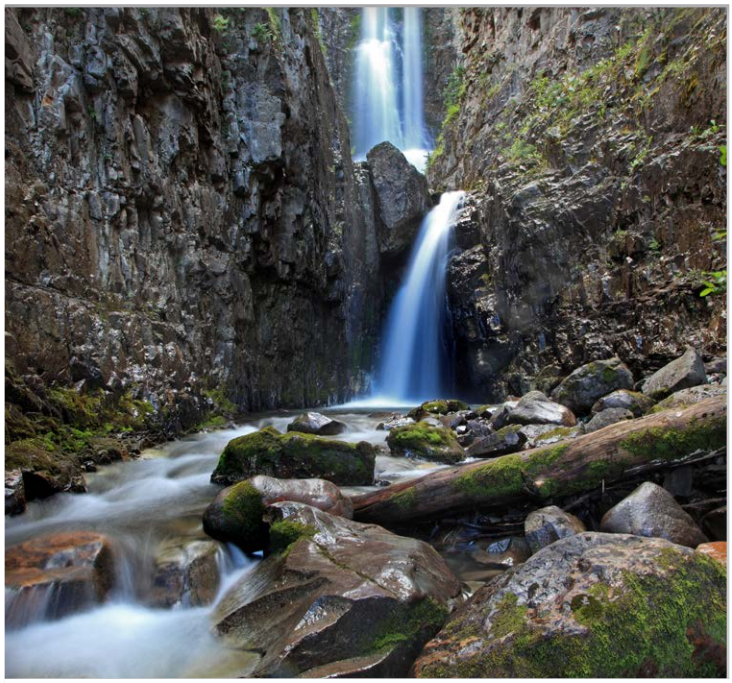
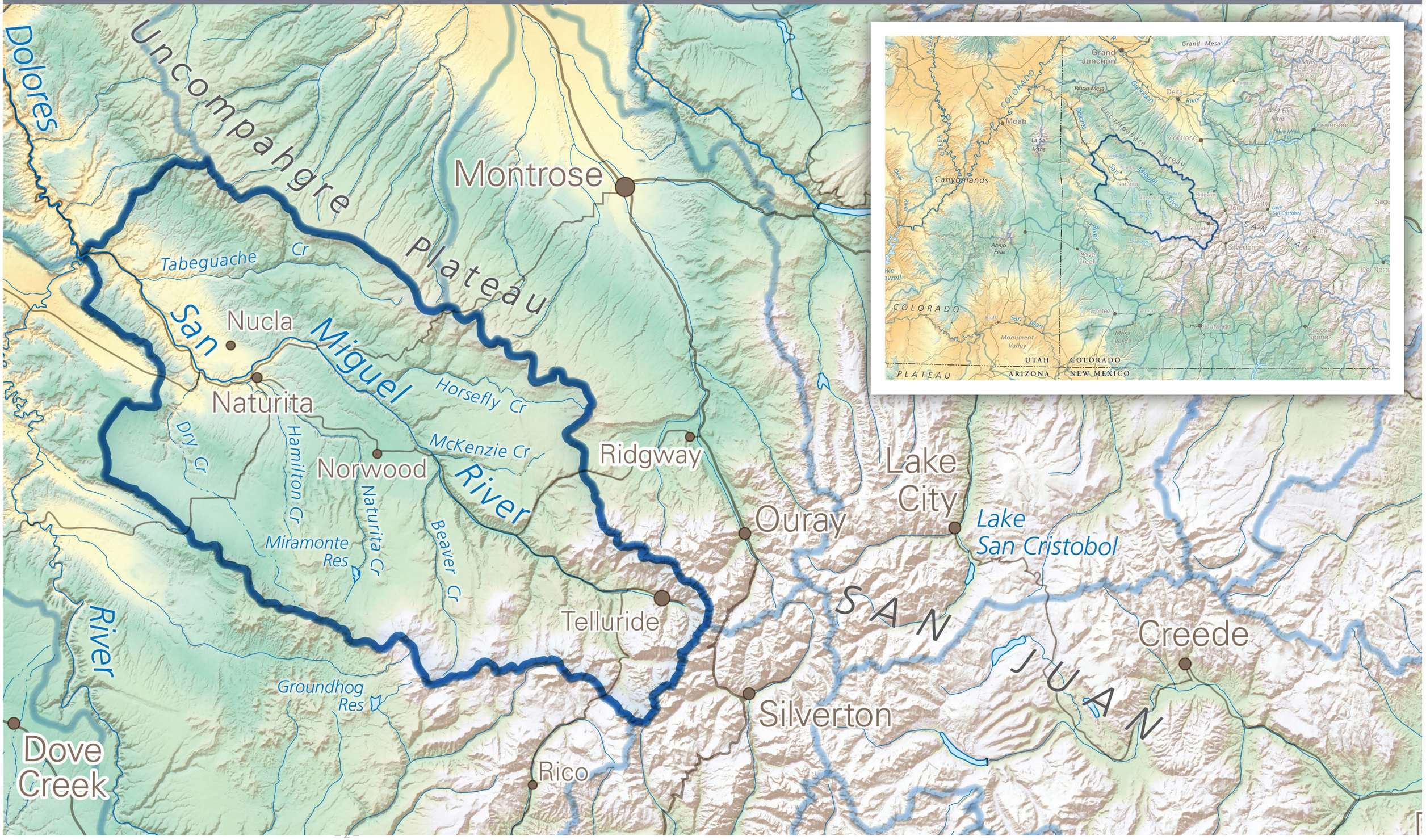
State of the San Miguel Watershed

– 2014 –



SAN MIGUEL WATERSHED COALITION

San Miguel Watershed Region



Introduction

The State of the San Miguel Watershed Report 2014 was produced by the San Miguel Watershed Coalition to assess ecological health within the drainage area of the San Miguel River in southwest Colorado. It is a revised sequel to the 2005 San Miguel Watershed Report Card and intended as a public information tool for watershed management discussions. Please refer to the acknowledgments (page 38) for a complete list of the partners who made this report possible.

The San Miguel Watershed Coalition's goal for this report is to establish a quantitative scientific grading system for watershed health by using existing data and recommending new monitoring to enable more complete future analysis. Although there is a qualitative narrative throughout this publication, we tried to keep such analysis to a minimum to avoid social or cultural bias.

The monitoring metrics used in this report are organized into four primary sections: aquatic ecosystem, terrestrial environment, climatic variables, and land-use activities. Each section is further divided into four subsections that address specific environmental and cultural indicators. The indicators that rely on data without a sufficient period of monitoring will not be graded until complete baseline conditions are identified. Recommendations are included in this report to work with agency partners to coordinate additional monitoring that will allow for more complete analysis in future reports.

There is a distinct interconnection between the monitoring metrics, where changes (positive or negative) in an actual condition will potentially affect other environmental conditions. An obvious example is that warming air temperatures will cause increases in evaporation and lead to less water in lakes and streams. Less water in streams leads to higher concentrations of pollutants in surface waters and warmer water temperatures. Increased pollutants and warmer stream temperatures affect fisheries and other aquatic life negatively. Attempting to understand the cascade of effects is one of the primary ongoing objectives of the State of the San Miguel Watershed Report.

Evaluating the health of an entire watershed is complicated and could be executed by comparing multiple watersheds to establish an understanding of relative health. Unfortunately, there is no comprehensive watershed rating program in which we can participate at this time, so the State of the San Miguel Watershed Report is an independent project. **Consequently, it is important to note that if this report were done in comparison to other watersheds around the West, the San Miguel would rank highly overall in terms of healthy, naturally functioning ecosystems.**

The relatively free-flowing hydrology of the San Miguel makes it one of the most ecologically intact watersheds in the West when viewed as a whole, and it is largely composed of healthy, naturally functioning ecosystems that are recognized by regional scientists and land managers as examples for more degraded watersheds. The grades in this report, however, are comparisons to undisturbed (pristine) environments and may appear low for a watershed that is recognized to be healthy. It's important to remember that the grades are based on undisturbed conditions, so achieving an "A" for any section is unlikely.

The Watershed Education Program provides students up and down the San Miguel with watershed tours. Photo Laura Kudo

INTERPRETING GRADES

- **A** All key processes are functional, and all critical habitats are in near-pristine condition.
- **B** Most key processes are functional, and most critical habitats are intact.
- **C** Some key processes are functional, and some critical habitats are impacted.
- **D** Many key processes are not functional, and many critical habitats are impacted.
- **F** Most key processes are not functional, and most critical habitats are impacted severely.

The State of the San Miguel Watershed Report should be viewed as a dynamic document that will be refined in the future, offering relevant information to the watershed community to spark thoughtful conversation among stakeholders. This report is not peer-reviewed science. It is a public information piece targeted at a general audience. By structuring this report on publicly available data with sections that can be updated at a necessary rate of repetition, the San Miguel Watershed Coalition intends to develop a measure for meaningful comparison of ecological and cultural conditions through time and a way to identify positive or negative changes to watershed health.

We welcome your feedback.

—The San Miguel Watershed Coalition

FRONT COVER IMAGES CLOCKWISE FROM TOP LEFT: Lake Fork of the San Miguel, photo Ryan Bonneau; lower San Miguel, photo Sheep Mountain Alliance; Bridal Veil Living Classroom students in the headwaters, photo Alessandra Jacobson; changing scrub oak foliage on the middle San Miguel, photo Carl Marcus.

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CLIMATE

Storms clouds over the San Juan Mountains. Photo Carl Marcus

AQUATIC ECOSYSTEM

Waterfall Creek high in the headwaters of the San Miguel. Photo John Richter

TERRESTRIAL ENVIRONMENT

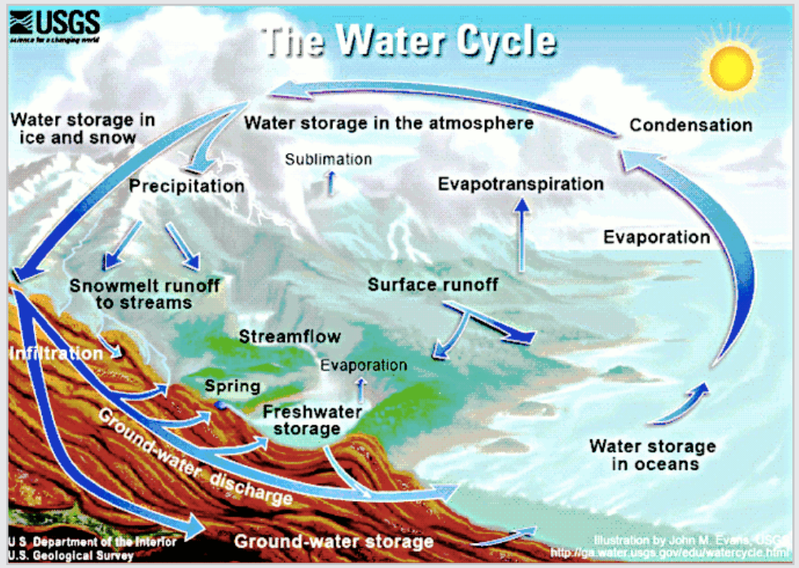
A diverse forest canopy. Photo Ryan Bonneau

LAND USE

The dense development of Telluride. Photo Ryan Bonneau

THE BASICS

The Earth has a finite amount of water, which moves on, above, and below its surface. This "water cycle" follows how the Earth's water is always in motion and always changing states from liquid to vapor to ice and back again. The cycle has been in action for billions of years, and all life on Earth depends upon it. In the arid Southwest, we are especially dependent upon precipitation, primarily in the form of rain or snow.



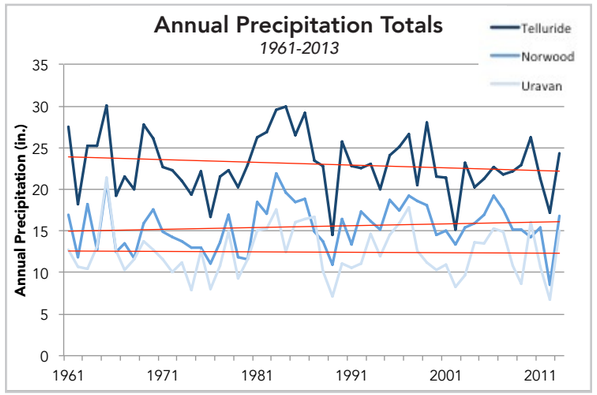
It's difficult to model the precipitation of the San Juan Mountain region because of its complex topography and the variability in its patterns. General circulation models help estimate precipitation based on a variety of scenarios, but these models yield results with a high degree of variability. Some studies indicate that annual precipitation will decrease slightly, while others project an increase, particularly in the winter months. Even if annual precipitation does not change, more precipitation may fall as rain in the future as a result of warming temperatures. Some models project more variable precipitation patterns with more frequent extreme events, which contribute to mudslides and erosion that negatively impact water quality with increased sediment in streams and rivers.

MONITORING

The National Oceanic and Atmospheric Administration maintains weather stations that monitor precipitation. Three stations have operated in the San Miguel Watershed for many decades, measuring rain and snowfall as "total precipitation" to calculate annual totals.

The Telluride monitoring station was one of the oldest continually operating stations in Colorado until it was removed in 2010. The Norwood station was disabled in August 2008 and relocated in October 2009. The Uravan station has operated continuously since 1961.

Long-term monitoring of precipitation allows for a solid understanding of changes in precipitation totals from year to year. We expect some years to be wetter than others, but it's important to monitor whether the total amount of annual precipitation falls within the expected range of probable totals. These long-term data sets help establish a trend line to indicate an increase or decrease in average annual precipitation.



Data derived from National Oceanic and Atmospheric Administration monitoring stations, and supplemented from alternate sources where needed, shows annual precipitation totals for monitoring stations in the San Miguel Watershed with individual trendlines. Telluride monthly data were sourced from the Internet (Thom Carnavale, 2010 to 2013). Norwood data for 2008 to 2009 was unavailable, so the annual mean was used for those years. Telluride precipitation totals appear to decrease slightly through time, while Norwood shows a slight increase. Uravan's precipitation totals appear to trend with historically average levels.

STATE OF THE SAN MIGUEL WATERSHED 2014
CLIMATE Precipitation

SPOTLIGHT: EL NIÑO / LA NIÑA

In the Southwest, "El Niño" and "La Niña" describe weather phenomena that potentially deliver either copious rain and snow to the region or cause widespread drought. These cycles are part of the El Niño–Southern Oscillation, a natural see-saw in ocean surface temperatures and surface air pressure between the east and west Pacific Ocean.

During El Niño, the trade winds blowing from the east slacken, enabling warm water to migrate east. The center of rain follows, moving east to the middle of the Pacific Ocean near Tahiti. La Niña events behave in the opposite way: Trade winds intensify and stack the warm surface water in the west more than normal. (The waters near Australia are often five feet higher than the ocean surface in the east during La Niña episodes.) The area of intense rainfall is dragged back toward Australia.

El Niño and La Niña episodes tend to develop between April and June and peak between December and January when sea surface temperatures reach their warmest or coldest states. As a result, changes to atmospheric circulation, and therefore weather, are most prominent in the winter.

The effect of these cycles on the Southwest is caused principally by the shifting jet streams. During El Niño events, the Pacific jet stream is straighter and pulled south, so storms form in the Pacific Ocean just west of California, partially because those waters are warmer than average during El Niño events. The combination of the jet stream and storms often results in a wet winter and increased rain and snow across California and the southern United States.

La Niña events, on the other hand, often bring dry conditions to Colorado because the jet streams take a more serpentine path. The Pacific jet stream usually carves north and enters North America through the northwestern U.S., bringing wetter-than-average conditions to that region and diverting storms away from the Southwest.

While past weather patterns show that El Niño and La Niña conditions deliver a wide range of variability, new modeling analysis indicates that El Niños will become more frequent, potentially bringing more intense precipitation events and subsequent flooding into the Southwest.

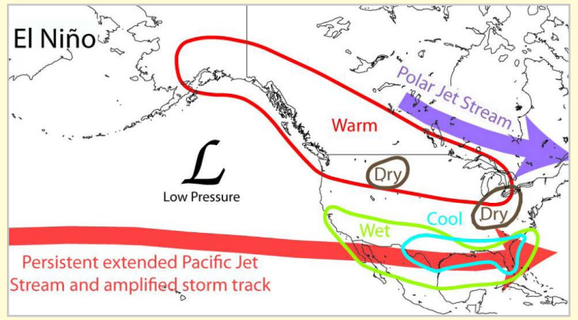


Figure 1. El Niño events cause the winter path of the jet streams to move over the Southwest, usually delivering more winter rain and snow in the region.

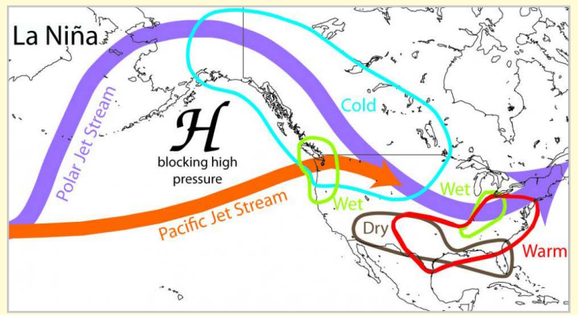


Figure 2. La Niña events also affect atmospheric circulation, often delivering drier-than-average winters to the Southwest.

ASSESSMENT & ACTION ITEMS

The current precipitation patterns within the San Miguel Watershed show a slight decrease in annual precipitation in the mountainous portion of the watershed and a static to mild increase on the plateau and mesa portions at the west end of the watershed. Long-term monitoring and data analysis should continue and be compared to regional climate data to verify that the local patterns are consistent with regional conditions.

