would otherwise remain as solid mineral phases in sediments. During high flow of 2023, as mentioned above DOC concentrations were low in the metal-rich waters of the upper East Mancos, with increasing DOC concentrations in a downstream direction, and a high DOC value for Mancos at San Juan River (Appendix HF16). During high flow 2024 with less water in streams, DOC concentrations were generally much higher across the watershed (Appendix HF17), except for stream drying out below Grassy Canyon. During high flow of 2026 with much less water in streams, DOC concentrations were much lower than DOC concentrations during 2024 (Appendix HF18). Causes of the low DOC concentrations are uncertain, but may be related to the general increase of metals in the upper basin which contributes to sequestration of DOC.

Stream Mass Loads of Selected Metals

Constituent mass loads are calculated by multiplying concentration (in milligrams per liter (mg/L) or micrograms per liter (ug/L)) by streamflow discharge in cfs to obtain pounds per day (lb/d) or kilograms per day (kg/day). Whereas constituent concentrations are important for aquatic toxicity, constituent mass load describes the amount of the metals that are being mobilized and transported by the stream system. Mass loading stream profiles plotted in a downstream direction can describe the attenuation or removal of metals, indicating that metals have dropped out of the water, presumably into the streambed sediments as solid phase minerals. Given analyses of the dissolved and total-recoverable constituent concentrations, the difference between total and dissolved load is called the suspended sediment load, indicating the fate and transport of metals in the aquatic system.

During the course of this study, there was great variability in the timing of the arrival of peak runoff in the Mancos River. Due to the variable conditions, the project team had to adjust the high-flow synoptic sampling of the whole basin from the typical runoff of May 2023, shifted earlier to April 2024, and shifted even earlier in March 2026 (Figure 44). If the team had sampled in May of 2024 or May of 2026, there would be a risk of missing runoff conditions.

An example of the variability is shown by plotting stream profiles of total dissolved solids (TDS), alkalinity, and hardness. During high flow of 2023, TDS loads ranged from 74,000 pounds per day (lb/d) at East Mancos to 632,000 lb/d in water for Mancos at San Juan River. Alkalinity load ranged from 35,000 to 285,000 lb/d, and hardness load ranged from 36,000 to 330,000 lb/d (Figure 45).

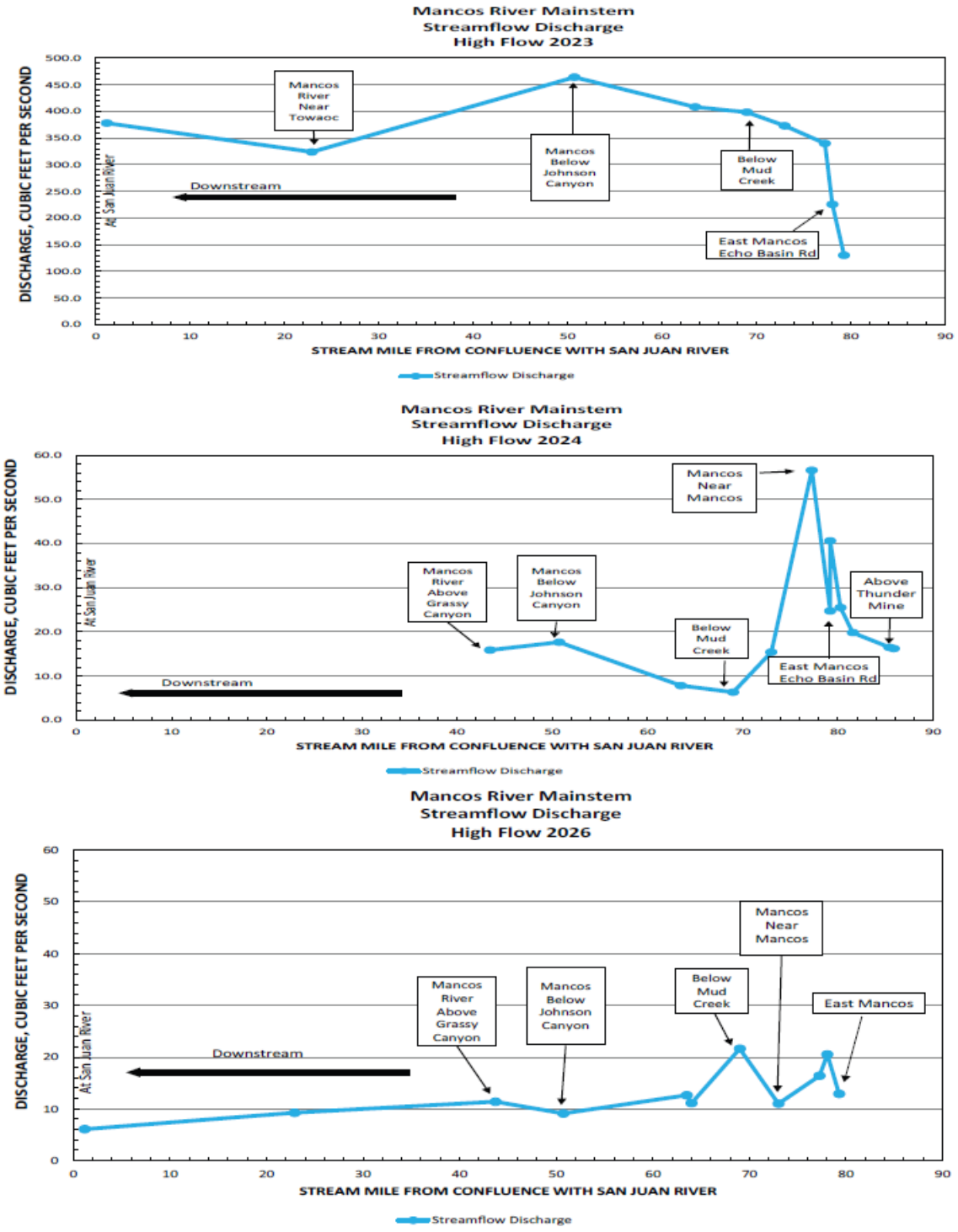
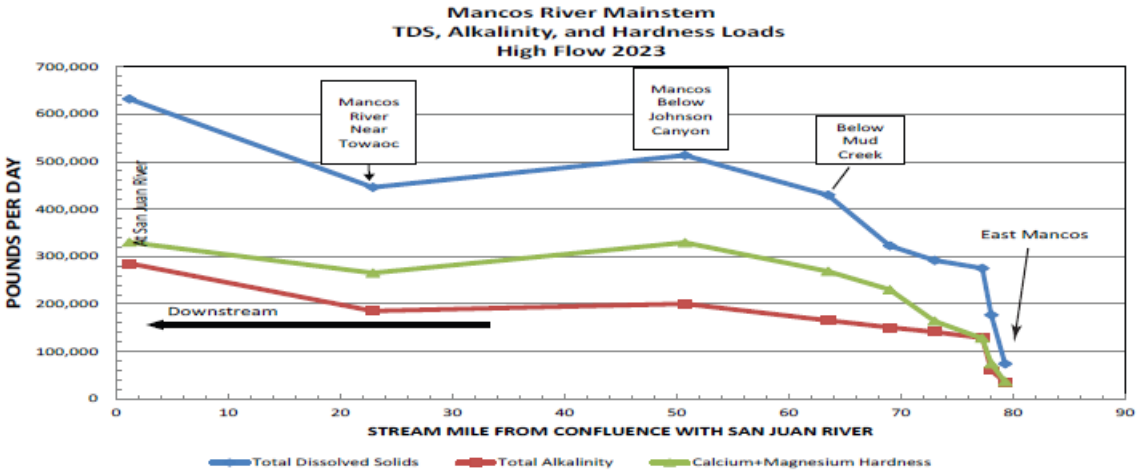
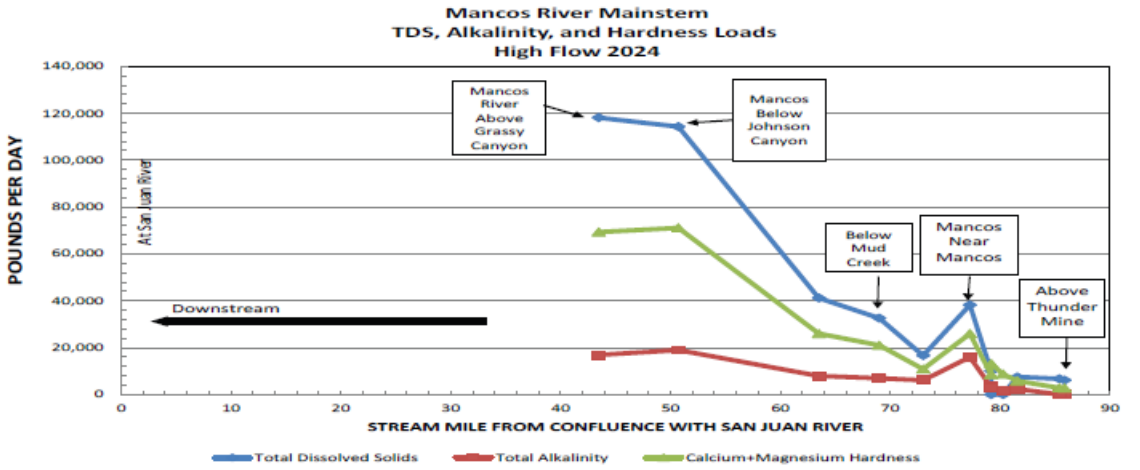


Figure 44. Stream profiles of discharge during high flow of 2023, 2024, and 2026.





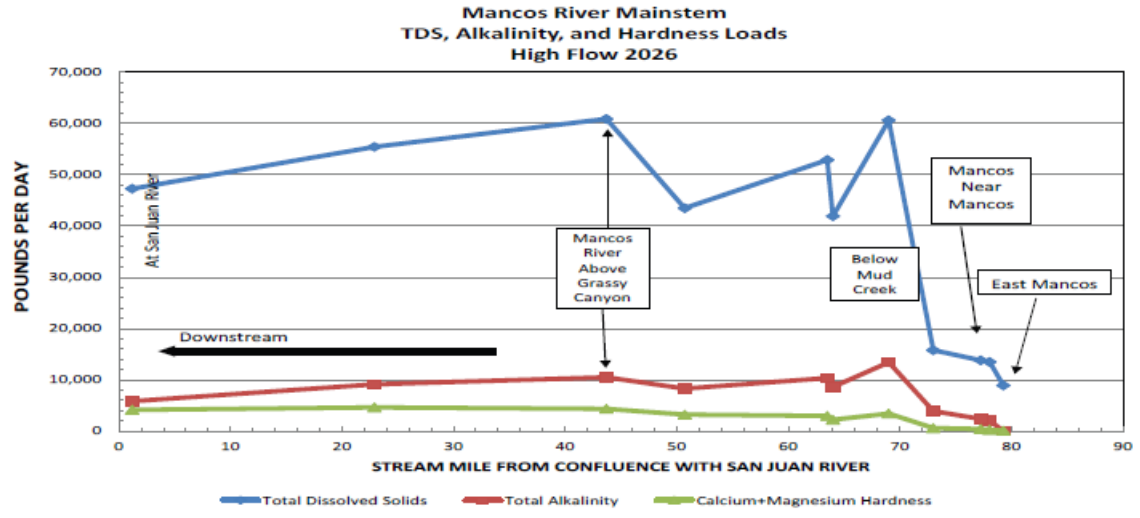


Figure 45. Mass loading stream profiles of total dissolved solids (TDS), total alkalinity, and hardness during high flow of 2023, 2024, and 2026.

During high flow of April 2024, TDS load ranged from 6,000 to 118,000 lb/d, a nearly six-fold decrease compared with 2023. Alkalinity load ranged from 1,600 to 19,000 lb/d (15-fold decrease), and hardness load ranged from 2,700 to 71,000 lb/d (nearly five-fold decrease). During high flow 2026, TDS loads ranged from 8,900 to 61,000 lb/d (10-fold decrease compared with 2023), alkalinity loads ranged from 2,100 to 13,400 lb/d (25-fold decrease compared with 2023), and hardness loads ranged from 6,100 to 40,000 lb/d (eight-fold decrease compared with 2023) (Figure 45).

The effects of variable year-to-jyear runoff are evident in stream metal mass loads. During high flow 2023, dissolved aluminum, total aluminum, and suspended sediment aluminum loads were in the 1,000's lb/d in the upper basin, with the total and suspended sediment loads increasing to 10,000 lb/d for Mancos at San Juan River (Figure 46). The increasing aluminum loads indicate an aluminum source in the lower reaches of the Mancos watershed. During high flow 2024 with less water in streams, dissolved, total, and suspended sediment aluminum loads were variable in the upper basin, reflecting aluminum attenuation due to mixing with inflows. During high flow 2026 with even less water in streams, dissolved, total, and suspended aluminum loads were variable in the upper basin, similarly exhibiting increases in the lower basin (Figure 46).

For copper loads, during high flow 2023, total copper was highest at East Mancos River, when dissolved copper comprised only about 10 percent of the copper load (Figure 47).

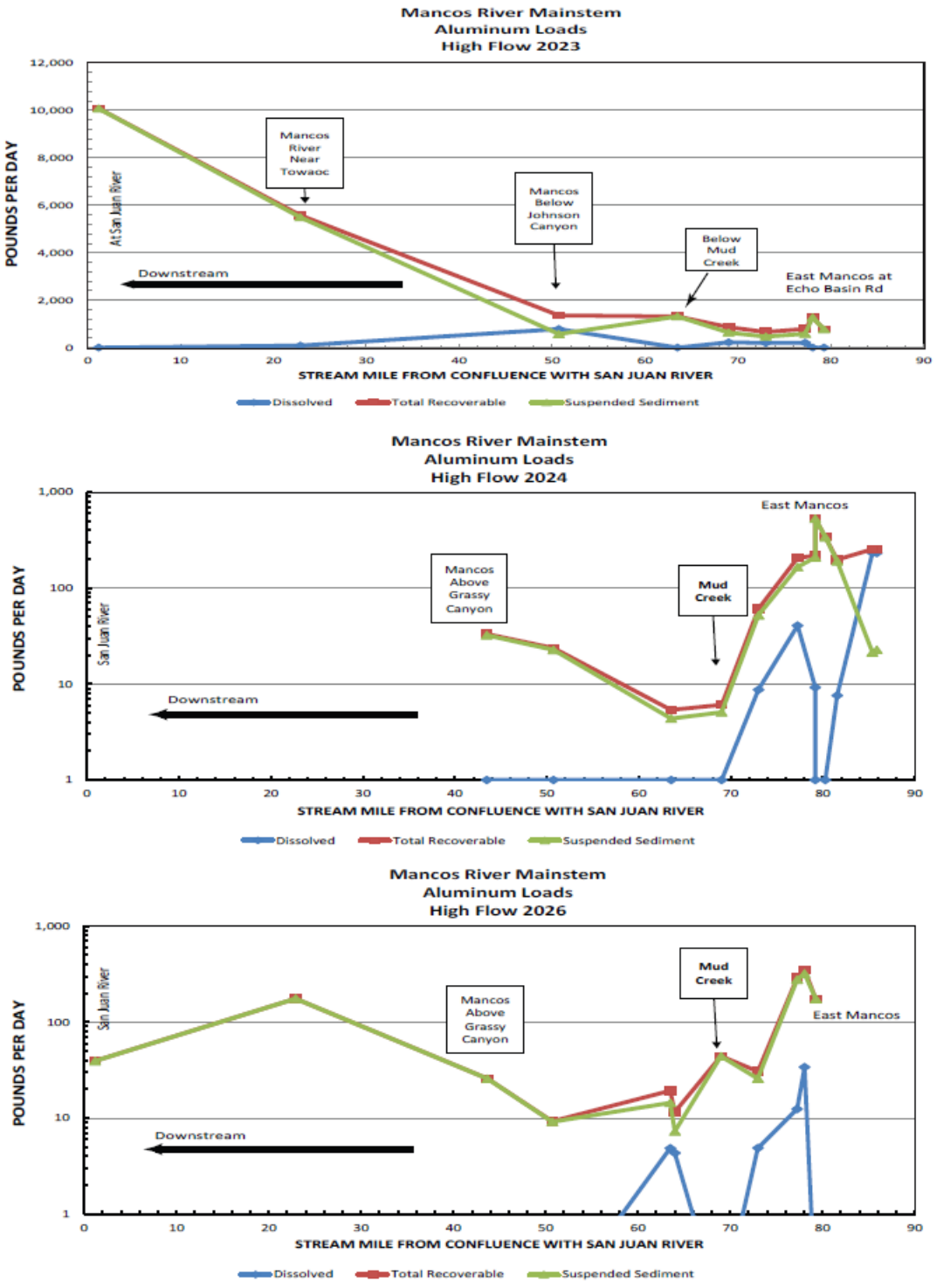


Figure 46. Mass loading stream profiles of dissolved aluminum, total aluminum, and suspended sediment aluminum during high flow of 2023, 2024, and 2026.

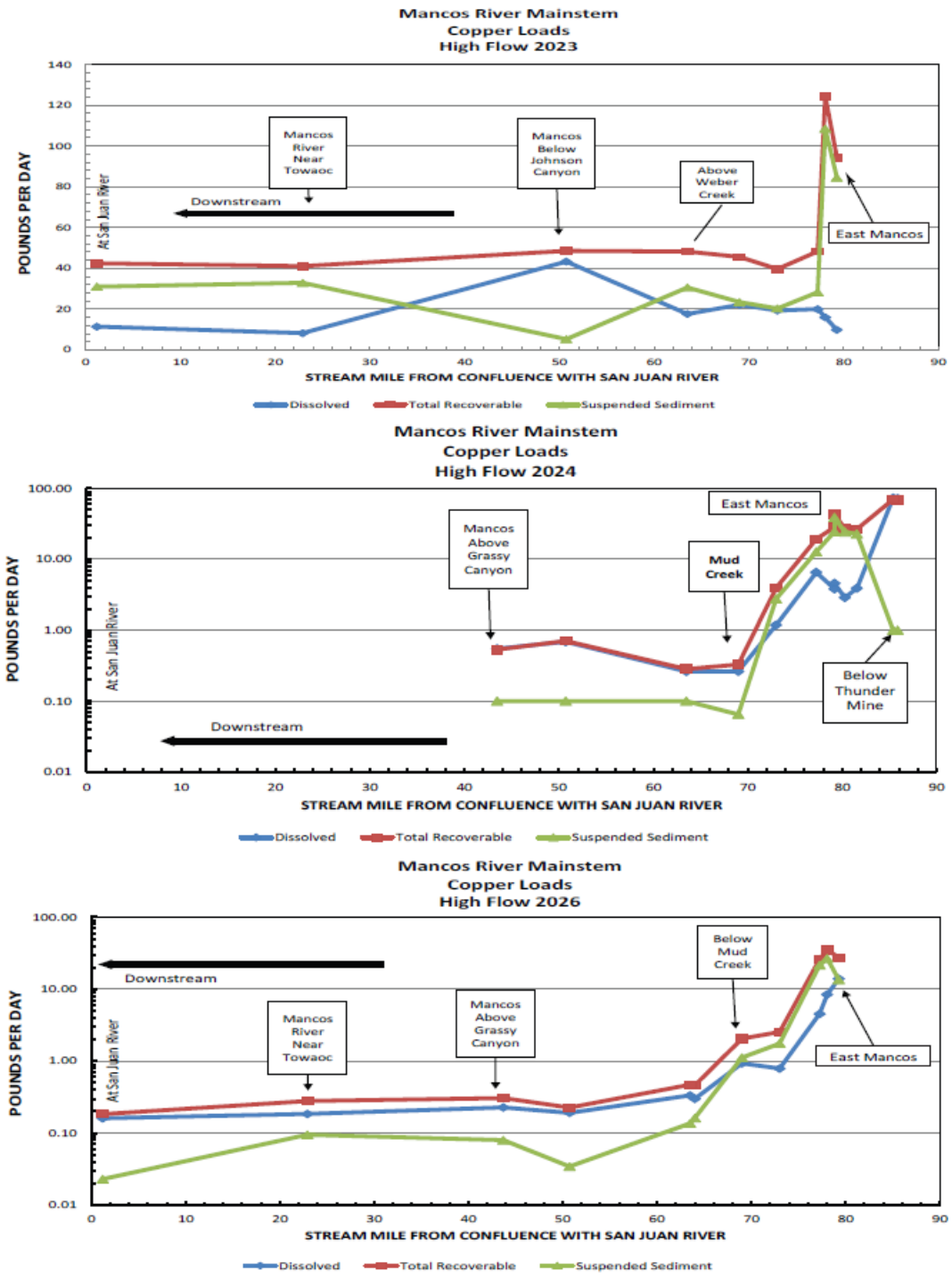


Figure 47. Mass loading stream profiles of dissolved copper, total copper, and suspended sediment copper during high flow of 2023, 2024, and 2026.

From an automated trail camera set up at the East Mancos streamflow gaging station (site EM-25A), the copper-colored turbidity of stream water on the day of sampling (May 30, 2023) was indicative of the suspended sediment loads during an above average high-flow runoff (Figure 48).



Figure 48. Automated trail camera photograph of copper-colored turbidity of stream water in the East Mancos River, site EM-25A, on May 30, 2023.

The high flow 2023 copper stream profile illustrates that the majority of the copper was sourced in the upper East Mancos (Figure 47). With a maximum total copper load of 124 lb/d, copper loads were attenuated in the Mancos Valley through mixing of tributaries – primarily West Mancos River and Chicken Creek. With 2023 total copper remaining steady into the lower reaches, there was an increase in the dissolved copper load relative to total copper load, and a decrease in suspended sediment copper between Mancos above Weber and Mancos below Johnson Canyon. This illustrates that chemical reactions in the stream were converting total copper into dissolved copper through the stream reach. Then copper loads remained steady through the lower Mancos River reaches of the UMUT Reservation, indicating that there are no other sources of copper in the lower basin (Figure 47).

During high flow 2024 with less water in streams, the copper load in the East Mancos was still relatively elevated at 73 lb/d, but was mostly comprised of dissolved copper. Copper loads were less attenuated in the Mancos Valley because of less water for inflow and tributary mixing. During high flow 2026 with much less water in streams, the total copper load at East Mancos load was only 35 lb/d, with about half comprised of dissolved copper (Figure 47). A small increase in copper load was shown between Mancos below Johnson (MRJC) and Mancos above Grassy Canyon (MRAG), but this may have been caused by different discharges measured and sampled during different times of the day.

For manganese mass loading during high flow 2023, manganese loads at East Mancos River were less than 100 lb/d, increasing slightly through the Mancos Valley, with large increases in total and suspended manganese loads in the lower reaches, indicating a manganese source in the lower basin (Figure 49). During high flow 2024 with less water in streams, manganese loads were highest in

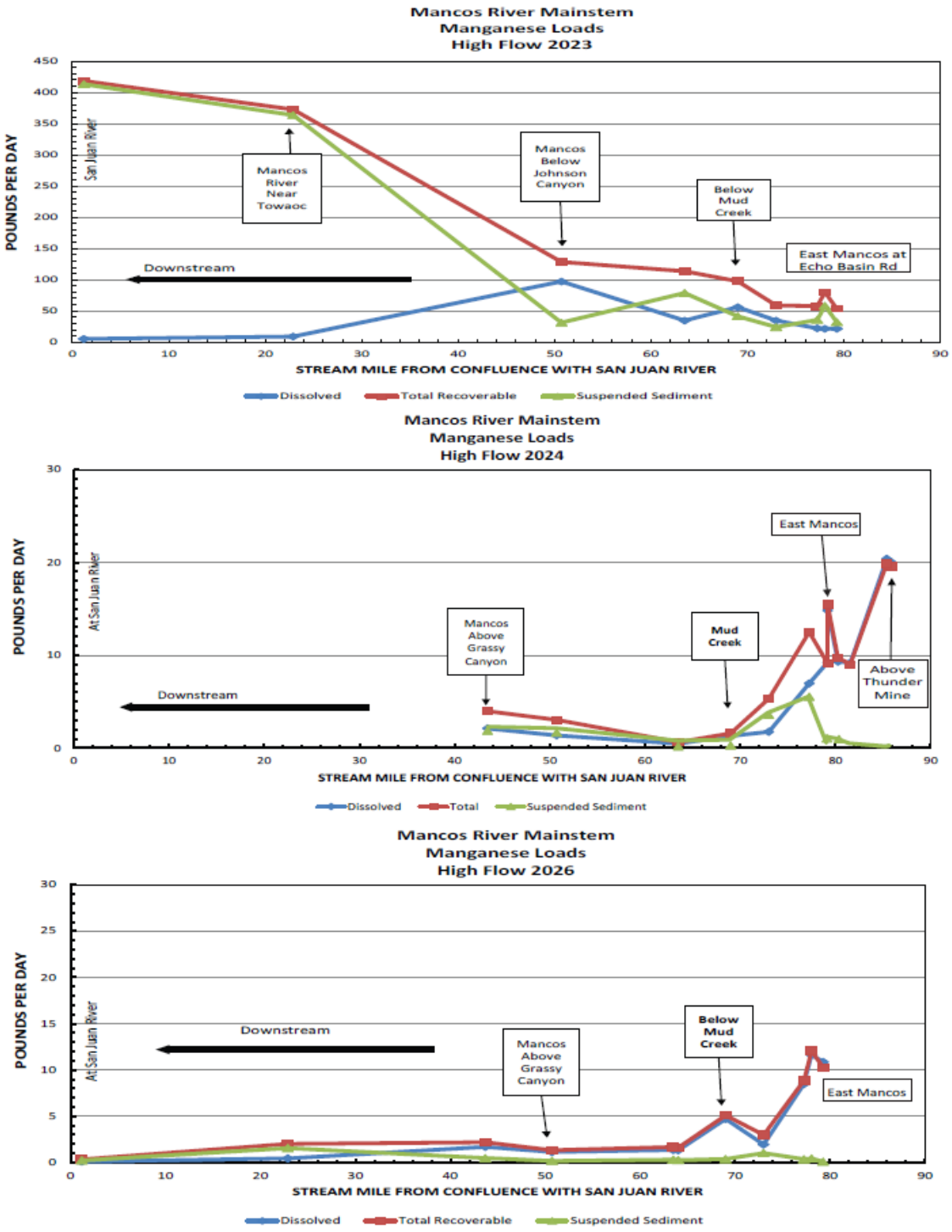


Figure 49. Mass loading stream profiles of dissolved manganese, total manganese, and suspended sediment manganese during high flow of 2023, 2024, and 2026.

water from East Mancos, decreasing to low manganese loads across the UMUT Reservation. During high flow 2026 with much less water in streams, East Mancos showed about half of the 2024 manganese load, with a slight increase below Mud Creek, and decreasing manganese loads through the UMUT Reservation. The manganese source in the lower reaches observed in the 2023 data was exhibited only slightly during 2024 and 2026 (Figure 49).

For zinc mass loading during high flow 2023, the total zinc loads at East Mancos were greater than 50 lb/d, comprised of less than 10 percent dissolved zinc (Figure 50). Zinc loads were attenuated through the Mancos Valley, but then zinc loads increased through the lower reaches of the watershed, climbing back up to 50 lb/d at Mancos River near Towaoc (MRNT). This indicates the presence of another zinc source in the lower reach, but that source may be the streambed sediments. During high flow 2024 with less water in streams, the highest zinc loads were in the East Mancos River, with loads almost entirely attenuated through the Mancos Valley, then increasing through the UMUT Reservation, once again indicating a zinc source. During high flow 2026 with much less water in streams, the highest zinc loads were in the East Mancos River, attenuating through the Mancos Valley, and then again increasing through the UMUT Reservation (Figure 50).

High-Flow Weekly Data and Results

During the East Mancos watershed study of 2018-19, weekly high-flow sampling was done at the mouth of the East Mancos watershed at site EM-25A (Wright et al., 2020). Results showed that metal concentrations and loads peaked before the streamflow discharge peak occurred, indicating that streambed precipitates in the upper East Mancos River were being scoured and flushed out ahead of the peak flows. For this study, weekly sampling was done at East Mancos at mouth (site EM-25A) during high-flow runoff during 2024 and 2026, and weekly sampling was done during 2026 for Mancos River above Weber (MRAW) and Mancos River below Johnson Canyon (MRJC). The 2019 and 2024 dates and data are plotted on selected graphs to illustrate the variabilities that can occur with streamflow discharge and metal concentrations.

During high flow of 2019, considered an above average runoff year, snowmelt runoff began in March, with continued rising hydrograph conditions until late April when weather became cold with new snow, shutting down the spring runoff. Temperatures warmed and snowmelt continued during late May, with the discharge peak on June 12, 2019 (Figure 51). During 2024 and 2026, streamflow discharges were much lower than 2019; however, if weekly sampling had occurred during 2023, the flows would have been above average.

During 2019, total aluminum concentrations exceeded 15,000 ug/L illustrating the precipitate flushing of the upper East Mancos River (Figure 51). During our weekly sampling period, dissolved copper concentrations and dissolved manganese concentrations in the East Mancos River were greater in 2024 and 2026 than in 2019 (Figure 51).

Among the three sites sampled weekly during high flow conditions of 2026, DOC concentrations were lowest in the East Mancos River, ranging from 0.7 to 1.1 mg/L (Figure 52). DOC concentrations in water from Mancos River above Weber (MRAW) ranged from 2.6 to 4.2 mg/L. DOC concentrations in water from Mancos River below Johnson Canyon (MRJC) showed the highest values, ranging from 2.8 to 8.1 mg/L (Figure 52). These high DOC concentrations between Weber and Johnson may play a role in the increasing metal loads and chemical changes in the stream, possibly related to re-mobilization of metal in streambed sediments.

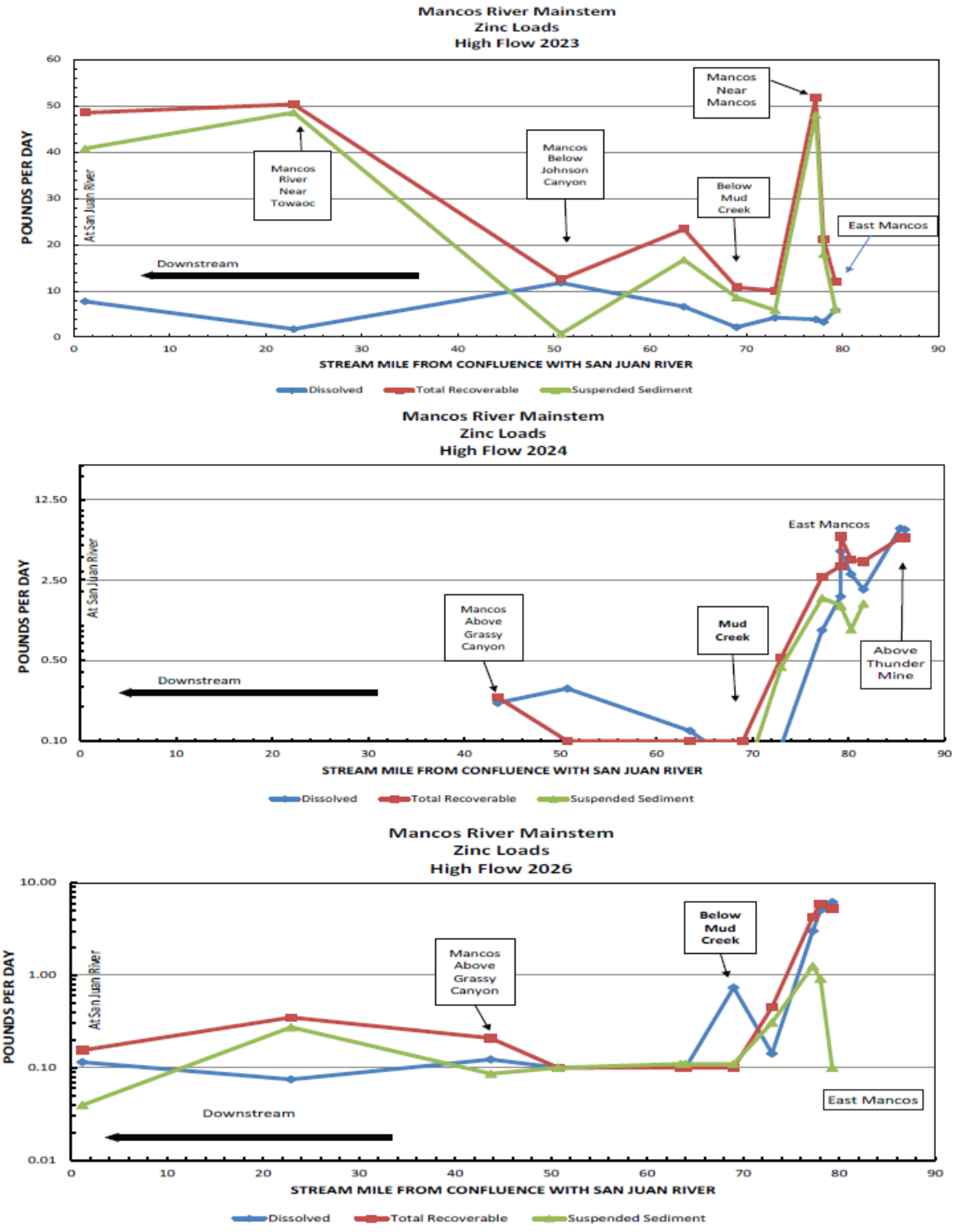


Figure 50. Mass loading stream profiles of dissolved zinc, total zinc, and suspended sediment zinc during high flow of 2023, 2024, and 2026.

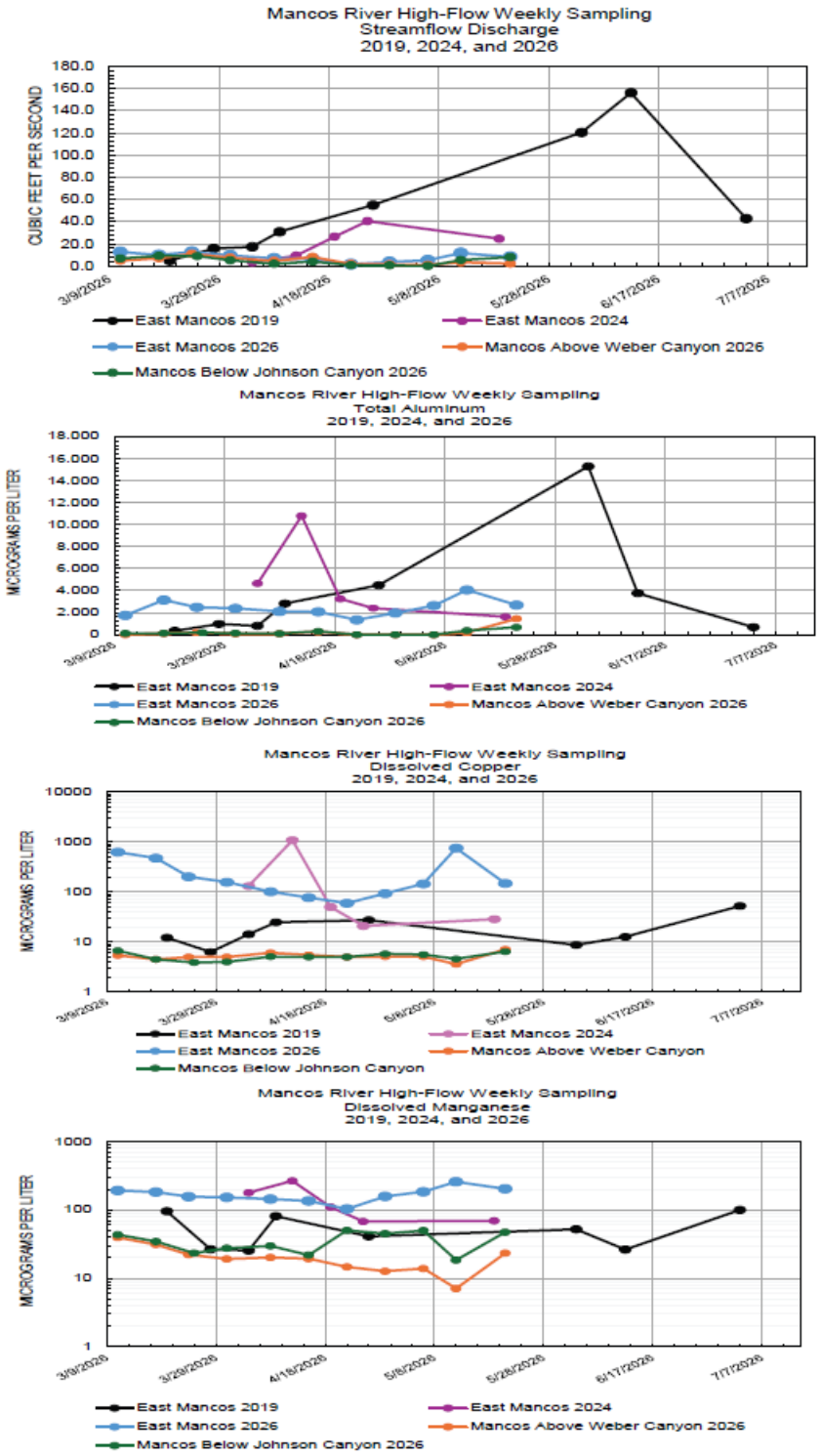


Figure 51. Discharge and concentrations of aluminum, copper, and manganese during weekly sampling in 2019, 2024, and 2026.

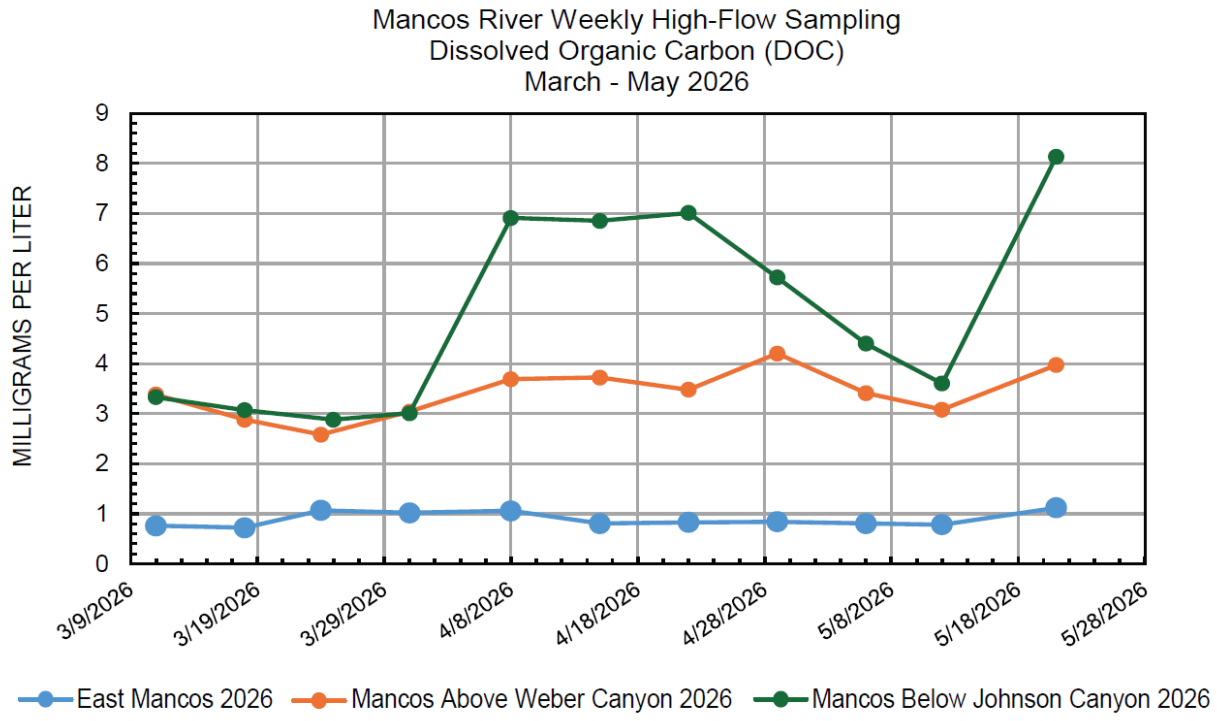


Figure 52. Dissolved organic carbon during weekly sampling in 2026.

Geochemical Model

Aqueous mineral species can describe the mineral sources that result from chemical weathering of rocks. Aqueous mineral speciation represents compounds that are dissolved in water samples under certain water-chemistry conditions. However, under different water-chemistry conditions, clay particles or colloids can precipitate from stream water onto the streambed, and small colloids can be transported downstream for many miles. Geochemical modeling can describe the chemistry of these solid-phase minerals. Modeling results can also be used in conjunction with streamflow data to determine the mass of minerals precipitated (removed) from or dissolved (added) into the water column.

Water chemistry data from Mancos River samples were input to the geochemical model Phreeqc (Parkhurst and Appelo, 1999). Through modeling the differences between each site in a downstream direction, the predominant mineral species with high activity were identified, and the model described the mass of mineral species added or removed from the water. The primary mineral identified in streams of the Mancos included the cuprous ferrite (CuFeO2), rhodochrosite (MnCO3), zinc silicate (ZnSiO3), aluminum hydroxide (AlOH3), and K-mica (KAlSiO3).

During high flow in 2023, relatively small amounts of copper (represented in the model as cuprous ferrite) were mobilized from the East Mancos (EM-25A) to the Mancos below Weber (MRBW) (Figure 53). Between MRBW and Johnson Canyon (MRJC), about 9,000 tons per day (tons/d) of copper were added to the stream reach, indicating either the presence of an additional copper source or mobilization of copper from streambed sediments. The reach from Johnson Canyon to Mancos near Towaoc (MRNT) showed more than 8,000 tons/d of copper removed from the stream (Figure 53).

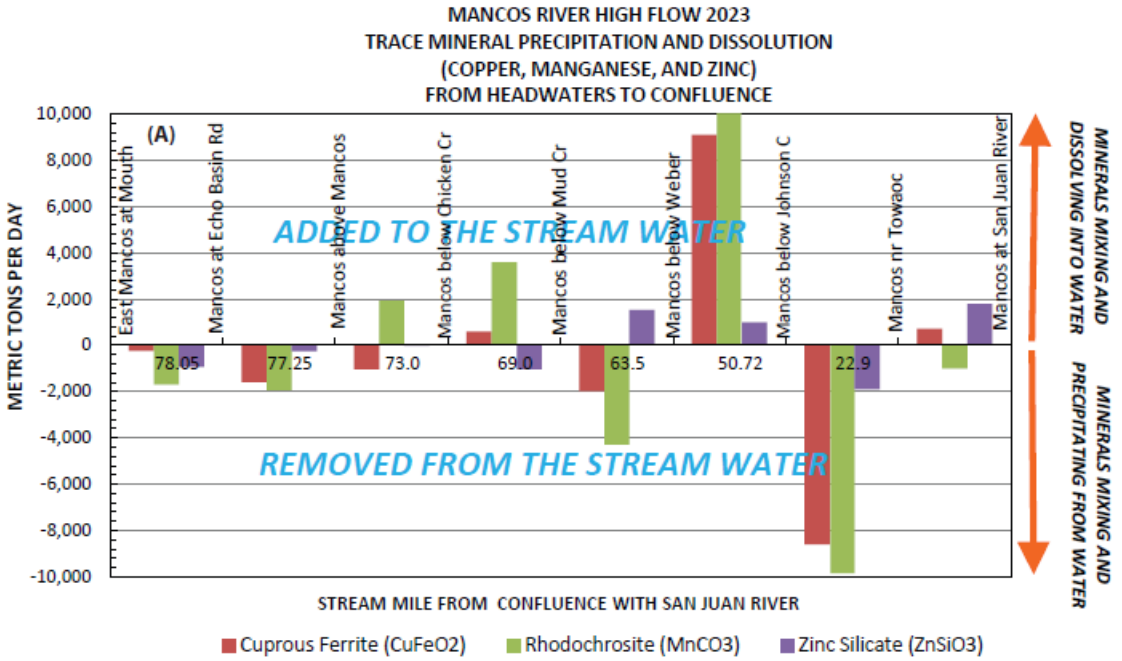


Figure 53. Longitudinal stream profiles of mineral dissolution (addition) and precipitation (removal) in water from the Mancos River during high flow 2023.

During high flow 2024, when discharge was much lower than during high-flow 2023, much of the copper present at the mouth of the East Mancos precipitated out between EM-25A and Mancos River near Mancos (MANMANCO), with additional copper removal between the MANMANCO site and the Mancos below Chicken Creek (MANCHICO) site (Figure 54).

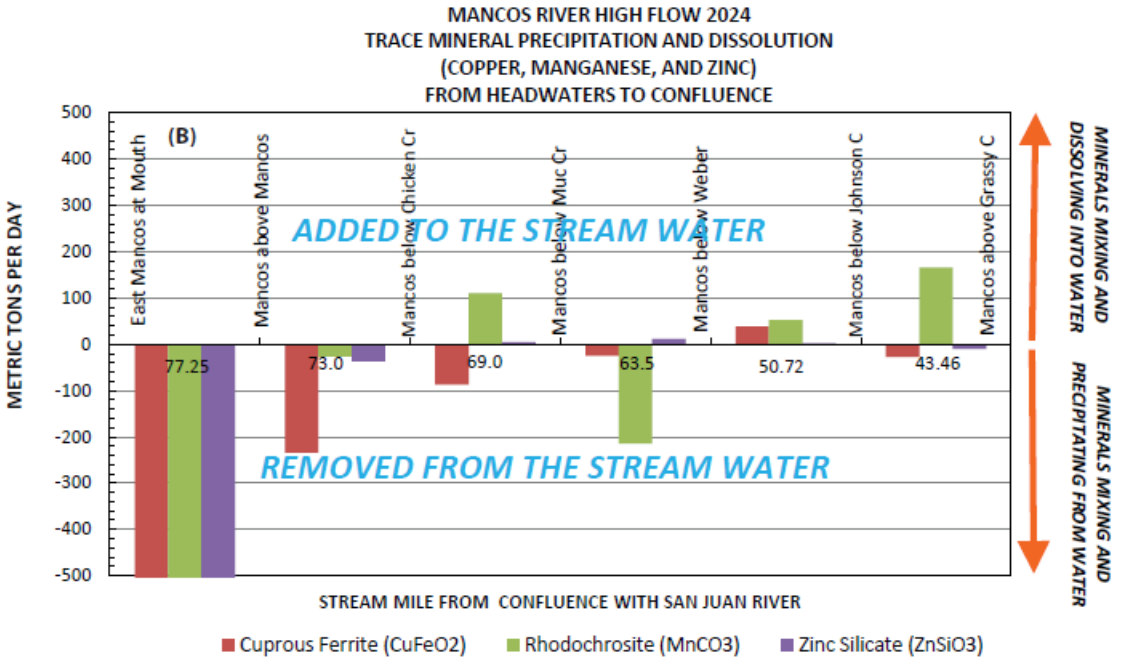


Figure 54. Longitudinal stream profiles of mineral dissolution (addition) and precipitation (removal) in water from the Mancos River during high flow 2024.

During high-flow 2026, characterized by extremely low peak discharge, copper, manganese and zinc were removed in succession from the East Mancos below Thunder Mine site (EMBT) downstream to the Mancos River above Weber (MRAW) (Figure 55).

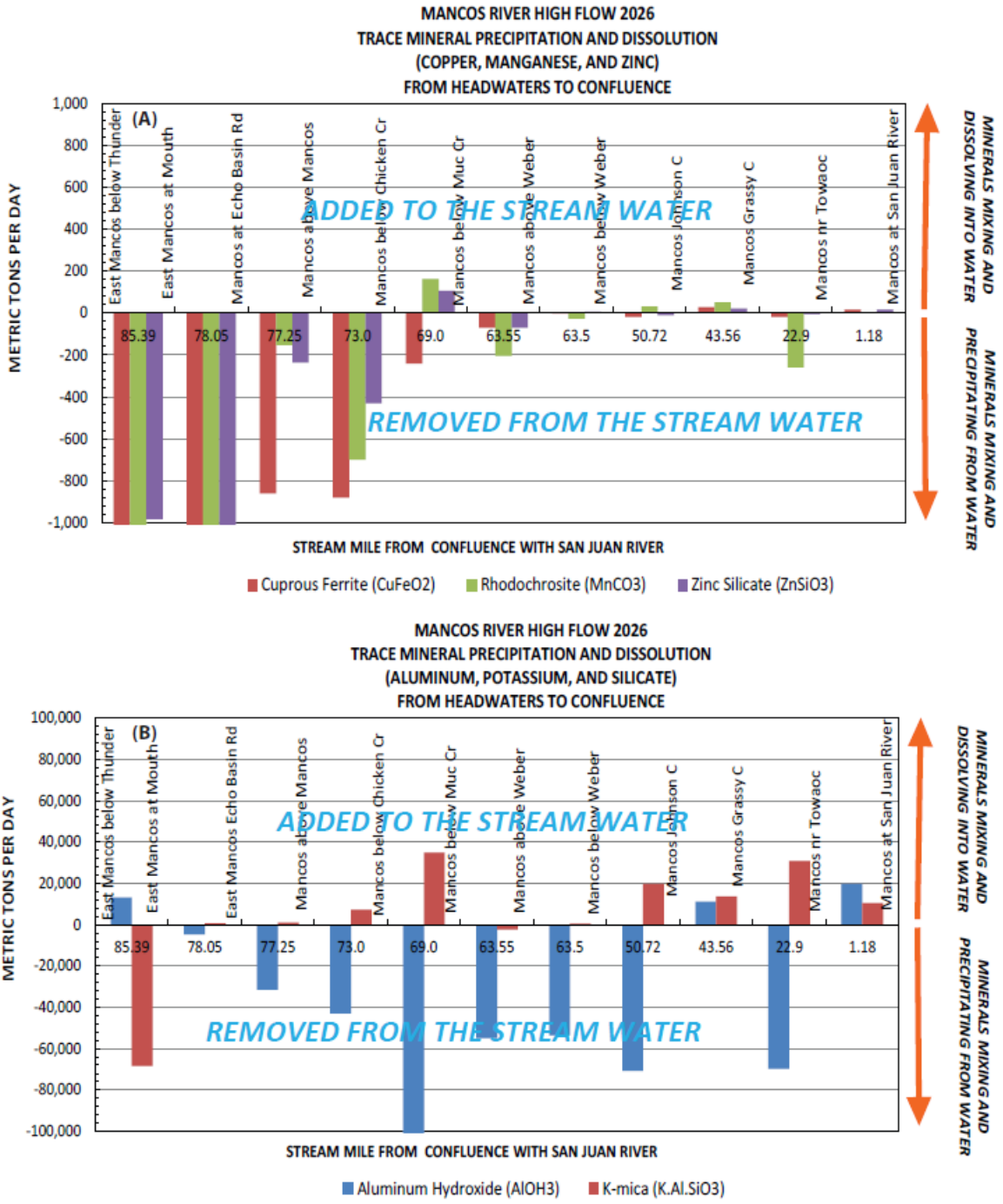


Figure 55. Longitudinal stream profiles of mineral dissolution (addition) and precipitation (removal) in water from the Mancos River during high flow 2026.

Aluminum (represented by aluminum hydroxide) was added to the stream between the Thunder Mine and East Mancos River mouth (EM-25A) and potassium (represented by K-mica) was removed. Aluminum was removed successively downstream all the way to Johnson Canyon, with aluminum added at Grassy Canyon and removed again at Mancos near Towaoc (Figure 55).

Aquatic Toxicity

Aquatic Toxicity - High-Flow Synoptic Sampling Events

In addition to the evaluation of metal concentrations and mass loading observed during high-flow sampling events, we also evaluated potential toxicity to aquatic life. We evaluate potential toxicity in context of water quality standards (CDPHE 2024a) and more advanced toxicity estimate approaches (EPA, 2018; Barr Engineering, 2025, Rodriguez et al., 2019; Ryan et al., 2019). We convey the risk to aquatic life from metal concentrations using Hazard Quotients (HQ), which are the ratio of observed concentration to a standard or toxicity estimate. An HQ value greater than 1.0 indicates elevated risk to aquatic life, and a HQ value less than 1.0 indicates less risk to aquatic life. We evaluate summed risk from metals using Cumulative Criteria Units (CCUs), which are the sum of individual hazard quotients for the following metals: aluminum, arsenic, cadmium, copper, iron, lead, manganese, nickel, selenium, silver, uranium, and zinc. For CCUs in the following maps and discussion, we used acute and chronic CDPHE water quality standards (CDPHE 2024a) for all metals except aluminum where we used the EPA criteria (EPA 2018).

2023 Synoptic Sampling Event

In 2023, we conducted a synoptic sampling event from May 30th to June 2nd. During runoff, the CODWR stream gage MANMANCO peaked on May 17th at 596 cfs. This synoptic event occurred slightly after peak runoff. Chronic CCUs ranged from 1.9 to 11.2 (Figure 56). The highest CCU occurred at MRSJ, followed by MRNT and EM-25A. Aluminum surpassed chronic standards at EM-25A and EMEB in the East Mancos River, and at MRNT and MRSJ at the lowest reach of the watershed. Copper surpassed the chronic standard in the East Mancos watershed and continued to surpass the standard at sites downstream on the Mancos River to MRBM, south of the town of Mancos. In the Mancos Canyon, copper did not surpass the chronic standard at MRBW, but did surpass the standard farther downstream at MRJC. This suggests that copper occurred at high enough concentrations to pose a risk to aquatic life from the East Mancos watershed downstream to at least MRBM. The exceedance at MRJC is either a different source of copper unrelated to the East Mancos or is due to chemical reactions within the water column and stream-bed sediments. Acute CCUs ranged from 0.7 to 2.8 (Figure 57). Acute CCUs decrease incrementally from 2.8 at EM-25a in a downstream direction through MRBW, but rise again at MRJC, MRNT, and MRSJ. Copper concentrations surpassed the acute standard in the East Mancos River sites (EM-25A, EMEB) and in the Mancos River near the town of Mancos (MANMANCO) and at the confluence with the San Juan River (MRSJ). Aluminum surpassed the acute water quality standard at MRSJ. No other measured analytes surpassed water quality standards during the 2023 spring synoptic event. These data suggest potential mobilization of metals from the East Mancos River downstream in the Mancos River.

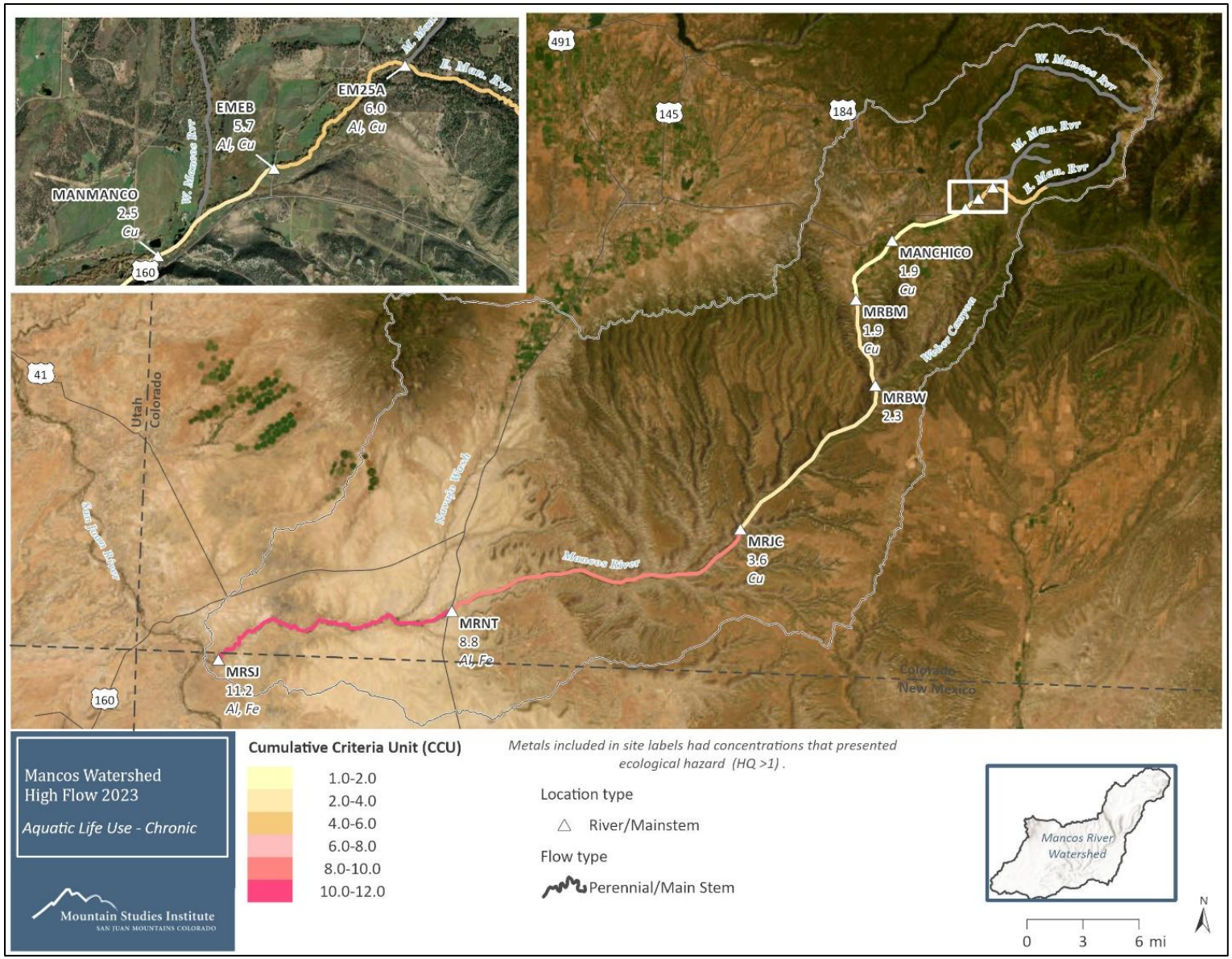


Figure 56. Chronic Cumulative Criteria Units (CCUs) at 2023 synoptic sampling location in the Mancos Watershed.

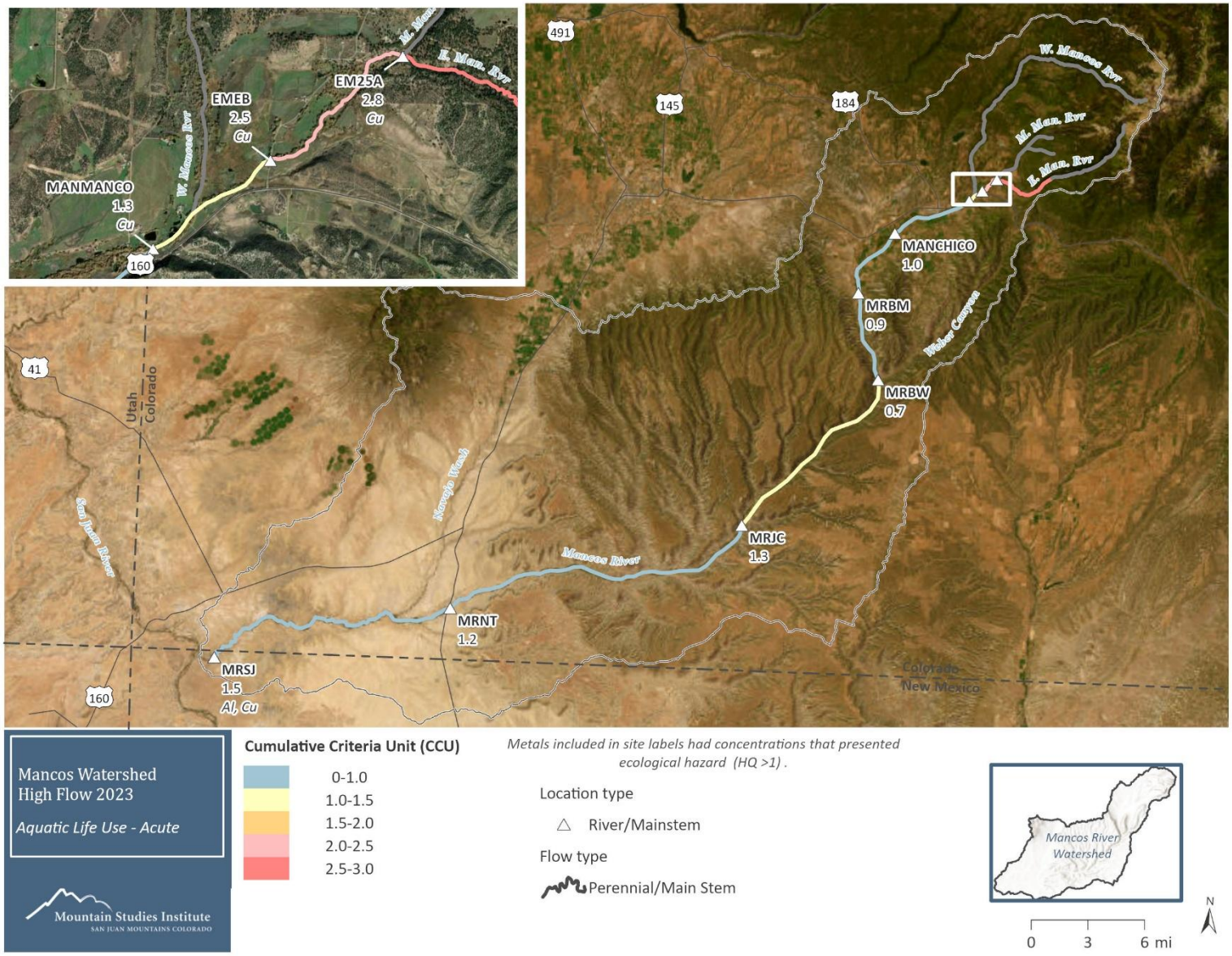


Figure 57. Acute Cumulative Criteria Units (CCUs) at 2023 synoptic sampling location in the Mancos Watershed.

In addition to the CDPHE water quality standards and EPA aluminum criteria depicted in CCU maps, we evaluated whether more advanced toxicity estimates would reach the same conclusion of risk to aquatic life. For copper and zinc we evaluated risk to aquatic life suggested by toxicity estimates from the Biotic Ligand Model (Barr Engineering, 2025) in addition to CDPHE water quality standards (CDPHE, 2024a). For aluminum, we evaluated risk to aquatic life suggested by CDPHE water quality standards, EPA criteria (EPA 2018), and a relatively new approach (Rodriguez et al., 2019) that focuses on the bioavailable fraction of aluminum (as described in the Methods section of this report).

Risk of acute and chronic aluminum toxicity, as estimated by CDPHE water quality standards as well as the EPA criteria, generally decreased from the East Mancos River (EM-25A) to the Mancos River below Weber Canyon (MRBW) (Figure 58). Downstream of MRBW, risk of aluminum toxicity generally increased all the way to the San Juan River. For acute toxicity, the EPA criteria produced higher aluminum HQs than the CDPHE water quality standard. Using EPA criteria, one site, MRSJ, had an acute aluminum HQ greater than 1.0, while there were no sites with an acute HQ greater than 1.0 using the CDPHE water quality standard. For chronic toxicity, the EPA criteria produced lower aluminum HQs than the CDPHE water quality standard. Using the CDPHE water quality standard, six sites had a chronic aluminum HQ greater than 1.0, while there were only four sites with a chronic aluminum HQ greater than 1.0 when using the EPA criteria. The bioavailable aluminum approach resulted in lower estimates of risk to aquatic life from aluminum than the EPA criteria or the CDPHE water quality standard. When evaluating risk to aquatic life from the bioavailable aluminum approach, no sites had acute aluminum HQs greater than 1.0 and only one site, EM-25A, had an acute aluminum HQ greater than 1.0 (Figure 58 and Figure AT1).

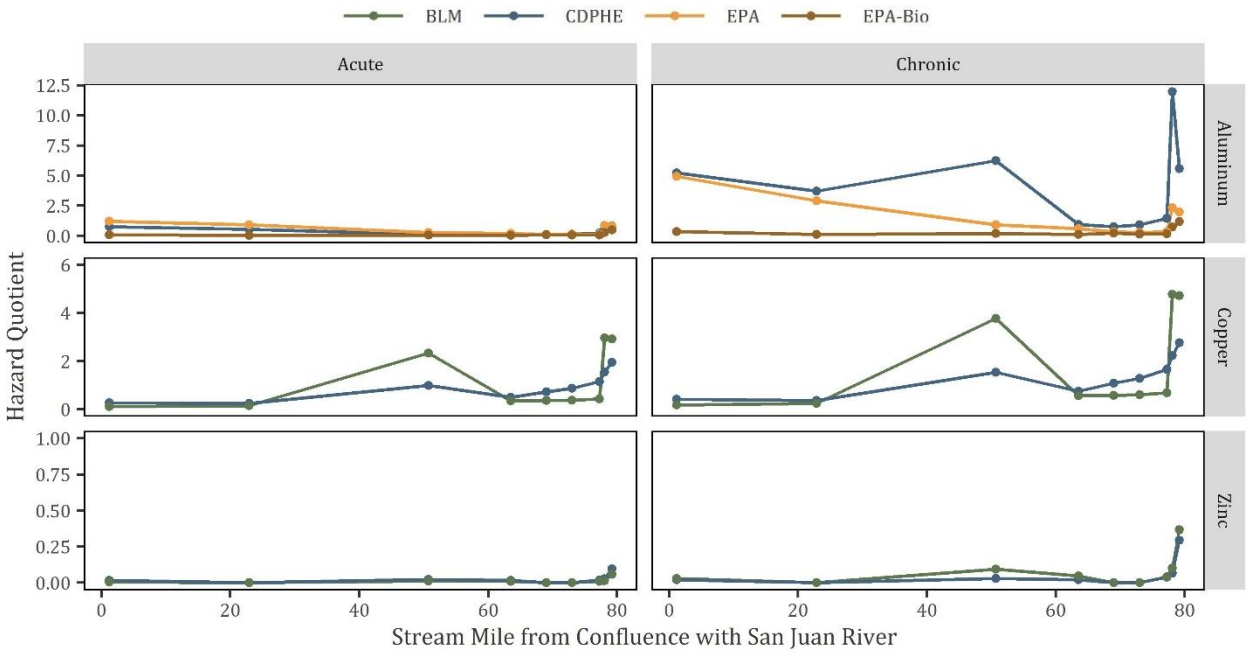


Figure 58. Hazard quotient values for aluminum, copper, and zinc for 2023 synoptic samples based on different toxicity estimate approaches: biotic ligand model (BLM); CDPHE water quality standards; EPA aluminum criteria using total aluminum (EPA); and EPA aluminum criteria using biologically available aluminum (EPA-Bio).

