October 15, 2010

Eagle River Watershed Council

State of the Rivers Report

Overview of the Eagle River Watershed

including a special section on the Colorado River

Contents

Principal Authors: Tambi Katieb, Land Planning Collaborative, Inc.
ERWC Director of Policy and Planning
Kirby Wynn, Wynn Environmental, LLC
ERWC Water Program Director

Watershed Mapping: Scott Flemming, Eagle County GIS Department

Special Acknowledgements:
Ray Merry and Clifford Simonton, Eagle County / Scott Conklin, VISTA / Melissa Macdonald, ERWC / Kendall Backich and Barry Nehring, Colorado Division of Wildlife / Linn Brooks, Eagle River Water & Sanitation District / Bob Weaver, Leonard Rice Engineering / Eagle County Soil Conservation District / David Brown, U.S. Geological Survey / Scott Schlosser and Scott Jones, Colorado River Ranch

Disclaimer: Maps created in this report by the Eagle County GIS Department are to be used for general purposes only. Eagle County does not warrant the accuracy of the data contained in this report. Selected land use and other uses depicted for land cover orientation purposes only, and are not inclusive of all similar land covers due to projection and scale of the maps.

This report is also made possible through support of our Eagle River watershed monitoring and assessment program partners, including: Upper Eagle Regional Water Authority, Eagle River Water and Sanitation District, Eagle County, Town of Vail, Vail Resorts, Homestake Partners (Colorado Springs Utilities and Aurora Water), Colorado River Water Conservation District, Town of Gypsum, Town of Eagle, Denver Water.

Principal Sponsors:

EAGLE COUNTY

Eagle River
Watershed Council, Inc.

Introduction

This report is designed to familiarize the reader with current water resource information on an easily understandable scale, highlighting issues and opportunities for our water resources that will form the basis of an update to the Eagle River Watershed Plan(ERWP), which was adopted by Eagle County in 1996. This important community master plan outlines a collaborative local philosophy for protecting and improving water quantity, water quality, wildlife habitat and recreational opportunities while promoting compatible land use practices in Eagle County. This report is based on a compilation of available records, reports, water quality analyses, and land use information of sometimes limited observation, yet this data provides a logical starting point for discussion among readers and master plan partners.

While specific objectives of the 1996 ERWP have been implemented by various partners, changing demographics, land use patterns and transportation needs combined with new climate and water resource issues have created an opportunity to update the ERWP, incorporating new data and concepts relevant to the management of our watersheds. The Watershed Council(ERWC) and Eagle County, with support and participation from the Eagle River Water and Sanitation District(ERWSD) and others, are providing the reader with this informational report on the present condition of our local watersheds as a first phase to the ERWP update process. There has been a focused effort by water users and government officials alike to keep our rivers and streams healthy since well before adoption of the ERWP. Sustaining this effort recognizes that healthy rivers, lakes and streams contribute to our quality of life and economy, and it requires regional cooperation and periodic introspection to truly be successful in our collective goal of preservation of the resource.

Watersheds are a geographic area in which all water drains to a common point or outlet like a larger stream or river, a lake or underlying aquifer. Watersheds exist in a variety of shapes and sizes which result from the influence of geography, geology and climate (ERWP, 1996).

While we all live within and tend to focus on political boundaries (towns, county) the watersheds that surround and support us are not defined by these settlement patterns. As a result of a recreation and tourism economy based on conserving natural resources while providing water for growth, our communities have adopted a watershed approach to managing the environment. A watershed approach is based on two simple principles: development within a watershed affects everybody (both upstream and downstream), and regional coordination of water management and water quality issues is paramount to preserving the natural environment and our quality of life in Eagle County. A sustainable water resource management approach is premised on a ‘triple bottom line’ that seeks balance to economic, social and environmental costs and benefits.

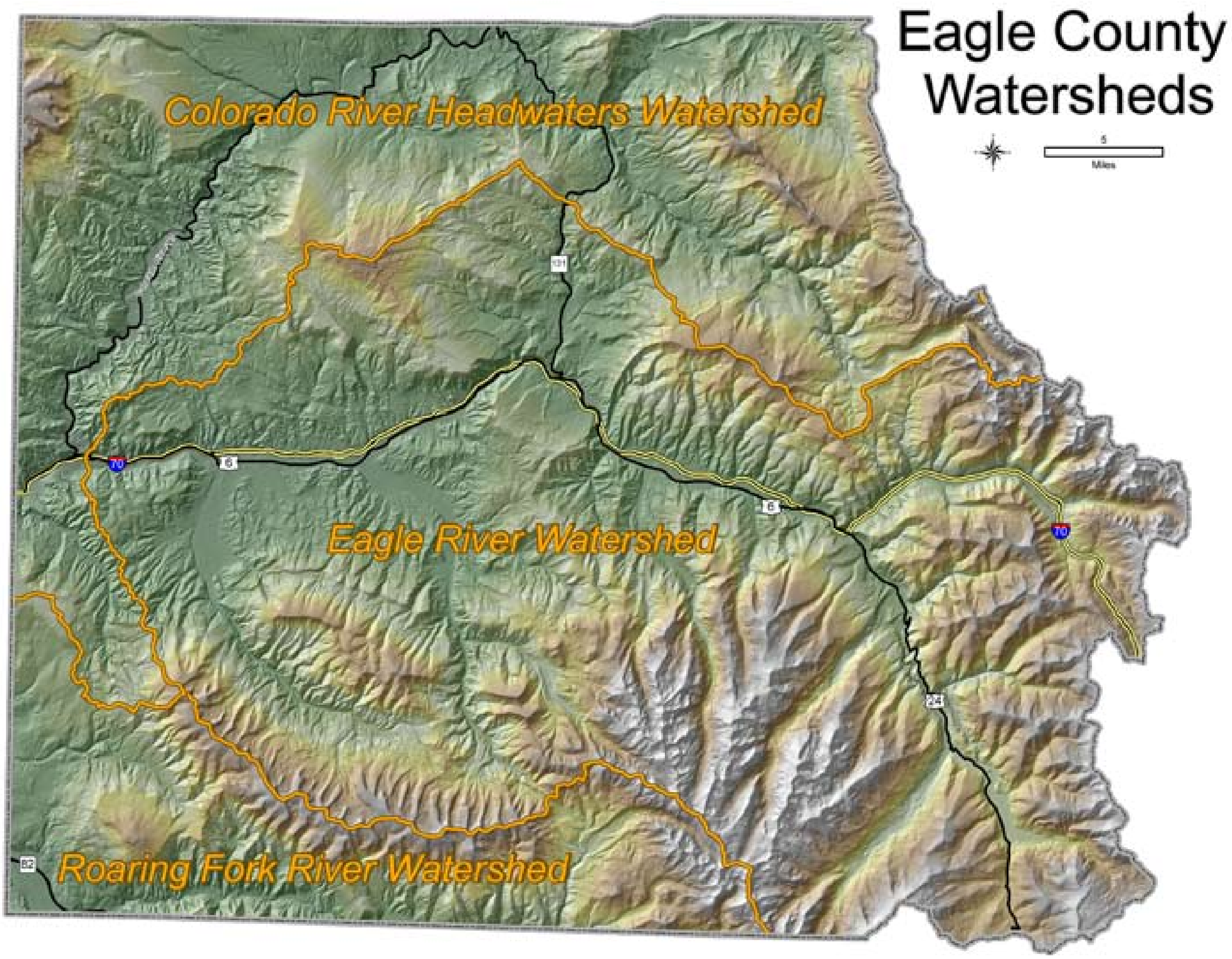
In the Eagle River watershed, the majority of lands suitable for settlement and transportation routes occur along the valley floors in close proximity to streams. For instance, roughly ninety percent of the Interstate corridor in the Gore Creek watershed is within an eighth of a mile of the creek (Eagle County, 2009). As our communities mature, so do our needs for more space to grow. A 2006 study by the Urban Land Institute recommended that over the next 20 years, more than 14,000 new dwelling units would be required to meet the affordable housing needs of Eagle County residents alone. It is probable that new development will often be constructed in the same areas that also support valuable watershed functions, like wildlife habitat and groundwater recharge zones.

We have an obvious need to understand the implications of a field of complex issues on limited water resources. On a local level, we can aniticipate the issues and opportunities in our watershed based on current and/or past water quality, water quantity, wildlife and land use impacts and trends.

Eagle River watershed

The Eagle River watershed is a network of clear mountain streams that cover a drainage area of approximately 960 square miles. It has an average annual water flow of roughly 414,000 acre feet. Elevations in the watershed range from 6,100 feet at Dotsero to 14,003 feet at Mount of the Holy Cross. Fed by numerous ephemeral, intermittent and perennial streams, springs and seeps, the Eagle River originates near the eastern border of Eagle County at Tennessee Pass and flows west for about 77 miles to its confluence with the Colorado River at Dotsero. Unique among Colorado watersheds, approximately 98% of the drainage is located in a single jurisdictional boundary - Eagle County. Nearly 75% of the watershed is on public land managed by two federal agencies - the United States Forest Service (USFS) and the Bureau of Land Management (BLM).

There are over 120 natural lakes and eight man-made reservoirs in the Eagle River watershed, the majority of these occurring on or adjacent to federal lands. Reservoirs are significant watershed elements as they serve to store and strategically release water into the local stream system. The physical location of these reservoirs presents both unique opportunities and constraints for water users and water suppliers. It should be noted the terms 'water users' and 'water suppliers' are thought of in broad terms and include the cities of Denver, Colorado Springs, Aurora and Pueblo, all of whom own and manage significant water rights in the Eagle River and Colorado River watersheds. Since community adoption of the 1996 ERWP we have learned much about our interactions with the stream corridors and how settlement patterns typical to our mountainous landscape affect the river system.



Eagle, Colorado and Roaring Fork watersheds in Eagle County.

Colorado River watershed

Approximately 525 square miles of the 9,830 square mile Colorado River watershed lies within Eagle County. The Colorado originates in Grand County, flows through Gore Canyon into the arid lower elevations of northern and western Eagle County before merging with the Eagle River at Dotsero and passing through Glenwood Canyon on its way to the canyon lands of western Colorado, Utah and Arizona. Prior to entering Eagle County, the river is already heavily managed at its headwaters in Grand County. The roughly 60 mile stretch of Colorado River through Eagle County is largely undeveloped. These are rural areas that maintain an agricultural and ranching heritage while at the same time hosting some of the most sought after recreational waters in the state and a considerable amount of habitat in White River National Forest for the largest elk herd in North America.

On June 2, 2010, the Upper Colorado was listed as America's sixth most endangered river by American Rivers (American Rivers, 2010). Two stretches in Eagle County – Pumphouse to State Bridge, and State Bridge to Dotsero- are being considered by the Bureau of Land Management for designation as "Wild and Scenic" as the agency updates their Resource Management Plan for the area. Eagle County has submitted information to establish minimum instream flow rights to the Colorado Water Conservation Board, the agency responsible for appropriation of such rights. There are proposals to expand transmountain diversions from headwaters of the Upper Colorado River basin that could further impact the timing and availability of instream flows to balance water supply, water quality, aquatic habitat and recreational needs. Importantly, the future of a historic water right at the "Shoshone" hydroelectric power plant in Glenwood Canyon that has long ensured water flows through Eagle County to the power plant during summer months is questionable and could significantly affect minimum instream flows in the Colorado if abandoned.

Historic uses combined with the uncertainty of the Shoshone Hydroelectric water right and emerging issues like climate change and dust on snow are further obscuring future water management options within this basin. Competing needs will require compromise in light of the broad range of possible environmental outcomes.

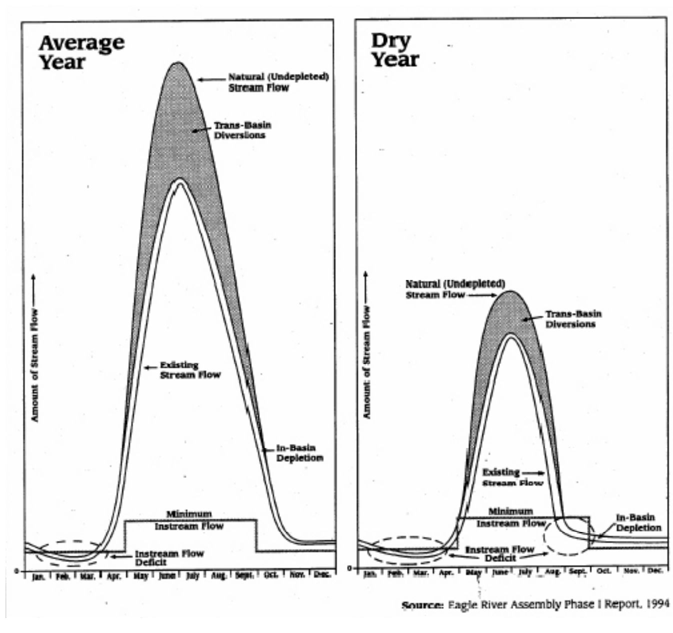
"*We need to be concerned with our water resources for future generations sake,*" says Scott Jones of the Colorado River Ranch - Eagle County's first certified organic ranch - standing near their new pivot irrigation system, which provides efficient watering and higher crop yields.

Water Quantity and Water Management

In 1996, the Eagle River Watershed Plan recognized a balance between human water demands (agriculture, recreation, urbanization) and the amount of water necessary to sustain natural resources. According to a report issued that same year by the American Water Works Research Foundation, Total Water Management is "*the exercise of stewardship of water resources for the greatest good of society and the environment*". A basic principle of Total Water Management is that the water supply is renewable, but limited, and should be managed in a manner that is sustainable. Whatever the terminology, successful management of water resources is adaptive and forward thinking.

Although the natural flow regime of the main stem of the Eagle River is more intact than other Colorado rivers of comparable size, human settlement has influenced and impacted the natural cycle of the river. Roughly seventy five percent of the average annual flow of the Eagle River occurs during the months of May, June and July, yet a minimum amount of water is necessary year round to support aquatic and other wildlife as well as community demands for affordable, clean and reliable water supplies during times of the year when natural water supply is the lowest(ERWP, 1996). Consumptive use in the Eagle River basin accounts for approximately 63,000 acre feet of the Eagle River's average annual yield of 414,000 acre feet measured at the Gypsum gage. The greatest consumptive use in the basin is transmountain diversion, which exports approximately 34,000 acre feet to the Front Range annually. This water is never returned to the Eagle River watershed and is therefore considered totally consumed. While these exports account for only 8% percent of the annual yield of the Eagle River, impacts on streamflows at the actual points of diversion in the headwaters are far greater. Transmountain diversions are taken in the headwaters during May-June peak flows, significantly reducing the annual peak and 'flushing flows' important to maintain the ecological and geomorphic health of the Upper Eagle. These distinct changes in peak flow magnitudes are most notable in the Upper Eagle and Homestake Creek drainages.

As our valleys have transformed from agriculture to urban settlements, streamflow patterns have also changed. Historic flood irrigation returned water to the river in late summer and fall months that urban settlements do not, however domestic use(development) is considered to return up to 90% of the water diverted year round, even during low flow periods. Highest in basin domestic use occurs in winter due to ski tourism - when the river flows are lowest.