SUGGESTED ACTION

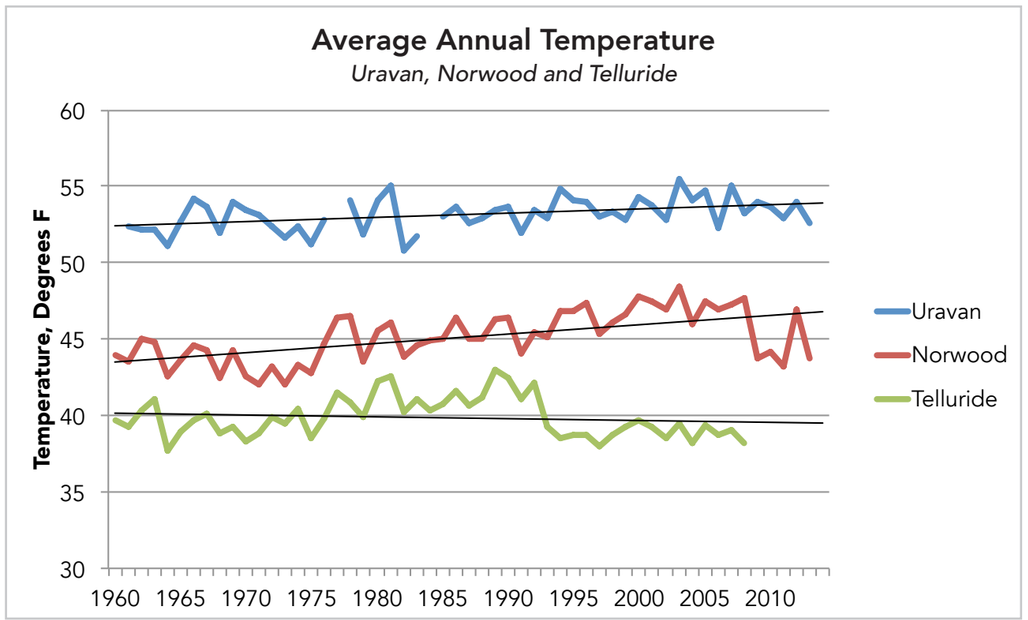
1. **Re-establish a long-term weather monitoring station in Telluride that meets the standards required by the National Oceanic and Atmospheric Administration to be included in the national network.**
2. **Partner with the Town of Telluride on its long-term monitoring plan on the Telluride Valley Floor, including analysis of data from the weather station that was installed in 2014.**

THE BASICS

Southwestern Colorado has warmed approximately 2.0°F over the last three decades (1977 to 2007). This rate exceeds the average warming in the majority of the western United States and all other region of the U.S., except Alaska.

Climate models predict that average temperatures in southwest Colorado are likely to increase by an additional 1.5°F to 3.5°F by 2025 and 2.5°F to 5.5°F by 2050. Additionally, summers are projected to warm more than winters. By 2050, typical average monthly temperatures in the summer are projected to be as warm as, or warmer than, the hottest 10 percent of summers from 1950 to 1999.

The potential effects of the warming pattern suggests that the climate of the mountains will migrate upward in elevation, and the climate of the desert Southwest will progress upward in elevation into the valley environments. Direct impacts from warming temperatures and drier conditions will combine with other factors, such as invasive species and increased wildfire cycles, causing changes that are difficult to predict. Increasing temperatures will affect the timing of runoff during snowmelt, influence water temperatures in rivers and streams, potentially affect the growth patterns of native plant species, impact forest cover types, and alter the way we interact with the landscape. Looking forward, trend analysis and modeling of this information can serve as tools to enable us to adapt to these changing conditions.



At present, temperature gauges are maintained in Uravan and Norwood. Telluride hosted one of the oldest and longest-running temperature gauges in the state of Colorado until 2009 when the site was decommissioned. Consequently, mean temperatures for Telluride are not available after 2008. Trendlines for the average annual temperature in Norwood and Uravan show a warming pattern, while the trend line for Telluride indicates little change to a slight cooling since 1960.

STATE OF THE SAN MIGUEL WATERSHED 2014
CLIMATE Air Temperature

FIGURE 5-2. January Observed and Projected Temperatures

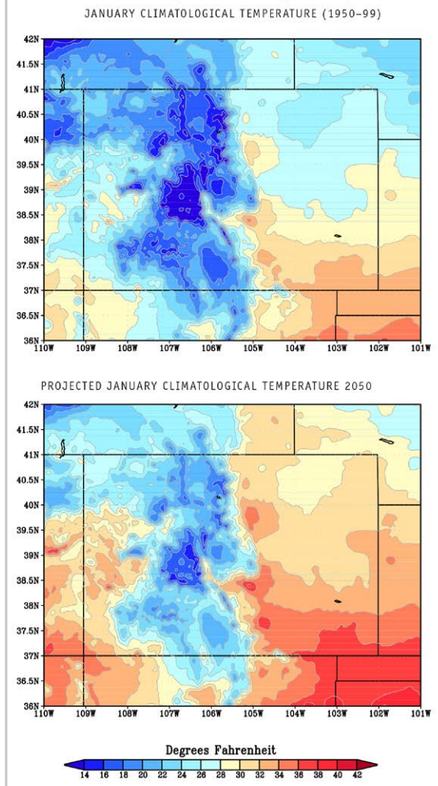
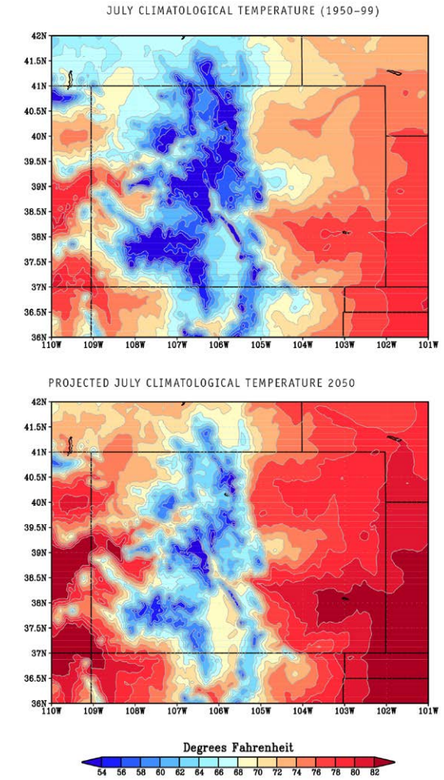


FIGURE 5-3. July Observed and Projected Temperatures



CASE STUDY

Observed and projected future temperatures for Colorado.

Left Panels: Observed average daily temperature in January in Colorado from 1950 to 1999 (top left) and projections for 2050 (bottom left). By 2050, the January climate of Colorado's Eastern Plains will have moved northward by a distance greater than half the state. The climate zones of the mountains will have migrated upward in elevation, and the climate of the desert Southwest will have progressed into the valleys of the Western Slope.

Right Panels: Observed average daily temperature in July in Colorado from 1950 to 1999 (top right) and projections for 2050 (bottom right). For July, the temperatures on the Eastern Plains will have moved westward and upslope, so much that the temperature regime near the western Kansas border will have reached the Front Range by 2050.

ASSESSMENT & ACTION ITEMS

Temperature data should continue to be monitored because it's a quantifiable metric with broad representation throughout the watershed. In a practical sense, temperature is one factor that may have far-reaching effects on the health of the San Miguel Watershed when combined with other variables, such as precipitation patterns and stream flows.

The Town of Telluride installed a weather monitoring station on the Valley Floor in 2014. Data from this station combined with the Norwood and Uravan monitoring stations will allow for continued trend analysis for the watershed.

SUGGESTED ACTION

1. **Consult with agencies, such as the National Oceanic and Atmospheric Administration, to present more in-depth analysis of climate patterns, including precipitation and air temperature and their projected effects on the ecology of the watershed.**
2. **Continue to work with land management agencies to stay informed of policy decisions regarding long-range public land management plans.**
3. **Identify opportunities to partner with organizations, such as the Colorado Climate Center, to develop a dashboard on the San Miguel Watershed Coalition website to present current weather conditions between State of the San Miguel Watershed Reports.**

THE BASICS

Nitrogen Deposition

The National Atmospheric Deposition Program, through its National Trends Network, monitors precipitation chemistry across the country through a series of devices operated by federal agency partners. As identified in the 2005 San Miguel River Report, nitrogen is a concern in the San Miguel Watershed because high-elevation ecosystems are sensitive to increases or decreases in the natural levels of nitrogen and other nutrients in our air, soil, and water. Excessive nitrogen in the atmosphere can lead to acid rainfall and contribute to "eutrophication" (too many nutrients) in streams and rivers. The identified source(s) of nitrogen in the Four Corners region are power plants and their associated emissions. While the National Trends Network does not have a station located in the San Miguel Watershed, the Molas Pass site serves as an acceptable indicator for the greater watershed.

Radionuclide Monitoring

The objective for a three-year baseline study, initiated in 2012 by the Mountain Studies Institute, was to establish current levels of radionuclides (a chemical that emits a type of radioactivity called gamma rays) in the ground water, surface water, and snow in the upper San Miguel Watershed. The study was commissioned by the Telluride, Ophir and San Miguel County to understand the baseline concentrations of trace metals and radionuclides prior to any future uranium mining in the region. The monitoring occurred from 2012 through 2014, and a final report will be issued in 2015. Preliminary analysis indicates minimal radionuclides in surface and ground waters of the upper San Miguel Watershed.

Dust on Snow & Spring Runoff

It's natural for soil to blow about in the wind, but humans have exacerbated circumstances since settling and developing the American West in the late-1800s. Research conducted in the San Juan Mountains suggests that when moderate dust settles on top of snow (observed from 2005 to 2008), the snow cover melts 18 to 35 days sooner because of "albedo," the reduction in the snow's reflective capacity. Snow darkened by layers of dust absorbs more of the sun's energy, and as a result, the snow pack melts earlier and more quickly.

2009 to 2010 saw unprecedented levels of dust on snowpacks — five times more than in 2005 to 2008. Compared to moderate levels, extreme quantities of dust absorb 2 to 4 times more of the sun's rays and advance peak snowmelt by 3 weeks, which is a total of 6 weeks earlier than it would be without dust. Spring runoff patterns change dramatically with the early snowmelt, impacting water management and suggesting that reducing dust could be an important component of any climate adaptation strategies.

The Colorado Dust-on-Snow program is housed at the Center for Snow and Avalanche Studies in Silverton, Colorado. This program monitors dust layers on 10 mountain passes throughout the state. That data, and snowpack data from nearby Snotel sites, indicate how dust is predicted to influence the timing of the spring snowmelt as it relates to the quantity of available water during the runoff season. This information assists reservoir operators; municipal and agricultural water providers; flood risk managers; and others at local, state, and federal agencies who are responsible for managing water flows. Informed water management is vital to all downstream water users.

The Center for Snow and Avalanche Studies received a special use permit in October 2003 to operate a deposition monitoring station in Senator Beck Basin, located in the Ouray Ranger District of the Uncompahgre National Forest. They have developed two study plots and a stream gauging station to meet long-term monitoring objectives.

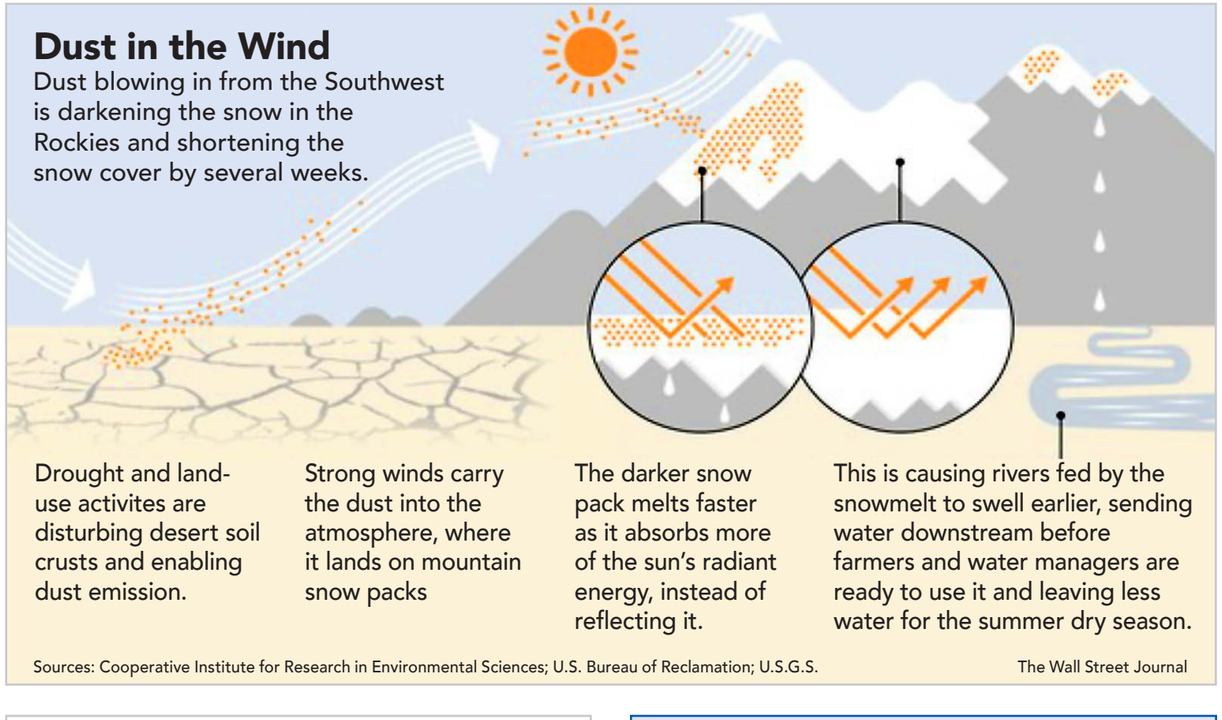
Dust-on-Snow Events Documented per Month, by Winter
Senator Beck Basin Study Area at Red Mountain Pass

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total	Wet	Dry
WY 2014	0	0	0	0	1	3	3	1	2	**10**	6	4
WY 2013	0	1	0	0	1	3	4	1	0	**10**	6	4
WY 2012	0	2	1	0	0	3	2	4	0	**12**	3	9
WY 2011	0	0	0	0	1	3	3	4	0	**11**	7	4
WY 2010	1	0	0	0	0	1	4	3	0	**9**	5	4
WY 2009	1	0	1	0	1	4	5	0	0	**12**	7	5
WY 2008	0	0	0	0	0	3	3	1	0	**7**	2	5
WY 2007	0	0	1	0	1	1	3	1	1	**8**	7	1
WY 2006	0	0	1	0	1	1	3	2	0	**8**	6	2
WY 2005	0	0	0	0	0	1	2	1	0	**4**	3	1
WY 2004							2	1		**3**	na	na
WY 2003					2		1			**3**	na	na

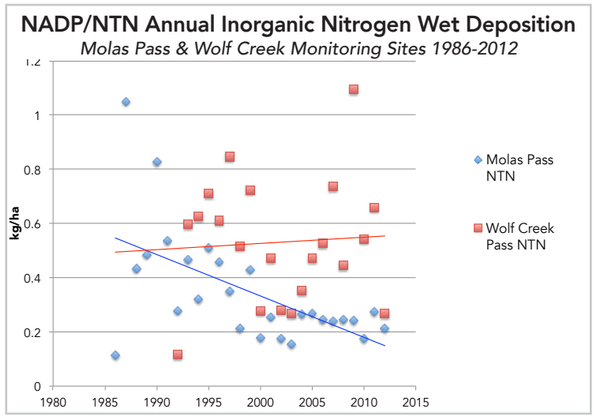
Dust-on-snow events recorded in Senator Beck Basin, the closest monitoring station to the San Miguel Watershed. "Wet" events are tied to rain or snowfall, while "Dry" events are associated with wind storms. Recent data indicate that an average of nine annual dust-on-snow events can be expected for our region.

WY = Water Year

STATE OF THE SAN MIGUEL WATERSHED 2014
CLIMATE Deposition



Sources: Cooperative Institute for Research in Environmental Sciences; U.S. Bureau of Reclamation; U.S.G.S. The Wall Street Journal



Wolf Creek and Molas Pass monitoring stations record inorganic nitrogen deposition rates. The Wolf Creek site displays a wide range of annual deposition rates in comparison to the Molas Pass site, where consistent deposition has been measured since approximately 2000. Previous studies completed in 2000 in the Telluride region show deposition rates of 1.41 kg/ha, which were 25 to 50 percent higher than other regional monitoring stations, including Molas and Wolf Creek. The short-term monitoring program completed in Telluride identified multiple factors that could influence the higher deposition rates and indicates that establishing an official Atmospheric Integrated Research Monitoring Network site in the Southwestern U.S. may be warranted.

ASSESSMENT & ACTION ITEMS

Trend analysis indicates that dust on snow will continue to be problematic with regard to snowpack melt rates and runoff timing for the foreseeable future. The San Miguel Watershed Coalition should continue to use available local and regional resources to understand how atmospheric deposition can influence conditions in the watershed.

SUGGESTED ACTION

1. **The San Miguel Watershed Coalition could pursue a more formal relationship with the Center for Snow and Avalanche Studies to explore opportunities for dust-on-snow monitoring sites within the San Miguel Watershed. Additional dust-on-snow analysis could be completed locally in collaboration with observations presently logged by Telluride Ski Patrol.**
2. **Inorganic nitrogen deposits negatively affect water and soil chemistry, and continued monitoring at the Molas and Wolf Creek Pass stations will provide an indicator of local conditions. San Miguel Watershed Coalition could consider partnership agreements to locate a monitoring station within the watershed boundary.**
3. **The Radionuclide Monitoring Report will be released in 2015, and results should be included in the next Watershed Report.**

THE BASICS

Extreme events are defined for this report as unusual situations associated with natural causes. Some extreme events may also be partially triggered by human actions or changes that occur on the landscape.