Acute and chronic copper risk to aquatic life was highest at the East Mancos River and decreased incrementally downstream except for a large increase at MRJC before decreasing again downstream toward the San Juan River (Figure 58). This pattern occurred in acute and chronic copper risk estimates regardless of whether CDPHE water quality standards or biotic ligand model results were used. The biotic ligand model produced higher copper risk than CDPHE water quality standards at EM-25A, EMEB, and MRJC, but produced lower copper risk than CDPHE water quality standards at all other sites. Based on the biotic ligand model, there were three sites with chronic copper HQs greater than 1.0. Based on the CDPHE standard, there were six sites with chronic copper HQs greater than 1.0 (Figure 58).

During the 2023 synoptic sampling event, acute and chronic risk to aquatic life from zinc was low and HQs did not surpass 1.0 for any sampled site (Figure 58).

2024 Synoptic Sampling Event

In 2024, synoptic sampling was conducted from May 18th to May 23rd. During runoff the CODWR gage MANMANCO peaked on April 24th at 75.6 cfs. This synoptic event occurred slightly after peak runoff. Surface water was not flowing in the Mancos River downstream of MRAG during this sampling event. Chronic CCUs ranged from 25.3 to 1.0 and Acute CCUs ranged from 12.2 to 0.3 (Figure 59). Acute and chronic CCUs generally decreased from the East Mancos until MRBW and then increased incrementally in the Mancos Canyon from MRBW to MRJC to MRAG. Aluminum and copper surpassed acute and chronic water quality standards throughout the East Mancos. In the Mancos River downstream of the East Mancos, MANMANCO had concentrations high enough to surpass the acute and chronic copper standards as well as the chronic aluminum standard. Further downstream, MANCHICO had concentrations high enough to surpass chronic aluminum and chronic copper standards. No other measured analytes surpassed water quality standards during the 2024 spring synoptic event. These data suggest potential mobilization of copper and aluminum from the East Mancos River downstream in the Mancos River.

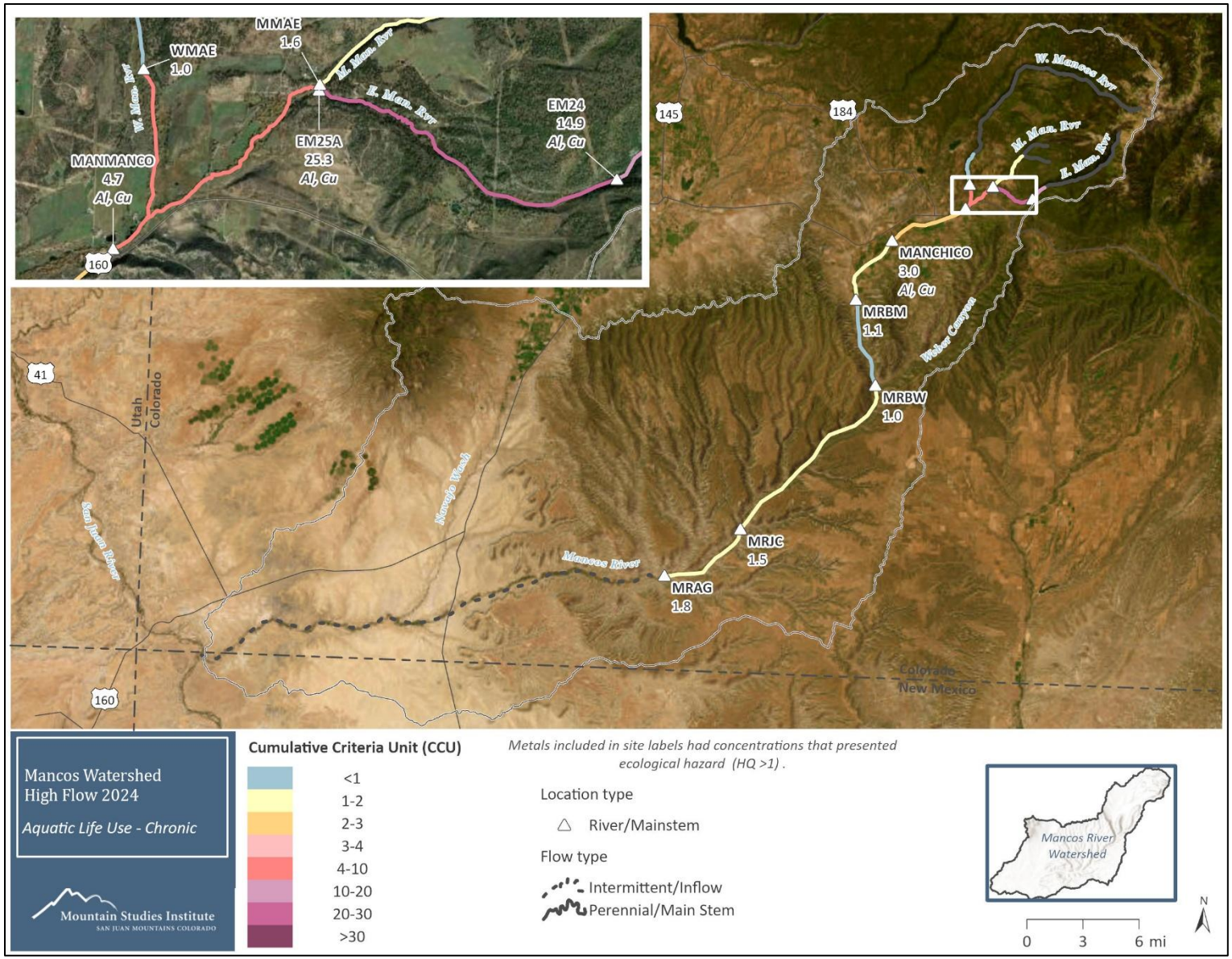


Figure 59. Chronic Cumulative Criteria Units (CCUs) at 2024 synoptic sampling locations in the Mancos Watershed.

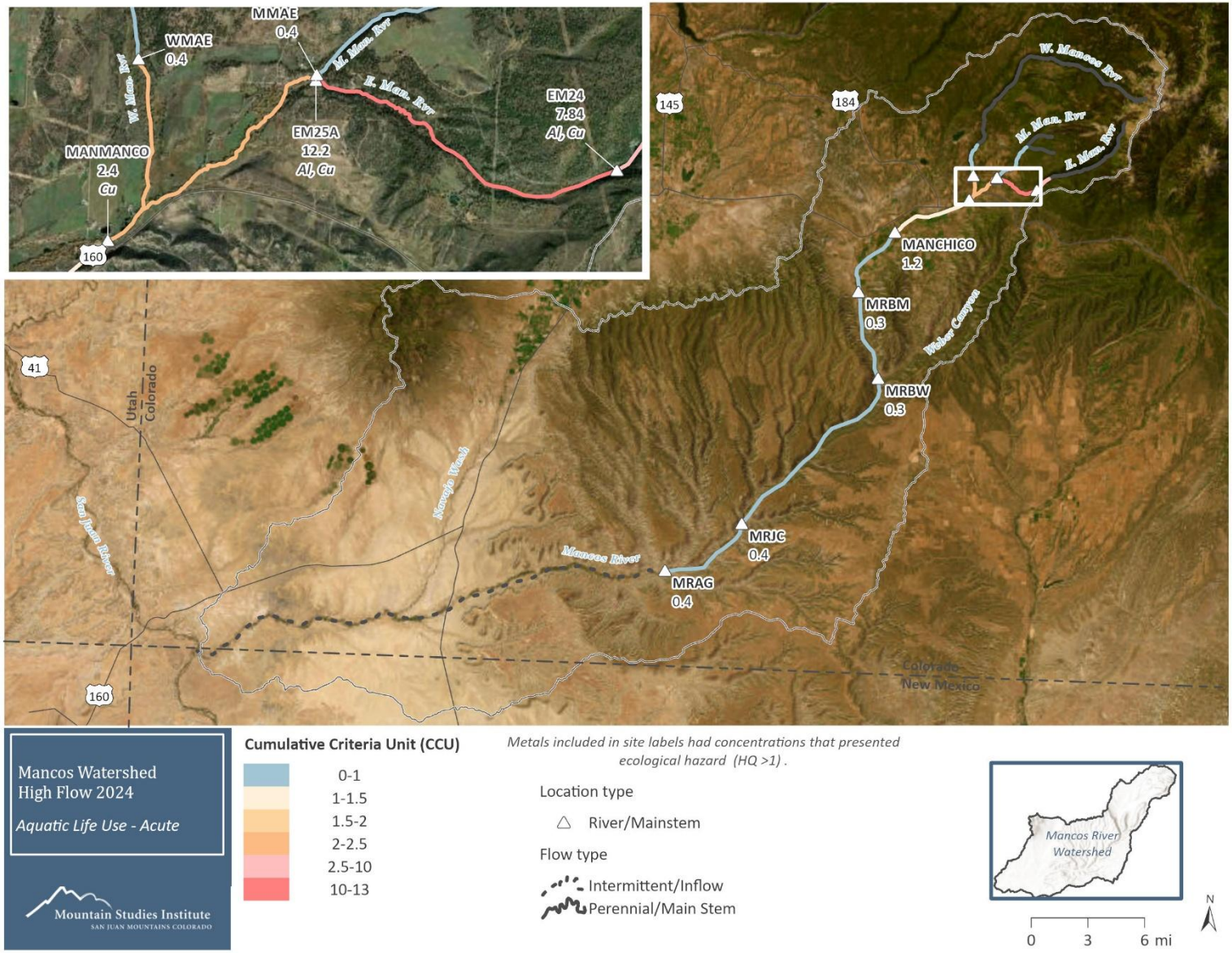


Figure 60. Acute Cumulative Criteria Units (CCUs) at 2024 synoptic sampling locations in the Mancos Watershed.

Differences between aluminum toxicity estimates followed a similar pattern in 2024 as in 2023 (Figure 61). Estimated acute risk to aquatic life was greater when using the EPA criteria compared to the CDPHE water quality standard, but estimated chronic risk to aquatic life was less when using the EPA criteria compared to the CDPHE water quality standard. As depicted in Figure 60, the EPA criteria produced an acute aluminum HQ greater than 1.0 for EM24 and EM-25A, but using the acute aluminum CDPHE standard, only EM24 has a HQ greater than 1.0. The bioavailable aluminum approach resulted in the lowest acute and chronic HQ values and the fewest instances where HQ values were greater than 1.0 (Figure 61).

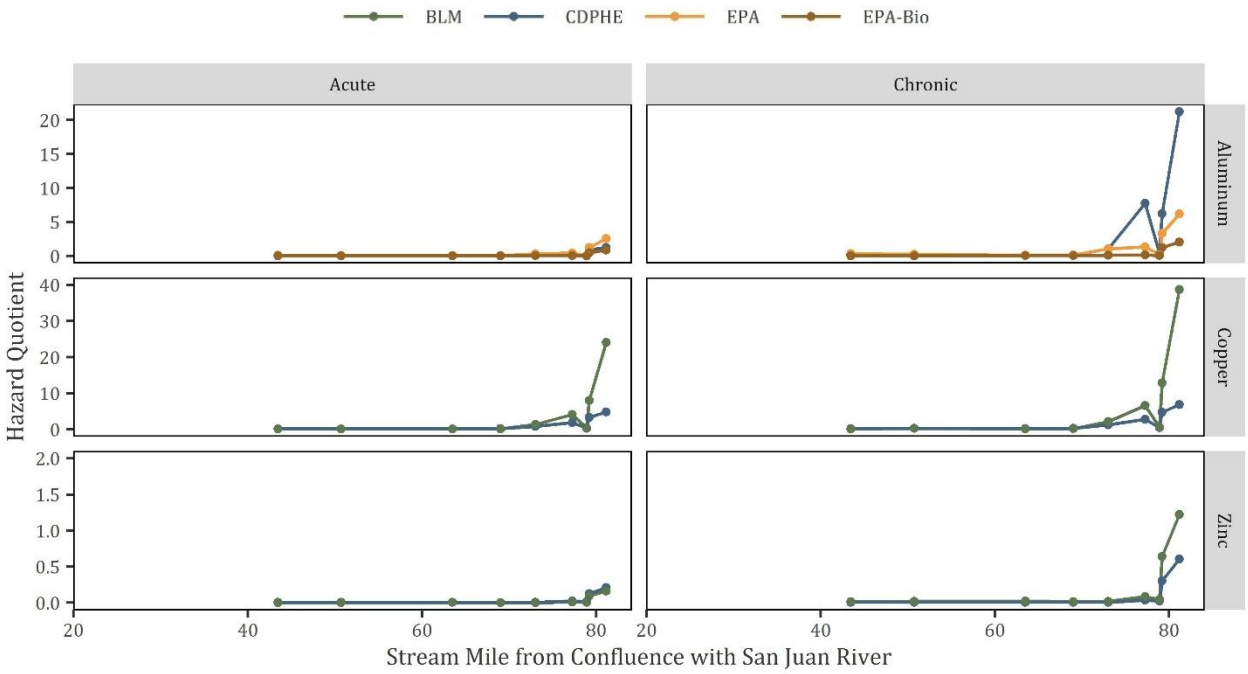


Figure 61. Hazard quotient values for aluminum, copper, and zinc for 2024 synoptic samples based on different toxicity estimate approaches: biotic ligand model (BLM); CDPHE water quality standards; EPA aluminum criteria using total aluminum (EPA); and EPA aluminum criteria using biologically available aluminum (EPA-Bio).

Acute and chronic copper risk to aquatic life was highest in the two East Mancos sampling sites (EM24 and EM-25A) and the two Mancos River sites that are in closest downstream proximity to the East Mancos River (MANMANCO and MANCHICO). The biotic ligand model produced much higher acute and chronic copper risk than CDPHE water quality standards in the upper at EM24, EM-25A, MANMANCO, and MANCHICO, but produced more similar copper risk to CDPHE water quality standards at sites lower in the watershed. The biotic ligand model and CDPHE water quality standards result in agreement on four sites having chronic copper HQs greater than one. However, based on the biotic ligand model, there were four sites with acute copper HQs greater than 1.0, but the CDPHE water quality standard only resulted in three sites with acute copper HQs greater than 1.0 (Figure 61 and Figure AT1).

Based on CDPHE water quality standards, acute and chronic risk to aquatic life from zinc was relatively low and HQs did not surpass 1.0 for any sampled site. Chronic risk to aquatic life from

zinc was also low when based on the biotic ligand model, but the biotic ligand model did produce a HQ for EM24 that was greater than 1.0 during the 2024 synoptic sampling event (Figure 61).

2026 Synoptic Sampling Event

In 2026, synoptic sampling was conducted on March 24th and 25th. During runoff the CODWR gage MANMANCO peaked on May 14th at 54.7 cfs. This synoptic event occurred before peak runoff. Despite the low snowpack, surface water was present during the sampling event for the entire course of the Mancos River to its confluence with the San Juan River.

Chronic CCUs ranged from 53.1 to 0.88 (Figure 62) and Acute CCUs ranged from 34.6 to 0.23 (Figure 63). Acute and chronic CCUs were highest in the East Mancos River where acute and chronic HQs for aluminum and copper were greater than 1.0 at EM-25A and EMEB. Downstream of the East Mancos River, the Mancos River site MANMANCO also had acute and chronic HQs for aluminum and copper that were greater than 1.0. In the Mancos River downstream of the East Mancos River, CCUs decreased incrementally until a small CCU increase in the Mancos Canyon from MRJC to MRAG and then a larger CCU increase from MRAG to MRNT. The Mancos River near Towaoc (MRNT) had HQs greater than 1.0 for acute and chronic aluminum and for chronic iron. Of note is that the Middle Mancos sampling location, which did not have any analyte with an HQ greater than 1.0 in 2024, had HQs for chronic greater than 1.0 for acute and chronic aluminum and for chronic iron (Figure 62 and Figure 63).

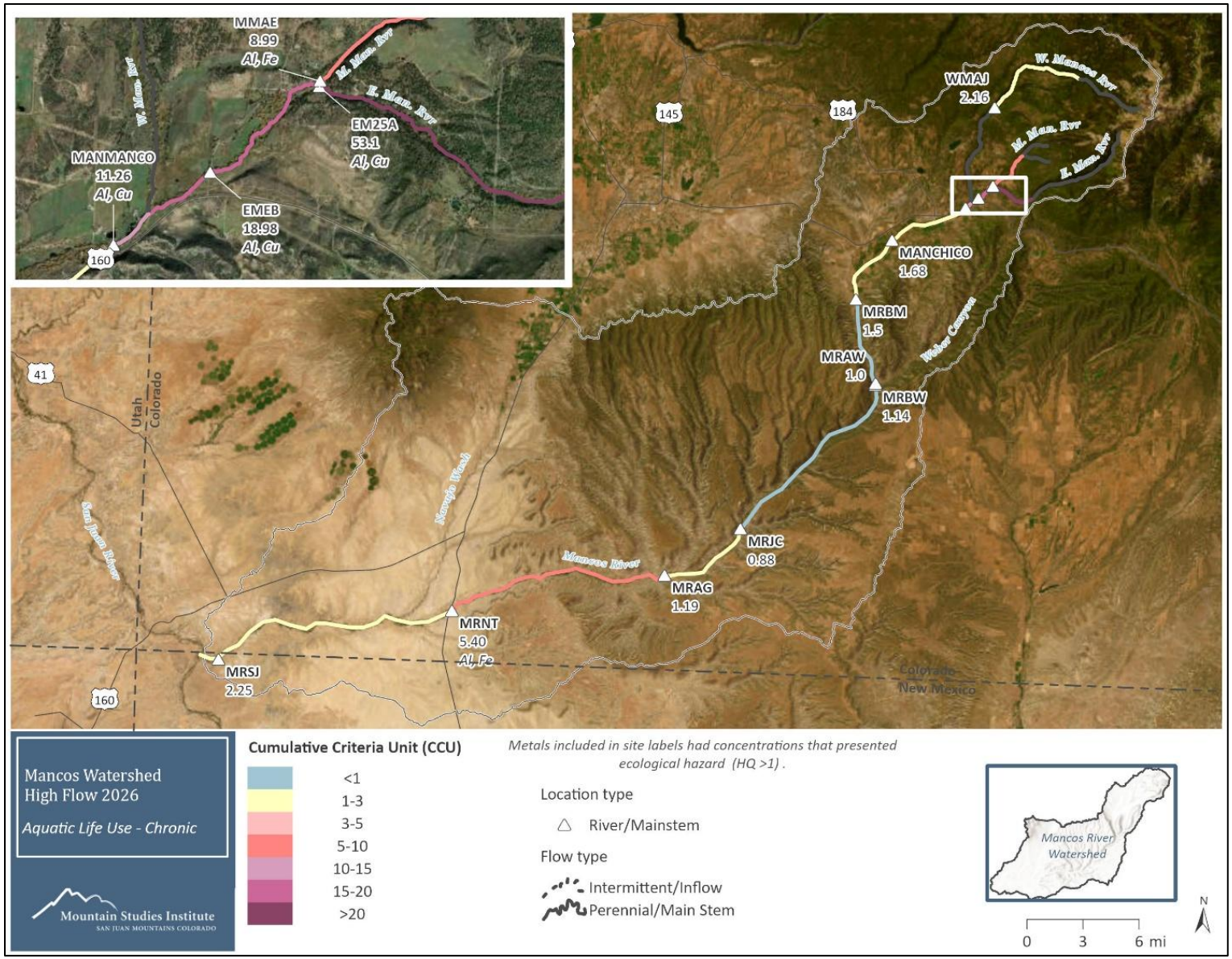


Figure 62. Chronic Cumulative Criteria Units (CCUs) at each 2026 synoptic sampling location in the Mancos Watershed.

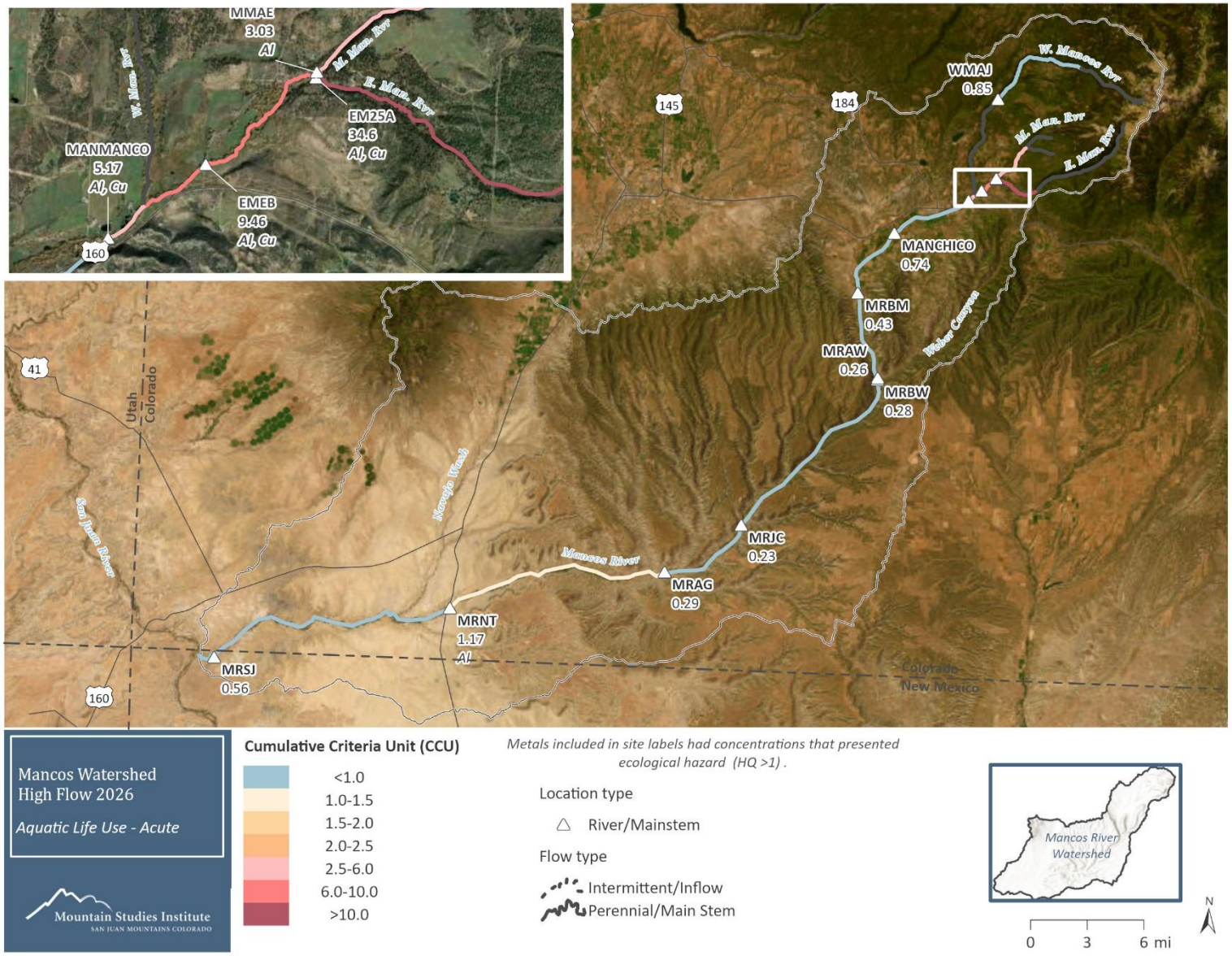


Figure 63. Acute Cumulative Criteria Units (CCUs) at each 2026 synoptic sampling location in the Mancos Watershed.

Differences between aluminum toxicity estimates followed a similar pattern in 2026 as the previous two sampling events. Estimated acute risk to aquatic life was greater when using the EPA criteria compared to the CDPHE water quality standard, but for chronic risk, it was inconsistent among 2026 synoptic samples whether the EPA criteria or the CDPHE water quality standard estimated higher risk. There was broad agreement with few exceptions on which sites had HQs greater than 1.0 between the EPA criteria and the CDPHE water quality standards (Figure AT1). The bioavailable aluminum approach resulted in the lowest acute and chronic HQ values and the fewest instances where HQ values were greater than 1.0 (Figure 64).

Similar to the 2024 results, acute and chronic copper risk to aquatic life in 2026 was highest in the two East Mancos sampling sites (EM24 and EM-25A) and the two Mancos River sites that are in closest downstream proximity to the East Mancos River (MANMANCO and MANCHICO). The biotic ligand model produced much higher acute and chronic copper risk than CDPHE water quality standards at the East Mancos River sites (EM-25A, EMEB). This difference seems to be mostly driven by the biotic ligand model's incorporation of alkalinity into its toxicity estimate and several samples from the East Mancos River had non-detectible concentrations of alkalinity in 2026.

Based on CDPHE water quality standards, acute and chronic risk to aquatic life from zinc was relatively low and HQs did not surpass 1.0 for any sampled site. Chronic risk to aquatic life from zinc was also low when based on the biotic ligand model, but the biotic ligand model did produce a HQ for EM-25A, EMEB, and MANMANCO that was greater than 1.0 during the 2026 synoptic sampling event (Figure 64).

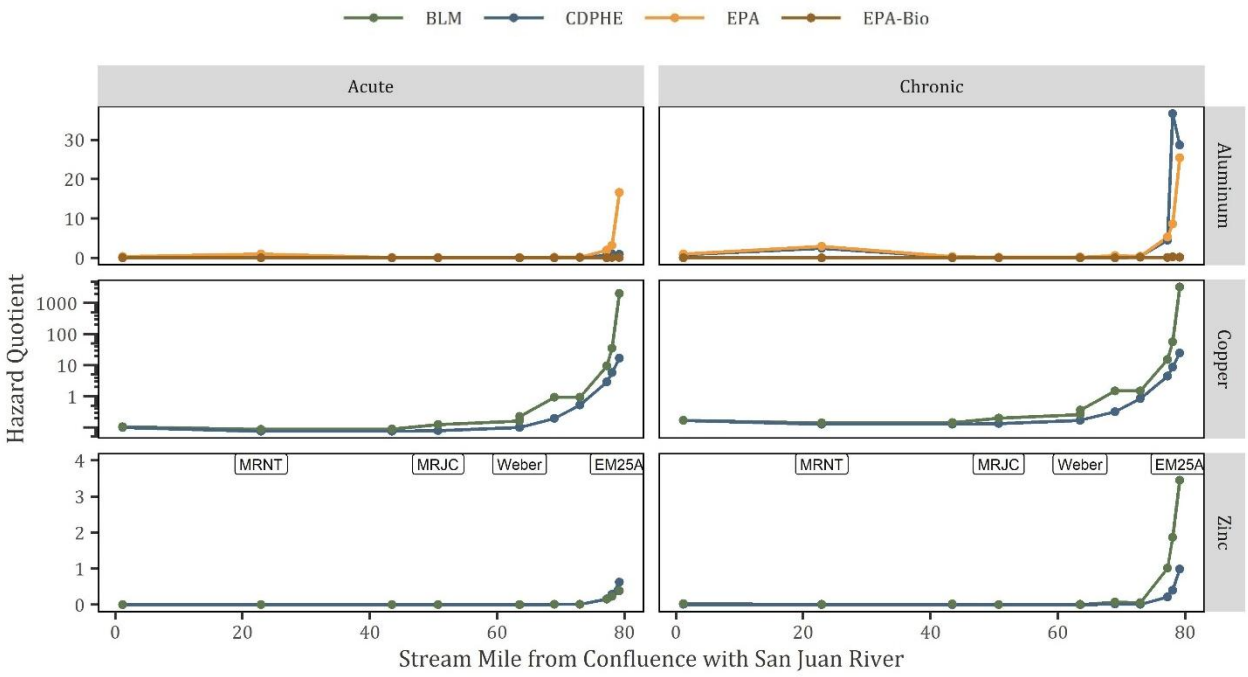


Figure 64. Hazard quotient values for aluminum, copper, and zinc for 2026 synoptic samples based on different toxicity estimate approaches: biotic ligand model (BLM); CDPHE water quality standards; EPA aluminum criteria using total aluminum (EPA); and EPA aluminum criteria using biologically available aluminum (EPA-Bio).

Summary of 2023, 2024, and 2026 Synoptic Sampling Events

Synoptic sampling events occurred over three different water years that varied greatly in magnitude and the timing of peak flows. Collecting synoptic watershed-wide samples during high flow periods provides perspectives and patterns of watershed condition. Aluminum and copper concentrations during all three sampling events were high enough to pose risk to aquatic life based on water quality standards and toxicity estimates.

When evaluating potential mobilization of metals from the mining districts of the West Mancos River and the East Mancos River, our primary analyte of concern was copper (Wright et al., 2000). During all three high-flow sampling events copper concentrations in the East Mancos River were elevated enough to pose risk to aquatic life. The extent to which copper concentrations in the Mancos River downstream of East Mancos River were ecologically relevant during high-flow sampling events differed among years. Ecologically significant levels (i.e., concentrations that surpassed water quality standards or toxicity estimates) of copper extended downstream to MRBM in 2023, MANCHICO in 2024, and MANMANCO in 2026. The difference in downstream extent of ecologically significant levels of copper during high-flow conditions seems to be driven by the magnitude of runoff. During lower water years, the downstream extent of ecologically relevant levels of copper was shorter, suggesting that copper was not mobilized as far downstream. For example, 2026 was a drought year with low snowpack and less runoff, and analytes of concern were mobilized not nearly as far downstream as in 2023 and 2024. When we were able to sample in the lower Mancos River downstream of MRAG in 2023 and 2026, we found ecologically relevant levels of several metals. In 2023, aluminum, iron and copper posed risks to aquatic life at various points from MRJC to MRSJ. In 2026, aluminum and iron posed risks to aquatic life at MRNT.

For each water year, acute and chronic CCU's follow similar spatial trends. Typically influenced by poor water quality in the East Mancos River, CCU's are high and begin to decline as distance increases downstream of the East Mancos River. Notably, the highest CCU's occurred in 2026, during the lowest snowpack in the sampling period. The lowest CCU's typically occur between MRBM and MRJC during the three sampling events. After reaching their lowest point, CCU's typically increase moving farther downstream in 2023 and 2026 below MRJC. In addition, analytes like aluminum, iron and copper appear again to surpass their water quality standard at these downstream sites. Water chemistry, flows, and temperature may play a role in precipitating analytes out of soluble form in the middle reaches of the watershed. Similar changes in conditions moving downstream may play a role to increase dissolved concentrations of these metals and cause water quality exceedances. Another reason for the presence of metals downstream on UMUT may be unidentified sources of metals reaching the Mancos River through unknown inputs. More targeted sampling of this reach between MRBW and MRSJ is required to better understand the stream conditions causing exceedances of aluminum, iron, and copper.

Among the synoptic sampling events, the threat posed to aquatic life by aluminum is greatest at sites in the East Mancos River, after which it decreases downstream through the confluence with Weber Canyon. After this point, hazard quotients generally begin to increase again. The CDPHE chronic aluminum water quality standards tended to produce the highest hazard quotients while the bioavailable aluminum approach tends to produce the lowest hazard quotients. Often, these bioavailable aluminum HQ values are below the threshold considered toxic to aquatic life. The only exceptions were for chronic thresholds at EM-25A in 2023 and 2024 and EM24 in 2024.

For most samples, the CDPHE aluminum water quality standards and the EPA aluminum criteria produced much higher HQs, suggesting higher risk to aquatic life, than the bioavailable aluminum approach (e.g., Figure 58). The bioavailable aluminum HQs become most divergent from CDPHE standards and EPA aluminum criteria in the downstream reaches of the Mancos River on Ute Mountain Ute and Navajo tribal lands. At these furthest downstream sites (MRNT, MRSJ) sampled during 2023 and 2026 synoptic events, total aluminum concentrations were greater than upstream sites (Figure 65). Despite having higher concentrations of total aluminum, the proportion of total aluminum that is potentially biologically available was lower. These results suggest that during spring high-flow events, there was a greater proportion of aluminum in the upper part of the watershed that was colloidal/dissolved, more biologically available, and potentially more toxic to aquatic life. Conversely, most of the total aluminum in the lower part of the watershed may be strongly sorbed to clays and particulate matters and is not as biologically available (Figure 65).

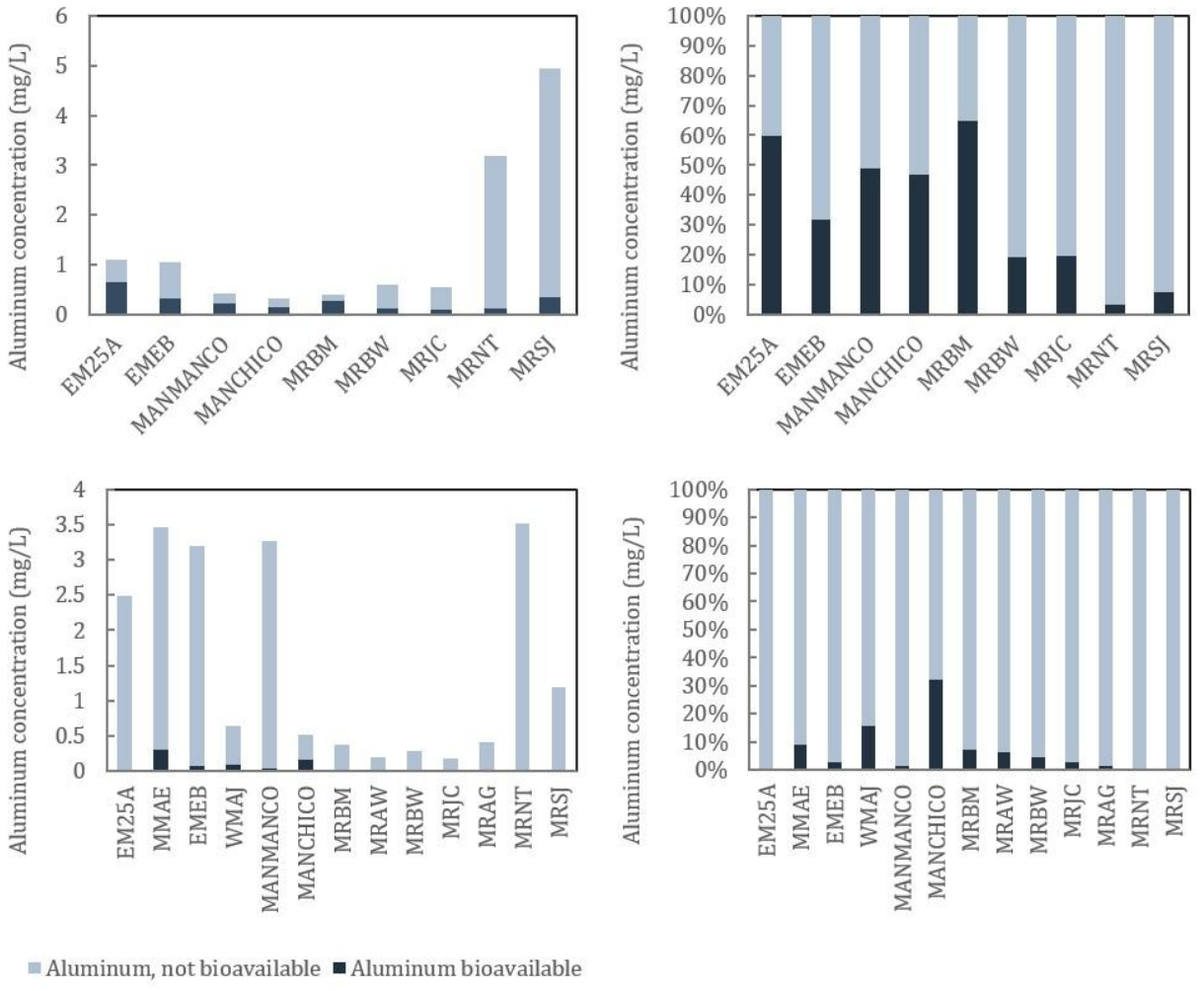


Figure 65. Total aluminum concentrations, and proportion of total aluminum that is bioavailable, during 2023 and 2026 synoptic sampling events.

Aquatic Toxicity - High-Flow Weekly Sampling Events

Of the various analytes sampled throughout the Mancos watershed, aluminum and copper seem to pose the most persistent concern in samples on Ute Mountain Ute tribal lands. In an effort to understand how the risk posed to aquatic life by these two metals changes over the course of a high flow event (the period when metals are most likely to be mobilized from the headwaters), we collected weekly samples over an 11-week period in 2026 at EM-25A, MRAW, and MRJC. For each sample we calculated hazard quotients for aluminum and copper. Calculated HQs included CDPHE water quality standards (CDPHE, 2024a), biotic ligand model (Barr Engineering, 2025), the EPA criteria for total aluminum (EPA, 2018), and the EPA criteria based on the bioavailable fraction of aluminum (Rodriguez et al., 2019).

Generally, aluminum and copper HQs decrease from upstream to downstream and drop below levels considered hazardous to aquatic life by the time the river reaches Weber Canyon (Figure 66, Figure 67).

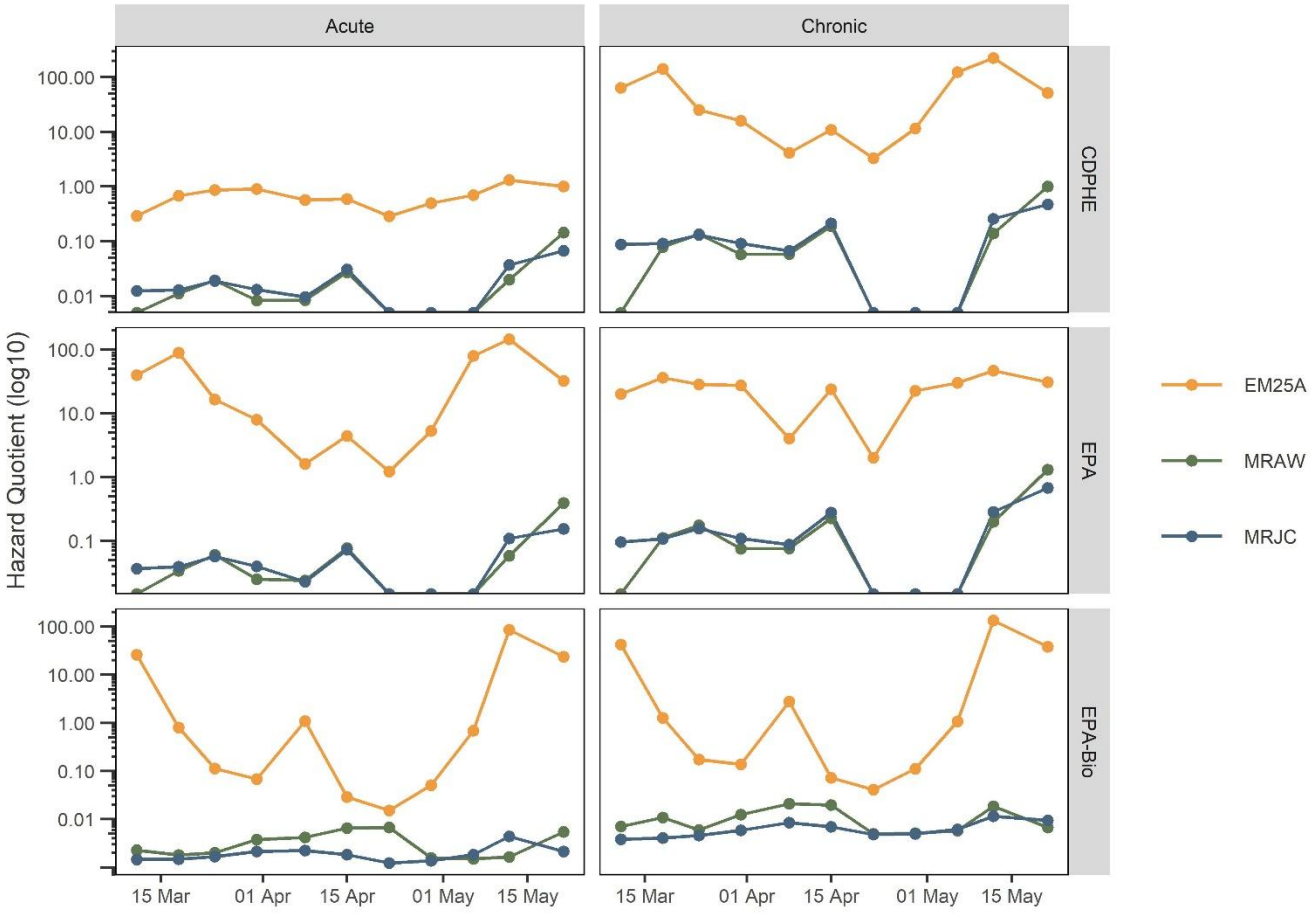


Figure 66. Hazard quotients for aluminum at the East Mancos (EM-25A), Mancos River above Weber Canyon (MRAW), and Mancos River at Johnson Canyon (MRJC) over an 11-week sampling period (11 March – 21 May 2026). Hazard quotients were calculated using three approaches: CDPHE water quality standards; EPA aluminum criteria using total aluminum (EPA); and EPA aluminum criteria using biologically available aluminum (EPA-Bio).

At EM-25A, aluminum and copper toxicity peaked in early March and early May. Chronic risk to aquatic life at EM-25A based on CDPHE standards and EPA criteria was at levels of concern for the

entire 11-week period. However, bioavailable aluminum at EM-25A only posed a chronic threat to aquatic life in samples from 3/11, 3/18, 4/8, 5/6, 5/12, and 5/21. Acute aluminum hazard quotients based on CDPHE standards at EM-25A were greater than 1.0 on 5/12 and 5/21 while acute aluminum hazard quotients based on the EPA criteria remained hazardous to aquatic life for the entire 11-week period. EPA criteria based on bioavailable aluminum produced hazard quotients greater than 1.0 at EM-25A on 3/11, 4/8, 5/12, and 5/21. At MRAW, most samples had low aluminum HQs except for a sample collected on 5/21 which had hazard quotients greater than 1.0 based on CDPHE standards and the EPA criteria. Bioavailable aluminum concentrations at MRAW remained below levels considered hazardous to aquatic life. Further downstream, at MRJC, none of the 11 samples demonstrated high risk (HQ>1.0) to aquatic life (Figure 66).

During 2026 weekly sampling, copper remained below levels considered hazardous to aquatic life at MRAW and MRJC for both acute and chronic conditions (Figure 67). At EM-25A, CDPHE standards and the biotic ligand model demonstrate high levels of toxicity throughout the 11-week period. The biotic ligand model produced particularly high copper HQs, a result of these samples having extremely low alkalinity, which is a factor in the toxicity estimate from the biotic ligand model. In addition, the biotic ligand model detected a short-term increase in copper toxicity at EM-25A between 4/8 and 4/22 that was not detected by CDPHE standards.

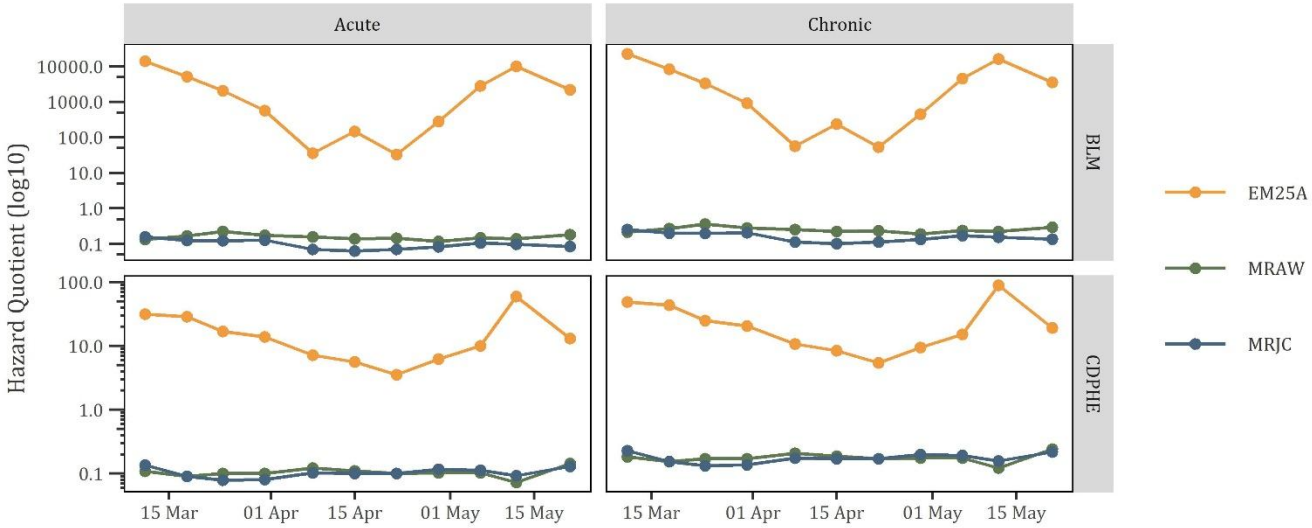


Figure 67. Hazard quotients for copper at the East Mancos (EM-25A), Mancos River above Weber Canyon (MRAW), and Mancos River at Johnson Canyon (MRJC) over an 11 week sampling period (11 March – 21 May 2026). Hazard quotients were calculated using two approaches: CDPHE water quality standards and biotic ligand model (BLM).

Unfortunately, snowmelt runoff in 2026 was exceptionally low compared to the historical record. During the 11-week weekly sampling period, which encompasses the first snowmelt-driven streamflow peak and the rising limb of the second peak (Figure 19; Figure 68), discharge peaked at 24 cfs on 3/26 at EM-25A, 34.5 cfs on 4/1 at MRAW, and 9.1 cfs on 3/25 at MRJC (Figure 68). At all three sites, discharge increased between 3/11 and 3/26, decreased through 4/30, and then increased again through the end of the sampling period.

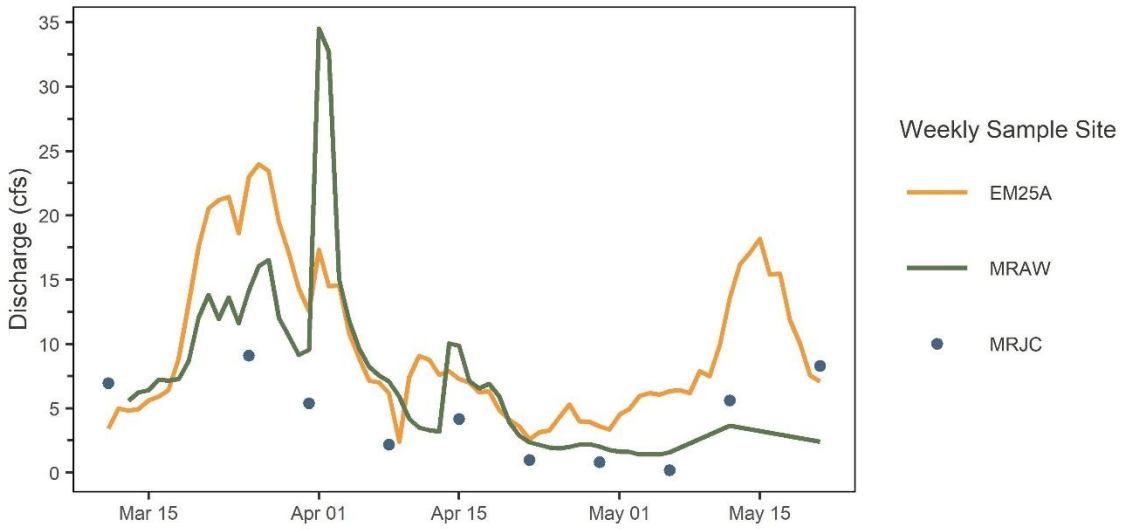


Figure 68. Continuous discharge (cfs) from sampling locations at two temporarily installed gaging stations (EM-25A and MRAW) and weekly manual discharge measurements at a third sampling location (MRJC).

We evaluated whether the different copper toxicity estimates correlated with discharge. For the East Mancos River site (EM-25A), acute and chronic HQs based on the biotic ligand model and acute and chronic HQs based on CDPHE standards both correlate significantly with discharge. At the downstream sites (MRAW and MRJC), acute and chronic copper HQs based on CDPHE standards had no correlation with discharge, but acute and chronic copper HQs based on the biotic ligand model did correlate with discharge (

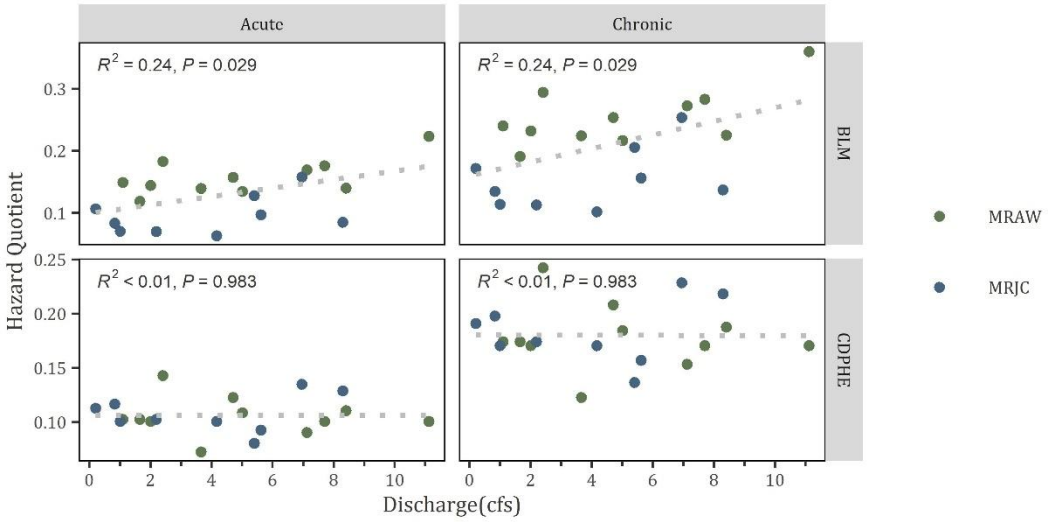


Figure 70, Figure 70). We conducted a similar analysis for different aluminum toxicity estimates, but found minimal correlation.

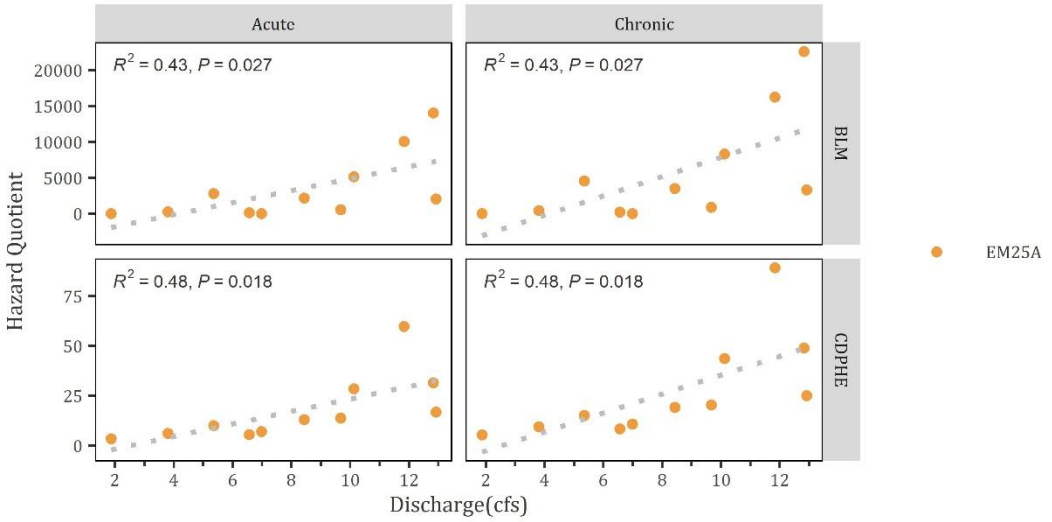


Figure 69. Correlation between dissolved copper hazard quotient values and discharge values at EM-25A for two different toxicity estimate approaches: the biotic ligand model (BLM) and CDPHE water quality standards.

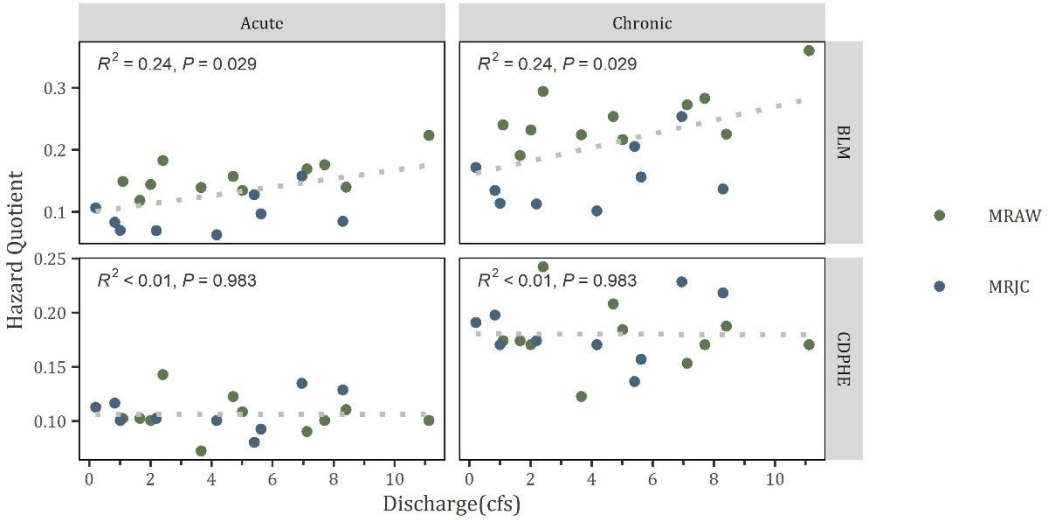


Figure 70. Correlation between dissolved copper hazard quotient values and discharge values at MRAW, and MRJC for two different toxicity estimate approaches: the biotic ligand model (BLM) and CDPHE water quality standards.

Fishery Status

The Mancos River fishery has historical documentation as well as being surveyed by Colorado Parks and Wildlife (CPW) as recently as 2025. Many other sources exist for both anecdotal and quantitative presence of fish species in the watershed. Historical data, and more recent surveys, reflect a mix of native and non-native fish as well as a mix of warm-water and cold-water fish (Figure 71).

In the lower reach of the West Mancos River, downstream of the north and south forks of the West Mancos River, surveys in the 1970s and in 2015 documented rainbow trout, brook trout, and mottled sculpin. This lower reach of the West Mancos River was surveyed again in 2025 and rainbow trout and mottled sculpin were found. Surveys were also conducted in the 1970s in the

upper West Mancos in the North Fork of the West Mancos River and the South Fork West Mancos River, but no fish were found. In a tributary to the North Fork of the West Mancos River, brook trout were found in 2025. These data demonstrate that fish are found in the lower reaches of the West Mancos River, but may not be readily found higher in the watershed in the South Fork West Mancos River.

In the Middle Mancos River, CPW documented trout in the 1970s and trout were also reported in a 2007 functional assessment (Stacey, 2007). In the lower reach of the East Mancos River, below the confluence with the Middle Mancos River, rainbow trout, speckled dace, and mottled sculpin were documented in the 1970s. During the 1970s and 1980s, Colorado Department of Wildlife (CDOW) stockd brook and rainbow trout in this reach (Wright et al., 2020). A survey in 1988 found bluehead sucker, mottled sculpin, rainbow trout, and speckled dace.

Upstream of the confluence with the Middle Mancos River, the fishery of the East Mancos River has not been well understood. USFS reported trout in this reach in 1969, but CDOW documented no fish in this reach in the 1970s (Horn, 2010). A breach of the Gold Dollar Mine in 1986 anecdotally led to substantial fish kill in the East Mancos River, and the USFS documented two years later in 1988 that the conditions in the upper reaches of the East Mancos were not suitable for fish survival. The last known fish survey of the reach of the East Mancos River above the Middle Mancos was conducted by CDOW in 1990 and they reported no fish.

In the Mancos River near the town of Mancos, fish surveys conducted before the year 2000 found rainbow trout, bluehead sucker, flannelmouth sucker, speckled dace, mottled sculpin, and fathead minnow. More recent surveys conducted from 2018-2025 documented brook trout, rainbow trout, bluehead sucker, speckled dace, mottled sculpin and fathead minnow.

Downstream of the town of Mancos, fish surveys conducted before the year 2000 found bluehead sucker, flannelmouth sucker, brown trout, catfish, common carp, roundtail chub, mottled sculpin, rainbow trout, red shiner, and speckled dace, etc. More recent surveys (2018-2025) documented bluehead sucker, flannelmouth sucker, roundtail chub, rio grande chub, speckled dace, and fathead minnow. In the Mancos Canyon reach of the Mancos River we expect that these fish are restricted to isolated pool habitat during low flow periods, especially in drought years.

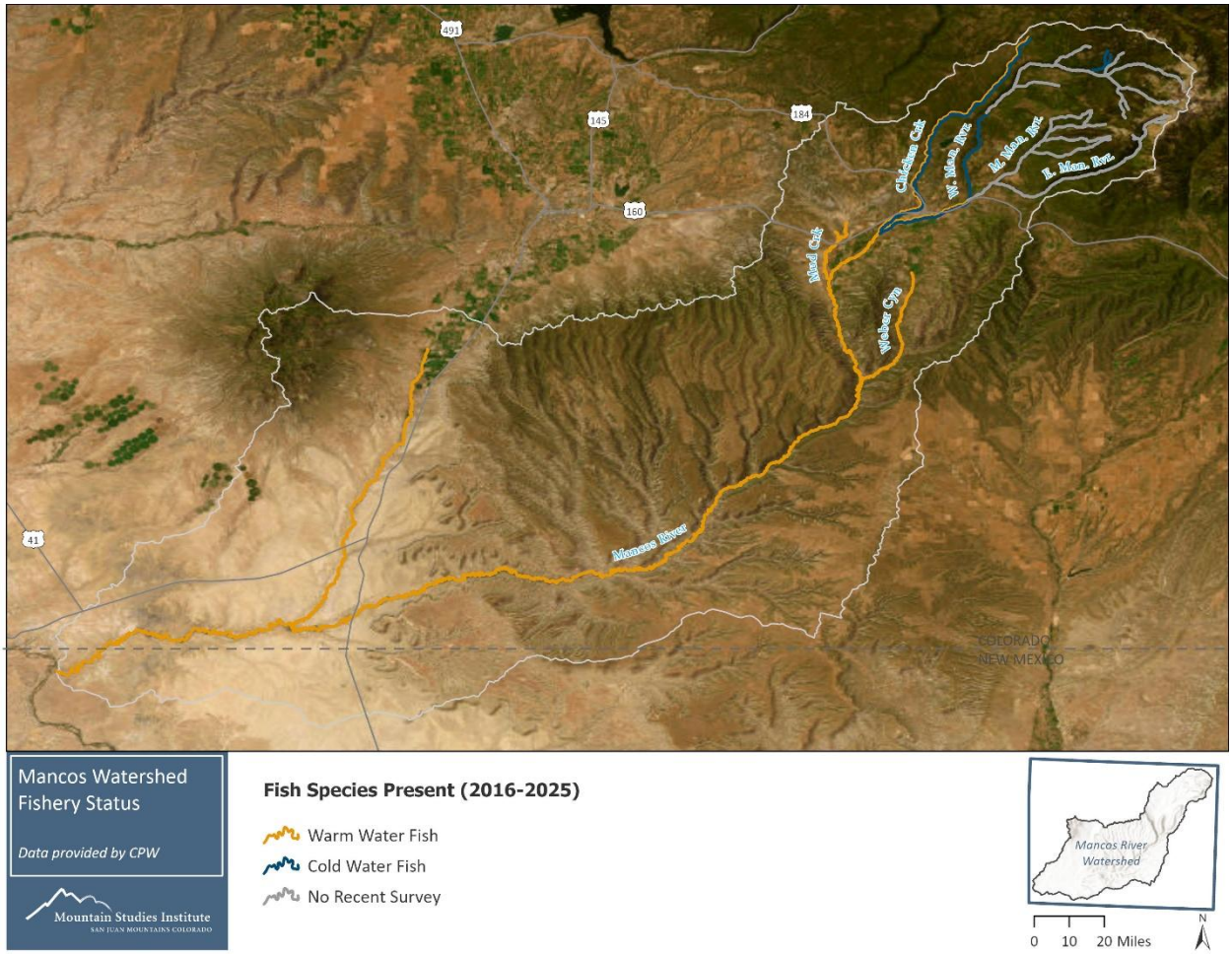


Figure 71. A representation of fish presence and absence in the Mancos River watershed. Fish presence and absence are presented at the reach scale and is not meant to be interpreted as site-specific. Data provided by CPW.

CPW has conducted recent (2018-2025) fish surveys on several major tributaries to the Mancos River including Chicken Creek, Weber Canyon Creek, and Mud Creek. Chicken Creek had bluehead sucker, longnose dace, sand shiner, speckled dace, bullhead minnow, and cutthroat trout. Weber Canyon Creek had bluehead sucker, fathead minnow, rio grande chub, roundtail chub, and speckled dace. Mud Creek had bluehead sucker, fathead minnow, rio grande chub, roundtail chub, speckled dace, and green sunfish. These tributaries appear to be supporting mostly warm-water fish species (apart from Chicken Creek) and potentially provide expanded upstream habitat from the Mancos River for warm-water fish in drought years.

The Mancos River supports both warm-water and cold-water fish species, and the temperature regimes of reaches may change over time. For example, with warmer temperatures, it is possible that the transition zone between warm and cold-water fishery may move upstream. Further investigation of altered temperature regimes is necessary to understand future fish population distribution.

Benthic Macroinvertebrate Community

Objectives of Benthic Macroinvertebrate Assessment

Aquatic insects, or benthic macroinvertebrates, are widely used as indicators of habitat conditions such as water quality and stream bottom substrate. In mineralized watersheds, legacy mining and natural geology can influence water quality and shape the structure of benthic macroinvertebrate communities (Clements et al. 2010; Herbst et al. 2018).

We evaluated benthic macroinvertebrate communities in the Mancos River watershed by collecting new benthic samples as well as assessing benthic samples collected by Mancos Conservation District (MCD) through the Colorado River Watch program (see Figure 34 and Figure 39). We focused our benthic macroinvertebrate evaluation on three primary objectives:

1. Characterize the benthic community near draining mine sites in Owens Basin on the South Fork West Mancos River. To our knowledge, benthic macroinvertebrate samples have not previously been described from this reach.
    - We collected samples from two locations, one location to reflect conditions upstream of draining mines and major mineralized inflows (WMAGB) and another location to reflect conditions downstream of draining mines and major mineralized inflows (WMAT).
2. Characterize the benthic community near the downstream terminuses of the East Mancos River and the West Mancos River where most mineralized waters originate. These benthic communities are of particular interest to this study as they would be exposed to pulses of mineralized material mobilized from upstream mining districts during high-flow scouring events.
    - We evaluated samples collected by MCD on the lower reach of the West Mancos River (WMAE), the lower reach of the East Mancos River (EM-25A), and on the mainstem of the Mancos River below both the East and West Mancos rivers in the town of Mancos (MANMANCO).
3. Characterize the Mancos River benthic community on the reach of the river in Mancos Canyon within Ute Mountain Ute tribal land. To reflect conditions as water flows onto Ute Mountain Ute tribal land we established a benthic monitoring site on the Mancos Rive just below the confluence with Weber Canyon (MRBW). To characterize benthic conditions within the Mancos Canyon we established benthic monitoring sites near the confluence with Johnosn Canyon (MRJC) and immediately below the confluence with Grassy Canyon (MRBG).

Benthic Data Analysis

We utilized the Ecological Data Application System (EDAS) developed by Colorado Department of Public Health and the Environment (CDPHE) to calculate all metrics including the Multi-Metric Index (MMI v5). To eliminate potential bias from differing subsample sizes, we employed an algorithm to randomly subsample all samples to a fixed count of 500 individuals. All metrics discussed in this report are based on the 500 count subsampled data, except MMI, which is based on a fixed count of 300 organisms per sample.

There are numerous metrics used to assess the composition and health of benthic communities. These relatively independent metrics provide multiple lines of evidence used to understand the overall habitat condition and water quality of an aquatic system. For this evaluation, we present

benthic community data in the context of the Colorado Multi-Metric Index (MMI); overall taxa richness, Shannon Diversity Index (SDI), richness of Ephemeroptera, Plecoptera, and Trichoptera taxa (EPT), density/abundance, habits, and Functional Feeding Groups (FFG). Due to our interest in how elevated metal concentrations in mineralized waters may influence benthic community composition in the Mancos River, we also evaluated the relative abundance metal-sensitive families (MSF), known to be particularly sensitive to elevated metals (Courtney and Clements 2002; Roberts 2017).