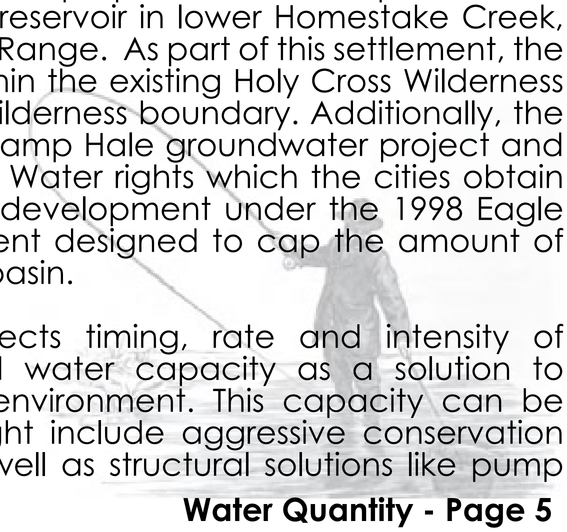
Conceptual flow diagram of the Eagle River in an average and dry year.

In order to help protect aquatic life during low flow periods in the Eagle River and its tributaries, the Colorado legislature established the Instream Flow Program in 1973, which has since appropriated over 8,500 miles of instream flow water rights to help preserve the natural environment. There are 76 segments of the Eagle River and tributary streams with these instream flow rights in place. In 2005, the Eagle River Inventory and Assessment (ERIA) observed that many of these rights offer limited protection of the river during low flow periods and are therefore not necessarily a good tool to evaluate ecological consequences of flow changes in the river (CSU, 2005). That said, Colorado passed the Healthy Rivers Act in 2008 which strengthens the ability of the instream flow program to utilize loaned or leased water that is not being used for environmental purposes- without the owner of those rights being penalized or having their water rights considered weakened, lost or abandoned under law. The Eagle River watershed might pursue a locally based water trust to benefit low stream flows. In 1994, the Eagle River Assembly estimated that to increase flows to minimum stream flow levels identified by the CWCB to protect the environment to a reasonable degree, up to 4,000 acre feet of water needs to be stored and released into the Eagle River during dry times of the year. The report estimated that up to 6,000 acre feet may be needed to ensure minimum instream flow as the County approached buildout of development approved as of 1994. At roughly the same time Eagle County estimated that there were approximately 11,000 existing approved unbuilt dwelling units in the watershed (ERWP, 1996). In 2009, Eagle County estimated that there were 18,009 existing approved unbuilt dwelling units in Eagle County, with a potential for another 5,134 units (Ivey, 2009). Of significant importance to long term water management is the possible addition of two water storage projects: the Wolcott reservoir and the Blodgett Reservoir or Camp Hale conjunctive use project.

In 2004, the conceptual Wolcott reservoir was subject of a feasibility study by Denver Water, City of Aurora, Colorado River Water Conservation District, Eagle River Water and Sanitation District, Northern Colorado Water Conservancy District, Upper Eagle Regional Water Authority and Vail Associates. The purpose of this study was to evaluate operation and feasibility of a 55,000 to 105,000 acre foot reservoir. The reservoir would be filled with water from both Alkali Creek and the Eagle River during snowmelt runoff periods, and would be cooperatively managed to meet West Slope and Front Range needs. All releases would be made to the Eagle River, primarily during low flow periods to compensate for diversions to the East slope made upstream in the Colorado River basin (GRC, GEI, 2004). In 2007, Boards of the Eagle River Water and Sanitation District and Upper Eagle Regional Water Authority settled a lawsuit with Denver Water wherein Denver agreed to abandon most of their water rights in Eagle County. While the settlement eliminated the possibility of a future transmountain diversion from Gore Creek, the Upper Eagle and the Piney River, it left open the possibility of a jointly developed reservoir north of Wolcott, water from which would serve West Slope purposes for recreation, beneficial uses in the Colorado River basin (including endangered fish protection), and as replacement or substitute water by West and East Slope water users for diversions elsewhere in the basin (UERWA, 2007).

In 2010, after years of litigation, Eagle County and the cities of Aurora and Colorado Springs settled a 1995 Water Court case involving the cities proposal for development of a groundwater project at Camp Hale and a surface water reservoir in lower Homestake Creek, which would be used for future water diversions to the Front Range. As part of this settlement, the cities have agreed to abandon significant water rights within the existing Holy Cross Wilderness Area, moving points of diversion to locations outside the wilderness boundary. Additionally, the settlement greatly reduces the potential size of both the Camp Hale groundwater project and the proposed reservoir at the mouth of Homestake Creek. Water rights which the cities obtain through the settlement will be dedicated to cooperative development under the 1998 Eagle River Memorandum of Understanding (MOU), an agreement designed to cap the amount of transmountain diversions by the cities from the Eagle River basin.

Climate change appears a near certainty, which affects timing, rate and intensity of precipitation. Water managers may look to increased water capacity as a solution to manage and balance growth and its impacts on the environment. This capacity can be accomplished through non-structural strategies that might include aggressive conservation measures or cooperative stream management plans as well as structural solutions like pump back systems or expanded water storage projects.



Water Quality

Water quality in the Eagle River watershed is the result of a number of physical conditions, historical and current, natural and man made. Examples include extensive operations at the Eagle Mine in Gilman, agricultural impacts on sensitive soils, and transportation and land use development along the Eagle and major tributaries like Gore Creek.

Two significant reports, the Eagle River Watershed Council's 2005 Eagle River Inventory and Assessment(ERIA) and the Assessment of Surface-Water Quantity and Quality, Eagle River Watershed 1947-2007 (Williams and others, 2010 in press) were prepared to guide decision-making for projects that can benefit water quality. The ERIA determined that the greatest water-quality threats in the Eagle River watershed will be increased development and associated stormwater runoff, and cumulative recreational demands on resources. These activities may in turn alter streamflow regimes and increase nutrient and metals loading. Williams and others recently summarized water quality conditions and trends to help define important water quality issues. Another report that has been valuable for enhancing community understanding of how water-quality issues have changed since 1996 is the Northwest Colorado Council of Government's 2002 Eagle River Water Quality Management Plan. This plan is required by the Clean Water Act and has been helpful to outline critical water-quality issues and potential solutions for our region.

These reports confirm the general consensus that waters of the Eagle River watershed are largely in good condition with some exceptions. Most streams originate in pristine alpine headwaters with crystalline bedrock geology and then merge with streams flowing through more erosive and saline sedimentary rock. That natural setting, combined with streams flowing through populated and developed lands tends to cause the streams to pick up increasing amounts of sediment and dissolved minerals and nutrients. Streams are generally more dilute during May-June peak flows and more concentrated during October-March base flow periods, in part because there is less snowmelt water available at base flow and also because winter base flow coincides with peak winter tourism activity and associated wastewater treatment discharges. Notable exceptions to these patterns have included increased metals and phosphorus in streams during the onset of snowmelt, when melt water reacts with and mobilizes phosphorus and metal-rich soils and geologic material.

Current water quality issues include excessive sedimentation (Black Gore Creek, Gore Creek, Ute/Alkali/Milk Creeks); elevated nutrients (Gore Creek and main stem Eagle River below the Gore); elevated metals (tributaries and the main stem Eagle River in the vicinity of the Eagle Mine and Eagle reaches downstream of Minturn toward Edwards); dissolved solids (increasing chloride trend in Gore Creek likely related to application of deicers on roadways). Other general water-quality findings include pH (no major concerns but generally higher in Gore Creek and in the Eagle River below the Gore possibly related to enriched nutrient and algae levels; and generally lower pH in the Eagle River and tributaries associated with Eagle Mine drainage); dissolved oxygen (no major issues), and temperature (elevated at times during summer low flows in the lower Eagle and many reaches during drought conditions such as were present during 2002).

Colorado Division of Wildlife Spring fish sampling of the Upper Eagle below the Eagle Mine.

Recent studies have also expanded our knowledge of the direct and interdependent relationship of water quality to water quantity, streamflow alteration, and land use practices.

Black Gore Creek, and to a degree Gore Creek, have been known to have persistent problems related to traction sand loading and hill-slope erosion into streams along Interstate 70 from Vail Pass to East Vail. In 2002, the Colorado Water Quality Control Commission added Black Gore Creek to the State's 303(d) list of impaired waters because of excessive sediment loading and related stream-habitat degradation. The Black Gore Steering Committee (BGSC) -a collaboration of stakeholder agencies- has implemented numerous sediment capture and mitigation programs that are stemming much of the flow of traction sand to Black Gore Creek and Black Lakes. The BGSC collaborated with the Forest Service to develop a draft plan to correct sediment impairment of the Creek. This plan is currently being considered for acceptance by the State of Colorado and the Environmental Protection Agency to establish the Total Maximum Daily Load(TMDL) for sediment. Adoption of the TMDL by early 2011 and continued emphasis by the BGSC for preventing traction sand from reaching area streams is expected to improve the condition of Black Gore and Gore Creeks over time.

Since 1984, remediation of the Eagle Mine Superfund Site has made notable progress as evidenced by improvements in the population of brown trout and significant decreasing trends for zinc, cadmium, and manganese concentrations in the Eagle River from Belden to Minturn. Even though the remediation effort has improved conditions to date, metals contamination still persists and is limiting productivity of aquatic life, as evidenced by limitations in brown trout numbers and growth rates and a lack of more sensitive native sculpin in the mine-affected stream reaches. While many of the readily identifiable metals-loading sources have been remediated, the majority of the remaining zinc loads in the Eagle mine area are from more diffuse sources near Belden, which will require further characterization before cost-effective remediation strategies of these sources can be developed.

Colorado River

The Colorado River has been monitored for water quality at two sites, at State Bridge and the Eagle River confluence at Dotsero, which bracket the entire 55-mile reach in Eagle County. Limited data collected near State Bridge indicate relatively good water quality with low dissolved solids, nutrients, and metals concentrations, and no results indicating there are current water-quality issues to address (USEPA). However, the Colorado River mainstem begins to show impacts from sediment in the segment downstream from State Bridge where the Eagle County Soil Conservation district has designated a stream bank erosion management area. (NWCCOG, 2002b; CWQCD, 1989). The NWCCOG report for the Upper Colorado River summarizes the major water quality issues for this reach of the Colorado as primarily resulting from impacts of transmountain water-diversions and sediment/dissolved solids loads from nonpoint sources.

In a 1995-98 data summary for a site near Dotsero, USGS reported generally good water quality with high dissolved oxygen, low dissolved solids and nitrate concentrations (Spahr and others, 2000). Total phosphorus concentrations were elevated but generally below 0.2 milligrams per liter. Suspended sediment concentrations were higher during the onset of annual snowmelt runoff, as expected, but were generally not excessive. Sample results for dissolved oxygen, nutrients, trace metals, and suspended sediment did not exceed applicable State standards in the Colorado River. However, most of these constituents are higher at the Dotsero site as compared to the upstream State Bridge site - likely due in part to the influence of inflows from the Eagle River (Spahr and others 2002; USGS).

Wildlife and Recreation

The 1996 Eagle River Watershed Plan outlined three main objectives to protect and enhance wildlife values in the watershed: to improve habitat of the fishery, to maintain and increase riparian habitat and to minimize disturbance to wildlife during critical times of year. There remain a number of management practices and specific projects that can further preservation and enhance aquatic and terrestrial wildlife in our basin.

Three specific issues appear to limit the quality and productivity of the fishery: low flows, excessive sedimentation and heavy metals loading (CSU, 2005). Insufficient streamflows can cause a variety of problems for the health of the fishery and there are times of year that selected stream reaches fall below State-designated instream flows. The methods used to quantify instream flow needs do not address 'non fishery' issues. For instance, kayak parks may require different streamflow levels and apply for their own state-designated instream flows (Avon has secured a recreational in-channel water right or "RICD" for its kayak park).

Sedimentation and turbidity, particularly during spring runoff or after a rain event is a significant deterrent to the fishery - particularly in the Lower Eagle. Excess sediment covers spawning areas, potentially burying fish eggs preventing spawning and macroinvertebrates thus limiting both fish reproduction and food supply (CSU, 2005). Sedimentation and turbidity also preclude productive fishing from Wolcott to the confluence of the Eagle and Colorado Rivers for considerable times of the year. This increases fishing pressure on the limited amount of publicly accessible waters in the Middle and Upper Eagle during spring and early summer months. Excessive sediment is continually introduced into the Eagle River as a result of natural erosion, land development and transportation system drainage.

Heavy metals from the Eagle Mine Superfund Site continue to limit fish productivity in the Eagle River even though the total load has been greatly reduced through extensive remediation efforts. Current water quality standards in the vicinity of the Eagle Mine allow higher zinc concentrations than for other segments of the Eagle and were established based on estimates of potential maximum reductions that are deemed achievable through remediation. These standards are acknowledged to be only partially protective of Brown trout through Minturn and not protective of Rainbow or sculpin (ERWC-Eaglemine website).

The Eagle and Colorado rivers, their tributaries, springs, streams and riparian zones provide important habitat to many forms of wildlife. Over half of the 1,000 species of wildlife in Colorado use or occupy riparian ecosystems (CDOW, 1992). Developing consistent riparian zone protection and promoting enhancement projects across the basin would therefore greatly benefit local wildlife.

Recreation along the river corridors of the Eagle and Colorado has increased dramatically in the last twenty years. Kayak parks have proven to be community and economic benefits to Vail and Avon and are under consideration in other locations. Coordinated efforts to identify appropriate points of access, optimal access design and estimated carrying capacity of recreational activities could further protect both wildlife and the quality of recreational experiences.

Emerging Issues

Water resources in the Upper Colorado basin, including the Eagle River watershed, are threatened by emerging issues that are not as readily controllable as are typical impacts to the river system. While we cannot easily predict how these issues affect our water resources, we can anticipate and adapt our management of the resource based on the best science available to us today.

The most significant of emerging issues is climate change, which affects temperature and precipitation as well as timing of streamflow patterns. A recent State-sponsored future Water Availability Study estimated there is anywhere from 0 to 900,000 acre feet of as-yet-undeveloped annual yield remaining that could be put to beneficial use in Colorado(CWCB, 2010) . For water planners, that is a broad and problematic range of uncertainty considering the entire State only uses about 2.5 million acre feet of water a year.   Study authors said they knew the study would return a broad range of outcomes because it is the first such effort to incorporate multiple climate-change models to predict Colorado's water availability. According to the study, by 2040 the Upper Colorado and Eagle River basins are projected to have up to a 5 to 8 percent streamflow reduction due to climate affects as compared to historical annual average streamflow, and up to a 17 percent reduction in average annual streamflow by 2070 (CWCB, 2010).

In general, the Colorado climate-change models predict warmer temperatures, wetter winters and drier summers, with more intense heat and dryness at lower elevations. The difference in estimated water yields is dramatic despite only a few degrees increase in mean annual air temperatures. There have been six major studies that have estimated streamflow levels in the Colorado River basin, including the Eagle River, will likely be reduced due to climate change (Udall, 2007). Significant streamflow reductions resulting from climate change will require water managers to rethink water allocation and use, and competition for water will dramatically increase to accommodate municipal, agricultural, recreational and environmental needs.

Depositions of dust from the Colorado Plateau and other desert areas onto Colorado's mountain snowpacks have been recognized as a more frequently occurring phenomenon in the high country. Until recently, however, the implications of dust on snow events were poorly understood. Research conducted by the Center for Snow and Avalanche Studies Dust on Snow(CODOS) program found that depositions of desert dust onto Colorado's mountain snowpacks can dramatically reduce snowcover albedo(reflectivity), advance snowmelt timing, and increase snowmelt runoff intensity. These changes can have serious implications for irrigators and water-providers who will need to account for earlier peak flows and reduced late-summer flows.