Rockfall, moderate flooding, and avalanches are common extreme events in the Rocky Mountain Region, but some instances are fairly unique to the San Miguel Watershed: Ice floes ("floe" from references to a mobile mass of ice at sea) occur at higher-than-average rates on the San Miguel River; mud slides are common in many of the watershed's canyons during summer monsoon rains; and landslides are prevalent because of distinct local geologic conditions.

Drought is an extreme event because of the impacts of its prolonged occurrence. Extended drought affects the health of vegetation, which, when combined with a drier landscape, often creates conditions that feed wildfires.

ICE FLOES

Research conducted by the Bureau of Land Management between 1998 and 2002 indicates that the San Miguel River is "naturally conducive" to ice floes. Additionally, flow and temperature conditions created by Trout Lake and the operation of the Ames Hydroelectric Project increase ice formation after the water has left the power plant.

When ice floes occur, the slurry of ice and water (and other debris) builds into a wave that can be measured by a pressure transducer. The research conducted on the South Fork of the San Miguel River used pressure transducers (and data recorders) to measure the weight of water-and-ice masses to determine their sizes and origins.

Water temperature data were also collected in Trout Lake and at the Ames plant, and there was a strong correlation between the temperature in Trout Lake and the formation of ice in the river below the power plant. Additionally, the operating schedule of the hydroelectric power plant contributed to the formation of excessive ice in the South Fork because of reduced releases at night (based on power demands). Collectively, those low-flow conditions and super-cooled water from Trout Lake increased the formation of frazzle ice—loose, needle-shaped crystals that originate on rocks at the bottom of the river. Over a period of days and weeks, frazzle ice grows to a thickness that can be measured in feet, creating multiple dams in the river. When one ice dam collapses under the force of the water it holds, a cascade of successive ice dams collapse to create ice floes large enough to float 64 miles from the South Fork to the confluence with the Dolores River. This slurry of ice, water, and debris scours the river channel, uprooting riparian vegetation and pushing fish populations downstream.

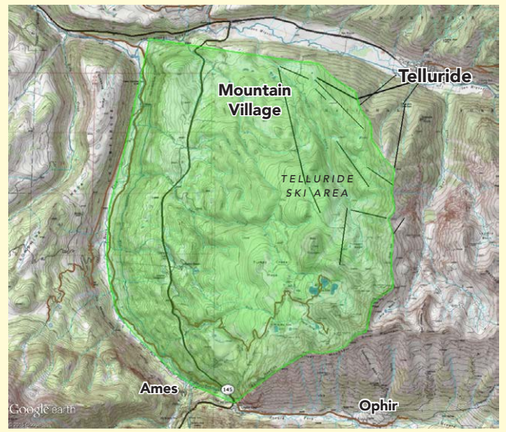
In an effort to curtail the influence of the Ames power plant on the formation of frazzle ice in the South Fork, operating requirements were modified when the plant's license came up for review. The following information summarizes the terms and conditions mandated by the Federal Energy Regulatory Commission for the May 19, 2010, license renewal to continue operation of the 3.5 megawatt Ames Hydroelectric by the Public Service Company of Colorado:

- Provide a year-round continuous minimum flow release of 3 cubic feet per second, or Lake Fork inflow to Trout Lake if less, from the project's lower valve house to downstream of Trout Lake dam.
- Maintain a year-round minimum streamflow of 13 cubic feet per second in the South Fork downstream of the powerhouse, while regulating flows in early fall for trout spawning and maximum flows during winter months.
- Install, maintain, and operate thermal mixing devices (i.e. subsurface propellers) in Trout Lake near the project's water intake to blend the water to 43 degrees.

SPOTLIGHT: SILVER MOUNTAIN LANDSLIDE

The largest and perhaps best example of an area covered by landslide debris in the San Juan Mountains is between the Lake Fork of the San Miguel and Silver Mountain, which sits above the historic mining town of Alta.

The landslide topography that comprises Turkey Creek Mesa is responsible for the numerous wetland features found near Alta Lakes, within Prospect Basin, and across the balance of Mountain Village and Ski Ranches, south to the U.S. Forest Service Sunshine campground. The various springs, lakes, wet meadows, and fens formed where the debris created a natural cup at or near the surface where groundwater collects and then runs downslope. Geologic analysis in the early 1900s indicates that this landslide, and other large landslides in the region, initially could have been a result of the last extensive ice occupation of the San Juan Mountains, but physical evidence shows either smaller-scale slips or continuous movement still occurring over time.



STATE OF THE SAN MIGUEL WATERSHED 2014
CLIMATE Extreme Events

DROUGHT

Drought is difficult to define because normal precipitation varies from region to region on a global scale. For example, the island of Kauai receives 450 inches of annual rainfall, while Norwood receives less than 20 inches annually. Therefore, the idea of below-average precipitation requires both conceptual and operational definitions when discussing this extreme event.

Conceptually, drought requires two elements: an extended period of time combined with decreased precipitation beyond levels that would be expected in the normal range of variability. Some years will be drier than others, but when multiple weeks, months, or years pass into extended periods of decreased precipitation, the cumulative shortfall leads to a state of drought.

Technical metrics and statistical data can be used to define drought in an operational sense. No single model defines drought, but a set of conditions or thresholds is often defined by change in precipitation levels from an established mean that is usually based on 30 years of data. Agricultural communities might examine the rates of evapotranspiration of crops versus soil moisture content. Foresters typically examine moisture content in fuel classes (10-hour to 1,000-hour fuels) to assess wildfire risks. While there is not a precise science to identify the start of drought conditions, operational definitions are used to help initiate response strategies and form mitigation plans by land managers and government support agencies.

The effects of drought are often felt across broad segments of society, and human activities exacerbate the impacts. Typically, the agricultural community is often hardest hit during drought cycles, but impacts reverberate in many places between the lack of precipitation and the demand people place on water supply. Distributing water for irrigation and agriculture, maintaining reserves in reservoirs for human consumption, relying on water for electricity generation, and using water for recreational purposes create stresses on the natural environment and water managers.

Finding a balance between our human needs and maintaining baseline environmental conditions will continue to be a challenge. Awareness is a critical first step: By simply understanding where water originates and how we use this finite resource, we can change our habits. With precipitation totals ranging from 15 to 23 inches annually between Uravan and Telluride, we don't have a large margin to work with and are reliant on each storm that delivers precipitation.

ASSESSMENT & ACTION ITEMS

Drought monitoring for the Southwest is receiving increased focus by federal agencies and national organizations. Local monitoring and modeling opportunities exist if relationships with academic or government agencies are developed. If predictive models are correct, and more extreme weather patterns are seen as a result of climate change conditions, then data collected in the San Miguel Watershed may prove to be dynamic and informative.

Mudslides will continue as a combined result of rain patterns that are typical in the summer and local geology. Mudslides that affect our transportation system often garner attention because of the impacts to the roads and highways. Ecologically, heavy sediment loads in the river are not considered beneficial unless the flooding is extreme enough that floodplains receive sediment deposits when the river overflows its banks. While monitoring the occurrence of mudslides and sedimentation is not practical in a scientific sense, it could lend trend analysis to a discussion about the negative or positive impacts of flood control as it impacts the San Miguel River.

Ice floe monitoring should be of interest in the watershed community because of the damaging effect when an ice floe scours the river. the Federal Energy Regulatory Commission license renewal of the Ames Power Plant, however, does not require replication of the 2002 Bureau of Land Management research. The license renewal does require Public Service Company of Colorado to monitor temperature gradients in Trout Lake associated with their thermal mixing plan and water temperature in multiple locations, including the penstock intake and discharge. The Thermal Mixing Plan Compliance Monitoring Report prepared by the company (October 2013) indicates that technical challenges and environmental conditions have prevented accurate measurement of temperatures at the penstock intake during the 2012 to 2013 monitoring period and within the water profile near the thermal mixers. Thermal mixing of Trout Lake was completed between October 2012 and March 2013, but temperatures were not recorded accurately because of icing within the thermal logger installation sleeve. Monitoring of the thermal mixing activities in Trout Lake will not be fully operational until the winter of 2015. It might be possible to install pressure transducers in the South Fork if a collaborative research project could be created to share the cost and research requirements across multiple interest groups.

SUGGESTED ACTION

1. **Conduct an annual review of the Public Service Company of Colorado's mandated monitoring implementation and data.**

THE BASICS

"Water quality" pertains to the characteristics of water as it exists in a drinking glass, wastewater treatment plant, or simply flowing in a stream and is evaluated based on chemical, physical, and biological properties and how those relate to the needs of humans and other species. Because of the high value placed on clean water, the Colorado Department of Public Health and Environment's Water Quality Control Division and the Water Quality Control Commission oversee that water quality monitoring practices adhere to the Colorado Water Quality Control Act and the federal Clean Water Act.

Recently, the San Miguel Watershed Coalition worked with scientists, agency officials, and stakeholders to revise its Water Quality Monitoring Program. The final program description and monitoring sections will be available in 2015. The goal of the program is to collect and evaluate water quality and quantity data at control, impact and special interest sites in the San Miguel Watershed in order to assess watershed health over different time scales with a focus on long-term trends. Areas of concern include impacts from resource extraction, both past and present; residential and commercial development; agriculture; naturally occurring metal inputs; and municipal discharges. In addition, the San Miguel Watershed Coalition will establish regular analysis of data collection, making specific data and annual trend analysis available to the public.

WATER QUALITY MONITORING

Data collection points for water chemistry are located throughout the watershed. Multiple parties conduct monitoring in the watershed, including the United States Geological Society, Environmental Protection Agency, state of Colorado, Idarado Mining Company, Bureau of Land Management, Tri-State's Nucla Power Plant, River Watch volunteers, and the San Miguel Watershed Coalition. While there is a great deal of water quality data on the San Miguel, only limited sites were monitored consistently over time to produce the data needed for a trend analysis.

Impaired Stream Segments Section 303(d) of the Clean Water Act states, "'states' are required to develop lists of impaired waters. These are waters for which regulations and other required controls are not stringent enough to meet the water quality standards."

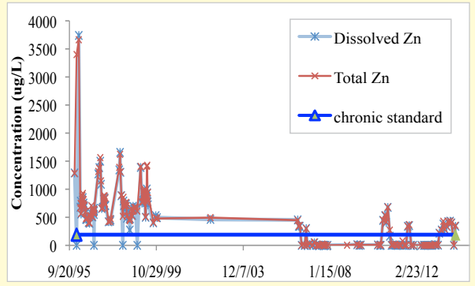
Colorado's Water Quality Control Division last updated their impaired list in 2012. There are 15 segments in the San Miguel Watershed. Eight of these sites are included because of high levels of heavy metals, including iron, lead, zinc, maganese, cadmium, and copper. These sites are located in and downstream of Telluride and Ophir. The balance of the sites located in the lower watershed are on the list due to concerns over pH, dissolved oxygen, temperature, selenium, and E. coli from agricultural and other anthropogenic activities. The state intends to conduct monitoring to update the impaired list in 2015.

The San Miguel Watershed Coalition's newly revised water monitoring program includes 34 locations in the watershed. These sites were selected to provide independent data and supplement analysis to the state and federal monitoring programs; provide data to Telluride, Mountain Village, Ophir and San Miguel County to address both historic and urban run off issues; and establish long-term data for a more complete trend analysis of the watershed.

SPOTLIGHT: RIVER WATCH

River Watch is a voluntary program run by the Colorado Watershed Assembly and Colorado Parks and Wildlife. Its mission is to work with voluntary stewards to monitor water quality and other indicators of watershed health and use the resulting high-quality data to educate citizens and inform decision makers about the condition of Colorado's waters. The data is also used in the Clean Water Act decision-making process. Volunteer groups receive training, support, and supplies needed to monitor their respective rivers and provide consistent and accurate data. Volunteers analyze samples for hardness, alkalinity, dissolved oxygen, pH, and temperature. Additional samples are analyzed by a professional lab for metals, nutrients, and macroinvertebrates. Quality assurance is essential, and data and quality control checks are performed regularly throughout the year.

River Watch volunteers in the San Miguel Watershed currently include Telluride High School, Telluride Mountain School, Norwood and Nucla/Naturita students, citizen volunteers, and the San Miguel Watershed Coalition (which recently helped establish programs in Telluride schools for the upper watershed). River Watch uploads data into the Colorado Data Sharing Network, which will soon be able to provide more easily accessible analysis of select watershed data for the public.



Zinc concentrations at the River Watch station located near Bear Creek, adjacent to Telluride Town Park. Zinc is the monitoring parameter the Colorado Department of Public Health and Environment selected as the primary indicator of metals presence in the upper San Miguel Watershed.

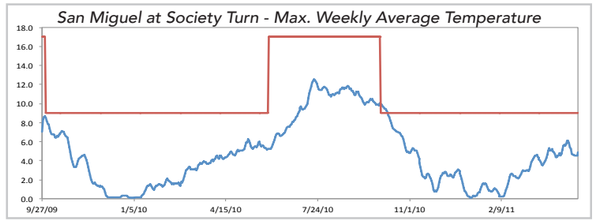
STATE OF THE SAN MIGUEL WATERSHED 2014
AQUATIC Water Quality

WATER TEMPERATURE

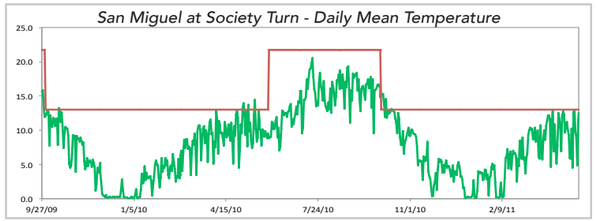
Water temperature governs the metabolic rate of fish, influences their behavior, and impacts the diversity and health of an aquatic community dramatically. Temperatures are affected by various factors, such as solar radiation, ambient air temperature, stream shade, channel morphology, stream flows, ground water inflows, and anthropogenic activities. Monitoring temperatures offers cost-effective data collection and meaningful analytical opportunities.

Colorado's temperature standard is intended to protect aquatic life from adverse warming and cooling that is caused by anthropogenic activities. From September of 2009 through May of 2011, the Colorado Department of Public Health and Environment deployed temperature data loggers in the San Miguel River near Society Turn and the Norwood Bridge.

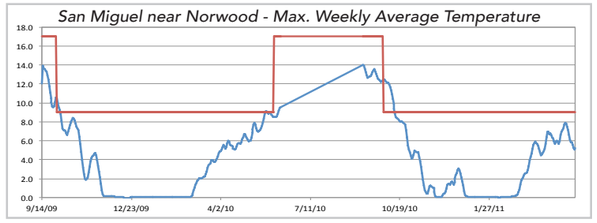
The limited results indicate that the maximum weekly average temperature is below the chronic high-temperature standard established for fish by the state at both Society Turn and Norwood Bridge for the majority of the year. The acute temperature standard (where prolonged exposure leads to lethal effects on fish) provides protection against the lethal effects caused by temperature. When compared to the daily maximum temperatures, the San Miguel appears to be warming, but not to acute levels.



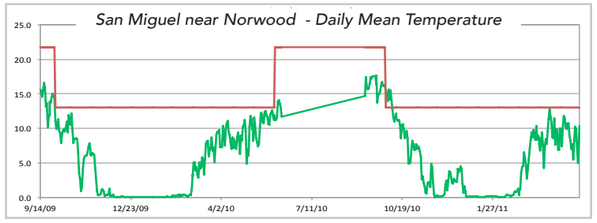
Results from data loggers near Society Turn that measure the maximum weekly average river water temperatures. The red line represents the chronic high-temperature levels.



Results from data loggers near Society Turn that measure the daily maximum river water temperatures. The red line represents the acute high-temperature levels. Daily maximum temperatures approach acute levels prior to peak runoff and during late summer and fall.



Results from data loggers near Norwood Bridge that measure the maximum weekly average river water temperatures. The red line represents the chronic high-temperature levels. (According to the Colorado Department of Public Health and Environment, data was lost for the period between June and September 2010.)



Results from data loggers near Norwood Bridge that measure the daily maximum river water temperatures. The red line represents the acute high-temperature levels. Daily maximum temperatures approach acute levels prior to peak runoff and during late summer and fall.

ASSESSMENT & ACTION ITEMS

Establishing a complete trend analysis for water quality in the San Miguel Watershed is difficult. State and federal agencies study specific sites for specific parameters, which allows for site-specific analysis. River Watch has over a decade of data and the Colorado Data Sharing Network will soon allow the public a cost-effective analytical tool. Analysis of existing data from these sources could be used to highlight specific issues in the watershed, and the San Miguel Watershed Coalition's revised Water Quality Monitoring Program should be used to fill data gaps and provide a complete trend analysis in the future.

Idarado Mining Company will soon be released from the Consent Decree that required remediation of their mining activity in the upper watershed. However heavy metals, from both natural sources and mining legacy remain a concern. In addition, temperature increases, urban drainage, septic system inputs, and lower watershed mining and agricultural activities all require additional scrutiny.