Benthic Results

Benthic macroinvertebrate communities varied substantially across the Mancos River watershed. One approach for describing the differences in benthic communities among sites is the Colorado Multi-Metric Index, developed by CDPHE to assess the extent to which biological communities may have been altered by environmental stressors. The MMI also allows the evaluation of whether a water body is in attainment or impairment of designated aquatic life use (CPDHE 2025). Two sampled locations, WMAT and EM-25A, had so few bugs (<150 organisms) that they do not conform with MMI data assumptions and thus MMI scores were not calculated. All of the remaining samples would be considered in attainment of aquatic life use designation except for the 2023 MANMANCO sample, which would be considered in impairment of aquatic life use (Figure 72). The MMI score for this sample fell between the impairment threshold and the attainment threshold necessitating further evaluation using auxiliary metrics, which concluded an impairment determination.

We found strong differences in benthic communities in mineralized headwater reaches vs. less mineralized reaches. Measures of diversity (taxa richness, SDI, EPT richness) and abundance were substantially lower at WMAT and EM-25A compared to other sites (Figure 73-Figure 76). The change in benthic community from upstream to downstream in the West Mancos River is particularly striking. All metrics decrease from WMAGB to WMAT, reflecting the change in water quality in the South Fork of West Mancos River after receiving inflows from draining mines and mineralized springs, but then rebound several miles downstream at WMAE.

The relative abundance of metal-sensitive families is a useful indicator of water quality in mineralized surface waters (Roberts 2017). One metal-sensitive family, Taeniopterygidae, was absent from all samples. The highest relative abundance of Heptageniidae occurred at WMAGB, located upstream of inflows from draining mines and mineralized springs. The highest relative abundance of Ephemerellidae occurred at WMAE. No metal-sensitive family taxa occurred at WMAT or EM-25A. Among Mancos Canyon sites, Heptageniidae was the only metal-sensitive family to occur (Figure 77).

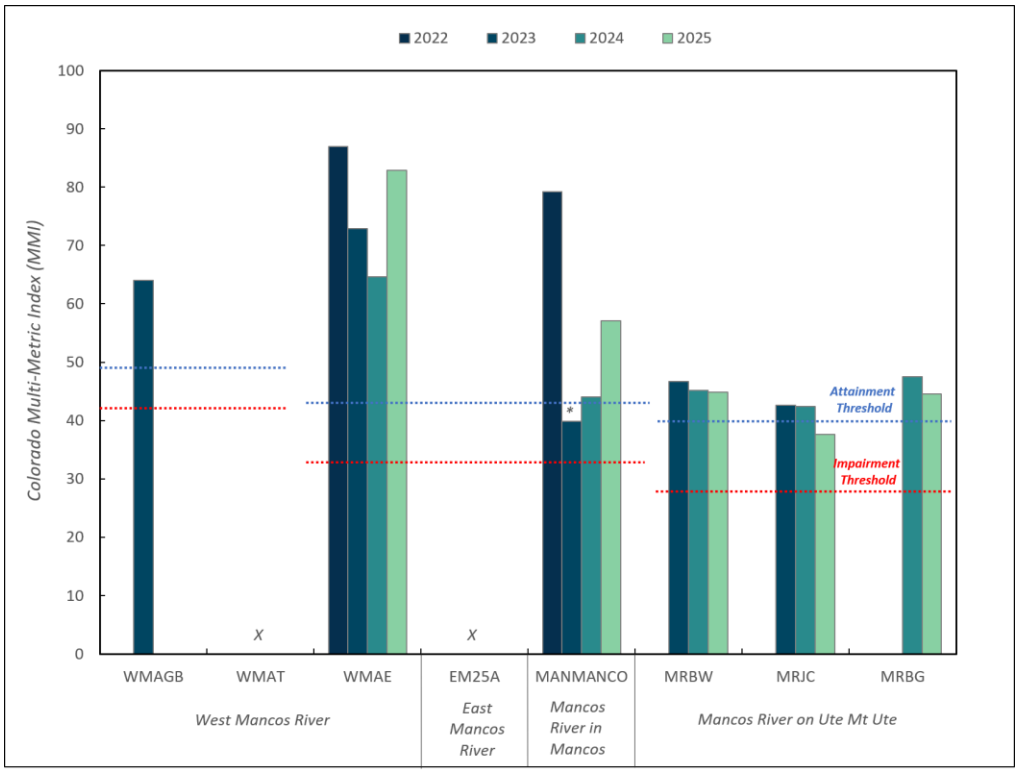


Figure 72. Colorado Multi-Metric Index (MMI). Thresholds are dependent on biotypes. *X indicates the sample did not have sufficient enough number of organisms for MMI. * Indicates impairment.*

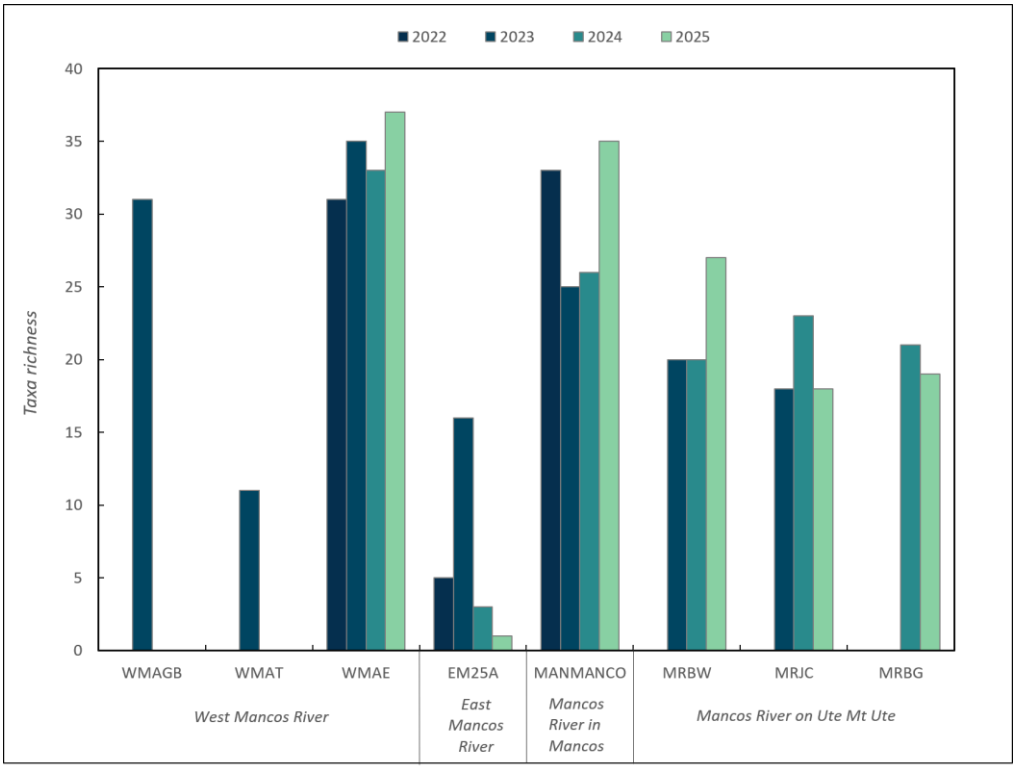


Figure 73. Taxa richness.

Although the headwaters of the West Mancos River and East Mancos River both contain natural mineralization and legacy mine sites, the benthic communities that occur near their downstream terminuses are quire different. The benthic community at WMAE, near the downstream terminus of the West Mancos River, has some of the highest diversity metrics among sites and has small abundances of metal-sensitive families. Converserly, the benthic community at EM-25A, near the downstream terminus of the East Mancos River, has much lower diversity metrics and metal-sensitive families do not occur.

Proportions of Functional Feeding Groups and habit types differed between headwater and canyon sites with greater proportion of filter/collectors and swimmers at Mancos Canyon sites (Figure 78-Figure 79).

There can be substantial year to year natural variability in benthic communities, even in undisturbed waterbodies (Scarsbrook et al. 2000). We collected multiple years of benthic macroinvertebrate samples from three sites within the Mancos Canyon on Ute Mountain Ute tribal land. These data can serve as a baseline dataset, contributing to the understanding of inter-annual variability of benthic communities in this reach of the Mancos River, and will allow for better detection of temporal trends in the future.

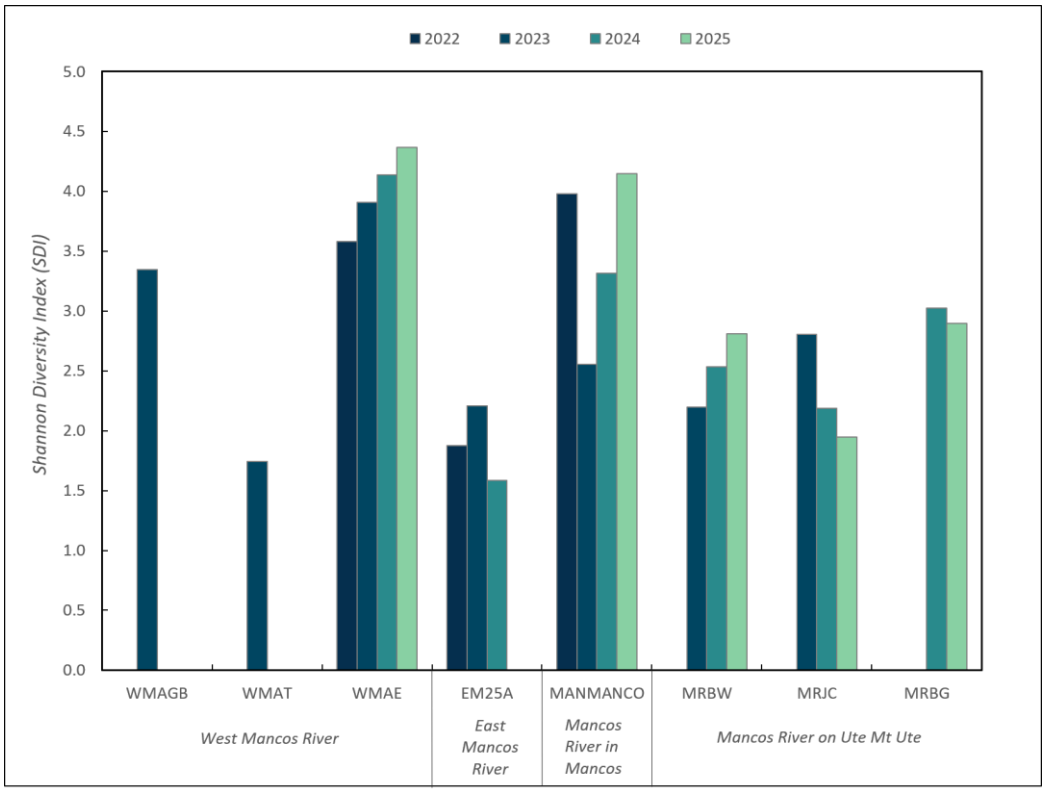


Figure 74. Shannon Diversity Index (SDI).

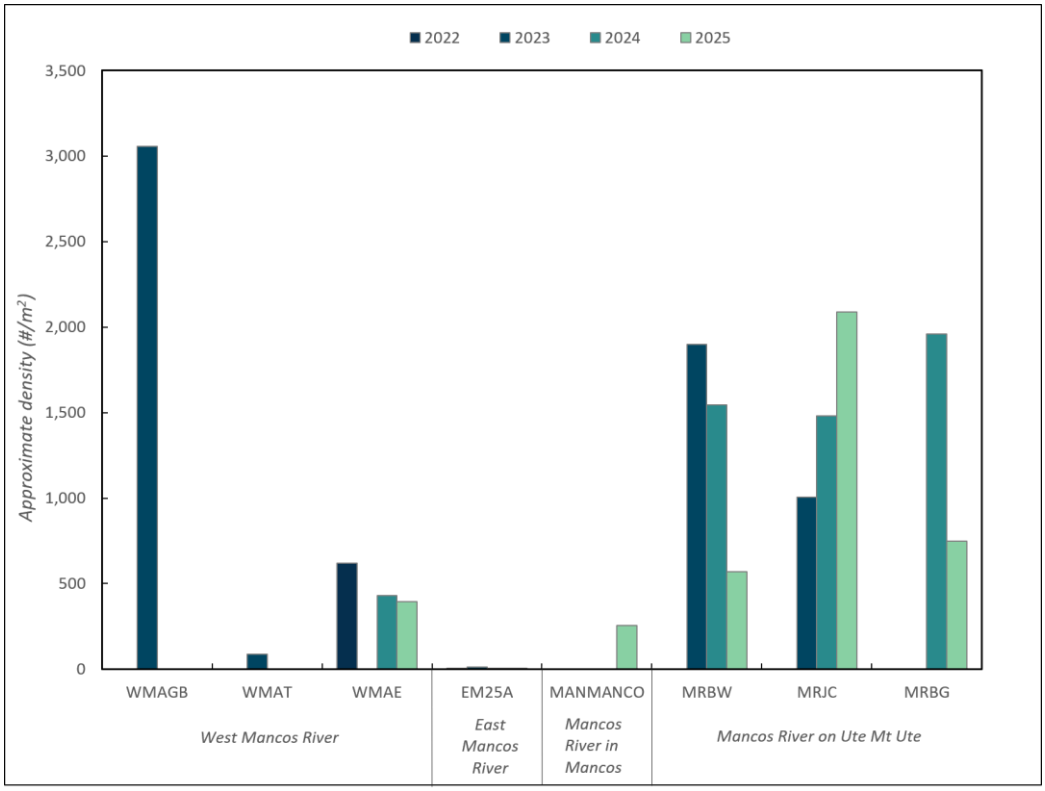


Figure 75. Approximate density/abundance (#/m²).

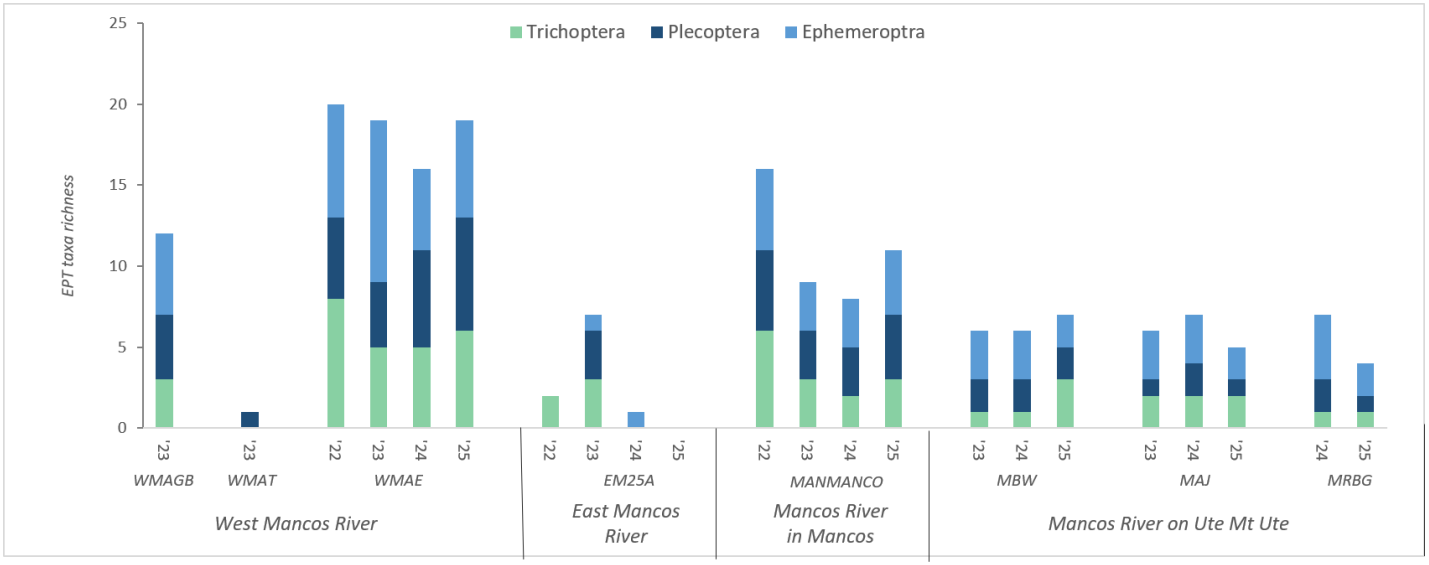


Figure 76. Richness of EPT taxa (Ephemeroptera, Plecoptera, and Trichoptera).

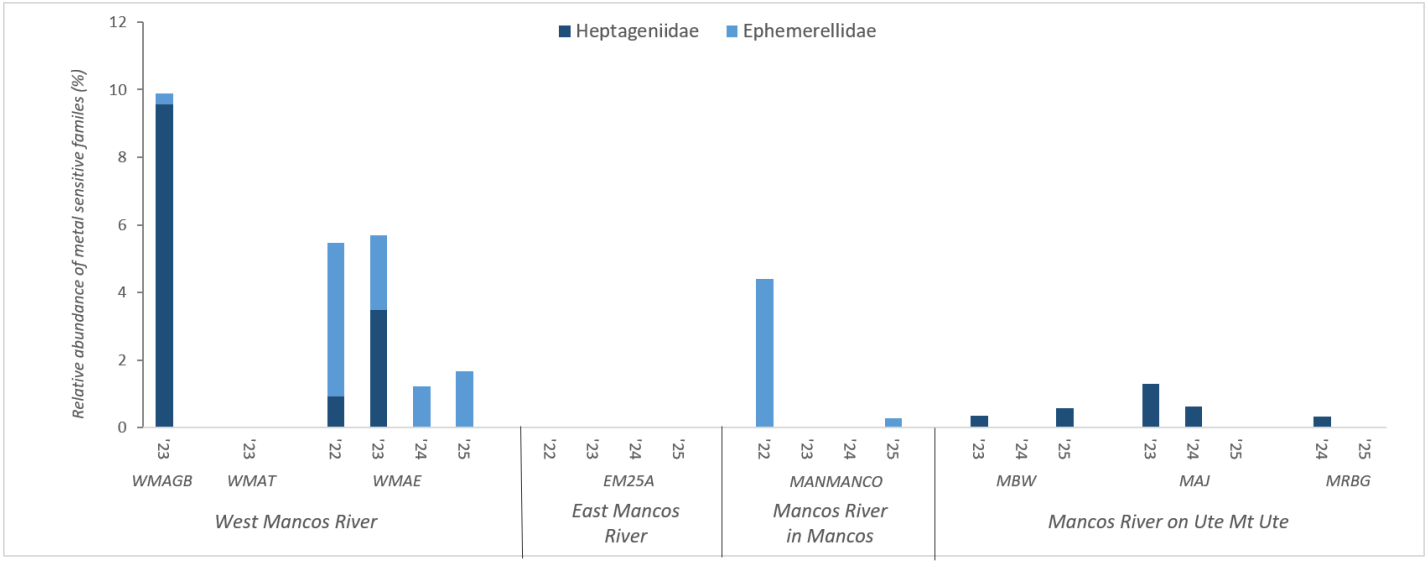


Figure 77. Relative abundance of metal-sensitive families (MSF).

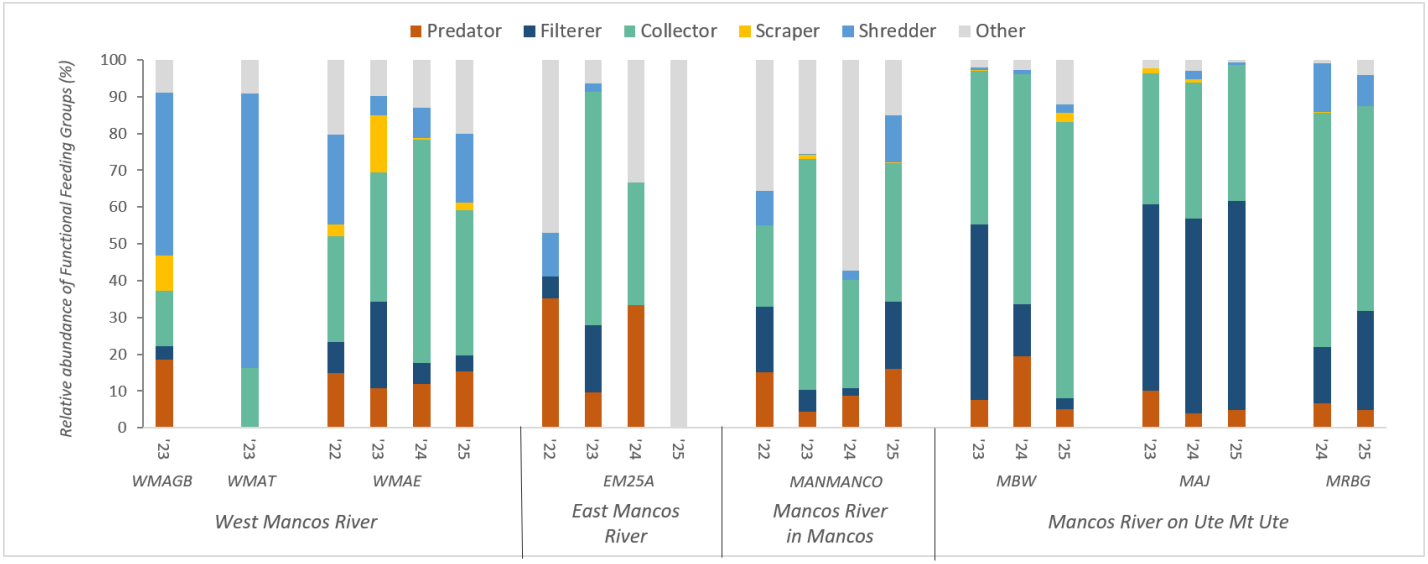


Figure 78. Relative abundance of Functional Feeding Groups (FFG).

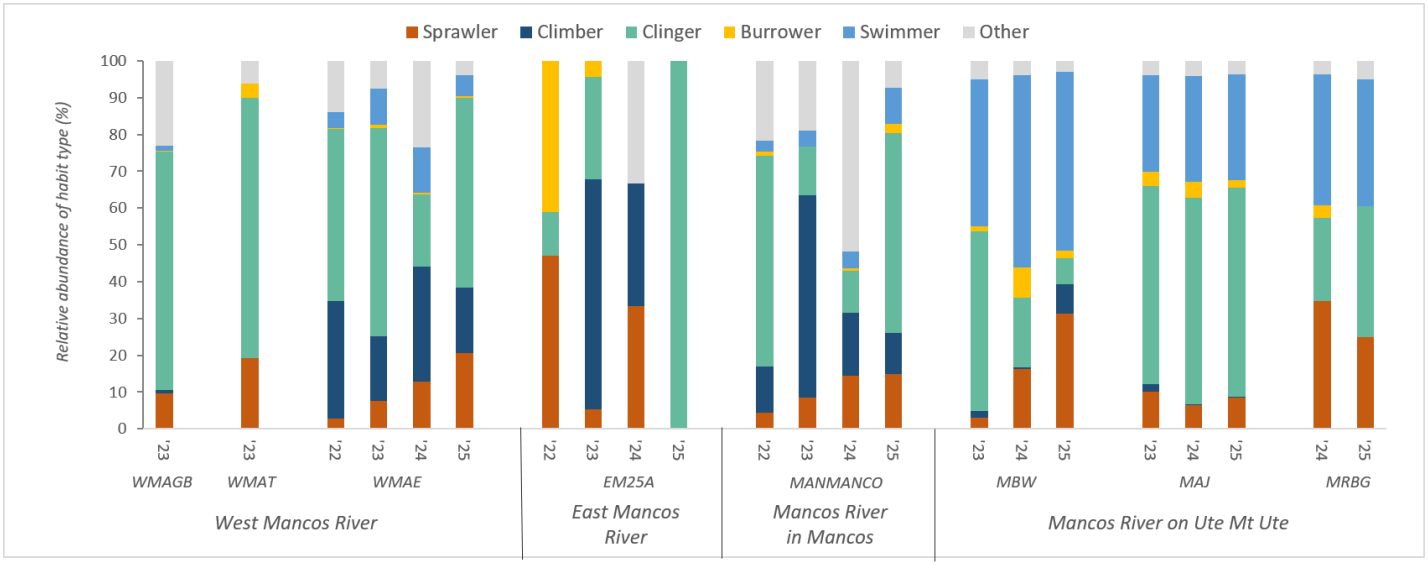


Figure 79. Relative abundance of habit types.

Summary

The 800 square mile Mancos River watershed encompasses the west side of the La Plata mountains, the Mancos Valley, and the desert lowland country of Ute Mountain Ute and Navajo Nation lands. Five primary tributaries contribute water of various quality: the East Mancos River, the West Mancos River, the Middle Mancos River, Chicken Creek, and Mud Creek. Elevated metal loads in the East Mancos watershed and the South Fork West Mancos River watershed are linked to both historic mining and natural mineralization. Key findings from investigations from 2023-2026 include the following:

- Historic dissolved copper concentrations have varied over time, with notable spikes in 2023 and 2024 in the East Mancos River and in 2012 at Weber Canyon. Sources of those periods of elevated concentrations are unclear.
- Remediation of the Thunder Mine waste rock pile was successfully completed in 2024 with immediate, distinct, localized improvements. However, a measurable response in downstream water quality of the East Mancos River was not detected. This is due to a number of factors including a) the poor water quality conditions that exist in the East Mancos River upstream of the Thunder Mine; b) the Thunder Mine drainage follows sub-surface flowpaths and mixes with other groundwater sources; and c) the Thunder Mine drainage accounts for less than 1% of the flow in the East Mancos River at the location where Thunder Mine drainage would enter the river.
- Of all the surveyed mines sites in the South Fork of the West Mancos River, only two warranted sampling, The Gold Bed Mine and the Peerless Mine. The waste rock from both sites is small in area and on the lower side for metals leaching when compared to other waste rock piles state wide and to Silverton area waste rock piles. Both mine sites are extremely remote with no roads or even trails and no reclamation is suggested at this time. The mine drainages from both sites do impact the headwaters of the South Fork of the West Mancos River, but any treatment of the mine drainage is not feasible due to costs, liability, and the remoteness of the sites.
- The Mancos River fishery transitions from warm water species to cold water species in the Mancos town reach and native warm water species are present in the lower watershed. The East Mancos River, upstream of the Middle Mancos River, and the South Fork West Mancos River likely have little to no fish present.
- Benthic macroinvertebrate samples collected from 2023 to 2025 from the lower reach of the West Mancos River and from three Mancos River sites in the Mancos Canyon on Ute Mountain Ut land would be considered in attainment of aquatic life use based on the Colorado Multi-Metric Index.
- Metals mobilization
    - A major focus of his report is addressing whether metals from the headwaters of the Mancos River, particularly copper, mobilize downstream at ecologically relevant levels to the lower reaches of the Mancos River.
    - We characterized mines in the South Fork West Mancos watershed and the lower East Mancos watersheds and assessed mines for unplanned releases.

- Draining mines and mineralized inflows to the South Fork West Mancos River in Owens Basin degrade water quality and create unsuitable habitat for aquatic life. However, water quality conditions improve in the lower reach of the West Mancos River.
- Synoptic sampling events demonstrate that during years with larger runoff (e.g., 2023), metals can be mobilized from the headwaters down the mainstem of the Mancos River.
- During high-flow runoff events, metals can persist, at high enough concentrations to pose risk to aquatic life, downstream from the headwaters through the mainstem of the Mancos River to the reach of the Mancos River immediately downstream of the town of Mancos.
- Additional sources of metals, particularly aluminum, occur in the lower reaches of the Mancos River. Elevated aluminum concentrations during high-flow conditions in the lower reaches of the Mancos River near Towaoc and the confluence of the San Juan River surpass CDPHE standards and EPA aluminum criteria. However, aluminum in these lower reaches is likely strongly sorbed to clays and particulate matters and may not be as biologically available as aluminum that occurs in the headwaters.

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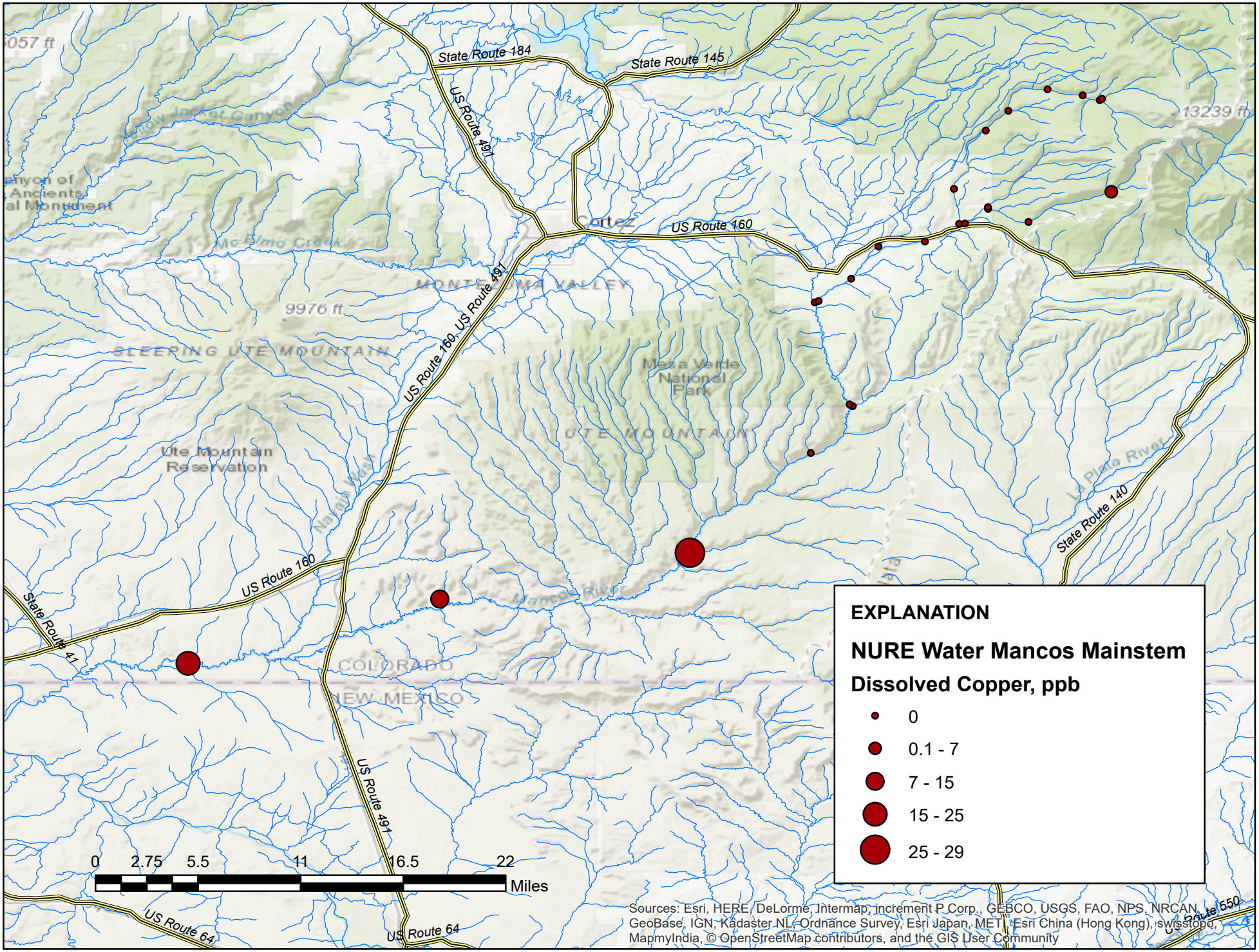


Figure H1. Concentrations of dissolved copper in water from the Mancos River as part of the NURE program (National Uranium Resource Evaluation) conducted during 1976-77.

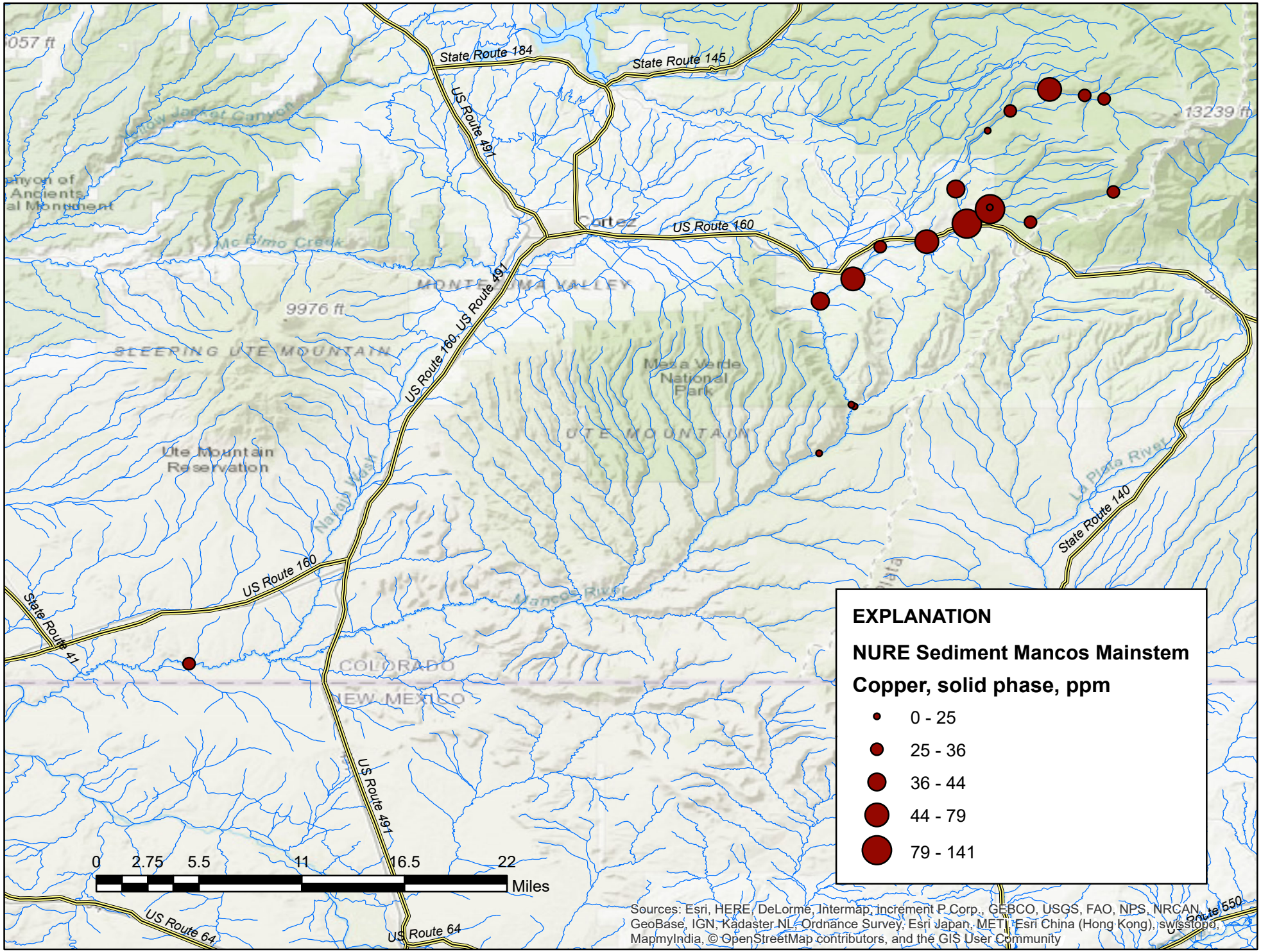


Figure H2. Concentrations of copper in streambed sediments from the Mancos River as part of the NURE program (National Uranium Resource Evaluation) conducted during 1976-77.

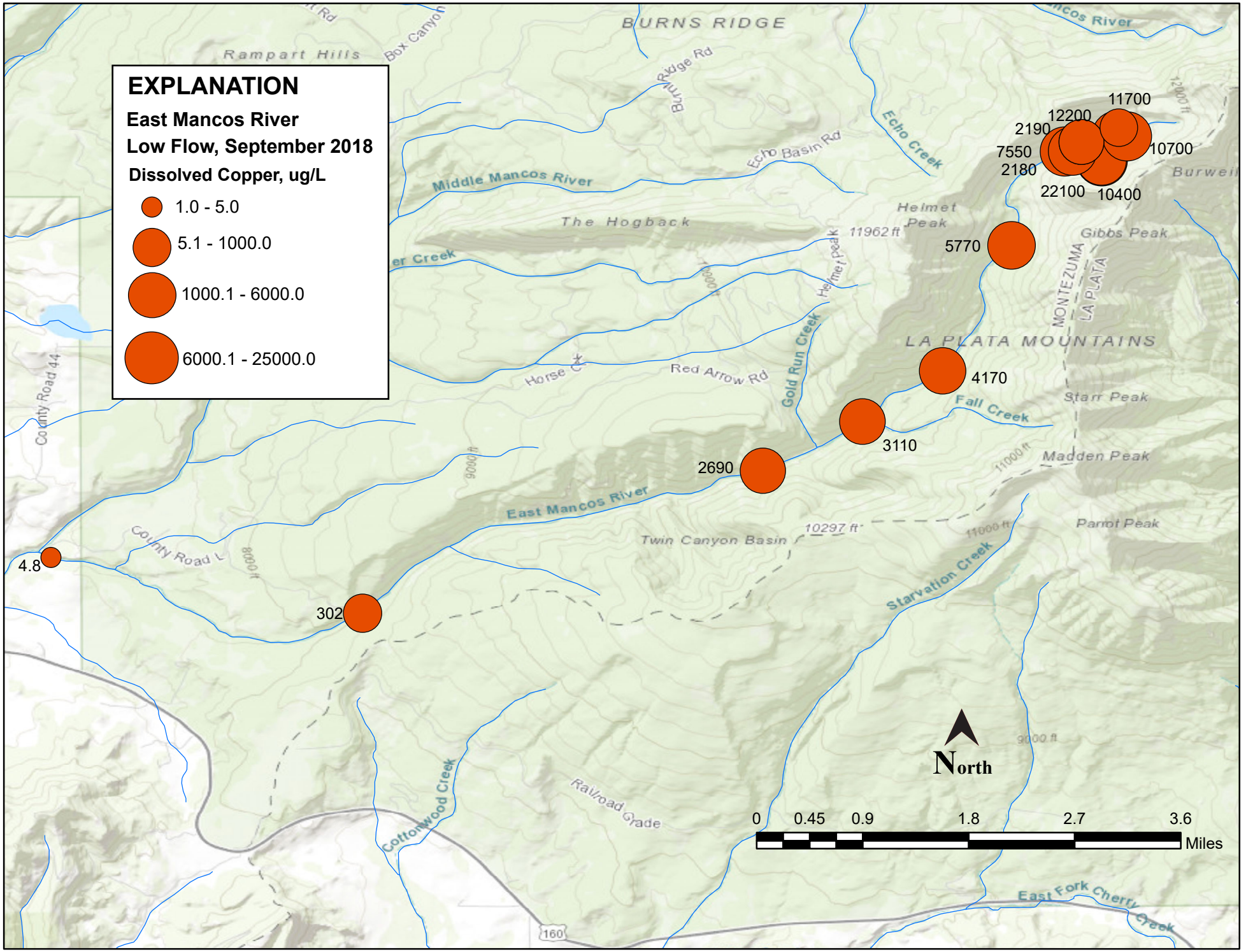


Figure H3. Dissolved-copper concentrations in water from the East Mancos River mainstem, low-flow conditions, September 2018.

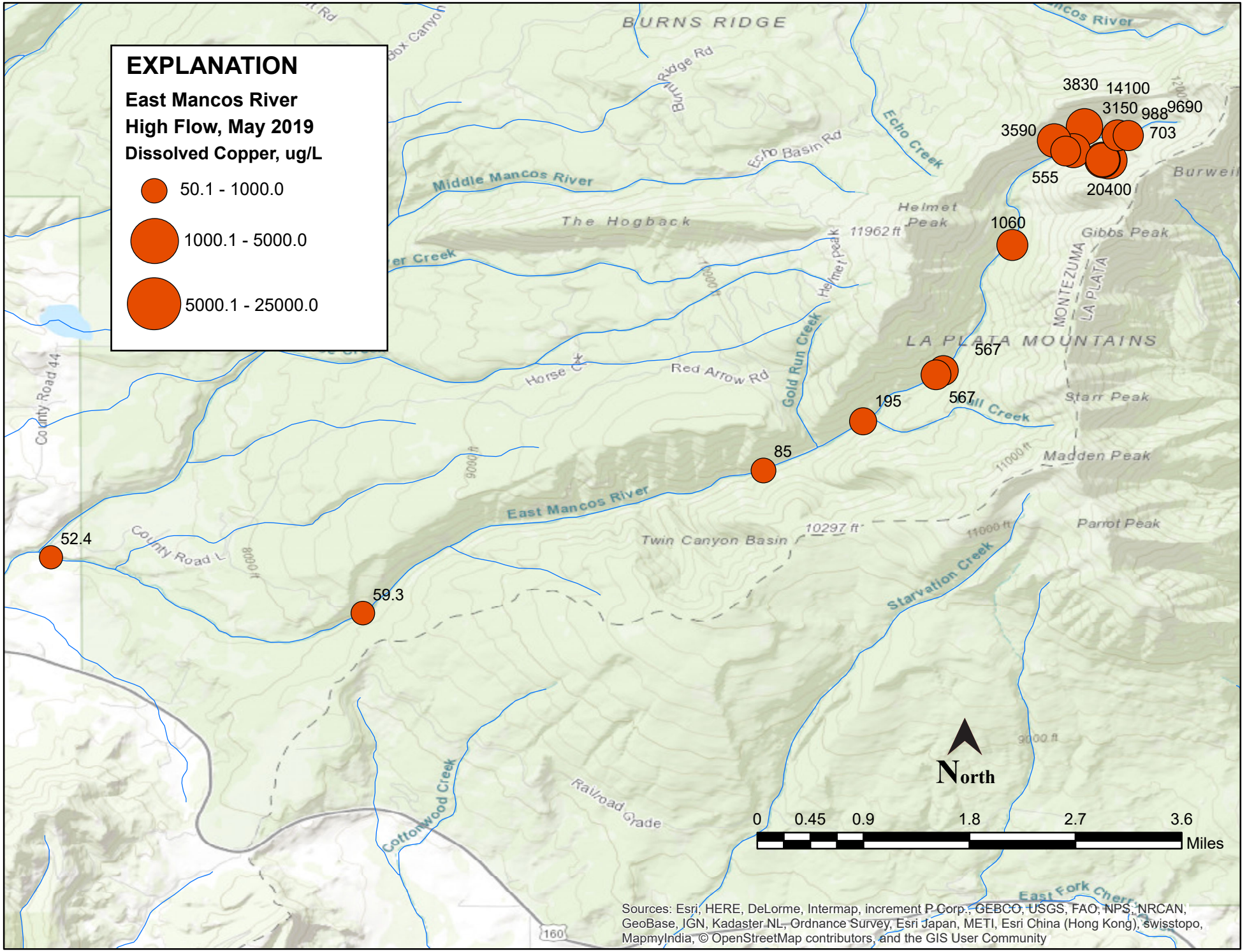


Figure H4. Dissolved-copper concentrations in water from the East Mancos River mainstem, high-flow conditions, May-July 2019.

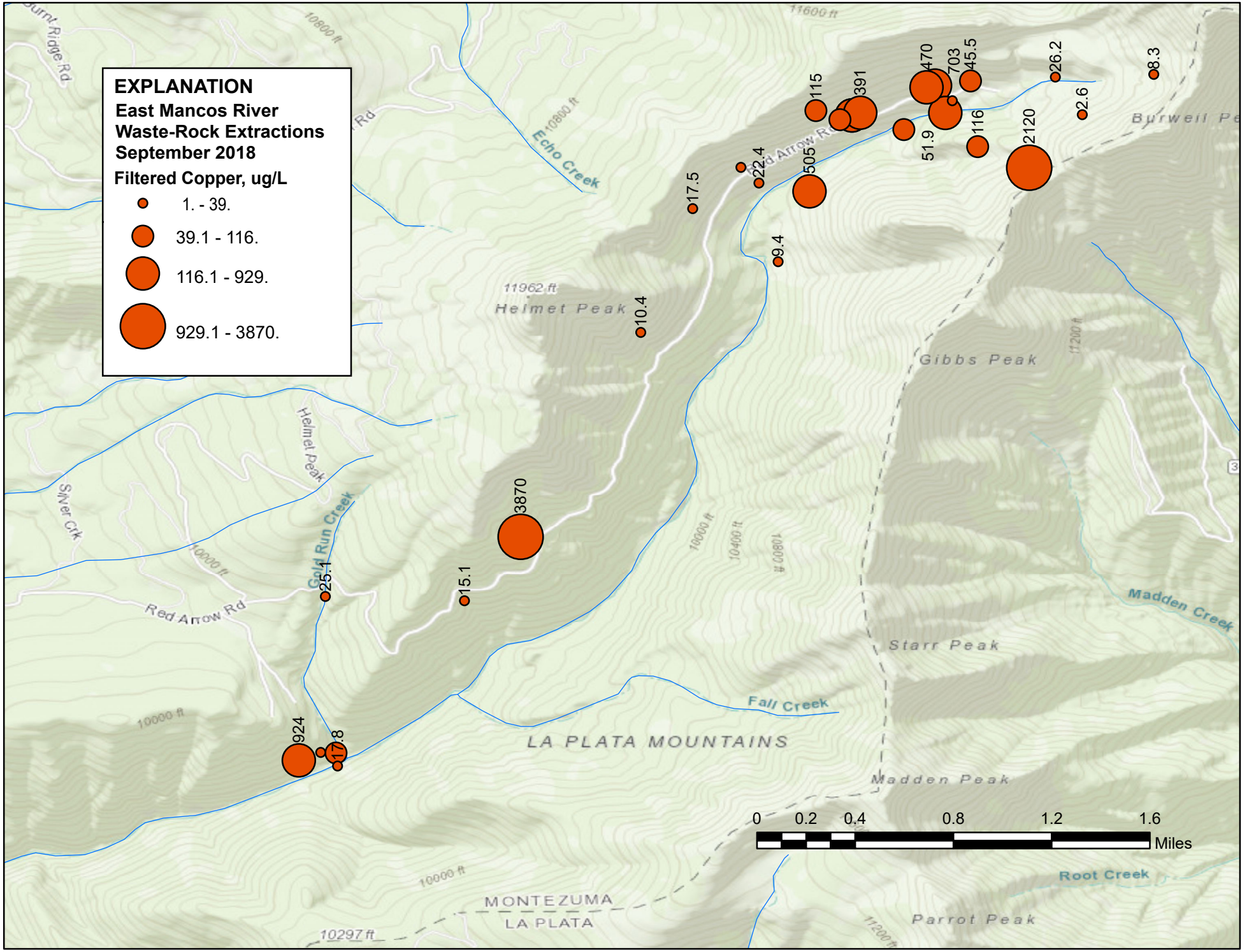


Figure H5. Filtered-copper concentrations in water from waste-rock extractions in the upper East Mancos watershed, September 2018.

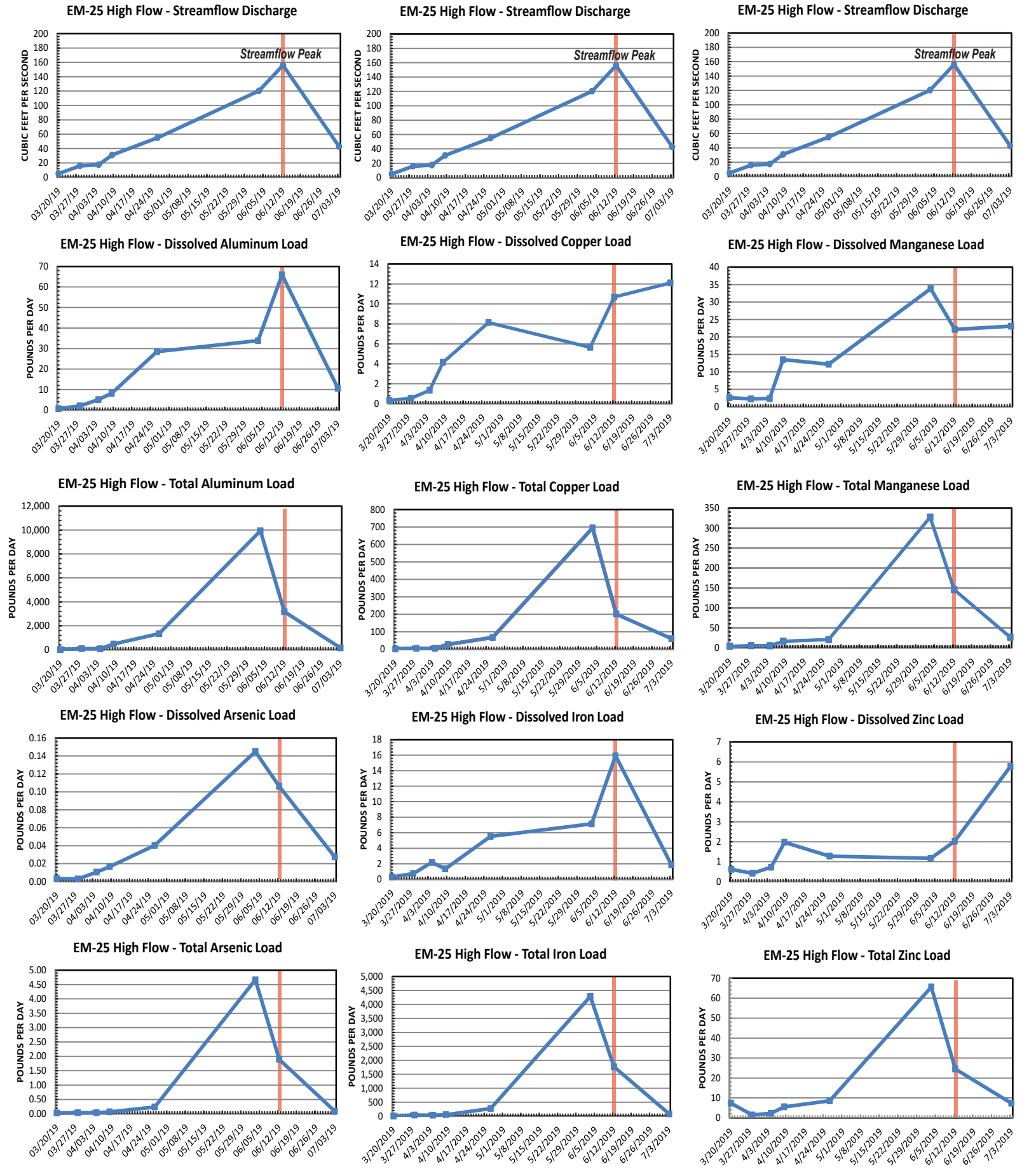
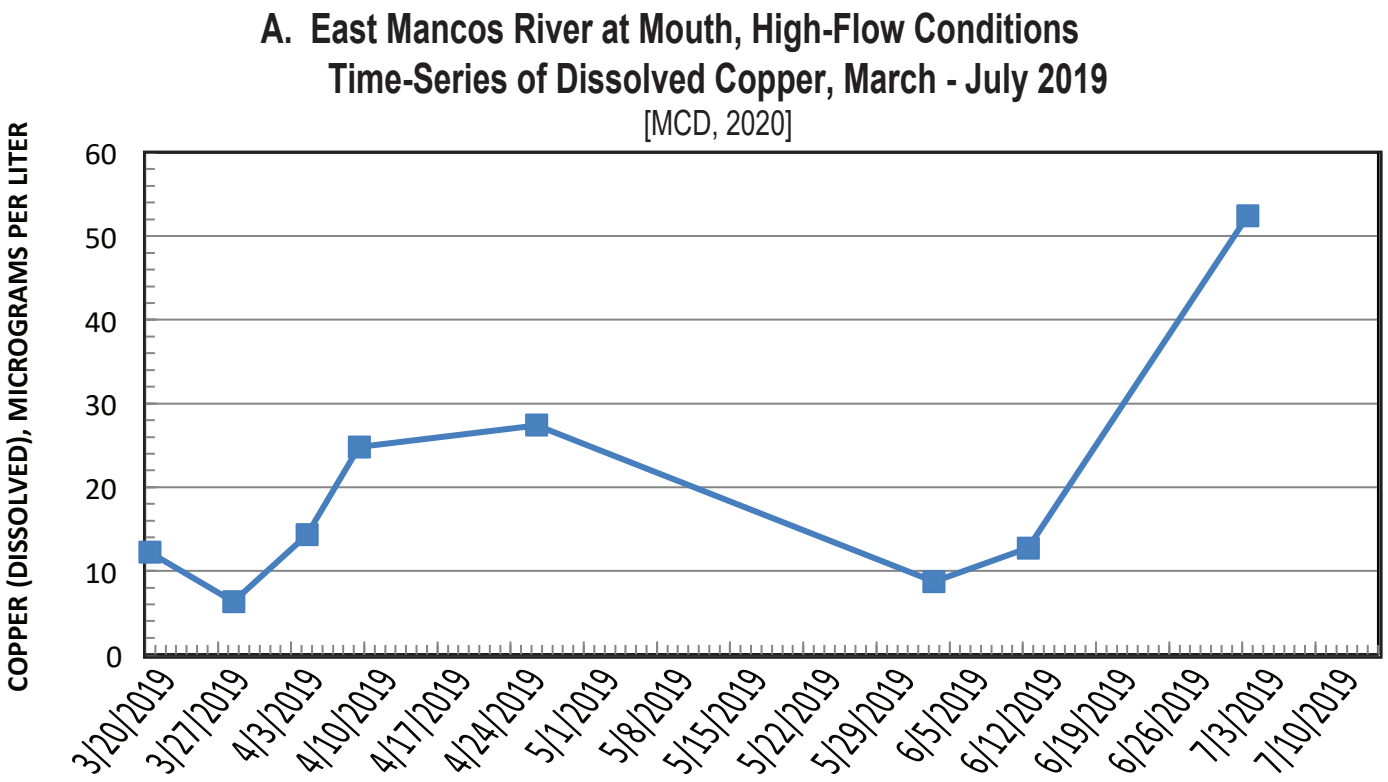


Figure H6. Time series of dissolved and total metal loads at site EM-WQ-25 (mouth of watershed) during snowmelt runoff period of March - July 2019. Streamflow peak is indicated by vertical line. Some metals showed a concentration peak before streamflow peak indicating flushing of metal solids accumulated on the streambed during fall and winter low-flow seasons (MCD, 2020).



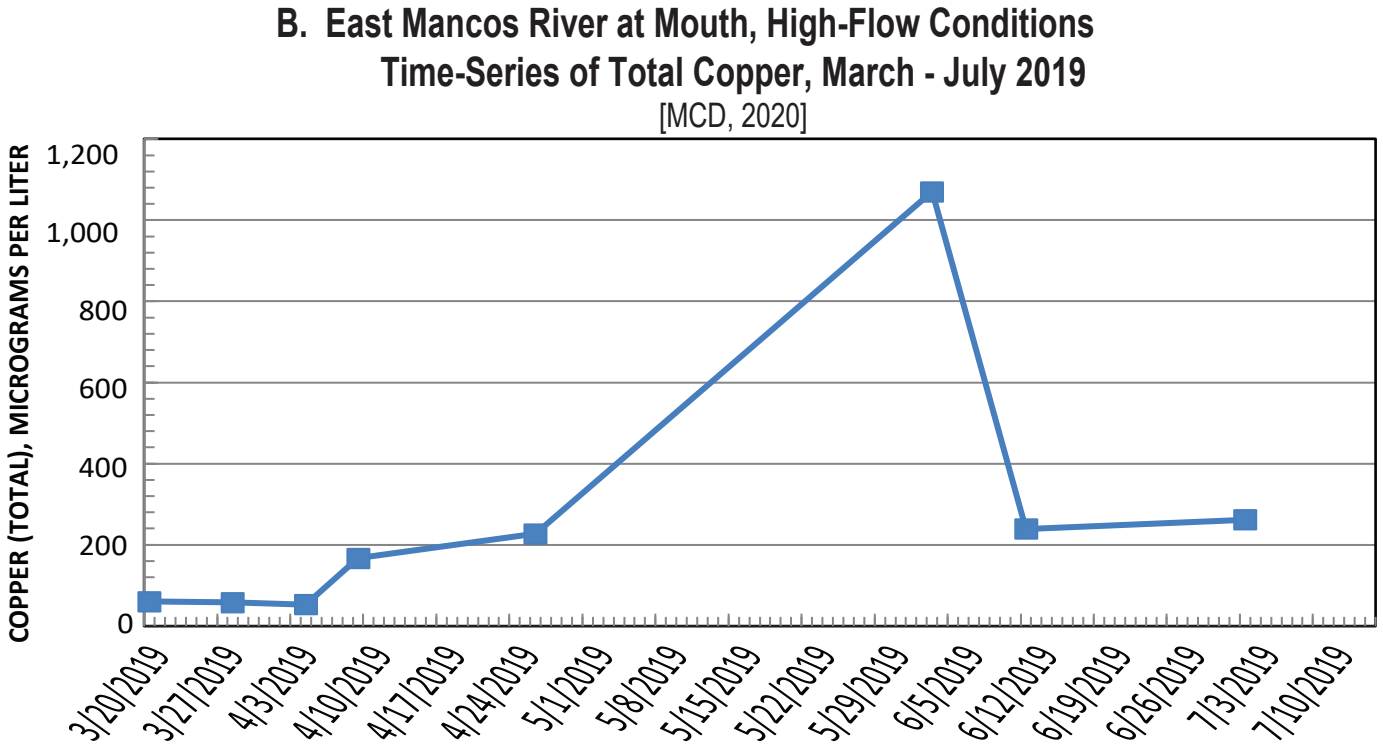


Figure H7 A. Time series of dissolved copper in East Mancos during high-flow conditions, March-July 2019. B. Time series of total copper in East Mancos during high-flow conditions, March-July 2019.











Figure H8. Photos of the upper East Mancos River where heavy-metal rich springs discharge into the upper basin, sourced from highly altered and mineralized bedrock. Stream and spring precipitates, called ferricrete, are comprised of iron and copper minerals (cupric ferrite) and the yellow substance is an iron-sulfate mineral (jarosite).

Table H1 Water-quality results of Mancos River samples collected by the NURE program (National Uranium Resource Evaluation) during the 1970's.

[dd, decimal degrees; °C, degrees Celsius; S.U., standard units; us/cm@25°C, microsiemens per centimeter at 25 degrees Celsius; uR/hr, microroentgens per hour; mg/L, milligrams per liter (ppm); ug/L, micrograms per liter (ppb)]

NURE Site Number	Description	Date	Time	Latitude, dd	Longitude, dd	Water Temperature, °C	pH, S.U.	Specific Conductance, us/cm@25°C	Gamma Ray, uR/hr	Calcium, Dissolved, mg/L	Magnesium, Dissolved, mg/L	Chromium, Dissolved, ug/L	Cobalt, Dissolved, ug/L	Copper, Dissolved, ug/L
1041281 (STREAM)	Mancos River blw Navajo Wash	9/14/1977	14:00	37.0133	-108.8528	20.0	7.4	920.0	13.0	126	40.579	29	104	25
1041278 (SPRING)	Spring, MeVe right bank	9/13/1977	20:00	37.0639	-108.6575	21.2	7.5	310.0	8.0	24.788	3.338	0	0	15
1041279 (STREAM)	Mancos River	9/15/1977	15:00	37.1003	-108.4633	24.0	7.6	1300.0	10.0	208	47.355	0	89	29
1041022 (STREAM)	Mancos River	5/24/1976	17:00	37.1786	-108.3694	14.2	8.6	975.0	14.0	138	60.693	0	102	0
1041020 (STREAM)	Weber Creek	5/24/1976	15:00	37.2156	-108.3369	14.7	8.3	2300.0	11.0	198	121	0	172	0
1041021 (STREAM)	Mancos River abv Weber Creek	5/24/1976	15:00	37.2169	-108.3392	15.9	8.5	875.0	14.0	98.446	40.035	0	0	0
1041079 (STREAM)	Mud Creek	5/27/1976	16:00	37.2972	-108.3664	14.1	8.0	1420.0	13.0	145	62.564	0	128	0
1041080 (STREAM)	Mancos River abv Mud Creek	5/27/1976	17:00	37.2983	-108.3633	14.0	8.3	1465.0	15.0	157	71.756	0	126	0
1041078 (STREAM)	Mancos River at G Road	5/27/1976	16:00	37.3158	-108.3381	13.9	8.2	1500.0	13.0	0	0	0	0	0
1041077 (STREAM)	Chicken Creek	5/27/1976	16:00	37.3411	-108.3169	14.4	8.4	650.0	13.0	62.652	23.365	0	0	0
1041076 (STREAM)	Mancos River at Mancos	5/27/1976	15:00	37.3450	-108.2808	14.3	8.2	233.0	15.0	33.153	9.087	43	0	0
1041058 (STREAM)	West Mancos abv East Mancos	5/27/1976	11:00	37.3589	-108.2542	13.1	8.0	180.0	17.0	21.557	4.258	0	0	0
1041059 (STREAM)	East Mancos abv West Mancos	5/27/1976	10:00	37.3592	-108.2497	13.0	8.0	150.0	17.0	18.707	5.454	0	0	0
1041066 (STREAM)	East Mancos abv Middle Mancos	5/26/1976	16:00	37.3706	-108.2317	15.3	8.0	150.0	18.0	17.984	4.207	0	0	< 4
1041065 (STREAM)	Middle Mancos	5/26/1976	16:00	37.3719	-108.2319	18.8	8.0	155.0	13.0	22.074	4.942	0	0	0
1041063 (STREAM)	East Mancos nr USFS Boundary	5/26/1976	14:00	37.3603	-108.2003	15.1	7.8	485.0	18.0	80.541	15.631	0	80	< 4
1041064 (STREAM)	East Mancos abv Red Arrow	5/26/1976	15:00	37.3842	-108.1361	13.5	8.0	100.0	20.0	12.354	2.442	31	0	7
1041067 (STREAM)	West Mancos nr Jackson Ditch Rd	5/26/1976	17:00	37.3864	-108.2583	14.6	8.2	145.0	16.0	20.883	3.214	0	0	0
1041173 (STREAM)	West Mancos River	7/6/1976	19:00	37.4322	-108.2336	8.5	8.2	135.0	22.0	22.762	3.197	0	0	0
1041172 (STREAM)	Box Canyon Trib to West Mancos	7/6/1976	19:00	37.4478	-108.2161	8.5	8.0	110.0	15.0	21.393	3.227	71	0	0
1041171 (STREAM)	West Mancos abv Crystal Creek	7/6/1976	18:00	37.4647	-108.1856	10.5	8.1	130.0	15.0	22.655	3.213	52	0	0
1041170 (STREAM)	West Mancos blw Deer Lick Creek	7/6/1976	17:00	37.4600	-108.1583	11.5	7.8	140.0	17.0	26.396	3.234	37	0	0
1041169 (STREAM)	South Fork West Mancos River	7/6/1976	16:00	37.4561	-108.1450	8.0	8.0	160.0	13.0	34.392	3.142	49	58	0
1041168 (STREAM)	North Fork West Mancos River	7/6/1976	15:00	37.4572	-108.1433	7.5	8.0	120.0	7.0	23.672	2.721	0	0	0

Table NURE water. Water-quality results of Mancos River samples collected by the NURE program (National Uranium Resource Evaluation) -- Cont'd.