During the winter of 2008/2009, twelve dust-on-snow events led to a 40 to 50 day earlier snowmelt with record streamflow rates. CODOS's monitoring and forecasting services enable water managers to anticipate these events and still provide reliable water supplies if possible. At the time of writing this report, there were a recorded nine dust on snow events in the Colorado Rockies in the 2009/2010 season(CODOS website, accessed June 11, 2010).

As with any forested environment, water resources in the Eagle River watershed are vulnerable to high intensity wildfire.   According to the Forest Service, pine beetle has infected most of the lodgepole pine in headwaters of the Eagle River watershed and the epidemic is moving west. In several decades it is anticipated that those dead trees will fall and greatly exacerbate high intensity wildfires (Mausolf, 2010). Water supply and aquatic habitat will be at risk without continued interaction and strategic planning by both water providers, wildlife and land use managers.

The Values of Preservation

The 1996 Eagle River Watershed Plan estimated the economic impact of rafting in the community using the results of a 1991 survey done by the Colorado River Outfitters Association (CROA). The study estimates $168 was spent on average by each person per raft day. This number includes the secondary economic benefits of rafting such as lodging, transportation, clothing and dining costs. Applying the above figures to known Eagle River rafting activity, approximately $1,300,000 was spent by people rafting on the Eagle River in 1991 during the six week long rafting season. Rafting revenues statewide have been growing at an average of 12.7% per year and observed activity on the Eagle River, which is listed among the eight most popular commercial river runs in the state, is testimony to that growth. In 2009, the same study estimated over $800,000 in economic impact from use on the Eagle River(CROA, 2009).

A 1989 study by the Colorado Division of Wildlife estimated direct fishing expenditures in Eagle County of $7,642,000. In 2008, the CDOW released a report titled the Economic Impacts of Hunting, Fishing and Wildlife Watching in Colorado, prepared by BBC Research & Consulting, which provided the most up to date economic impact projections on a county level. According to the research, the total impact of fishing (including direct expenditures and secondary spending by business and households) in Eagle County alone was $38,820,000 in 2007. Of the 64 counties in Colorado, Eagle County ranks as the 8th highest in total economic benefit from hunting and fishing activity combined – over $67,000,000 dollars of economic activity was generated in 2007, including the generation or support of over 900 jobs related to those expenditures (BBC, 2008).

A recreation oriented economy relies on clean and plentiful water supplies.

The population of Eagle County was forecast to almost double in the period from 1996 to 2010 (estimated from 30,608 to 57,300). The State Demography Office estimated a fulltime resident population of 54,721 in Eagle County in July 2009. Vail Resorts estimated a visitor population in the winter 2008/09 Vail ski season of over 1.6 million guest visits and 650,000 guest visits in winter and summer seasons, respectively. Special events draw tens of thousands of tourists to the area. For example, the Teva mountain games held each June attract over 40,000 attendees annually(MTRIP, 2009).

The 1996 ERWP recommended that a carrying capacity be established that balances resource protection with recreational experiences. Continued effort to regularly monitor recreational use and the effect on water resource health protects infrastructure investments and the economic value generated by millions of annual visitors drawn to the area by the unique qualities of the Eagle and Colorado River watersheds.

Looking forward- what we heard and next steps

The Eagle River Watershed Council, Eagle County and the Eagle River Water and Sanitation District hosted six community open houses throughout the watershed to solicit public input on current priorities that amendments to the ERWP should consider. While attendance was often limited, a seven page list of priority issues among community members, elected officials, recreationalists, environmentalists and ranchers was generated.

Comments were categorized according to the five core topics of the 1996 Eagle River Watershed Plan: water quantity, water quality, wildlife, recreation and land use. Most of the comments addressed water quality, land use or wildlife issues. Many land use and water quality concerns were related to perceived inadequate mitigation from urban development and its potential negative affect on stream water quality and fishery habitat. Additional comments focused on recreation, and issues related to multiple uses of the river (access, recreation needs, and dispersed impacts on the riparian zones). Finally, water quantity issues (low flows, water-storage project potential and the like) received the least attention during the open houses. While the comments received do not equate to an extensive survey by the Council, they do indicate the general focus areas the community would like to see addressed through amendments in the watershed plan.

A direct goal of this report is to frame the extent of amendments to the existing watershed plan in a way that reflects today's concerns, opportunities and issues. The existing ERWP includes 60 action goals, roughly 42 of which have been implemented in whole or part by Eagle County and partners(Merry, 2010). Many of these action items require on-going attention (education, partnership water quality monitoring, and best management land use practices, etc.). For example, Colorado River area residents expressed concern that more water might be exported to the East Slope - a sentiment echoed through the NRCS Watershed Conservation Input Forum held on March 31, 2010 in Gypsum. Based on community input and the results presented in this report, the Eagle River Watershed Council and Eagle County, through a partnership advisory team, will propose specific amendments to the existing Watershed Plan that can serve to supplement and expand regional and municipal master plan policies regarding water resources. In the context of this report's findings, the following recommendations are offered for updating the ERWP:

- Confirm the purpose, vision and goals of the existing Eagle River Watershed Plan with partnership advisory team of stakeholders.

- Expand the geographic scope of the plan to include the Upper Colorado River in each topic area (water quality, quantity, recreation, land use, wildlife) to foster local investment and visibility of resource issues.

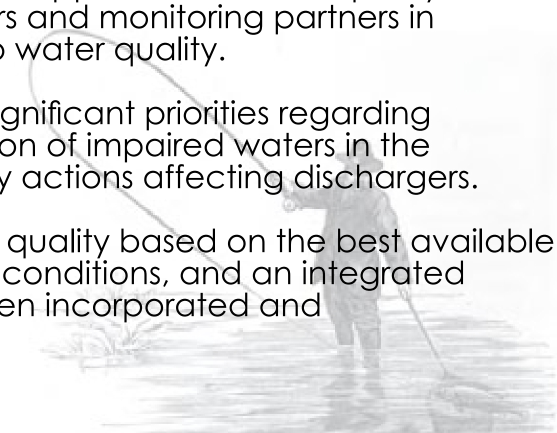
- Incorporate a subwatershed approach that includes specific goals and policies supportive of sustainable practices in local community land use master plans.

- Incorporate basin wide goals to minimize wildfire risk and protect management of resource values like aquatic habitat or water supply.

- Incorporate a basin wide "Water Quality Report Card" approach to water quality monitoring that is easily understood by all stakeholders and monitoring partners in order to inform future priorities and projects related to water quality.

- Update the Plan's Water Quality goals to recognize significant priorities regarding water quality in basin. These include State classification of impaired waters in the Gore and Upper Eagle basins and pending regulatory actions affecting dischargers.

- Develop strategies to monitor issues that effect water quality based on the best available scientific information, desired future basin ecological conditions, and an integrated strategy for managing urban runoff consistent between incorporated and unincorporated areas.



- Update the Plan's regional Water Quantity objectives to recognize climate change and water resource implications, significant changes regarding inbasin/transbasin water settlements and potential new water storage projects.

- Update projections of growth and water use and revisit streamflow thresholds and action items considered in 1996.

- Incorporate all major recommendations of the 2005 CSU Eagle River Inventory and Assessment, including the Multi-Criterion Decision Analysis approach as a flexible, rational and transparent means to restoration and preservation decision making, promoting improvement projects that maximize community investments that benefit the watershed.

- Incorporate by reference any existing TMDL strategies (Black Gore Creek and Upper Eagle) and create a specific process to address any future load reduction management plans or strategies.

- Support and invest in a resource inventory and assessment for the Upper Colorado river in Eagle County.

- Update the implementation strategies of the Plan to identify the Eagle River Watershed Council as the entity for implementing watershed-wide objectives, including restoration and education projects.

With the guidance of a Partnership Advisory Team, the ERWC and Eagle County will draft Watershed Plan updates and solicit public input as part of the plan amendment process. Ideally, the updated ERWP will be adopted as guidance and policy document by the Eagle County Planning Commission, municipalities and metropolitan districts in Eagle County, whose individual water resource goals and action items can be articulated in each subwatershed section of the plan. The next section of this report will identify the unique subwatersheds of the Eagle and Upper Colorado Rivers.

Upper Eagle River

The Upper Eagle River is defined as the headwaters of the river to Dowd Junction, at a point above the confluence of the Eagle River with Gore Creek. It drains an area of approximately 247 square miles, and includes the tributary streams of Resolution, Turkey, Rock, Two Elk and Game Creeks from the north and Homestake, Peterson, Fall, Cross, Martin and Grouse Creeks from the south. There are many healthy steams through wilderness areas in the drainage, for example Cross Creek was identified as a potential conservation area for the occurrence of genetically pure populations of Colorado River Cutthroat (Armstrong, 2000).

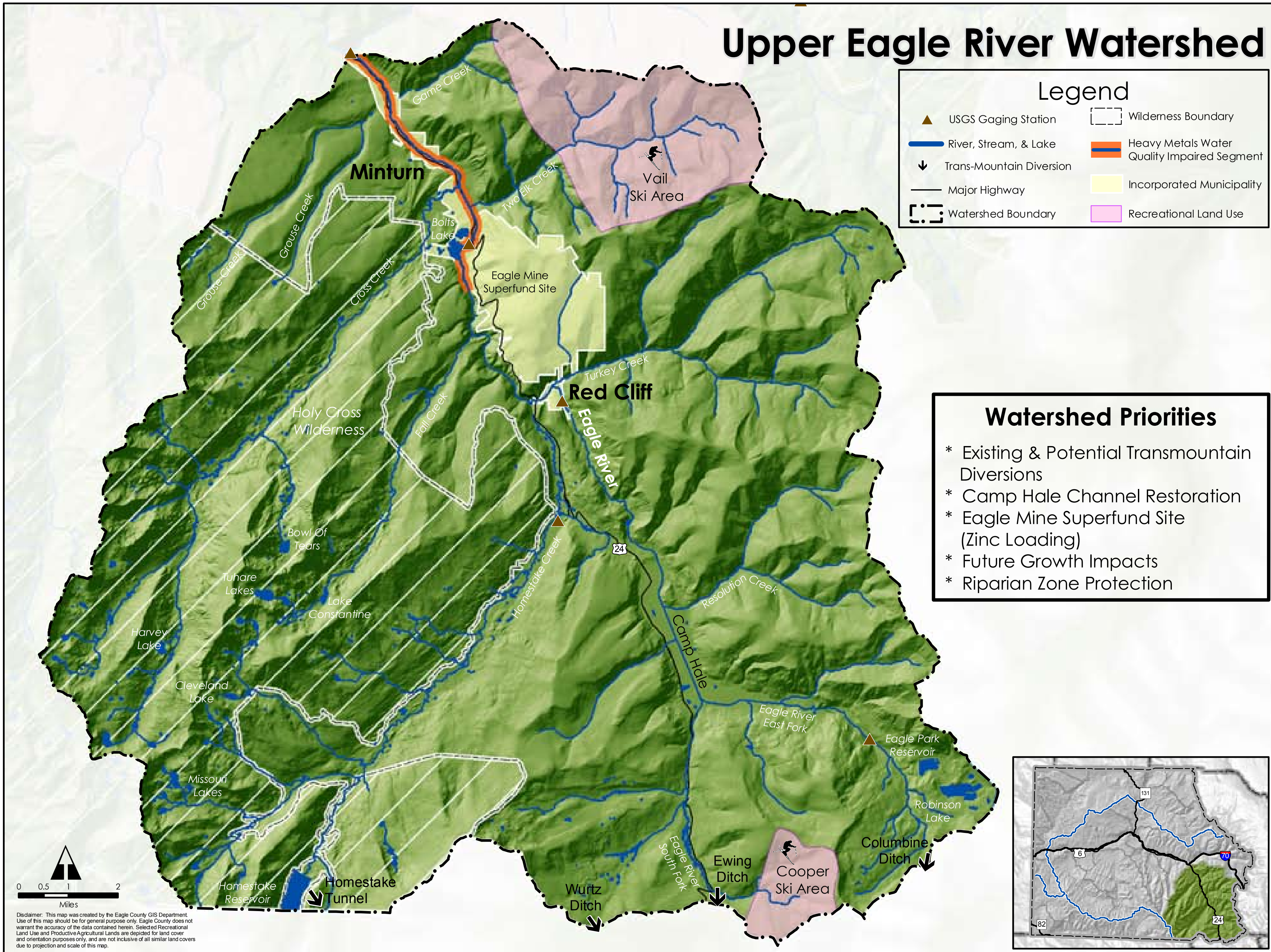
There are four transmountain diversions that take water out of the Upper Eagle and transport it to the Front Range. These diversions include the Homestake Tunnel, Wurtz Ditch, Ewing Ditch and Columbine Ditch. Homestake Creek has had peak flows reduced to less than half of the historic values as a result of the transmountain diversion at its headwaters (CSU, 2005).

The Eagle river begins as two streams- the East Fork and the South Fork- both originating near the continental divide in south-eastern Eagle County. The confluence of the East and South Forks is at the southern limit of Camp Hale. The River flows northwest for approximately 24 miles to Dowd Junction. The reach from the northern extent of Camp Hale to Maloit Park near Minturn is approximately 10 miles, and flows through Redcliff and the Eagle Mine Superfund site. The lower reach of the Upper Eagle flows 3.5 miles from Maloit Park to Dowd Junction through the Town of Minturn. The Upper Eagle has experienced extensive land use changes in close proximity to the river corridor. There are numerous, site-specific physical and chemical influences to the Upper Eagle River from the Climax Molybdenum Mine, Homestake Reservoir and transbasin diversions, the historic Camp Hale military training site, and the Eagle Mine Superfund site. The Towns of Minturn and Red Cliff have a combined permanent population of less than 2,000 residents, although annexation by Minturn of over 4,300 acres of Battle Mountain property in 2008 to accommodate a potential ski resort and new residential community could more than double the permanent population in this subwatershed.

Persistent water quality degradation caused by drainage from the Eagle Mine area is the primary water quality concern in the Upper Eagle River watershed. Although remediation of Eagle Mine has reduced metals loading, zinc concentrations remain a limiting factor for aquatic organisms and depresses brown trout numbers and growth rates, also preculding an abundance of native sculpin in the mine-affected stream reaches. While many of the more obvious remediation opportunities have been addressed, the remaining metals sources in the Eagle mine area will be more difficult to handle. Over the last two years there were several operational failures at the Superfund site. As a result, both the EPA and State are reviewing new maintenance standards in addition to proposed new approaches to further reduce metals contamination coming from the mine. Sample results from 2009 indicate the standard was not exceeded for Cadmium or Copper; however, zinc concentrations regularly exceeded the standard in the Eagle River above Rock Creek and near Tigiwon Road from mid March through April. This is a period when elevated zinc concentrations have historically impacted the fishery.

Aside from the adverse effects of the Eagle Mine Superfund Site, other areas and measures of water quality in the Upper Eagle River watershed indicate good water quality conditions. Upstream from the mine, streams sourced in alpine headwaters are generally clean and are not being significantly degraded by current land uses. However, the Red Cliff wastewater facility historically had problems meeting their discharge permit requirements during the winter months due to hydraulic overload. The facility is currently undergoing reconstruction which should bring the plant into compliance. Urban runoff and drainage impacts from the developed areas around Minturn and Red Cliff aren't currently implicated as causing persistent water quality issues. Nutrients and dissolved solids concentrations are generally low to very low and not increasing over time and general water quality indicators such as dissolved oxygen, pH, and stream temperature are within acceptable ranges throughout the area. However, the cumulative effects of projected growth and development combined with expanded transmountain diversions could impact water quality conditions, and are recommended to be addressed through enhanced water quality planning and protection efforts.