SUGGESTED ACTION

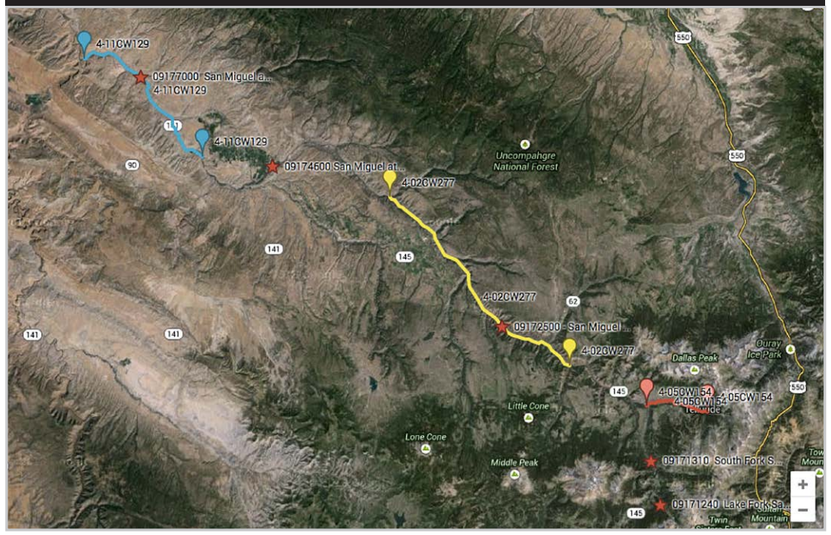
1. **Conduct a thorough analysis of data collected by various entities to identify specific water quality issues and address gaps in monitoring both chemistry and temperature.**
2. **Coordinate with state and federal agencies and River Watch to provide trend analysis, which will allow the San Miguel Watershed Coalition to target improvement priorities.**
3. **Ensure consistent collection and regular uploading of San Miguel Watershed Coalition's data into the Colorado Data Sharing Network and provide annual updates to the community.**

THE BASICS

Water is arguably the most critical natural resource in any watershed. Within the San Miguel Watershed, it serves agricultural production, human water supply, and supports many ecosystems. Secondary uses include recreational activities and the intrinsic aesthetic that lakes and streams offer.

The Colorado Water Conservation Board was created nearly 75 years ago to "conserve, develop, protect, and manage Colorado's water for present and future generations." In 1973, to help balance the competing demands placed on this limited resource, the board initiated the Instream Flow Program. Instream flows are new water rights filed to maintain minimum healthy water levels in streams and lakes. These water rights have an appropriation date that prioritizes them behind all water rights filed previously. There are 43 unique instream water rights within the San Miguel Watershed. The associated flows were developed based on discharge measurements collected for the last century and computer models that identify minimum flow requirements for native fish and, in one instance, riparian vegetation along the river corridor. Each section is evaluated thoroughly to determine if the water for an instream right is available and if that right can be filed without causing material injury to other water rights and their historical uses. Seven stream gauges provide continuous flow data within the San Miguel Watershed. Instream flows represent an estimation that allow for maintenance of stream functions and values, but these rights are often not met because of the water demands of senior rights during low-flow periods.

Instream Flow Gauges on San Miguel River



A Google Earth image of the three monitored Instream Flow reaches on the San Miguel and their associated stream gauges.

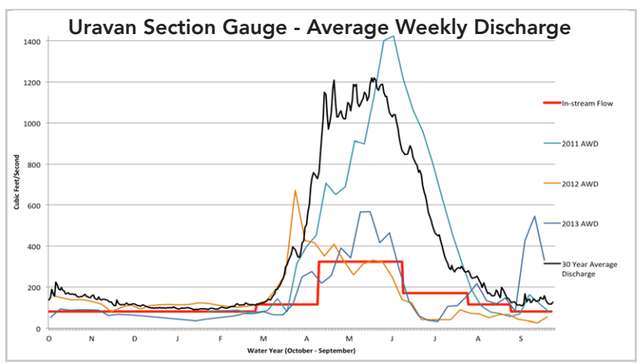
RED *–Bear Creek to South Fork (Telluride section)*

YELLOW *– Fall Creek to Horsefly Creek (Placerville section)*

BLUE *– Calamity Draw to the confluence with the Dolores River (Uravan section)*

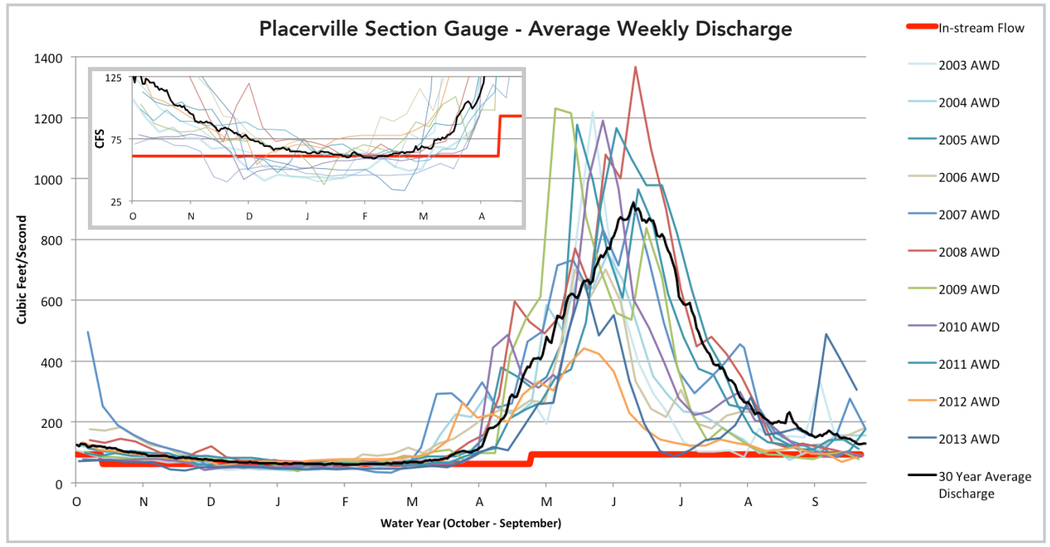
Gauges for each are indicated by red stars and are operated by the U.S. Geological Society. Additional stream gauges monitor tributaries of the San Miguel with Instream Flow Rights.

The upper (Telluride reach) gauge was installed recently and can be included when average flow calculations are developed.



The weekly average discharge at the Uravan section (Calamity Draw to the Dolores River confluence) gauge since the 2011 Instream Flow appropriation for the 17.24-mile reach.

STATE OF THE SAN MIGUEL WATERSHED 2014
AQUATIC Water Quantity



The weekly average discharge at the Placerville section (Fall Creek to Horsefly Creek) gauge since the 2002 Instream Flow appropriation for the 24.1-mile reach. The inset graph shows the period between October and May when low flows are somewhat evenly distributed above and below the Instream Flow and the 30-year average discharge at the Placerville gauge.

ASSESSMENT & ACTION ITEMS

Water quantity scoring metrics rely on the assumption that the Instream Flow levels were developed to maintain environmental functions and values at a minimal level and that flows below these levels are detrimental to fisheries (compounding negatively if they remain low for consecutive weeks). The following grading rubric and scores were developed as a preliminary method for rating the water quantity regime in the San Miguel Watershed with the available data, which is limited to the two identified stream reaches that serve as reasonable proxies for the entire watershed, including tributaries, because the main-stem reaches are in the lower portions of the watershed and reflect cumulative flow volumes from the tributary creeks and streams.

D
Water Quantity Grade

GRADING RUBRIC

# of Weeks Below Instream Flow	Letter Grade	Grade Point
11+	F	1
zero flow for 1 week	F	1
8 to 10	D	2
3 consecutive	D	2
5 to 7	C	3
2 to 4	B	4
0 to 1	A	5

WATERSHED GRADE

	Grade Point	Letter Grade
Watershed Average	2.1	D

URAVAN

Year	# of Weeks Below Instream Flow	Letter Grade	Grade Point
2011	10	D	2
2012	21	F	1
2013	29	F	1
Average		**F**	**1.33**

PLACERVILLE

Water Year	# of Weeks Below Instream Flow	Letter Grade	Grade Point
2002	16	F	1
2003	16	F	1
2004	11	F	1
2005	6	C	3
2006	1	A	5
2007	13	F	1
2008	2	B	4
2009	8	D	2
2010	18	F	1
2011	4	B	4
2012	3	B	4
2013	22	F	1
Average		**D**	**2.33**

SUGGESTED ACTION

1. Support the continued collection of continuous stage and discharge data within the watershed.
2. Support the initiation and continuation of flow data collection of water withdrawals.
3. Analyze discharge data to understand and anticipate patterns associated with flow levels below Instream Flow water rights within main and tributary reaches and the effect on the fisheries within those reaches.
4. Develop a geospatial database to understand seasonal flow patterns in relationship to seasonal water withdrawals throughout the watershed.
5. Support water conservation programs and projects, especially those that increase irrigation efficiency for agricultural producers and promote additional Instream Flow water rights.

THE BASICS

The San Miguel Watershed hosts three distinct fish populations that include native warm-water species, native cold-water sculpin and cutthroat trout, and non-native cold-water sport fish.

The lower San Miguel River and its tributaries are habitat for three native warm-water species: the roundtail chub, flannelmouth sucker, and bluehead sucker. Although Colorado Parks and Wildlife reports that these populations have increased steadily below the Uravan cleanup and near Norwood during the last decade, all three remain on the Bureau of Land Management's Sensitive Species List because of a significant reduction of historic range and unprotected habitat. These fish serve as an indicator of overall health for the warm-water aquatic system and are the primary focus of ongoing conservation efforts.

Cutthroat trout and mottled sculpin represent the native cold-water community of the San Miguel. Cutthroat trout were once present in most of the high-elevation streams, but they were extirpated by human-related impacts, such as water diversion, fish stocking, and mining.

Currently, seven genetically pure cutthroat trout conservation populations live in the watershed in addition to 11 other cutthroat trout populations. Woods Lake and its upstream tributaries, Fall and Muddy Creek, are stocked by Colorado Parks & Wildlife with genetically pure, hatchery-reared cutthroat trout to create a brood stock source population to repatriate additional streams. The Woods Lake population will be a "core conservation population," which is considered 99 percent genetically pure. Ongoing work to identify existing, and restore historical, populations will assist in the recovery of cutthroat trout throughout the basin.

Populations of non-native trout species (brook, rainbow, and brown trout) live in select reaches in much of the San Miguel Watershed, including many high-mountain lakes. These species offer sport fishing opportunities that stimulate the local economy and are useful indicators of aquatic ecosystem health.

Generally, the San Miguel River contains healthy populations of brook, brown, and rainbow trout, despite water-quality issues related to heavy metals, the steep gradient of the river (few pools for refuge), and ice floes that scour the river channel.

MONITORING

Colorado cutthroat trout by Ryan Bonneau

Colorado Parks and Wildlife monitors the native warm-water species, native cold-water species, and non-native cold-water sport fish. Evaluations are conducted by electrofishing, which delivers an electrical current into the water that attracts fish and stuns them long enough to be netted for analysis. This allows Colorado Parks and Wildlife to estimate the number of fish and evaluate their overall health, as well as monitor the watershed as a whole to see how fish respond to changes in the management of the system, such as altered flow conditions or habitat improvement projects.

Several defined reaches on the San Miguel River and its tributaries downstream of Naturita are used for monitoring native warm-water species (roundtail chub, flannelmouth sucker, bluehead sucker, and speckled dace). These species move frequently within the river and use tributaries, such as Tabeguache and Naturita Creeks, to spawn and rear their young. Because of this movement, these species are evaluated across the watershed based on their continued presence and their estimated population in comparison to the populations of competing non-native fish, such as smallmouth bass, northern pike, and white suckers.

	2005	2013
Rainbow Trout	19.7 ± 0	178.8 ± 9.6
Brown Trout	49.3 ± 0	343.8 ± 6.1

Estimated fish per mile of stream with a 95-percent confidence interval for brown and rainbow trout in the South Fork of the San Miguel River in 2005 and 2013.

Native cutthroat trout and mottled sculpin inhabit the cold-water e Native cutthroat trout and mottled sculpin inhabit the cold-water sections of the San Miguel in high-elevation streams. Cutthroat trout conservation consists of identifying, maintaining, and repopulating streams with genetically pure cutthroat that were native to the area. Monitoring via electrofishing determines the population size and viability in each stream and offers the opportunity to collect genetic material (fin clips) to assess the purity of the population. Mottled sculpin are also documented during these surveys.

Non-native trout species—such as brown, brook, and rainbow—represent important sport fish in the San Miguel. Population densities and the overall condition of individual fish are evaluated at several locations throughout the watershed via semi-annual electrofishing. These indices help indicate how river health and fish populations change in relation to management actions.

2013 Cutthroat Trout Assessment	Core Conservation Population (3 pts. Ea.)	Conservation Population (2 pts. Ea.)	Current Distribution Population (1 pt. ea.)	Total Points	Grade
San Miguel Watershed Occurances	0	7	11	25	C

Total Point Grade Scale: where a cumulative score of greater than 35=A; 31-35=B; 21-30=C; 11-20=D; less than 11=F.
Scores within 2 points either above or below the grade cutoff will result in a + or – added to the grade.

STATE OF THE SAN MIGUEL WATERSHED 2014
AQUATIC Fisheries

SPOTLIGHT: SMALLMOUTH BASS

In 2010, Colorado Parks and Wildlife biologists discovered illegally stocked smallmouth bass in Miramonte Reservoir. The reservoir had long served as a fishing destination for trophy brown and rainbow trout, but the rapid proliferation of smallmouth bass in the reservoir led to predation of juvenile trout that caused a decline in the trout population. Additionally, in other parts of the Colorado River Basin, smallmouth bass have been particularly damaging to native warm-water species found in the lower San Miguel River, into which Miramonte Reservoir drains.

In 2013, Colorado Parks and Wildlife used a chemical called rotenone to eliminate smallmouth bass from the reservoir to protect the warm-water native fish of the San Miguel River and to restore the trout fishery at Miramonte Reservoir. Rotenone is a naturally derived chemical that is widely used to remove unwanted fish species. It breaks down naturally and has not been proven to affect aquatic invertebrates, mammals, or birds when applied at levels to control fish species.

Using rotenone at Miramonte Reservoir was an unfortunate necessity, but Colorado Parks and Wildlife reintroduced rainbow and brown trout in October 2013, which should restore the sport fishery rapidly. No smallmouth bass appear to have escaped the reservoir, so the native fish of the San Miguel River were protected.

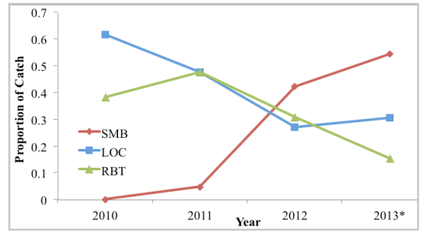
Illegal fish introductions are one of the largest issues facing the conservation of fisheries in the San Miguel Watershed and throughout the entire Colorado River Basin. Colorado Parks and Wildlife encourages angler assistance to address this issue and appreciates information related to possible illegal introductions in order to protect the fisheries of the San Miguel River and state of Colorado.

2013 Native warm-water fish	Colorado Pike Minnow (Federally Listed as Endangered)	Speckled Dace	Rountail Chub	Bluehead Sucker	Flannelmouth Sucker	Razorback Sucker (Federally Listed as Endangered)	Five Non-Native problem species (# present)	Grade
San Miguel Watershed Presence	No	Yes	Yes	Yes	Yes	No	0	4/6 = B+

Letter grade is assigned based on the presence of non-listed and endangered species in the system, where 4 non-listed and 1 or more endangered=A; 4 non-listed=B; 3 non-listed=C; 1-2 non-listed=D; and no native fish=F. No non-native problem fish (bass, pike, walleye, white suckers & longnose sucker) in the system earns a "+"; if 2 problem species are present, a "-" is added; and if 3 or more problem species are present, a full letter grade will be dropped.

2013 Native cold-water fish Biomass (lbs./acre)	South Fork San Miguel near Galloping Goose bridge	San Miguel near Telluride Town Park	San Miguel Below Deep Creek	San Miguel near Placerville	San Miguel below Norwood Bridge	San Miguel below Saltado Creek	Grade (based on average lbs/ac.)
2003				31		14	
2004							
2005							C-
2008			30				
2013	62	49					

Cumulative biomass is one of the metrics considered when identifying Gold Medal Trout waters. The Gold Medal standard is 60 lbs./acre, and the Wild Trout standard is 40 lbs./acre. Surveyed reaches extend from the upstream portions of the river to the lower extent of the trout inhabited section of the river. Biomass in excess of 60 lbs/ac=A; biomass between 40-59 lbs/ac=B; between 30-39 lbs/ac=C; 20-29 lbs/ac=D; less than 19 lbs/ac=F. Scores within 2 points either above or below the grade cutoff will result in a + or – added to the grade.



Relative abundance of smallmouth bass (SMB), brown trout (LOC) and rainbow trout (RBT) captured in 2010 and 2013 at Miramonte Reservoir after the illegal introduction of smallmouth bass.

ASSESSMENT & ACTION ITEMS

The San Miguel River offers a unique mix of fish across its varied habitat zones, providing for both native threatened warm-water and cold-water sport fishing species. The cutthroat populations in the watershed include a "core-conservation" population considered to be 99 percent genetically pure and the future brood stock of cutthroat restorations projects.

The lower San Miguel River and its tributaries provide habitat for three native warm-water species: the roundtail chub, flannelmouth sucker, and bluehead sucker. Although, according to Colorado Parks and Wildlife, these populations have increased steadily during the last decade, all three are on the Bureau of Land Management's Sensitive Species list.

Continued collaboration with Colorado Parks and Wildlife on restorative projects and monitoring activities will further strengthen the relationship between the two entities and expand the understanding of the overall health of the fisheries populations in the San Miguel Watershed.

SUGGESTED ACTION

1. **Consider funding for habitat improvement projects to enhance deep-water, winter trout survival.**
2. **Maintain, identify and restore native cutthroat trout populations.**
3. **Increase monitoring for non-native predatory species in local reservoirs and in the San Miguel River.**
4. **Continue to support projects that enhance San Miguel Watershed populations of the three native species deemed sensitive by the Bureau of Land Management.**

C+
Fisheries Grade

THE BASICS

Aquatic macroinvertebrates, bugs that spend part of their lives underwater, are good indicators of water quality and overall stream health because they are sensitive to pollutants and changes in flow and temperature. As relatively immobile species with a lifespan of a year or more, their presence over time indicates more about water quality than an instantaneous water sample that reflects only conditions at the time of collection. Macroinvertebrates respond predictably and linearly to human-induced disturbance factors, such as increased sedimentation and changes in water chemistry or temperature. In short, a relatively high number of macroinvertebrates within a stream section can be interpreted to mean that the general conditions (water quality, temperature, and flow) are within a range of "normal" that allows macroinvertebrates to thrive. Conversely, a low number of macroinvertebrates can be attributed to a variety of conditions or disturbances and is typically an indicator of poor ecological health.