NURE Site Number	Description	Iron, Dissolved, ug/L	Lead, Dissolved, ug/L	Manganese, Dissolved, ug/L	Molybdenum, Dissolved, ug/L	Nickel, Dissolved, ug/L	Titanium, Dissolved, ug/L	Uranium, Dissolved, ug/L	Zinc, Dissolved, ug/L
1041281 (STREAM)	Mancos River blw Navajo Wash	218	0	33	0	70	32	0.52	0
1041278 (SPRING)	Spring, MeVe right bank	68	0	0	0	33	0	0.21	0
1041279 (STREAM)	Mancos River	539	0	33	0	30	32	0.7	53
1041022 (STREAM)	Mancos River	93	0	38	0	78	33	3.27	0
1041020 (STREAM)	Weber Creek	122	0	129	116	182	59	6.16	207
1041021 (STREAM)	Mancos River abv Weber Creek	63		17		0	21		157
1041079 (STREAM)	Mud Creek	73	0	52	153	72	39	3.35	173
1041080 (STREAM)	Mancos River abv Mud Creek	64	0	109	185	194	48	4.72	214
1041078 (STREAM)	Mancos River at G Road	0	0	0	0	0	0	9.1	0
1041077 (STREAM)	Chicken Creek	75	0	54	178	0	17	0.86	151
1041076 (STREAM)	Mancos River at Mancos	118	0	47	164	50	16	0.25	70
1041058 (STREAM)	West Mancos abv East Mancos	118	0	31	100	35	11	0.62	62
1041059 (STREAM)	East Mancos abv West Mancos	95	0	17	66	0	0	0.65	100
1041066 (STREAM)	East Mancos abv Middle Mancos	82	0	21	82	0	7	0.1	0
1041065 (STREAM)	Middle Mancos	189	0	24	64	0	11	0.29	67
1041063 (STREAM)	East Mancos nr USFS Boundary	236	0	53	65	0	18	1.14	0
1041064 (STREAM)	East Mancos abv Red Arrow	178	0	21	77	0	9	0.36	72
1041067 (STREAM)	West Mancos nr Jackson Ditch Rd	108	0	25	72	0	9	0.1	187
1041173 (STREAM)	West Mancos River	90	0	11	0	0	10	0.54	0
1041172 (STREAM)	Box Canyon Trib to West Mancos	109	0	31	104	0	26	0.1	0
1041171 (STREAM)	West Mancos abv Crystal Creek	254	0	38	73	78	19	0.54	59
1041170 (STREAM)	West Mancos blw Deer Lick Creek	170	0	39	87	37	16	0.29	63
1041169 (STREAM)	South Fork West Mancos River	138	0	35	99	64	22	0.37	0

Table H2. Streambed sediment chemistry of Mancos River samples collected by the NURE program (National Uranium Resource Evaluation) during the 1970's.[dd, decimal degrees; mg/kg, milligrams per kilogram, which is equivalent to ppm, parts per million]

SiteNo	Description	Date	Time	Latitude, dd	Longitude, dd	Aluminum, mg/kg (ppm)	Antimony, mg/kg (ppm)	Barium, mg/kg (ppm)	Beryllium, mg/kg (ppm)	Bismuth, mg/kg (ppm)	Cadmium, mg/kg (ppm)	Calcium, mg/kg (ppm)	Cerium, mg/kg (ppm)	Cesium, mg/kg (ppm)
5053315 (STREAM)	Mancos River blw Navajo Wash	9/14/1977	14:00	37.0133	-108.8528	7.625	0	588	1	0	0	2.626	83	6.3
5052939 (STREAM)	Mancos River abv Lewis Creek	5/24/1976	17:00	37.1786	-108.3642	3.993	0	540	2	0	0	1.154	47	2.5
5052936 (STREAM)	Weber Creek	5/24/1976	15:00	37.2156	-108.3369	4.763	0	603	0	0	0	4.161	50	3.1
5052937 (STREAM)	Mancos River abv Weber Creek	5/24/1976	15:00	37.2169	-108.3392	4.337	0	518	1	0	0	5.902	32	2.8
5053046 (STREAM)	Mud Creek	5/27/1976	16:00	37.2972	-108.3664	4.558	0	314	0	5	0	6.691	44	2.6
5053047 (STREAM)	Mancos River abv Mud Creek	5/27/1976	17:00	37.2983	-108.3633	5.214	0	517	0	0	0	4.286	27	3.5
5053045 (STREAM)	Mancos River nr G Road	5/27/1976	16:00	37.3158	-108.3381	5.111	0	445	1	0	0	4.065	52	3.8
5053044 (STREAM)	Chicken Creek	5/27/1976	16:00	37.3411	-108.3169	6.025	0	337	1	0	0	1.975	50	4.8
5053043 (STREAM)	Mancos River in Mancos	5/27/1976	15:00	37.3450	-108.2808	4.445	0	570	0	0	0	1.064	35	1.9
5053020 (STREAM)	East Mancos abv West Mancos	5/27/1976	10:00	37.3592	-108.2497	4.32	0	730	1	0	0	0.733	41	3.1
5053029 (STREAM)	East Mancos abv Middle Mancos	5/26/1976	16:00	37.3706	-108.2317	2.592	2	942	0	6	0	0.3683	30	2.3
5053028 (STREAM)	Middle Mancos River	5/26/1976	16:00	37.3719	-108.2319	6.136	0	320	1	5	0	1.3	65	5.2
5053026 (STREAM)	Spring nr East Mancos River nr USFS Boundary	5/26/1976	14:00	37.3603	-108.2003	5.304	0	505	1	0	0	0.6166	63	3.6
5053027 (STREAM)	Spring nr East Mancos River abv Red Arrow	5/26/1976	15:00	37.3842	-108.1361	4.473	0	499	2	0	0	0.329	41	3.9
5053030 (STREAM)	West Mancos nr Jackson Ditch Rd	5/26/1976	17:00	37.3864	-108.2583	4.65	0	429	0	5	0	0.5586	52	2.9
5053156 (STREAM)	West Mancos at Jackson Gulch Diversion	7/6/1976	19:00	37.4322	-108.2336	7.59	0	563	2	0	0	1.342	61	2.9
5053155 (STREAM)	Box Canyon at West Mancos R.	7/6/1976	19:00	37.4478	-108.2161	5.087	0	477	1	0	0	0.7873	39	2.9
5053154 (STREAM)	West Mancos blw Crystal Creek	7/6/1976	18:00	37.4647	-108.1856	5.578	0	436	2	0	0	0.7175	61	4.2
5053153 (STREAM)	West Mancos blw SF and NF confluence	7/6/1976	17:00	37.4600	-108.1583	6.744	0	420	1	6	0	0.9897	61	4.6
5053152 (STREAM)	South Fork West Mancos River	7/6/1976	16:00	37.4561	-108.1450	5.071	0	344	1	0	0	0.4454	53	3
5053151 (STREAM)	North Fork West Mancos River	7/6/1976	15:00	37.4572	-108.1433	6.443	0	454	2	0	0	1.101	52	3.9

Table NUREsediment. Streambed sediment chemistry of Mancos River samples collected by the NURE program (National Uranium Resource Evaluation) -- Continued.

SiteNo	Description	Chlorine, mg/kg (ppm)	Chromium, mg/kg (ppm)	Cobalt, mg/kg (ppm)	Copper, mg/kg (ppm)	Dysprosium, mg/kg (ppm)	Europium, mg/kg (ppm)	Gold, mg/kg (ppm)	Hafnium, mg/kg (ppm)	Iron, mg/kg (ppm)	Lanthanum, mg/kg (ppm)	Lead, mg/kg (ppm)	Lithium, mg/kg (ppm)	Lutetium, mg/kg (ppm)
5053315 (STREAM)	Mancos River blw Navajo Wash	0	54	10.9	33	4	1.4	0	5.7	1.795	47	10	36	0.6
5052939 (STREAM)	Mancos River abv Lewis Creek	0	27	7.1	19	3	0.9	0	11	0.7255	27	13	28	0.3
5052936 (STREAM)	Weber Creek	0	48	6.6	25	4	1	0	13.1	1.192	31	7	69	0.4
5052937 (STREAM)	Mancos River abv Weber Creek	0	28	8.7	23	3	0.8	0	5.4	1.018	19	10	67	0.3
5053046 (STREAM)	Mud Creek	0	37	8.3	20	3	1	0	5.2	1.367	28	13	65	0.3
5053047 (STREAM)	Mancos River abv Mud Creek	0	32	8.8	44	4	0.9	0	5	1.069	24	10	60	0.2
5053045 (STREAM)	Mancos River nr G Road	0	39	10.3	79	3	1	0	7	1.288	31	10	61	0.3
5053044 (STREAM)	Chicken Creek	0	48	8.6	31	4	1.1	0	7.7	1.571	0	14	58	0.3
5053043 (STREAM)	Mancos River in Mancos	0	17	7.6	68	3	0.8	0	7.4	0.8328	21	14	33	0.2
5053020 (STREAM)	East Mancos abv West Mancos	0	31	6.2	126	3	1	0	9.7	1.143	27	11	28	0.3
5053029 (STREAM)	East Mancos abv Middle Mancos	0	17	6.1	141	2	0.7	0	5	0.7066	15	0	20	0.2
5053028 (STREAM)	Middle Mancos River	0	43	7.7	23	3	1	0	8.4	1.513	38	11	41	0.3
5053026 (STREAM)	Spring nr East Mancos River nr USFS Boundary	0	49	8.9	36	4	1.1	0	11.3	1.234	34	11	33	0.5
5053027 (STREAM)	Spring nr East Mancos River abv Red Arrow	0	15	7.1	32	4	0.8	0	8.5	0.7205	23	20	16	0.3
5053030 (STREAM)	West Mancos nr Jackson Ditch Rd	0	27	7.5	38	3	0.9	0	8.6	1.175	26	13	32	0.4
5053156 (STREAM)	West Mancos at Jackson Gulch Diversion	0	30	7.4	25	4	1.3	0	6.9	1.902	39	10	45	0.3
5053155 (STREAM)	Box Canyon at West Mancos R.	0	0	7.5	34	4	0.8	0	7.9	0.9054	21	13	41	0.3
5053154 (STREAM)	West Mancos blw Crystal Creek	0	38	9.2	67	5	1.1	0.2	16.4	1.752	37	14	46	0.4
5053153 (STREAM)	West Mancos blw SF and NF confluence	106	44	10.1	29	4	1	0	8.1	1.513	40	13	41	0.4
5053152 (STREAM)	South Fork West Mancos River	0	32	5.9	19	3	1.2	0	12.8	1.023	32	8	36	0.4
5053151 (STREAM)	North Fork West Mancos River	0	33	9.4	31	5	1	0	5.7	1.336	34	17	63	0.3

Table H2 (cont). Streambed sediment chemistry of Mancos River samples collected by the NURE program (National Uranium Resource Evaluation) -- Continued.

SiteNo	Description	Magnesium, mg/kg (ppm)	Manganese, mg/kg (ppm)	Nickel, mg/kg (ppm)	Niobium, mg/kg (ppm)	Potassium, mg/kg (ppm)	Rubidium, mg/kg (ppm)	Samarium, mg/kg (ppm)	Scandium, mg/kg (ppm)	Silver, mg/kg (ppm)	Sodium, mg/kg (ppm)	Strontium, mg/kg (ppm)	Tantalum, mg/kg (ppm)
5053315 (STREAM)	Mancos River blw Navajo Wash	1.773	362	15	30	2	84	4.5	10.7	0	0.9385	0	0
5052939 (STREAM)	Mancos River abv Lewis Creek	0.9923	158	0	0	1.326	30	2.9	4.1	0	0.7818	0	0
5052936 (STREAM)	Weber Creek	2.266	240	0	0	1.254	0	4.4	5.7	0	0.8976	0	0
5052937 (STREAM)	Mancos River abv Weber Creek	1.527	216	19	0	1.068	0	2	4.1	0	0.6132	0	0
5053046 (STREAM)	Mud Creek	1.396	224	0	0	1.139	0	3.8	5.7	0	0.485	0	0
5053047 (STREAM)	Mancos River abv Mud Creek	1.847	504	19	0	1.568	0	2.8	4.8	0	0.6338	0	0
5053045 (STREAM)	Mancos River nr G Road	1.05	504	0	0	1.33	41	4.1	5.5	0	0.656	0	0
5053044 (STREAM)	Chicken Creek	1.276	291	16	0	1.479	0	4.6	7	0	0.5662	0	0
5053043 (STREAM)	Mancos River in Mancos	0.8922	404	0	0	1.417	0	2.2	3.8	0	0.6126	0	0
5053020 (STREAM)	East Mancos abv West Mancos	0.535	314	0	0	1.34	54	2.1	4.2	0	0.471	0	0
5053029 (STREAM)	East Mancos abv Middle Mancos	0.3199	389	0	0	1.062	23	1.5	2.3	0	0.2547	0	0
5053028 (STREAM)	Middle Mancos River	1.232	267	0	0	1.519	0	4.3	7.1	0	0.6219	0	0
5053026 (STREAM)	Spring nr East Mancos River nr USFS Boundary	0.8249	863	21	0	1.41	52	4.7	6.5	0	0.728	0	0
5053027 (STREAM)	Spring nr East Mancos River abv Red Arrow	0.5086	858	0	0	1.797	39	3	4	0	0.3584	0	0
5053030 (STREAM)	West Mancos nr Jackson Ditch Rd	0.7439	403	0	0	1.377	36	3.5	5.2	0	0.6749	0	0
5053156 (STREAM)	West Mancos at Jackson Gulch Diversion	1.078	473	0	0	1.28	0	2.5	7.8	0	1.402	0	0
5053155 (STREAM)	Box Canyon at West Mancos R.	0.7278	336	0	0	1.471	32	2.7	4.2	0	0.6217	0	0
5053154 (STREAM)	West Mancos blw Crystal Creek	0.9207	496	21	0	1.494	43	4.3	6.8	0	0.6377	0	0
5053153 (STREAM)	West Mancos blw SF and NF confluence	1.307	413	0	0	1.688	43	4.6	7.7	0	0.7996	0	0
5053152 (STREAM)	South Fork West Mancos River	0.7938	325	0	0	1.049	47	2.7	5.4	0	0.4149	0	0
5053151 (STREAM)	North Fork West Mancos River	1.132	409	21	0	1.86	40	3.2	5.8	0	0.6674	0	0

Table NUREsediment. Streambed sediment chemistry of Mancos River samples collected by the NURE program (National Uranium Resource Evaluation) -- Continued.

SiteNo	Description	Thorium, mg/kg (ppm)	Tin, mg/kg (ppm)	Titanium, mg/kg (ppm)	Tungsten, mg/kg (ppm)	Uranium, mg/kg (ppm)	Vanadium, mg/kg (ppm)	Ytterbium, mg/kg (ppm)	Zinc, mg/kg (ppm)
5053315 (STREAM)	Mancos River blw Navajo Wash	12.8	0	5505	0	4.2	95	0	226
5052939 (STREAM)	Mancos River abv Lewis Creek	7.7	0	2711	0	2.6	41	1.7	75
5052936 (STREAM)	Weber Creek	9.8	0	2822	0	3.4	52	2.9	0
5052937 (STREAM)	Mancos River abv Weber Creek	6.2	0	2358	0	3.2	57	0	82
5053046 (STREAM)	Mud Creek	9.3	0	2569	0	3.3	67	0	0
5053047 (STREAM)	Mancos River abv Mud Creek	6	0	2511	0	3.6	87	0	81
5053045 (STREAM)	Mancos River nr G Road	8.4	0	3621	0	3.6	78	3.1	53
5053044 (STREAM)	Chicken Creek	11.8	0	3789	0	4.3	88	0	0
5053043 (STREAM)	Mancos River in Mancos	5.9	0	2504	0	3	56	2	0
5053020 (STREAM)	East Mancos abv West Mancos	6.9	0	2470	0	3.1	59	2.6	57
5053029 (STREAM)	East Mancos abv Middle Mancos	3.9	0	1726	0	1.7	33	1.8	60
5053028 (STREAM)	Middle Mancos River	10.5	0	3466	15	4.2	76	2.9	0
5053026 (STREAM)	Spring nr East Mancos River nr USFS Boundary	9.6	0	3701	0	3.8	55	2.8	83
5053027 (STREAM)	Spring nr East Mancos River abv Red Arrow	5.8	0	2676	0	2.5	38	2.4	0
5053030 (STREAM)	West Mancos nr Jackson Ditch Rd	8.2	0	2453	0	3	58	2.4	0
5053156 (STREAM)	West Mancos at Jackson Gulch Diversion	8.5	0	3378	15	2.9	83	0	0
5053155 (STREAM)	Box Canyon at West Mancos R.	5.7	0	3114	0	3.3	55	2.2	0
5053154 (STREAM)	West Mancos blw Crystal Creek	10.2	0	3402	0	4.1	90	3.7	128
5053153 (STREAM)	West Mancos blw SF and NF confluence	11.3	0	4160	0	4	104	3.6	0
5053152 (STREAM)	South Fork West Mancos River	9.6	0	3553	0	3.6	42	0	83
5053151 (STREAM)	North Fork West Mancos River	8.1	0	3011	0	4.5	99	2.5	116

Appendix M. METHODS OF INVESTIGATION FOR THE MANCOS METALS MOBILIZATION AND AQUATIC TOXICITY REPORT

Table M1. Laboratory parameter list for analysis of water and waste-rock leachate samples

Parameter	Method
Water Samples	
Aluminum 200.2 by ICP	EPA 200.7
Aluminum Dissolved by ICP	EPA 200.7
Aluminum, Bioavailable by ICPMS	EPA 200.8
Arsenic 200.2 by ICPMS	EPA 200.8
Arsenic Dissolved by ICPMS	EPA 200.8
Cadmium 200.2 by ICPMS	EPA 200.8
Cadmium Dissolved by ICPMS	EPA 200.8
Copper 200.2 by ICPMS	EPA 200.8
Copper Dissolved by ICPMS	EPA 200.8
Dissolved Organic Carbon	5310C
Fluoride by IC	EPA 300.0
Iron 200.2 by ICP	EPA 200.7
Iron Dissolved by ICP	EPA 200.7
Lead 200.2 by ICPMS	EPA 200.8
Lead Dissolved by ICPMS	EPA 200.8
Manganese 200.2 by ICPMS	EPA 200.8
Manganese Dissolved by ICPMS	EPA 200.8
Metals Digestion	USGS In-Bottle Digestion Method
Molybdenum 200.2 by ICPMS	EPA 200.8
Molybdenum Dissolved by ICPMS	EPA 200.8
Nickel 200.2 by ICPMS	EPA 200.8
Nickel Dissolved by ICPMS	EPA 200.8
Nitrate/Nitrite by IC Package	varies
Phosphate as P Total by Lachat	EPA 365.1
Selenium 200.2 by ICPMS	EPA 200.8
Selenium Dissolved by ICPMS	EPA 200.8
Silica Dissolved by ICP, SiO2	calc, 200.7
Total Dissolved Solids	calc, ROE
Total Kjeldahl Nitrogen [TKN]	EPA 351.2
Uranium 200.2 by ICPMS	EPA 200.8
Uranium Dissolved by ICPMS	EPA 200.8
Zinc 200.2 by ICPMS	EPA 200.8
Zinc Dissolved by ICPMS	EPA 200.8

Table M2. Water-quality field parameters and detection limits

Parameter	Method	Reporting units	Minimum reporting limit	Precision, in RSD
Date, time	--	mm/dd/yyyy, 24 hr	--	--
Stream stage	--	ft	0	±10 percent
Discharge, instantaneous	Flow anemometer (pygmy or AA meter), or flow sensor (Hach FS950)	cubic feet per second (ft^3/s)	0.001 ft^3/s	±10 percent
Specific conductance	Field electro-metric meter	microsiemens per centimeter (µS/cm)	10 µS/cm	±10 percent
pH	Double-junction electrometric probe	Standard Units	1.68	± 0.05 pH units
Water temperature	Digital thermometer	°C	-10 °C	±1 percent
Dissolved oxygen	Field meter, gold cathode probe	milligrams per liter (mg/L)	0 mg/L	±1 percent
Alkalinity, as $CaCO_3$	Incremental breakpoint titration	mg/L as $CaCO_3$	0.5 mg/L as $CaCO_3$	±5 percent
Turbidity	Field spectrophotometer	Formazin Absorption Units	1 FAU	±5 percent

Appendix S. STREAMFLOW DISCHARGE DATA AND GAGES IN THE MANCOS RIVER WATERSHED

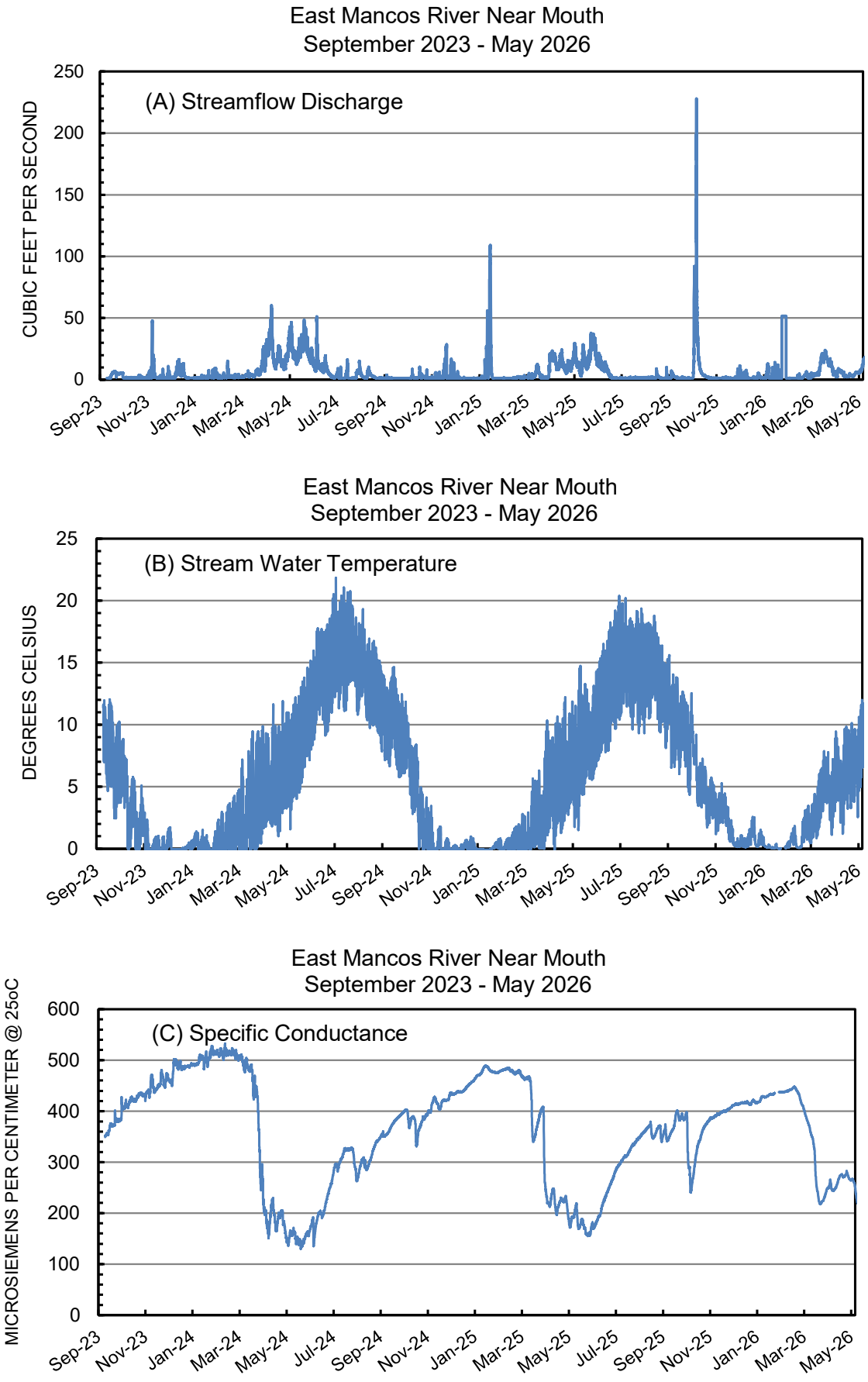


Figure S2. Streamflow gaging station East Mancos River Near Mouth: Streamflow discharge, stream water temperature, and specific conductance during September 2023 through May 2026.

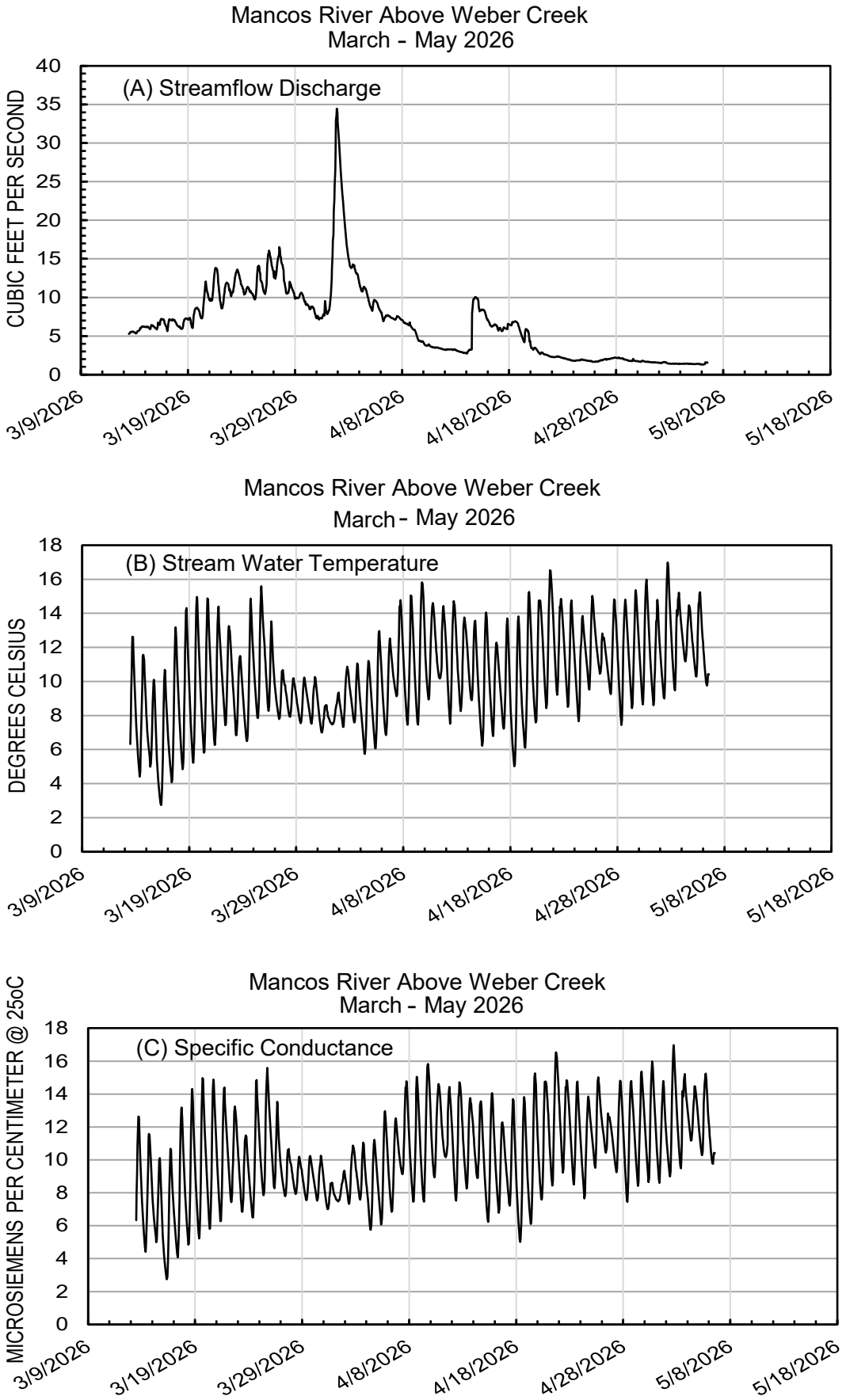


Figure S3. Streamflow gaging station Mancos River Above Weber Creek: Streamflow discharge, stream water temperature, and specific conductance during September 2023 through May 2026.

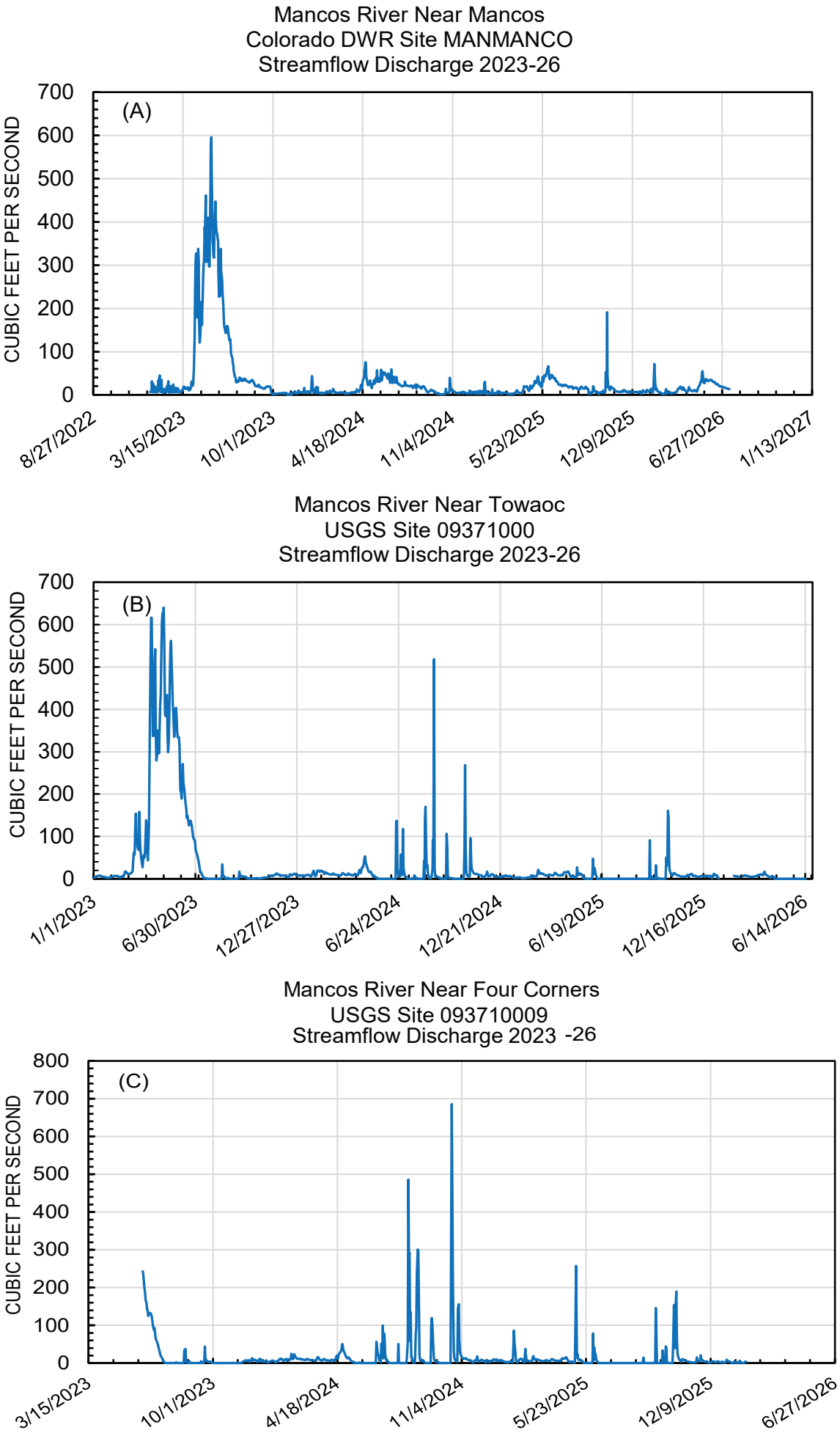


Figure S4. Streamflow discharge hydrographs for Mancos River near Mancos, Mancos River near Towaoc, and Mancos River near Four Corners.

Appendix TM. THUNDER MINE WIIN ACT CLOSEOUT REPORT

Thunder WIIN Act Closeout Report
CT PKAA 2025*0585
CMS 193594

Introduction

This closeout report covers the Thunder WIIN Act Mine Waste Reclamation Project (2024), funded through EPA's Water Infrastructure Improvements for the Nation Act. The Thunder Mine is located on United States Forest Service system lands.

Location

The Thunder Mine is located in the East Mancos River watershed, 10 miles from the town of Mancos in Montezuma County, Colorado. The mine is located solely on USFS administered lands roughly halfway up the East Mancos River watershed from the confluence. The mine is located in Township 26 North, Range 12 West, Section 12 on USGS's Rampart Hills 7.5' Quadrangle at latitude 37.397140 degrees and longitude –108.127899 degrees. The site is located in the La Plata Mountains in the East Mancos River Mining District at an elevation of 10,600 feet above mean sea level and occupies approximately 5 acres.

From Mancos, access to the site is via Highway 160. Follow Highway 160 east for approximately 2.3 miles to the Echo Basin Road (Road 44) turn off to the North. Take Echo Basin Road for slightly less than a mile and turn onto the Red Arrow Mine Road (Road L) to the east. Follow Road L for approximately 4 miles until a fork in the road, stay on the southern fork on the Red Arrow Mine Road. In another 1.9 miles there will be another fork in the road, stay on the southern fork and on the Red Arrow Mine Road. From the last fork in the road, stay on the main Red Arrow Mine Road for another approximately 2 miles to the Thunder access road turn off. When the mine drainage in the ephemeral drainage is visibly staining the road and the drainage above and below the road a rusty orange color, then you have reached the site.

The nearest population center to the site is Mancos, Colorado (approximately 10 miles to the west/southwest of the site). The immediate area surrounding the site is not populated and consists of USFS administered lands. The closest residential properties are located at least 2 miles away near Schubert Flats where there is a summer cabin. Year-round residences are located at least 5 miles away.

Background

Sampling and analytical results from the (Wright et al., 2020). reports identified the Thunder Mine as the highest priority site for remediation of contaminants of concern out of 31 mine waste rock piles analyzed in the East Mancos Watershed. The mine waste pile was the highest priority in the watershed due to acidity (4th), pH (3rd), arsenic (1st), copper (1st), lead (1st), mercury (1st), cadmium(6th), and zinc (2nd). In addition to the chemical characteristics of the waste rock pile, the waste rock pile sat in an ephemeral drainage with an apparent groundwater seep at the toe of the waste rock, and the mine drainage pooled and flowed through the waste rock pile on all sides. The vegetation kill zone (an area devoid of vegetation) below the waste rock pile extends from the toe of the waste rock all the way to the East Mancos River 1,500 below the site with an approximate 10 foot wide swath of no vegetation.

Funding

The Thunder WIIN Act mine waste reclamation project is part of a larger grant to collect baseline data on the East and West Mancos Rivers all the way from the headwaters to south of Mancos and onto Ute Mountain Ute tribal lands. Because of the connection to tribal lands and the Mancos River, the Ute Mountain Ute (UMU) Tribe is the project sponsor and EPA WIIN Act grant recipient. UMU then contracted with MSI and CODRMS to complete the grant tasks associated with sampling the rivers and completing the reclamation project. MSI and CODRMS set up separate agreements with UMU to complete the work tasks under the grant.

The Thunder UMU/CODRMS agreement was set up for $456,000.00

CODRMS committed $40,000.00 in cash match to the grant as a whole and spent the entire $40,000.00 cash match on the Thunder reclamation project construction costs in 2024.

The remainder of the Thunder reclamation costs were paid out in the UMU/CODRMS agreement to utilize the WIIN Act funds.

There remains approximately $350,000.00 in the Thunder WIIN Act UMU/CODRMS agreement because construction costs came in lower than expected. The remainder of the funding is being considered for maintenance and operation of the Thunder mine waste project if needed in 2025 and other East and West Mancos wide sampling and projects as agreed upon by EPA, UMU, CODRMS, and MSI in upcoming planning meetings.

Construction Costs	
Total Construction Costs =	$131,624.50
CODRMS Cash Match =	$40,000.00
UMU Agreement Costs =	$91,624.50

Construction

The Thunder WIIN Act Project Notice to Proceed was issued on September 23, 2024 to Ryno Construction LTD and construction was completed by October 8, 2024.

The construction work consisted of the following work tasks:

1. Mobilizing and Demobilizing
2. Safety and Health Plan
3. Site Access Improvements
4. Stormwater Controls
5. Mine Waste Consolidation
6. Cover Material
7. Drainage Channel
8. Revegetation
9. Boulders

The scope of work was to remove waste rock from the ephemeral channel to reduce mobilization of metals and provide a stable conduit for natural runoff that does not contact waste rock. Waste rock was

relocated to an area west (on-site) of the current waste rock pile and ephemeral drainage path. Waste rock was completely excavated out of the ephemeral channel, utilizing the x-ray fluorescence meter as a guide, keeping lead levels below 2,000 parts per million. The relocated and consolidated mine waste was covered with clean cover talus and scree harvested from west side of the site.

A drainage channel to convey acid mine drainage from the collapsed Thunder portal was constructed within the existing portal access road prism. This drainage channel is approximately 1,000 feet in length. The drainage channel was constructed such that all terrain vehicles are not able to access the portal area. The drainage channel empties onto the main road into Rush Basin and immediately drains off the road into an unnamed ephemeral drainage that cuts through the red Dolores formation that has higher buffering capacity for the acid mine water.

Restoration activities following waste rock removal included revegetation of ¾ of an acre. Boulders were placed at the bottom end of the mine drainage channel at the main road intersection to prevent traffic up to the Thunder portal and reclamation area.

Change Order

One change order was issued during construction for the following change in work tasks:

Change Order Items:
(3) Site Access Improvements to the Red Arrow Road were increased due to rough road conditions for an additional $7,000.00
(6) An additional 1,000 cubic yards of cover material was utilized to cover the consolidated waste rock for an additional $8,500.00
(8) The revegetation area was decreased by 1 and ¼ acres due to talus cover areas not needing revegetation for a reduction in costs of $7,312.50
(10) Additional limestone amendment was eliminated from the scope of work for a reduction in costs of $1,000.00.
Total Change Order = $7,187.50

Project Details

Project Manager:	Kirstin Brown
Contract Number:	PO PKAA 2025*0585
CMS Number:	193594
Successful Bid Amount:	$124,437.00
Notice to Proceed Date	09/23/24
Construction Completion Date	10/08/2024
Change Order(s)	(1) Change Order for $7,187.50
Contractor: Address: Phone:	Ryno Construction - Ryan Crocker 3081 Bookcliff Avenue Grand Junction, CO 81504 (970) 712-1644
Final TOTAL PROJECT Cost:	$131,624.50

Operation, Maintenance, and Monitoring

The Thunder mine waste reclamation project will be monitored and water sampled for the next three years under the WIIN Act funding by MSI and CODRMS. In May of 2025, CODRMS will inspect the reclamation site for any maintenance needs after the first winter. Additional work may be designed and agreed upon by partners in early 2025 with the additional remaining funds.

Kristin L Brown

Project Manager

1/10/25

Date

Tara Tafi

Senior Project Manager

1/10/2025

Date



N
W E
S

Thunder Pre-Existing Site Conditions

- Talus Cover Borrow Area
- Thunder Waste Rock Pre Reclamation
- Portal
- Thunder AMD Drainage Pre Reclamation
- Ephemeral Drainage Pre Reclamation
- Roads

COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

0 62.5 125 250 375 500 Feet

Map Created by Kirstin Brown for the Thunder Closeout Report 2/5/25



Map Created by Kirstin Brown for the Thunder Closeout Report 2/5/25

Thunder As-Built Map

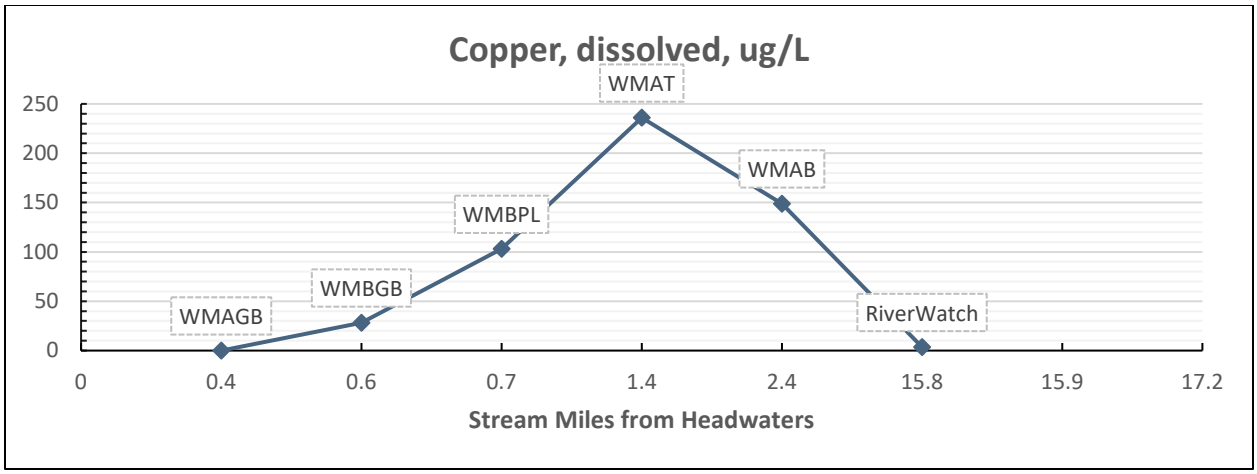
COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

0 62.5 125 250 375 500 Feet

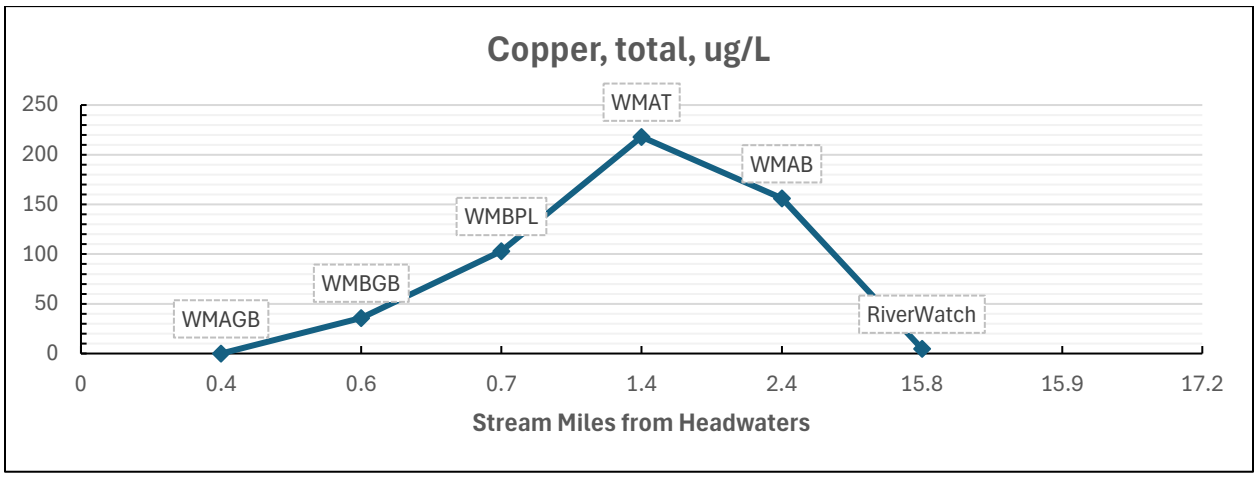
Legend

- Portal
- Thunder AMD Path Post Reclamation
- Roads
- Ephemeral Drainage Post Reclamation Final
- Talus Cover Borrow Area
- Consolidation/Cap Area

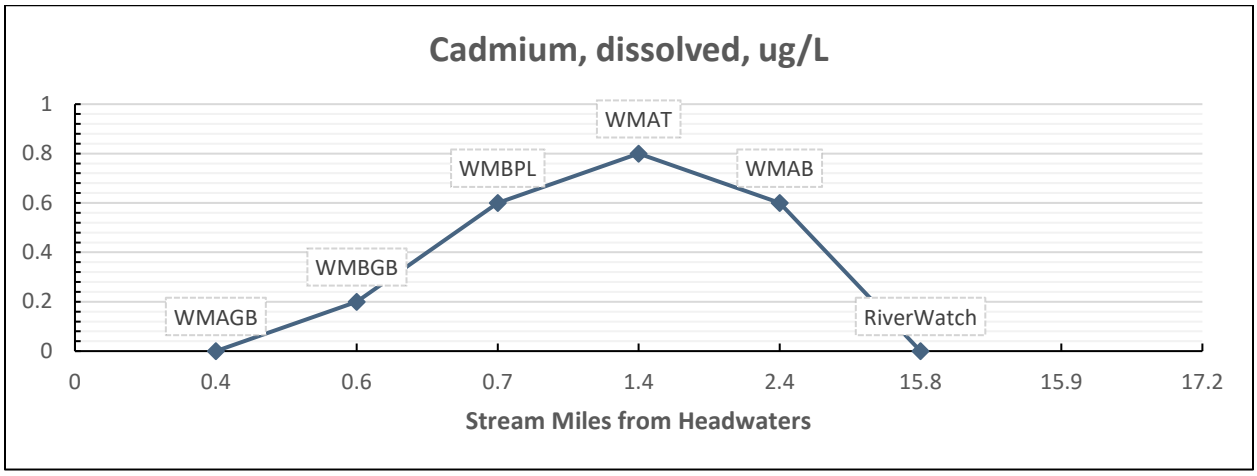
Appendix WM. WEST MANCOS WATERSHED METAL CONCENTRATIONS AND AQUATIC TOXICITY



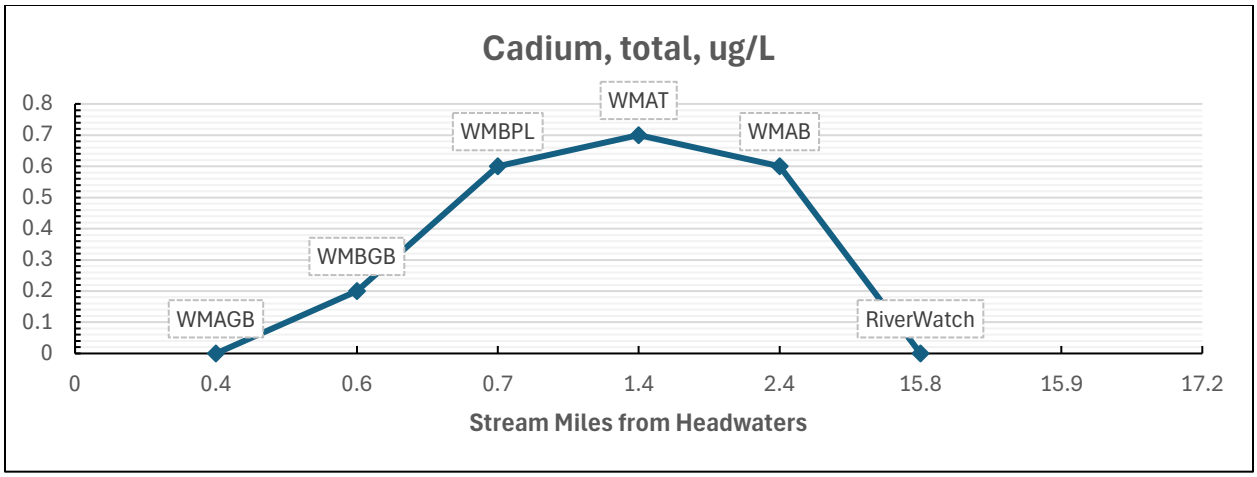
WM 1: Dissolved copper concentration between WMAGB and the River Watch site.



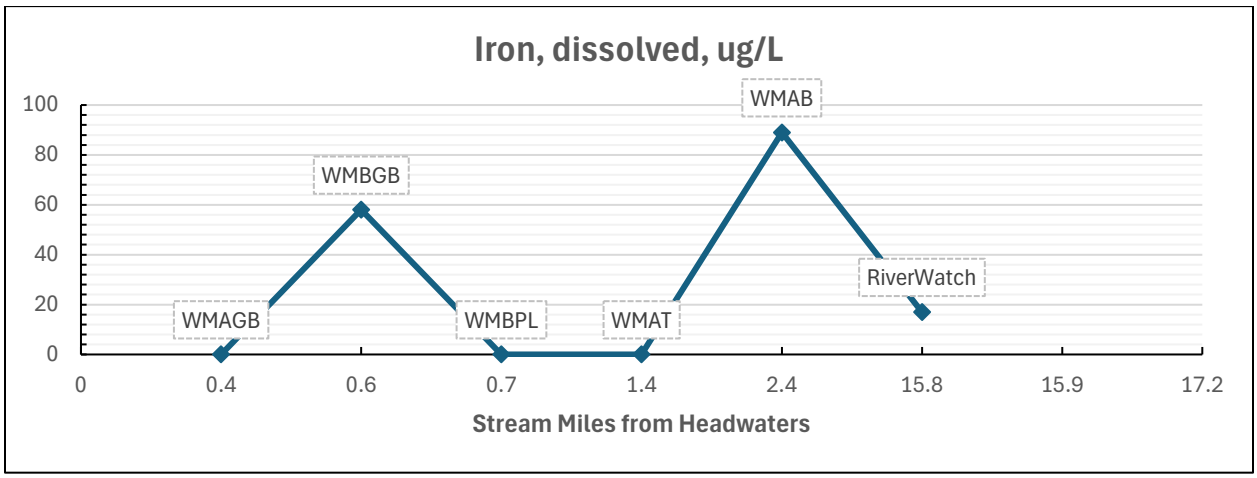
WM 2: Total copper concentration between WMAGB and the River Watch site.



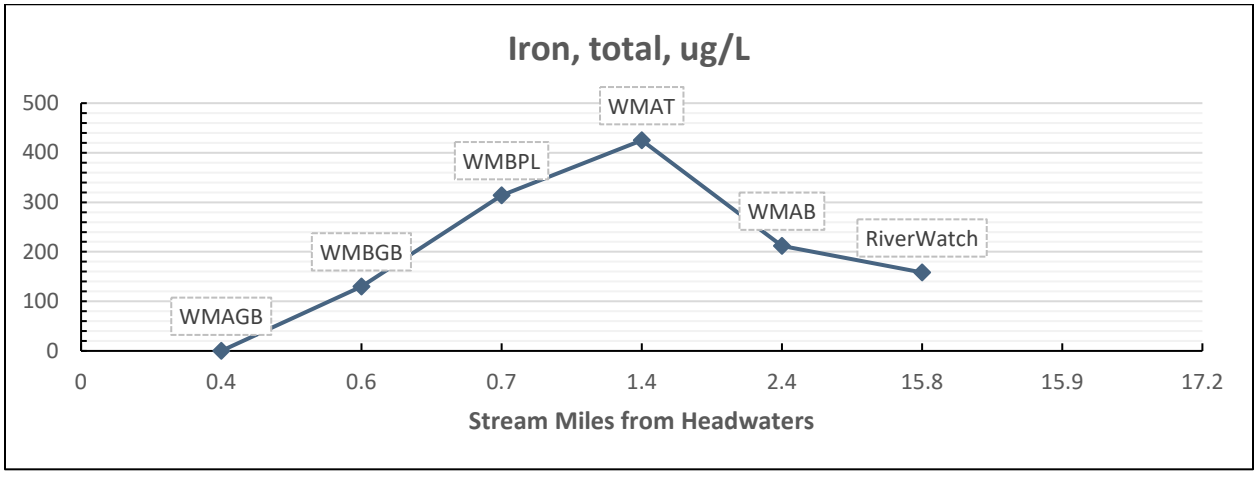
WM 3: Dissolved cadmium concentration between WMAGB and the River Watch site.



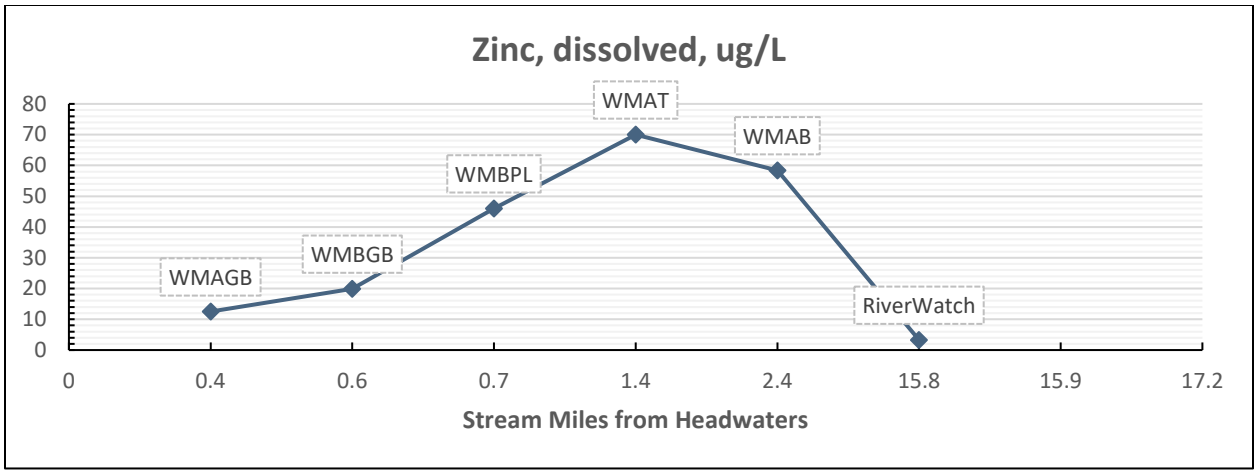
WM 4: Total cadmium concentration between WMAGB and the River Watch site.



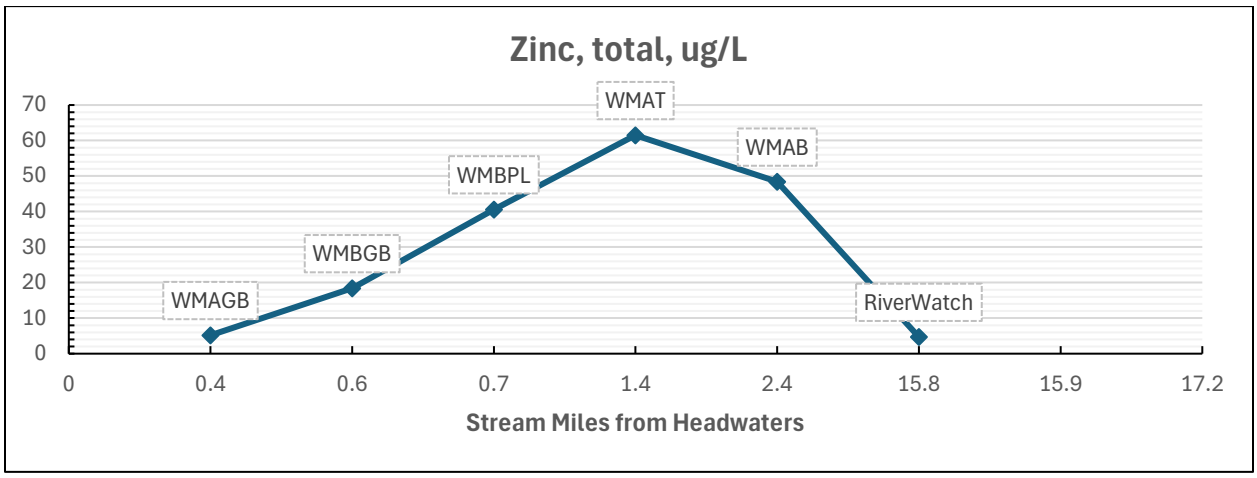
WM 5: Dissolved iron concentration between WMAGB and the River Watch site.



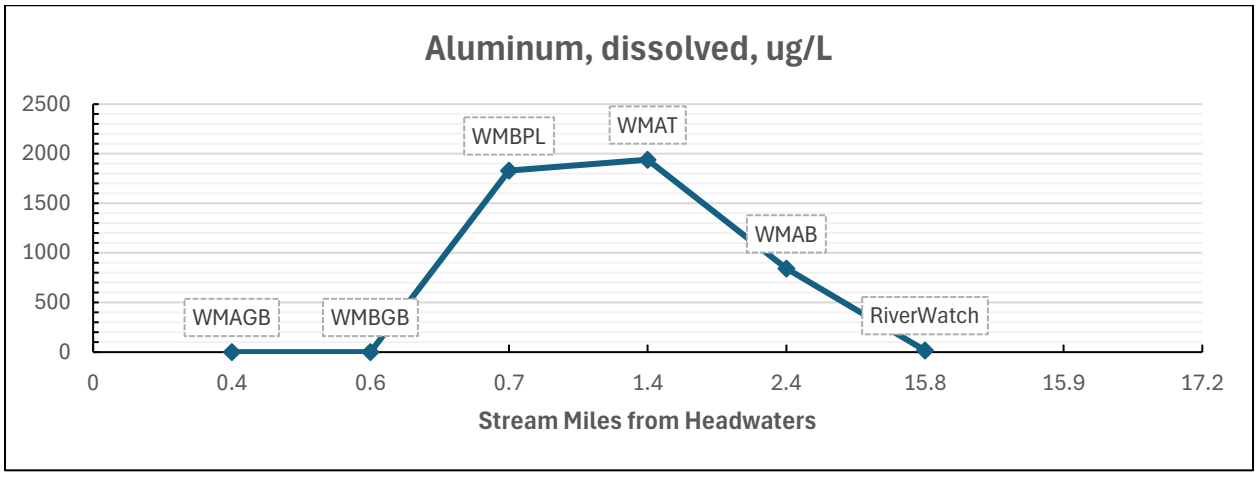
WM 6: Total iron concentration between WMAGB and the River Watch site.



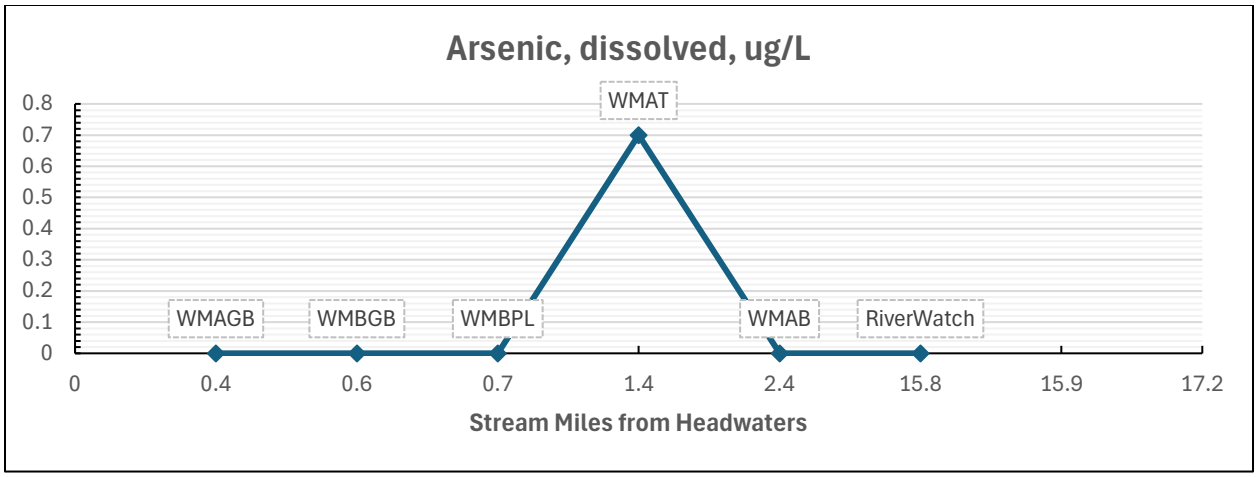
WM 7: Dissolved zinc concentration between WMAGB and the River Watch site.



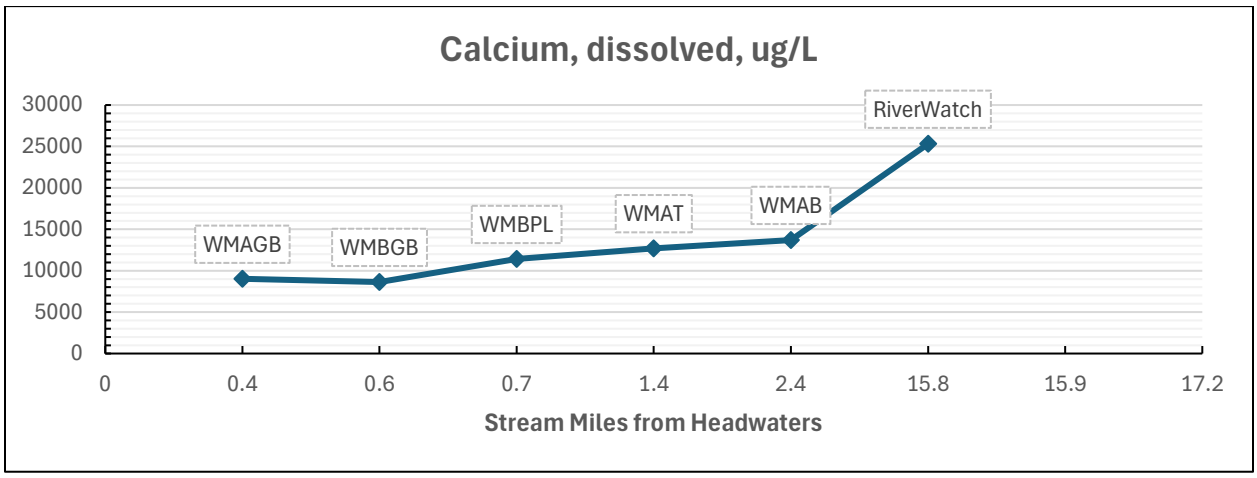
WM 8: Total zinc concentration between WMAGB and the River Watch site.



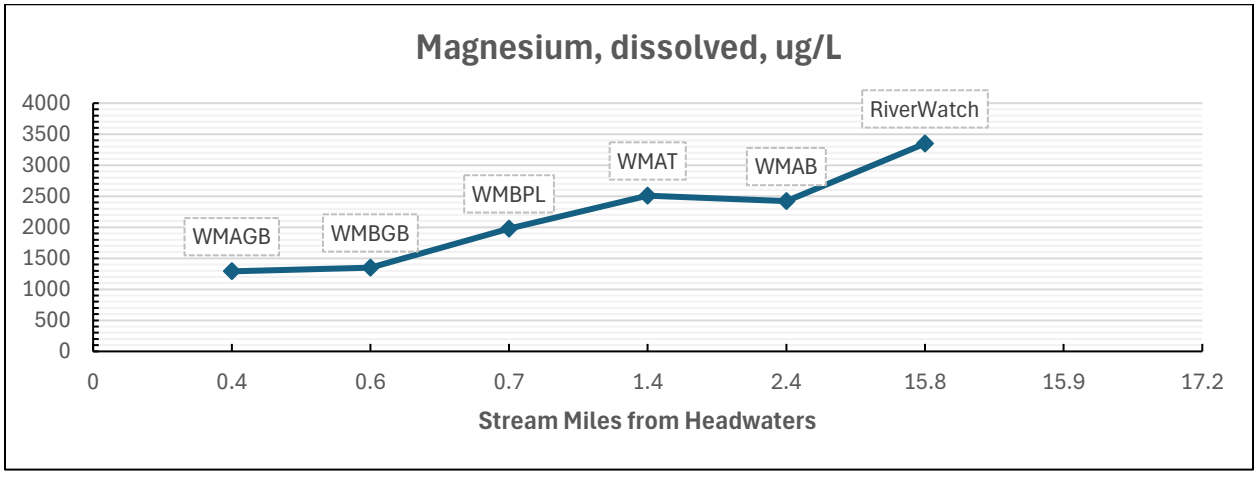
WM 9: Dissolved aluminum concentration between WMAGB and the River Watch site.



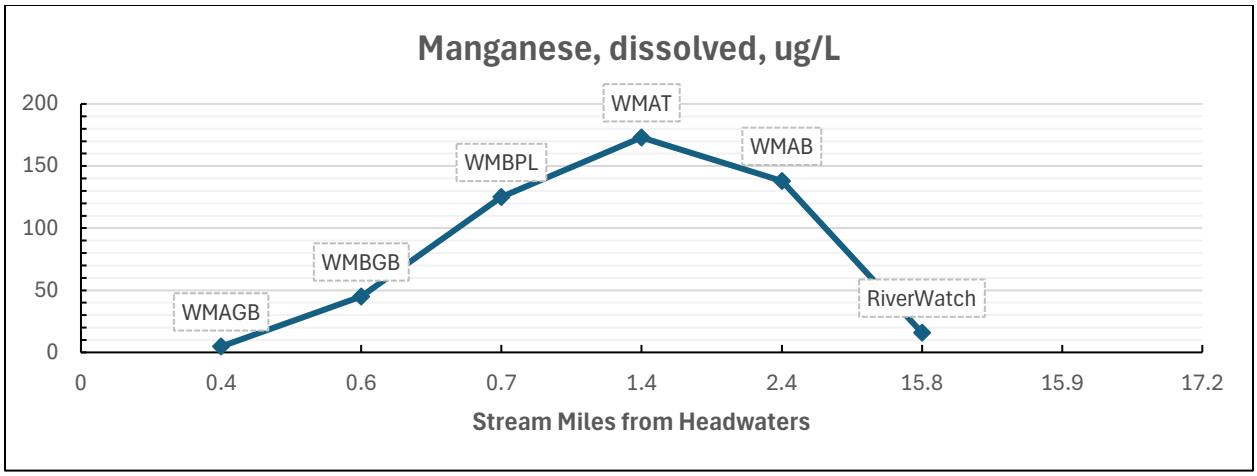
WM 10: Dissolved arsenic concentration between WMAGB and the River Watch site.



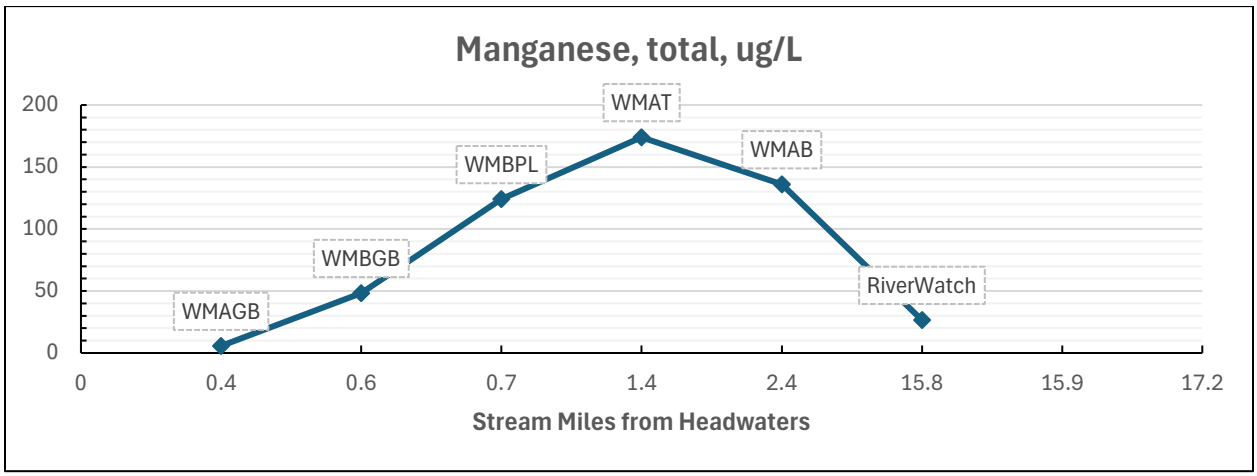
WM 11: Dissolved calcium concentration between WMAGB and the River Watch site.