Upper Eagle River Watershed



Watershed Priorities

* Existing & Potential Transmountain Diversions
* Camp Hale Channel Restoration
* Eagle Mine Superfund Site (Zinc Loading)
* Future Growth Impacts
* Riparian Zone Protection

Gore Creek

Gore Creek originates above timberline in the Gore Range within the Eagle's Nest Wilderness. The creek flows west for about 19 miles to its confluence with the Eagle River at Dowd Junction, two miles north of the town of Minturn. The drainage area of the Gore Creek sub-watershed is approximately 102 square miles, and its tributaries include Deluge, Bighorn, Pitkin, Booth, Spraddle, Middle, Red Sandstone, and Buffehr Creeks from the north and Black Gore and Mill Creeks from the south. The lower reach of Gore Creek roughly parallels Interstate 70 through the developed municipal setting of the resort Town of Vail. The lower 4 miles of Gore Creek downstream from Red Sandstone Creek and upstream from Dowd Junction have been designated a Gold Medal fishery by the Colorado Division of Wildlife.

The Gore Creek watershed has undergone rapid land-use changes since the 1960s as the Vail area shifted from traditional mountain ranchlands to a four-season resort community. While only eight percent of the watershed is developed urban, recreation, and transportation land cover (USGS, 2010), most development occurs close to the stream corridor which greatly magnifies water quality effects beyond what would normally be observed in a predominantly undeveloped watershed. Estimated total permanent population of Vail was 5,027 in 2009; however, the infrastructure of the Town is designed to accommodate a seasonal population of over 20,000 guests at one time (MTRIP, 2009).

Streambank and channel restoration work completed by the Town of Vail at Stephens Park in lower Gore Creek's gold medal designated waters.

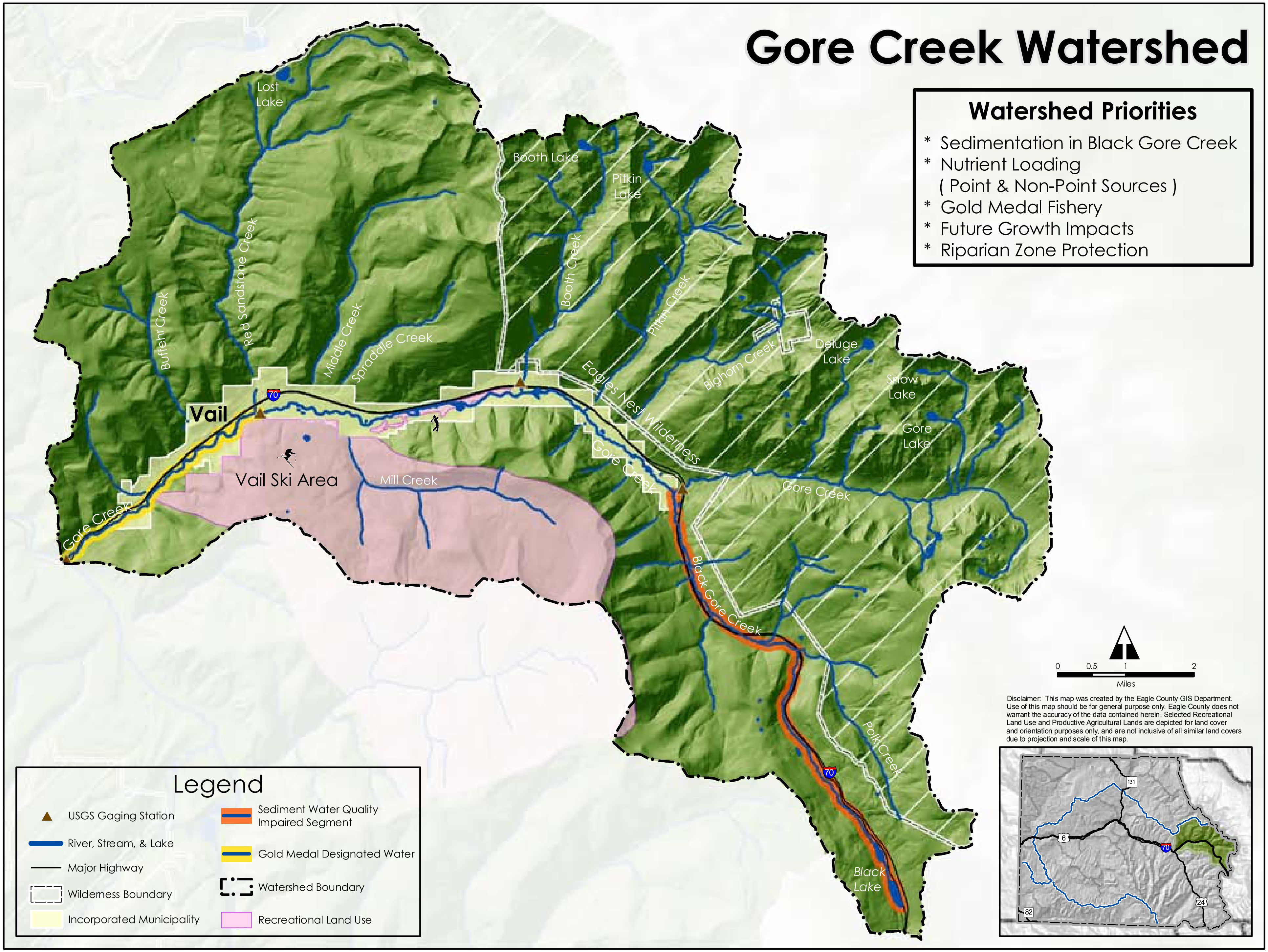
With the exception of Black Gore Creek, water quality conditions are generally excellent in the upper reaches of Gore Creek and its tributaries as they flow from alpine headwaters to the main stem of Gore Creek in Vail. As the stream flows through the more urbanized areas it becomes increasingly enriched with nutrients, sediments, and dissolved solids derived from urban runoff and other nonpoint/point sources, including stormwater runoff from construction sites and impervious surfaces. Numerous data collection efforts have been conducted by local, State, and Federal agencies and individuals within the Gore Creek sub-basin. These data include surface and ground water quality and quantity parameters, macroinvertebrates, fish population estimates, and evaluating the overall ecological condition of the watershed.

Seasonal variations show that for many nutrient species, concentrations tend to be lowest May-June and highest January - March. The gradual changes in concentrations between seasons may be related to dilution effects from increases and decreases in streamflow. In the Gore Creek area, nitrate and phosphorous concentrations are not increasing or decreasing over time (William and others, 2010 in press). Nutrients in Gore Creek are mostly derived from wastewater treatment discharges but a significant portion is also derived from other nonpoint sources.

A nuisance algae, didymosphenia geminata - commonly known as ‘rock snot’ - has been increasingly observed in Gore Creek(Grove, 2010). This algae commonly occurs in streams with low flows and low nutrient concentrations and can colonize new areas through accidental transplant between streams via wading shoes, fishing equipment, rafts, etc. Trace metals are generally near or below detectable levels and are not considered an issue. Total dissolved solids are not especially elevated but Williams and others (2010 in press) reported an upward trend that suggests it may be associated with increased use of chloride salts to control ice on roadways and other paved areas. That report also noted downward trends in dissolved oxygen coincide with upward water-temperature trends on Gore Creek near its confluence with the Eagle River, although it is not deemed a critical issue currently.

One exception to the generally healthy condition in the watershed is Black Gore Creek, a tributary that originates at Black Lakes near the summit of Vail Pass. The entire length of Black Gore Creek is on the list of impaired waters because of excessive sediment loading and related stream-habitat degradation primarily caused by traction sand that was applied to Interstate 70 during winter months over a 30 year period and subsequently migrated to the creek. The sediment load to Black Gore Creek has also impacted the main stem of Gore Creek (Grove, 2010).

In 2001, a sediment load reduction management plan was adopted by the Black Gore Steering Committee. Since that time, partners have invested millions of dollars in sediment control capital projects, remediation processes and management activities on Vail Pass and along Interstate 70. In 2010, the scope of work was expanded to repair several culverts that had failed, causing erosion of fill slopes below the highway and further adding to sediment loads in the creek. It will require years of focused effort to fully recover Black Gore Creek. Measures taken to reduce sediment impacts will need to meet regulated standards in 2011, when a final TMDL for sediment is expected to be adopted by the State Water Quality Control Commission – the TMDL a result of Black Gore Creek being listed as an impaired water body.



Gore Creek Watershed
Watershed Priorities
* Sedimentation in Black Gore Creek
* Nutrient Loading
(Point & Non-Point Sources)
* Gold Medal Fishery
* Future Growth Impacts
* Riparian Zone Protection
Lost Lake
Booth Lake
Pitkin Lake
Booth Creek
Pitkin Creek
Bighorn Creek
Deluge Lake
Snow Lake
Gore Lake
Buffehr Creek
Red Sandstone Creek
Middle Creek
Spraddle Creek
Eagles Nest Wilderness
Vail
Vail Ski Area
Mill Creek
Gore Creek
Black Gore Creek
Polk Creek
Black Lake
70
0 0.5 1 2
Miles
Disclaimer: This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein. Selected Recreational Land Use and Productive Agricultural Lands are depicted for land cover and orientation purposes only, and are not inclusive of all similar land covers due to projection and scale of this map.
Legend
USGS Gaging Station
River, Stream, & Lake
Major Highway
Wilderness Boundary
Incorporated Municipality
Sediment Water Quality Impaired Segment
Gold Medal Designated Water
Watershed Boundary
Recreational Land Use
131
6
24
82

Middle Eagle River

The Middle Eagle River is delineated as the segment from the confluence of Gore Creek to a point one mile downstream of Wolcott where the river is joined by Alkali Creek. The Middle Eagle River flows for approximately 15 miles in a northwesterly direction draining an area of approximately 118 square miles. When contributing areas of the Upper Eagle, Gore Creek and Lake Creek basins are added, the total drainage of the Middle Eagle is approximately 600 square miles. Tributaries from the north include Traer Creek, Nottingham Gulch, Swift Gulch, Buck Creek, Metcalf Creek, June Creek, Berry Creek, Beard Creek Tames Creek, Spring Creek, Red Canyon Creek, and Ute Creek. Tributaries from the south include Whiskey Creek, Stone Creek, Beaver Creek, Bachelor Gulch, McCoy Creek, Lake Creek, Squaw Creek, and Travis Creek. Although Lake Creek is included in the Middle Eagle River sub-watershed, it is separately delineated and described in the Watershed Plan because of its large contributing area and the nature of land uses it supports. ERWC, in partnership with the Eagle River Water and Sanitation District and Eagle County, is completing a 1.6 mile restoration project in the Eagle River near Edwards, including the confluence of Lake Creek, that reconnects segments of high quality upstream and downstream aquatic and riparian habitat.

Growth in the Middle Eagle subwatershed has been dramatic over the last 40 years. Land uses include Interstate 70, extensive residential neighborhoods, and four regional commercial centers including the Town of Avon and Edwards and the resort community of Beaver Creek. According to the most recent State Demography data for 2009 and 2010, the population of the Middle Eagle includes approximately 2,821 full time residents in Eagle Vail, 7,108 full time residents in Avon, and 8,156 full time residents in the Edwards area. The majority of growth and development in this area has occurred in the last 40 years with moderate-to-dense urban and recreation land uses in close proximity to the stream channel throughout most of the reach. Significant recreational land uses include the ski areas of Beaver Creek, Bachelor Gulch and Arrowhead and eleven golf courses. Beaver Creek resort has over 18,000 beds and, in combination with Avon's buildout of expected tourist lodging, will accommodate as many if not more visitors at one time as Vail(Vail Resorts, 2010).

As a result of these established land use patterns, the Middle Eagle may be subjected to greater and more complex water quality stressors than other areas of the Eagle River Watershed. Source waters for the Middle Eagle flow from areas draining similarly-developed Gore Creek, Beaver Creek, and upper Squaw Creek watersheds as well as the Eagle Mine superfund site in the Upper Eagle. Water quality of the Middle Eagle would also be directly affected by future operational changes in trans-mountain diversions that may occur in the Upper Eagle. Setbacks from rivers and streams in this area of the watershed vary widely, between Minturn, Avon, Beaver Creek Resort, and unincorporated areas in Eagle County(Eagle Vail and Edwards). Effective water quality management and planning for the Middle Eagle is complicated by the need to address upstream issues and will require partnerships among a diverse group of stakeholders.

Restoration work on the Middle Eagle near Edwards.

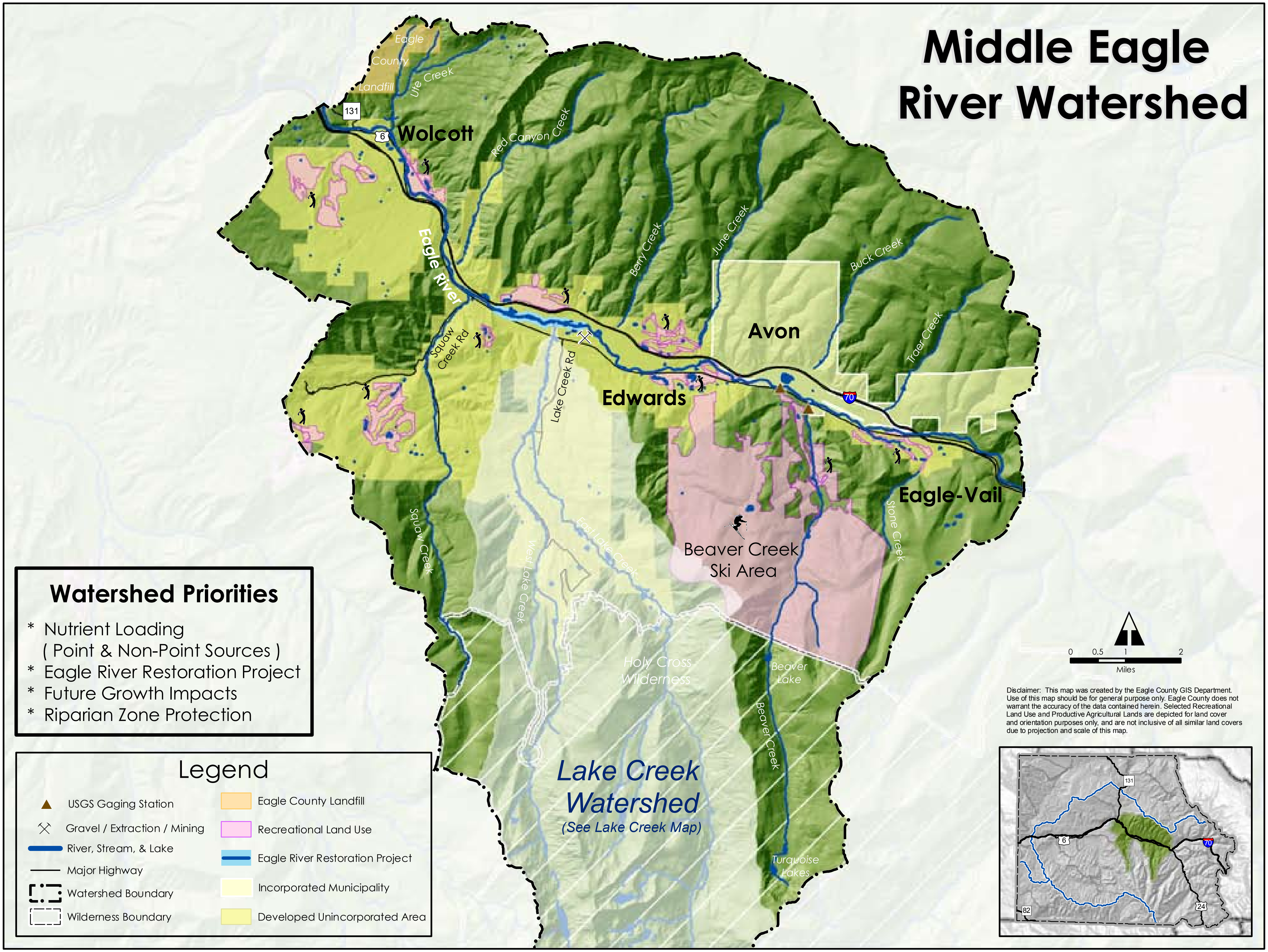
Nutrient loading from point and nonpoint sources is a primary water quality issue for the Middle Eagle. Nutrient concentrations are relatively low upstream from Gore Creek and progressively increase to their highest levels near Wolcott as the Eagle flows through the developed areas of Eagle-Vail, Avon, and Edwards and receives tributary inflows from highly developed watersheds including Gore Creek, Beaver Creek, Buck Creek, and Squaw Creek (Williams and others, 2010 in press; NWCCOG, 2002). Most of this nutrient increase is derived from wastewater treatment discharges but a significant portion is also derived from other nonpoint sources such as runoff from roadways, individual septic systems, and other urban and recreational land-use areas (NWCCOG, 2002).