The Bureau of Land Management has a macroinvertebrate monitoring plan whose objective is to assess the status and trend of the macroinvertebrate population on the San Miguel River. Macroinvertebrate trends reflect upon the suitability of the habitat and conditions to support resources that include sensitive/endangered warm-water and recreational cold-water fisheries.

BUREAU OF LAND MANAGEMENT MONITORING PLAN

YEAR 1 (2012):
Determine status of population to establish monitoring baseline.

TREND QUESTION:
Do macroinvertebrate assemblages within the suitable segments differ significantly from Colorado regional reference conditions? If so, what are the causes of observed biological impairment?

METHOD:
A. Select a targeted site within each of the four segments to sample.

B. Choose sites with existing water quality and macroinvertebrate data.

C. Sample between July 1 and Oct. 15.

D. Collect water quality field parameters, including discharge and pebble count.

YEAR 2 (2014):
Trend analysis relative to baseline conditions and regional reference conditions.

TREND QUESTION:
Are macroinvertebrate assemblages within the suitable segments approaching or deviating from Colorado regional reference conditions through time?

METHOD:
A. Sample the same sites again.

B. Start macro sample with random location.

C. Collect water quality field parameters, including discharge and pebble count.

D. Sample close to previously collected date.

YEAR 5 (2016):
Trend analysis relative to previously observed and regional reference conditions.

TREND QUESTION:
Same trend question as Year 2.

METHOD:
A- Sample the same sites again.

B- Start macro sample with random location.

C- Collect concurrent suite of water quality data, including metals.

D- Collect water quality field parameters, including discharge and pebble count.

E- Sample close to previously collected date.

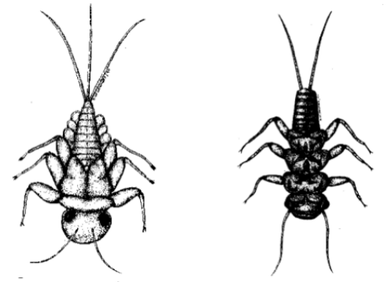
YEAR 8 (2019):
Trend analysis relative to previously observed and regional reference conditions.

TREND QUESTION:
Are macroinvertebrate assemblages within the suitable segments approaching or deviating from Colorado regional reference conditions through time?

METHOD:
A. Use the same monitoring criteria as Year 5.

REGULATORY MONITORING METHOD

The Colorado Department of Public Health and Environment uses a multimetric index approach to assess the existence of aquatic life. This method integrates monitoring metrics that summarize macroinvertebrate responses to a range of human impacts and then compares them to reference conditions. Ideal population numbers for macroinvertebrates are calculated using statistical models that weigh species diversity and population densities against macroinvertebrate population data collected on different rivers with similar physical conditions to the study reach. All monitored segments on the San Miguel River satisfied the minimum threshold for macroinvertebrates, meaning that the sampled sections are not considered impaired by the Colorado Department of Public Health and Environment or Environmental Protection Agency.

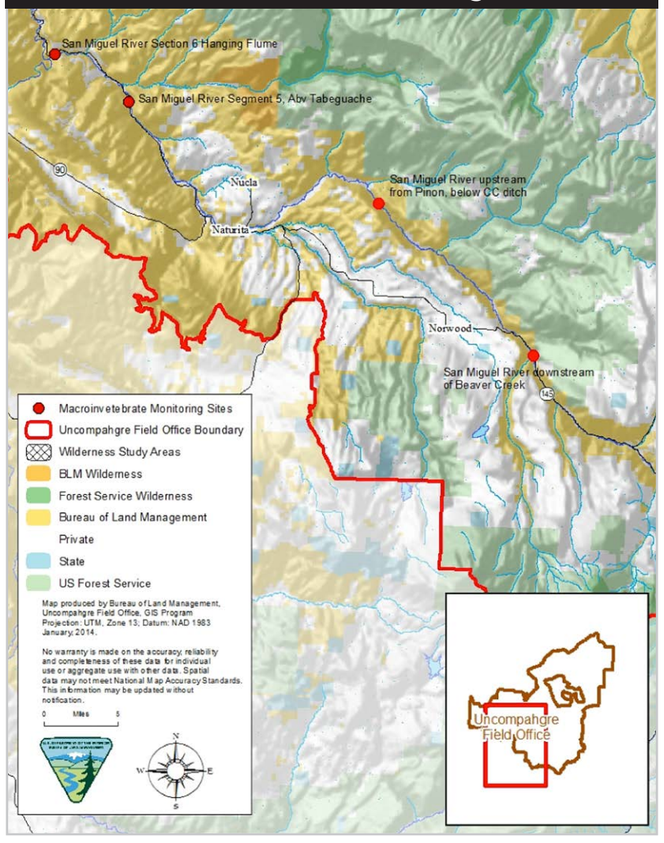


Mayfly Nymph (Order Emphemeroptera)

Stonefly Nymph (Order Plecoptera)

STATE OF THE SAN MIGUEL WATERSHED 2014
AQUATIC Macroinvertebrates

Macroinvertebrate Monitoring Sites



ALTERNATE METHODS

Another method to analyze macroinvertebrate data is a multivariate approach, using observed versus expected population data, where macroinvertebrates observed at monitoring sites are compared to the populations expected to be found in undisturbed locations. The Bureau of Land Management's method applied to the San Miguel is the Colorado Department of Public Health and Environment's multimetric index combined with an observed versus expected method. This approach yields a finer scale of analysis than the multivariate approach and is based on the deviation of a monitoring sites score from the mean score of the reference site data.

MONITORING RESULTS

Early results indicate that two monitored segments (downstream of Beaver Creek and upstream of the San Miguel River/Tabeguache Creek confluence, downstream of Naturita) are "good," falling within one standard deviation of the mean expected score. The segment below the historic Uravan Mill site is considered "fair," scoring between one and two standard deviations from the mean expected score. And the section downstream of the CCC Ditch qualifies as "poor," scoring beyond two standard deviations below the mean expected score.

ASSESSMENT & ACTION ITEMS

For the Watershed Report, rating the health of the macroinvertebrate community on the lower San Miguel River relies on combining the results of the multimetric index with an observed versus expected method of evaluation. The multimetric index population scores allow for a "pass/fail" determination that indicates if the river segment fails to meet the defined habitat conditions. All monitored segments meet the population threshold minimums and receive a passing grade based on the available 2013 data.

The "good," "fair," and "poor" ratings used by the observed versus expected method correlate to "B," "C," and "D" grades, respectively. Assigning a numeric value ("D" = 1, "C" = 2, and "B" = 3) to the letter grades allows for the development of a cumulative score for the evaluated river segments and the macroinvertebrate indicator. Two segments were rated as "good"; one segment was "fair"; and one segment was "poor." Nine total points divided by the number of segments (4) yields a cumulative score of 2.25, "C," for the condition of the macroinvertebrate community.

SUGGESTED ACTION

1. **Identify additional macroinvertebrate sampling locations that are representative of the upper watershed. Locations to consider include South Fork within the Nature Conservancy Preserve, Telluride Valley Floor, or within the Sawpit reach.**
2. **Coordinate with monitoring organizations—including the Bureau of Land Management, state of Colorado, River Watch, and Town of Telluride—to standardize the methods used to evaluate macroinvertebrate populations.**
3. **Work with Bureau of Land Management to further evaluate degraded macroinvertebrate habitat and populations downstream of the CCC Ditch.**

C
Macro-invertebrate Grade

THE BASICS

Vegetation plays a vital role in the health of San Miguel Watershed's ecosystems, communities, and natural resource-based industries. "Native vegetation" refers to any plant species that is indigenous to the the ecosystems of the San Miguel Watershed. From small ground covers and native grasses to large trees and wetland plants, indigenous plants are important because they provide essential habitat for animals and help protect land and water against erosion, salinity, and climate change.

The "riparian zone" consists of the stream and river corridors and the diverse community of plants that occupy these areas. Riparian zones in the San Miguel Watershed are considered to be high quality cumulatively and have a relatively high level of protection from established regulations at both the local and federal levels.

Age diversity in vegetation communities is desired because old plants play a vital role in the environment. Too many aged or dying plants, however, can indicate future problems, such as loss of habitat for native fauna and the conversion of a plant community to a monoculture dominated by one species.

Plant communities can exist in varying states, ranging from severely degraded (because of non-native species or disease) to relatively pristine, where the native plant community is largely intact and vigorous.

Monitoring for this report is based on data collected by the Bureau of Land Management and information provided by the San Miguel and Montrose County Weed Program managers. U.S. Forest Service lands are underrepresented in this 2014 Report because, at present, they do not have comprehensive vegetation monitoring programs that rely on permanent transects.

MONITORING

Vegetation Trends

Data are from permanent vegetation monitoring transects in the San Miguel Watershed on Bureau of Land Management lands managed by the Uncompahgre Field Office. Only transects that have been read at least twice, with the most recent reading since 2006, are included. Riparian transects are not represented in the data set.

Monitoring Parameter	Average Value from Most Recent Survey	Percentage of Transects in Declining State**	Percentage of Transects in Static State**	Percentage of Transects in Improving State**
Non–Native Plant Composition	18%	52%	29%	19%
Low–Vigor Vegetation*	36%	32%	8%	60%
Native Plant Species Diversity (number of species per transect)	10%	18%	48%	13%
Herbaceous Cover	16%	10%	19%	65%

* Obtained by combining the percent of low–vigor shrubs and trees to the percent of those that are decadent and dead in a stand. As derived by n/200 = % of low vigor vegetation.

** "Declining" indicates that conditions have worsened by more than 10 percent; "static" remains within 10 percent of prior values; and "improving" marks movement in a positive direction of more than 10 percent from prior values.

Non-native Species

Non-native species (commonly called "weeds") were evaluated for the 2005 Report Card. Interviews conducted with County Weed Program managers for this 2014 Report confirm that all species present in 2005/06 still persist today, with the addition of purple loosestrife and increased presence for existing species.

Weeds are classified by the state of Colorado and are separated into three categories by threat ("**A**," "**B**," "**C**"), which consist of regulated species with varying management plans. **A=eradication mandatory**; **B=manage and control the spread**; **C=support the use of integrated management methods** and provide educational, research and biological control resources. There is also a watch list with an unregulated list of species that may be considered noxious in Colorado when more is known about the biology and behavior of the plants.

Listed Invasive Species in San Miguel Watershed

A

cyprus spurge, meadow knapweed, myrtle spurge, purple loosestrife, yellow starthistle

B

absinth wormwood, black henbane, bull thistle, Canada thistle, Chinese clematis, common tansy, dame's rocket, diffuse knapweed, hoary cress, houndstongue, jointed goatgrass, leafy spurge, musk thistle, oxeye daisy, perennial pepperweed, plumeless thistle, quackgrass, Russian knapweed, Russian olive, salt cedar (tamarisk), Scotch thistle, spotted knapweed, wild caraway

C

common burdock, common mullein, downy brome, field bindweed, poison hemlock, Russian thistle

STATE OF THE SAN MIGUEL WATERSHED 2014
TERRESTRIAL Vegetation

SPOTLIGHT: TAMARISK ERADICATION

Tamarisk, also known as salt cedar, is extremely invasive in riparian areas, often replacing native vegetation with impenetrable thickets. It overtakes native vegetation because it taps into water aggressively and stores salt in the foliage, which increases the salinity of surrounding soil surfaces as leaf litter accumulates. Tamarisk grows in dense stands that don't support healthy biodiversity, and its density can block wildlife access to the water.

Thanks to an eight-year effort led by The Nature Conservancy, a tamarisk control project along the San Miguel River has cleared approximately 120 miles of waterway, allowing for the return of willows, cottonwoods, and native grasses. Efforts to eradicate the plant have relied on cutting and applying herbicide to the amputated trunk. Killing tamarisk completely typically requires more cutting and herbicide treatments, but success rates are relatively high after two or three years of treatment. Additional treatment included importing tamarisk beetles from Eurasia in the 1990s. After years of quarantine and testing, scientists released the beetles in Utah, Wyoming, and Colorado, where the beetles have defoliated many miles of tamarisk-infested river corridor.

Tamarisk control on the San Miguel River continues to serve as a model on western rivers in the United States and as an example of private and public partnership to achieve a common beneficial goal. While The Nature Conservancy initiated the project, support from private landowners, federal agencies, other organizations (most notably the Tamarisk Coalition), and corporate sponsors has been critical to the project's ultimate success.

Tamarisk removal courtesy of The Nature Conservancy.

NON-NATIVE & NATIVE LOW-VIGOR VEGETATION

Quantifiable vegetation monitoring relies on the data collected by the Bureau of Land Management across their permanent monitoring transects. Data are evaluated and scored inside the categories of Non-Native Composition and Native Low-Vigor Dominance, where the percentage of total non-native cover is identified as an indicator of overall native composition, and native low-vigor plants are seen as a negative factor (optimal conditions support high levels of strong native plants). Trends are identified by metrics with more than 50 percent of the total transects categorized as declining, static or improving. Native low-vigor plant communities are considered improving with 60 percent of the transects showing a decrease in native low-vigor biomass. Herbaceous cover is also improving across 65 percent of the transects.

Non-Native Plant Community Composition	less than 0-10%	A
	11-20%	B
	21-30%	C
	31-50%	D
	greater than 50%	F
Watershed Score	**18%**	**B**

Low-Vigor Dominance (average percentage of the population not considered to be low-vigor vegetation)	100-91%	A
	90-81%	B
	80-71%	C
	70-61%	D
	greater than 50%	F
Watershed Score	**82%**	**B**

ASSESSMENT & ACTION ITEMS

The results of the selected monitoring approaches that examine non-native species and native low-vigor dominance indicate that native plant populations occupy approximately 82 percent of the studied landscape and that native low-vigor plants occupy approximately one-third of the studied vegetative communities. Native plants still dominate the flora community (based on the transect data), but trend patterns indicate that non-natives are increasing across the landscape. This means that native species have persisted, although they are stressed by environmental variables. The percent of transects in an improving state offers hope that native low-vigor numbers may improve as environmental conditions change.

SUGGESTED ACTION

1. Identify a corollary monitoring program for vegetation on U.S. Forest Service and private lands within the watershed to broaden the scope of data and to conduct more in-depth analysis.
2. Sponsor a round-table discussion on riparian vegetation and identify a methodology for more comprehensive analysis of the primary riparian corridor of the San Miguel River (and secondary corridors on tributaries).
3. Help initiate a program to eradicate Russian olive, which is a non-native threat to the vegetation communities of the San Miguel Watershed.
4. Work with Bureau of Land Management to place a stronger weight on weeds in future grading rubrics because of their significant role in vegetation health.

B
Vegetation Grade

THE BASICS

The forest lands of Colorado are experiencing significant change at present with extreme levels of mortality from insects and disease, which is caused, in part, by the warmer and drier weather of the past decade. The San Miguel Watershed is not exempt and has localized outbreaks of multiple insects and diseases that have caused increased mortality in mature trees.

Significant mortality on the Uncompahgre Plateau was measured in the mid-2000s within the piñon pine communities after an Ips beetle outbreak. Ips beetles are not usually considered as destructive or aggressive as bark beetles (mountain pine beetle, spruce beetle, Douglas-fir beetle). Normally, Ips beetles limit attacks to trees that are in decline from root injuries, wounding, or other stresses. Under widespread conditions that allow improved survival and large population build-ups, however, Ips beetles can be a considerable threat to living trees.

Spruce beetles and spruce budworm continue to pose a significant threat in the San Miguel Watershed and the surrounding forest regions with outbreaks occurring in the subalpine spruce-fir forests of the upper watershed.

Subalpine spruce-fir decline continues in many high-elevation forests across Colorado. The mortality is the result of the western balsam bark beetle and two species of fungi that attack the root systems of these trees. Areas of significant spruce-fir decline are the Upper San Miguel River Basin near Telluride, including the Telluride Ski Resort.

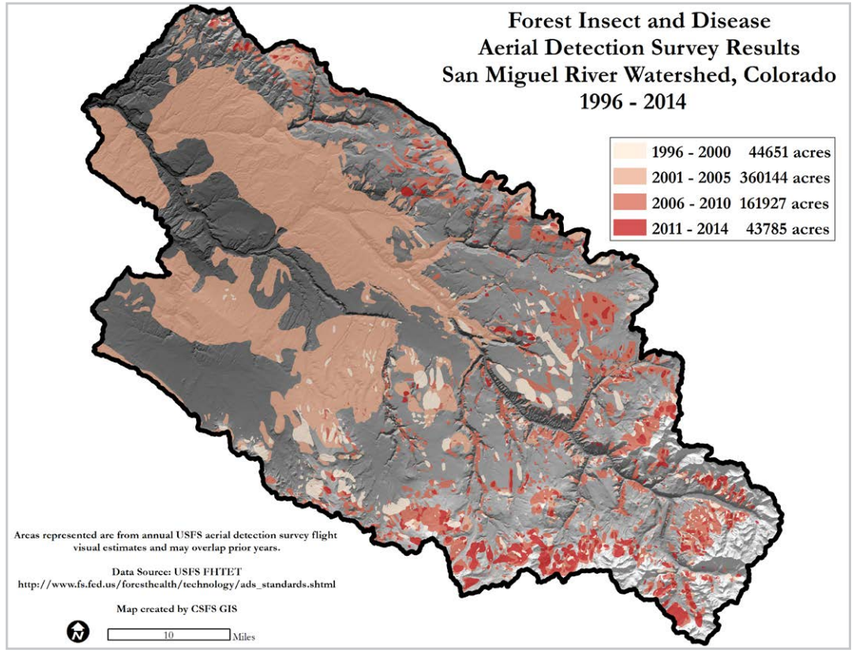
Although there was great concern about Sudden Aspen Decline in the early 2000s, research indicates that aspen progress naturally to higher and wetter elevations. In 2008, roughly 17 percent of the state's aspen forests were affected by this transition and other insect and disease conditions. The San Miguel Watershed aspen have experienced additional stress from the western tent caterpillar and large aspen tortrix in recent years, which weaken trees through defoliation. Peak outbreak levels occurred in 2013 across Colorado. Overall aspen health statewide is improving.