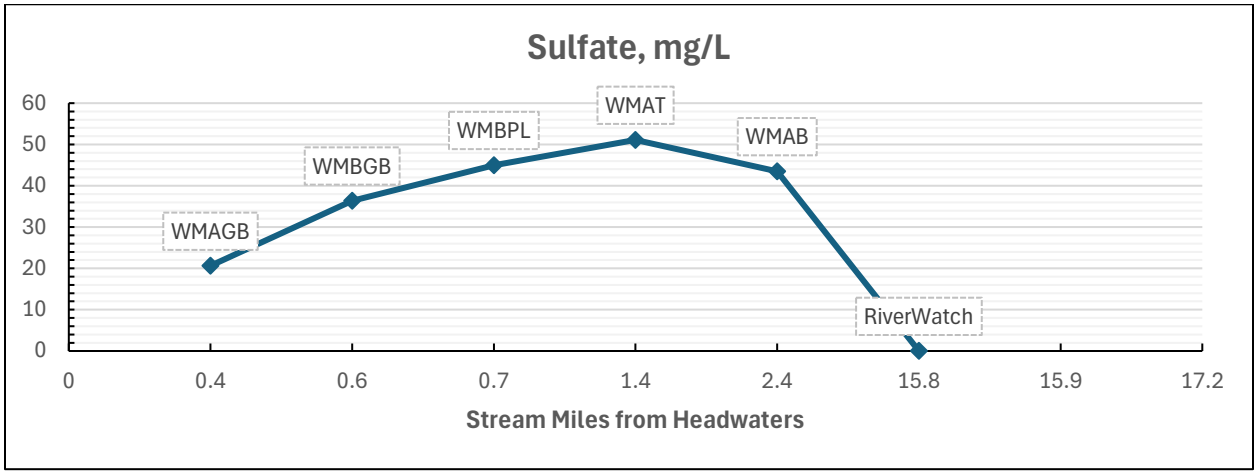
WM 12: Dissolved magnesium concentration between WMAGB and the River Watch site.



WM 13: Dissolved manganese concentration between WMAGB and the River Watch site.



WM 14: Total manganese concentration between WMAGB and the River Watch site.



WM 15: Sulfate concentration between WMAGB and the River Watch site.

Appendix HF. METAL CONCENTRATION, MASS LOADING, AND AQUEOUS GEOCHEMISTRY DURING HIGHFLOW IN THE MANCOS WATERSHED

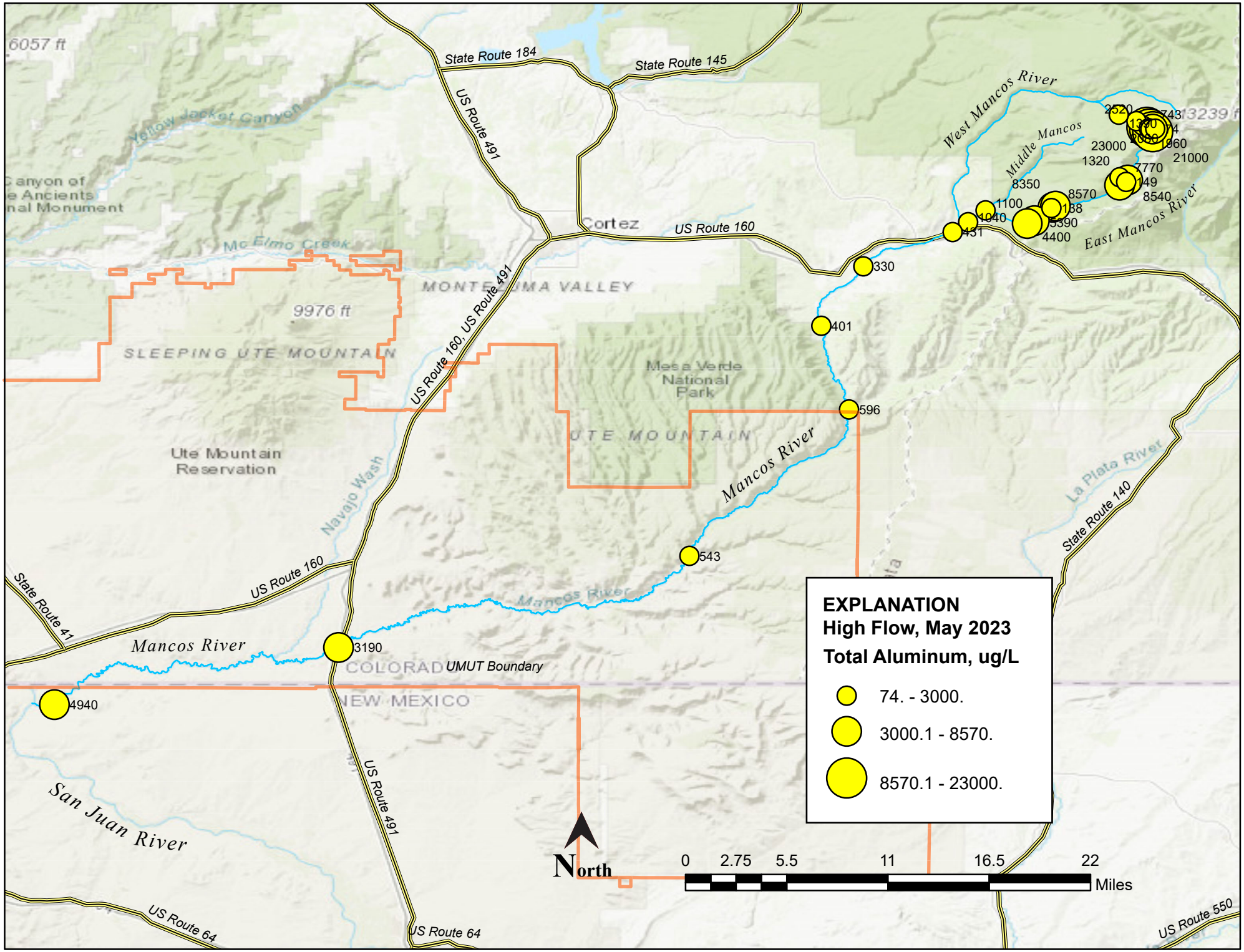


Figure HF1. Distribution of total aluminum in streams of the Mancos River Watershed, high flow May 2023.

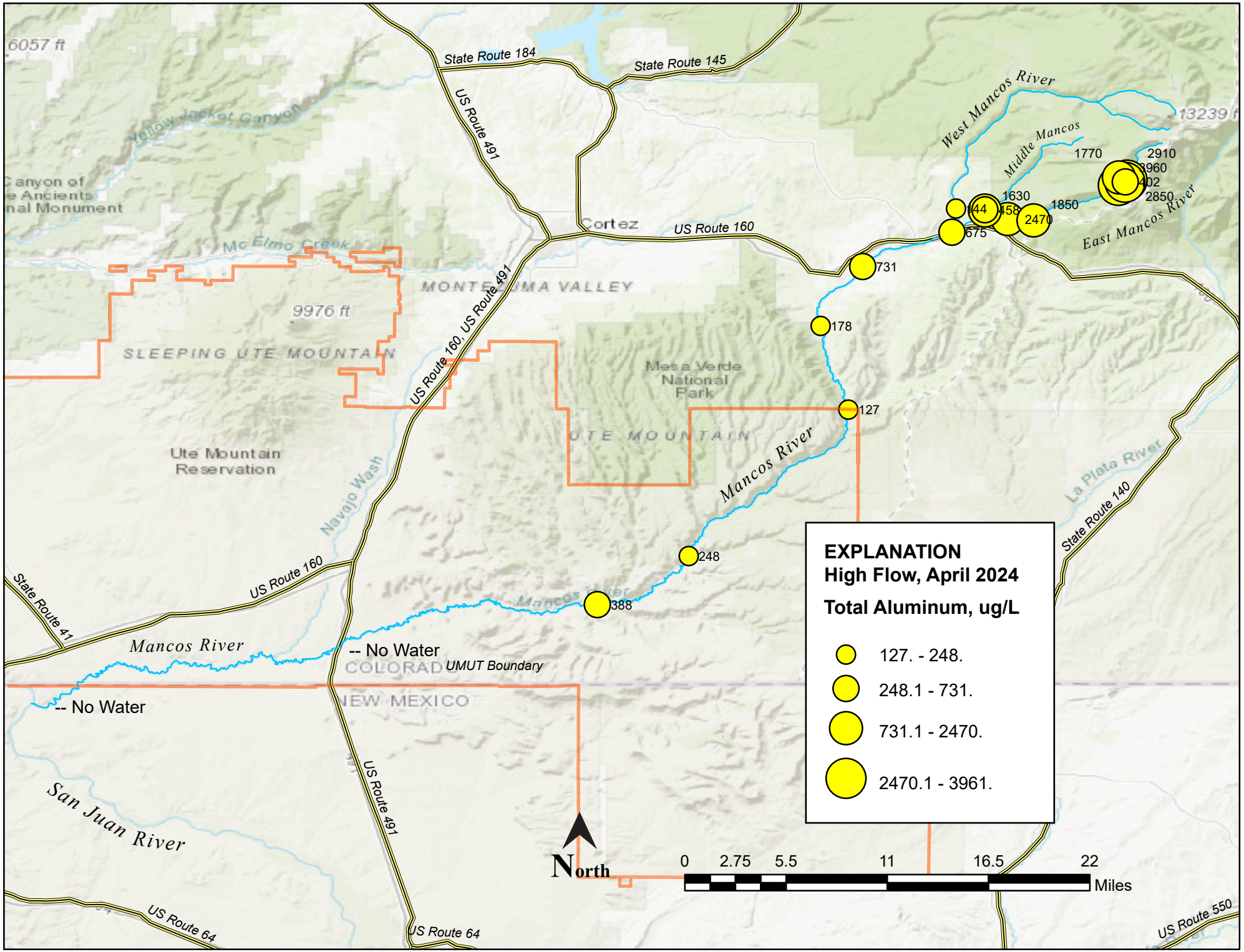


Figure HF2. Distribution of total aluminum in streams of the Mancos River Watershed, high flow April 2024.

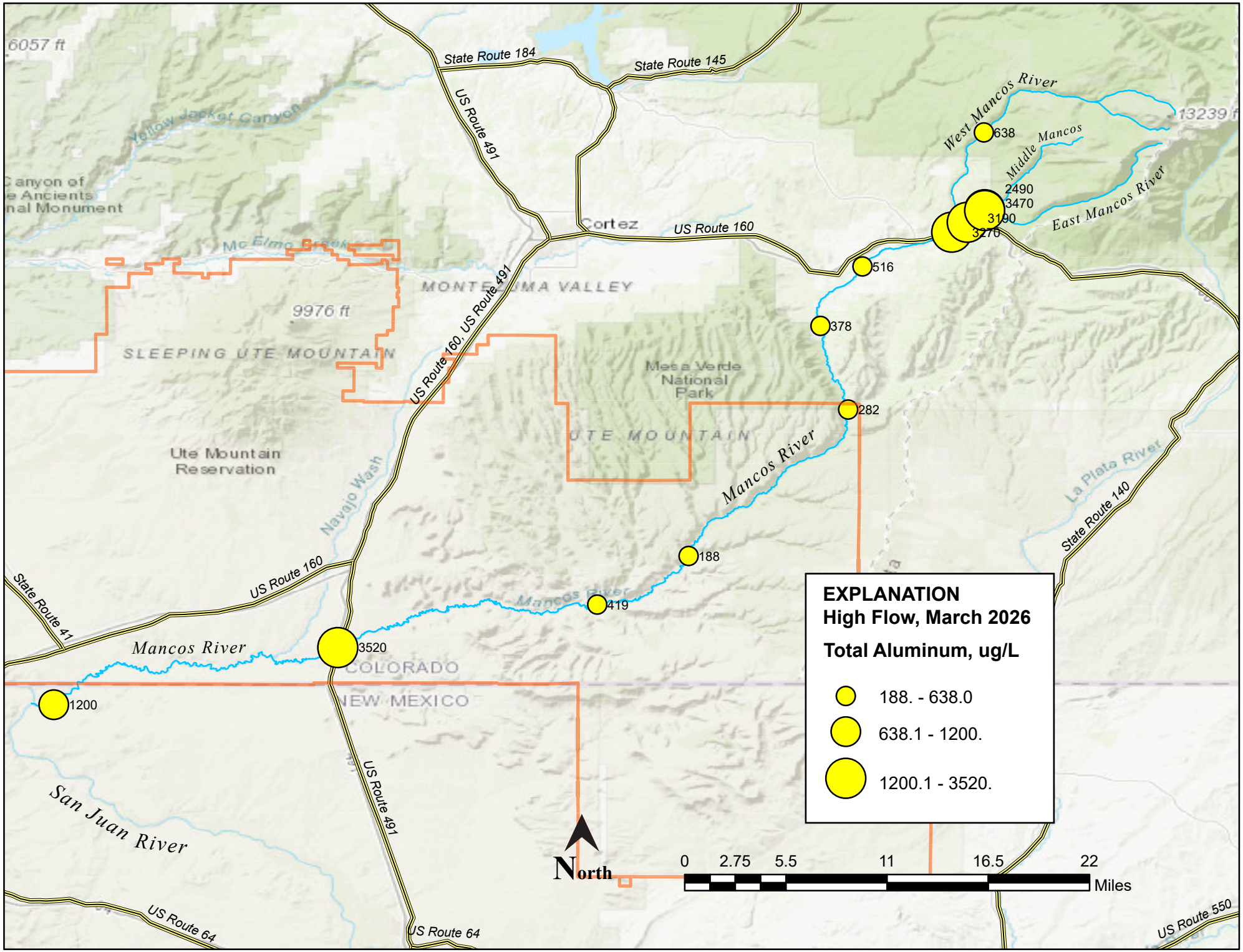


Figure HF3. Distribution of total aluminum in streams of the Mancos River Watershed, high flow March 2026.

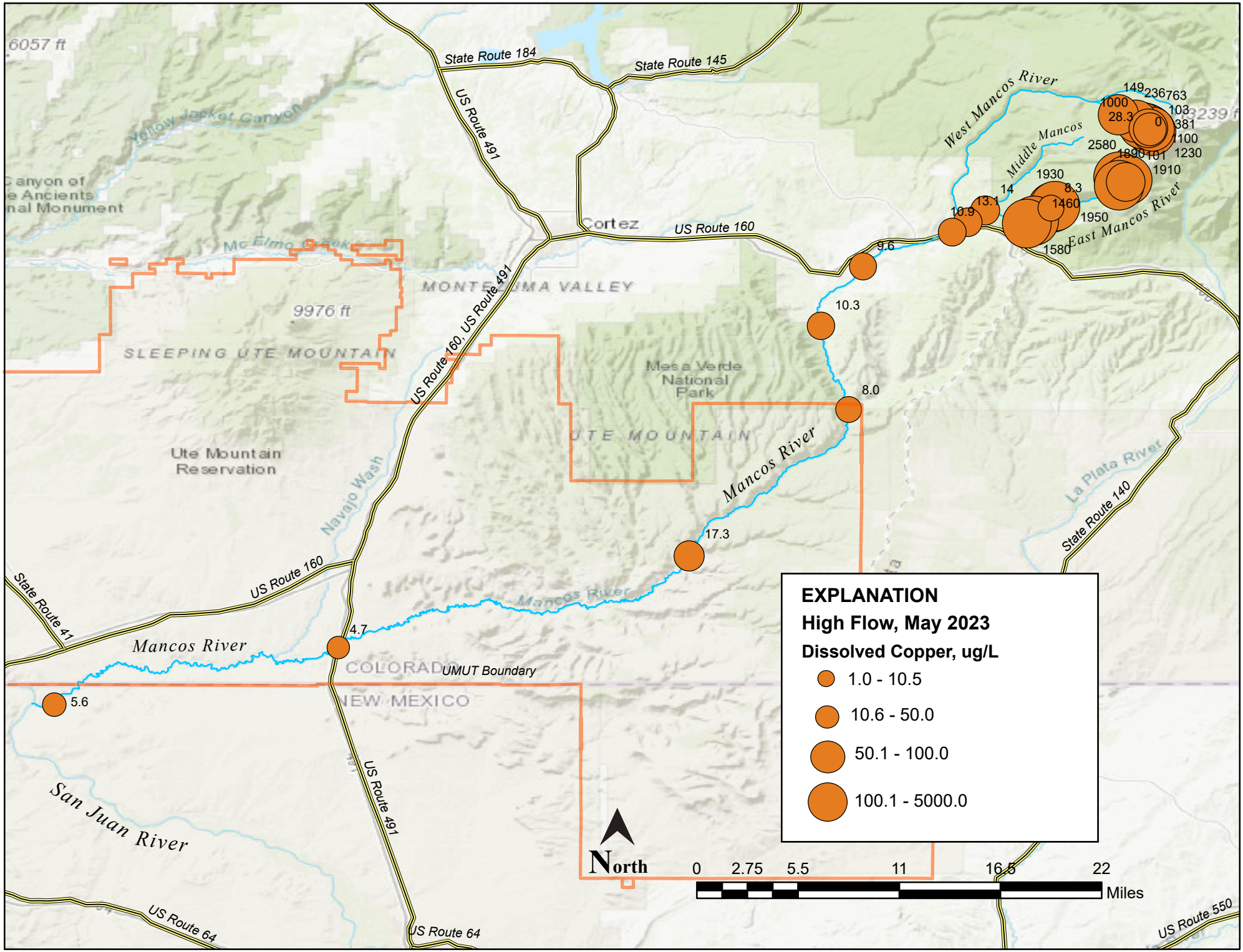


Figure HF4. Distribution of dissolved copper in streams of the Mancos River Watershed, high flow May 2023.

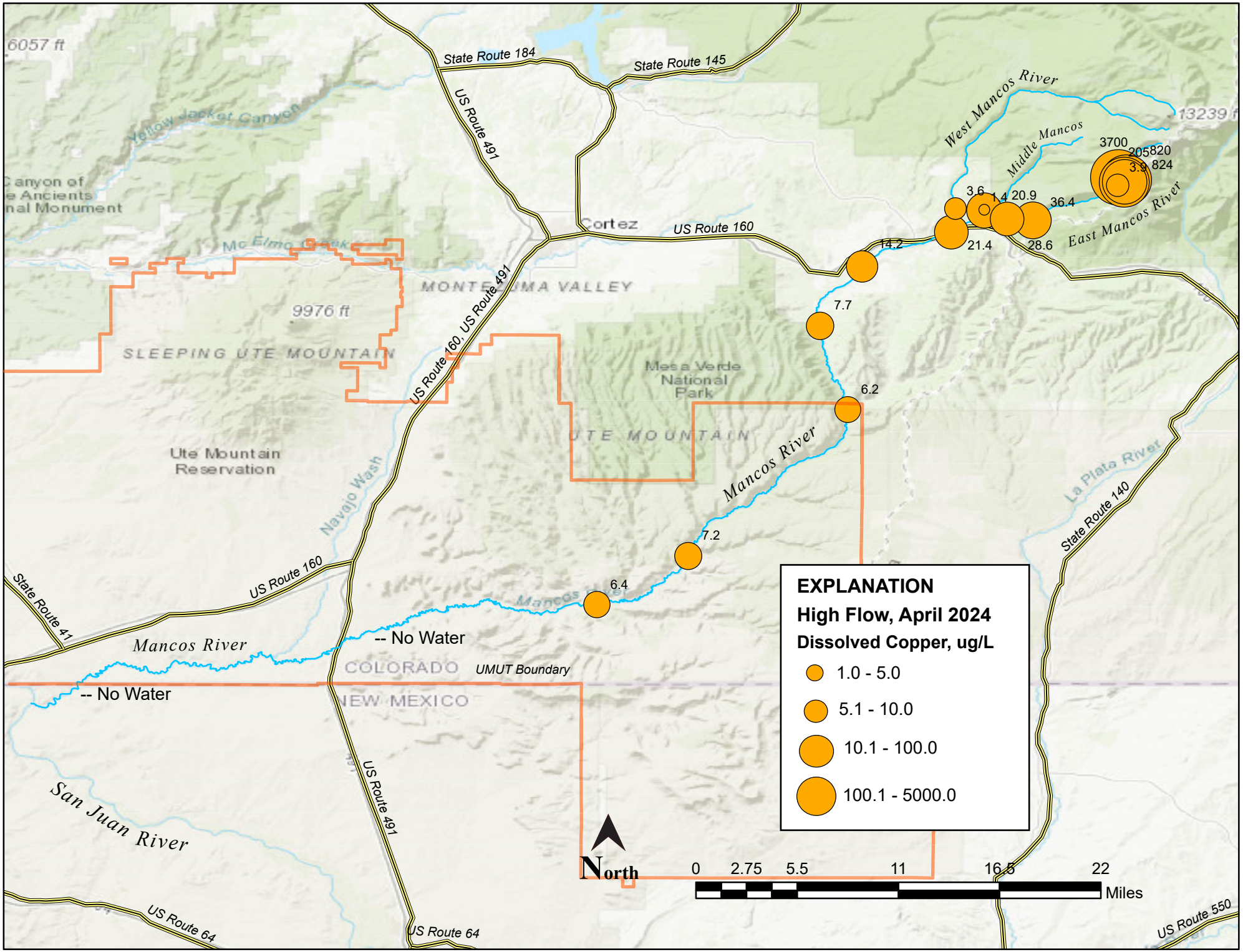


Figure HF5. Distribution of dissolved copper in streams of the Mancos River Watershed, high flow April 2024.

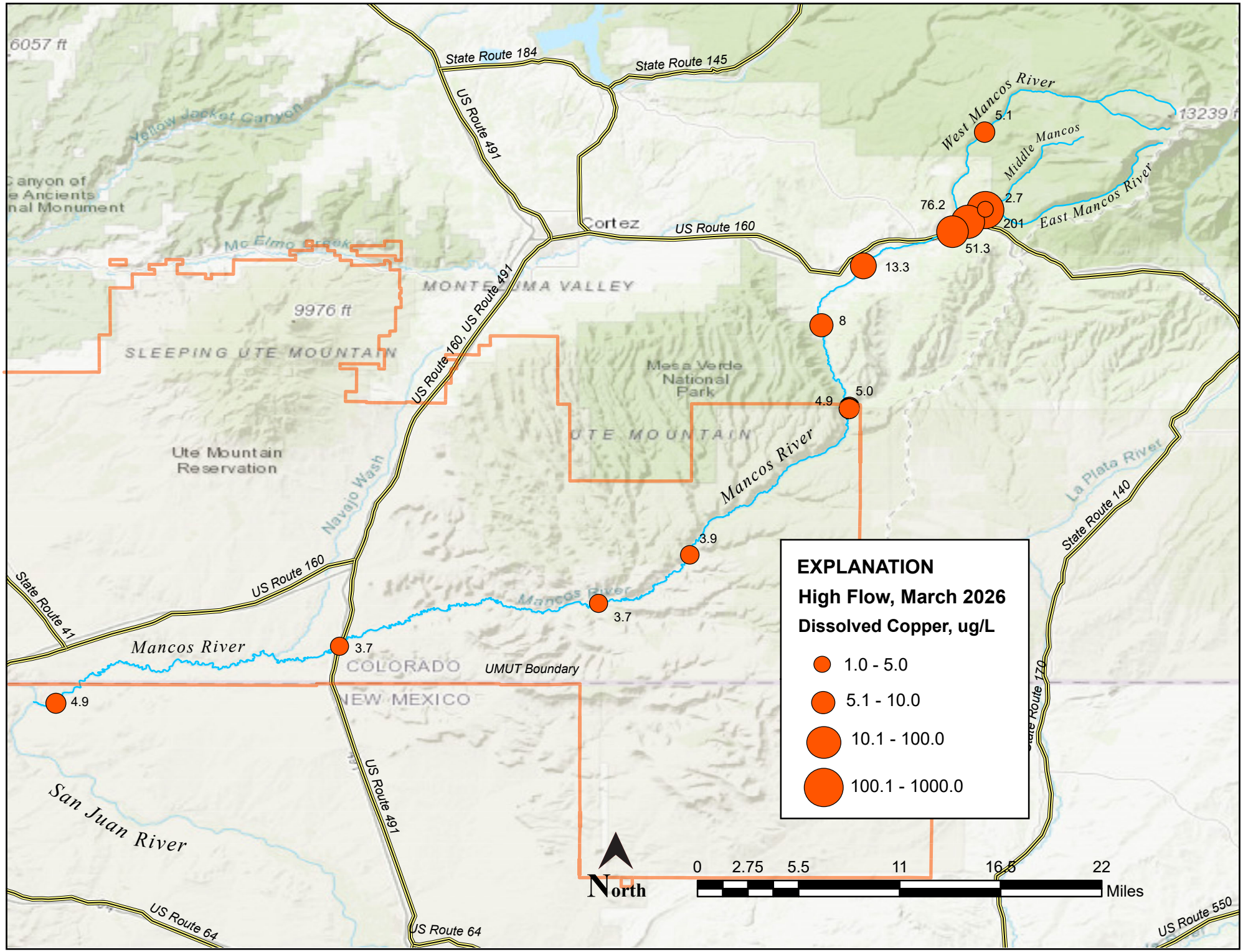


Figure HF6. Distribution of dissolved copper in streams of the Mancos River Watershed, high flow March 2026.

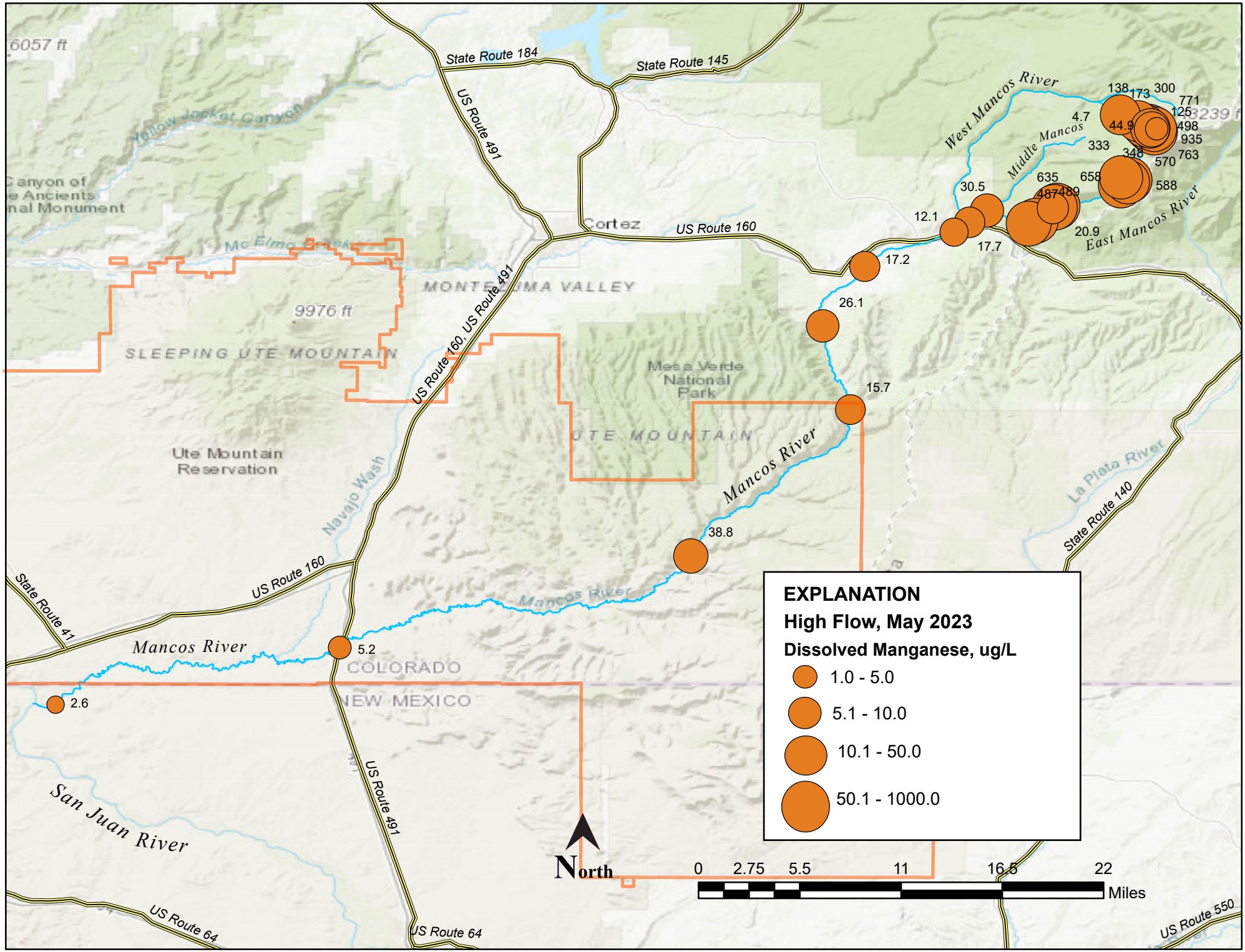


Figure HF7. Distribution of dissolved manganese in streams of the Mancos River Watershed, high flow May 2023.

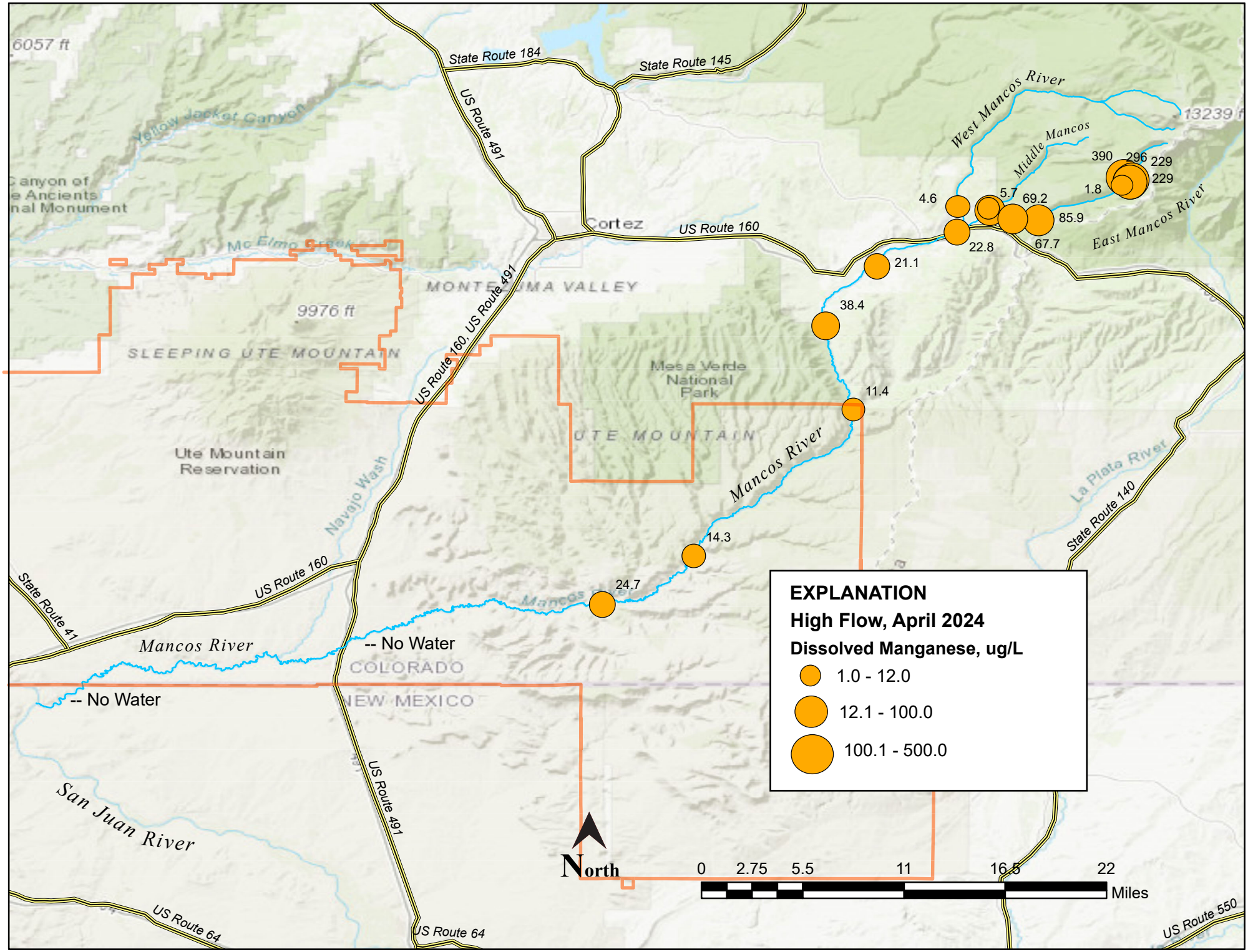


Figure HF8. Distribution of dissolved manganese in streams of the Mancos River Watershed, high flow April 2024.

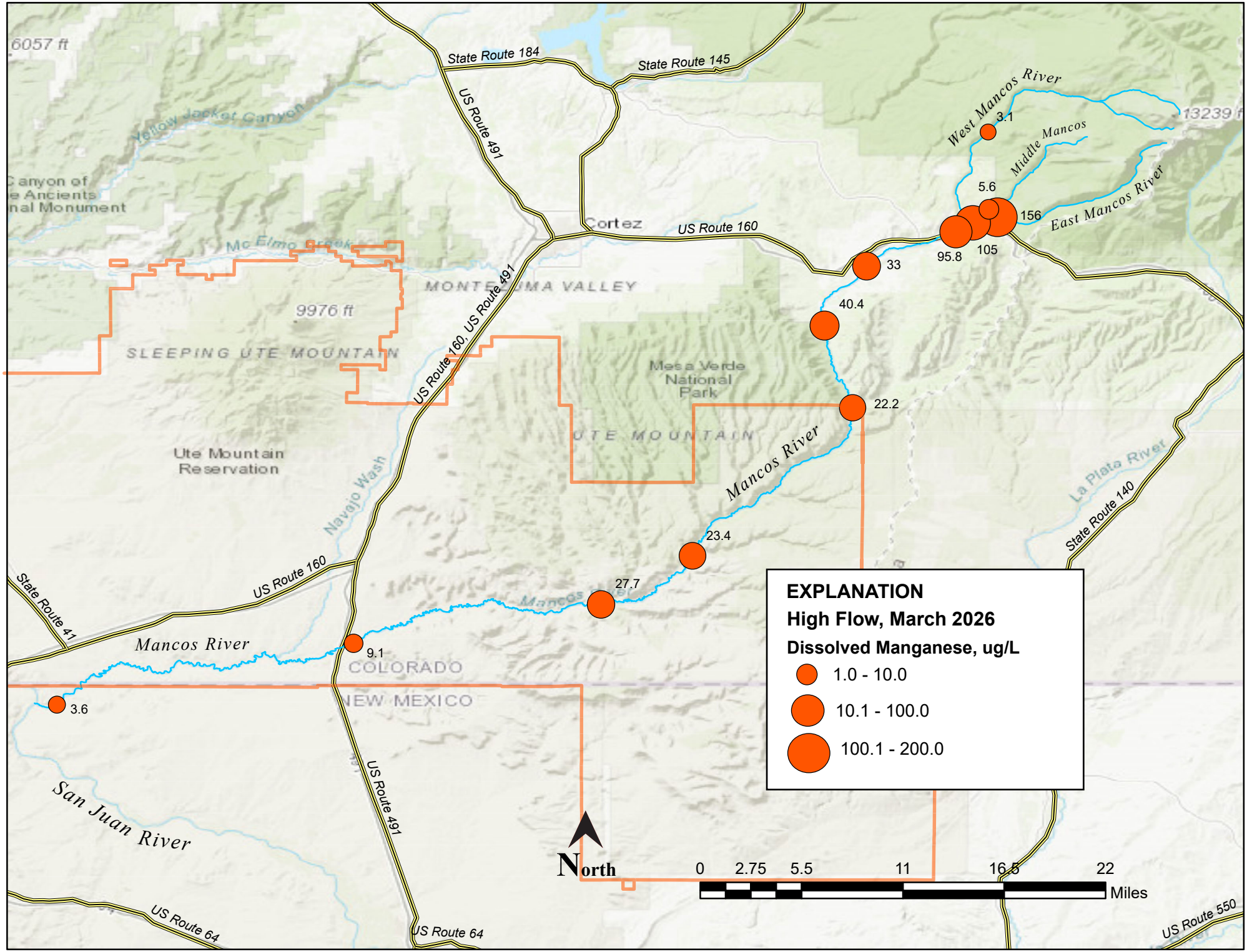


Figure HF9. Distribution of dissolved manganese in streams of the Mancos River Watershed, high flow March 2026.

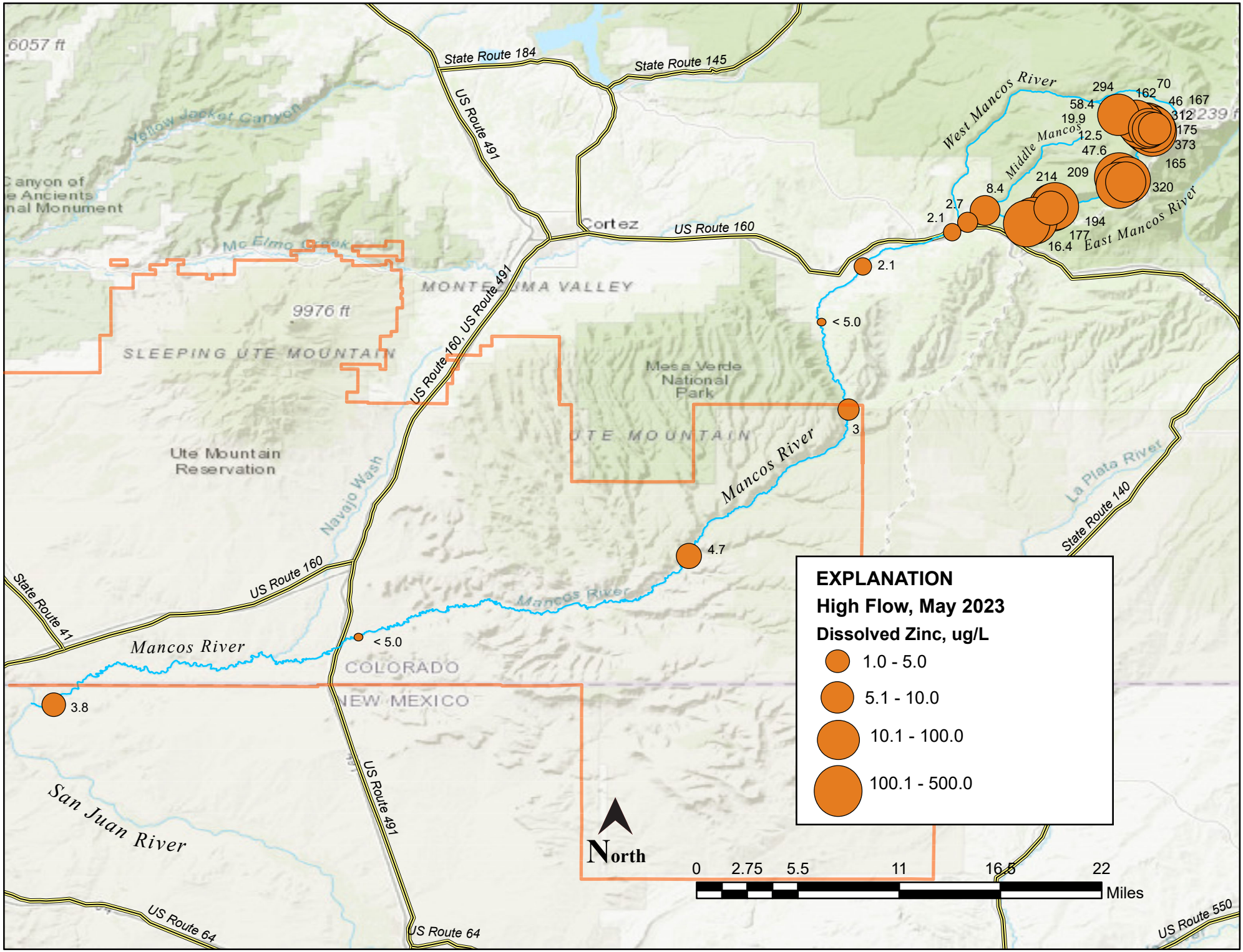


Figure HF10. Distribution of dissolved zinc in streams of the Mancos River Watershed, high flow May 2023.

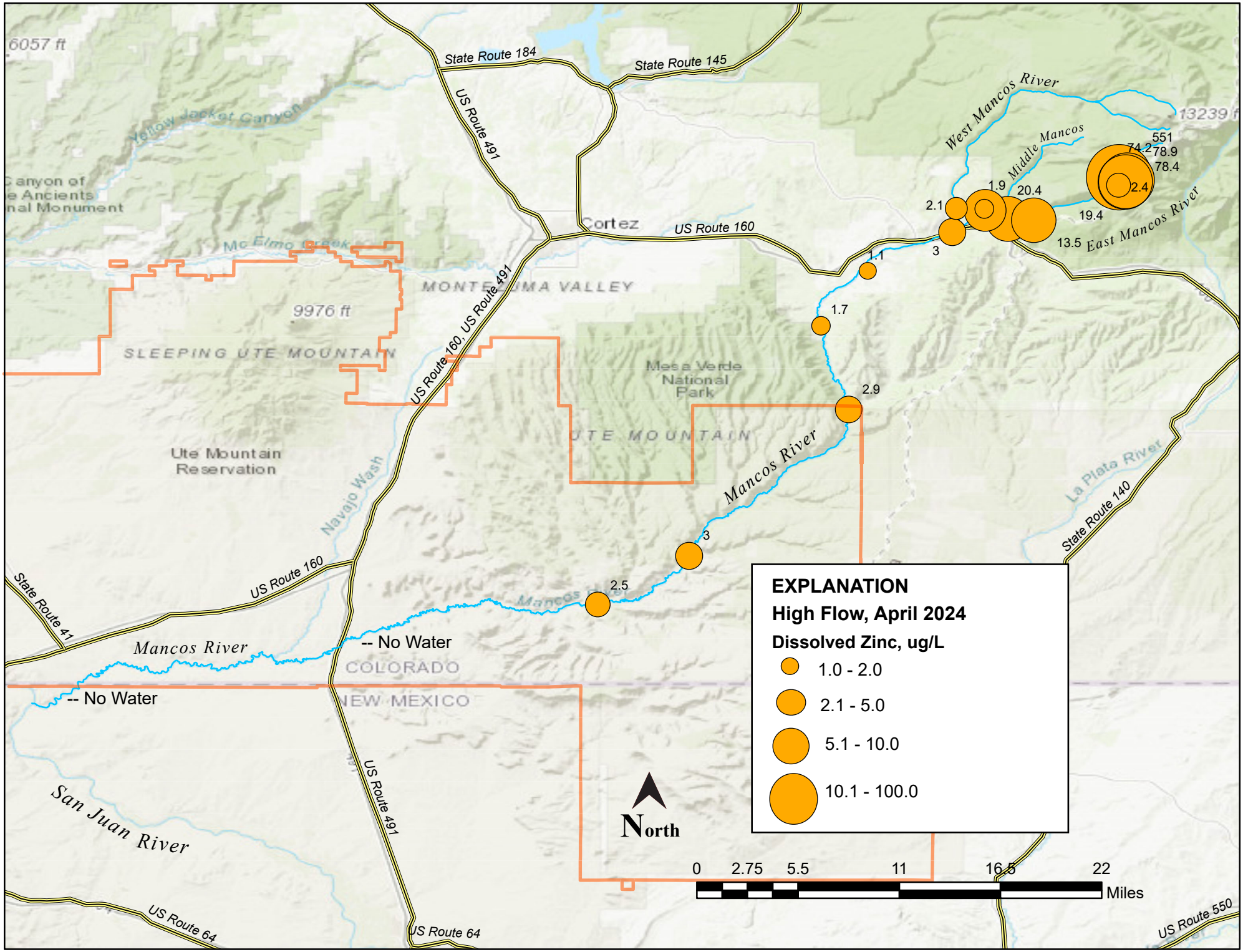


Figure HF11. Distribution of dissolved zinc in streams of the Mancos River Watershed, high flow April 2024.

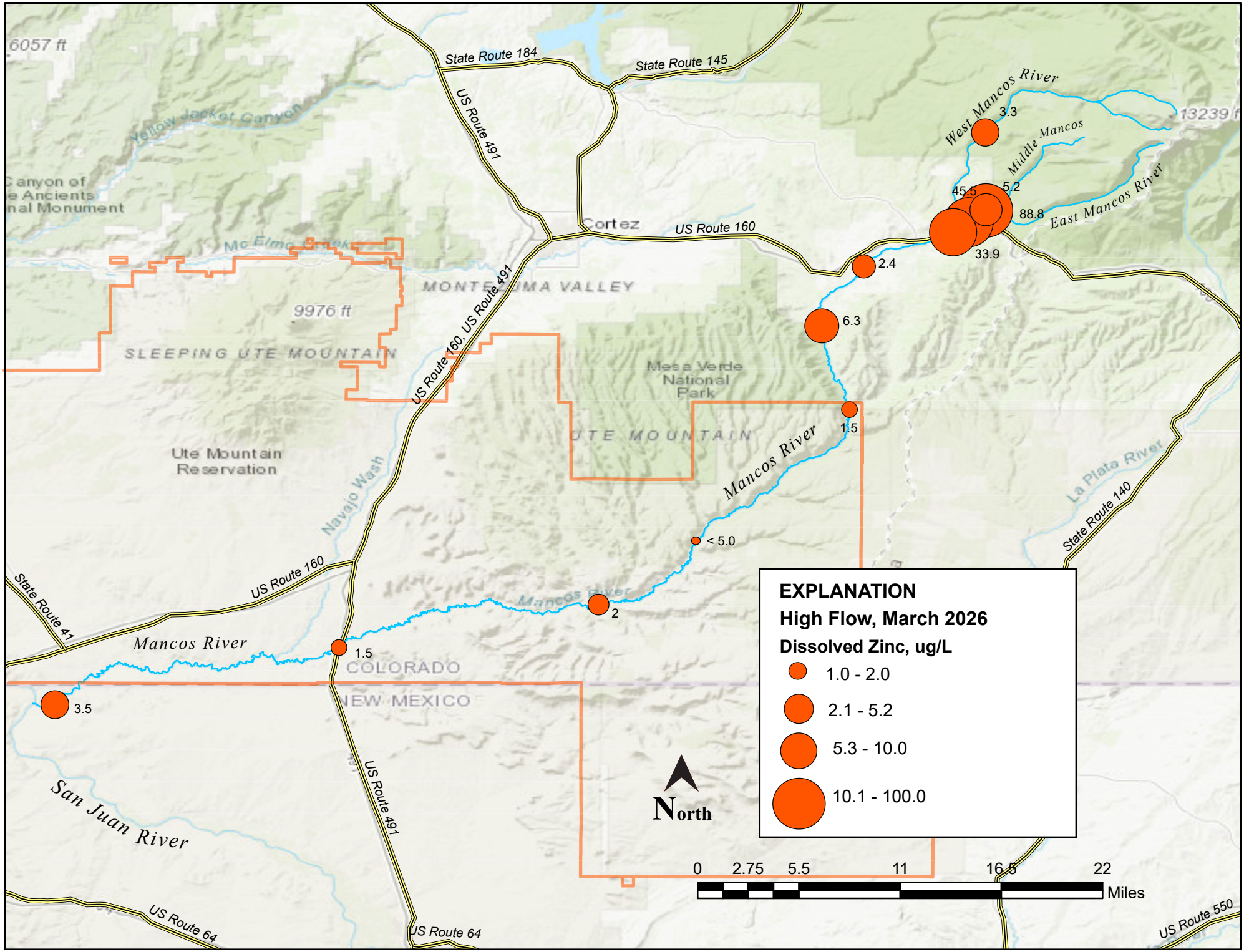


Figure HF12. Distribution of dissolved zinc in streams of the Mancos River Watershed, high flow March 2026.

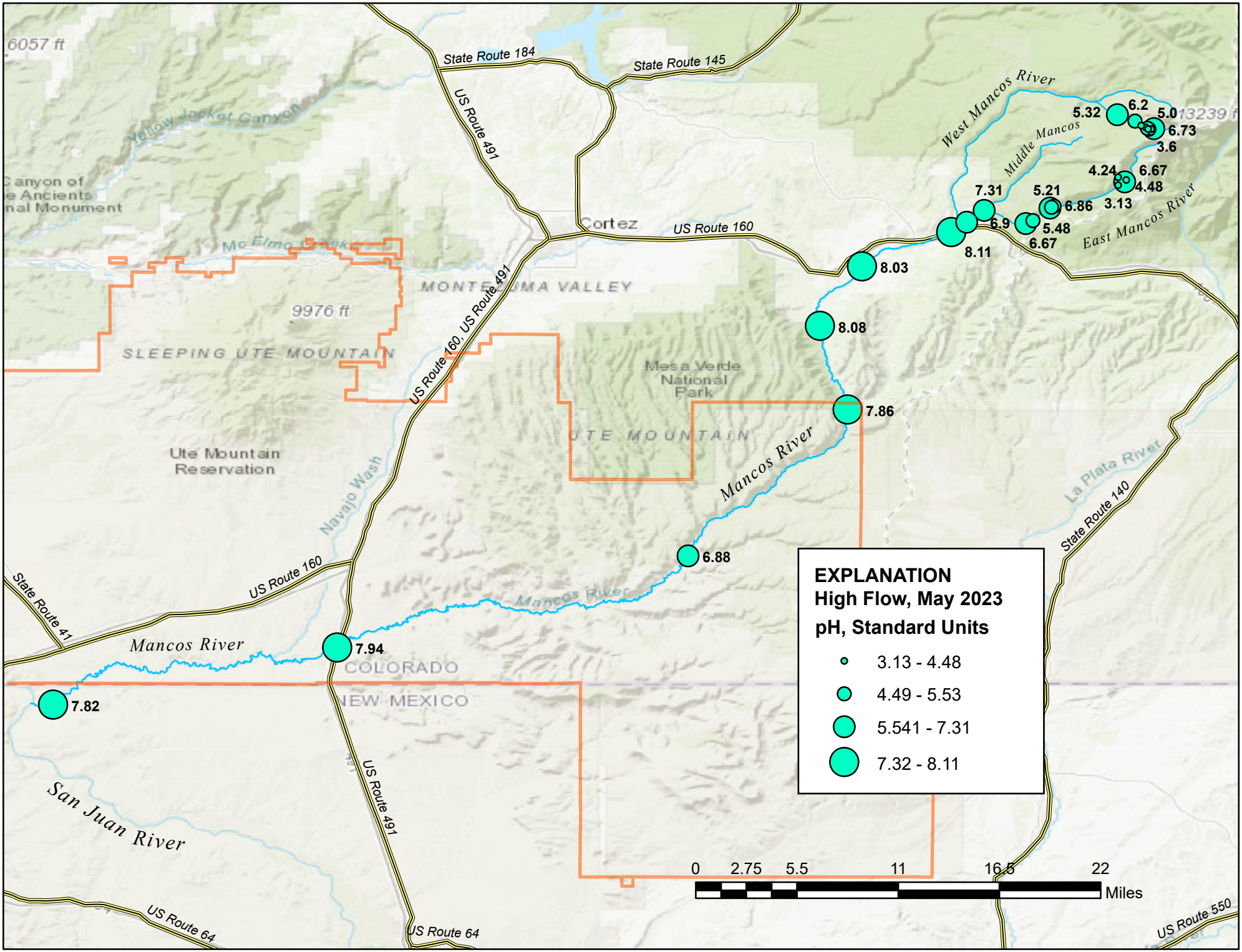


Figure HF13. Distribution of pH of stream water in the Mancos River Watershed, high flow May 2023.

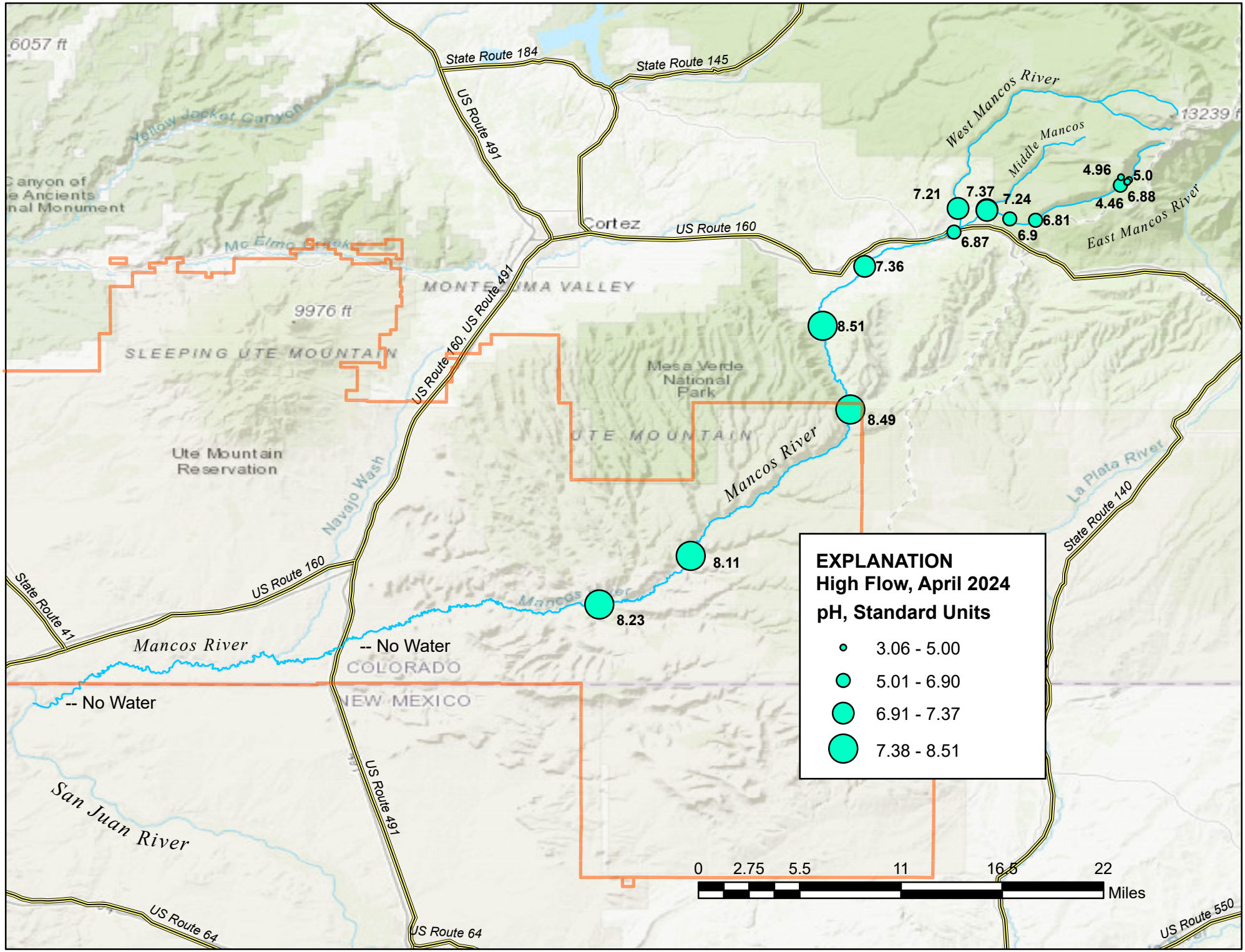


Figure HF14. Distribution of pH of stream water in the Mancos River Watershed, high flow April 2024.

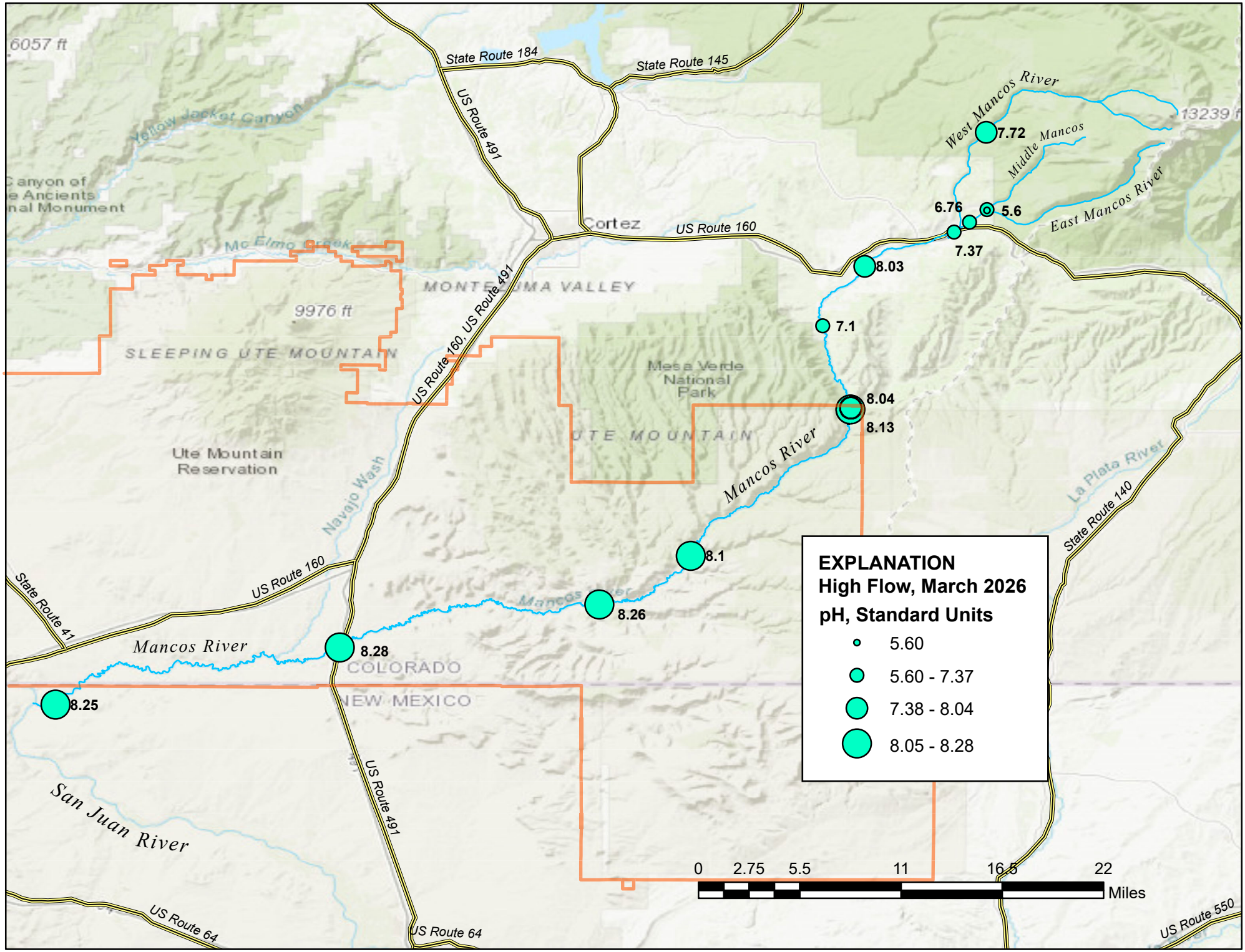


Figure HF15. Distribution of pH of stream water in the Mancos River Watershed, high flow March 2026.

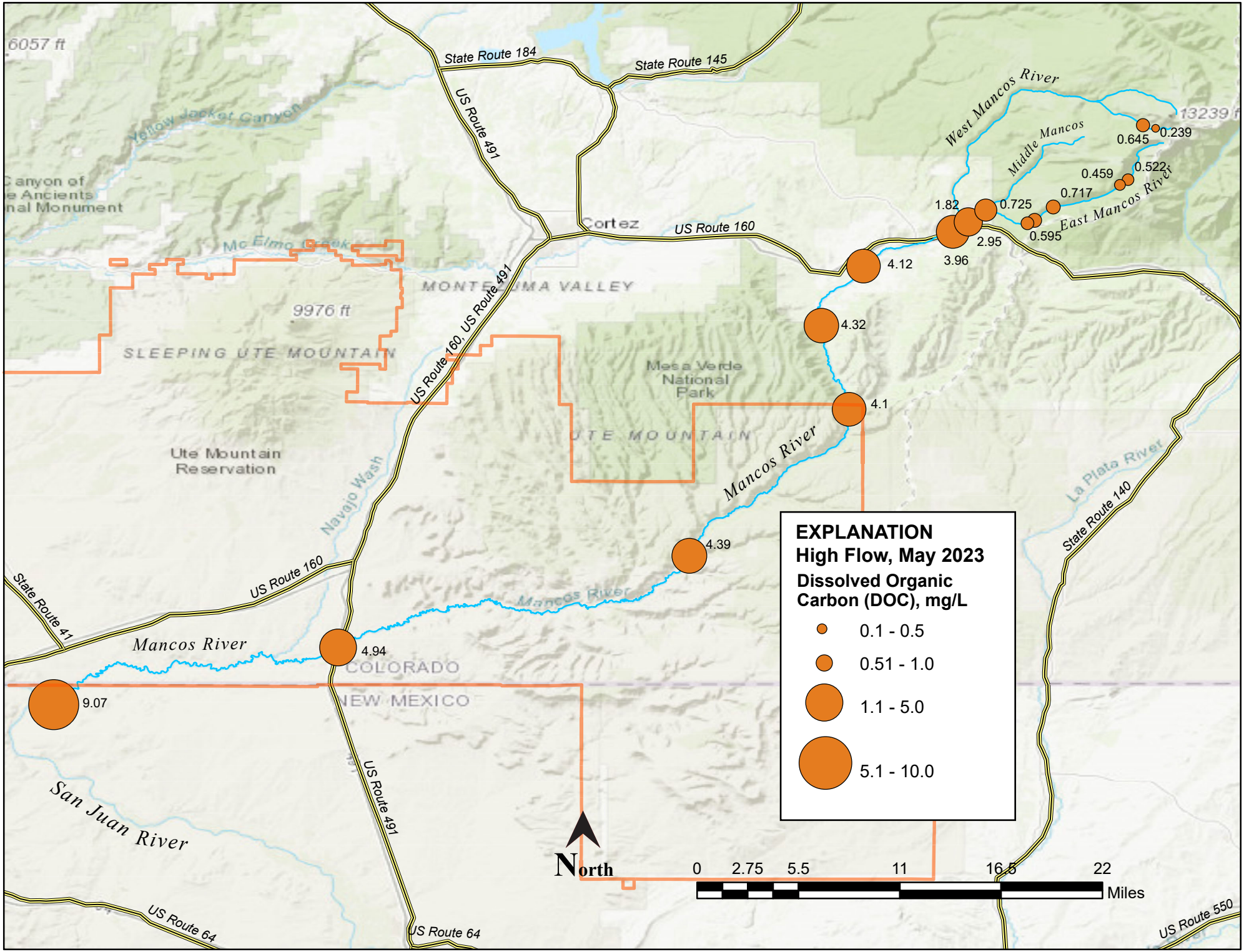


Figure HF16. Distribution dissolved organic carbon in stream water of the Mancos River Watershed, high flow May 2023.

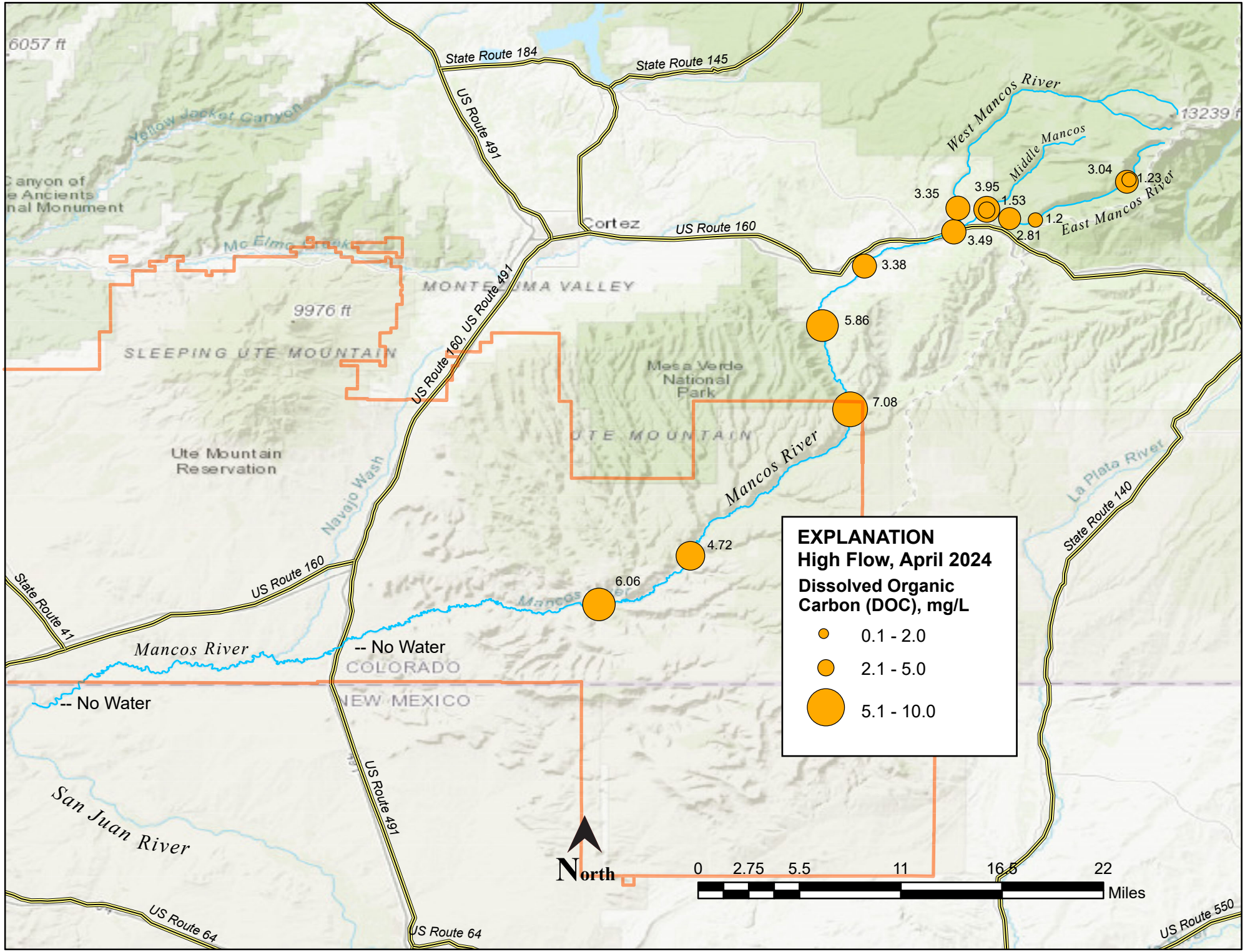


Figure HF17. Distribution of dissolved organic carbon in stream water of the Mancos River Watershed, high flow April 2024.