Total phosphorus has been a nutrient of concern in the Middle Eagle. In the 1980s and early 1990s total phosphorus concentrations just downstream from Edwards were commonly observed by CDPHE to be above the USEPA-recommended (but not formally adopted by Colorado) level of 0.1 mg/L and ranging up to about 0.4 mg/L . For the more recent 1995-2001 period (latest available data for the Edwards area), concentrations were much lower with few values above 0.1 mg/L occurring in the low-flow midwinter period when algal growth with associated phosphorus uptake/removal as well as diluting tributary inflows were at extreme lows.

The USGS has been collecting nutrient samples in the Eagle River on a monthly to bi-monthly schedule for sites in Avon just below Beaver Creek and three miles downstream from Wolcott. Results for the January 2007 to January 2010 period (25 samples per site) indicate average total phosphorous concentrations of 0.05 and 0.14 mg/L and maximum concentrations of 0.21 and 0.31 at Avon and Wolcott, respectively. Thus the most elevated total phosphorus concentrations are occurring at the downstream extent of the Middle Eagle and sources primarily from point source discharges.

The State of Colorado is currently developing numeric and biological-condition based standards for total nitrogen and phosphorus. These new standards are intended to define impairment thresholds and adopt protective biological and numeric criteria for the control and management of nutrients (total nitrogen and phosphorus) in streams, reservoirs, and lakes statewide(CDPHE, 2009). The State rulemaking schedule anticipates adoption of these standards by June 2011, although the process is contentious among many stakeholders who are concerned that the costs of compliance may come without reasonable assurance that the new standards will have the desired outcome of improving water quality and protecting aquatic life (Hall, 2010).

Despite the many water quality stressors to the Middle Eagle, water quality is generally good during most of the year. Water temperature, pH, dissolved oxygen, hardness and suspended sediment values are generally within acceptable ranges. Comparisons of pH, water temperature, and dissolved oxygen to State stream standards show that sites have fewer than five observations outside these limits. Watershed-wide, less than one percent of the total number of oxygen measurements exceeded the State standard for chronic dissolved oxygen(Williams and others, 2010 in press).


Middle Eagle River Watershed
Eagle County Landfill
Ute Creek
131
6
Wolcott
Red Canyon Creek
Eagle River
Berry Creek
June Creek
Buck Creek
Avon
Traer Creek
Squaw Creek Rd
Lake Creek Rd
Edwards
70
Eagle-Vail
Stone Creek
Squaw Creek
West Lake Creek
East Lake Creek
Beaver Creek Ski Area
Holy Cross Wilderness
Beaver Lake
Beaver Creek
Turquoise Lakes
Lake Creek Watershed
(See Lake Creek Map)
Watershed Priorities
* Nutrient Loading
(Point & Non-Point Sources)
* Eagle River Restoration Project
* Future Growth Impacts
* Riparian Zone Protection
Legend
USGS Gaging Station
Gravel / Extraction / Mining
River, Stream, & Lake
Major Highway
Watershed Boundary
Wilderness Boundary
Eagle County Landfill
Recreational Land Use
Eagle River Restoration Project
Incorporated Municipality
Developed Unincorporated Area
0 0.5 1 2
Miles
Disclaimer: This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein. Selected Recreational Land Use and Productive Agricultural Lands are depicted for land cover and orientation purposes only, and are not inclusive of all similar land covers due to projection and scale of this map.
131
6
70
82
24

Lake Creek

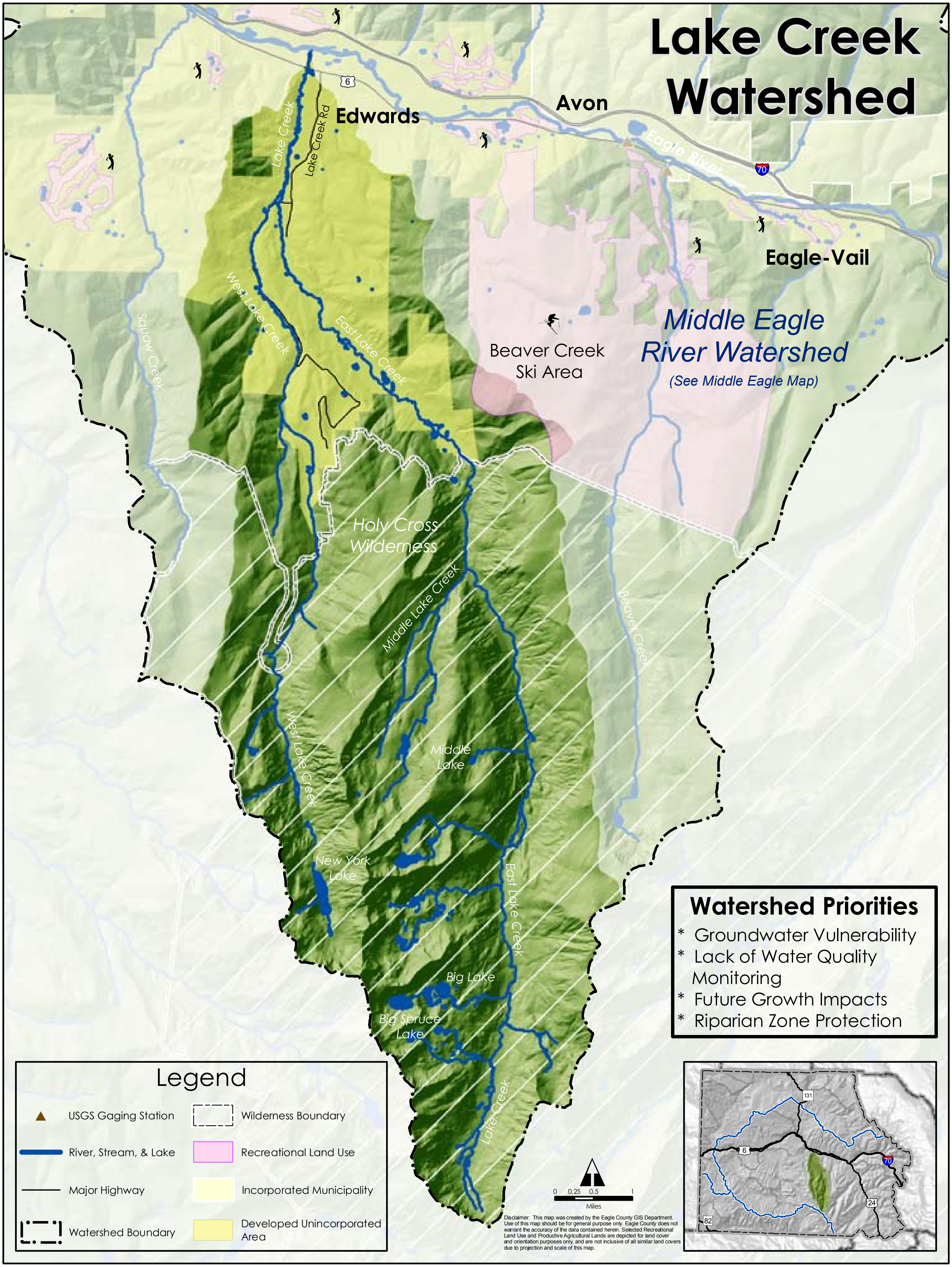
Lake Creek is a major tributary of the Middle Eagle basin. It originates in the Holy Cross Wilderness as three tributary streams which meet to form the main stem of Lake Creek two miles above its confluence with the Eagle River. The drainage area covers approximately 49 square miles. Tributaries to East Lake Creek include Lime and Rock Creeks from the east and Middle Lake Creek from the west. Tributaries to West Lake Creek include Ohio Creek from the east and Casteel Creek from the west. Middle Lake Creek has no named tributaries.

The lower reaches of the three forks and the main stem of Lake Creek flow through ranchlands and large and medium sized lot residential development. The lower segment has not undergone much channelization; however, it is not entirely free to migrate within the floodplain due to the proximity of residential development (Bledsoe et al, ERIA). The upper reaches of the East and West forks are typically healthy streams in wilderness areas, for example Upper East Lake Creek contains an identified population of Colorado River Cutthroat trout (Armstrong, 2000).

The Lake Creek drainage and Holy Cross Wilderness Area.

Surface-water quality in Lake Creek watershed has been monitored only a few times in recent years and thus a thorough determination of current conditions is not feasible. About 40 specific conductance measurements (analogous to 'dissolved solids content') have been made in the downstream reach of Lake Creek since 1998 and indicate the water generally has low concentrations of dissolved solids with higher dissolved solids content during fall/winter and lower during spring when snowmelt, with almost no dissolved solids content, drains into the stream. No data were available to consider potential effects of stormwater runoff from developed areas of the watershed. A few late-summer, low-flow stream samples have been collected for dissolved solids, nutrients and trace metals, all of which indicate low to very low concentrations, although more extensive sampling would be needed to describe the water quality within the watershed and to understand how current land-uses may be affecting Lake Creek.

The Lake Creek subwatershed is perhaps one of the most concerning relative to the potential for groundwater to be contaminated from human activities. This is largely due to the several hundred residential properties within Lake Creek that are not connected to a sanitary sewer system and utilize septic systems to dispose of household wastewater. Many of these systems were installed in the 1970s in areas known to have thin soils and shallow groundwater. A recent report by the USGS (Rupert and others, 2009) characterized portions of the Lake Creek watershed's alluvial aquifer system as highly susceptible to groundwater contamination from human activities. Continued subdivision of the few remaining large agricultural parcels in this basin, if unmitigated, could compound concern for ground water contamination. Other threats include point and nonpoint source loading from irrigated pastures and road systems; livestock grazing; and continued residential development within the stream corridor that can impact riparian vegetation and increase stream bank erosion and sedimentation.



Lake Creek Watershed
Edwards
Avon
Eagle-Vail
Eagle River
Lake Creek
Lake Creek Rd
West Lake Creek
East Lake Creek
Squaw Creek
Beaver Creek Ski Area
Middle Eagle River Watershed
(See Middle Eagle Map)
Holy Cross Wilderness
Middle Lake Creek
Beaver Creek
Middle Lake
New York Lake
Big Lake
Big Spruce Lake
Watershed Priorities
* Groundwater Vulnerability
* Lack of Water Quality Monitoring
* Future Growth Impacts
* Riparian Zone Protection
Legend
USGS Gaging Station
Wilderness Boundary
River, Stream, & Lake
Recreational Land Use
Major Highway
Incorporated Municipality
Watershed Boundary
Developed Unincorporated Area
0 0.25 0.5 1
Miles
Disclaimer: This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein. Selected Recreational Land Use and Productive Agricultural Lands are depicted for land cover and orientation purposes only, and are not inclusive of all similar land covers due to projection and scale of this map.
6
70
131
24
82

Lower Eagle

The Lower Eagle River is the segment from the confluence of Alkali Creek with the Eagle below Wolcott to the confluence of the Eagle and Colorado Rivers at Dotsero. The Lower Eagle drainage is 26 miles long and covers approximately 148 square miles. This segment is influenced by the entire Eagle River drainage which covers 965 square miles, and includes all upstream subbasins of the watershed (Upper Eagle River, Gore Creek, Middle Eagle, Lake Creek, and Alkali Creek).

Tributaries to the Lower Eagle from the north include Milk Creek, Castle Creek, Eby Creek and Cottonwood Creek. Tributaries from the south include Brush Creek, Abrams Creek, Alkali Creek (near Gypsum), Spring Creek and Gypsum Creek. Brush and Gypsum Creeks are the principal subwatersheds of the Lower Eagle, and support the established Towns of Eagle and Gypsum. Because of their large areas, significant future community development and contribution to the Lower Eagle, Alkali Creek, Brush Creek and Gypsum Creek subwatersheds are described separately in this report.

The Lower Eagle has a diverse spectrum of land uses that include residential, commercial and industrial, resource extraction, ranching, recreation, airport and public lands access. Combined full time resident population of the Lower Eagle surpassed the combined full time resident populations of Vail and Avon in the late 1990s. The majority of growth in both Towns has occurred through annexation and conversion of agricultural lands to residential subdivisions along Brush Creek and Gypsum Creek unlike the Gore Creek watershed where extensive redevelopment has taken place. Both Towns operate municipal water and wastewater treatment facilities, and have made significant capital investments to meet the demands of the new resident population while preserving stream flow and ecological qualities of these major tributaries. While Brush Creek and Gypsum Creek currently provide municipal water supply, the Eagle River may serve an important water supply role in the future.

Gypsum Ponds State Wildlife Area on the Lower Eagle.