MONITORING

The Forest Health Monitoring Program is managed cooperatively to determine the status, changes, and trends in indicators of forest condition on an annual basis. It is a national partnership of the U.S. Forest Service, state and federal agencies, academic institutions, and NGOs.

The Forest Health Annual Aerial Survey is an assessment program conducted by the U.S. Forest Service and the Colorado State Forest Service. Aerial survey data are used to estimate acreage totals for impacted forest land in Colorado. All forest types are assessed, and representative ground-truthing activities allow foresters to refine aerial data based on observations and severity measurements. The annual surveys provide information about observed areas of disturbance.

San Miguel Watershed's forest impacts associated with both insects and other diseases are lower than elsewhere in Colorado. Studies show that, so far, we have not seen epidemic mortality levels. Current research points to our region's diverse forest cover, higher elevation, and slower snowmelt. Additionally, the wind is not blowing large populations of beetles in this direction.



The cumulative insect- and disease-affected areas since 1996 in the San Miguel Watershed. Many of the older disturbance areas have started the recovery cycle and are no longer in decline. Recently identified areas of insect and disease are located primarily in the conifer forests at upper elevations of the watershed. The Colorado State Forest Service does not place a rating on forest lands surveyed as a part of the annual aerial forest health survey; it issues a comprehensive state-wide report annually.

STATE OF THE SAN MIGUEL WATERSHED 2014
TERRESTRIAL Forest Health

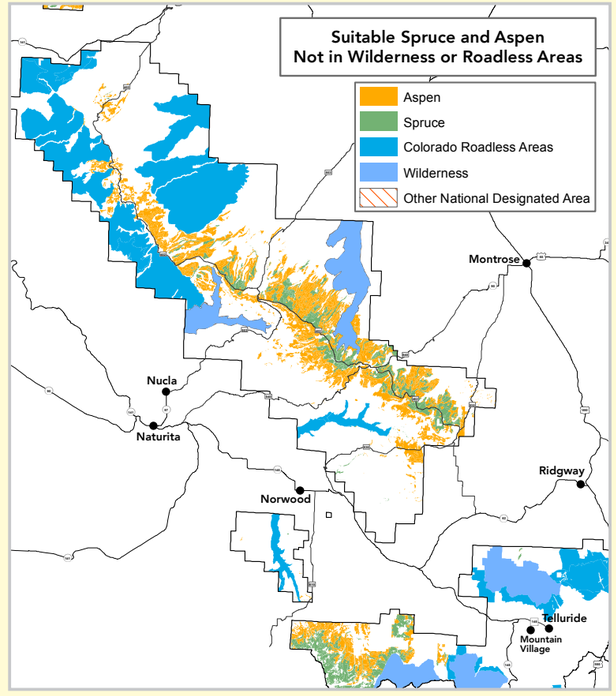
SPOTLIGHT: SBEADMR PROJECT

The Spruce Beetle Epidemic and Aspen Decline Management Response (SBEADMR) is a U.S. Forest Service-proposed approach to respond proactively and adaptively to declining forest vegetation conditions. The project is in its early phases and will require an Environmental Impact Statement with public review before implementation. The first draft of this statement is expected in the spring of 2015.

The project's approach is to manage forest vegetation in a manner consistent with the goals outlined in the Western Bark Beetle Strategy (July 2011), the goals of which are driven by desired ecological conditions and human health and safety concerns. The proposed actions are intended to increase the safety of the public and community infrastructure and encourage healthy regeneration after both natural and human disturbance. U.S. Forest Service officials intend to encourage local communities to participate in planning and monitoring of treatments using an adaptive implementation process designed to facilitate learning and improved management during the life of this project.

The purpose of the project is to treat affected stands, improve the resiliency of stands at risk of these large-scale epidemics, and reduce the safety threats of falling, dead trees and large-scale wildfires. The objectives of the project include:

- **Public Safety**: Help ensure that people and community infrastructure are protected from the risk of falling trees and able to be more safely defended in the event of wildfire.
- **Recovery**: Salvage dead and dying trees for economic benefit to local communities, increase cost-effectiveness of all treatments, and re-establish desired forest conditions.
- **Resiliency**: In threatened spruce and fir, prevent or mitigate future bark beetle outbreaks. In aspen, promote healthy clones.



Areas that would be available for treatment activities under the SBEADMR Project. Roadless areas and Wilderness areas are excluded from the proposed treatment boundaries, which include portions of the Uncompahgre Plateau (center of map) and the far western part of the Wilson massif (lower portions of map).

ASSESSMENT & ACTION ITEMS

"Forest Health" is closely intertwined with the "Vegetation," "Soils," and "Climate" sections of this Report and difficult to assess independently. Presently, no comprehensive monitoring plan exists for forest health in the San Miguel Watershed. Instead, a series of monitoring activities are oriented toward specific land-management objectives. The U.S. Forest Service has rated the forest lands within the San Miguel Watershed as having "poor/impaired" conditions in regard to insects and disease and having "good/functioning" conditions relative to forest cover as a part of their watershed condition classification project (2011). Bureau of Land Management lands are typically not forested and are addressed in the "Vegetation" section of this Report. The Town of Mountain Village is implementing a forest resiliency and wildfire mitigation program within it boundaries, but this represents a tiny portion of the watershed landscape.

Mature trees are dying, and forest composition is changing, but overall forest health in the San Miguel Watershed is better than most of the region's neighboring forestlands. Mortality from epidemic beetle outbreaks is much higher to the south (Rio Grande National Forest), east (Gunnison National Forest), and on the Front Range.

SUGGESTED ACTION

1. Initiate a discussion with U.S. Forest Service, Colorado Forest Service, and other stakeholders to develop a forest health monitoring program for the watershed.
2. Support local research projects focused on forest health conditions.
3. Monitor SBEADMR as it pertains to management prescriptions for the San Miguel Watershed.

THE BASICS

As annual funding allows, Colorado Parks and Wildlife conducts helicopter classification counts of mule deer, elk, and bighorn sheep to determine the number of young per adult females as an indication of that year's recruitment, as well as male-to-female ratios for harvest management purposes. Young-to-female ratios are used to assess population productivity because the ratios are indicative of habitat quality, climate conditions, and predation effects on a population over time.

To establish a grading index for the status of breeding rates on an annual basis in the San Miguel Watershed, young-to-female ratios were averaged between game management units in the San Miguel Watershed. These ratios were evaluated over time to determine an overall average and standard deviation to develop an index for a grading scale.

SENSITIVE SPECIES

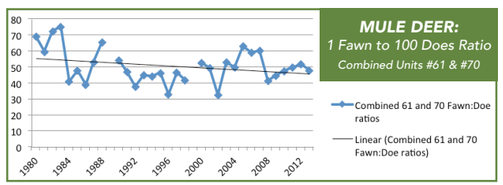
Gunnison sage grouse populations are estimated by counting the number of males on "leks" (traditional breeding grounds) during the spring breeding season. The maximum number of males is then adjusted, based on the percentage of males that attend leks and the number of females per male, to develop a population estimate. In response to declining numbers, the San Miguel Basin Gunnison Sage Grouse Working Group was formed in 1997 "to work together and coordinate efforts to ensure a thriving population of Gunnison sage grouse in a healthy, conserved sagebrush ecosystem while helping to ensure a sustainable community in the San Miguel Basin…" Despite extensive habitat restoration projects, the population of this species in the San Miguel Basin has been reduced to a biologically unsustainable level of 206, according to the 2014 lek count, compared to 392 in 2001. Because of continued threats to the Gunnison sage grouse and its habitat, the U.S. Fish and Wildlife Service determined that the species requires the protection of the Endangered Species Act as a threatened species.

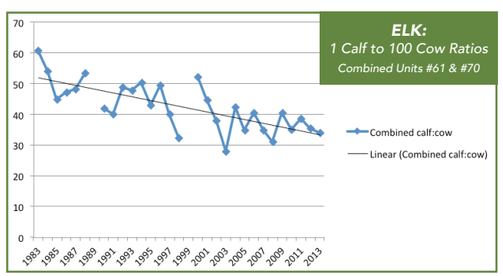
River otters were reintroduced to the Dolores River System by Colorado Parks and Wildlife between 1988 and 1991. The initial release site was on the Dolores 140 km upstream of the confluence with the San Miguel River. In 2003, the Colorado Wildlife Commission downlisted the river otter from state endangered to threatened. As part of the otter recovery plan, the San Miguel River was surveyed for otter in 2003 and 2013. In 2003, a 78-km stretch of the San Miguel was surveyed, from Norwood Bridge to the confluence with the Dolores River, and signs of otter were observed at nine locations. During surveys conducted in 2013, signs of otter were observed at 60 locations in a 29-km stretch of the San Miguel from Naturita to the confluence with the Dolores. The methodology from these surveys does not allow direct inference for population size, but results indicate that otters have dispersed from the release site and established a population on the San Miguel River. Survey results of the Dolores and San Miguel otter recovery area indicate that this population is achieving the delisting recovery criteria established in the 2003 Otter Recovery Plan.

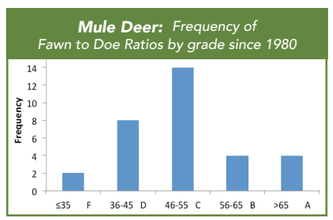
Canada lynx has been recognized as a threatened species by the U.S. Fish and Wildlife Service since March of 2000. Colorado Parks and Wildlife released 218 lynx throughout Colorado between 1999 and 2007. By 2010, they determined that 141 lynx kittens were born within Colorado and that reproduction outpaced mortality rates over the 11-year study. The findings led biologists to believe that the Colorado lynx population was self-sustaining and that suitable habitat existed for lynx in Colorado and the greater Southern Rockies. Recent decisions by the U.S. Fish and Wildlife Service exclude the Southern Rockies because they "do not believe the Southern Rockies contain the physical and biological features lynx need in the quantities and spatial arrangements necessary to support lynx populations over time." In September 2014, the U.S. Fish and Wildlife Service revised Endangered Species Act protections for the Canada lynx, declaring Colorado "unsuitable" for critical habitat. Meanwhile, Colorado Parks and Wildlife initiated a 10-year monitoring program in the fall of 2014 to determine the stability of lynx populations in areas including and surrounding the San Miguel Watershed.

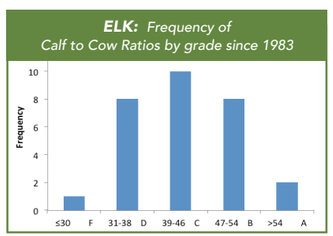
MONITORING

Game Management Unit 61 (west of the Uncompahgre Plateau with the San Miguel and Highway 141 acting as the western boundary) and 70 (encompassing the southern half of the watershed) have experienced the steady decline of mule deer seen across the West. Recent declines are attributed to drought conditions, from the early 2000s to present, and significant winter events between 2007 and 2009.









STATE OF THE SAN MIGUEL WATERSHED 2014
TERRESTRIAL Wildlife

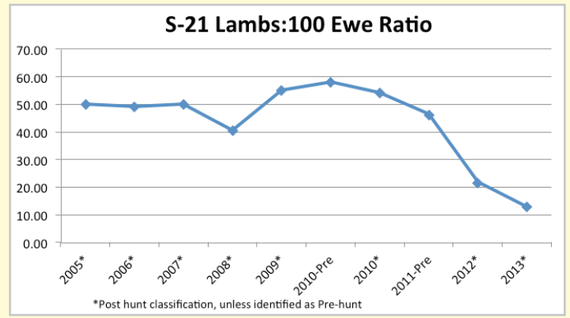
SPOTLIGHT: BIGHORN SHEEP

The San Juans west herd (game management unit S-21, which includes the San Miguel Watershed) is an indigenous bighorn sheep herd that has received few augmentations, thus making it a priority herd for Colorado Parks and Wildlife. Like many herds in the state, population declines are usually caused by unregulated hunting, loss of habitat from human activity, competition for prime habitats with domestic livestock, and mortality from disease and parasites introduced by domestic livestock.

Twenty Rocky Mountain bighorns were released in the Sawpit area in 1980. The San Miguel Watershed appeared to have excellent habitat, but the population died out by the early 1990s. As populations rebounded around Ouray, however, sightings of the sheep started to increase around Sawpit in the late 2000s. By 2011, the population estimate for all of S-21 was 250 bighorns, up from a low of 40 in the mid-1980s. In 2013, as many as 22 bighorns were observed wintering in the Sawpit area.

The S-21 population had been rebounding and producing good lamb-to-ewe ratios (more 50 lambs per 100 ewes), but starting in 2012, post-hunt ratios dropped to 21.7 lambs per 100 ewes. Then in 2013, post-hunt ratios dropped again to 12.82 lambs per 100 ewes. In August of 2013, a pre-hunt classification survey observed only one lamb in the San Miguel Watershed. Based on the low ratios and total bighorns observed during classification efforts in 2013, the current population estimate for all of S-21 (including the San Miguel Watershed) is 225, and with the current low lamb-to-ewe ratio, the grade for Rocky Mountain bighorn in 2013 is an F. The failing grade is surprising based on how bighorn numbers improved in the San Miguel watershed since the 2005 Watershed Report, but this exemplifies how wildlife populations can fluctuate because of disease, which can range from bronchopneumonia to bovine respiratory syncytial viruses. Although Colorado Parks and Wildlife has not identified the specific diseases affecting the local population, interactions with domestic livestock could be infecting bighorn sheep.


Bighorn sheep above Sawpit. Photo courtesy Colorado Parks & Wildlife



Mule Deer Grading Scale

Observed fawns: 100 Doe ratio	
> 65	A
56 - 65	B
46 - 55	C
36 - 45	D
≤ 35	F

Elk Grading Scale

Observed calves: 100 Cow ratio	
> 54	A
47 - 54	B
39 - 46	C
31 - 38	D
≤ 30	F

ASSESSMENT & ACTION ITEMS

Although there is species-specific data analysis included in this section, a true analysis of wildlife in the San Miguel Watershed might be better derived from a diversity analysis or a predator analysis, which is representative typically of both wildlife and vegetation health. Currently, there are no monitoring programs that could provide this data, though it may be possible for the lynx monitoring program in the future.

SUGGESTED ACTION

1. **The San Miguel Watershed Coalition should explore the opportunities to measure wildlife and predator diversity within the watershed.**
2. **Identify opportunities to work with available bird data for future watershed reports.**

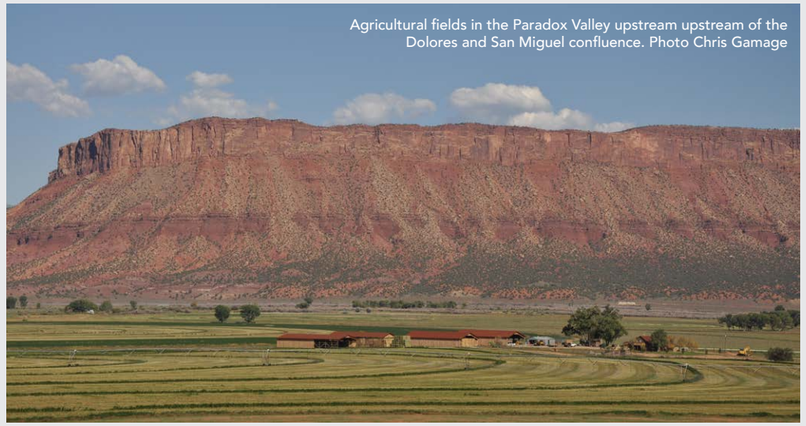
C
2013 Mule Deer Grade
48 fawns per 100 does

D
2013 Elk Grade
34 calves per 100 cows

TERRESTRIAL Soils

THE BASICS

Soil is a vital and dynamic ecosystem that supports life for plants, animals and humans by regulating water, filtering pollutants, cycling nutrients, sustaining plant and animal life, and providing geologic stability and structure for the landscape. Soil fertility is dependent upon a variety of factors that include its structure, pH value, nutrients, minerals, microorganisms, etc.



Agricultural fields in the Paradox Valley upstream upstream of the Dolores and San Miguel confluence. Photo Chris Gamage

Understanding soil health means assessing and managing soil so that it functions optimally now and is not degraded for future use. By monitoring changes in soil health, a land manager can determine if a set of practices is sustainable.

Recently, there has been an increased focus on soil health in the San Miguel watershed, and limited studies have been initiated to understand the range of soil conditions on the landscape. Unfortunately, there is no comprehensive monitoring program that represents the entire watershed's conditions. The Bureau of Land Management conducts monitoring on lands they manage, comparing soil health across a variety of landscape treatments used to stimulate vegetation growth, but the data set is not developed to a point where definitive results can be presented.

PAYMENT FOR ECOSYSTEM SERVICES

San Miguel County initiated a Payment for Ecosystem Services project in 2010, funded by a Colorado State University Center for Collaborative Conservation fellowship for Commissioner Art Goodtimes and funds from the county's Open Space Fund. The first project, completed in 2013, paid West End ranchers for permission to have a state botanist survey their land for rare plants. They found several populations of Gypsum Valley cat's eye, a Colorado Natural Heritage Program sensitive species and currently proposed as a Bureau of Land Management sensitive species.