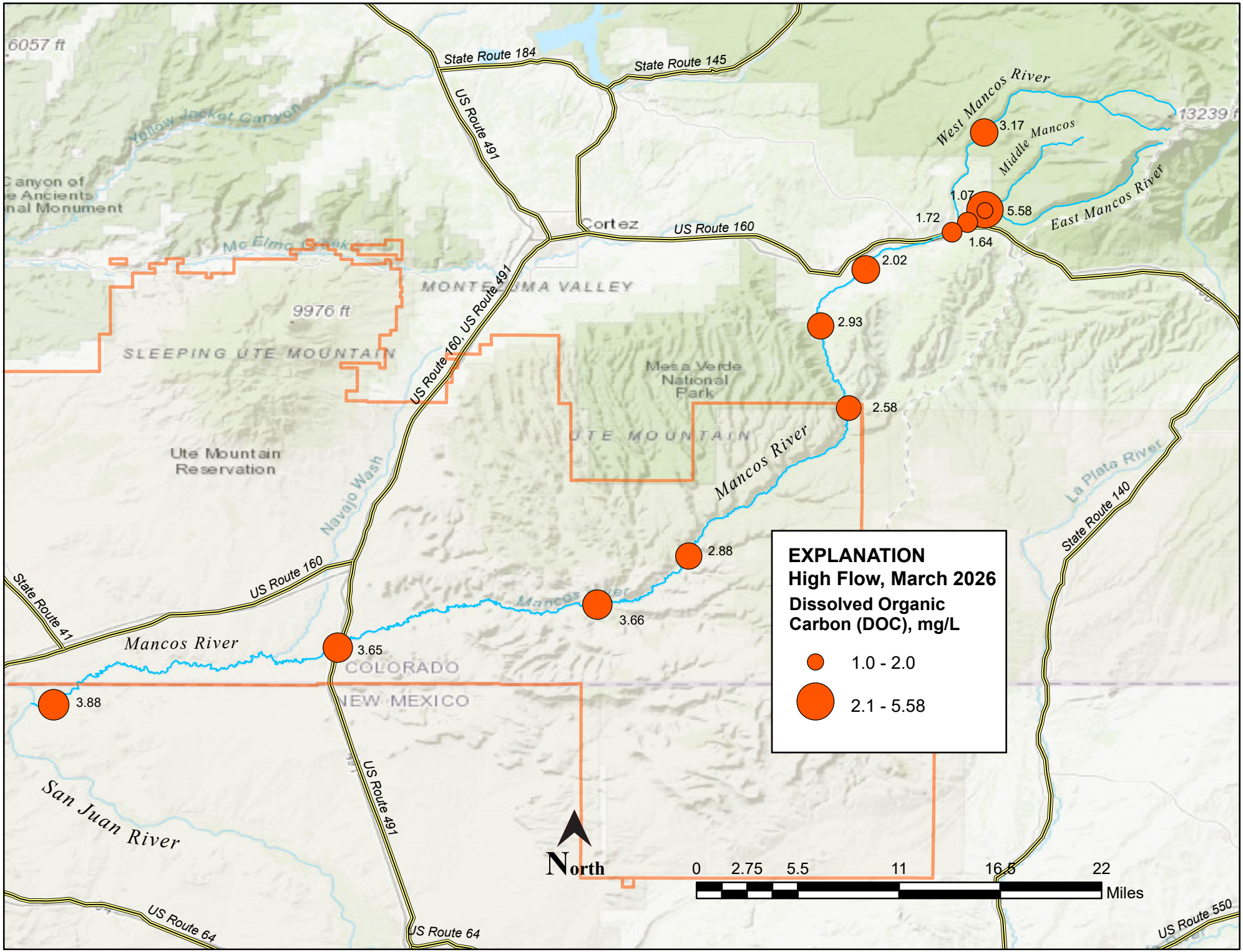


Figure HF18. Distribution of dissolved organic carbon in stream water of the Mancos River Watershed, high flow March 2026.

Table HF1. Sites where detailed water-quality samples were collected in the Mancos River watershed 2022-26

Name	Description	Latitude	Longitude	Altitude	Stream Mile above confluence with San Juan River
MANMANCO	Mancos River near Mancos	37.354004	-108.259153	7,219	77.25
MANCHICO	Mancos River at CJ's Bridge	37.327079	-108.329369	6,776	73.00
MRBM	Mancos River below Mud Creek	37.280344	-108.362442	6,456	69.00
MRAW	Mancos River above Weber Canyon	37.215806	-108.340403	6,173	64.00
MRBW	Mancos River below Weber Canyon	37.214489	-108.340612	6,173	63.50
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72
MRNT	Mancos River near Towaoc (USGS site)	37.027364	-108.742003	5,056	22.90
MRSJ	Mancos River at San Juan River (USGS site)	36.982446	-108.965482	4,679	1.18
MRAG	Mancos River above Grassy Canyon	37.060907	-108.538603	5,497	43.70
EMAP	East Mancos River above blue pools	37.374340	-108.178380	8,333	82.78
EMBP	East Mancos River below blue pools	37.373520	-108.180360	8,261	82.55
SPBP	Spring Right Bank below blue pools	37.372950	-108.181500	8,256	82.50
EM-24B	East Mancos River at Williams Ditch	37.362960	-108.194940	8,016	81.00
MMAE	Middle Mancos at Road L	37.371650	-108.233217	7,483	79.30
EM-25A	East Mancos River near mouth	37.371071	-108.233354	7,482	79.28
EMEB	East Mancos at Echo Basin Road	37.361836	-108.246998	7,328	78.05
WMAGB	South Fork West Mancos River above Gold Bed Mine	37.435268	-108.099946	10,716	94.47
WMBGB	South Fork West Mancos River below Gold Bed Mine	37.434830	-108.103669	10,625	94.22
Gold Bed Mine	Owen Basin, above Peerless Mine	37.43296	-108.10192	10,990	94.28
Peerless Mine	Owen Basin, Peerless Mine, main	37.43502	-108.10423	10,603	94.20
Gold Bed/Peerless Inflow	Mine drainage inflows to South Fork West Mancos River	37.435000	-108.101810	10,678	94.30
WMAB	South Fork West Mancos River above beaver pond	37.446240	-108.128490	9,603	92.40
WMAT	South Fork West Mancos River at trail	37.441310	-108.114730	10,122	93.40
WMBPL	South Fork West Mancos River below Peerless Mine	37.435689	-108.104945	10,530	94.10
WMIF	South Fork West Mancos River Iron Fen	37.437709	-108.109827	10,423	93.70
WMIS	South Fork West Mancos River Iron Spring	37.43637	-108.1064	10,447	94.02
WMAJ	West Mancos above Jackson Gulch Inlet	37.43243	-108.233869	8,010	84.20
WMEM	West Mancos above East Mancos	37.37254	-108.256059	7,404	78.90
Thunder Mine	Mine drainage at collapsed adit	37.397167	-108.127884	10,529	85.70
TDME	Thunder Drainage Midway Emergence	37.395399	-108.124935	10,117	85.70
EMAT	East Mancos River above Thunder Mine	37.394917	-108.121443	9,680	85.86
EMAT#2	East Mancos River above Thunder Mine	37.395070	-108.121380	9,700	85.90
EM-19	Spring below Thunder Mine at East Mancos River	37.393520	-108.122760	9,650	85.74
THSP2	Spring #2 below Thunder Mine at East Mancos River	37.390852	-108.128435	9,473	85.34
EMBT	East Mancos River below Thunder Mine	37.390809	-108.127940	9,481	85.39
EMBT#2	East Mancos River below Thunder Mine	37.393218	-108.123115	9,481	85.39

Appendix AT. AQUATIC TOXICITY IN THE MANCOS WATERSHED

Table AT1. Hazard quotient values for aluminum, copper, and zinc calculated using CDPHE and more advanced methods for synoptic sample events (2023, 2024, 2026)

				Aluminum								Copper				
				Aluminum T	Aluminum	Acute			Chronic			Copper D	Acute		Chronic	
Site	Year	Sample	Date	mg/L	Bio mg/L	CDPHE	EPA Acute	EPA Bio	CDPHE	EPA	EPA Bio	mg/L	CDPHE	BLM	CDPHE	BLM
EM25A	2023	Synoptic	5/30/2023	1.1000	0.6580	0.80	0.79	0.47	5.58	1.96	1.18	0.0140	1.94	2.93	2.75	4.71
EMEB	2023	Synoptic	5/30/2023	1.0400	0.3300	0.60	0.87	0.28	11.95	2.31	0.73	0.0131	1.55	2.96	2.23	4.77
MANMANCO	2023	Synoptic	5/30/2023	0.4310	0.2110	0.21	0.13	0.07	1.45	0.33	0.16	0.0109	1.14	0.42	1.66	0.68
MANCHICO	2023	Synoptic	5/30/2023	0.3300	0.1540	0.13	0.11	0.05	0.90	0.28	0.13	0.0096	0.87	0.38	1.28	0.61
MRBM	2023	Synoptic	5/31/2023	0.4010	0.2590	0.11	0.12	0.08	0.75	0.33	0.22	0.0103	0.72	0.36	1.09	0.57
MRBW	2023	Synoptic	5/31/2023	0.5960	0.1140	0.13	0.19	0.04	0.93	0.60	0.11	0.0080	0.49	0.35	0.75	0.56
MRJC	2023	Synoptic	6/1/2023	0.5430	0.1060	0.11	0.27	0.05	6.24	0.92	0.18	0.0173	0.99	2.34	1.53	3.77
MRNT	2023	Synoptic	6/1/2023	3.1900	0.1090	0.53	0.91	0.03	3.69	2.90	0.10	0.0047	0.24	0.15	0.37	0.24
MRSJ	2023	Synoptic	6/2/2023	4.9400	0.3570	0.75	1.20	0.09	5.23	4.94	0.36	0.0056	0.26	0.11	0.41	0.17
EM24	2024	Synoptic	5/18/2024	1.8500	0.6140	1.25	2.57	0.85	21.26	6.17	2.05	0.0364	4.81	24.08	6.85	38.76
EM25A	2024	Synoptic	5/19/2024	1.6300	0.6040	0.89	1.25	0.46	6.23	3.33	1.23	0.0286	3.27	8.03	4.71	12.92
MANMANCO	2024	Synoptic	5/20/2024	0.6750	0.0794	0.25	0.45	0.05	7.76	1.35	0.16	0.0214	1.86	4.07	2.75	6.55
MANCHICO	2024	Synoptic	5/20/2024	0.7310	0.0741	0.15	0.30	0.03	1.04	1.04	0.11	0.0142	0.82	1.31	1.26	2.11
MMAE	2024	Synoptic	5/23/2024	0.4580	0.0483	0.22	0.23	0.02	1.53	0.73	0.08	0.0014	0.15	0.14	0.21	0.23
MRAG	2024	Synoptic	5/21/2024	0.3880	0.0112	0.04	0.09	0.00	0.27	0.35	0.01	0.0064	0.13	0.09	0.22	0.15
MRBM	2024	Synoptic	5/19/2024	0.1780	0.0460	0.02	0.05	0.01	0.12	0.14	0.04	0.0077	0.16	0.10	0.26	0.16
MRBW	2024	Synoptic	5/19/2024	0.1270	0.0536	0.01	0.03	0.01	0.09	0.11	0.04	0.0062	0.12	0.07	0.21	0.11
MRJC	2024	Synoptic	5/21/2024	0.2480	0.0166	0.02	0.07	0.00	0.17	0.23	0.02	0.0072	0.15	0.15	0.25	0.24
WMAE	2024	Synoptic	5/23/2024	0.1440	0.0328	0.05	0.07	0.02	0.35	0.21	0.05	0.0036	0.30	0.35	0.45	0.57
EM25A	2026	Weekly&Syn	3/24/2026	2.4900	0.0171	0.87	16.60	0.11	28.62	25.41	0.17	0.2010	16.89	2069.94	25.06	3332.60
EMEB	2026	Synoptic	3/25/2026	3.1900	0.0808	0.95	3.19	0.08	36.67	8.62	0.22	0.0762	5.76	35.25	8.63	56.75
MANMANCO	2026	Synoptic	3/25/2026	3.2700	0.0444	0.65	1.92	0.03	4.52	5.27	0.07	0.0513	2.91	9.66	4.48	15.55
MANCHICO	2026	Synoptic	3/24/2026	0.5160	0.1650	0.06	0.18	0.06	0.43	0.43	0.14	0.0133	0.53	0.94	0.84	1.52
MMAE	2026	Synoptic	3/24/2026	3.4700	0.3030	1.79	2.67	0.23	39.89	6.94	0.61	0.0027	0.30	0.56	0.43	0.90
MRAG	2026	Synoptic	3/25/2026	0.4190	0.0052	0.04	0.12	0.00	0.29	0.35	0.00	0.0037	0.07	0.09	0.13	0.14
MRAW	2026	Weekly&Syn	3/24/2026	0.1930	0.0120	0.02	0.06	0.00	0.13	0.18	0.01	0.0050	0.10	0.22	0.17	0.36
MRBM	2026	Synoptic	3/25/2026	0.3780	0.0263	0.04	0.15	0.01	0.26	0.57	0.04	0.0080	0.19	0.94	0.32	1.51
MRBW	2026	Synoptic	3/24/2026	0.2820	0.0126	0.03	0.08	0.00	0.20	0.26	0.01	0.0049	0.10	0.16	0.17	0.26
MRJC	2026	Weekly&Syn	3/25/2026	0.1880	0.0055	0.02	0.06	0.00	0.13	0.16	0.00	0.0039	0.08	0.12	0.13	0.20
MRNT	2026	Synoptic	3/25/2026	3.5200	0.0054	0.35	1.01	0.00	2.45	2.93	0.00	0.0037	0.07	0.09	0.13	0.14
MRSJ	2026	Synoptic	3/25/2026	1.2000	0.0050	0.12	0.34	0.00	0.83	1.00	0.00	0.0049	0.10	0.10	0.17	0.17
WMAJ	2026	Synoptic	3/24/2026	0.6380	0.0984	0.24	0.26	0.04	1.65	0.71	0.11	0.0051	0.45	0.35	0.66	0.57

Table AT1. (cont)

				Zinc				
					Acute		Chronic	
Site	Year	Sample Event	Date	Zinc D mg/L	CDPHE Acute	BLM Acute	CDPHE Chronic	BLM Chronic
EM25A	2023	Synoptic	5/30/2023	0.0084	0.10	0.06	0.29	0.37
EMEB	2023	Synoptic	5/30/2023	0.0027	0.03	0.01	0.07	0.10
MANMANCO	2023	Synoptic	5/30/2023	0.0021	0.02	0.01	0.04	0.04
MANCHICO	2023	Synoptic	5/30/2023		0.00	0.00	0.00	0.00
MRBM	2023	Synoptic	5/31/2023		0.00	0.00	0.00	0.00
MRBW	2023	Synoptic	5/31/2023	0.003	0.02	0.01	0.02	0.05
MRJC	2023	Synoptic	6/1/2023	0.0047	0.02	0.01	0.03	0.09
MRNT	2023	Synoptic	6/1/2023		0.00	0.00	0.00	0.00
MRSJ	2023	Synoptic	6/2/2023	0.0038	0.02	0.01	0.02	0.03
EM24	2024	Synoptic	5/18/2024	0.0194	0.21	0.16	0.61	1.22
EM25A	2024	Synoptic	5/19/2024	0.0135	0.13	0.10	0.30	0.64
MANMANCO	2024	Synoptic	5/20/2024	0.003	0.02	0.01	0.04	0.09
MANCHICO	2024	Synoptic	5/20/2024	0.0011	0.01	0.00	0.01	0.02
MMAE	2024	Synoptic	5/23/2024	0.0019	0.02	0.01	0.03	0.05
MRAG	2024	Synoptic	5/21/2024	0.0025	0.00	0.00	0.01	0.02
MRBM	2024	Synoptic	5/19/2024	0.0017	0.00	0.00	0.00	0.01
MRBW	2024	Synoptic	5/19/2024	0.0029	0.01	0.00	0.01	0.02
MRJC	2024	Synoptic	5/21/2024	0.003	0.01	0.00	0.01	0.02
WMAE	2024	Synoptic	5/23/2024	0.0021	0.01	0.01	0.02	0.05
EM25A	2026	Weekly&Syn	3/24/2026	0.0888	0.62	0.38	0.99	3.45
EMEB	2026	Synoptic	3/25/2026	0.0455	0.29	0.23	0.40	1.86
MANMANCO	2026	Synoptic	3/25/2026	0.0339	0.16	0.15	0.22	1.02
MANCHICO	2026	Synoptic	3/24/2026	0.0024	0.01	0.01	0.01	0.06
MMAE	2026	Synoptic	3/24/2026	0.0052	0.05	0.02	0.11	0.16
MRAG	2026	Synoptic	3/25/2026	0.002	0.00	0.00	0.00	0.02
MRAW	2026	Weekly&Syn	3/24/2026		0.00	0.00	0.00	0.00
MRBM	2026	Synoptic	3/25/2026	0.0063	0.01	0.01	0.02	0.07
MRBW	2026	Synoptic	3/24/2026	0.0015	0.00	0.00	0.00	0.02
MRJC	2026	Weekly&Syn	3/25/2026		0.00	0.00	0.00	0.00
MRNT	2026	Synoptic	3/25/2026	0.0015	0.00	0.00	0.00	0.01
MRSJ	2026	Synoptic	3/25/2026	0.0035	0.01	0.00	0.01	0.03
WMAJ	2026	Synoptic	3/24/2026	0.0033	0.02	0.01	0.04	0.07

Table AT2. Hazard quotient values for aluminum, copper, and zinc calculated using CDPHE and more advanced methods for samples collected over an 11 week period (3/11/26-5/21/26) at 3 different sites.

					Parameters				**Aluminum**							
											Acute			Chronic		
Site	Year	Sample Event	Date	Time	pH	DOC	Calcium_D	Magnesium_D	Aluminum T mg/L	Aluminum Bio mg/L	CDPHE Acute	EPA Acute	EPA Bio Acute	CDPHE Chronic	EPA Chronic	EPA Bio Chronic
EM25A	2026	Weekly	3/11/2026	14:40	4.87	0.761	44.9	9.45	1.75	1.14	0.29	39.77	25.91	64.81	20.11	42.22
EM25A	2026	Weekly	3/18/2026	15:20	4.45	0.722	37.1	7.81	3.15	0.0282	0.68	90.00	0.81	143.18	36.21	1.28
EM25A	2026	Weekly	3/31/2026	11:30	6.04	1.02	24.6	5.29	2.39	0.0206	0.90	7.97	0.07	15.93	27.47	0.14
EM25A	2026	Weekly	4/8/2026	10:30	7.28	1.06	31.3	6.62	2.11	1.41	0.57	1.62	1.08	4.14	4.02	2.76
EM25A	2026	Weekly	4/15/2026	10:30	6.39	0.805	30.2	6.43	2.08	0.0137	0.59	4.43	0.03	10.95	23.91	0.07
EM25A	2026	Weekly	4/22/2026	10:45	7.1	0.829	37.6	7.9	1.35	0.0168	0.29	1.23	0.02	3.29	2.01	0.04
EM25A	2026	Weekly	4/29/2026	10:30	6.14	0.842	33	6.99	1.97	0.0189	0.50	5.32	0.05	11.59	22.64	0.11
EM25A	2026	Weekly	5/6/2026	10:15	4.88	0.806	31.7	6.99	2.64	0.0227	0.70	80.00	0.69	125.71	30.34	1.08
EM25A	2026	Weekly	5/12/2026	10:30	4.26	0.784	27.4	5.92	4.07	2.4	1.32	145.36	85.71	226.11	46.78	133.33
EM25A	2026	Weekly	5/21/2026	10:30	5.36	1.12	24.2	5.61	2.69	1.98	1.01	32.41	23.86	51.73	30.92	38.08
EM25A	2026	Weekly&Synoptic	3/24/2026	10:00	5.6	1.07	26	5.58	2.49	0.0171	0.87	16.60	0.11	25.41	28.62	0.17
MRAW	2026	Weekly	3/11/2026	14:15	8.16	3.38	176	73.5	0.07	0.0078	0.00	0.00	0.00	0.00	0.00	0.01
MRAW	2026	Weekly	3/18/2026	15:10	8.01	2.88	161	62	0.112	0.006	0.01	0.03	0.00	0.08	0.11	0.01
MRAW	2026	Weekly	3/31/2026	14:50	8.11	3.04	127	47.8	0.083	0.0138	0.01	0.03	0.00	0.06	0.08	0.01
MRAW	2026	Weekly	4/8/2026	14:45	8.2	3.69	149	59.2	0.084	0.023	0.01	0.02	0.00	0.06	0.08	0.02
MRAW	2026	Weekly	4/15/2026	13:30	8.21	3.72	145	59.9	0.271	0.0237	0.03	0.08	0.01	0.19	0.23	0.02
MRAW	2026	Weekly	4/22/2026	13:25	8.03	3.48	202	90.6	0.349	0.0055	0.00	0.00	0.01	0.00	0.00	0.01
MRAW	2026	Weekly	4/29/2026	13:00	8.05	4.2	224	99.4	0.349	0.0056	0.00	0.00	0.00	0.00	0.00	0.01
MRAW	2026	Weekly	5/6/2026	13:00	7.96	3.41	234	111	0.349	0.0058	0.00	0.00	0.00	0.00	0.00	0.01
MRAW	2026	Weekly	5/12/2026	10:40	7.98	3.08	120	47	0.198	0.0185	0.02	0.06	0.00	0.14	0.20	0.02
MRAW	2026	Weekly	5/21/2026	9:15	8.08	3.97	165	74.5	1.45	0.0074	0.14	0.39	0.01	1.01	1.32	0.01
MRAW	2026	Weekly&Synoptic	3/24/2026	15:30	8.04	2.58	107	48.7	0.193	0.012	0.02	0.06	0.00	0.13	0.18	0.01
MRJC	2026	Weekly	3/11/2026	10:30	8.32	3.33	173	90.6	0.125	0.005	0.01	0.04	0.00	0.09	0.10	0.00
MRJC	2026	Weekly	3/18/2026	10:50	8.24	3.07	166	82.9	0.13	0.0049	0.01	0.04	0.00	0.09	0.11	0.00
MRJC	2026	Weekly	3/31/2026	12:00	8.21	3.01	121	57.5	0.131	0.0071	0.01	0.04	0.00	0.09	0.11	0.01
MRJC	2026	Weekly	4/8/2026	16:00	8.18	6.91	152	77.4	0.096	0.0094	0.01	0.02	0.00	0.07	0.09	0.01
MRJC	2026	Weekly	4/15/2026	10:00	8.19	6.85	193	118	0.305	0.0077	0.03	0.07	0.00	0.21	0.28	0.01
MRJC	2026	Weekly	4/22/2026	10:00	8.09	7.01	162	96.4	0.349	0.0053	0.00	0.00	0.00	0.00	0.00	0.00
MRJC	2026	Weekly	4/29/2026	10:40	8.16	5.72	206	125	0.349	0.0055	0.00	0.00	0.00	0.00	0.00	0.01
MRJC	2026	Weekly	5/6/2026	10:15	8.17	4.4	203	130	0.349	0.0068	0.00	0.00	0.00	0.00	0.00	0.01
MRJC	2026	Weekly	5/12/2026	13:00	8.34	3.6	190	109	0.371	0.0149	0.04	0.11	0.00	0.26	0.29	0.01
MRJC	2026	Weekly	5/21/2026	11:05	8.06	8.13	131	77.9	0.675	0.0094	0.07	0.15	0.00	0.47	0.68	0.01
MRJC	2026	Weekly&Synoptic	3/25/2026	17:25	8.25	2.88	122	56.6	0.188	0.0055	0.02	0.06	0.00	0.13	0.16	0.00

Table AT2 (cont).

							Copper					**Zinc**			
								Acute		Chronic			Acute		Chronic	
Site	Year	Sample Event	Date	Time	pH	DOC	Copper_D mg/L	CDPHE Acute	BLM Acute	CDPHE	BLM	Zinc_D mg/L	CDPHE	BLM	CDPHE	BLM
EM25A	2026	Weekly	3/11/2026	14:40	4.87	0.761	0.62	31.53	14049.88	49.06	22620.31	0.15	0.64	0.20	0.84	1.90
EM25A	2026	Weekly	3/18/2026	15:20	4.45	0.722	0.47	28.62	5192.48	43.80	8359.89	0.12	0.61	0.08	0.81	0.75
EM25A	2026	Weekly	3/31/2026	11:30	6.04	1.02	0.16	13.89	574.13	20.51	924.36	0.08	0.56	0.45	0.96	3.91
EM25A	2026	Weekly	4/8/2026	10:30	7.28	1.06	0.10	7.15	35.59	10.78	57.29	0.07	0.44	0.44	0.58	3.13
EM25A	2026	Weekly	4/15/2026	10:30	6.39	0.805	0.08	5.63	148.73	8.46	239.46	0.06	0.40	0.36	0.52	3.09
EM25A	2026	Weekly	4/22/2026	10:45	7.1	0.829	0.06	3.55	32.86	5.44	52.90	0.06	0.32	0.32	0.43	2.55
EM25A	2026	Weekly	4/29/2026	10:30	6.14	0.842	0.09	6.26	280.13	9.48	451.01	0.08	0.45	0.38	0.59	3.35
EM25A	2026	Weekly	5/6/2026	10:15	4.88	0.806	0.14	10.04	2840.49	15.17	4573.19	0.08	0.47	0.12	0.62	1.17
EM25A	2026	Weekly	5/12/2026	10:30	4.26	0.784	0.75	59.88	10100.09	89.27	16261.14	0.12	0.78	0.06	1.16	0.55
EM25A	2026	Weekly	5/21/2026	10:30	5.36	1.12	0.15	13.05	2191.69	19.27	3528.61	0.08	0.58	0.26	0.98	2.41
EM25A	2026	Weekly&Synoptic	3/24/2026	10:00	5.6	1.07	0.20	16.89	2069.88	25.06	3332.51	0.09	0.62	0.38	0.99	3.45
MRAW	2026	Weekly	3/11/2026	14:15	8.16	3.38	0.01	0.11	0.13	0.18	0.22	0.00	0.01	0.00	0.01	0.03
MRAW	2026	Weekly	3/18/2026	15:10	8.01	2.88	0.00	0.09	0.17	0.15	0.27	0.00	0.00	0.00	0.00	0.02
MRAW	2026	Weekly	3/31/2026	14:50	8.11	3.04	0.01	0.10	0.18	0.17	0.28	0.00	0.00	0.00	0.00	0.02
MRAW	2026	Weekly	4/8/2026	14:45	8.2	3.69	0.01	0.12	0.16	0.21	0.25	0.00	0.00	0.00	0.00	0.02
MRAW	2026	Weekly	4/15/2026	13:30	8.21	3.72	0.01	0.11	0.14	0.19	0.23	0.00	0.00	0.00	0.00	0.01
MRAW	2026	Weekly	4/22/2026	13:25	8.03	3.48	0.01	0.10	0.14	0.17	0.23	0.00	0.00	0.00	0.01	0.01
MRAW	2026	Weekly	4/29/2026	13:00	8.05	4.2	0.01	0.10	0.12	0.17	0.19	0.00	0.00	0.00	0.00	0.01
MRAW	2026	Weekly	5/6/2026	13:00	7.96	3.41	0.01	0.10	0.15	0.17	0.24	0.00	0.00	0.00	0.01	0.01
MRAW	2026	Weekly	5/12/2026	10:40	7.98	3.08	0.00	0.07	0.14	0.12	0.22	0.00	0.00	0.00	0.00	0.01
MRAW	2026	Weekly	5/21/2026	9:15	8.08	3.97	0.01	0.14	0.18	0.24	0.29	0.00	0.00	0.00	0.00	0.01
MRAW	2026	Weekly&Synoptic	3/24/2026	15:30	8.04	2.58	0.01	0.10	0.22	0.17	0.36	0.00	0.00	0.00	0.00	0.01
MRJC	2026	Weekly	3/11/2026	10:30	8.32	3.33	0.01	0.14	0.16	0.23	0.25	0.01	0.01	0.01	0.01	0.05
MRJC	2026	Weekly	3/18/2026	10:50	8.24	3.07	0.00	0.09	0.13	0.15	0.20	0.00	0.00	0.00	0.01	0.02
MRJC	2026	Weekly	3/31/2026	12:00	8.21	3.01	0.00	0.08	0.13	0.14	0.21	0.00	0.00	0.00	0.00	0.02
MRJC	2026	Weekly	4/8/2026	16:00	8.18	6.91	0.01	0.10	0.07	0.17	0.11	0.00	0.00	0.00	0.00	0.01
MRJC	2026	Weekly	4/15/2026	10:00	8.19	6.85	0.01	0.10	0.06	0.17	0.10	0.00	0.00	0.00	0.00	0.01
MRJC	2026	Weekly	4/22/2026	10:00	8.09	7.01	0.01	0.10	0.07	0.17	0.11	0.00	0.01	0.00	0.01	0.02
MRJC	2026	Weekly	4/29/2026	10:40	8.16	5.72	0.01	0.12	0.08	0.20	0.14	0.00	0.00	0.00	0.00	0.01
MRJC	2026	Weekly	5/6/2026	10:15	8.17	4.4	0.01	0.11	0.11	0.19	0.17	0.00	0.00	0.00	0.01	0.01
MRJC	2026	Weekly	5/12/2026	13:00	8.34	3.6	0.00	0.09	0.10	0.16	0.16	0.00	0.00	0.00	0.00	0.02
MRJC	2026	Weekly	5/21/2026	11:05	8.06	8.13	0.01	0.13	0.09	0.22	0.14	0.00	0.00	0.00	0.00	0.01
MRJC	2026	Weekly&Synoptic	3/25/2026	17:25	8.25	2.88	0.00	0.08	0.12	0.13	0.20	0.00	0.00	0.00	0.00	0.01

Final July 30, 2026

Appendix 1. WATER-QUALITY DATA FOR THE MANCOS RIVER, EAST MANCOS RIVER, AND WEST MANCOS RIVER, INCLUDING PARTS OF THE UTE MOUNTAIN UTE RESERVATION, MONTEZUMA COUNTY, COLORADO

Final Data Base 2022-26

Mancos River Restoration WIIN Project
Water-Quality Results, 2022-26

EXPLANATIONS

Site Type	
SW	Stream or Surface Water
SP	Spring Water
MW	Mining Influenced Water Drainage
L	Lake or pond
MS	Mining Influenced Soil or Rock
QA	Quality assurance sample

Sample Type	
W	Water sample
S	Soil and rock mixture
WR	Mine Waste Rock Material

Laboratory	
GAL	Green Analytical Laboratories, Inc., Durango, Colo.

Column heading units	
dd	decimal degrees
ft	Feet
ft3/sec	cubic feet per second
gal/min	gallons per minute
uS/cm @ 25oC	microsiemens per centimeter at 25 degrees Celsius
oC	degrees Celsius
mg/L	milligrams per liter (ppm)
ug/L	micrograms per liter (ppb)
CaCO3	calcium carbonate
mg/L as N	milligrams per liter as nitrogen
Dissolved	Operational definition of constituents in water that pass through a 0.45 micrometer filter
Total	Unfiltered sample, or analysis of the total recoverable portion of the constituent in water after laboratory digestion

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2022-23

SITE PROPERTIES AND CONSTITUENT CONCENTRATIONS, NOVEMBER 2022 - SEPTEMBER 2023

Site Number	Site Name	Latitude, dd	Longitude, dd	Altitude, ft	Stream Mile from mouth	Site Type	Sample Type	Date	Time	Labor-atory	Sample Laboratory ID	Discharge, instantaneous, ft3/sec	Discharge, instantaneous, gal/min	Field Specific Conductance, uS/cm @ 25oC	Field pH, standard units	Water Temperature, oC	Dissolved Oxygen, mg/L	Dissolved Oxygen, % sat
MAINSTEM MANCOS RIVER																		
MANMANCO	Mancos River near Mancos	37.354004	-108.259153	7,219	77.25	SW	W	5/30/2023	15:38	GAL	2305330	340.0	152592.0	150.5	8.11	12.2	8.65	81
MANCHICO	Mancos River at CJ's Bridge	37.327079	-108.329369	6,776	73.00	SW	W	5/30/2023	15:08	GAL	2305330	373.0	167402.4	178.8	8.03	12.7	8.78	82.2
MRBM	Mancos River below Mud Creek	37.280344	-108.362442	6,456	69.00	SW	W	5/31/2023	17:30	GAL	2306046	398.5	178846.8	247.1	8.08	12.6	7.55	117
MRBW	Mancos River below Weber Canyon	37.214489	-108.340612	6,173	63.50	SW	W	5/31/2023	16:45	GAL	2306038	408.3	183245.0	274.4	7.86	12.9	8.58	97.6
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	6/1/2023	11:30	GAL	2306045	464.1	208288.1	309.8	6.88	9.5	8.9	101
MRNT	Mancos River near Towaoc (USGS site)	37.027364	-108.742003	5,056	22.90	SW	W	6/1/2023	15:00	GAL	2306045	324.0	145411.2	363.6	7.94	13.7	7.55	95
MRSJ	Mancos River at San Juan River (USGS site)	36.982446	-108.965482	4,679	1.18	SW	W	6/2/2023	12:45	GAL	2306052	378.0	169646.4	387.4	7.82	12.8	8.87	
EAST MANCOS RIVER																		
EMAP	East Mancos River above blue pools	37.374340	-108.178380	8,333	82.78	SW	W	8/26/2023	14:00	GAL	2308395	7.40	3321.1	287.0	5.35	11.5	6.19	99
EMBP	East Mancos River below blue pools	37.373520	-108.180360	8,261	82.55	SW	W	8/26/2023	13:00	GAL	2308395	7.40	3321.1	288.4	5.21	11.8	6.57	97
SPBP	Spring Right Bank below blue pools	37.372950	-108.181500	8,256	82.50	SW	W	8/26/2023	15:00	GAL	2308395	0.01	2.2	270.6	6.86	10.7	3.96	63.8
EM-24	East Mancos River above Williams Ditch	37.360640	-108.200576	7,897	81.15	SW	W	8/28/2023	18:20	GAL	2308433	--	--	281	6.67	9.1	--	--
EM-25A	East Mancos River near mouth	37.371071	-108.233354	7,482	79.28	SW	W	5/30/2023	15:30	GAL	2305330	130.4	58523.5	120	7.31	10.1	7.81	95
EMEB	East Mancos at Echo Basin Road	37.361836	-108.246998	7,328	78.05	SW	W	5/30/2023	17:30	GAL	2305330	225.9	101383.9	139	6.90	11.3	7.00	95.3
EM-25A	East Mancos River near mouth	37.371071	-108.233354	7,482	79.28	SW	W	7/28/2023	9:30	GAL	2307297	3.03	1359.9	234	7.36	13.0	6.95	101
EM-24B	East Mancos River near USFS Boundary, at Williams Ditch	37.362960	-108.194940	8,016	81.00	SW	W	9/26/2023	12:00	GAL	2309303	3.40	1525.9	326	5.48	7.5	8.98	98.4
EM-25A	East Mancos River near mouth	37.371071	-108.233354	7,482	79.28	SW	W	9/26/2023	11:00	GAL	2309303	3.50	1570.8	329	6.84	8.6	8.09	86.3
WEST MANCOS RIVER																		
WMAP	South Fork West Mancos River above Peerless Mine	37.435268	-108.099946	10,716	94.47	SW	W	7/25/2023	12:20	GAL	2307250	2.0	893.1	67.95	6.73	5.4	--	--
WMBP	South Fork West Mancos River below Peerless Mine	37.434830	-108.103669	10,625	94.22	SW	W	7/25/2023	15:10	GAL	2307250	3.7	1638.1	72.25	5.53	7.4	--	--
Gold Bed Mine	Owen Basin, above Peerless Mine	37.43296	-108.10192	10,990	94.28	MW	W	7/25/2023	13:00	GAL	2307250	0.06	26.8	442.9	3.72	1.9	--	--
Peerless Mine	Owen Basin, Peerless Mine, main	37.43502	-108.10423	10,603	94.20	MW	W	7/25/2023	15:31	GAL	2307250	0.01	2.4	789.5	3.41	18.1	--	--
Gold Bed/Peerless Inflow	Mine drainage inflows to South Fork West Mancos River	37.435000	-108.101810	10,678	94.30	MW	W	7/25/2023	14:39	GAL	2307250	0.04	17.0	220.5	3.60	9.8	--	--
WMAB	South Fork West Mancos River above beaver pond	37.446240	-108.128490	9,603	92.40	SW	W	8/10/2023	11:05	GAL	2308234	2.3	1041.2	101.7	6.20	7.9	--	--
WMAT	South Fork West Mancos River at trail	37.441310	-108.114730	10,122	93.40	SW	W	8/10/2023	16:19	GAL	2308234	2.0	902.1	112	5.32	9.3	--	--
WMBW	South Fork West Mancos River below waterfall	37.435689	-108.104945	10,530	94.10	SW	W	8/10/2023	14:28	GAL	2308234	1.2	529.6	102.9	5.00	7.2	--	--
WMIF	South Fork West Mancos River Iron Fen	37.437709	-108.109827	10,423	93.70	GW	W	8/10/2023	15:32	GAL	2308234	0.22	97.4	190.6	3.76	9.3	--	--
WMIS	South Fork West Mancos River Iron Spring	37.43637	-108.1064	10,447	94.02	GW	W	8/23/2023	12:40	GAL	2308375	0.022	9.9	433.7	3.84	3.9	--	--
THUNDER MINE AND EAST MANCOS RIVER																		
Thunder Mine	Mine drainage at collapsed adit	37.397167	-108.127884	10,529	85.70	MW	W	11/1/2022	10:49	GAL	2211031	0.0055	2.5	1302	2.96	5.5	--	--
EMAT	East Mancos River above Thunder Mine	37.394917	-108.121443	9,680	85.86	SW	W	11/1/2022	12:51	GAL	2211031	1.5	691.2	294.4	4.47	1.8	--	--
EM-WQ-19	Spring below Thunder Mine at East Mancos River	37.393520	-108.122760	9,650	85.74	SP	W	11/1/2022	13:50	GAL	2211031	0.003	1.3	242.9	5.28	2.5	--	--
EMBT	East Mancos River below Thunder Mine	37.390809	-108.127940	9,481	85.39	SW	W	11/1/2022	12:50	GAL	2211031	1.7	740.5	332.2	4.58	0.8	9.1	102
Thunder Mine	Mine drainage at collapsed adit	37.397167	-108.127884	10,529	85.70	MW	W	7/19/2023	9:04	GAL	2307182	0.0	2.2	677	3.13	6.1	--	--
EMAT	East Mancos River above possible inflow from Thunder Mine (site EM-WQ-19)	37.394917	-108.121443	9,680	85.86	SW	W	7/19/2023	12:40	GAL	2307182	3.7	1669.5	208.5	4.24	12.4	--	--
EM-WQ-19	Drainage below Thunder Mine at East Mancos River	37.393520	-108.122760	9,650	85.74	SP	W	7/19/2023	12:35	GAL	2307182	0.001	0.4	450.1	6.67	12.7	--	--
EMBT	East Mancos River below Thunder Mine	37.390809	-108.127940	9,481	85.39	SW	W	7/19/2023	11:15	GAL	2307182	3.9	1754.8	196.9	4.48	9.1	--	--
QUALITY ASSURANCE SAMPLES																		
MRR-Blank-1	Deioized water in width-depth sample bottle for 2 hours	37.258397	-107.948769	7,500	--	QA	W	5/19/2023	10:00	GAL	2305242	--	--	--	--	--	--	--
MRBW BLANK	Equipment blank at Mancos River below Weber Canyon	37.214489	-108.340612	6,173	--	QA	W	5/31/2023	17:15	GAL	2306038	--	--	--	--	--	--	--
MRBW DUP	Mancos River below Weber Canyon - Replicate sample	37.214489	-108.340612	6,173	--	QA	W	5/31/2023	17:15	GAL	2306038	408.3	183245.0	274.4	7.86	12.9	8.58	97.6
WM-IS-30	West Mancos Iron Spring - Replicate sample	37.43637	-108.1064	10,447	--	QA	W	8/23/2023	12:40	GAL	2308375	0.022	9.9	433.7	3.84	3.9	--	--
WM-IS-90	Blank atWest Mancos Iron spring	37.43637	-108.1064	10,447	--	QA	W	8/23/2023	12:40	GAL	2308393	--	--	--	--	--	--	--
EMBT - DUP	East Mancos River below drainage from Thunder Mine	37.390826	-108.128359	9,481	--	QA	W	7/19/2023	11:15	GAL	2307182	3.9	1754.8	196.9	4.48	9.1	--	--

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2022-23

Site	Date	Turbidity, FAU	Hardness, mg/L as CaCO3	Total Dissolved Solids, mg/L	Alkalinity, total, lab, as CaCO3, mg/L	Bicarbonate, as HCO3 mg/L	Calcium, dissolved, mg/L	Magnesium, dissolved, mg/L	Sodium, dissolved, mg/L	Potassium, dissolved, mg/L	Sulfate, dissolved, mg/L	Chloride, dissolved, mg/L	Fluoride, dissolved, mg/L	Silicon as Si, dissolved, mg/L	Silicate as SiO2, mg/L	Ammonia, dissolved, mg/L as N	Nitrate+ Nitrite, dissolved, mg/L as N	Phosphorus, total, mg/L	Aluminum, dissolved, ug/L	Aluminum, total, ug/L
MAINSTEM MANCOS RIVER																				
MANMANCO	5/30/2023	17.5	69.5	150	70	85.4	21.9	3.60	2.14	< 1.0	21.5	< 1.0	< 0.1	3.72	7.96	< 0.1	0.0585	< 0.05	113	431
MANCHICO	5/30/2023	--	81.4	145	70	85.4	25.0	4.60	2.89	< 1.0	29.3	1.13	< 0.1	3.77	8.07	< 0.1	0.0654	< 0.05	98	330
MRBM	5/31/2023	25.0	107.0	150	70	85.4	31.0	7.18	5.33	1.07	52.2	1.51	< 0.1	3.7	7.9	< 0.1	0.0664	< 0.05	105	401
MRBW	5/31/2023	43.0	122.0	195	75	91.5	34.5	8.70	6.99	1.14	64.6	1.65	< 0.1	3.56	7.61	< 0.1	0.024	< 0.05	< 50	596
MRJC	6/1/2023	--	131.5	205	80	97.6	36.0	10.10	8.18	1.12	74.9	1.79	< 0.1	3.84	8.2	< 0.1	0.0508	< 0.05	314	543
MRNT	6/1/2023	--	151.7	255	106	129.3	40.3	12.40	11.7	1.41	99.3	2.31	< 0.1	3.62	7.75	< 0.1	0.025	0.128	50	3190
MRSJ	6/2/2023	485.0	161.9	310	140	170.7	41.9	13.90	14.4	1.50	112	2.63	< 0.1	3.52	7.53	< 0.1	0.0989	0.366	< 50	4940
EAST MANCOS RIVER																				
EMAP	8/26/2023	--	91.0	--	< 6.06	--	26.7	5.90	1.68	2.52	141	0.44	0.462	5.49	11.7	< 0.0719	0.171	< 0.0215	6,220	8,350
EMBP	8/26/2023	--	90.8	185	< 6.06	--	26.6	5.91	1.67	2.57	137	0.508	0.47	5.54	11.8	< 0.0719	0.146	< 0.0215	6,550	8,570
SPBP	8/26/2023	--	116.0	--	39	47.6	33.7	7.74	1.67	1.9	87.2	0.54	0.215	3.74	8.00	< 0.0719	0.013	< 0.0215	< 4.4	138
EM-24	8/28/2023	--	105.1	220	< 6.06	--	30.3	7.14	1.87	2.48	124	0.457	0.372	5.04	10.8	< 0.0719	0.106	0.07	942	4,400
EM-25A	5/30/2023	25.5	51.6	105	50	61.0	15.5	3.12	< 1.0	< 1.0	20.4	< 1.0	0.111	2.91	6.22	< 0.1	0.0905	< 0.05	< 50	1100
EMEB	5/30/2023	--	61.1	145	49	59.8	18.8	3.43	1.39	< 1.0	22	< 1.0	< 0.1	3.35	7.16	< 0.1	0.075	< 0.05	< 50	1040
EM-25A	7/28/2023	--	108.7	155	33	40.2	32.3	6.81	1.75	1.84	75.9	0.463	0.186	3.92	8.39	< 0.054	0.0558	0.252	53	502
EM-24B	9/26/2023	--	135.9	240	< 10.0	--	39.4	9.12	2.04	2.65	156	< 1.0	0.382	5.66	12.1	< 0.1	0.079	< 0.05	5,640	5,390
EM-25A	9/26/2023	5.0	156.3	340	23	28.0	46.4	9.83	2.77	2.22	134	< 1.0	0.204	4.57	9.77	< 0.1	0.045	< 0.25	56	529
WEST MANCOS RIVER																				
WMAP	7/25/2023	--	27.8	80	9	11.0	9.0	1.29	0.414	0.32	20.6	0.39	0.051	2	4.29	< 0.054	0.153	< 0.0215	< 44	74
WMBP	7/25/2023	--	27.1	80	10	12.2	8.6	1.35	0.411	0.48	26.4	0.41	0.054	2.44	5.22	< 0.054	0.135	< 0.0215	< 44	743
Gold Bed Mine	7/25/2023	--	40.0	295	< 6.06	--	11.6	2.67	0.696	4.26	252	0.42	0.341	15.4	33	--	0.047	--	21,000	21,000
Peerless Mine	7/25/2023	--	42.2	360	< 6.06	--	12.1	2.90	0.839	4.91	272	0.42	0.345	16.9	36.3	--	< 0.04	--	21,300	21,400
Gold Bed/Peerless Inflow	7/25/2023	--	25.6	195	< 6.06	--	7.4	1.71	< 0.409	1.97	87.4	0.37	0.204	8.13	17.4	< 0.054	0.0951	< 0.0215	7,670	7,660
WMAB	8/10/2023	--	44.2	115	< 10	--	13.7	2.42	< 1.0	1.04	43.5	< 1.0	< 0.1	4.6	9.84	< 0.1	0.108	< 0.05	843	1,390
WMAT	8/10/2023	--	42.0	90	< 10	--	12.7	2.51	< 1.0	1.38	51.1	< 1.0	0.1	5.39	11.5	< 0.1	0.225	< 0.05	1,940	2,080
WMBW	8/10/2023	--	36.6	95	< 10	--	11.4	1.98	< 1.0	< 1.0	45.0	< 1.0	< 0.1	3.9	8.35	< 0.1	0.148	< 0.05	1,830	1,960
WMIF	8/10/2023	--	45.0	135	< 10	--	12.2	3.53	< 1.0	2.85	75.0	< 1.0	0.128	10.0	12.4	< 0.1	0.0495	< 0.05	2,620	2,520
WMIS	8/23/2023	--	49.9	540	< 10	--	13.8	3.75	1.12	5.51	263.0	< 5.0	0.505	20.6	44.1	--	< 0.04	--	22,500	23,000
MANCOS RIVER																				
Thunder Mine	11/1/2022	--	62.3	645	< 2.27	--	17.0	4.81	0.436	3.42	524	1.05	0.147	13.8	29.6	< 0.054	< 0.024	--	4,600	4,700
EMAT	11/1/2022	--	73.3	265	< 2.27	--	22.4	4.22	1.35	2.52	173	0.465	0.583	6.84	14.6	< 0.054	0.126	< 0.0164	15,100	15,800
EM-WQ-19	11/1/2022	--	111.1	235	18	22.0	33.6	6.61	1.07	1.41	123	0.560	0.159	8.56	18.3	< 0.054	< 0.012	< 0.0164	563	717
EMBT	11/1/2022	--	81.5	305	< 2.27	--	25.1	4.58	1.46	2.46	167	0.409	0.553	6.71	14.3	< 0.054	0.123	< 0.0164	13,600	15,000
Thunder Mine	7/19/2023	--	49.5	190	< 6.06	--	13.5	3.83	0.473	2.51	148	0.48	0.071	10.1	21.7	--	< 0.04	--	1,330	1,320
EMAT	7/19/2023	--	43.1	130	13	15.9	13.1	2.53	0.886	1.76	102	0.407	0.376	5.38	11.5	< 0.054	0.142	< 0.0245	8,500	8,540
EM-WQ-19	7/19/2023	--	77.5	155	12	14.6	24.6	3.90	1.21	1.24	73.7	0.462	0.099	6.65	14.2	< 0.054	0.014	--	98	149
EMBT	7/19/2023	--	46.3	150	9	11.0	14.1	2.70	0.908	1.75	97.0	0.404	0.361	5.27	11.3	< 0.054	0.137	< 0.0245	7,840	7,770
QUALITY ASSURANCE SAMPLES																				
MRR-Blank-1	5/19/2023	--	--	< 10	< 6.06	--	< 0.062	< 0.035	< 0.409	< 0.104	**0.35**	**4.610**	< 0.00971	< 0.076	< 1.07	< 0.0544	< 0.008	< 0.0245	< 44	--
MRBW BLANK	5/31/2023	--		25	< 10	--	< 0.1	< 0.1	< 1.0	<1.0	<1.0	< 1.0	< 0.1	< 0.5	< 1.0	< 0.1	< 0.04	< 0.05	< 50	< 50
MRBW DUP	5/31/2023	--	120.6	220	77	93.9	34.0	8.67	6.85	1.10	65	1.70	< 0.1	3.56	7.61	< 0.1	0.032	< 0.05	< 50	508
WM-IS-30	8/23/2023	--	49.9	330	< 10	--	13.8	3.75	1.14	5.49	265.0	< 5.0	0.505	20.6	44.1	--	< 0.04	--	22,700	22,800
WM-IS-90	8/23/2023	--	--	15	< 6.06	--	< 0.062	< 0.035	< 0.409	< 0.104	0.201	0.337	0.049	< 0.076	< 1.07	--	< 0.008	--	< 44	< 44
EMBT - DUP	7/19/2023	--	46.5	150	7	8.5	14.2	2.67	0.914	1.74	97.3	0.396	0.361	5.24	11.2	< 0.054	0.139	< 0.0245	7,680	7,930

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2022-23

Site	Date	Aluminum, Bioavailable, ug/L	Arsenic, dissolved, ug/L	Arsenic, total, ug/L	Cadmium, dissolved, ug/L	Cadmium, total, ug/L	Chromium, total, ug/L	Copper, dissolved, ug/L	Copper, total, ug/L	Iron, dissolved, ug/L	Iron, total, ug/L	Iron, Ferrous (Fe^{2+}), mg/L	Lead, dissolved, ug/L	Lead, total, ug/L	Manganese, dissolved, ug/L	Manganese, total, ug/L	Mercury, total, ng/L	Molyb-denum, total, ug/L	Nickel, dissolved, ug/L	Nickel, total, ug/L
MAINSTEM MANCOS RIVER																				
MANMANCO	5/30/2023	211	< 0.5	< 1.0	< 0.5	< 0.5	< 2.0	10.9	26.3	78	415	0.033	< 0.5	0.6	12.1	31.6	< 100	0.6	1.0	1.9
MANCHICO	5/30/2023	154	< 0.5	< 1.0	< 0.5	< 0.5	< 2.0	9.6	19.7	63	282	0.03	< 0.5	0.5	17.2	29.2	< 100	0.6	1.2	1.9
MRBM	5/31/2023	259	0.6	< 1.0	< 0.5	< 0.5	< 2.0	10.3	21.2	59	429	0.016	< 0.5	0.7	26.1	45.4	< 100	0.7	2.0	2.4
MRBW	5/31/2023	114	< 0.5	1.0	< 0.5	< 0.5	< 2.0	8.0	21.9	< 50	899	0.02	< 0.5	1.1	15.7	51.5	< 100	0.6	1.8	3.1
MRJC	6/1/2023	106	0.7	1.0	< 0.5	< 0.5	< 2.0	17.3	19.4	440	829	0.063	0.9	1.2	38.8	51.3	< 100	0.5	2.7	3.1
MRNT	6/1/2023	109	0.8	2.2	< 0.5	< 0.5	< 2.0	4.7	23.5	82	5,490	0.09	< 0.5	10.1	5.2	213	< 100	< 0.5	2.5	8.6
MRSJ	6/2/2023	357	0.6	2.4	< 0.5	< 0.5	< 2.0	5.6	20.8	50	5,480	0.22	< 0.5	10.3	2.6	205	< 100	< 0.5	2.8	9.5
EAST MANCOS RIVER																				
EMAP	8/26/2023	--	1.0	1.0	1.6	1.5	< 1.1	1,930	2,290	73	204	--	0.1	< 0.4	658	663	< 24.8	< 0.3	19.8	20.4
EMBP	8/26/2023	6,080	1.0	1.1	1.7	1.6	< 1.1	1,950	2,260	69	208	--	0.1	< 0.4	635	660	< 24.8	< 0.3	19.7	20.5
SPBP	8/26/2023	--	< 0.4	< 0.4	0.07	< 0.1	< 1.1	8	27.5	< 0.04	129	--	< 0.04	< 0.4	20.9	28.1	< 24.8	< 0.3	2.2	3.7
EM-24	8/28/2023	949	0.9	0.9	1.4	1.3	< 1.1	1,460	1,440	24	86	--	0.07	< 0.4	487	477	< 24.8	< 0.3	17.1	16.9
EM-25A	5/30/2023	658	< 0.5	1.4	< 0.5	< 0.5	< 2.0	14.0	134.0	< 50.0	886	0.026	< 0.5	0.9	30.5	76.2	< 100	< 0.5	1.1	2.3
EMEB	5/30/2023	330	< 0.5	1.5	< 0.5	< 0.5	< 2.0	13.1	102.0	< 50	996	< 0.01	< 0.5	1.3	17.7	65.5	< 100	< 0.5	1.1	2.5
EM-25A	7/28/2023	359	< 0.4	< 0.4	0.3	0.3	< 1.1	49.6	146.0	< 15.0	< 39.0	--	< 0.04	< 0.4	105	110	< 24.8	< 0.3	5.2	4.3
EM-24B	9/26/2023	4,660	< 0.5	< 1.0	1.4	1.4	< 2.0	1,580	1,710	66	62	--	< 0.5	< 0.5	489	498	< 100	< 0.5	18.3	20.2
EM-25A	9/26/2023	271	< 0.5	< 1.0	0.6	0.6	< 2.0	164.0	295.0	< 50.0	< 50.0	--	< 0.5	< 0.5	197	202	< 100	< 0.5	8.9	10.8
WEST MANCOS RIVER																				
WMAP	7/25/2023	26.3	< 0.4	< 0.4	< 0.03	< 0.1	< 1.1	< 0.4	< 0.4	< 15	< 39	--	< 0.04	< 0.4	4.7	5.7	< 24.8	0.5	0.9	0.6
WMBP	7/25/2023	496	< 0.4	< 0.4	0.2	0.2	< 1.1	28.3	35.9	58	130	--	< 0.04	< 0.4	44.9	48.3	< 24.8	0.4	1.9	1.6
Gold Bed Mine	7/25/2023	20,500	6.6	6.0	2.0	1.9	< 2.2	1,000	968	11,100	11,700	--	0.08	< 0.4	763	793	< 24.8	0.4	27.2	25.1
Peerless Mine	7/25/2023	20,200	< 0.4	< 0.4	18.7	17.0	< 1.1	1,230	1,190	10,500	11,100	--	0.7	0.7	935	948	< 24.8	< 0.3	29.6	27.4
Gold Bed/Peerless Inflow	7/25/2023	7,440	< 0.4	< 0.4	0.9	0.8	< 1.1	381	393	128	137	--	0.2	< 0.4	498	517	< 24.8	< 0.3	11.7	12.1
WMAB	8/10/2023	850	< 0.5	< 1.0	0.6	0.6	< 2.0	149.0	156.0	89.0	212.0	--	< 0.5	< 0.5	138	136	< 100	< 0.5	4.1	3.9
WMAT	8/10/2023	1,630	0.7	< 1.0	0.8	0.7	< 2.0	236.0	218.0	386.0	425.0	--	< 0.5	< 0.5	173	174	< 100	< 0.5	4.9	4.8
WMBW	8/10/2023	1,560	< 0.5	< 1.0	0.6	0.6	< 2.0	103.0	103.0	295.0	314.0	--	< 0.5	< 0.5	125	124	< 100	< 0.5	3.5	3.5
WMIF	8/10/2023	2,420	< 0.5	< 1.0	1.3	1.2	< 2.0	763.0	675.0	706.0	725.0	--	< 0.5	< 0.5	300	299	< 100	< 0.5	9.1	8.8
WMIS	8/23/2023	22,600	52.4	49.1	2.9	2.9	< 8.0	1,100	1,300	17,600	17,900	--	< 0.5	< 0.5	771	908	< 100	4.5	24.3	30.1
MANCOS RIVER																				
Thunder Mine	11/1/2022	5,170	1,470	1,390	3.1	3.0	< 0.6	12,000	11,100	106,000	114,000	--	91.4	91.9	553	541	< 24.8	13.2	16.2	15.9
EMAT	11/1/2022	17,000	< 0.2	1.6	1.9	1.8	< 0.6	2,570	2,370	587	1,810	--	< 0.09	0.8	1,030	996	< 24.8	0.2	26.3	25.4
EM-WQ-19	11/1/2022	883	0.4	2.3	0.6	0.6	< 0.6	250	244	314	864	--	0.1	0.4	564	550	< 24.8	0.08	8.6	8.7
EMBT	11/1/2022	14,600	< 0.2	1.7	1.8	1.7	< 0.6	2,310	2,000	288	2,240	--	< 0.09	0.2	951	962	< 24.8	0.4	24.4	24.7
Thunder Mine	7/19/2023	1,260	219	314	1.4	1.4	< 2.2	2,580	2,580	24,900	26,100	--	37.1	38.3	333	347	< 24.8	3.8	6.2	6.8
EMAT	7/19/2023	8,710	< 0.4	< 0.4	1.3	1.3	< 1.1	1,910	1,940	412	668	--	0.07	< 0.4	588	598	< 24.8	< 0.3	16.3	16.8
EM-WQ-19	7/19/2023	65.8	0.6	1.0	0.3	0.3	< 1.1	101	111	561	744	--	< 0.04	< 0.4	348	364	< 24.8	< 0.3	4.4	4.5
EMBT	7/19/2023	7,410	< 0.4	< 0.4	1.3	1.3	< 1.1	1,890	1,850	391	249	--	0.07	< 0.4	570	560	< 24.8	< 0.3	15.9	16.1
QUALITY ASSURANCE SAMPLES																				
MRR-Blank-1	5/19/2023	--	< 0.4	--	< 0.03	--	--	< 0.4	--	< 15	--	--	< 0.04	--	< 0.2	--	< 24.8	--	< 0.2	--
MRBW BLANK	5/31/2023	< 10	< 0.5	< 1.0	< 0.5	< 0.5	< 2.0	< 0.5	< 1.5	< 50	< 50	--	< 0.5	< 0.5	< 0.5	< 2.0	< 100	< 0.5	< 0.5	< 0.5
MRBW DUP	5/31/2023	271	< 0.5	1.2	< 0.5	< 0.5	< 2.0	7.7	20.0	< 50	740	0.033	< 0.5	1.0	16.0	49	< 100	0.6	1.8	2.9
WM-IS-30	8/23/2023	22,600	52.5	49.0	2.9	2.9	< 8.0	1,120	1,310	17,800	17,800	--	< 0.5	< 0.5	771	919	< 100	4.4	24.0	30.1
WM-IS-90	8/23/2023	7	< 0.4	< 0.4	< 0.03	< 0.1	< 1.1	< 0.4	< 0.4	< 15	< 39	--	< 0.04	< 0.4	< 0.2	< 1.6	< 24.8	< 0.3	< 0.2	< 0.2
EMBT - DUP	7/19/2023	7,400	< 0.4	< 0.4	1.3	1.3	< 1.1	1,840	1,870	249	404	--	0.07	< 0.4	561	573	< 24.8	< 0.3	15.8	16.4

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2022-23

Site	Date	Selenium, dissolved ug/L	Selenium, total, ug/L	Silver, dissolved, ug/L	Silver, total, ug/L	Uranium, total, ug/L	Vanadium, total, ug/L	Zinc, dissolved, ug/L	Zinc, total, ug/L	Dissolved Organic Carbon, mg/L
MAINSTEM MANCOS RIVER										
MANMANCO	5/30/2023	< 1.0	< 1.0	< 0.2	< 0.5	< 0.5	< 5.0	2.1	< 10.0	3.96
MANCHICO	5/30/2023	< 1.0	< 1.0	< 0.2	< 0.5	< 0.5	< 5.0	2.1	< 10.0	4.12
MRBM	5/31/2023	< 1.0	< 1.0	< 0.2	< 0.5	0.7	< 5.0	< 2.0	< 10.0	4.32
MRBW	5/31/2023	< 1.0	< 1.0	< 0.2	< 0.5	0.8	< 5.0	3.0	10.6	4.10
MRJC	6/1/2023	< 1.0	< 1.0	< 0.2	< 0.5	0.8	< 5.0	4.7	< 10	4.39
MRNT	6/1/2023	< 1.0	< 1.0	< 0.2	< 0.5	1.5	< 5.0	< 2.0	28.8	4.94
MRSJ	6/2/2023	1.2	1.2	< 0.2	< 0.5	1.7	< 5.0	3.8	23.8	9.07
EAST MANCOS RIVER										
EMAP	8/26/2023	2.7	4.4	< 0.1	< 0.2	7.1	< 1.2	209	183	--
EMBP	8/26/2023	2.5	4.6	< 0.1	< 0.2	7.0	< 1.2	214	186	0.717
SPBP	8/26/2023	< 0.4	0.9	< 0.1	< 0.2	0.1	< 1.2	16.4	15.4	--
EM-24	8/28/2023	4.5	4.2	< 0.1	< 0.2	4.6	< 1.2	177	149	0.595
EM-25A	5/30/2023	< 1.0	< 1.0	< 0.2	< 0.5	0.8	< 5.0	8.4	17.1	1.82
EMEB	5/30/2023	< 0.1	< 1.0	< 0.2	< 0.5	0.6	< 5.0	2.7	17.4	2.95
EM-25A	7/28/2023	< 0.4	< 0.4	< 0.1	< 0.2	0.5	< 1.2	24.5	28.3	1.09
EM-24B	9/26/2023	< 1.0	1.0	< 0.2	< 0.5	5.1	< 5.0	194	184	0.725
EM-25A	9/26/2023	< 1.0	< 1.0	< 0.2	< 0.5	0.6	< 5.0	74.6	76.2	0.79
WEST MANCOS RIVER										
WMAP	7/25/2023	< 0.4	< 0.4	< 0.1	< 0.2	< 0.03	< 1.2	12.5	5.2	0.24
WMBP	7/25/2023	< 0.4	< 0.4	< 0.1	< 0.2	0.4	< 1.2	19.9	18.4	0.23
Gold Bed Mine	7/25/2023	< 0.4	< 0.4	< 0.1	< 0.2	10.8	7.7	294.0	271	--
Peerless Mine	7/25/2023	< 0.4	< 0.4	< 0.1	< 0.2	14.8	< 1.2	373.0	360	--
Gold Bed/Peerless Inflow	7/25/2023	< 0.4	< 0.4	< 0.1	< 0.2	4.2	< 1.2	175.0	155	0.385
WMAB	8/10/2023	< 1.0	< 1.0	< 0.2	< 0.5	1	< 5.0	58.4	48.4	< 0.5
WMAT	8/10/2023	< 1.0	< 1.0	< 0.2	< 0.5	1.5	< 5.0	70.0	61.5	< 0.5
WMBW	8/10/2023	< 1.0	< 1.0	< 0.2	< 0.5	1.1	< 5.0	46.0	40.6	< 0.5
WMIF	8/10/2023	< 1.0	< 1.0	< 0.2	< 0.5	1.3	< 5.0	162.0	133	0.65
WMIS	8/23/2023	< 1.0	1.0	< 0.2	< 0.5	18.8	< 20.0	312.0	329	--
MANCOS RIVER										
Thunder Mine	11/1/2022	< 0.6	< 0.7	< 0.09	0.09	3.7	1.1	1200.0	998	--
EMAT	11/1/2022	< 0.6	< 0.7	< 0.09	< 0.07	9	< 1.5	324.0	235	0.209
EM-WQ-19	11/1/2022	< 0.6	< 0.7	< 0.09	< 0.07	< 0.1	< 1.5	102.0	89.6	0.468
EMBT	11/1/2022	< 0.6	< 0.7	< 0.09	< 0.07	8.4	< 1.5	261.0	236	< 0.175
Thunder Mine	7/19/2023	< 0.4	< 0.4	< 0.1	< 0.2	1.1	14.3	320.0	298	--
EMAT	7/19/2023	0.7	< 0.4	< 0.1	< 0.2	5.5	1.8	167.0	160	0.522
EM-WQ-19	7/19/2023	< 0.4	< 0.4	< 0.1	< 0.2	0.04	< 1.2	47.6	44	--
EMBT	7/19/2023	0.7	< 0.4	< 0.1	< 0.2	5.0	< 1.2	165.0	149	0.459
QUALITY ASSURANCE SAMPLES										
MRR-Blank-1	5/19/2023	< 0.4	--	**0.2**	< 0.2	< 0.03	< 1.2	< 0.5	--	--
MRBW BLANK	5/31/2023	< 1.0	< 1.0	< 0.2	< 0.5	< 0.5	< 5.0	< 2.0	< 10	< 0.5
MRBW DUP	5/31/2023	< 1.0	< 1.0	< 0.2	< 0.5	0.8	< 5.0	7.0	< 10	4.17
WM-IS-30	8/23/2023	< 1.0	1.1	< 0.2	< 0.5	18.9	< 20.0	315.0	329	--
WM-IS-90	8/23/2023	< 0.4	0.6	< 0.1	< 0.2	< 0.03	< 1.2	2	< 0.7	--
EMBT - DUP	7/19/2023	0.6	< 0.4	< 0.1	< 0.2	5.2	1.3	163.0	154	0.527