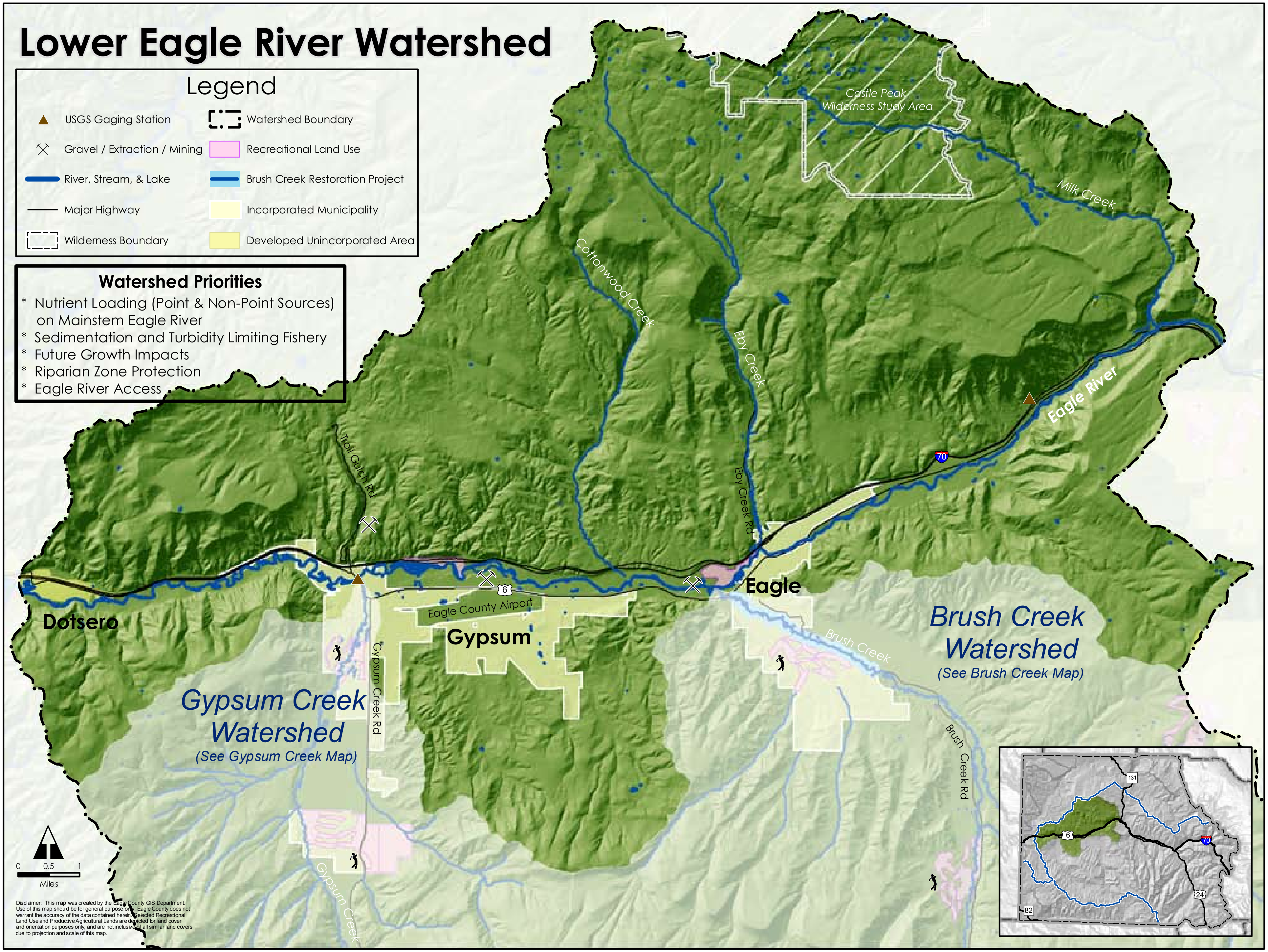
Water quality in the Lower Eagle is largely influenced by contributions from the Middle and Upper Eagle and their tributaries which drain some of the more developed recreational and urbanized areas. Brush Creek, the largest tributary to the Lower Eagle, contributes high-quality streamflows which can serve to significantly dilute constituents of concern such as nutrients, sediments, and trace metals. Point sources within the Lower Eagle include the wastewater treatment facilities for the Towns of Eagle and Gypsum. These same towns divert water from Brush Creek and Gypsum Creek, respectively, to provide drinking water for residents. The Town of Gypsum also provides some of its residents with non-potable water for irrigation and other uses.

Water quality conditions are generally good and well within State standards in the Lower Eagle River and tributary reaches during most of the year. Exceptions include Ute, Alkali and Milk Creeks which are natural sediment-loading sources to the Lower Eagle that cause an observed degradation of aquatic insect and fish habitat and associated reductions in fish production (Bledsoe and others, 2005). Trace metal concentrations are generally much lower in the Lower Eagle watershed as compared to the Middle and Upper Watersheds. Upward trends in nutrients between the Towns of Avon and Gypsum were detected for nitrate, orthophosphate and total phosphorous. There was a significant upward trend for total phosphorous at a site in the Lower Eagle for 1995-2007. Neither the cause nor specific nutrient loading source for this trend was determined (Williams and others, 2010 in press). Streams in the Lower Eagle are generally well oxygenated with few exceedances of State standards

During late summer, and especially during low streamflow years, afternoon stream temperatures can be elevated in the Lower Eagle causing severe stress to trout which can be exacerbated when recreational fishing is not curtailed (as it was in the drought conditions of 2002). Opportunities to improve water quality in the Lower Eagle include mitigation of excessive sedimentation from the Ute, Milk, and Alkali Creek drainages and major riparian zone planting/restoration work along the mainstem of the river(CSU, 2005).

As expected, dissolved solids are elevated in the Lower Eagle as compared to other areas, primarily because of the erosive soils associated with sedimentary geology of the area that includes highly saline evaporite (gypsum) and marine shale formations. While mostly a natural phenomenon, the salinity-loading from these areas can be minimized through effective land and water management practices aimed at controlling erosion and limiting excessive irrigation.

The major nonpoint source water quality issues for the Lower Eagle especially as the recipient of all contaminants that make it into the river upstream are urban and construction activities, historic mining activities, hydrologic modifications, recreation, and agricultural operations (NWCCOG, 2002). One of the key management issues to help protect water quality in the Lower Eagle as streams reach their capacity to assimilate contaminants will be the careful management of future regional growth. Urban and construction activities have been shown to impact water quality by increasing sediment, nutrients, metals, fecal bacteria, and organic pollutants. In particular, stream-side development, if not managed properly, denudes riparian vegetation which directly impacts water quality and the aquatic community (NWCCOG, 2002).



Lower Eagle River Watershed
Legend
USGS Gaging Station
Gravel / Extraction / Mining
River, Stream, & Lake
Major Highway
Wilderness Boundary
Watershed Boundary
Recreational Land Use
Brush Creek Restoration Project
Incorporated Municipality
Developed Unincorporated Area
Watershed Priorities
* Nutrient Loading (Point & Non-Point Sources) on Mainstem Eagle River
* Sedimentation and Turbidity Limiting Fishery
* Future Growth Impacts
* Riparian Zone Protection
* Eagle River Access
Castle Peak Wilderness Study Area
Milk Creek
Cottonwood Creek
Eby Creek
Eby Creek Rd
Eagle River
70
Trail Gulch Rd
Dotsero
Eagle
Gypsum
Eagle County Airport
6
Gypsum Creek Rd
Brush Creek
Brush Creek Rd
Brush Creek Watershed
(See Brush Creek Map)
Gypsum Creek Watershed
(See Gypsum Creek Map)
Gypsum Creek
131
24
82
0 0.5 1
Miles
Disclaimer: This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein. Selected Recreational Land Use and Productive Agricultural Lands are depicted for land cover and orientation purposes only, and are not inclusive of all similar land covers due to projection and scale of this map.

Alkali Creek

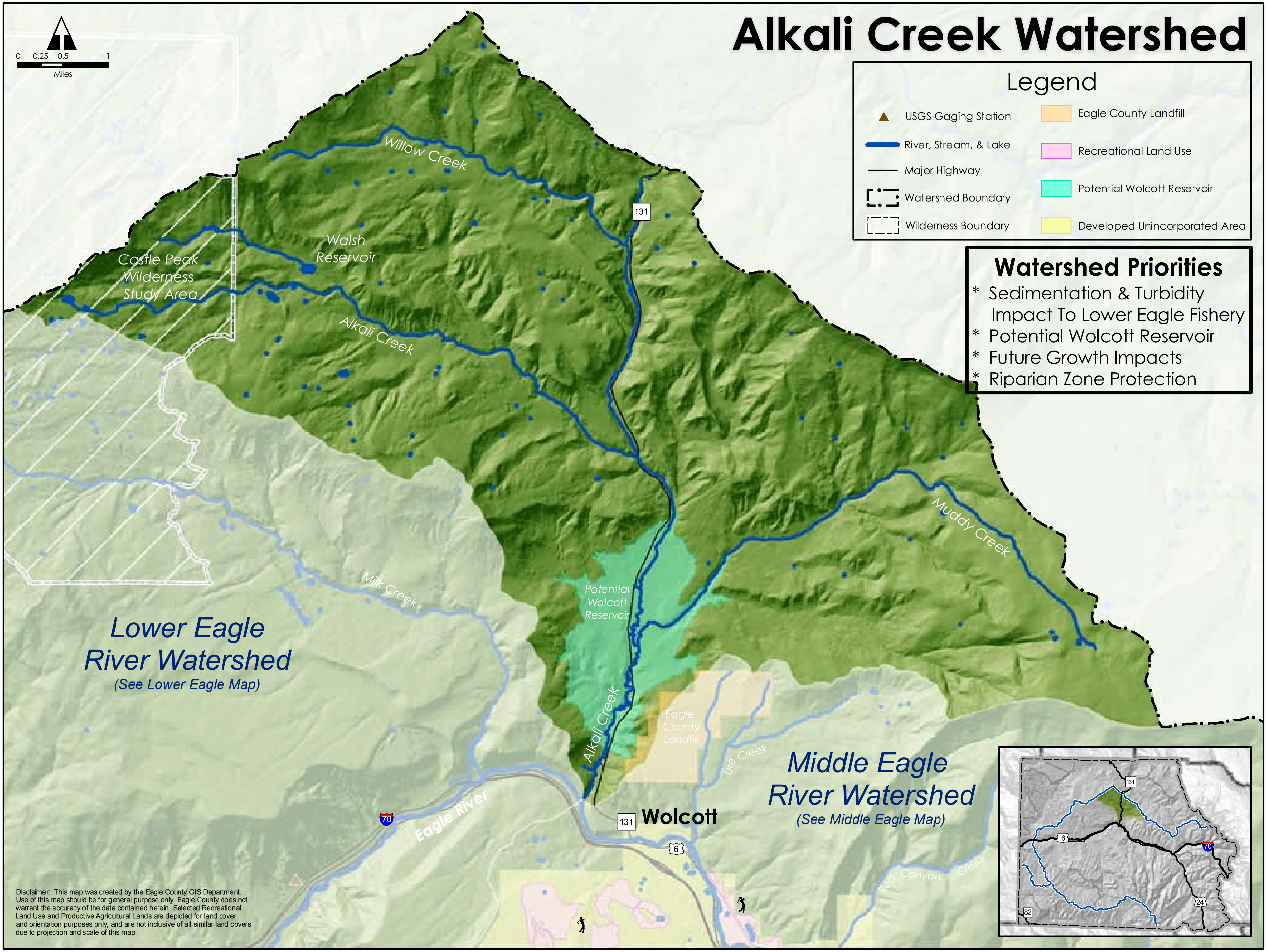
Alkali Creek originates on the north-facing slopes of Horse Mountain at approximately 9,000 above sea level draining in a southeasterly direction for about 11 miles to the confluence with the Eagle River near Wolcott. The drainage area of the Alkali Creek sub-watershed is roughly 45 square miles, and includes the tributary drainages of Muddy, Cache and Willow Creeks from the north and east. The watershed is generally characterized as high elevation sagebrush, pinion-juniper shrubland with areas of irrigated land along the valley floor (the pastures of 4-Eagle Ranch for instance).

A reconnaissance-level feasibility assessment for a new 55,000 to 105,000 acre foot in-channel reservoir (Wolcott Reservoir) in lower Alkali Creek determined that much of the sediment runoff from this drainage would be trapped by the reservoir and thus reducing a portion of the lower Eagle sedimentation problem (GRC/GEI, 2004). According to the feasibility study, operation of the potential Wolcott Reservoir would also release much colder-than-ambient waters, possibly easing water temperature issues in the Lower Eagle. The potential for residential or commercial growth and development in the Alkali basin is limited except for the potential of additional development if a reservoir is constructed.

The underlying geology in the Ute, Alkali and Milk Creek drainages is dominated by highly erosive marine shales and shale-derived soils. Southerly aspects, sparse natural vegetation and historic grazing practices have contributed to the well documented sediment and salinity contributions from this area. Incision of the stream channel on the lower reach of Milk Creek is especially pervasive as compared to Alkali Creek, and according to NWCCOG extremely high sediment concentrations as high as 12,000 mg/L have been recorded during spring runoff. Suspended sediment and turbidity from Alkali and neighboring Milk and Ute Creeks severely limits the coldwater fishery of the Eagle River below Wolcott during runoff and storm events. While natural conditions in the watershed are responsible for much of the sediment and salt load, the effects of historical overgrazing and associated removal of riparian vegetation is considered to have increased sediment runoff (Bledsoe and others, 2005). Large quantities of sediment and salt drain from Alkali Creek into the Eagle River from the onset of snowmelt in March/April through the summer. However, the primary water quality and ecological impacts may be attributed to late summer thunderstorm events that transport high sediment loads to the lower Eagle River. These events create a seasonal degradation of aquatic insect and fish habitat and associated reductions in fish production as documented by CDOW (CSU, 2005; Eagle River Assembly, 1994).

Water quality in Alkali Creek has been monitored only a few times in recent years, therefore a thorough determination of current conditions is not feasible. During low flow periods, historical dissolved solids concentrations of the Eagle River near Gypsum have typically ranged from about 500 to 1,000 mg/l(GRC/GEI, 2004). Shale sources, such as the Pierre shale that underlies the Alkali Creek watershed, are known sources of selenium, which in elevated concentrations can be harmful to fish and aquatic life. Streamflow gaging would be needed to describe the water resources within the watershed and to understand the magnitude of dissolved solids and selenium concentrations and loads to the Eagle River. Stream gaging would also be required to refine runoff and flow estimates ranging from 800 to 5,000 acre feet of annual yield (depending on precipitation patterns)(GRC/GEI, 2004).

Alkali Creek Watershed



Brush Creek

Brush Creek originates on two tributaries, East and West Brush Creek, in the Sawatch Range south of the Town of Eagle. West Brush Creek originates near Crooked Creek Pass and flows northwest to its confluence with East Brush Creek at approximately. Sylvan Lake on West Brush Creek is the center piece of Sylvan Lake State Park and provides recreation and water storage. East Brush Creek originates in the Holy Cross wilderness and includes the historic mining Town of Fulford. The majority of the West and East forks are relatively undisturbed public lands under the management of the U.S. Forest Service and Colorado Department of Natural Resources (State Parks Division).