San Miguel County is following this success by working with the Soil Carbon Coalition, Quivira Coalition, and others to explore a carbon ranching project that would measure carbon sequestered by West End ranches and organic farms. Eventually, the goal is to establish a voluntary carbon credit demonstration project that provides monetary incentives to landowners to preserve and enhance the healthy soil functions of their land and to give upper watershed tourism-based businesses a carbon offset opportunity.

Gypsum Valley cat's eye found through the Payment for Ecosystems project.

ASSESSMENT & ACTION ITEMS

The condition of the soil cover within the watershed is an important monitoring parameter. A diverse range of healthy, functioning soil systems prevent erosion, dust disbursal, and provide critical carbon sequestration. Productive soil systems also provide food for plants and animals.

SUGGESTED ACTION

1. **The San Miguel Watershed Coalition should coordinate with the Bureau of Land Management and U.S. Forest Service to initiate monitoring for future analysis.**
2. **Identify opportunities to help develop the Payment for Ecosystems Services project.**

TERRESTRIAL Habitat Restoration

SPOTLIGHT: TABEGUACHE DAM REMOVAL

In March 2014, the San Miguel Watershed Coalition, The Nature Conservancy, Bureau of Land Management and Colorado Parks and Wildlife—with funds provided by the Southwest Water Conservation District—removed a small concrete dam from Tabeguache Creek. The goal of the project was to enable native fish, particularly the roundtail chub, bluehead sucker, and flannelmouth sucker (Bureau of Land Management Colorado Sensitive Species) to move upstream, allowing the fish to access important spawning habitat and restoring populations of these native fish. The dam was created in the 1930s for the town of Uravan, and water rights were declared abandoned in 2011.

Colorado Parks & Wildlife and the San Miguel Watershed Coalition's coordinator conducted a native fish survey in July 2014. Results indicate successful recruitment into the new habitat and a good first-year population for these fish.

Removal begins on the Tabeguache dam.

Colorado Parks & Wildlife's fish survey upstream from the removed dam finds a healthy population, including this flannelmouth sucker fry.
Photos Sarah Bobbe

SPOTLIGHT: CCC DITCH REPAIR

The Colorado Cooperative Company was formed in 1894 to "establish a cooperative community somewhere in Colorado where equality and service, rather than greed and competition, should be the basis of the community." The group found land in Tabeguache Park and settled temporarily in Naturita, while construction began on a 15-mile ditch, the CCC Ditch, from the San Miguel to Tabeguache, now Nucla. The CCC Ditch, finished in 1904, is the most senior water right holder on the San Miguel River.

In 2011, the San Miguel Watershed Coalition partnered with the Nature Conservancy and Colorado Water Trust to improve flows between the ditch headgate and return flow, 1,500 feet downstream, a section that has run dry during low flow periods historically. The partners also installed a fish ladder as part of the habitat improvement project. Another habitat restoration opportunity presented itself in 2013 when a tree may have punctured the diversion structure, creating a scour hole that hindered safe fish and boater passage over the structure.

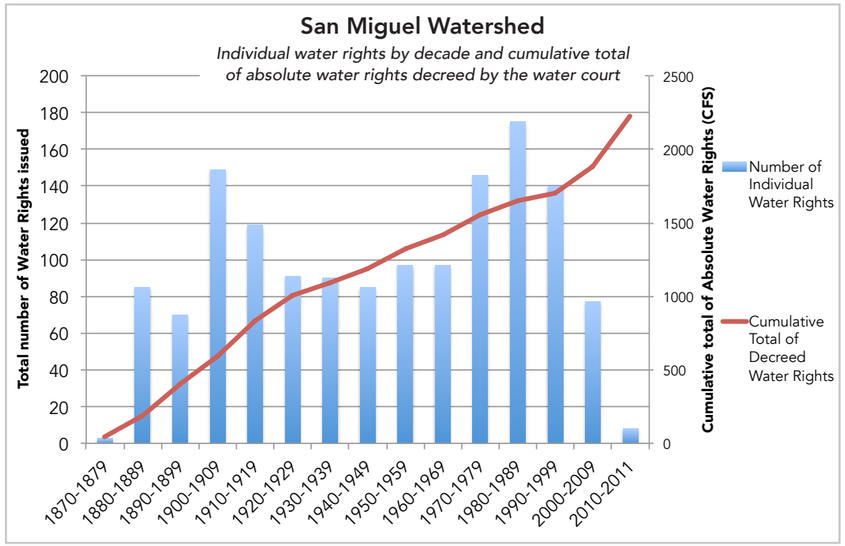
The San Miguel Watershed Coalition partnered with the Bureau of Land Management and secured funding from the Southwest Water Conservation District to repair the scour hole. In November 2014, Reams Construction used 60 tons of locally harvested rock to fill the hole. The repair restored safe recreational and fish passage successfully over the CCC Ditch Diversion Structure.

Local rock was used to improve flows over the CCC Ditch.
Photos courtesy of FlyWater, Inc

THE BASICS

Population and development have increased in Colorado over the past 40 years, and the San Miguel Watershed is no exception to the trend. Most development in the watershed is concentrated in the Telluride region. Developers built many residential and commercial buildings to support the working community and visitors, and a thriving real-estate economy has been supported by these properties. These development activities clearly affect the local watershed, but it's difficult to quantify changes and negative or positive impacts.

Common methods to determine total build-out capacity do not represent the entire population and its potential impacts on the watershed accurately because many residences are not occupied year-round. Census data provide a good understanding of how many people live within the watershed, but the census is conducted only every 10 years, so the lagging reports don't provide information frequently enough for this Report's analysis. Therefore, alternatives are needed to evaluate how increased development affects watershed health.

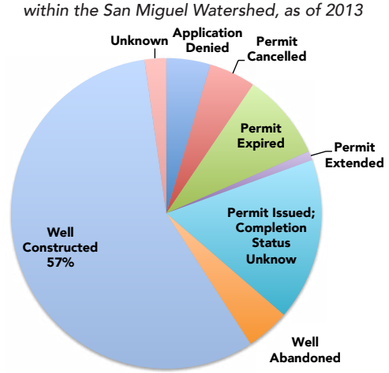


WATER RIGHTS

Colorado's State Engineer's Office maintains records for water rights applications for surface diversions and well permits. By looking at the cumulative total of water rights and well permits, we can monitor increased water use each year.

In short, the water within the San Miguel Watershed has been "over-appropriated," meaning that more water rights have been issued than the total available water in the river system. Runoff in the San Miguel River typically peaks at the Placerville gauge at approximately 1,400 cubic feet per second, where as the sum of all absolute water rights issued in the watershed is approximately 2,225 cubic feet per second (a total that users may divert year-round if it's available). Since 1970, approximately 1,250 cubic feet per second of new water rights have been issued, based in part on demands from development.

Status of the 3,286 well permit applications within the San Miguel Watershed, as of 2013

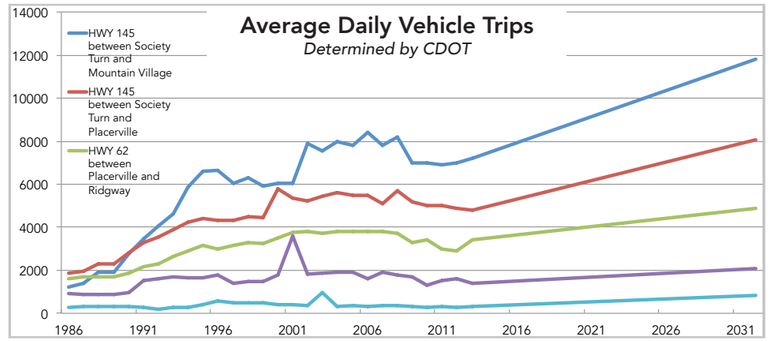


- A total of 1,432 individual water rights have been appropriated in the San Miguel Watershed.
- Since 1970, 546 individual water rights, totaling 807 cubic feet per second, have been issued in the watershed.
- Water is used for agricultural irrigation, mining, and municipal and domestic applications.

STATE OF THE SAN MIGUEL WATERSHED 2014
LAND USE Development

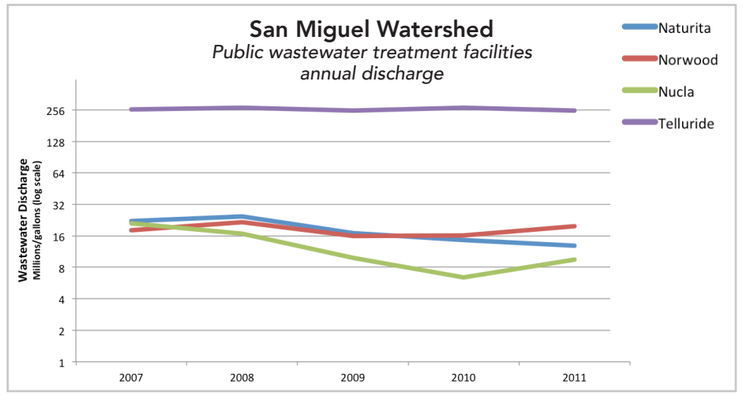
TRAFFIC

Traffic volume on our state highways is another good indicator of population within the watershed. The Colorado Department of Transportation tracks vehicle trips and projects totals on specific segments of the highway network within the watershed annually, including HWY 62, HWY 141, and HWY 145. Vehicle trips in the watershed are indicative of the number of people living, working, or visiting the watershed and the impact traffic may have on air and water quality. While not all of vehicle trips represent people affecting the watershed, the general trends are telling of the local traffic and the area's relationship with development. Traffic measured between Society Turn and Mountain Village dropped by approximately 1,000 daily vehicle trips during the 2008 to 2013 economic recession. Projections for vehicle trips in 2032 are shown here and indicate the likelihood that traffic in the region will increase by 30 percent.



WASTEWATER

Another way to gauge development and growth is through the total discharge volumes from the wastewater treatment facilities in Telluride, Norwood, Nucla, and Naturita. By looking at the total volume of wastewater treated over time, we can determine which areas of the watershed are experiencing growth. We can then target locations in which to monitor water quality to understand the impacts of growth and development. Wastewater treatment discharges are generated by a small percentage of the population residing within the service areas of the Telluride, Norwood, Nucla, and Naturita, but the total volume of treated water discharged from these facilities is quantifiable and available to the public, providing a good indicator of regional population in the watershed. From 2007 to 2011 (the available period of record), treatment totals in Nucla and Naturita were approximately 50 percent below the highest recorded levels. Norwood decreased slightly in discharge, while the Telluride facility remained at a steady discharge level. These volumes indicate that Nucla and Naturita's population decreased significantly, while Norwood and Telluride's populations remained relatively stable during the economic downturn. This baseline data set will serve to help understand future growth patterns within the areas surrounding these communities within the watershed.



ASSESSMENT & ACTION ITEMS

The majority of growth and development in the San Miguel Watershed is fairly concentrated in the Telluride region, but conditions could change and spur additional growth in the west end of the watershed.

SUGGESTED ACTION

1. **Establishing a baseline for water consumption, traffic patterns, and waste discharge will help monitor changing patterns of growth. At present, the trend implies renewed development activity, so future monitoring is critical to evaluate growth and development metrics.**
2. **Monitoring and reporting should continue to rely on the most up-to-date data available. Wastewater treatment data for 2012 to 2013 will be available from the EPA in 2014, and the wastewater graph should be updated at that time to reflect the most current dataset. Additional updates from the Colorado State Engineer's Office for water rights and from Colorado Department of Tranportation for traffic data should be obtained in 2014 for reporting purposes.**

THE BASICS

In recent decades, recreation has become an increasingly important part of land use in Colorado. From national parks to open space preserves, an increasing number of visitors are drawn to the variety of outdoor activities, such as hiking, biking, camping, winter sports, hunting, fishing, and off-road vehicle use. Paradoxically, recreation on Colorado's public lands can contribute to both its conservation and its degradation.

Tourism contributes heavily to the economy of the San Miguel Watershed because of the area's exceptional scenic beauty, the rich cultural history of the communities, and the entertainment opportunities offered throughout the year in Telluride. Recreational activities are embraced by residents and visitors alike. Skiing at the Telluride Ski Resort draws people from around the world; hunting offers game species to harvest; hiking, biking, fishing, climbing, and rafting provide a way to enjoy the outdoors; and non-traditional activities, such as gold-panning, also attract visitors to the area.

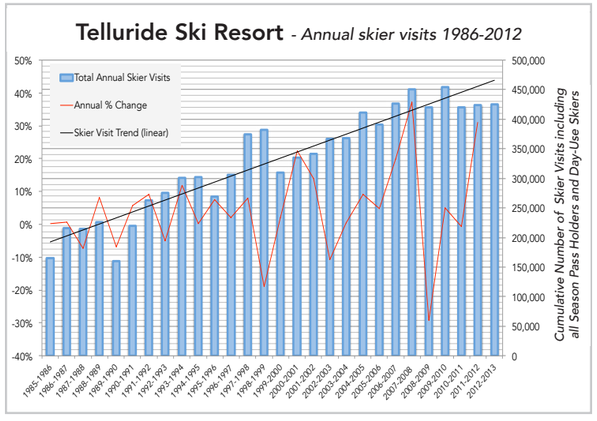
Few metrics regarding tourism and recreation exist to evaluate the effects of these activities on watershed health, but preliminary analysis of skier visits and review of mining claims along the San Miguel River allow for a better understanding of trends in the recreation niche. Future analysis may be expanded to include quantifiable metrics that more accurately identify total visitor numbers and what people do while staying in the region.

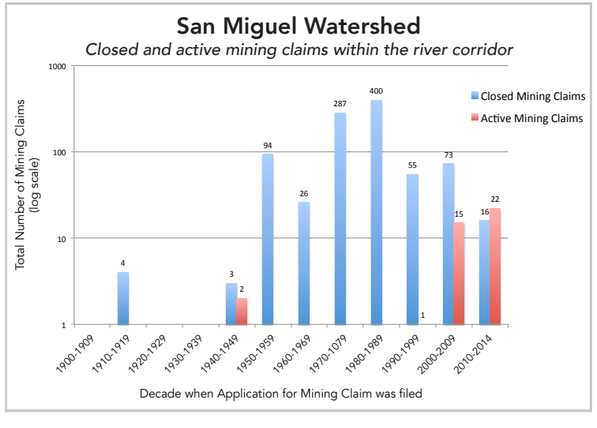
RESOURCES: SKIER VISITS & MINING CLAIMS

With the development of the Telluride Ski Resort in 1972, population and visitor numbers increased measurably in the San Miguel Watershed. Winter sports enthusiasts and transplants to the area began to live and work in the region that had traditionally been a mining- and agriculture-based economy. As skier visits continued to rise through the '80s and '90s, increases in development and dependance on finite water resources rose commensurately. Trends in skier visits continue to grow annually, putting increased pressure on watershed health. Skier visits will continue to serve as a quantifiable metric for visitors to the region, and absent any other quantifiable visitor calculation, this provides the best indicator for future recreation- and tourism-related activities in the watershed.

Mining claims along the San Miguel River were identified from the Bureau of Land Management's LR2000 database and tracked by decade to determine the number of active claims that could be used for placer mining activities. Presently, 40 claims are active. This total will be tracked to monitor an increase in interest in placer mining along the San Miguel.

The monitoring of mining claims on the San Miguel is important because of the potential environmental impacts associated with recreational mining activities that border on small-scale commercial operations. Mining that involves dredging the river bottom increases sediment loads and can cause physical changes to the channel and riparian corridor as waste rock materials are stockpiled and equipment is staged for sluice boxes.





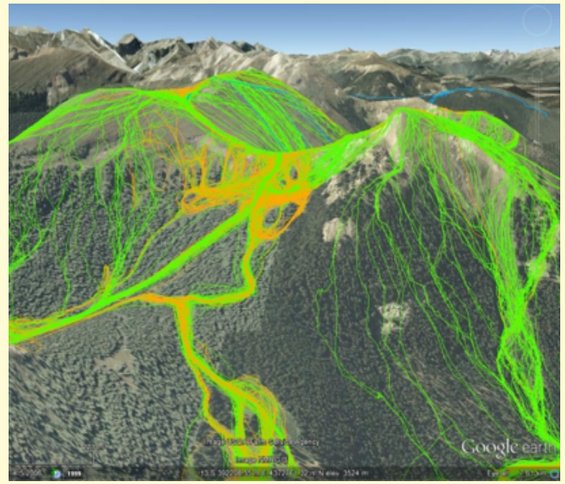
STATE OF THE SAN MIGUEL WATERSHED 2014
LAND USE Recreation & Tourism

SPOTLIGHT: LYNX & RECREATION ACTIVITIES

The White River National Forest, located less than 60 miles from Denver, is the most visited national forest in the nation with over 9.6 million annual visits (70 percent for downhill skiing). This area and other national forests throughout western Colorado (including the Grand Mesa Uncompahgre and Gunnison National Forest of the San Miguel Watershed) are primary recreation destinations because of ski resorts and other winter recreation, including snowmobiling, snowshoeing, and back-country skiing. These national forests are also home to Canada lynx, a federally listed species that was reintroduced to Colorado by Colorado Parks and Wildlife in 1999. Approximately 220 lynx from Alaska, Manitoba, Quebec, British Colombia, and the Yukon were released in Colorado, and these animals are now producing kittens. It's important to determine how winter recreation, both developed (e.g. ski areas) and dispersed (e.g. snowmobiling, back-country skiing), impact the management and conservation of lynx in Colorado.

Travelers spend approximately $1.7 billion in Colorado on skiing-related activities. In addition, it's estimated that snowmobile recreation contributes $113 million to gross sales in Colorado. These dollars are enormously important to the economy of many communities throughout western Colorado. The high mountains of Colorado are also crucially important to Canada lynx. The U.S. Fish and Wildlife Service, in listing of the lynx as a threatened species, determined that human alteration of forest abundance, forest composition, and habitat connectivity are the most influential factors on lynx habitat. Thus, management plans must consider the conservation requirements of lynx, as well as the needs of winter-recreation enthusiasts.