Mancos River Watershed -- Mainstem Synoptic Constituent Loads, 2023

MAINSTEM SITE PROPERTIES AND CONSTITUENT LOADS, NOVEMBER 2022 - SEPTEMBER 2023

Site Number	Site Name	Latitude, dd	Longitude, dd	Altitude, ft	Stream Mile from mouth	Site Type	Sample Type	Date	Time	Laboratory Name	Sample Laboratory ID	Discharge, instantaneous, ft3/sec	Discharge, instantaneous, gal/min	Field Specific Conductance, uS/cm @ 25oC	Field pH, standard units	Water Temperature, oC
MAINSTEM MANCOS RIVER																
EM-25A	East Mancos River near mouth	37.371071	-108.233354	7,482	79.28	SW	W	5/30/2023	15:30	GAL	2305330	130.4	58523.5	120	7.31	10.1
EMEB	East Mancos at Echo Basin Road	37.361836	-108.246998	7,328	78.05	SW	W	5/30/2023	17:30	GAL	2305330	225.9	101383.9	139	6.90	11.3
MANMANCO	Mancos River near Mancos	37.354004	-108.259153	7,219	77.25	SW	W	5/30/2023	15:38	GAL	2305330	340.0	152592.0	150.5	8.11	12.2
MANCHICO	Mancos River at CJ's Bridge	37.327079	-108.329369	6,776	73.00	SW	W	5/30/2023	15:08	GAL	2305330	373.0	167402.4	178.8	8.03	12.7
MRBM	Mancos River below Mud Creek	37.280344	-108.362442	6,456	69.00	SW	W	5/31/2023	17:30	GAL	2306046	398.5	178846.8	247.1	8.08	12.6
MRBW	Mancos River below Weber Canyon	37.214489	-108.340612	6,173	63.50	SW	W	5/31/2023	16:45	GAL	2306038	408.3	183245.0	274.4	7.86	12.9
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	6/1/2023	11:30	GAL	2306045	464.1	208288.1	309.8	6.88	9.5
MRNT	Mancos River near Towaoc (USGS site)	37.027364	-108.742003	5,056	22.90	SW	W	6/1/2023	15:00	GAL	2306045	324.0	145411.2	363.6	7.94	13.7
MRSJ	Mancos River at San Juan River (USGS site)	36.982446	-108.965482	4,679	1.18	SW	W	6/2/2023	12:45	GAL	2306052	378.0	169646.4	387.4	7.82	12.8

Mancos River Watershed -- Mainstem Synoptic Constituent Loads, 2023

Site	Date	Dissolved Oxygen, mg/L	Dissolved Oxygen, % sat	Hardness, mg/L as CaCO3	Total Dissolved Solids, lb/d	Alkalinity, total, lab, as CaCO3, lb/d	Bicarbonate, as HCO3 lb/d	Calcium, dissolved, lb/d	Magnesium, dissolved, lb/d	Sodium, dissolved, lb/d	Potassium, dissolved, lb/d	Sulfate, dissolved, lb/d	Chloride, dissolved, lb/d	Fluoride, dissolved, lb/d	Silicon as Si, dissolved, lb/d	Silicate as SiO2, lb/d	Ammonia, dissolved, lb/d as N	Nitrate+ Nitrite, dissolved, lb/d as N
MAINSTEM MANCOS RIVER																		
EM-25A	5/30/2023	7.81	95	36285.8	73906.6776	35193.656	42919.1	10910.03336	2196.084134	--	--	14359.01165	--	78.12991632	2048.270779	4378.090806	--	63.70051736
EMEB	5/30/2023	7.00	95.3	74464.5	176807.6379	59748.78798	72864.4	22924.02478	4182.415159	1694.914598	--	26825.98644	--	--	4084.866117	8730.639223	--	91.4522265
MANMANCO	5/30/2023	8.65	81	127566.7	275287.8	128467.64	156667.9	40192.0188	6606.9072	3927.43928	--	39457.918	--	--	6827.13744	14608.60592	--	107.362242
MANCHICO	5/30/2023	8.78	82.2	163824.3	291940.013	140936.558	171873.9	50334.485	9261.54524	5818.666466	--	58992.01642	2275.118722	--	7590.440338	16247.97176	--	131.6750128
MRBM	5/31/2023	7.55	117	230104.1	322653.495	150571.631	183623.9	66681.7223	15444.34729	11464.95419	2301.594931	112283.4163	3248.045183	--	7958.78621	16993.08407	--	142.8279471
MRBW	5/31/2023	8.58	97.6	268819.2	429764.7393	165294.1305	201578.2	76035.30003	19174.11914	15405.41296	2512.470784	142373.3444	3636.470871	--	7845.961394	16771.84444	--	52.89412176
MRJC	6/1/2023	8.9	101	329382.6	513549.3909	200409.5184	244401.9	90184.28328	25301.7017	20491.87326	2805.733258	187633.4116	4484.162974	--	9619.656883	20541.97564	--	127.2600442
MRNT	6/1/2023	7.55	95	265292.7	445966.236	185382.0432	226075.7	70480.15416	21686.20128	20461.98024	2465.930952	173664.499	4039.929432	--	6330.971664	13553.8758	--	43.72218
MRSJ	6/2/2023	8.87	--	330263.2	632514.204	285651.576	348355.6	85491.43596	28361.12076	29381.30496	3060.5526	228521.2608	5366.168892	--	7182.096768	15363.97405	--	201.7924348

Mancos River Watershed -- Mainstem Synoptic Constituent Loads, 2023

Site	Date	Phosphorus, total, lb/d	Aluminum, dissolved, lb/d	Aluminum, total, lb/d	Aluminum, Bioavailable, lb/d	Arsenic, dissolved, lb/d	Arsenic, total, lb/d	Cadmium, dissolved, lb/d	Cadmium, total, lb/d	Chromium, total, lb/d	Copper, dissolved, lb/d	Copper, total, lb/d	Iron, dissolved, lb/d	Iron, total, lb/d	Iron, Ferrous (Fe^{2+}), lb/d	Lead, dissolved, lb/d	Lead, total, lb/d	Manganese, dissolved, lb/d	Manganese, total, lb/d
MAINSTEM MANCOS RIVER																			
EM-25A	5/30/2023	--	--	774.260432	463.148513	--	0.985422368	--	--	--	9.85422368	94.31899808	--	623.631584	0.018300701	--	0.63348581	21.46813016	53.63513174
EMEB	5/30/2023	--	--	1268.137541	402.3897966	--	1.82904453	--	--	--	15.97365556	124.375028	--	1214.48557	--	--	1.58517193	21.58272545	79.86827781
MANMANCO	5/30/2023	--	207.383476	790.993612	387.238172	--	--	--	--	--	20.0042468	48.2671276	143.149656	761.62958	0.060563316	--	1.1011512	22.2065492	57.9939632
MANCHICO	5/30/2023	--	197.3111812	664.415202	310.0604276	--	--	--	--	--	19.32844224	39.66357418	126.8429022	567.772991	0.060401382	--	1.0066897	34.63012568	58.79067848
MRBM	5/31/2023	--	225.8574465	862.5603433	557.1150347	1.29061398	--	--	--	--	22.15553999	45.60169396	126.9103747	922.788996	0.034416373	--	1.50571631	56.14170813	97.65645782
MRBW	5/31/2023	--	--	1313.537357	251.2470784	--	2.20392174	--	--	--	17.63137392	48.26588611	--	1981.32564	0.044078435	--	2.42431391	34.60157132	113.5019696
MRJC	6/1/2023	--	786.6073597	1360.279606	265.5426119	1.753583286	2.50511898	--	--	--	43.33855835	48.59930821	1102.252351	2076.74363	0.157822496	2.25460708	3.00614278	97.19861642	128.5126037
MRNT	6/1/2023	223.8575616	87.44436	5578.950168	190.6287048	1.39910976	3.84755184	--	--	--	8.21976984	41.0988492	143.4087504	9601.39073	0.157399848	--	17.6637607	9.09421344	372.5129736
MRSJ	6/2/2023	746.7748344	--	10079.4199	728.4115188	1.22422104	4.89688416	--	--	--	11.42606304	42.43966272	102.01842	11181.2188	0.448881048	--	21.0157945	5.30495784	418.275522

Mancos River Watershed -- Mainstem Synoptic Constituent Loads, 2023

Site	Date	Mercury, total, ng/L	Molyb-denum, total, lb/d	Nickel, dissolved, lb/d	Nickel, total, lb/d	Selenium, dissolved lb/d	Selenium, total, lb/d	Silver, dissolved, lb/d	Silver, total, lb/d	Uranium, total, lb/d	Vanadium, total, lb/d	Zinc, dissolved, lb/d	Zinc, total, lb/d	Dissolved Organic Carbon, lb/d	Copper Suspended Sediment Load (Cu tot - Cu diss), lb/d
MAINSTEM MANCOS RIVER															
EM-25A	5/30/2023	< 100	--	0.774260432	1.618908176	--	--	--	--	0.563098496	--	5.912534208	12.03623035	1281.04908	84.4647744
EMEB	5/30/2023	< 100	--	1.341299322	3.04840755	--	--	--	--	0.731617812	--	3.292280154	21.21691655	3597.12091	108.4013725
MANMANCO	5/30/2023	< 100	1.1011512	1.835252	3.4869788	--	--	--	--	--	--	3.8540292	--	7267.59792	28.2628808
MANCHICO	5/30/2023	< 100	1.20802764	2.41605528	3.82542086	--	--	--	--	--	--	4.22809674	--	8295.12313	20.33513194
MRBM	5/31/2023	< 100	1.50571631	4.3020466	5.16245592	--	--	--	--	1.50571631	--	--	--	9292.42066	23.44615397
MRBW	5/31/2023	< 100	1.322353044	3.967059132	6.832157394	--	--	--	--	1.763137392	--	6.61176522	23.36157044	9036.07913	30.63451219
MRJC	6/1/2023	< 100	1.25255949	6.763821246	7.765868838	--	--	--	--	2.004095184	--	11.77405921	--	10997.4723	5.260749858
MRNT	6/1/2023	< 100	--	4.372218	15.04042992	--	--	--	--	2.6233308	--	--	50.36795136	8639.50277	32.87907936
MRSJ	6/2/2023	< 100	--	5.71303152	19.3834998	2.44844208	2.44844208	--	--	3.46862628	--	7.75339992	48.56076792	18506.1414	31.01359968

West Mancos River -- Waste-Rock Leachate Analytical Results, 2023

Site Number	Site Description	Latitude, dd	Longitude, dd	Altitude, ft	Site Type	Sample Type	Labor-atory	Laboratory ID	Analysis Method	Collection Date	Collection Date	Waste Rock Pile Surface Area, ft2	Hardness, mg/L as CaCO3	Calcium, SPLP diss, mg/L	Magnesium, SPLP diss, mg/L	Sodium, SPLP diss, mg/L
West Mancos Mine 1	SPLP leachate, Gold Bed Mine	37.43296	-108.10192	10,990	MS	S	GAL	2307249	SPLP	7/25/2023	13:45	5,200	22.8	6.77	1.43	4.64
West Mancos Mine 2	SPLP leachate, Peerless Mine	37.43502	-108.10423	10,603	MS	S	GAL	2307249	SPLP	7/25/2023	15:45	5,860	23.1	7.46	1.08	4.58

West Mancos River -- Waste-Rock Leachate Analytical Results, 2023

Site	Sulfur, SPLP diss, mg/L	Aluminum, SPLP diss, ug/L	Antimony, SPLP diss, ug/L	Arsenic, SPLP diss, ug/L	Cadmium, SPLP diss, ug/L	Chromium, SPLP diss, ug/L	Cobalt, SPLP diss, ug/L	Copper, SPLP diss, ug/L	Iron, SPLP diss, ug/L	Lead, SPLP diss, ug/L	Manganese, SPLP diss, ug/L	Mercury, SPLP diss, ng/L	Molyb-denum, SPLP diss, ug/L	Nickel, SPLP diss, ug/L	Selenium, SPLP diss ug/L	Silver, SPLP diss, ug/L	Uranium, SPLP diss, ug/L	Vanadium, SPLP diss, ug/L	Zinc, SPLP diss, ug/L
West Mancos Mine 1	21.3	3,740	3.2	21	0.8	< 1.0	8.0	213.0	1,840	3	363	45.4	0.9	13	< 0.4	< 0.2	2.4	16.8	109
West Mancos Mine 2	15.8	534	0.8	< 0.4	0.9	< 1.0	3	29.4	< 39.0	< 0.4	224	< 24.8	< 0.3	4.2	< 0.4	< 0.2	0.5	3.6	37

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2024

SITE PROPERTIES AND CONSTITUENT CONCENTRATIONS, APRIL - JUNE 2024

Site Number	Site Name	Latitude, dd	Longitude, dd	Altitude, ft	Stream Mile from mouth	Site Type	Sample Type	Date	Time	Labor-atory	Sample Laboratory ID	Discharge, instantaneous, ft3/sec	Discharge, instantaneous, gal/min	Field Specific Conductance, uS/cm @ 25oC	Field pH, standard units	Water Temperature, oC	Dissolved Oxygen, mg/L
MAINSTEM MANCOS RIVER																	
MANMANCO	Mancos River near Mancos	37.354004	-108.259153	7,219	77.25	SW	W	5/20/2024	12:50	GAL	2405242	56.6	25402.1	210.4	6.87	9	8.93
MANCHICO	Mancos River at CJ's Bridge	37.327079	-108.329369	6,776	73.00	SW	W	5/20/2024	14:20	GAL	2405242	15.4	6911.5	287.6	7.36	12.5	8.79
MRBM	Mancos River below Mud Creek	37.280344	-108.362442	6,456	69.00	SW	W	5/19/2024	14:10	GAL	2405237	6.32	2836.4	1,029	8.51	20.2	8.16
MRBW	Mancos River below Weber Canyon	37.214489	-108.340612	6,173	63.50	SW	W	5/19/2024	16:20	GAL	2405237	7.82	3509.6	1,020	8.49	22.3	8.24
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	5/21/2024	11:30	GAL	2405269	17.65	7921.3	1515	8.11	13.8	9.08
MRAG	Mancos River above Grassy Canyon	37.061191	-108.537967	5,502	43.46	SW	W	5/21/2024	13:40	GAL	2405269	15.86	7118.0	1684	8.23	18.3	9.15
EAST MANCOS RIVER																	
EM-24A	East Mancos River at Williams Ditch	37.363313	-108.195096	7,977	81.56	SW	W	5/18//24	15:30	GAL	2405237	19.80	8886.2	151	6.81	7.8	7.83
EMAC	East Mancos River 1.3 miles above mouth	37.364410	-108.215250	7,694	80.27	SW	W	4/23/2024	11:00	GAL	2404238	25.50	11444.4	165	6.90	4.3	8.87
EM-25A	East Mancos River near mouth	37.371050	-108.233308	7,483	79.18	SW	W	4/4/2024	12:30	GAL	2404096	3.8	1683.0	410	6.15	5.9	7.7
EM-25A	East Mancos River near mouth	37.371050	-108.233308	7,483	79.18	SW	W	4/12/2024	12:55	GAL	2404140	9.5	4250.1	325	6.16	6.9	7.8
EM-25A	East Mancos River near mouth	37.371050	-108.233308	7,483	79.18	SW	W	4/19/2024	13:15	GAL	2404200	26.6	11938.1	203	6.69	6.1	8.49
EM-25A	East Mancos River near mouth	37.371050	-108.233308	7,483	79.18	SW	W	4/25/2024	12:45	GAL	2404238	40.6	18219.9	155	6.54	5.2	9.51
EM-25A	East Mancos River near mouth	37.371050	-108.233308	7,483	79.18	SW	W	5/19/2024	15:30	GAL	2405237	24.7	11094.3	148	7.21	10.1	8.3
MIDDLE MANCOS RIVER																	
MMAE	Middle Mancos River above East Mancos	37.371632	-108.233229	7,482	79.05	SW	W	5/23/2024	17:00	GAL	2405307	4.2	1885.0	162	7.24	11.6	7.68
WEST MANCOS RIVER																	
WMAE	West Mancos River above East Mancos	37.372609	-108.256029	7,402	78.9	SW	W	5/23/2024	16:00	GAL	2405307	45.1	20240.9	195.9	7.37	11.2	7.85
THUNDER MINE MONITORING																	
Thunder Mine	Mine drainage at collapsed adit	37.397167	-108.127884	10,529	85.70	MW	W	6/5/2024	15:40	GAL	2406080	0.12	53.9	628.6	3.06	6.1	--
EMAT	East Mancos River above Thunder Mine	37.394917	-108.121443	9,680	85.86	SW	W	6/5/2024	11:13	GAL	2406080	16.2	7270.6	96	5.00	6.5	--
EM-WQ-19	Spring below Thunder Mine at East Mancos River	37.393640	-108.122880	9,663	85.74	SP	W	6/5/2024	12:00	GAL	2406080	0.02	9.0	191.9	4.46	5.9	7.44
EMBT	East Mancos River below Thunder Mine	37.393218	-108.123115	9,637	85.39	SW	W	6/5/2024	12:50	GAL	2406080	16.5	7405.2	98.7	4.96	10.2	--
THSP2	Spring downstream from Thunder Mine at East Mancos River	37.390852	-108.128435	9,473	85.34	SP	W	5/31/2024	12:30	GAL	2406006	0.010	4.5	365.3	6.88	7.9	5.02
QUALITY ASSURANCE SAMPLES																	
MRR-Blank-2	Deioized water passed through sample apparatus (syringe, tubing, and cartridge filter)	37.258397	-107.948769	7,500	--	QA	W	5/24/2024	10:00	GAL	2405307	--	--	--	--	--	--

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2024

Site	Date	Dissolved Oxygen, % sat	Turbidity, FAU	Hardness, mg/L as CaCO3	Total Dissolved Solids, mg/L	Alkalinity, total, lab, as CaCO3, mg/L	Bicarbonate, as HCO3 mg/L	Calcium, dissolved, mg/L	Magnesium, dissolved, mg/L	Sodium, dissolved, mg/L	Potassium, dissolved, mg/L	Sulfate, dissolved, mg/L	Chloride, dissolved, mg/L	Fluoride, dissolved, mg/L	Silicon as Si, dissolved, mg/L	Silicate as SiO2, mg/L	Ammonia, dissolved, mg/L as N	Nitrate+ Nitrite, dissolved, mg/L as N	Phosphorus, total, mg/L	Aluminum, dissolved, ug/L	Aluminum, total, ug/L
MAINSTEM MANCOS RIVER																					
MANMANCO	5/20/2024	108.5	13.5	84.9	125	52	63.4	25.8	4.98	3.24	0.958	38.2	0.79	0.102	3.44	7.35	--	0.036	< 0.0215	133	675
MANCHICO	5/20/2024	104.9	16.5	130.3	200	73	89.0	38.2	8.48	5.64	1.17	65.6	2.01	0.117	3.54	7.57	--	0.038	< 0.0215	105	731
MRBM	5/19/2024	98	10.5	615.3	955	203	247.6	146.0	60.90	53.6	3.05	522	9.89	0.208	4.07	8.71	--	< 0.008	< 0.0215	< 22.0	178
MRBW	5/19/2024	101.2	6.5	615.3	975	187	228.0	146.0	60.90	54.0	2.74	526	10.50	0.187	3.59	7.68	--	< 0.008	< 0.0215	< 22.0	127
MRJC	5/21/2024	105.2	15.5	746.4	1,200	199	242.7	164.0	81.80	72.9	3.13	723	12.20	0.202	3.72	7.96	--	< 0.008	< 0.0215	< 22.0	248
MRAG	5/21/2024	106.8	27.0	809.9	1380	197	240.2	169.0	94.20	96.6	3.42	826	13.60	0.194	3.61	7.73	--	< 0.008	< 0.0215	< 22.0	388
EAST MANCOS RIVER																					
EM-24A	5/18//24	103.4	11.0	54.3	70	22	26.8	16.2	3.37	0.934	0.923	36.5	0.456	0.15	2.84	6.08	--	0.092	< 0.0215	71	1,850
EMAC	4/23/2024	105.8	19.0	63.3	--	12	14.6	18.7	4.04	1.1	1.21	56.1	--	--	2.88	6.16	--	--	--	< 22	2,470
EM-25A	4/4/2024	107.5	--	200.4	295	10	12.2	59.0	12.90	3.29	2.48	192	0.673	0.225	3.86	8.26	--	0.028	< 0.0215	< 22	4,650
EM-25A	4/12/2024	101.3	21.0	143.3	230	< 8.0	--	42.2	9.20	2.35	2.47	154	0.642	0.265	4.14	8.86	--	0.044	< 0.0215	280	10,800
EM-25A	4/19/2024	101.6	22.0	85.4	--	13	15.9	25.3	5.40	1.47	1.58	75.5	--	--	3.29	7.04	--	--	--	47	3,260
EM-25A	4/25/2024	102.7	19.5	60.3	--	17	20.7	18.0	3.72	1.06	1.11	49.3	--	--	2.75	5.87	--	--	--	< 22	2,410
EM-25A	5/19/2024	104.3	10.5	63.4	75.1	24	29.3	18.9	3.94	1.15	1.05	40.7	0.476	0.156	2.97	6.35	--	0.079	< 0.0215	69	1,630
MIDDLE MANCOS RIVER																					
MMAE	5/23/2024	101.1	28.5	69.9	95	51	62.2	20.9	4.30	2.82	0.817	27.6	0.670	0.064	4.16	8.9	--	0.012	< 0.0215	466	458
WEST MANCOS RIVER																					
WMAE	5/23/2024	103.0	8.5	87.5	120	61	74.4	28.4	4.03	2.75	0.79	28.5	0.641	0.077	2.71	5.8	--	0.018	< 0.0215	45	144
THUNDER MINE MONITORING																					
Thunder Mine	6/5/2024	--	8.5	54.1	285	< 8.0	--	14.6	4.28	0.371	2.71	227	0.441	0.104	10.1	21.6	< 0.063	< 0.26	0.0411	1,890	1,770
EMAT	6/5/2024	--	6.5	30.9	70	< 8.0	--	9.24	1.89	0.540	0.86	47.0	0.336	0.211	3.49	7.46	--	0.186	< 0.0215	2,650	2,910
EM-WQ-19	6/5/2024	94	0.0	68.1	125	< 8.0	--	20.1	4.36	0.614	1.08	72.8	0.418	0.127	6.84	14.6	< 0.063	< 0.013	< 0.0215	440	402
EMBT	6/5/2024	--	5.5	31.4	75.1	< 8.0	--	9.46	1.88	0.538	0.880	48.5	0.328	0.225	3.55	7.59	--	0.179	< 0.0215	2,610	2,850
THSP2	5/31/2024	74	--	172.5	220	168		47.0	13.40	2.47	1.64	25.4	0.639	0.085	3.93	8.4	< 0.063	< 0.013	< 0.0215	< 22.0	3,960
SAMPLES																					
MRR-Blank-2	5/24/2024	--	--	--	< 10	< 8	--	0.2	< 0.03	0.658	< 0.075	0.227	0.216	< 0.009	0.844	1.81	--	< 0.008	< 0.0215	< 22.0	--

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2024

Site	Date	Aluminum, Bioavailable, ug/L	Arsenic, dissolved, ug/L	Arsenic, total, ug/L	Cadmium, dissolved, ug/L	Cadmium, total, ug/L	Chromium, total, ug/L	Copper, dissolved, ug/L	Copper, total, ug/L	Iron, dissolved, ug/L	Iron, total, ug/L	Iron, Ferrous (Fe^{2+}), mg/L	Lead, dissolved, ug/L	Lead, total, ug/L	Manganese, dissolved, ug/L	Manganese, total, ug/L	Mercury, total, ng/L	Molyb-denum, total, ug/L	Nickel, dissolved, ug/L	Nickel, total, ug/L
MAINSTEM MANCOS RIVER																				
MANMANCO	5/20/2024	79.4	< 0.6	< 0.7	< 0.06	0.08	--	21.4	63	45	430		< 0.1	0.4	22.8	40.9	--	0.5	1.8	2
MANCHICO	5/20/2024	74.1	< 0.6	< 0.7	< 0.06	< 0.07	--	14.2	47.4	22	510		< 0.1	0.4	21.1	64.1	--	0.7	1.9	2.3
MRBM	5/19/2024	46	< 0.6	0.8	< 0.06	< 0.07	--	7.7	9.6	< 20	304		< 0.1	< 0.3	38.4	46.6	--	2.8	7.3	7.4
MRBW	5/19/2024	53.6	< 0.6	< 0.7	< 0.06	< 0.07	--	6.2	6.7	< 20	182		< 0.1	< 0.3	11.4	15.1	--	2.2	6.9	7.2
MRJC	5/21/2024	16.6	< 0.6	< 0.7	< 0.06	< 0.07	--	7.2	7.4	< 20	443		< 0.1	0.5	14.3	31.8	--	2.5	8.3	8
MRAG	5/21/2024	11.2	< 0.6	< 0.7	< 0.06	< 0.07	--	6.4	6.2	< 20	585		< 0.1	0.7	24.7	46.4	--	2.4	8.7	8.4
EAST MANCOS RIVER																				
EM-24A	5/18//24	614	< 0.6	< 0.7	0.2	0.3	--	36	249	23	683		< 0.1	< 0.3	85.9	84.4	--	< 0.2	3.7	3.7
EMAC	4/23/2024	--	< 0.6	< 0.7	--	--	--	21	197	< 20	699		--	< 0.3	67.7	70.7	--	--	--	--
EM-25A	4/4/2024	800	< 0.6	< 0.7	0.8	0.7	--	131.0	596.0	< 20	96		0.3	< 0.3	178	165	--	< 0.2	14.6	13.5
EM-25A	4/12/2024	531	< 0.6	< 0.7	0.9	0.8	--	1,080	1,280	26	531		< 0.1	< 0.3	265	257	--	< 0.2	16.5	153
EM-25A	4/19/2024	--	< 0.6	< 0.7	--	--	--	50	272	< 20	556		--	< 0.3	110	110	--	--	--	--
EM-25A	4/25/2024	--	< 0.6	< 0.7	--	--	--	21	197	< 20	699		--	< 0.3	67.7	70.7	--	--	--	--
EM-25A	5/19/2024	604	< 0.6	< 0.7	0.2	0.2	--	28.6	212.0	< 20	538		< 0.1	< 0.3	69.2	68.4	--	< 0.2	3.4	3.4
MIDDLE MANCOS RIVER																				
MMAE	5/23/2024	48.3	< 0.6	< 0.7	< 0.06	< 0.07	--	1.4	1.5	227	394		< 0.1	0.6	5.7	10.9	--	0.4	1.4	1.5
WEST MANCOS RIVER																				
WMAE	5/23/2024	32.8	< 0.6	< 0.7	< 0.06	< 0.07	--	3.6	4	22	118		< 0.1	< 0.3	4.6	12.7	--	0.7	1.7	1.4
THUNDER MINE MONITORING																				
Thunder Mine	6/5/2024	--	456	491	1.9	1.7	< 1.4	3,700	3,620	50,600	47,800	2.18	105	103	390	366	< 19.6	3.8	9.1	8.6
EMAT	6/5/2024	2,510	< 0.6	2.1	0.8	0.7	--	824	785	922	2,830	0.41	< 0.1	< 0.3	229	224	--	0.3	6.3	5.9
EM-WQ-19	6/5/2024	--	< 0.6	< 0.7	0.6	0.5	< 1.4	205	193	< 20	< 26	0.015	< 0.1	< 0.3	296	287	< 19.6	< 0.2	6.6	6.3
EMBT	6/5/2024	2,520	< 0.6	1.3	0.7	0.7	--	820	785	904	2,080	0.655	< 0.1	< 0.3	229	223	--	0.1	6.4	6.1
THSP2	5/31/2024	--	< 0.6	2.9	< 0.06	0.1	2.5	4	81	< 20	3,760	0.02	< 0.1	4.5	1.8	253	< 19.6	0.4	2.4	4.2
QUALITY ASSURANCE SAMPLES																				
MRR-Blank-2	5/24/2024	--	< 0.6	--	< 0.06	--	--	0.3	--	< 20	--	--	< 0.1	--	0.3	--	--	< 0.05	< 0.05	--

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2024

Site	Date	Selenium, dissolved ug/L	Selenium, total, ug/L	Silver, dissolved, ug/L	Silver, total, ug/L	Uranium, total, ug/L	Vanadium, total, ug/L	Zinc, dissolved, ug/L	Zinc, total, ug/L	Dissolved Organic Carbon, mg/L
MAINSTEM MANCOS RIVER										
MANMANCO	5/20/2024	0.5	--	--	--	0.5	--	3	8.7	3.49
MANCHICO	5/20/2024	0.6	--	--	--	0.8	--	1.1	6.4	3.38
MRBM	5/19/2024	1.7	--	--	--	4.8	--	1.7	< 2.7	5.86
MRBW	5/19/2024	2	--	--	--	4.3	--	2.9	< 2.7	7.08
MRJC	5/21/2024	2.5	--	--	--	5.3	--	3.0	< 2.7	4.72
MRAG	5/21/2024	2.4	--	--	--	5.1	--	2.5	2.8	6.06
EAST MANCOS RIVER										
EM-24A	5/18//24	< 0.3	--	--	--	1.2	--	19.4	34	1.20
EMAC	4/23/2024	--	--	--	--	--	--	20.4	27.2	2.81
EM-25A	4/4/2024	0.5	--	--	--	2.4	--	122	123	1.55
EM-25A	4/12/2024	< 0.3	--	--	--	5.2	--	174	151	3.13
EM-25A	4/19/2024	--	--	--	--	--	--	47.4	50	1.29
EM-25A	4/25/2024	--	--	--	--	--	--	20.4	27.2	2.81
EM-25A	5/19/2024	< 0.3	--	--	--	1.1	--	13.5	24.8	1.53
MIDDLE MANCOS RIVER										
MMAE	5/23/2024	0.7	--	--	--	0.1	--	1.9	< 2.7	3.95
WEST MANCOS RIVER										
WMAE	5/23/2024	0.9	--			0.2	--	2.1	< 2.7	3.35
THUNDER MINE MONITORING										
Thunder Mine	6/5/2024	0.6	0.6	--	< .3	1.0	< 3.0	551.0	585	--
EMAT	6/5/2024	< 0.3	--	--	--	2.2	--	78.4	66.3	1.23
EM-WQ-19	6/5/2024	< 0.3	0.6	--	< 0.3	< 0.07	< 3.0	74.2	62.8	--
EMBT	6/5/2024	< 0.3	--	--	--	2.3	--	78.9	65.2	3.04
THSP2	5/31/2024	0.9	1.2	--	< 0.3	1.4	7.2	2.4	11	--
QUALITY ASSURANCE SAMPLES										
MRR-Blank-2	5/24/2024	< 0.3	--	--	--	< 0.04	--	1.1	--	0.32

Mancos River Watershed -- Mainstem Synoptic Constituent Loads, 2024

MANCOS RIVER MAINSTEM, SITE PROPERTIES AND CONSTITUENT LOADS, APRIL - JUNE 2024
Mainstem Constituent Loads, 2024

Site Number	Site Name	Latitude, dd	Longitude, dd	Altitude, ft	Stream Mile from mouth	Site Type	Sample Type	Date	Time	Labor-atory	Sample Laboratory ID	Discharge, instantaneous, ft3/sec	Discharge, instantaneous, gal/min	Field Specific Conductance, uS/cm @ 25oC	Field pH, standard units	Water Temperature, oC	Dissolved Oxygen, mg/L	Dissolved Oxygen, % sat
MAINSTEM MANCOS RIVER																		
EMAT	East Mancos River above Thunder Mine	37.394917	-108.121443	9,680	85.86	SW	W	6/5/2024	11:13	GAL	2406080	16.2	7270.6	96	5.00	6.5	--	--
EMBT	East Mancos River below Thunder Mine	37.393218	-108.123115	9,637	85.39	SW	W	6/5/2024	12:50	GAL	2406080	16.5	7405.2	98.7	4.96	10.2	--	--
EM-24A	East Mancos River at Williams Ditch	37.363313	-108.195096	7,977	81.56	SW	W	5/18//24	15:30	GAL	2405237	19.80	8886.2	151	6.81	7.8	7.83	103.4
EMAC	East Mancos River 1.3 miles above mouth	37.364410	-108.215250	7,694	80.27	SW	W	4/23/2024	11:00	GAL	2404238	25.50	11444.4	165	6.9	4.3	8.87	105.8
EM-25A	East Mancos River near mouth	37.371050	-108.233308	7,483	79.18	SW	W	4/25/2024	12:45	GAL	2404238	40.6	18219.9	155	6.54	5.2	9.51	102.7
EM-25A	East Mancos River near mouth	37.371050	-108.233308	7,483	79.18	SW	W	5/19/2024	15:30	GAL	2405237	24.7	11094.3	148	7.21	10.1	8.3	104.3
MANMANCO	Mancos River near Mancos	37.354004	-108.259153	7,219	77.25	SW	W	5/20/2024	12:50	GAL	2405242	56.6	25402.1	210.4	6.87	9	8.93	108.5
MANCHICO	Mancos River at CJ's Bridge	37.327079	-108.329369	6,776	73.00	SW	W	5/20/2024	14:20	GAL	2405242	15.4	6911.5	287.6	7.36	12.5	8.79	104.9
MRBM	Mancos River below Mud Creek	37.280344	-108.362442	6,456	69.00	SW	W	5/19/2024	14:10	GAL	2405237	6.32	2836.4	1,029	8.51	20.2	8.16	98
MRBW	Mancos River below Weber Canyon	37.214489	-108.340612	6,173	63.50	SW	W	5/19/2024	16:20	GAL	2405237	7.82	3509.6	1,020	8.49	22.3	8.24	101.2
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	5/21/2024	11:30	GAL	2405269	17.65	7921.3	1515	8.11	13.8	9.08	105.2
MRAG	Mancos River above Grassy Canyon	37.061191	-108.537967	5,502	43.46	SW	W	5/21/2024	13:40	GAL	2405269	15.86	7118.0	1684	8.23	18.3	9.15	106.8

Mancos River Watershed -- Mainstem Synoptic Constituent Loads, 2024

Site	Date	Hardness, lb/d as CaCO3	Total Dissolved Solids, lb/d	Alkalinity, total, lb/d as CaCO3	Bicarbonate, lb/d as HCO3	Calcium, dissolved, lb/d	Magnesium, dissolved, lb/d	Sodium, dissolved, lb/d	Potassium, dissolved, lb/d	Sulfate, dissolved, lb/d	Chloride, dissolved, lb/d	Fluoride, dissolved, lb/d	Silicon as Si, dissolved, lb/d	Silicate as SiO2, lb/d	Ammonia, dissolved, lb/d as N	Nitrate+ Nitrite, dissolved, lb/d as N	Phosphorus, total, lb/d	Aluminum, dissolved, lb/d	Aluminum, total, lb/d	Aluminum, Bioavailable, lb/d
MAINSTEM MANCOS RIVER																				
EMAT	6/5/2024	2698.1	6121.1	--	--	808.0	165.3	47.2	75.4	4109.9	29.4	18.5	305.2	652.3	--	16.3	--	231.7	254.5	219.5
EMBT	6/5/2024	2793.3	6688.7	--	--	842.5	167.4	47.9	78.4	4319.6	29.2	20.0	316.2	676.0	--	15.9	--	232.5	253.8	224.4
EM-24A	5/18//24	5806.5	7481.4	2351.3	2867.4	1731.4	360.2	99.8	98.6	3901.0	48.7	16.0	303.5	649.8	--	9.8	--	7.6	197.7	65.6
EMAC	4/23/2024	8717.1	--	1651.7	2014.3	2573.9	556.1	151.4	166.5	7721.8	--	--	396.4	847.9	--	--	--	--	340.0	--
EM-25A	4/25/2024	13206.1	--	3725.3	4543.0	3944.4	815.2	232.3	243.2	10803.3	--	--	602.6	1286.3	--	--	--	--	528.1	--
EM-25A	5/19/2024	8462.1	10020.9	3202.4	3905.4	2521.9	525.7	153.4	140.1	5430.7	63.5	20.8	396.3	847.3	--	10.5	--	9.2	217.5	80.6
MANMANCO	5/20/2024	25947.5	38189.4	15886.8	19374.2	7882.3	1521.5	989.9	292.7	11670.7	241.4	31.2	1051.0	2245.5	--	11.0	--	40.6	206.2	24.3
MANCHICO	5/20/2024	10831.8	16625.2	6068.2	7400.3	3175.4	704.9	468.8	97.3	5453.1	167.1	9.7	294.3	629.3	--	3.2	--	8.7	60.8	6.2
MRBM	5/19/2024	20992.0	32579.0	6925.2	8445.3	4980.7	2077.5	1828.5	104.0	17807.6	337.4	7.1	138.8	297.1	--	--	--	--	6.1	1.6
MRBW	5/19/2024	25974.3	41155.5	7893.4	9626.1	6162.8	2570.6	2279.4	115.7	22202.9	443.2	7.9	151.5	324.2	--	--	--	--	5.4	2.3
MRJC	5/21/2024	71106.6	114325.4	18959.0	23120.7	15624.5	7793.2	6945.3	298.2	68881.1	1162.3	19.2	354.4	758.4	--	--	--	--	23.6	1.6
MRAG	5/21/2024	69335.6	118140.6	16865.0	20567.1	14467.9	8064.4	8269.8	292.8	70713.1	1164.3	16.6	309.0	661.8	--	--	--	--	33.2	1.0

Mancos River Watershed -- Mainstem Synoptic Constituent Loads, 2024

Site	Date	Arsenic, dissolved, lb/d	Arsenic, total, lb/d	Cadmium, dissolved, lb/d	Cadmium, total, lb/d	Chromium, total, lb/d	Copper, dissolved, lb/d	Copper, total, lb/d	Copper Suspended Sediment Load (Cu tot - Cu diss), lb/d	Iron, dissolved, lb/d	Iron, total, lb/d	Iron, Ferrous (Fe^{2+}), mg/L	Lead, dissolved, lb/d	Lead, total, lb/d	Manganese, dissolved, lb/d	Manganese, total, lb/d	Mercury, total, ng/L	Molyb-denum, total, lb/d	Nickel, dissolved, lb/d	Nickel, total, lb/d
MAINSTEM MANCOS RIVER																				
EMAT	6/5/2024	--	0.2	0.1	0.1	--	72.1	68.6	-3.41	80.6	247.5	--	--	--	20.0	19.6	--	0.0	0.6	0.5
EMBT	6/5/2024	--	0.1	0.1	0.1	--	73.0	69.9	-3.12	80.5	185.3	--	--	--	20.4	19.9	--	0.0	0.6	0.5
EM-24A	5/18//24	--	--	0.02	0.03	--	3.9	26.6	22.72	2.5	73.0	--	--	--	9.2	9.0	--	--	0.4	0.4
EMAC	4/23/2024	--	--	--	--	--	2.9	27.1	24.24	--	96.2	--	--	--	9.3	9.7	--	--	--	--
EM-25A	4/25/2024	--	--	--	--	--	4.6	43.2	38.59	--	153.2	--	--	--	14.8	15.5	--	--	--	--
EM-25A	5/19/2024	--	--	0.03	0.03	--	3.8	28.3	24.47	--	71.8	--	--	--	9.2	9.1	--	--	0.5	0.5
MANMANCO	5/20/2024	--	--	--	0.02	--	6.5	19.2	12.71	13.7	131.4	--	--	0.1	7.0	12.5	--	0.2	0.5	0.6
MANCHICO	5/20/2024	--	--	--	--	--	1.2	3.9	2.76	1.8	42.4	--	--	0.03	1.8	5.3	--	0.1	0.2	0.2
MRBM	5/19/2024	--	0.03	--	--	--	0.3	0.3	0.06	--	10.4	--	--	--	1.3	1.6	--	0.1	0.2	0.3
MRBW	5/19/2024	--	--	--	--	--	0.3	0.3	0.02	--	7.7	--	--	--	0.5	0.6	--	0.1	0.3	0.3
MRJC	5/21/2024	--	--	--	--	--	0.7	0.7	0.02	--	42.2	--	--	0.05	1.4	3.0	--	0.2	0.8	0.8
MRAG	5/21/2024	--	--	--	--	--	0.5	0.5	0.02	--	50.1	--	--	0.1	2.1	4.0	--	0.2	0.7	0.7

Mancos River Watershed -- Mainstem Synoptic Constituent Loads, 2024

Site	Date	Selenium, dissolved lb/d	Selenium, total, lb/d	Silver, dissolved, lb/d	Silver, total, lb/d	Uranium, total, lb/d	Vanadium, total, lb/d	Zinc, dissolved, lb/d	Zinc, total, lb/d	Dissolved Organic Carbon, lb/d
MAINSTEM MANCOS RIVER										
EMAT	6/5/2024	--	--	--	--	0.2	--	6.9	5.8	107.6
EMBT	6/5/2024	--	--	--	--	0.2	--	7.0	5.8	270.8
EM-24A	5/18//24	--	--	--	--	0.1	--	2.1	3.6	128.3
EMAC	4/23/2024	--	--	--	--	--	--	2.8	3.7	386.8
EM-25A	4/25/2024	--	--	--	--	--	--	4.5	6.0	615.8
EM-25A	5/19/2024	--	--	--	--	0.1	--	1.8	3.3	204.2
MANMANCO	5/20/2024	0.2	--	--	--	0.2	--	0.9	2.7	1066.2
MANCHICO	5/20/2024	0.05	--	--	--	0.1	--	0.1	0.5	281.0
MRBM	5/19/2024	0.1	--	--	--	0.2	--	0.1	--	199.9
MRBW	5/19/2024	0.1	--	--	--	0.2	--	0.1	--	298.9
MRJC	5/21/2024	0.2	--	--	--	0.5	--	0.3	--	449.7
MRAG	5/21/2024	0.2	--	--	--	0.4	--	0.2	0.2	518.8

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2026

SITE PROPERTIES AND CONSTITUENT CONCENTRATIONS, March - May 2026

Site Number	Site Name	Latitude, dd	Longitude, dd	Altitude, ft	Stream Mile from mouth	Site Type	Sample Type	Date	Time	Labor-atory	Discharge, instantaneous, ft3/sec	Discharge, instantaneous, gal/min	Field Specific Conductance, uS/cm @ 25oC	Field pH, standard units	Laboratory pH, standard units	Water Temperature, oC	Dissolved Oxygen, mg/L
EM25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	3/11/2026	14:40:00	GAL	12.82	5,754	354	4.87	6.71	5.2	9.58
EM25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	3/18/2026	15:20:00	GAL	10.12	4,542	302.1	4.45	6.44	7.5	10.12
EM-25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	3/24/2026	10:00	GAL	12.91	5,794	242.9	5.60	7.04	3.7	10.23
EM25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	3/31/2026	11:30:00	GAL	9.67	4,340	226.6	6.04	7.2	5.3	10.2
EM25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	4/8/2026	10:30:00	GAL	6.98	3,133	257.5	7.28	7.29	3.9	11.39
EM25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	4/15/2026	10:30:00	GAL	6.56	2,944	252.5	6.39	7.34	2.8	10.94
EM25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	4/22/2026	10:45:00	GAL	1.87	839	295.0	7.1	7.49	5.7	10.24
EM25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	4/29/2026	10:30:00	GAL	3.8	1,705	272.2	6.14	7.3	5.5	10.8
EM25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	5/6/2026	10:15:00	GAL	5.35	2,401	265.9	4.88	7.25	5.3	9.32
EM25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	5/12/2026	10:30:00	GAL	11.83	5,309	235.8	4.26	6.34	7.7	9.83
EM25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	5/21/2026	10:30:00	GAL	8.43	3,783	246.4	5.36	7.17	6.3	9.36
EMAT#2	East Mancos River above Thunder Mine, #2	37.395070	-108.121380	9,680	85.86	SW	W	4/24/2026	13:15:00	GAL	3.43	1,539	274	4.65	4.54	6.5	11.4
EMBT#2	East Mancos River below Thunder Mine, #2	37.393218	-108.123115	9637	85.39	SW	W	4/24/2026	12:00:00	GAL	4.82	2,163	253.3	4.79	4.56	3.5	12.79
EMEB	East Mancos at Echo Basin Road	37.361836	-108.246998	7,328	78.05	SW	W	3/25/2026	10:00:00	GAL	20.52	9,209	220.8	6.76	7.36	5.8	10.65
EMWQ19	Spring below Thunder Mine at East Mancos River	37.393640	-108.122880	9,663	85.74	SP	W	4/24/2026	12:00:00	GAL	0.032	14	264	4.81	4.78	4.3	10.41
MANCHICO	Mancos River at CJ's Bridge	37.327079	-108.329369	6,776	73.00	SW	W	3/24/2026	13:50:00	GAL	11	4,937	500	8.03	7.99	11.2	13.29
MANCHICO_30	Mancos River at CJ's Bridge	37.327079	-108.329369	6,776	73.00	QA	W	3/24/2026	13:50:00	GAL	11	4,937	500	8.03	8.02	11.2	13.29
MANCHICO_90	Mancos River at CJ's Bridge	37.327079	-108.329369	6,776	73.00	QA	W	3/24/2026	13:50:00	GAL	0	0	0	0	5.75	0	0
MANMANCO	Mancos River near Mancos	37.354004	-108.259153	7,219	77.25	SW	W	3/25/2026	9:30:00	GAL	16.4	7,360	268.2	7.37	7.53	5.6	13.8
MMAE	Middle Mancos River above East Mancos	37.371650	-108.233217	7,482	79.19	SW	W	3/24/2026	11:30:00	GAL	4.68	2,100	164.9	6.56	7.81	5.8	10.18
MRAG	Mancos River above Grassy Canyon	37.061191	-108.537967	5,502	43.46	SW	W	3/25/2026	15:40:00	GAL	11.39	5,112	1324	8.26	8.33	17.7	10.65
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	3/11/2026	14:15:00	GAL	5.01	2,248	1639	8.16	8.21	9.6	12.15
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	3/18/2026	15:10:00	GAL	7.12	3,195	1399	8.01	8.27	13.7	10.27
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	3/24/2026	15:30:00	GAL	11.11	4,986	1173	8.04	8.26	15.3	10.31
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	3/31/2026	14:50:00	GAL	7.7	3,456	1193	8.11	8.23	12.6	10.53
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	4/8/2026	14:45:00	GAL	4.7	2,109	1336	8.2	8.27	15.2	10.56
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	4/15/2026	13:30:00	GAL	8.4	3,770	1258	8.21	8.22	12.3	11.37
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	4/22/2026	13:25:00	GAL	2	898	1918	8.03	8.2	15.4	10.17
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	4/29/2026	13:00:00	GAL	1.65	741	2056	8.05	8.12	12.7	10.45
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	5/6/2026	13:00:00	GAL	1.09	489	2082	7.96	8.02	11.9	10.5
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	5/12/2026	10:40:00	GAL	3.66	1,643	1097	7.98	8.19	12.3	11.39
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	5/21/2026	9:15:00	GAL	2.4	1,077	1892	8.08	8.1	12.3	10.71
MRAW_30	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	QA	W	4/22/2026	13:25:00	GAL	2	898	1918	8.03	8.2	15.4	10.17
MRAW_90	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	QA	W	3/11/2026	14:15:00	GAL	0	0	0	--	5.77	--	--
MRAW_90	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	QA	W	3/18/2026	15:10:00	GAL	7.12	3,195	0	--	5.62	--	--
MRAW_90	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	QA	W	4/22/2026	13:25:00	GAL	0	0	0	--	5.82	--	--
MRBM	Mancos River below Mud Creek	37.280344	-108.362442	6,456	69.00	SW	W	3/25/2026	12:30:00	GAL	21.63	9,708	801.8	7.10	8.18	13.2	10.15
MRBW	Mancos River below Weber Canyon	37.214489	-108.340612	6,173	63.50	SW	W	3/24/2026	16:45:00	GAL	12.64	5,673	1263	8.13	8.24	15.8	9.99
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	3/11/2026	10:30:00	GAL	6.95	3,119	1888	8.32	8.28	6.8	13.43
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	3/18/2026	12:00:00	GAL	9.4	4,219	1340	8.24	8.27	7.6	11.18
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	3/25/2026	17:25:00	GAL	9.1	4,084	1352	8.25	8.32	17.39	8.03
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	3/31/2026	12:00:00	GAL	5.4	2,424	1376	8.21	8.28	11.45	8.47
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	4/8/2026	16:00:00	GAL	2.19	983	1714	8.18	8.34	15.64	7.99
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	4/15/2026	10:00:00	GAL	4.17	1,871	1981	8.19	8.24	7.7	9.32
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	4/22/2026	10:00:00	GAL	1	449	1929	8.09	8.21	11.67	8.01
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	4/29/2026	10:40:00	GAL	0.83	373	2195	8.16	8.22	10.56	8.94
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	5/6/2026	10:15:00	GAL	0.2	90	2242	8.17	8.18	11.4	8.44
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	5/12/2026	13:00:00	GAL	5.61	2,518	1849	8.34	8.34	16.9	11.3
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	5/21/2026	11:05:00	GAL	8.3	3,725	1631	8.06	8.24	14.6	8.6
MRJC_30	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	QA	W	5/12/2026	13:00:00	GAL	5.61	2,518	1849	8.34	8.35	16.9	11.3
MRJC_90	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	QA	W	5/12/2026	13:00:00	GAL		0			5.72		
MRNT	Mancos River near Towaoc (USGS site)	37.027364	-108.742003	5,056	22.90	SW	W	3/25/2026	17:00:00	GAL	9.25	4,151	1497	8.28	8.33	19.5	9.9
MRSJ	Mancos River at San Juan River (USGS site)	36.982446	-108.965482	4,679	1.18	SW	W	3/25/2026	19:00:00	GAL	6.08	2,729	1891	8.25	8.26	18.9	9.82
QAEB	QA East Mancos Echo Basin					QA	W	3/25/2026	15:00:00	GAL		0					
TDME	Thunder Drainage at FS567					SW	W	4/24/2026	11:15:00	GAL		0	306.1	3.65	4.34	4.6	11.4
Thunder Mine	Thunder adit drainage				85.7	MW	W	4/24/2026	11:00:00	GAL	0.011	5	638.8	2.63	3.12	10.1	n/a
WMAJ	West Mancos above Jackson Gulch Diversion	37.43243	-108.233869	8010		SW	W	3/24/2026	11:15:00	GAL	35.12	15,762	205.7	7.72	7.92	3.3	13.51

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2026

Site	Date	Dissolved Oxygen, % sat	Turbidity, FAU	Hardness, mg/L as CaCO3	Total Dissolved Solids, mg/L	Alkalinity, total, lab, as CaCO3, mg/L	Bicarbonate, as HCO3 mg/L	Calcium, dissolved, mg/L	Magnesium, dissolved, mg/L	Sodium, dissolved, mg/L	Potassium, dissolved, mg/L	Sulfate, dissolved, mg/L	Chloride, dissolved, mg/L	Fluoride, dissolved, mg/L	Silicon as Si, dissolved, mg/L	Silicate as SiO2, mg/L	Nitrate+ Nitrite, dissolved, mg/L as N
EM25A	3/11/2026	101.7	5.0	151	209	<6	--	44.9	9.45	2.51	2.39	149	0.617	0.258	4.3	9.21	<0.0119
EM25A	3/18/2026	103	17.3	125	186	14	17.1	37.1	7.81	2.27	1.98	128	0.558	0.21	3.99	8.53	0.049
EM-25A	3/24/2026	101.1	14.6	88	128	<6.00	--	26.0	5.58	1.62	1.55	89.5	0.554	0.138	3.35	7.16	0.067
EM25A	3/31/2026	103	16.3	83	124	8	9.8	24.6	5.29	1.46	1.46	85.8	0.537	0.172	3.27	7	0.0646
EM25A	4/8/2026	104.6	10.0	105	144	15	18.3	31.3	6.62	1.91	1.76	93.2	0.563	0.181	3.42	7.31	0.0586
EM25A	4/15/2026	99	7.3	102	141	12	14.6	30.2	6.43	2.18	1.77	92.5	0.569	0.208	3.2	6.84	0.0453
EM25A	4/22/2026	101.4	6.3	126	172	20	24.4	37.6	7.9	2.53	1.73	110	0.597	0.189	3.55	7.6	0.083
EM25A	4/29/2026	101.1	9.7	111	159	18	22.0	33	6.99	2.2	1.81	104	0.551	0.183	3.41	7.29	0.0406
EM25A	5/6/2026	101.7	14.7	108	153	11	13.4	31.7	6.99	2.59	1.93	103	0.531	0.196	3.47	7.42	0.044
EM25A	5/12/2026	99	24.3	93	133	<6	--	27.4	5.92	1.95	1.85	94.9	0.525	0.199	3.78	8.08	0.124
EM25A	5/21/2026	100	12.7	84	134	11	13.4	24.2	5.61	2.3	1.52	93.7	0.513	0.161	3.53	7.56	0.137
EMAT#2	4/24/2026	92.7	13.6	54	210	<6	--	16.6	2.95	1.44	1.94	134	<0.497	0.403	4.87	10.4	0.057
EMBT#2	4/24/2026	12.88	13.3	55	200	<6	--	17	3.11	1.13	1.75	125	<0.497	0.377	4.79	10.2	0.06
EMEB	3/25/2026	103.3	23.7	98	122	19	23.2	29.1	6.23	2.23	1.56	71.9	<0.497	0.134	4.09	8.75	0.0489
EMWQ19	4/24/2026		0.7	115	235	<6	--	33.9	7.33	0.795	1.52	133	0.573	0.214	7.18	15.4	<0.009
MANCHICO	3/24/2026	115	4.7	194	266	66	80.5	50.7	16.4	10.2	1.77	144	3.51	0.149	3.65	7.8	0.135
MANCHICO_30	3/24/2026	115	3.7	196	268	70	85.4	52.7	15.6	10.5	1.81	142	3.49	0.146	3.52	7.52	0.131
MANCHICO_90	3/24/2026	0	0.0	1	<5.45	<6	--	0.145	<0.074	<0.498	<0.169	<0.563	<0.497	<0.0336	<0.11	<0.235	<0.0119
MANMANCO	3/25/2026	104.4	23.0	133	156	27	32.9	37.4	9.66	4.92	1.58	85.6	1.01	0.139	4.28	9.15	<0.0119
MMAE	3/24/2026	102.7	14.6	65.9	82.8	53	64.6	19.3	4.31	2.94	0.856	22.6	0.962	0.072	4.69	10	0.038
MRAG	3/25/2026	105.8	11.3	656	990	171	208.5	148	69.5	71	3.14	586	10.2	0.181	3.34	7.14	<0.0119
MRAW	3/11/2026	101	5.0	742	466	209	254.9	176	73.5	71.6	2.99	<5.63	16.1	0.178	2.82	6.03	0.57
MRAW	3/18/2026	96.9	5.0	657	1010	192	234.1	161	62	58.5	2.63	602	12.5	0.172	3.24	6.94	<0.0119
MRAW	3/24/2026	101	3.7	468	699	144	175.6	107	48.7	37.3	2.17	410	8	0.176	3.17	6.79	<0.0119
MRAW	3/31/2026	100.2	5.0	514	823	169	206.1	127	47.8	45.3	2.26	488	11.7	0.183	2.65	5.68	<0.0119
MRAW	4/8/2026	95.3	3.3	616	957	192	234.1	149	59.2	56.4	2.69	563	11.7	0.193	3.15	6.74	<0.0119
MRAW	4/15/2026	102	3.3	609	896	181	220.7	145	59.9	54.5	2.87	514	10.7	0.191	3.8	8.13	<0.0119
MRAW	4/22/2026	99.4	2.0	877	1520	216	263.4	202	90.6	89.7	2.63	988	16.8	0.189	3.61	<2.35	<0.0358
MRAW	4/29/2026	108	1.3	969	1690	224	273.2	224	99.4	99.3	3.22	1100	22.6	0.192	3.68	7.88	<0.0119
MRAW	5/6/2026	90.6	2.7	1041	1640	215	262.2	234	111	112	3.62	1030	20	0.194	3.57	7.63	<0.0119
MRAW	5/12/2026	96.5	6.3	493	751	170	207.3	120	47	44	3.75	426	7.34	0.146	3.52	7.53	<0.0119
MRAW	5/21/2026	102.5	22.3	719	1410	201	245.1	165	74.5	83.6	2.91	951	16.5	0.145	2.99	6.4	<0.0119
MRAW_30	4/22/2026	99.4	2.8	908	1410	225	274.4	208	94.3	90.1	3.43	866	16.9	0.19	3.55	<2.35	<0.0358
MRAW_90	3/11/2026	--	--	1	<5.45	<6	--	0.109	<0.074	<0.498	<0.169	<0.563	<0.497	<0.0336	<0.11	<0.235	<0.0119
MRAW_90	3/18/2026	--	--	1	<5.45	15	18.3	0.119	<0.074	<0.498	<0.169	<0.563	<0.497	0.034	<0.11	<0.235	<0.0119
MRAW_90	4/22/2026	--	--	0	<5.45	<6	--	0.073	<0.074	<0.498	<0.169	<0.563	<0.497	<0.0336	<0.11	<0.235	<0.0119
MRBM	3/25/2026	112.7	10.0	328	519	115	140.2	84.5	28.5	29.6	2.23	299	6.32	0.168	2.76	5.9	0.0427
MRBW	3/24/2026	102	7.3	519	775	152	185.4	113	57.4	43.7	2.18	459	8.12	0.185	3.45	7.38	<0.0119
MRJC	3/11/2026	114	6.0	805	1280	212	258.5	173	90.6	93.4	3.23	778	16.9	0.169	3.59	7.68	0.646
MRJC	3/18/2026	94.3	3.0	756	1230	205	250.0	166	82.9	81.2	2.83	764	13.8	0.189	3.42	7.31	<0.0119
MRJC	3/25/2026	89	5.3	538	885	169	206.1	122	56.6	65.8	2.8	526	9.62	0.181	2.93	6.26	<0.0119
MRJC	3/31/2026	109	6.7	539	958	182	222.0	121	57.5	58.7	2.48	598	10.4	0.18	2.76	5.9	<0.0119
MRJC	4/8/2026	80.8	4.0	698	1120	195	237.8	152	77.4	77.2	2.9	681	12.9	0.19	3.14	6.71	<0.0119
MRJC	4/15/2026		6.0	968	1480	216	263.4	193	118	108	4.33	907	15.8	0.16	5.2	11.1	<0.0119
MRJC	4/22/2026	74.2	5.0	801	1370	204	248.8	162	96.4	93.6	<1.69	877	14.7	0.181	3.43	<2.35	<0.0358
MRJC	4/29/2026	80.9	4.0	1029	1120	202	246.3	206	125	126	3.49	518	16.6	0.169	3.9	8.34	<0.0119
MRJC	5/6/2026	78	5.3	1042	1710	206	251.2	203	130	136	3.74	1100	17.5	0.181	3.74	8	<0.0119
MRJC	5/12/2026	103.9	11.7	923	1420	189	230.5	190	109	103	4.41	885	13.9	0.156	3.71	7.94	<0.0119
MRJC	5/21/2026	85.1	7.7	648	1370	194	236.6	131	77.9	85.7	2.76	942	12	0.157	3.4	7.26	<0.0119
MRJC_30	5/12/2026	103.9	13.7	903	1420	194	236.6	187	106	102	3.66	890	14	0.156	3.81	8.16	<0.0119
MRJC_90	5/12/2026		0.0	1	<5.45	<6	--	0.13	<0.074	<0.498	<0.169	1.36	<0.497	<0.0336	<0.11	<0.235	<0.0119
MRNT	3/25/2026	100.8	82.7	638	1110	183	223.2	142	68.9	93.2	4.09	684	11.8	0.192	3.22	6.9	<0.0119
MRSJ	3/25/2026	99.3	27.0	763	1440	178	217.1	157	90.1	127	4.57	941	17.3	0.182	3.12	6.67	0.663
QAEB	3/25/2026		0.0				--								<0.11	<0.235	<0.009
TDME	4/24/2026	15.6	6.7	94		<6	--	27.3	6.36	0.65	2.04	128	0.579	0.17	8.03	17.2	0.048
Thunder Mine	4/24/2026	n/a	6.0	56		<6	--	15.3	4.44	<0.498	2.65	184	0.524	0.093	9.48	20.3	<0.009
WMAJ	3/24/2026	110	5.7	84	97	59	72.0	26.8	4.2	2.49	0.904	26.6	0.582	0.069	4.29	9.17	<0.0119

Mancos River Watershed -- Site Properties and Water-Quality Data for Streams, Springs, and Mines, 2026