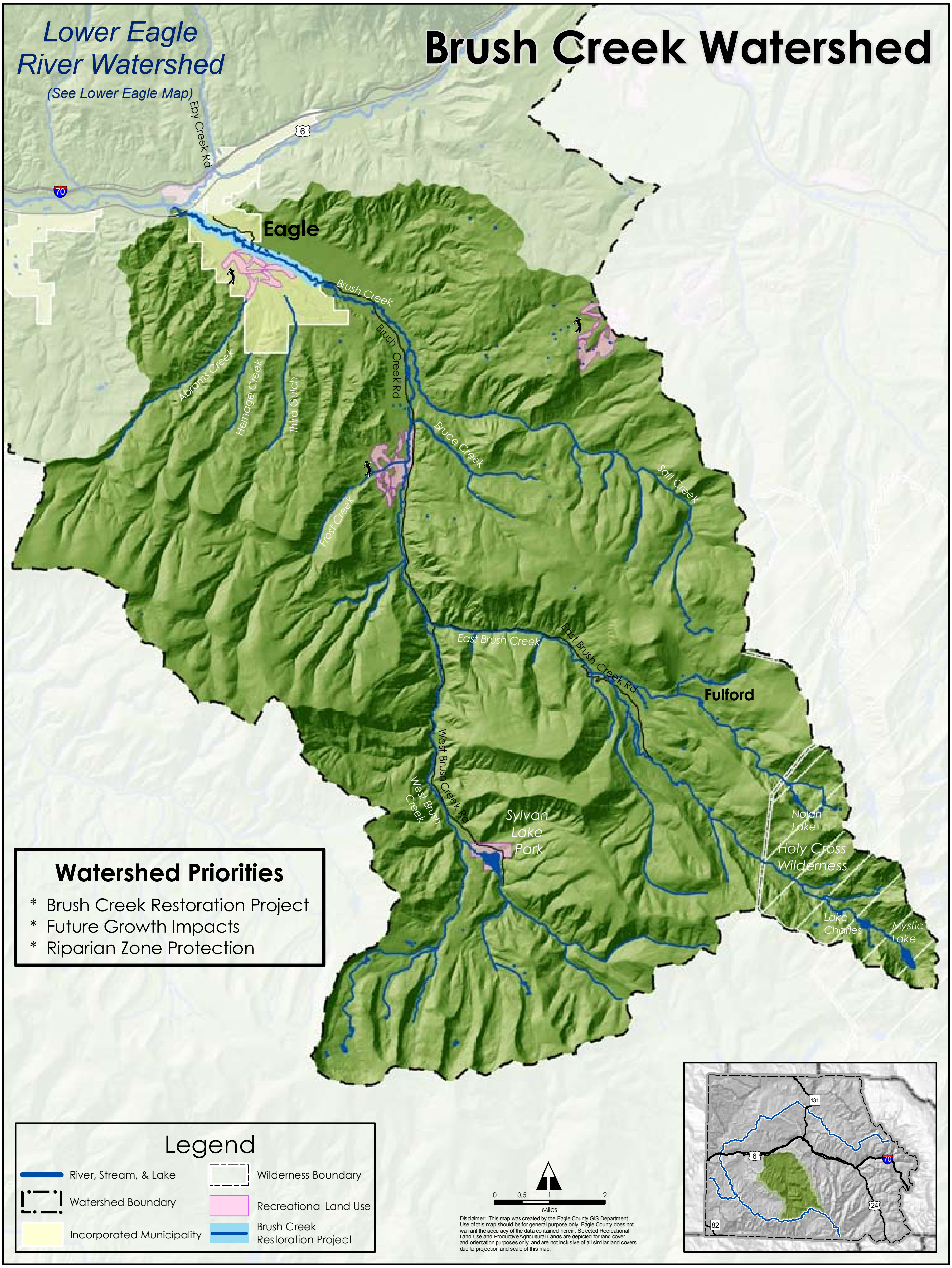
Below the confluence of East and West Brush Creeks the stream flows approximately 10 miles to its confluence with the Eagle River in the Town of Eagle. The drainage area of the entire sub-watershed is approximately 147 square miles. Major tributaries to lower Brush Creek include Bruce Creek, Salt Creek, Frost Creek, and Abrams Creek. Several of these lower tributaries originate on public lands and are considered healthy, for example Abrams Creek contains an identified population of genetically pure Colorado River Cutthroat trout (CSU, 2005).

However, the Brush Creek basin is highly developed near its confluence with the Eagle River. In 2009, there were an estimated 6,054 full time residents in the Town of Eagle, the majority living in the Brush Creek drainage. A stream improvement project was initiated on 3.5 miles of stream to address eroded bank conditions and to improve trout habitat on the lower reach of Brush Creek. The project was completed in 2009. Most of the Town of Eagle's water supply comes from an intake on Brush Creek located seven miles upstream of the Confluence with the Eagle River, just above the Adams Mountain County Club golf course and residential subdivision. To accommodate future population growth, plans are in place for the construction of a second water treatment facility near the confluence of Brush Creek and the Eagle River. This facility will have intakes in Brush Creek and the Eagle River to provide greater options for water supply and treatment (Powell, 2010).

Historically, the primary water quality stressors in Brush Creek have been sedimentation, irrigation return flows, runoff from livestock grazing in the upstream reaches and urban runoff in the developed lower reaches. More recently, as ranch lands have converted to residential development, the effects of irrigation return flows and sedimentation have been reduced. Livestock grazing within the riparian zone has also been curtailed in some areas, and other areas have undergone stream channel rehabilitation to improve riparian vegetation and streambank stability. Over time, these land use changes are expected to reduce sedimentation in Brush Creek (CSU, 2005).

Recent monitoring by the Town of Eagle, Adam's Mountain Country Club (the Frost Creek Development), and the USGS generally indicate good water quality in Brush Creek. Nutrient and trace metals concentrations are low and dissolved solids concentrations are moderate and indicative of the sedimentary geology that underlies most of the area (USGS website, 2010). In the summer of 2008, excessive blooms of filamentous algae were noted in the lower reaches of Brush creek just upstream from the Town (Merry, 2010). This previously unobserved phenomenon may indicate episodic or otherwise poorly-understood water quality issues that should be monitored and addressed in the future. Previous algae monitoring by USGS in 2000 and 2001 did not find a similar occurrence.

A novel and proactive water quality monitoring and mitigation program has been implemented in the watershed. Eagle County required the developers of Adams Rib Ranch (Frost Creek) to provide baseline monitoring prior to construction, during construction, and on an ongoing basis thereafter. This monitoring is designed to ensure that pre-existing water quality conditions are well understood before development and that potential development impacts are identified and addressed before they become severe (Wright Water Engineers, 2009; Merry, 2010). This collaborative program may serve as an excellent and economical model throughout the Eagle River watershed for incorporation into future development plans where appropriate.



Brush Creek Watershed
Lower Eagle River Watershed
(See Lower Eagle Map)
Eby Creek Rd
6
70
Eagle
Brush Creek
Brush Creek Rd
Abrams Creek
Hernage Creek
Third Gulch
Bruce Creek
Salt Creek
Frost Creek
East Brush Creek
East Brush Creek Rd
Fulford
West Brush Creek Rd
West Brush Creek
Sylvan Lake Park
Nolan Lake
Holy Cross Wilderness
Lake Charles
Mystic Lake
Watershed Priorities
* Brush Creek Restoration Project
* Future Growth Impacts
* Riparian Zone Protection
Legend
River, Stream, & Lake
Watershed Boundary
Incorporated Municipality
Wilderness Boundary
Recreational Land Use
Brush Creek Restoration Project
0 0.5 1 2
Miles
Disclaimer: This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein. Selected Recreational Land Use and Productive Agricultural Lands are depicted for land cover and orientation purposes only, and are not inclusive of all similar land covers due to projection and scale of this map.
131
6
70
24
82

Gypsum Creek

Gypsum Creek originates in numerous small streams that descend from the north-facing slope of Red Table Mountain within the White River National Forest. LEDE reservoir is at the headwaters of the Creek. The Creek flows in a northwesterly direction for about 20 miles to its confluence with the Eagle River within the Town of Gypsum. Tributaries to Gypsum Creek include Grundell Creek, Campbell Creek, Red Creek, Erickson Creek, Sundell Creek, and Sapdell Creeks among others. The drainage area of Gypsum Creek is approximately 103 square miles.

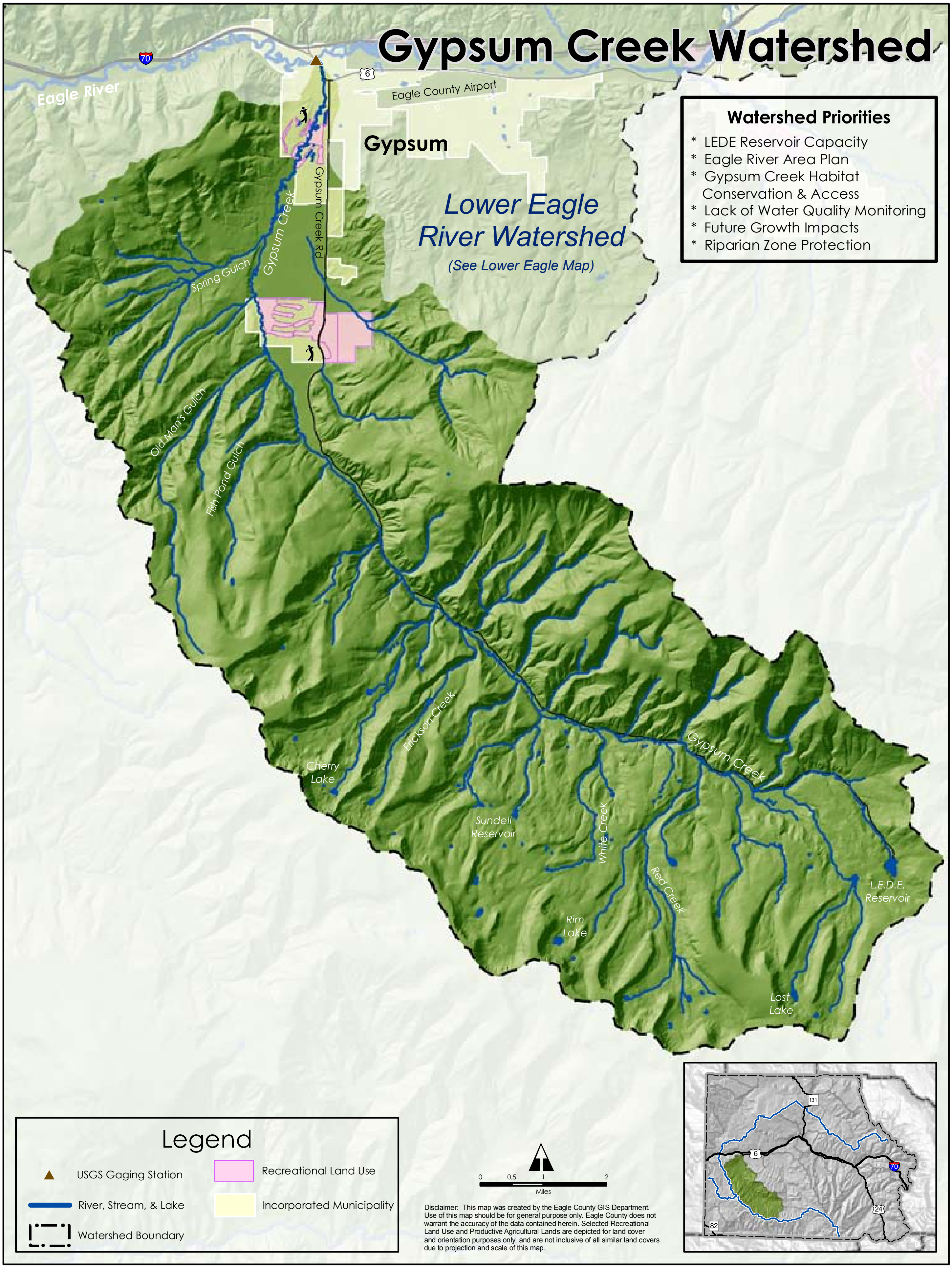
Gypsum Creek is a drinking water source for the Town of Gypsum. The upper watershed is influenced by ranching and forest lands primarily vegetated with areas of mixed coniferous and deciduous aspen forest. The habitat quality has been observed as variable in these upstream reaches, with riparian areas in both good and degraded conditions (CSU, 2005). Downstream of the narrow upper valley the drainage widens considerably and the creek flows through the Brightwater golf course and residential subdivision. The Town of Gypsum has undergone tremendous growth over the past several decades resulting in new suburban neighborhoods constructed in the lower Gypsum Creek valley. In 2009, there were approximately 6,786 full time residents in Gypsum, many of them living in the Gypsum Creek drainage. The portion of Gypsum Creek through town center to the confluence with the Eagle River is highly channelized and constrained.

Water quality in Gypsum Creek has been monitored only a few times in recent years, thus a thorough determination of current conditions is not feasible. Historically, the observed primary water quality stressors in Gypsum Creek have been livestock grazing, sedimentation and irrigation return flows in upstream reaches and urban stormwater runoff in the developed lower reaches (CSU, 2005). Limited data indicate dissolved solids are at moderate levels, and generally lower than in the Eagle River near Gypsum. Trace metal and nutrient concentrations are generally low prior to 2006 (USGS website accessed 06/10/2010).

As ranch lands along the valley floor have converted to residential and other urban land uses, the Town has sought the purchase of public property along Gypsum Creek to preserve fishing access through conservation easements and potentially improve riparian habitat areas (Gallegos, 2010). However, irrigation return flows are being reduced and urban runoff will potentially increase as the Town develops.

The Town recently acquired LEDE reservoir and has current plans to expand it to more than double its existing capacity. This acquisition and expansion will assist the Town in regulation and monitoring of minimum in-stream flows for Gypsum Creek, which will benefit wildlife, habitat and recreation.

Unfortunately, little recent water quality data is available for evaluation to determine if noteworthy changes have occurred. To better evaluate water quality conditions and track potential effects from ongoing residential, commercial, recreation, and related infrastructure development, it is recommended that a consistent monitoring program be implemented for Gypsum Creek.



Gypsum Creek Watershed
Watershed Priorities
* LEDE Reservoir Capacity
* Eagle River Area Plan
* Gypsum Creek Habitat Conservation & Access
* Lack of Water Quality Monitoring
* Future Growth Impacts
* Riparian Zone Protection
70
6
Eagle River
Eagle County Airport
Gypsum
Gypsum Creek Rd
Gypsum Creek
Lower Eagle River Watershed
(See Lower Eagle Map)
Spring Gulch
Old Man's Gulch
Fish Pond Gulch
Erickson Creek
Cherry Lake
Sundell Reservoir
White Creek
Red Creek
Rim Lake
Gypsum Creek
L.E.D.E. Reservoir
Lost Lake
Legend
USGS Gaging Station
River, Stream, & Lake
Watershed Boundary
Recreational Land Use
Incorporated Municipality
0 0.5 1 2
Miles
Disclaimer: This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein. Selected Recreational Land Use and Productive Agricultural Lands are depicted for land cover and orientation purposes only, and are not inclusive of all similar land covers due to projection and scale of this map.
131
6
70
24
82

Colorado River

The Upper Colorado River headwaters originate in Grand County and encompass a large area of 1,869 square miles (NWCCOG, 208 Plan). The lower portion of the Upper Colorado watershed includes parts of Routt, Eagle and Garfield counties and technically ends at the confluence with the Roaring Fork River in Glenwood Springs. The Colorado River enters the northern part of Eagle County and flows generally southwest for approximately 55 miles through Gore Canyon to State Bridge, and then past the rural communities of Bond, McCoy and Burns to its confluence with the Eagle River at Dotsero. Several miles west of Dotsero the river leaves Eagle County and enters Glenwood Canyon. The drainage area of the Colorado River sub-watershed in Eagle County is approximately 525 square miles.

The Upper Colorado as it passes through Eagle County has few urban influences, and is typified by public lands, large ranches and scattered recreational sites and trailheads. Tributaries include the Piney River which enters the river at State Bridge, Rock Creek which flows to its confluence at McCoy, and Sweetwater Creek which flows to its confluence about seven miles upstream of Dotsero (NWCCOG, 208). The Eagle River is the largest contributing flow to this reach of the Colorado River. There are major water storage facilities in the Upper Colorado before the river enters Eagle County, including Lake Granby, Shadow Mountain, Windy Gap, Willow Creek, Williams Fork, and Wolford Mountain Reservoirs. As such, flows in the river are highly managed. Constructed transmountain diversions on the headwaters of the Colorado transport as much as 600,000 acre feet per year to the Front Range - nearly one and half times the average annual yield of the Eagle River basin (CFWE, 2009).

Water quality in the Eagle County reach of the Colorado River has been monitored at two sites, one near State Bridge and one downstream of Dotsero. The site at State Bridge was monitored as recently as 2008 and indicated fairly dilute water of good quality with low dissolved solids, nutrients, and metals concentrations, with no results that would indicate there are current water quality issues to address (USEPA website accessed June 12, 2010). However, the 1989 Addendum to the Colorado Nonpoint Source Assessment Report states that "the Colorado River mainstem begins to show impacts from sediment in the segment downstream from State Bridge. The Eagle County Soil Conservation district has designated a stream bank erosion management area which may help explain the elevated sediment levels in this reach." (NWCCOG, 2002b; CWQCD, 1989).