The Rocky Mountain Research Station, in cooperation with Region 2 of the U. S. Forest Service and Colorado Parks and Wildlife, initiated a study in 2009 that investigates lynx and winter recreation. Researchers trap and fit lynx with GPS collars that plot their movements in areas of winter recreation. Then, on a voluntary basis, snowmobilers, back-country skiers, and others are asked to carry GPS units in the same areas. This research is novel: It applies the same analytical methods to quantify the movements of both people and lynx. Locally, data have been collected in the area between the Telluride Ski Resort and Trout Lake. Analysis of these results commenced in 2014 and will be available for review and publication near the end of the year.



Skiers on Vail Pass carry GPS units to identify their movement paths through forested landscapes. The mapped routes are then used to evaluate the interaction with tracked lynx patterns.

ASSESSMENT & ACTION ITEMS

Recreation and tourism present the classic double-edged sword, whereby local economies are reliant on the economic benefits of a strong tourist-based economy, yet increased visitor numbers can impact watershed health. Additionally, recreation creates impacts. Quantitative metrics that examine recreation and tourism on the scale of the San Miguel Watershed are limited, and future monitoring and reporting will rely on the development of additional methods to assess how recreation and tourism affect watershed health.

Tourism presents an opportunity to help educate visitors about the unique environment of the San Miguel Watershed and the importance of conserving natural resources and protecting specific areas.

SUGGESTED ACTION

1. The San Miguel Watershed Coalition should work with local outfitters, guides, and trade groups to develop methods to obtain accurate numbers for people recreating in the watershed. This could be achieved through surveys conducted in the field during high season or at the end of the season from numbers reported by outfitters.
2. Develop calculations of total regional population throughout the year to gauge peak stress periods and identify the potential effects increased temporary populations have on the finite environmental resources in the watershed.
3. Site-specific monitoring of placer mining should be initiated to document the activities and any associated impacts.
4. Develop outreach to educate visitors about the watershed.

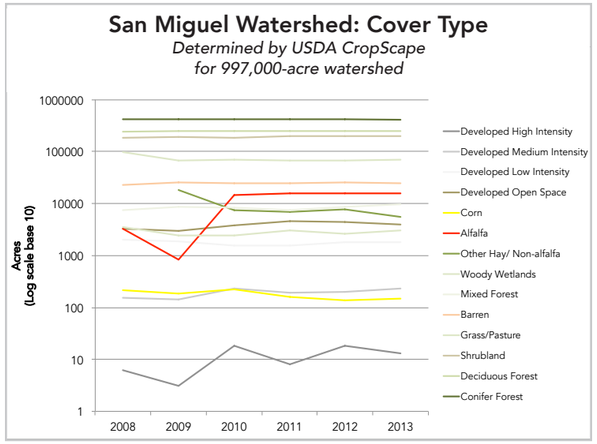
THE BASICS

Production activities include traditional agricultural practices and ranching associated with livestock husbandry. Some of the San Miguel Watershed's earliest Anglo settlements were related to agriculture and the development of a utopian community that would be free from the greed and corruption that was perceived to fuel development in the American West. The result was the founding of Piñon, later renamed Nucla, in the Tabeguache section of the San Miguel Watershed.

The senior water rights on the San Miguel River are related to that original development plan conceived by residents of Denver who formed the Colorado Co-operative Company in 1893 and constructed a 15-mile-long canal to bring water from the San Miguel to the lands targeted for irrigation (approximately 20,000 acres). Nucla, its sister town of Naturita, and Norwood all retain a strong heritage rooted in their agricultural and ranching legacies with many fifth- and sixth-generation families still working the land as their families have for over 100 years.

Lands in the San Miguel Watershed used for agricultural purposes represent approximately 9 percent (over 91,000 acres) of the total area of the watershed. When compared to the approximate 87 percent of the watershed dominated by conifer/deciduous forests and shrub-dominated landscapes (over 87,000 acres), it's clear that production-oriented lands occupy a unique niche on the landscape.

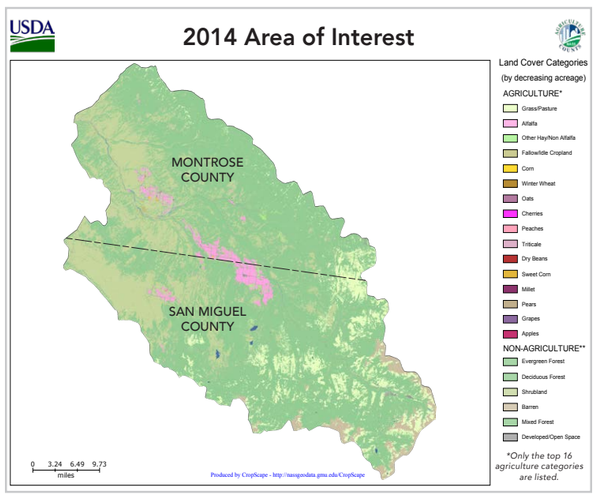
Primary cover type categories in the San Miguel Watershed. All types are relatively static with the exception of alfalfa, which increased in production by an order of magnitude in 2010.



RESOURCES

The U.S. Department of Agriculture's National Agricultural Statistics Service (NASS) conducts hundreds of surveys every year and prepares reports about most aspects of American agriculture. Production and supplies of food and fiber, prices paid and received by farmers, farm labor and wages, farm finances, chemical use, and producer demographics are a few examples of the information they gather.

In 2011, NASS launched CropScape, a digital map-based evaluation tool that provides access to a variety of new resources and information, including the 2014 Cropland data layer. The service offers advanced tools to monitor land cover; biodiversity; extreme events, including flooding, drought, and severe storm assessment; and issues related to agricultural sustainability. The collection of the Cropland layer was compiled using on-the-ground farm information, including field locations, crop type, elevation, tree canopy, and urban infrastructure.



STATE OF THE SAN MIGUEL WATERSHED 2014
LAND USE Production

SPOTLIGHT: FUNDING FOR AGRICULTURE

The U.S. Department of Agriculture's Natural Resource Conservation Service operates funding programs designed to assist small producers with a broad range of projects. The Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to agricultural producers to help address natural resource concerns and deliver environmental benefits. Examples of funded projects include those that target water or air quality improvement, conservation of soil and surface waters, erosion control to reduce sediment deposition in streams, and wildlife habitat creation or restoration.

Nucla residents Louise Meier and Terry Boekhout have participated in the EQIP program since 2003 and implemented a range of projects on their 80-acre property, Rockfield Place, which overlooks the San Miguel River. They have embraced the spirit required to transform a sage-dominated landscape since 1994 when they purchased the land. Since that time, they have developed irrigated fields for alfalfa; constructed two hoop-style greenhouses for organic produce to sell at local farmer's markets; and added field crops of lavender, seedless grapes, blackberries, raspberries, and an orchard of 200 tart cherry trees. Additional projects have included pipeline and pump station improvements to maximize irrigation efficiency. They are near completion of a micro hydro plant to take advantage of the kinetic energy in their irrigation system to produce up to 7.5kw of electricity to use on their property and in their home.

According to Jim Boyd of the U.S. Department of Agriculture's Natural Resource Conservation Service (Norwood), approximately $250,000 is distributed annually to residents within the San Miguel watershed through the EQIP program for projects that can lead to improved water and air quality, conserved ground and surface water, and reduced soil erosion. All that is required of participants is a willingness to partner with the federal government to identify and plan the projects and a contribution of matching sweat equity or cash to facilitate a project's completion.

Alfalfa fields, organic produce, cherry orchard and irrigation systems of Rockfield Place. Photos Louise Meier

ASSESSMENT & ACTION ITEMS

As water resources become more scarce in the San Miguel Watershed, the issues surrounding priority use for production purposes need to balance with the desire to maintain healthy and diverse ecosystems.

Proactive discussions with the agricultural community to identify opportunities to increase irrigation efficiency in the water distribution network and application methods could potentially lead to increased water for riparian habitats. It is unrealistic, however, to assume that changes to the current approach to the movement and consumption of water by agricultural users is possible without improving the foundation of these relationships.

The San Miguel Watershed Coalition can become the trusted entity that facilitates conversations, but it will require broader representation from the agricultural community to gain realistic and measurable results.

SUGGESTED ACTION

1. **Identify members of the agricultural community interested in participating in the San Miguel Watershed Coalition.**
2. **Conduct a portion of the coalition meetings in Norwood, Nucla, and Naturita to expand the organization's audience.**
3. **Identify funding sources for projects that will help increase efficiency in irrigation while preserving water rights.**

THE BASICS

Ownership of the San Miguel Watershed's 995,000 acres is divided between properties administered by the U.S. Forest Service, Bureau of Land Management, and state of Colorado; privately owned parcels, including patented mining claims; and privately owned property, where a conservation easement has been sold or donated in exchange for restricted development.

Public ownership accounts for 62 percent of the total watershed acreage, extending from the high-alpine U.S. Forest Service lands to the lower watershed's canyon and mesa environments managed by the Bureau of Land Management. Portions of the public lands in the watershed are protected with such designations as wilderness, roadless, special management area, and areas of critical environmental concern to protect natural habitat and regulate land-use activities.

Private property (including 58,000 acres of federal inholdings) accounts for the remaining third of the watershed's acreage. In Colorado, parcels of 35 acres and greater are exempt from subdivision regulations, which allows large tracts to be cut into small pieces that fragment the landscape. The 35-acre subdivision entitlement, however, also allows owners of large parcels to sell single or multiple 35-acre tracts to receive capital for operational expenses.

A "conservation easement" is a legal agreement between a landowner and a land trust or government agency that limits a property's uses in order to protect its ecological or open-space values. Such benefits could include conservation of agricultural land, open space, wildlife habitats, and scenic vistas. In Colorado, landowners may subject their land to a conservation easement and receive state tax credits in return. This arrangement serves the dual purpose of permanently preserving agricultural land and open space while providing the landowner with some of the value of the land. Colorado law currently allows for tax credits on donated land that are based on the appraised fair-market value, and if a landowner is unable to use the tax credits, they may be sold (at a discount) to generate cash. The use of conservation easements is not a method to regulate the development of 35-acre parcels directly, but by providing a fiscal benefit a conservation easement can help mitigate a landowner's desire to divide a parcel that may provide other community benefits if kept intact.

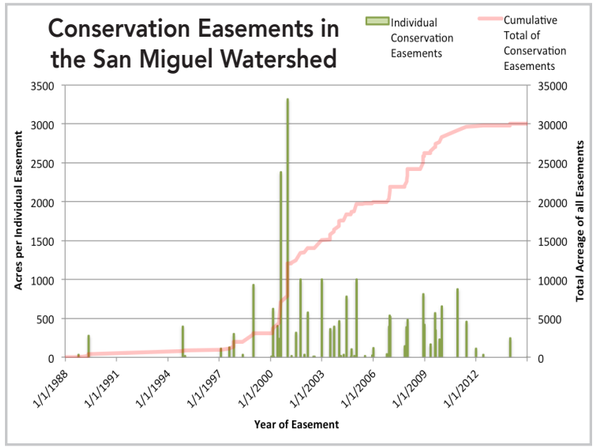
Presently, 10 land trust organizations operate in the San Miguel Watershed, holding perpetual easements on over 30,000 acres collectively.

Land Ownership	Acres	% of Total Area
Forest Service (excludes 58k of in-holdings)	349,000	35%
Bureau of Land Management	270,000	27%
Private Property	343,000	34%
State, County, & Land Trust	33,000	3%

CONSERVATION EASEMENTS

The first conservation easement established in the San Miguel Watershed was in 1977 when The Nature Conservancy accepted an easement for the Skyline Guest Ranch from the Farney Family. In 1988, The Nature Conservancy identified and acquired a 37-acre parcel with high conservation values along the South Fork of the San Miguel River, creating the second protected private parcel in the watershed. Thus began the process of landowners working with land trusts to preserve private property within the watershed.

Between 1988 and 1998, approximately 10 percent of the current total of conserved land was placed in an easement. During 2000 and 2001, the amount of land protected with an easement tripled to over 12,000 acres. In the last 10 years, the acres added to the inventory has doubled to a total of approximately 30,000 acres, which is roughly 3 percent of the total watershed acreage or 8.5 percent of all private lands within the watershed. With the improving economy, and the increased opportunity to use tax credits, we may see continued expansion of land preservation conservation easements.



STATE OF THE SAN MIGUEL WATERSHED 2014
LAND USE Preservation

SPOTLIGHT: TELLURIDE VALLEY FLOOR

In 2004, the citizens of Telluride voted to begin condemnation proceedings on the 570-acre parcel known as the Valley Floor, for open-space purposes. The condemnation action had been discussed with the landowner (San Miguel Valley Corporation) during the proceeding five years after the unveiling of conceptual development plans that involved lakes, a golf course, and a mix of commercial and residential structures. Negotiations with the landowner did not lead to solutions that satisfied either side, and condemnation was seen as the only alternative to achieve the open space goals identified by the citizens of Telluride.

Following the initiation of the condemnation process, the landowner appealed to the state judicial and legislative systems to assist in barring condemnation. Although some in the legislative branch felt compelled to offer statutory relief, the condemnation proceeding ended up in court.

The trial was moved from Telluride to Delta, Colorado, where the landowner felt the jury might be more sympathetic and impartial. The Delta jury set the fair-market price at $50 million, the highest value possible from the range presented in court.

With the goal to raise at least half of the $50 million, the grassroots Valley Floor Preservation Partners formed to find donations, ranging from $5 million to pocket change placed in a Save the Valley Floor Wishing Well, to meet the fundraising target. In the end, the effort was successful, generating enough to match the $25.5 million approved by Telluride's voters as bond capacity for the purchase.

Presently, the Valley Floor is owned and managed by the Town of Telluride with a conservation easement managed by the San Miguel Conservation Foundation to ensure the land remains open space in perpetuity. A monitoring program was developed and initiated in 2014. Planning has begun for the restoration of a more natural river alignment and remediation of historic mine tailings.


Telluride's Valley Floor. Photo Ryan Bonneau

ASSESSMENT & ACTION ITEMS

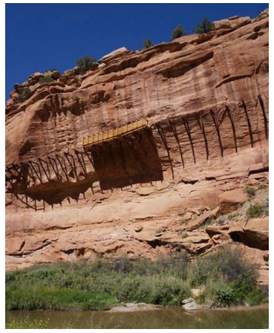
The San Miguel River is one of two rivers in Colorado without a dam impeding its main stem. This ecological connectivity is unique and, coupled with the public ownership of two-thirds of the acreage of the watershed, there is opportunity for progressive land management to strike a balance between environmental benefits and protection of natural resources and human impact. This is a challenging task that calls for informed input from all watershed residents.

Quantification of the total protected acreage of both private and public lands within the watershed offers a metric that can be tracked over time to indicate how land preservation is trending. The initial assessment of land protection indicates that 90 percent of private lands protected are located in San Miguel County, which is possibly a result of the county's Open Space Commission that has incentivized conservation easements.

SUGGESTED ACTION

1. **Develop a metric to track protected public land within the watershed to complete the land preservation analysis.**
2. **Continue to educate landowners about the benefits of conservation easements for the landowners themselves, as well as agricultural values, water rights, open space, wildlife habitat, and scenic vistas.**

2014 fall confluence clean, a collaborative effort by watershed groups. Photo Hilary Cooper



The 2013 reconstruction of a section of the Hanging Flume just above the confluence. Photo Hilary Cooper

Telluride River Watch students participate in training on the Valley Floor. Photo Laura Kudo

ACKNOWLEDGEMENTS

The State of the San Miguel Watershed Report was created as a science-based document that will allow for specific long- and short-term trend analysis through consistent data collection. We intend to update analysis when new data is available each year and release a new State of the Watershed Report every five years.

The San Miguel Watershed Coalition partnered with the following organizations that provided the science and technical input to make this publication possible:

Bureau of Land Management

United States Forest Service

Natural Resource Conservation Service

Colorado Parks & Wildlife

Colorado State Forest Service

Colorado Department of Natural Resources

Colorado Department of Public Health & Environment

The Nature Conservancy

Sheep Mountain Alliance

Mountain Studies Institute

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Contributions of data, narrative materials and technical advice were provided by Amanda Clements and Jedd Sondergard of the Bureau of Land Management; Warren Young and Gary Shellhorn of the U.S. Forest Service; Eric Gardunio, Brad Banulis and Evan Phillips of Colorado Parks and Wildlife. Additional narrative and research contributions were provided by Jamie Gomez; Sarah Bobbe, San Miguel Watershed Coalition Coordinator; and Rory Cowie of Mountain Studies Institute.

Photographs courtesy of Sarah Bobbe, Ryan Bonneau, Colorado Parks and Wildlife, Hilary Cooper, Chris Gamage, Chris Hazen, Alessandra Jacobson, Laura Kudo, Louise Meier, The Nature Conservancy, John Richter, and Sheep Mountain Alliance.

Finally, the project could not have been completed without the coordination and technical contributions of Hilary Cooper, copy editing by Lise Waring and graphic design services of Tor Anderson at True North Designworks.

—Chris Hazen, Coordinator
State of the San Miguel Watershed Report

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Town of Telluride

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Southwest Water Conservation District

Bureau of Land Management

U.S. Forest Service

Sheep Mountain Alliance

Telluride Institute

SAN MIGUEL WATERSHED COALITION

MISSION:

The San Miguel Watershed Coalition exists to give all of us a voice in directing the future of our watershed.

The mission of the Coalition is to advance the ecological health and promote the economic vitality of the watershed through the collaborative efforts of the entire community.

Our ultimate goal is to realize a watershed that is healthy in every respect while offering a sustainable and quality lifestyle for all who live in it.

We Need Your Support!

Your contributions go directly to water quality monitoring and analysis, education and outreach programs, watershed improvement projects and the publication of future State of the San Miguel Watershed Reports.

Please donate today!

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