Site	Date	Phosphorus, total, mg/L	Aluminum, dissolved, ug/L	Aluminum, total, ug/L	Aluminum, Bioavailable, ug/L	Arsenic, dissolved, ug/L	Arsenic, total, ug/L	Cadmium, dissolved, ug/L	Cadmium, total, ug/L	Copper, dissolved, ug/L	Copper, total, ug/L	Iron, dissolved, ug/L	Iron, total, ug/L	Lead, dissolved, ug/L	Lead, total, ug/L	Manganese, dissolved, ug/L	Manganese, total, ug/L	Molyb-denum, dissolved, ug/L
EM25A	3/11/2026	<0.0231	<26	1750	1140	<0.4	<0.4	0.8	0.8	625	724	<27	60	<0.1	<0.08	192	187	<0.3
EM25A	3/18/2026	<0.0231	<26	3150	28.2	<0.4	<0.4	0.7	0.6	474	643	<27	263	<0.1	0.1	182	176	<0.3
EM-25A	3/24/2026	<0.0231	13	2490	17.1	<0.4	<0.4	0.6	0.5	201	394	<27	373	<0.1	0.1	156	147	0.4
EM25A	3/31/2026	<0.0231	<26	2390	20.6	<0.4	<0.4	0.5	0.5	157	429	<27	380	<0.1	0.1	152	148	<0.3
EM25A	4/8/2026	<0.0231	98	2110	1410	<0.4	<0.4	0.4	0.4	101	351	<27	238	<0.1	<0.08	144	141	<0.3
EM25A	4/15/2026	<0.0231	<26	2080	13.7	<0.4	<0.4	0.4	0.4	77	321	<27	289	<0.1	<0.08	135	127	<0.3
EM25A	4/22/2026	0.0248	<26	1350	16.8	<0.4	<0.4	0.4	0.4	59.5	214	<27	152	<0.1	<0.08	103	101	<0.3
EM25A	4/29/2026	<0.0231	43	1970	18.9	<0.4	<0.4	0.5	0.5	93	330	<27	150	<0.1	<0.08	157	153	<0.3
EM25A	5/6/2026	<0.0231	29	2640	22.7	<0.4	<0.4	0.5	0.5	145	457	<27	216	<0.1	<0.08	184	175	<0.3
EM25A	5/12/2026	<0.0231	44	4070	2400	<0.4	0.7	0.8	0.7	750	1030	42	724	<0.1	0.09	257	256	<0.3
EM25A	5/21/2026	<0.0231	<26	2690	1980	<0.4	<0.4	0.6	0.6	148	513	<27	221	<0.1	<0.08	203	216	<0.3
EMAT#2	4/24/2026	<0.0231	11900	12200	10600	0.5	1	1.1	1	1530	1500	1220	1,850	<0.1	0.1	510	511	<0.3
EMBT#2	4/24/2026	<0.0231	10100	9900	9130	<0.4	0.9	1	0.9	1300	1270	752	1,380	<0.1	0.09	449	446	<0.3
EMEB	3/25/2026	<0.0231	306	3190	80.8	<0.4	<0.4	0.3	<0.04	76.2	317	113	715	<0.1	<0.08	105	109	<0.3
EMWQ19	4/24/2026	<0.0231	970	952	794	<0.4	<0.4	1.1	1	396	380	70	67	0.2	0.2	629	634	<0.3
MANCHICO	3/24/2026	<0.0231	82	516	165	<0.4	<0.4	<0.05	0.05	13.3	42.9	<27	328	<0.1	0.1	33	50.4	0.6
MANCHICO_30	3/24/2026	<0.0231	65	500	48.8	<0.4	<0.4	<0.05	0.05	12.8	39.6	<27	281	<0.1	0.1	31	42.3	0.7
MANCHICO_90	3/24/2026	<0.0231	<26	<35	4.8	<0.4	<0.4	<0.05	<0.04	0.4	<0.7	<27	<24	<0.1	<0.08	1	<0.5	<0.3
MANMANCO	3/25/2026	<0.0231	140	3270	44.4	<0.4	0.5	0.3	0.3	51.3	294	71	805	<0.1	0.3	95.8	100	<0.3
MMAE	3/24/2026	<0.0231	936	3470	303	<0.4	0.5	<0.05	0.1	2.7	3.5	407	1,330	0.2	0.8	5.6	10.1	0.4
MRAG	3/25/2026	<0.0231	<26	419	5.2	0.5	<0.4	<0.05	<0.04	3.7	5	<27	340	<0.1	0.3	27.7	35.7	1.5
MRAW	3/11/2026	<0.0231	<52	<70	7.8	<0.4	<0.4	<0.05	<0.04	5.4	5.6	<54	234	<0.1	0.1	39.5	40.3	2
MRAW	3/18/2026	<0.0231	32	112	6	<0.4	<0.4	<0.05	<0.04	4.5	4.8	<27	210	<0.1	0.1	31.2	34	1.7
MRAW	3/24/2026	<0.0231	72	193	12	0.5	<0.4	<0.05	<0.04	5	7.7	<54	253	<0.1	0.1	22.2	26.7	1.4
MRAW	3/31/2026	<0.0231	83	83	13.8	<0.4	0.5	<0.05	<0.04	5	6.8	<27	171	<0.1	<0.08	19.2	21.6	1.6
MRAW	4/8/2026	<0.0231	<26	84	23	<0.4	0.5	<0.05	<0.04	6.1	7.2	<27	173	<0.1	0.09	20.2	21.9	2
MRAW	4/15/2026	<0.0231	55	271	23.7	<0.4	<0.4	<0.05	<0.04	5.5	7.8	<54	247	<0.1	0.1	19.4	24.3	1.9
MRAW	4/22/2026	<0.0231	<262	<349	5.5	<0.4	<0.4	<0.05	<0.04	5	5.5	<269	251	<0.1	<0.08	14.7	16.8	2.3
MRAW	4/29/2026	<0.0231	<52	<349	5.6	<0.8	<0.8	1.2	<0.08	5.1	6.1	<54	<239	<0.2	<0.2	12.7	14.4	0.7
MRAW	5/6/2026	0.0519	69	<349	5.8	<0.4	<0.4	<0.05	<0.04	5.1	5.6	<54	<239	<0.1	0.1	13.9	15.5	2.1
MRAW	5/12/2026	0.0303	<131	198	18.5	<0.4	<0.4	<0.05	<0.04	3.6	5.4	<134	299	<0.1	0.2	7.1	12.5	1.8
MRAW	5/21/2026	<0.0231	<131	1450	7.4	<0.4	<0.4	<0.05	0.06	7.1	6.5	<134	845	<0.1	0.5	23.4	40.5	2.1
MRAW_30	4/22/2026	<0.0231	<262	<349	5.3	<0.4	<0.4	<0.05	<0.04	5.1	5.6	<269	<239	<0.1	<0.08	14.7	16.9	2.3
MRAW_90	3/11/2026	<0.0231	<26	<35	4.8	<0.4	<0.4	<0.05	<0.04	0.8	<0.7	<27	<24	<0.1	<0.08	0.3	<0.5	<0.3
MRAW_90	3/18/2026	<0.0231	<26	<35	4.6	<0.4	<0.4	<0.05	<0.04	<0.3	<0.7	<27	<24	<0.1	<0.08	0.5	<0.5	<0.3
MRAW_90	4/22/2026	<0.0231	<26	<35	<4.2	<0.4	<0.4	<0.05	<0.04	0.4	<0.7	<27	<24	<0.1	<0.08	<0.2	<0.5	<0.3
MRBM	3/25/2026	<0.0231	<26	378	26.3	<0.4	<0.4	<0.05	<0.04	8	17.6	<27	313	<0.1	<0.08	40.4	43.7	1.4
MRBW	3/24/2026	<0.0231	71	282	12.6	0.7	<0.4	<0.05	<0.04	4.9	6.9	<54	332	<0.1	0.2	20.1	24.7	1.5
MRJC	3/11/2026	<0.0231	<52	125	5	<0.4	<0.4	<0.05	<0.04	6.7	5.4	<27	120	<0.1	0.1	43.4	43.6	1.8
MRJC	3/18/2026	<0.0231	<26	130	4.9	<0.4	<0.4	<0.05	<0.04	4.5	4.3	<27	140	<0.1	0.2	34.6	36	1.8
MRJC	3/25/2026	<0.0231	<26	188	5.5	<0.4	<0.4	<0.05	<0.04	3.9	4.6	<27	209	<0.1	0.2	23.4	27.2	1.5
MRJC	3/31/2026	<0.0231	<52	131	7.1	0.5	<0.4	<0.05	<0.04	4	4.9	<27	159	<0.1	0.1	27.6	31	1.5
MRJC	4/8/2026	<0.0231	<26	96	9.4	<0.4	<0.4	<0.05	<0.04	5.1	5	<27	126	<0.1	0.1	29.8	30.6	1.8
MRJC	4/15/2026	<0.0231	<262	305	7.7	0.5	<0.4	<0.05	<0.04	5	5.4	<269	236	<0.1	0.2	21.9	29.6	1.9
MRJC	4/22/2026	<0.0231	<262	<349	5.3	<0.4	0.5	<0.05	<0.04	5	5.2	<269	269	<0.1	0.1	50.3	53.4	1.8
MRJC	4/29/2026	<0.0231	<52	<349	5.5	<0.8	<0.8	<0.09	<0.08	5.8	6	<54	<239	<0.2	<0.2	45	46.6	1.7
MRJC	5/6/2026	<0.0231	<52	<349	6.8	<0.4	0.5	<0.05	<0.04	5.6	6.2	<54	<239	<0.1	0.1	49.9	51.5	1.8
MRJC	5/12/2026	<0.0231	<131	371	14.9	<0.4	0.5	<0.05	<0.04	4.6	5.4	<134	369	<0.1	0.3	18.5	31.2	2.2
MRJC	5/21/2026	<0.0231	<131	675	9.4	<0.4	<0.4	<0.05	<0.04	6.4	4.9	<134	297	<0.1	0.2	47.3	56	1.7
MRJC_30	5/12/2026	<0.0231	<131	555	9.3	<0.4	0.5	<0.05	<0.04	4.6	6.1	<134	447	<0.1	0.4	18.7	37.8	2.2
MRJC_90	5/12/2026	<0.0231	<26	<35	<4.2	<0.4	<0.4	<0.05	<0.04	0.7	<0.7	<27	<24	<0.1	<0.08	<0.2	<0.5	<0.3
MRNT	3/25/2026	<0.0231	<26	3520	5.4	0.5	0.9	<0.05	<0.04	3.7	5.6	<27	1,950	<0.1	1.7	9.1	40.5	1.6
MRSJ	3/25/2026	<0.0231	<26	1200	5	0.6	0.6	<0.05	<0.04	4.9	5.6	<27	613	<0.1	0.5	3.6	10.7	2.1
QAEB	3/25/2026	<0.0231	<26			<0.4		<0.05		1.2		<27		<0.1		<0.2		<0.3
TDME	4/24/2026	<0.0231	3930	3660	2930	0.8	0.6	1.6	1.4	579	562	1460	973	0.2	0.1	687	681	<0.3
Thunder Mine	4/24/2026	0.0312	1530	3820	1270	207	1890	1.5	1.4	1950	1940	27900	71,500	47.3	96.8	403	409	1.7
WMAJ	3/24/2026	<0.0231	148	638	98.4	<0.4	<0.4	0.08	<0.04	5.1	7.5	96	311	<0.1	0.2	3.1	5.7	1.1

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Site	Date	Molyb-denum, total, ug/L	Nickel, dissolved, ug/L	Nickel, total, ug/L	Selenium, dissolved ug/L	Selenium, total, ug/L	Uranium, dissolved, ug/L	Uranium, total, ug/L	Vanadium, total, ug/L	Zinc, dissolved, ug/L	Zinc, total, ug/L	Dissolved Organic Carbon, mg/L
EM25A	3/11/2026	<0.08	15.6	15.1	<0.8	0.5	0.7	0.7	2.2	148	126	0.761
EM25A	3/18/2026	0.09	12.8	12.8	<0.8	0.4	0.5	0.5	2.3	120	106	0.722
EM-25A	3/24/2026	0.2	9.8	9.4	<0.8	0.5	0.1	0.1	1.4	88.8	75.5	1.07
EM25A	3/31/2026	0.2	9.4	8.8	<0.8	0.5	<0.09	<0.09	1.8	76.4	69.9	1.02
EM25A	4/8/2026	0.1	10.3	9.1	<0.8	0.3	0.1	0.1	1.6	73.8	68.2	1.06
EM25A	4/15/2026	0.1	9	8.6	<0.8	0.3	<0.09	<0.09	1.6	64.4	60.7	0.805
EM25A	4/22/2026	0.2	8.7	8.5	<0.8	0.4	<0.09	<0.09	1	64.2	55	0.829
EM25A	4/29/2026	0.2	10.6	10.4	<0.8	0.5	<0.09	<0.09	1.5	79.2	76.2	0.842
EM25A	5/6/2026	0.2	11.2	10.8	<0.8	0.5	<0.09	<0.09	2	80.8	77.5	0.806
EM25A	5/12/2026	0.1	12.6	11.8	<0.8	0.4	0.6	0.6	3.2	117	98.2	0.784
EM25A	5/21/2026	0.1	10.4	11	<0.8	0.4	<0.09	<0.09	2.2	78.6	81.6	1.12
EMAT#2	4/24/2026	0.3	18.7	18.4	<0.8	0.4	7.4	7.4	7.8	173	145	0.584
EMBT#2	4/24/2026	0.3	16.4	16	<0.8	0.3	6	6	6.3	150	127	0.295
EMEB	3/25/2026	<0.08	6.5	7.1	<0.8	<0.2	<0.09	<0.09	1.3	45.5	53.8	1.72
EMWQ19	4/24/2026	<0.08	13.4	13	<0.8	<0.2	<0.09	<0.09	0.06	160	135	0.855
MANCHICO	3/24/2026	0.7	4.6	4.9	<0.8	0.6	0.7	0.7	0.8	2.4	7.6	2.02
MANCHICO_30	3/24/2026	0.6	3.9	4.8	<0.8	0.7	0.7	0.7	0.8	2.2	6.9	5.23
MANCHICO_90	3/24/2026	<0.08	<0.1	<0.2	<0.8	<0.2	<0.09	<0.09	<0.03	2.6	<3.1	0.293
MANMANCO	3/25/2026	0.4	6.1	6.8	<0.8	0.5	<0.09	<0.09	1.4	33.9	48.1	1.64
MMAE	3/24/2026	0.5	2	2.4	<0.8	0.3	0.1	0.2		5.2	5.7	5.58
MRAG	3/25/2026	1.5	8.4	10	1.4	1.6	4	4	4.1	2	3.4	3.66
MRAW	3/11/2026	2.1	12.8	13.6	2.6	2.5	7.4	7.4	7.5	3.6	<3.1	3.38
MRAW	3/18/2026	1.8	11.4	10.7	2.2	2	5.2	5.2	5	1.8	<3.1	2.88
MRAW	3/24/2026	1.4	6.8	8.8	1.6	1.5	3.2	3.2	3.2	<1.2	<3.1	2.58
MRAW	3/31/2026	1.7	10.8	8.6	1.7	1.7	4.2	4.2	4.3	1.6	6.2	3.04
MRAW	4/8/2026	1.9	12.8	9.4	2.1	1.8	5.6	5.6	5.1	2	<3.1	3.69
MRAW	4/15/2026	2	9.2	9.3	1.9	1.5	5	5	5.2	1.5	<3.1	3.72
MRAW	4/22/2026	2.3	13.9	13.5	3.3	2.9	7.3	7.3	7.5	2.2	<3.1	3.48
MRAW	4/29/2026	2.3	8	18.7	<1.6	2.8	<0.2	<0.2	7.9	1.8	2.3	4.2
MRAW	5/6/2026	2.1	17.8	15.6	3.7	3.2	8.5	8.5	8.6	2.2	<3.1	3.41
MRAW	5/12/2026	1.7	9.4	10.1	1.9	1.4	3.8	3.8	3.9	1.3	<3.1	3.08
MRAW	5/21/2026	2.3	16.1	18.2	2.7	3	7.1	7.1	7.8	1.8	3.7	3.97
MRAW_30	4/22/2026	2.3	14.1	13.9	3.4	2.9	7.3	7.3	7.5	2.1	<3.1	3.47
MRAW_90	3/11/2026	<0.08	<0.1	<0.2	<0.8	<0.2	<0.09	<0.09	<0.03	2.5	<3.1	0.409
MRAW_90	3/18/2026	<0.08	<0.1	<0.2	<0.8	<0.2	<0.09	<0.09	<0.03	1.7	<3.1	0.299
MRAW_90	4/22/2026	<0.08	<0.1	<0.2	<0.8	<0.2	<0.09	<0.09	<0.03	3.2	<3.1	0.329
MRBM	3/25/2026	1.2	6	7.1	1	<0.2	2.3	2.3	2.3	6.3	<3.1	2.93
MRBW	3/24/2026	1.4	7.3	8.9	1.5	1.6	3.6	3.6	3.6	1.5	<3.1	3.23
MRJC	3/11/2026	1.8	13.1	13.6	2.6	2.5	8	8	8	6	<3.1	3.33
MRJC	3/18/2026	1.6	12.7	11.3	2.2	1.9	6	6	5.5	2.4	3.7	3.07
MRJC	3/25/2026	1.5	7.9	9.8	1.5	1.8	4	4	4	<1.2	<3.1	2.88
MRJC	3/31/2026	1.6	10.9	9	1.5	1.4	4.5	4.5	4.5	1.4	<3.1	3.01
MRJC	4/8/2026	1.7	13.2	9.2	2	1.6	6	6	5.2	1.5	<3.1	6.91
MRJC	4/15/2026	1.9	11.5	11.4	2.3	2.1	6.7	6.7	6.8	1.9	<3.1	6.85
MRJC	4/22/2026	1.9	11.9	11.7	2.3	2	5.8	5.8	6	3	3.2	7.01
MRJC	4/29/2026	1.8	17.1	16.4	2.2	2.2	6.6	6.6	6.6	<2.5	<6.2	5.72
MRJC	5/6/2026	1.8	15.6	14.8	2.4	2.2	6.7	6.7	6.9	2.3	<3.1	4.4
MRJC	5/12/2026	2.1	13.6	13.7	2.7	1.9	6.3	6.3	6.7	1.8	<3.1	3.6
MRJC	5/21/2026	1.9	13.8	15.4	1.2	1.8	5.1	5.1	5.7	1.9	<3.1	8.13
MRJC_30	5/12/2026	2.1	13.9	14.4	2.7	1.9	6.4	6.4	6.7	1.8	<3.1	3.66
MRJC_90	5/12/2026	<0.08	<0.1	<0.2	<0.8	<0.2	<0.09	<0.09	<0.03	2.3	<3.1	0.386
MRNT	3/25/2026	1.6	9.6	11.5	1.5	1.8	4.7	4.7	4.9	1.5	7	3.65
MRSJ	3/25/2026	2.2	10.3	12.8	1.8	2.2	6.5	6.5	6.8	3.5	4.7	3.88
QAEB	3/25/2026		<0.1		<0.8		<0.09	<0.09		3		0.434
TDME	4/24/2026	<0.08	12.7	12.3	<0.8	0.3	0.7	0.7	0.7	178	147	
Thunder Mine	4/24/2026	10.4	8.4	8.3	<0.8	<0.2	0.7	0.7	0.8	420	356	
WMAJ	3/24/2026	0.7	2.3	2.2	1.2	0.7	0.4	0.4	0.3	3.3	3.6	3.17

Mancos River Watershed High-Flow
Synoptic 2026 Mainstem Sites

Site Number	Site Name	Latitude, dd	Longitude, dd	Altitude, ft	Stream Mile from mouth	Site Type	Sample Type	Date	Time	Labor-atory	Discharge, instant-aneous, ft3/sec	Discharge, instant-aneous, gal/min	Field Specific Conductance, uS/cm @ 25oC	Field pH, standard units	Laboratory pH, standard units	Water Temper-ature, oC	Dissolved Oxygen, mg/L
EMBT#2	East Mancos River below Thunder Mine, #2	37.393218	-108.123115	9637	85.39	SW	W	4/24/2026	12:00:00	GAL	4.82	2,163	253.3	4.79	4.56	3.5	12.79
EM-25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.18	SW	W	3/24/2026	10:00	GAL	12.91	5,794	242.9	5.60	7.04	3.7	10.23
EMEB	East Mancos at Echo Basin Road	37.361836	-108.246998	7,328	78.05	SW	W	3/25/2026	10:00:00	GAL	20.52	9,209	220.8	6.76	7.36	5.8	10.65
MANMANCO	Mancos River near Mancos	37.354004	-108.259153	7,219	77.25	SW	W	3/25/2026	9:30:00	GAL	16.4	7,360	268.2	7.37	7.53	5.6	13.8
MANCHICO	Mancos River at CJ's Bridge	37.327079	-108.329369	6,776	73.00	SW	W	3/24/2026	13:50:00	GAL	11	4,937	500	8.03	7.99	11.2	13.29
MRBM	Mancos River below Mud Creek	37.280344	-108.362442	6,456	69.00	SW	W	3/25/2026	12:30:00	GAL	21.63	9,708	801.8	7.10	8.18	13.2	10.15
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	63.55	SW	W	3/24/2026	15:30:00	GAL	11.11	4,986	1173	8.04	8.26	15.3	10.31
MRBW	Mancos River below Weber Canyon	37.214489	-108.340612	6,173	63.50	SW	W	3/24/2026	16:45:00	GAL	12.64	5,673	1263	8.13	8.24	15.8	9.99
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	3/25/2026	17:25:00	GAL	9.1	4,084	1352	8.25	8.32	17.39	8.03
MRAG	Mancos River above Grassy Canyon	37.061191	-108.537967	5,502	43.46	SW	W	3/25/2026	15:40:00	GAL	11.39	5,112	1324	8.26	8.33	17.7	10.65
MRNT	Mancos River near Towaoc (USGS site)	37.027364	-108.742003	5,056	22.90	SW	W	3/25/2026	17:00:00	GAL	9.25	4,151	1497	8.28	8.33	19.5	9.9
MRSJ	Mancos River at San Juan River (USGS site)	36.982446	-108.965482	4,679	1.18	SW	W	3/25/2026	19:00:00	GAL	6.08	2,729	1891	8.25	8.26	18.9	9.82

Mancos River Watershed High-Flow
Synoptic 2026 Mainstem Sites

Site	Date	Dissolved Oxygen, % sat	Turbidity, FAU	Hardness, mg/L as CaCO3	Total Dissolved Solids, mg/L	Alkalinity, total, lab, as CaCO3, mg/L	Bicarbonate, as HCO3 mg/L	Calcium, dissolved, mg/L	Magnesium, dissolved, mg/L	Sodium, dissolved, mg/L	Potassium, dissolved, mg/L	Sulfate, dissolved, mg/L	Chloride, dissolved, mg/L	Fluoride, dissolved, mg/L	Silicon as Si, dissolved, mg/L	Silicate as SiO2, mg/L	Nitrate+ Nitrite, dissolved, mg/L as N	Phosphorus, total, mg/L
EMBT#2	4/24/2026	12.88	13.3	55	200	<6	--	17	3.11	1.13	1.75	125	<0.497	0.377	4.79	10.2	0.06	<0.0231
EM-25A	3/24/2026	101.1	14.6	88	128	<6.00	--	26.0	5.58	1.62	1.55	89.5	0.554	0.138	3.35	7.16	0.067	<0.0231
EMEB	3/25/2026	103.3	23.7	98	122	19	23.2	29.1	6.23	2.23	1.56	71.9	<0.497	0.134	4.09	8.75	0.0489	<0.0231
MANMANCO	3/25/2026	104.4	23.0	133	156	27	32.9	37.4	9.66	4.92	1.58	85.6	1.01	0.139	4.28	9.15	<0.0119	<0.0231
MANCHICO	3/24/2026	115	4.7	194	266	66	80.5	50.7	16.4	10.2	1.77	144	3.51	0.149	3.65	7.8	0.135	<0.0231
MRBM	3/25/2026	112.7	10.0	328	519	115	140.2	84.5	28.5	29.6	2.23	299	6.32	0.168	2.76	5.9	0.0427	<0.0231
MRAW	3/24/2026	101	3.7	468	699	144	175.6	107	48.7	37.3	2.17	410	8	0.176	3.17	6.79	<0.0119	<0.0231
MRBW	3/24/2026	102	7.3	519	775	152	185.4	113	57.4	43.7	2.18	459	8.12	0.185	3.45	7.38	<0.0119	<0.0231
MRJC	3/25/2026	89	5.3	538	885	169	206.1	122	56.6	65.8	2.8	526	9.62	0.181	2.93	6.26	<0.0119	<0.0231
MRAG	3/25/2026	105.8	11.3	656	990	171	208.5	148	69.5	71	3.14	586	10.2	0.181	3.34	7.14	<0.0119	<0.0231
MRNT	3/25/2026	100.8	82.7	638	1110	183	223.2	142	68.9	93.2	4.09	684	11.8	0.192	3.22	6.9	<0.0119	<0.0231
MRSJ	3/25/2026	99.3	27.0	763	1440	178	217.1	157	90.1	127	4.57	941	17.3	0.182	3.12	6.67	0.663	<0.0231

Mancos River Watershed High-Flow
Synoptic 2026 Mainstem Sites

Site	Date	Aluminum, dissolved, ug/L	Aluminum, total, ug/L	Aluminum, Bioavailable, ug/L	Arsenic, dissolved, ug/L	Arsenic, total, ug/L	Cadmium, dissolved, ug/L	Cadmium, total, ug/L	Copper, dissolved, ug/L	Copper, total, ug/L	Iron, dissolved, ug/L	Iron, total, ug/L	Lead, dissolved, ug/L	Lead, total, ug/L	Manganese, dissolved, ug/L	Manganese, total, ug/L	Molyb-denum, dissolved, ug/L	Molyb-denum, total, ug/L	Nickel, dissolved, ug/L
EMBT#2	4/24/2026	10,100	9,900	9130	<0.4	0.9	1	0.9	1300	1270	752	1380	<0.1	0.09	449	446	<0.3	0.3	16.4
EM-25A	3/24/2026	13	2,490	17.1	<0.4	<0.4	0.6	0.5	201	394	<27	373	<0.1	0.1	156	147	0.4	0.2	9.8
EMEB	3/25/2026	306	3,190	80.8	<0.4	<0.4	0.3	<0.04	76.2	317	113	715	<0.1	<0.08	105	109	<0.3	<0.08	6.5
MANMANCO	3/25/2026	140	3,270	44.4	<0.4	0.5	0.3	0.3	51.3	294	71	805	<0.1	0.3	95.8	100	<0.3	0.4	6.1
MANCHICO	3/24/2026	82	516	165	<0.4	<0.4	<0.05	0.05	13.3	42.9	<27	328	<0.1	0.1	33	50.4	0.6	0.7	4.6
MRBM	3/25/2026	<26	378	26.3	<0.4	<0.4	<0.05	<0.04	8	17.6	<27	313	<0.1	<0.08	40.4	43.7	1.4	1.2	6
MRAW	3/24/2026	72	193	12	0.5	<0.4	<0.05	<0.04	5	7.7	<54	253	<0.1	0.1	22.2	26.7	1.4	1.4	6.8
MRBW	3/24/2026	71	282	12.6	0.7	<0.4	<0.05	<0.04	4.9	6.9	<54	332	<0.1	0.2	20.1	24.7	1.5	1.4	7.3
MRJC	3/25/2026	<26	188	5.5	<0.4	<0.4	<0.05	<0.04	3.9	4.6	<27	209	<0.1	0.2	23.4	27.2	1.5	1.5	7.9
MRAG	3/25/2026	<26	419	5.2	0.5	<0.4	<0.05	<0.04	3.7	5	<27	340	<0.1	0.3	27.7	35.7	1.5	1.5	8.4
MRNT	3/25/2026	<26	3,520	5.4	0.5	0.9	<0.05	<0.04	3.7	5.6	<27	1950	<0.1	1.7	9.1	40.5	1.6	1.6	9.6
MRSJ	3/25/2026	<26	1,200	5	0.6	0.6	<0.05	<0.04	4.9	5.6	<27	613	<0.1	0.5	3.6	10.7	2.1	2.2	10.3

Mancos River Watershed High-Flow
Synoptic 2026 Mainstem Sites

Site	Date	Nickel, total, ug/L	Selenium, dissolved ug/L	Selenium, total, ug/L	Uranium, total, ug/L	Vanadium, total, ug/L	Zinc, dissolved, ug/L	Zinc, total, ug/L	Dissolved Organic Carbon, mg/L
EMBT#2	4/24/2026	16	<0.8	0.3	6	6.3	150	127	0.295
EM-25A	3/24/2026	9.4	<0.8	0.5	0.1	1.4	88.8	75.5	1.07
EMEB	3/25/2026	7.1	<0.8	<0.2	<0.09	1.3	45.5	53.8	1.72
MANMANCO	3/25/2026	6.8	<0.8	0.5	<0.09	1.4	33.9	48.1	1.64
MANCHICO	3/24/2026	4.9	<0.8	0.6	0.7	0.8	2.4	7.6	2.02
MRBM	3/25/2026	7.1	1	<0.2	2.3	2.3	6.3	<3.1	2.93
MRAW	3/24/2026	8.8	1.6	1.5	3.2	3.2	<1.2	<3.1	2.58
MRBW	3/24/2026	8.9	1.5	1.6	3.6	3.6	1.5	<3.1	3.23
MRJC	3/25/2026	9.8	1.5	1.8	4	4	<1.2	<3.1	2.88
MRAG	3/25/2026	10	1.4	1.6	4	4.1	2	3.4	3.66
MRNT	3/25/2026	11.5	1.5	1.8	4.7	4.9	1.5	7	3.65
MRSJ	3/25/2026	12.8	1.8	2.2	6.5	6.8	3.5	4.7	3.88

Mancos River Watershed High-Flow Synoptic
Mainstem Loads 2026

Mainstem Loads 2026

Site Number	Site Name	Latitude, dd	Longitude, dd	Altitude, ft	Stream Mile from mouth	Site Type	Sample Type	Date	Time	Labor-atory	Discharge, instantaneous, ft3/sec	Discharge, instantaneous, gal/min	Field Specific Conductance, uS/cm @ 25oC	Lab specific conductance, us/cm	Field pH, standard units	Lab pH, standard units	Water Temperature, oC	Dissolved Oxygen, mg/L	Dissolved Oxygen, % sat	Turbidity, FAU
EM-25A	East Mancos River near mouth	37.37105	-108.233308	7483	79.28	SW	W	3/24/2026	10:00	GAL	12.91	5794.0	242.9	227	5.60	7.04	3.7	12.23	101.1	14.6
EMEB	East Mancos at Echo Basin Road	37.361836	-108.246998	7,328	78.05	SW	W	3/25/2026	10:00	GAL	20.52	9209.4	220.8	215	6.76	7.36	5.8	10.65	103.3	23.7
MANMANCO	Mancos River near Mancos	37.354004	-108.259153	7,219	77.25	SW	W	3/25/2026	9:30	GAL	16.4	7360.3	268.2	262	7.37	7.53	5.6	13.8	104.4	23.0
MANCHICO	Mancos River at CJ's Bridge	37.327079	-108.329369	6,776	73.00	SW	W	3/24/2026	13:50	GAL	11	4936.8	500	453	8.03	7.99	11.2	13.29	115	4.7
MRBM	Mancos River below Mud Creek	37.280344	-108.362442	6,456	69.00	SW	W	3/25/2026	12:30	GAL	21.63	9707.5	801.8	822	7.10	8.18	13.2	10.15	112.7	10.0
MRAW	Mancos River above Weber Canyon	37.215653	-108.340404	6,173	64.00	SW	W	3/24/2026	15:30	GAL	11.11	4986.2	1173	1050	8.04	8.26	15.3	10.31	101	3.7
MRBW	Mancos River below Weber Canyon	37.214489	-108.340612	6,173	63.50	SW	W	3/24/2026	16:45	GAL	12.64	5672.8	1263	1150	8.13	8.24	15.8	9.99	102	7.3
MRJC	Mancos River below Johnson Canyon	37.099328	-108.466182	5,684	50.72	SW	W	3/25/2026	17:25	GAL	9.1	4084.1	1352	1340	8.25	8.32	17.4	8.03	89	16.3
MRBG	Mancos River above Grassy Canyon	37.061191	-108.537967	5,502	43.70	SW	W	3/25/2026	15:40	GAL	11.39	5111.8	1324	1360	8.26	8.33	17.7	10.65	105.8	11.3
MRNT	Mancos River near Towaoc (USGS site)	37.027364	-108.742003	5,056	22.90	SW	W	3/25/2026	17:00	GAL	9.25	4151.4	1497	1540	8.28	8.33	19.5	9.9	100.8	82.7
MRSJ	Mancos River at San Juan River (USGS site)	36.982446	-108.965482	4,679	1.18	SW	W	3/25/2026	19:00	GAL	6.08	2728.7	1891	1940	8.25	8.26	18.9	9.82	99.3	27.0

Mancos River Watershed High-Flow Synoptic
Mainstem Loads 2026

Site	Date	Hardness, lb/d as CaCO3	Total Dissolved Solids, lb/d	Alkalinity, total, lb/d as CaCO3	Bicarbonate, lb/d as HCO3	Calcium, dissolved, lb/d	Magnesium, dissolved, lb/d	Sodium, dissolved, lb/d	Potassium, dissolved, lb/d	Sulfate, dissolved, lb/d	Chloride, dissolved, lb/d	Fluoride, dissolved, lb/d	Silicon as Si, dissolved, lb/d	Silicate as SiO2, lb/d	Nitrate+ Nitrite, dissolved, lb/d as N	Phosphorus, total, lb/d	Aluminum, total, lb/d	Aluminum, Suspended Sediment, lb/d	Aluminum, Bioavailable, lb/d
EM-25A	3/24/2026	6,125	8,920	--	--	1,811.8	388.8	112.9	108.0	6,236.9	38.6	9.6	233.4	498.9	4.7	0	173.52	173.42	1.19
EMEB	3/25/2026	10,890	13,513	2,104	2,566	3,223.2	690.1	247.0	172.8	7,963.8	--	14.8	453.0	969.2	5.4	0	353.33	319.44	8.95
MANMANCO	3/25/2026	11,789	13,810	2,390	2,915	3,310.8	855.1	435.5	139.9	7,577.6	89.4	12.3	378.9	810.0	0.0	0	289.47	277.08	3.93
MANCHICO	3/24/2026	11,527	15,794	3,919	4,779	3,010.4	973.8	605.6	105.1	8,550.1	208.4	8.8	216.7	463.1	8.0	0	30.64	25.77	9.80
MRBM	3/25/2026	38,337	60,596	13,427	16,374	9,865.7	3,327.5	3,455.9	260.4	34,909.6	737.9	19.6	322.2	688.9	5.0	0	44.13	44.03	3.07
MRAW	3/24/2026	28,049	41,919	8,636	10,531	6,416.7	2,920.5	2,236.9	130.1	24,587.5	479.8	10.6	190.1	407.2	0.0	0	11.57	7.26	0.72
MRBW	3/24/2026	35,379	52,877	10,371	12,647	7,709.8	3,916.3	2,981.6	148.7	31,316.7	554.0	12.6	235.4	503.5	0.0	0	19.24	14.40	0.86
MRJC	3/25/2026	26,412	43,471	8,301	10,124	5,992.6	2,780.2	3,232.1	137.5	25,837.1	472.5	8.9	143.9	307.5	0.0	0	9.23	9.13	0.27
MRBG	3/25/2026	40,317	60,866	10,513	12,821	9,099.2	4,272.9	4,365.1	193.1	36,027.8	627.1	11.1	205.3	439.0	0.0	0	25.76	25.66	0.32
MRNT	3/25/2026	31,870	55,422	9,137	11,143	7,090.0	3,440.2	4,653.4	204.2	34,151.9	589.2	9.6	160.8	344.5	0.0	0	175.75	175.65	0.27
MRSJ	3/25/2026	25,043	47,259	5,842	7,124	5,152.5	2,957.0	4,168.0	150.0	30,882.3	567.8	6.0	102.4	218.9	21.8	0	39.38	39.28	0.16

Mancos River WatershedHigh-Flow Synoptic
Mainstem Loads 2026

Site	Date	Aluminum, dissolved, lb/d	Arsenic, dissolved, lb/d	Arsenic, total, lb/d	Cadmium, dissolved, lb/d	Cadmium, total, lb/d	Copper, dissolved, lb/d	Copper, total, lb/d	Copper, Suspended Sediment, lb/d	Iron, dissolved, lb/d	Iron, total, lb/d	Lead, dissolved, lb/d	Lead, total, lb/d	Manganese, dissolved, lb/d	Manganese, total, lb/d	Manganese, Suspended Sediment, lb/d
EM-25A	3/24/2026	0.10	0.00	0.00	0.04	0.03	14.01	27.46	13.45	0.00	25.99	0.00	0.01	10.87	10.24	0.10
EMEB	3/25/2026	33.89	0.00	0.00	0.03	0.00	8.44	35.11	26.67	12.52	79.20	0.00	0.00	11.63	12.07	0.44
MANMANCO	3/25/2026	12.39	0.00	0.04	0.03	0.03	4.54	26.03	21.48	6.29	71.26	0.00	0.03	8.48	8.85	0.37
MANCHICO	3/24/2026	4.87	0.00	0.00	0.00	0.00	0.79	2.55	1.76	0.00	19.48	0.00	0.01	1.96	2.99	1.03
MRBM	3/25/2026	0.10	0.00	0.00	0.00	0.00	0.93	2.05	1.12	0.00	36.54	0.00	0.00	4.72	5.10	0.39
MRAW	3/24/2026	4.32	0.03	0.00	0.00	0.00	0.30	0.46	0.16	0.00	15.17	0.00	0.01	1.33	1.60	0.27
MRBW	3/24/2026	4.84	0.05	0.00	0.00	0.00	0.33	0.47	0.14	0.00	22.65	0.00	0.01	1.37	1.69	0.31
MRJC	3/25/2026	0.10	0.00	0.00	0.00	0.00	0.19	0.23	0.03	0.00	10.27	0.00	0.01	1.15	1.34	0.19
MRBG	3/25/2026	0.10	0.03	0.00	0.00	0.00	0.23	0.31	0.08	0.00	20.90	0.00	0.02	1.70	2.19	0.49
MRNT	3/25/2026	0.10	0.02	0.04	0.00	0.00	0.18	0.28	0.09	0.00	97.36	0.00	0.08	0.45	2.02	1.57
MRSJ	3/25/2026	0.10	0.02	0.02	0.00	0.00	0.16	0.18	0.02	0.00	20.12	0.00	0.02	0.12	0.35	0.23

Mancos River Watershed High-Flow Synoptic
Mainstem Loads 2026

Site	Date	Molybdenum, dissolved, lb/d	Molyb-denum, total, lb/d	Nickel, dissolved, lb/d	Nickel, total, lb/d	Nickel, Suspended Sediment, lb/d	Selenium, dissolved lb/d	Selenium, total, lb/d	Uranium, total, lb/d	Vanadium, total, lb/d	Zinc, dissolved, lb/d	Zinc, total, lb/d	Zinc, Suspended Sediment, lb/d	Dissolved Organic Carbon, lb/d
EM-25A	3/24/2026	0.03	0.01	0.68	0.66	0.00	0.00	0.03	0.01	0.10	6.19	5.26	0.00	74.56
EMEB	3/25/2026	0.00	0.00	0.72	0.79	0.07	0.00	0.00	0.00	0.14	5.04	5.96	0.92	190.51
MANMANCO	3/25/2026	0.00	0.04	0.54	0.60	0.06	0.00	0.04	0.00	0.12	3.00	4.26	1.26	145.18
MANCHICO	3/24/2026	0.04	0.04	0.27	0.29	0.02	0.00	0.04	0.04	0.05	0.14	0.45	0.31	119.94
MRBM	3/25/2026	0.16	0.14	0.70	0.83	0.13	0.12	0.00	0.27	0.27	0.74	0.00	0.00	342.09
MRAW	3/24/2026	0.08	0.08	0.41	0.53	0.12	0.10	0.09	0.19	0.19	0.00	0.00	0.00	154.72
MRBW	3/24/2026	0.10	0.10	0.50	0.61	0.11	0.10	0.11	0.25	0.25	0.10	0.00	0.00	220.38
MRJC	3/25/2026	0.07	0.07	0.39	0.48	0.09	0.07	0.09	0.20	0.20	0.00	0.00	0.00	141.47
MRBG	3/25/2026	0.09	0.09	0.52	0.61	0.10	0.09	0.10	0.25	0.25	0.12	0.21	0.09	225.02
MRNT	3/25/2026	0.08	0.08	0.48	0.57	0.09	0.07	0.09	0.23	0.24	0.07	0.35	0.27	182.24
MRSJ	3/25/2026	0.07	0.07	0.34	0.42	0.08	0.06	0.07	0.21	0.22	0.11	0.15	0.04	127.34

FIELD DATA SHEETS AND CALIBRATION REPORTS

WATER-SAMPLE DATA COLLECTION SHEET

SITE NAME: MANCHICO

SITE DESCRIPTION: Nancos river @ CR55 bridge

Latitude:_____ Longitude:_____ ALTITUDE:_____

DATE SAMPLE COLLECTED: 20260324 TIME: 1350

REMARKS: collected deep, NOT, just upstream of concrete bench

SITE PROPERTIES

AIR TEMPERATURE:_____ °C Baro Pres:_____ WEATHER: Sunny, clear

DISCHARGE: 11 m³/s METHOD: gage COMMENTS:_____

WATER PROPERTIES

TEMPERATURE: 11.2 °C pH: 8.03 SC: 900 µS/cm

DISSOLVED OXYGEN: 13.29 mg/L (DO SAT. = 11.98 mg/L)

115%

IN-HOUSE ANALYTICAL RESULTS

[Fe^{2+}]:_____ [Turbidity]:_____

SAMPLE BOTTLES

Bottle size and type

FA = Filtered Acidified Nitric
FU = Filtered Unpreserved
RA = Raw Acidified Nitric
RU = Raw Unpreserved
FAS = Filtered Acidified Sulfuric

1. 250 RU - Bio aluminum, lab pH+SC
2. 250 RA - Total Metals
3. 250 FA - Dissolved Metals
4. 250 FU - Dissolved Anions+Alkalinity
5. 250 RU "SWHL" - Turbidity and archive
6. 250 FAS - Nutrients
7. 40 mL x 3 glass FAS - DOC

COLLECTED BY:

DATE OF SAMPLE DELIVERY:

SHL

WATER-SAMPLE DATA COLLECTION SHEET

SITE NAME: ~~WMAC 2026~~ WMAJ

SITE DESCRIPTION: above jackson intake

LATITUDE: 37.43235 LONGITUDE: -108.23412 ALTITUDE: _____

DATE SAMPLE COLLECTED: 3/24/26 TIME: 11:15

REMARKS: most of river captured by Jackson Reservoir intake downstream

SITE PROPERTIES

AIR TEMPERATURE: ~~XXX~~ °C WEATHER: sunny, some light, high clouds

DISCHARGE: 35.12 METHOD: HACH, manual calc of end pts. COMMENTS: _____

WATER PROPERTIES

TEMPERATURE: 3.3 °C pH: 7.72 SC: 205.7 µS/cm

DISSOLVED OXYGEN: 13.51 mg/L DO SAT = 12.32 mg/L, 110 %

IN-HOUSE ANALYTICAL RESULTS

[Fe^{2+}]: _____ [Turbidity]: _____

SAMPLE BOTTLES

Bottle size and type

FA = Filtered Acidified Nitric
FU = Filtered Unpreserved
RA = Raw Acidified Nitric
RU = Raw Unpreserved
FAS = Filtered Acidified Sulfuric

1. 250 FA - Dissolved Metals
2. 250 FU - Dissolved Anions+Alkalinity
3. 250 FAS - Nutrients
4. 40 mL x 3 glass FAS - DOC
5. 250 RU - Bio aluminum, lab pH+SC
6. 250 RA - Total Metals
7. 250 RU "SWHL" - Turbidity and archive

COLLECTED BY:

DATE OF SAMPLE DELIVERY:

SWHL

WATER-SAMPLE DATA COLLECTION SHEET

SITE NAME: MRAW

SITE DESCRIPTION:

LATITUDE: LONGITUDE: ALTITUDE:

DATE SAMPLE COLLECTED: 3/24/26 TIME: 15:30

REMARKS: Water coming in from river left, Graphe from L+PDR structures upstream

SITE PROPERTIES

AIR TEMPERATURE: °C WEATHER: Sunny

DISCHARGE: 11.11 METHOD: HACH, manual COMMENTS: hot
calc w/ end pts.

WATER PROPERTIES

suspect

TEMPERATURE: 15.3 °C pH: 8.04 SC: 1173 µS/cm

DISSOLVED OXYGEN: 10.31 mg/L DO SAT = 10.19 mg/L, 101 %

IN-HOUSE ANALYTICAL RESULTS

[Fe^{2+}]: [Turbidity]:

SAMPLE BOTTLES

Bottle size and type

FA = Filtered Acidified Nitric
FU = Filtered Unpreserved
RA = Raw Acidified Nitric
RU = Raw Unpreserved
FAS = Filtered Acidified Sulfuric

1. 250 FA - Dissolved Metals
2. 250 FU - Dissolved Anions+Alkalinity
3. 250 FAS - Nutrients
4. 40 mL x 3 glass FAS - DOC
5. 250 RU - Bio aluminum, lab pH+SC
6. 250 RA - Total Metals
7. 250 RU "SWHL" - Turbidity and archive

COLLECTED BY:

DATE OF SAMPLE DELIVERY:

SHL SW

WATER-SAMPLE DATA COLLECTION SHEET

SITE NAME: MRBW

SITE DESCRIPTION: Nances River blw confluence w/ Weber

LATITUDE: _____ LONGITUDE: _____ ALTITUDE: _____

DATE SAMPLE COLLECTED: 20260324 TIME: 1645

REMARKS: _____

SITE PROPERTIES

AIR TEMPERATURE: _____ °C WEATHER: _____

DISCHARGE: 12.64 METHOD: HACH manual calc w/ end pts COMMENTS: _____

WATER PROPERTIES

TEMPERATURE: 15.8 °C (suspect, upstream gage read 12.9) pH: 8.13 SC: 1263 µS/cm

DISSOLVED OXYGEN: 9.99 mg/L DO SAT = ~~4.99~~ 9.80 mg/L, 102% %

IN-HOUSE ANALYTICAL RESULTS

[Fe^{2+}]: _____ [Turbidity]: _____

SAMPLE BOTTLES

Bottle size and type

FA = Filtered Acidified Nitric
FU = Filtered Unpreserved
RA = Raw Acidified Nitric
RU = Raw Unpreserved
FAS = Filtered Acidified Sulfuric

1. 250 FA - Dissolved Metals
2. 250 FU - Dissolved Anions+Alkalinity
3. 250 FAS - Nutrients
4. 40 mL x 3 glass FAS - DOC
5. 250 RU - Bio aluminum, lab pH+SC
6. 250 RA - Total Metals
7. 250 RU "SWHL" - Turbidity and archive

COLLECTED BY:

DATE OF SAMPLE DELIVERY:

SWHL

WATER-SAMPLE DATA COLLECTION SHEET

SITE NAME: MR55

SITE DESCRIPTION: _____

LATITUDE: _____ LONGITUDE: _____ ALTITUDE: _____

DATE SAMPLE COLLECTED: 3/25/26 TIME: 1900

REMARKS: _____

SITE PROPERTIES

AIR TEMPERATURE: _____ °C WEATHER: _____

DISCHARGE: _____ METHOD: _____ COMMENTS: _____

WATER PROPERTIES

TEMPERATURE: 18.9 °C pH: 8.25 SC: 1,891 µS/cm

DISSOLVED OXYGEN: 9.82 mg/L DO SAT = 9.89 mg/L, _____ %

IN-HOUSE ANALYTICAL RESULTS

[Fe^{2+}]: _____ [Turbidity]: _____

SAMPLE BOTTLES

Bottle size and type

FA = Filtered Acidified Nitric
FU = Filtered Unpreserved
RA = Raw Acidified Nitric
RU = Raw Unpreserved
FAS = Filtered Acidified Sulfuric

1. 250 FA - Dissolved Metals
2. 250 FU - Dissolved Anions+Alkalinity
3. 250 FAS - Nutrients
4. 40 mL x 3 glass FAS - DOC
5. 250 RU - Bio aluminum, lab pH+SC
6. 250 RA - Total Metals
7. 250 RU "SWHL" - Turbidity and archive

COLLECTED BY:

DATE OF SAMPLE DELIVERY:

SWHL

03/2026

WATER-SAMPLE DATA COLLECTION SHEET

SITE NAME: MRBG

SITE DESCRIPTION: Manco's river- downstream of bridge @ grassy

Latitude:_____ Longitude:_____ ALTITUDE:_____

DATE SAMPLE COLLECTED: 20260325 TIME: 15:40

REMARKS: clear, sunny, light wind;

SITE PROPERTIES

AIR TEMPERATURE:_____ °C Baro Pres:_____ WEATHER:_____

DISCHARGE:_____ METHOD:_____ COMMENTS:_____

WATER PROPERTIES

TEMPERATURE: 17.7 °C pH: 8.26 SC: 1324 µS/cm

DISSOLVED OXYGEN: 10.65 mg/L (DO SAT. = 10.07 mg/L)

IN-HOUSE ANALYTICAL RESULTS

$[Fe^{2+}]$:_____ [Turbidity]:_____

SAMPLE BOTTLES

Bottle size and type

FA = Filtered Acidified Nitric
FU = Filtered Unpreserved
RA = Raw Acidified Nitric
RU = Raw Unpreserved
FAS = Filtered Acidified Sulfuric

1. 250 RU - Bio aluminum, lab pH+SC
2. 250 RA - Total Metals
3. 250 FA - Dissolved Metals
4. 250 FU - Dissolved Anions+Alkalinity
5. 250 RU "SWHL" - Turbidity and archive
6. 250 FAS - Nutrients
7. 40 mL x 3 glass FAS - DOC

COLLECTED BY:

DATE OF SAMPLE DELIVERY:

SWHL

WATER-SAMPLE DATA COLLECTION SHEET

SITE NAME: MRNT

SITE DESCRIPTION:

LATITUDE: LONGITUDE: ALTITUDE:

DATE SAMPLE COLLECTED: 5/25/26 TIME: 1700

REMARKS:

SITE PROPERTIES

AIR TEMPERATURE: °C WEATHER:

DISCHARGE: METHOD: COMMENTS:

WATER PROPERTIES

TEMPERATURE: 19.5 °C pH: 8.28 SC: 1497 µS/cm

DISSOLVED OXYGEN: 9.90 mg/L DO SAT = 9.82 mg/L, 100.8 %

IN-HOUSE ANALYTICAL RESULTS

[Fe^{2+}]: [Turbidity]:

SAMPLE BOTTLES

Bottle size and type

FA = Filtered Acidified Nitric
FU = Filtered Unpreserved
RA = Raw Acidified Nitric
RU = Raw Unpreserved
FAS = Filtered Acidified Sulfuric

1. 250 FA - Dissolved Metals
2. 250 FU - Dissolved Anions+Alkalinity
3. 250 FAS - Nutrients
4. 40 mL x 3 glass FAS - DOC
5. 250 RU - Bio aluminum, lab pH+SC
6. 250 RA - Total Metals
7. 250 RU "SWHL" - Turbidity and archive

COLLECTED BY: LD

DATE OF SAMPLE DELIVERY:

SWHL

WATER-SAMPLE DATA COLLECTION SHEET

SITE NAME: Plankinton

SITE DESCRIPTION: _____

LATITUDE: _____ LONGITUDE: _____ ALTITUDE: _____

DATE SAMPLE COLLECTED: 3/25/26 TIME: 9:30

REMARKS: _____

SITE PROPERTIES

AIR TEMPERATURE: _____ °C WEATHER: Sunny

DISCHARGE: _____ METHOD: _____ COMMENTS: _____

WATER PROPERTIES

TEMPERATURE: 5.6 °C pH: 7.37 SC: 268.2 µS/cm

DISSOLVED OXYGEN: 13.80 mg/L DO SAT = 13.22 mg/L, 104.4 %

IN-HOUSE ANALYTICAL RESULTS

[Fe^{2+}]: _____ [Turbidity]: _____

SAMPLE BOTTLES

Bottle size and type

FA = Filtered Acidified Nitric
FU = Filtered Unpreserved
RA = Raw Acidified Nitric
RU = Raw Unpreserved
FAS = Filtered Acidified Sulfuric

1. 250 FA - Dissolved Metals
2. 250 FU - Dissolved Anions+Alkalinity
3. 250 FAS - Nutrients
4. 40 mL x 3 glass FAS - DOC
5. 250 RU - Bio aluminum, lab pH+SC
6. 250 RA - Total Metals
7. 250 RU "SWHL" - Turbidity and archive

COLLECTED BY:

DATE OF SAMPLE DELIVERY:

SHL

STN NO _____ DATE 4/22/26

METER CALIBRATIONS/FIELD MEASUREMENTS

TEMPERATURE Meter make/model _____

Lab Tested against NIST Thermometer/Thermister? Y N Date: _____ ± _____ °C

Measurement Location : FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **°C** Remark ___ ___ Qualifier ___ ___

pH Meter make/model YSI Pro Quattro Electrode type _____ Type: GEL LIQUID OTHER _____

Sample: FILTERED UNFILTERED FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

pH Buffer	Buffer Temp	Theoretical pH from table	pH Before Adj.	pH After Adj.	Slope	Millivolts
pH 7	19.1°C	7.02	6.93	7.0		
pH 7						
pH 7						
pH 10	19.0	10.05	9.84	10.0		
pH 4	18.9	4.0	3.62	4.0		
pH ___						
CHECK pH ___						

Temperature effects on pH buffers

	Buffer and Nominal pH value		
Temp °C	4.01	7.00	10.00
0	4.00	7.14	10.30
5	4.00	7.10	10.23
10	4.00	7.07	10.17
15	4.00	7.04	10.11
20	4.00	7.02	10.05
25	4.01	7.00	10.00
30	4.01	6.99	9.96
35	4.02	6.98	9.92
40	4.03	6.98	9.88
45	4.05	6.98	9.85
50	4.06	6.98	9.82
55	4.07	6.98	9.79
60	4.09	6.99	9.76

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **units** Remark ___ ___ Qualifier ___ ___

SPECIFIC CONDUCTANCE Meter make/model YSI Pro Quattro Sensor Type: Dip Flow-thru Other _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points

Std Value µs/cm	Std Temp	SC Before Adj.	SC After Adj.	Std Lot No.	Std Exp. Date
1000	18.9°C	949	1000	25G100154	1/4/27

AUTO TEMP COMPENSATED METER ___

MANUAL TEMP COMPENSATED METER ___

CORRECTION FACTOR APPLIED? Y N

CORRECTION FACTOR= _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **µs/cm** Remark ___ ___ Qualifier ___ ___

DISSOLVED OXYGEN Meter make/model YSI Pro Quattro Probe type _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points BOD bottle stirrer Used? Y N

Air Calibration Chamber in Water Air-Saturated Water Air Calibration Chamber in Air Winkler Titration Other _____

Water Temp °C	Barometric Pressure mm Hg	DO Table Reading mg/L	Salinity Corr. Factor	DO Before Adj.	DO After Adj.
	765			100.9	100.7

Zero DO Check _____ mg/L Adj. to _____ mg/L Date: _____

Zero DO Solution Date _____ Thermister Check? Y N Date _____

Membrane Changed? N Y Date: _____ Time: _____

Barometer Calibrated? N Y Date: _____ Time: _____

Battery Check: REDLINE _____ RANGE _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **mg/L** Remark ___ ___ Qualifier ___ ___

EMAT
EMBT
Thmstor

STN NO WQ-19 DATE 4/24/26

METER CALIBRATIONS/FIELD MEASUREMENTS

TEMPERATURE Meter make/model _____

Lab Tested against NIST Thermometer/Thermister? Y N Date: _____ ±_____ °C

Measurement Location : FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:**_____ **°C** Remark ___ ___ Qualifier ___ ___

pH Meter make/model _____ Electrode type _____ Type: GEL LIQUID OTHER _____

Sample: FILTERED UNFILTERED FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

pH Buffer	Buffer Temp	Theoretical pH from table	pH Before Adj.	pH After Adj.	Slope	Millivolts
pH 7	18.9	7.02	7.24	7.00		
pH 7						
pH 7						
pH 10	18.9	10.05	~~9.59~~ 9.94	10.00		
pH 4	18.9	4.00	3.99	4.00		
pH ___						
CHECK pH ___						

Temperature effects on pH buffers

	Buffer and Nominal pH value		
Temp °C	4.01	7.00	10.00
0	4.00	7.14	10.30
5	4.00	7.10	10.23
10	4.00	7.07	10.17
15	4.00	7.04	10.11
20	4.00	7.02	10.05
25	4.01	7.00	10.00
30	4.01	6.99	9.96
35	4.02	6.98	9.92
40	4.03	6.98	9.88
45	4.05	6.98	9.85
50	4.06	6.98	9.82
55	4.07	6.98	9.79
60	4.09	6.99	9.76

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4_____ # 5 _____ **MEDIAN:** _____ **units** Remark ___ ___ Qualifier ___ ___

SPECIFIC CONDUCTANCE Meter make/model YSI Pro Quattro Sensor Type: Dip Flow-thru Other _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points

Std Value µs/cm	Std Temp	SC Before Adj.	SC After Adj.	Std Lot No.	Std Exp. Date
1000	18.9	952	1000	25 6N00154	1/4/27

AUTO TEMP COMPENSATED METER ___

MANUAL TEMP COMPENSATED METER ___

CORRECTION FACTOR APPLIED? Y N

CORRECTION FACTOR= _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **µs/cm** Remark ___ ___ Qualifier ___ ___

DISSOLVED OXYGEN Meter make/model YSI Pro Quattro Probe type _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points BOD bottle stirrer Used? Y N

Air Calibration Chamber in Water Air-Saturated Water Air Calibration Chamber in Air Winkler Titration Other _____

Water Temp °C	Barometric Pressure mm Hg	DO Table Reading mg/L	Salinity Corr. Factor	DO Before Adj.	DO After Adj.
19	762.76			99.8	100.3

Zero DO Check _____mg/lL Adj. to _____ mg/L Date: _____

Zero DO Solution Date_____ Thermister Check? Y N Date_____

Membrane Changed? N Y Date: _____ Time: _____

Barometer Calibrated? N Y Date: _____ Time: _____

Battery Check: REDLINE _____ RANGE _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4_____ # 5 _____ **MEDIAN:** _____ **mg/L** Remark___ ___ Qualifier___ ___

STN NO MRALW DATE 4/29/26

METER CALIBRATIONS/FIELD MEASUREMENTS

TEMPERATURE Meter make/model _____

Lab Tested against NIST Thermometer/Thermister? Y N Date: _____ ±_____ °C

Measurement Location : FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **°C** Remark ___ ___ Qualifier ___ ___

pH Meter make/model YSI Pro Quatro Electrode type _____ Type: GEL LIQUID OTHER _____

Sample: FILTERED UNFILTERED FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

pH Buffer	Buffer Temp	Theoretical pH from table	pH Before Adj.	pH After Adj.	Slope	Millivolts
pH 7	18.5°C	7.02	7.15	7.00		
pH 7						
pH 7						
pH 10	18.5°C	9.(0.05	9.94	10.00		
pH 4	18.5°C	4.00	4.17	4.00		
pH ___						
CHECK pH ___						

Temperature effects on pH buffers

	Buffer and Nominal pH value		
Temp °C	4.01	7.00	10.00
0	4.00	7.14	10.30
5	4.00	7.10	10.23
10	4.00	7.07	10.17
15	4.00	7.04	10.11
20	4.00	7.02	10.05
25	4.01	7.00	10.00
30	4.01	6.99	9.96
35	4.02	6.98	9.92
40	4.03	6.98	9.88
45	4.05	6.98	9.85
50	4.06	6.98	9.82
55	4.07	6.98	9.79
60	4.09	6.99	9.76

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4_____ # 5 _____ **MEDIAN:** _____ **units** Remark ___ ___ Qualifier ___ ___

SPECIFIC CONDUCTANCE Meter make/model YSI Pro Quatro Sensor Type: Dip Flow-thru Other _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points

Std Value µs/cm	Std Temp	SC Before Adj.	SC After Adj.	Std Lot No.	Std Exp. Date
1000	18.5°C	1017	1000	J561001 54	1/4/27

AUTO TEMP COMPENSATED METER ___

MANUAL TEMP COMPENSATED METER ___

CORRECTION FACTOR APPLIED? Y N

CORRECTION FACTOR= _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **µs/cm** Remark ___ ___ Qualifier ___ ___

DISSOLVED OXYGEN Meter make/model YSI Pro Quatro Probe type _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points BOD bottle stirrer Used? Y N

Air Calibration Chamber in Water Air-Saturated Water Air Calibration Chamber in Air Winkler Titration Other _____

Water Temp °C	Barometric Pressure mm Hg	DO Table Reading mg/L	Salinity Corr. Factor	DO Before Adj.	DO After Adj.
	764.7			96.0	100.7

Zero DO Check _____mg/L Adj. to _____ mg/L Date: _____

Zero DO Solution Date_____ Thermister Check? Y N Date_____

Membrane Changed? N Y Date: _____ Time: _____

Barometer Calibrated? N Y Date: _____ Time: _____

Battery Check: REDLINE _____ RANGE _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4_____ # 5 _____ **MEDIAN:** _____ **mg/L** Remark___ ___ Qualifier___ ___

STN NO MRAW DATE 5/6/26

METER CALIBRATIONS/FIELD MEASUREMENTS

TEMPERATURE Meter make/model _____

Lab Tested against NIST Thermometer/Thermister? Y N Date: _____ ±_____ °C

Measurement Location : FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:**_____ **°C** Remark ___ ___ Qualifier ___ __

pH Meter make/model VSI Pro Quattro Electrode type _____ Type: GEL LIQUID OTHER _____

Sample: FILTERED UNFILTERED FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

pH Buffer	Buffer Temp	Theoretical pH from table	pH Before Adj.	pH After Adj.	Slope	Millivolts
pH 7	18.9	7.02	6.93	7.0		
pH 7						
pH 7						
pH 10	18.9	10.05	9.78	10.0		
pH 4	18.8	4.0	3.70	4.0		
pH ___						
CHECK pH ___						

Temperature effects on pH buffers

	Buffer and Nominal pH value		
Temp °C	4.01	7.00	10.00
0	4.00	7.14	10.30
5	4.00	7.10	10.23
10	4.00	7.07	10.17
15	4.00	7.04	10.11
20	4.00	7.02	10.05
25	4.01	7.00	10.00
30	4.01	6.99	9.96
35	4.02	6.98	9.92
40	4.03	6.98	9.88
45	4.05	6.98	9.85
50	4.06	6.98	9.82
55	4.07	6.98	9.79
60	4.09	6.99	9.76

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4_____ # 5 _____ **MEDIAN:** _____ **units** Remark ___ Qualifier __ __

SPECIFIC CONDUCTANCE Meter make/model YSI Pro Quattro Sensor Type: Dip Flow-thru Other _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points

Std Value µs/cm	Std Temp	SC Before Adj.	SC After Adj.	Std Lot No.	Std Exp. Date
1413	19.0	1438	1413	CC29359	1/30/27

AUTO TEMP COMPENSATED METER ___

MANUAL TEMP COMPENSATED METER ___

CORRECTION FACTOR APPLIED? Y N

CORRECTION FACTOR= _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____**µs/cm** Remark ___ ___ Qualifier ___ ___

DISSOLVED OXYGEN Meter make/model YSI Pro Quattro Probe type _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points BOD bottle stirrer Used? Y N

Air Calibration Chamber in Water Air-Saturated Water Air Calibration Chamber in Air Winkler Titration Other _____

Water Temp °C	Barometric Pressure mm Hg	DO Table Reading mg/L	Salinity Corr. Factor	DO Before Adj.	DO After Adj.
18.8	762			99.2	100.3

Zero DO Check _____mg/L Adj. to _____ mg/L Date: _____

Zero DO Solution Date_____ Thermister Check? Y N Date_____

Membrane Changed? N Y Date: _____ Time: _____

Barometer Calibrated? N Y Date: _____ Time: _____

Battery Check: REDLINE _____ RANGE _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4_____ # 5 _____ **MEDIAN:** _____ **mg/L** Remark___ ___ Qualifier___ ___

STN NO MRAW DATE 5/21/26

METER CALIBRATIONS/FIELD MEASUREMENTS

TEMPERATURE Meter make/model _____

Lab Tested against NIST Thermometer/Thermister? Y N Date: _____ ±_____ °C

Measurement Location : FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **°C** Remark ___ ___ Qualifier ___ ___

pH Meter make/model YSI Pro Quattro Electrode type _____ Type: GEL LIQUID OTHER _____

Sample: FILTERED UNFILTERED FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

pH Buffer	Buffer Temp	Theoretical pH from table	pH Before Adj.	pH After Adj.	Slope	Millivolts
pH 7	19.5°C	7.08	7.15	7.00		
pH 7						
pH 7						
pH 10	19.3	10.05	10.05	10.00		
pH 4	19.6	4.00	3.99	4.00		
pH ___						
CHECK pH ___						

Temperature effects on pH buffers

	Buffer and Nominal pH value		
Temp °C	4.01	7.00	10.00
0	4.00	7.14	10.30
5	4.00	7.10	10.23
10	4.00	7.07	10.17
15	4.00	7.04	10.11
20	4.00	7.02	10.05
25	4.01	7.00	10.00
30	4.01	6.99	9.96
35	4.02	6.98	9.92
40	4.03	6.98	9.88
45	4.05	6.98	9.85
50	4.06	6.98	9.82
55	4.07	6.98	9.79
60	4.09	6.99	9.76

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **units** Remark ___ ___ Qualifier ___ ___

SPECIFIC CONDUCTANCE Meter make/model YSI Pro Quattro Sensor Type: Dip Flow-thru Other _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points

Std Value µs/cm	Std Temp	SC Before Adj.	SC After Adj.	Std Lot No.	Std Exp. Date
1413	19.5°C	1390	1413	CC29359	1/30/27

AUTO TEMP COMPENSATED METER ___

MANUAL TEMP COMPENSATED METER ___

CORRECTION FACTOR APPLIED? Y N

CORRECTION FACTOR= _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **µs/cm** Remark ___ ___ Qualifier ___ ___

DISSOLVED OXYGEN Meter make/model YSI Pro Quattro Probe type _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points BOD bottle stirrer Used? Y N

Air Calibration Chamber in Water Air-Saturated Water Air Calibration Chamber in Air Winkler Titration Other _____

Water Temp °C	Barometric Pressure mm Hg	DO Table Reading mg/L	Salinity Corr. Factor	DO Before Adj.	DO After Adj.
19.0	764.7			102.7	100.6

Zero DO Check _____ mg/L Adj. to _____ mg/L Date: _____

Zero DO Solution Date _____ Thermister Check? Y N Date _____

Membrane Changed? N Y Date: _____ Time: _____

Barometer Calibrated? N Y Date: _____ Time: _____

Battery Check: REDLINE _____ RANGE _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **mg/L** Remark ___ ___ Qualifier ___ ___

STN NO Madden Mines DATE 6/26/26

METER CALIBRATIONS/FIELD MEASUREMENTS

TEMPERATURE Meter make/model _____

Lab Tested against NIST Thermometer/Thermister? Y N Date: _____ ±_____ °C

Measurement Location : FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **°C** Remark ___ ___ Qualifier ___ ___

pH Meter make/model YSI Pro Quattro Electrode type _____ Type: GEL LIQUID OTHER _____

Sample: FILTERED UNFILTERED FLOW-THRU CHAMBER SINGLE POINT AT _____ ft blw LSD VERTICAL AVG. OF ____ POINTS

pH Buffer	Buffer Temp	Theoretical pH from table	pH Before Adj.	pH After Adj.	Slope	Millivolts
pH 7	19.2	7.02	6.59	7.02		
pH 7						
pH 7						
pH 10	19.2	10.05	9.76	10.05		
pH 4	~~4.0~~ 19.2	4.0	4.03	4.00		
pH ___						
CHECK pH ___						

Temperature effects on pH buffers

	Buffer and Nominal pH value		
Temp °C	4.01	7.00	10.00
0	4.00	7.14	10.30
5	4.00	7.10	10.23
10	4.00	7.07	10.17
15	4.00	7.04	10.11
20	4.00	7.02	10.05
25	4.01	7.00	10.00
30	4.01	6.99	9.96
35	4.02	6.98	9.92
40	4.03	6.98	9.88
45	4.05	6.98	9.85
50	4.06	6.98	9.82
55	4.07	6.98	9.79
60	4.09	6.99	9.76

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **units** Remark ___ ___ Qualifier ___ ___

SPECIFIC CONDUCTANCE Meter make/model YSI Pro Quattro Sensor Type: Dip Flow-thru Other _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points

Std Value µs/cm	Std Temp	SC Before Adj.	SC After Adj.	Std Lot No.	Std Exp. Date
1413	19.2	1384	1413	CC293~~5~~9	1/30/27

AUTO TEMP COMPENSATED METER ___

MANUAL TEMP COMPENSATED METER ___

CORRECTION FACTOR APPLIED? Y N

CORRECTION FACTOR= _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **µs/cm** Remark ___ ___ Qualifier ___ ___

DISSOLVED OXYGEN Meter make/model _____ Probe type _____

Sample: Flow-thru chamber Single point at _____ ft blw lsd Vertical avg. of _____ points BOD bottle stirrer Used? Y N

Air Calibration Chamber in Water Air-Saturated Water Air Calibration Chamber in Air Winkler Titration Other _____

Water Temp °C	Barometric Pressure mm Hg	DO Table Reading mg/L	Salinity Corr. Factor	DO Before Adj.	DO After Adj.
19.4	603.4			93.3	79.3

Zero DO Check _____ mg/L Adj. to _____ mg/L Date: _____

Zero DO Solution Date _____ Thermister Check? Y N Date _____

Membrane Changed? N Y Date: _____ Time: _____

Barometer Calibrated? N Y Date: _____ Time: _____

Battery Check: REDLINE _____ RANGE _____

Field Readings # 1 _____ # 2 _____ # 3 _____ # 4 _____ # 5 _____ **MEDIAN:** _____ **mg/L** Remark ___ ___ Qualifier ___ ___