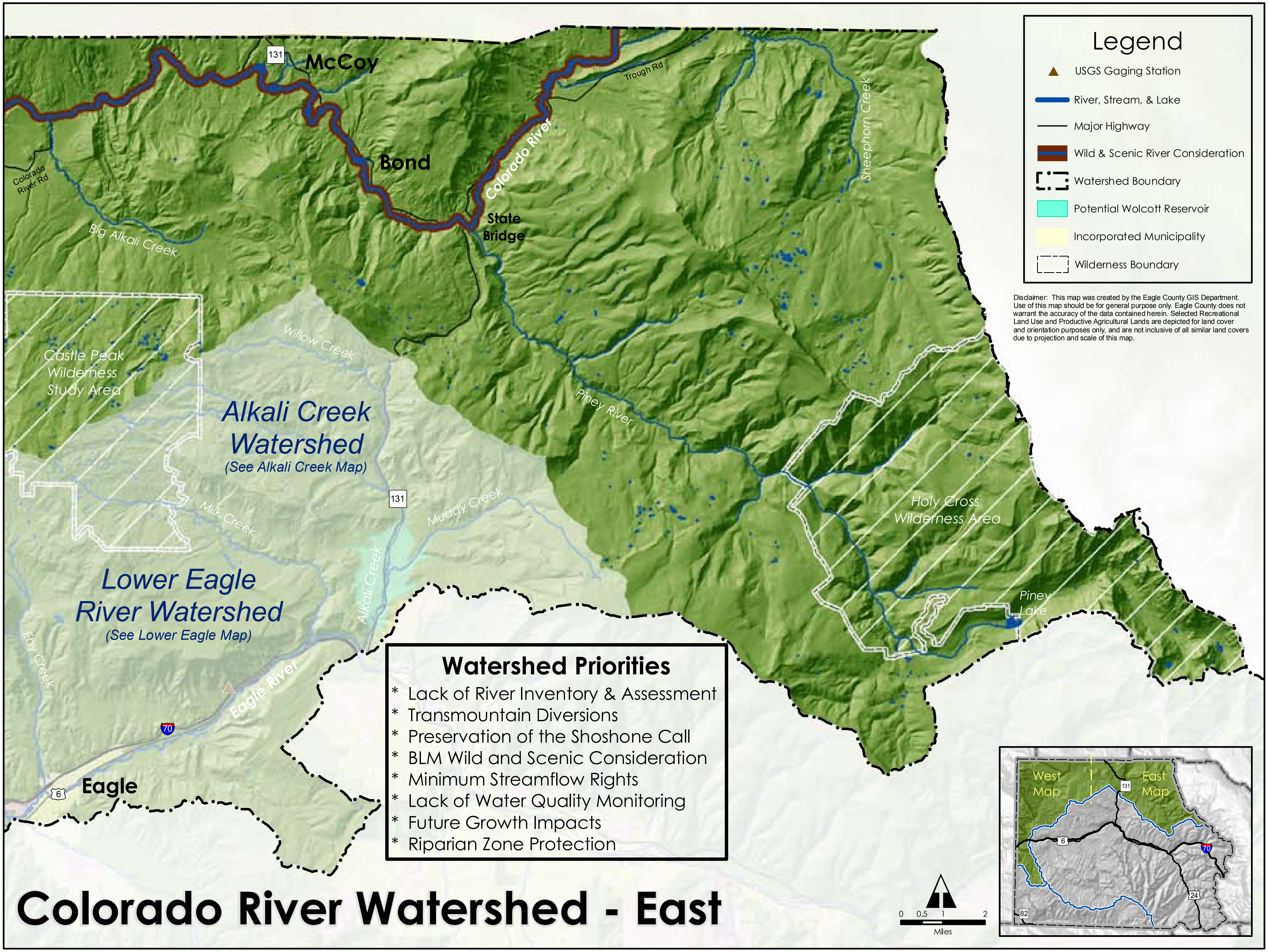
US Forest Service East Fork Red Dirt Creek streambank restoration.

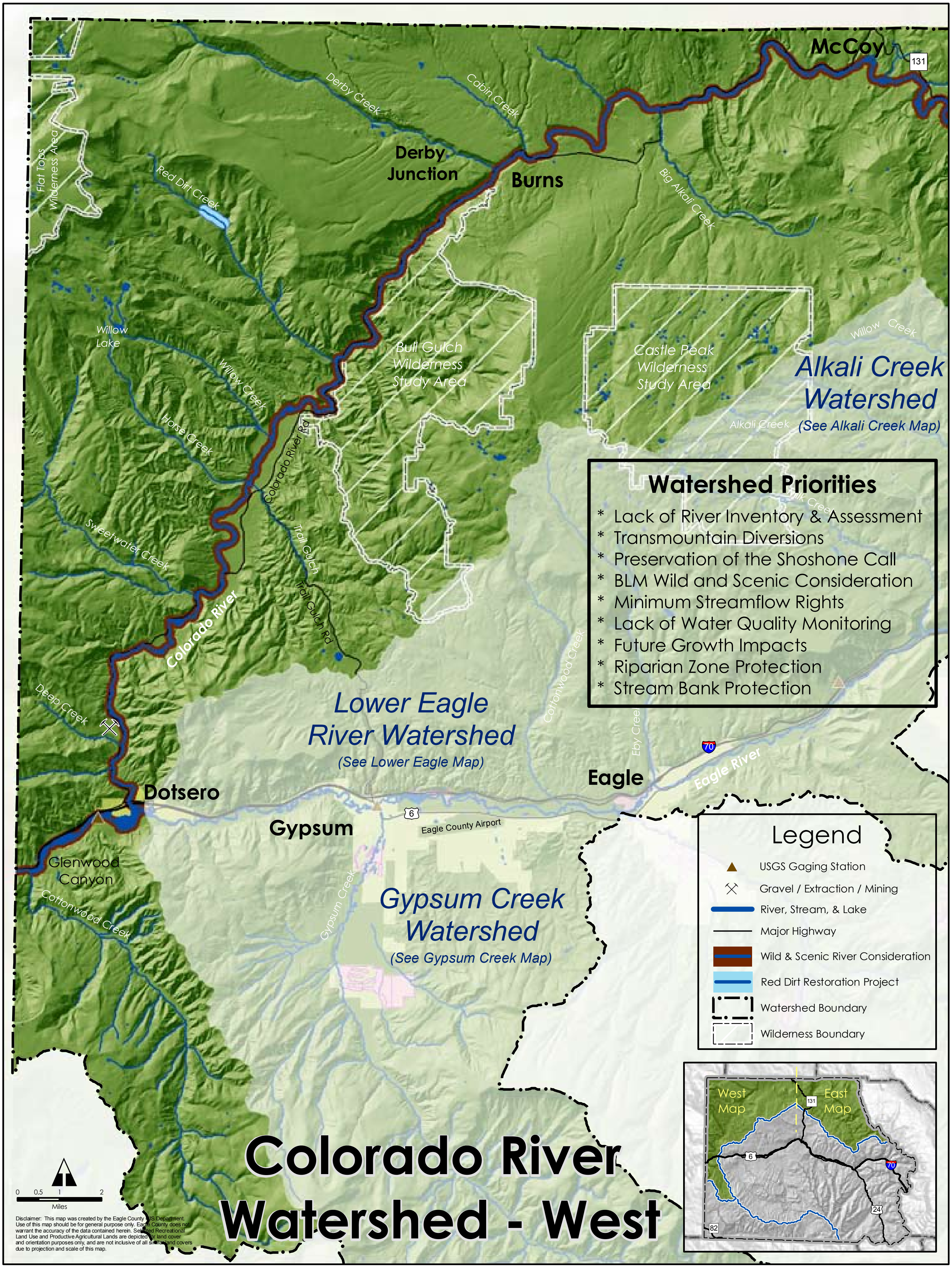
The NWCCOG report for the Upper Colorado River summarizes the major water quality issues for this reach of the Colorado as primarily derived from impacts of transmountain water diversions, as well as sediment and dissolved solids loads from nonpoint sources. In early October of this year, the Forest Service completed a streambank reconstruction and riparian planting of East Red Dirt Creek to repair historic grazing impacts to the creek that potentially threatened a Colorado Cutthroat population.

The USGS has monitored water quality in the Colorado River at a location downstream from Dotsero near the Eagle County line. In a data summary for the 1995-1998 period, USGS results indicate generally good water quality with high dissolved oxygen, low dissolved solids and nitrate concentrations (Spahr and others, 2000). Total phosphorus concentrations were elevated at times and generally below 0.2 milligrams per liter with no apparent relation between streamflow magnitude and phosphorus concentration. Suspended sediment concentrations were higher during the onset of annual snowmelt runoff as expected but were generally not excessive. Total phosphorus and sediment concentrations were generally similar to but slightly lower than those observed in the Eagle River at Gypsum. Sample results for dissolved oxygen, nutrients, trace metals, and suspended sediment did not exceed applicable State standards in the Colorado River. However, nutrients, dissolved solids, trace metals and suspended sediment concentrations are higher at the Dotsero site as compared to the upstream State Bridge site. This is likely due, at least in part, to the influence of inflows from the Eagle River (Spahr and others 2002; USGS website accessed 06/10/2010).

The reach through Eagle County is currently being considered for "Wild and Scenic" designation by the Bureau of Land Management. Risks to the water resource values of the Colorado are numerous, and include climate change, transmountain diversions, future growth and land use, oil and shale production, and potential loss of the Shoshone Call – the primary controlling senior water right on the Colorado River according to the Colorado River Water Conservation District (Sentinel, 2010). This historic 1902 water right ensures that water flows through Eagle County to the Shoshone Power Plant in Glenwood Canyon.

Streamflow management objectives for the Colorado to protect and enhance watershed values like aquatic habitat and recreation may become an increasingly complex issue to manage on a local and regional level.


Colorado River Watershed - East
Legend
USGS Gaging Station
River, Stream, & Lake
Major Highway
Wild & Scenic River Consideration
Watershed Boundary
Potential Wolcott Reservoir
Incorporated Municipality
Wilderness Boundary
Disclaimer: This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein. Selected Recreational Land Use and Productive Agricultural Lands are depicted for land cover and orientation purposes only, and are not inclusive of all similar land covers due to projection and scale of this map.
Watershed Priorities
* Lack of River Inventory & Assessment
* Transmountain Diversions
* Preservation of the Shoshone Call
* BLM Wild and Scenic Consideration
* Minimum Streamflow Rights
* Lack of Water Quality Monitoring
* Future Growth Impacts
* Riparian Zone Protection
McCoy
Bond
State Bridge
Eagle
Colorado River
Trough Rd
Colorado River Rd
Big Alkali Creek
Sheephorn Creek
Piney River
Willow Creek
Muddy Creek
Milk Creek
Alkali Creek
Eby Creek
Eagle River
Castle Peak Wilderness Study Area
Alkali Creek Watershed
(See Alkali Creek Map)
Lower Eagle River Watershed
(See Lower Eagle Map)
Holy Cross Wilderness Area
Piney Lake
131
70
6
0 0.5 1 2
Miles
West Map
East Map
24
82


McCoy
131
Derby Creek
Cabin Creek
Derby
Junction
Burns
Flat Tops
Wilderness Area
Red Dirt Creek
Big Alkali Creek
Willow
Lake
Willow Creek
Horse Creek
Bull Gulch
Wilderness
Study Area
Castle Peak
Wilderness
Study Area
Willow Creek
Alkali Creek
Watershed
(See Alkali Creek Map)
Alkali Creek
Colorado River Rd
Trail Gulch
Trail Gulch Rd
Sweetwater Creek
Colorado River
Watershed Priorities
* Lack of River Inventory & Assessment
* Transmountain Diversions
* Preservation of the Shoshone Call
* BLM Wild and Scenic Consideration
* Minimum Streamflow Rights
* Lack of Water Quality Monitoring
* Future Growth Impacts
* Riparian Zone Protection
* Stream Bank Protection
Deep Creek
Cottonwood Creek
Eby Creek
Lower Eagle
River Watershed
(See Lower Eagle Map)
70
Eagle River
Eagle
Dotsero
Gypsum
6
Eagle County Airport
Glenwood
Canyon
Cottonwood Creek
Gypsum Creek
Gypsum Creek
Watershed
(See Gypsum Creek Map)
Legend
USGS Gaging Station
Gravel / Extraction / Mining
River, Stream, & Lake
Major Highway
Wild & Scenic River Consideration
Red Dirt Restoration Project
Watershed Boundary
Wilderness Boundary
West
Map
East
Map
131
6
70
24
82
0 0.5 1 2
Miles
Disclaimer: This map was created by the Eagle County GIS Department. Use of this map should be for general purpose only. Eagle County does not warrant the accuracy of the data contained herein. Selected Recreational Land Use and Productive Agricultural Lands are depicted for land cover and orientation purposes only, and are not inclusive of all similar land covers due to projection and scale of this map.
Colorado River
Watershed - West

Glossary of Terms and Waterfacts

Acre Foot (Feet): The volume of water required to cover one acre of land to a depth of one foot. An acre foot is equal to approximately 325,825 gallons. For example, Nottingham Lake near Avon holds approximately 100 acre feet.

Aquatic Habitat: Habitat available for use by fish and other aquatic species. The area of useable habitat in a stream typically increases as stream flow increases, except when stream flow is very high and water velocity is great than desirable.

Augmentation: A means to allow diversion of water by a junior water right when this junior water right would otherwise be out of priority and unable to divert water. An augmentation plan typically replaces (or augments) the amount of water consumed by a junior water right with water from a reservoir, or with water previously used for another purpose such as irrigation. By replacing the amount of water consumed, the amount of water available to senior downstream water rights is not diminished. In the Eagle River watershed, augmentation is most commonly filed from Green Mountain Reservoir in the Blue River watershed in Summit County or from Eagle Park reservoir in Eagle County. See C.R.S. 37-92-103 for definition of augmentation plan under state statute.

Baseflow: the period of the year in which the stream flow in rivers and streams is the lowest, typically from August through April. During this period, stream flow primarily results from ground water that is discharged to streams and rivers.

Black Gore Creek Steering Committee(BGSC): In the late 1990's, the BGSC was formed to allow concerned stakeholders to meet and discuss the issues of safe I-70 operation and sediment issues. A number of local, state, and federal entities are members of this Committee, including the Colorado Department of Transportation, Eagle County, Eagle River Water & Sanitation District, Eagle River Watershed Council, River Restoration.org, Town of Vail, US Forest Service.

Build out conditions: The population that is projected to occur with complete development assuming a development density comparable to existing conditions on all planned and platted sites. Actual build out could vary significantly, depending upon market conditions and land use approvals.

Carrying Capacity: The amount and type of use an area can accommodate without altering either the environment or the user's experience beyond a degree of change deemed acceptable by the management objective.

Conjunctive Use: A term used to describe the practice of storing surface water in a groundwater basin in wet years and withdrawing it from the basin in dry years.

Cubic Foot per Second (cfs): A rate of stream flow equal to one cubic foot of water (7.5 gallons) every second. One cfs flowing for one day results in a volume of water equal to approximately two acre feet. The Eagle River near Gypsum typically flows about 100 to 200 cfs during the low flow winter months. During peak snowmelt the flow of the river near Gypsum often exceeds 3,000 cfs. The flow of Gore Creek at Vail is usually about 10 to 15 cfs during the winter months. Peak snowmelt stream flow of Gore Creek is often 900 cfs or greater.

Consumptive Water Use: That amount of water that is actually consumed by a given water use (a hay crop or golf course) and does not return to the stream.

Camp Hale: The large glacial valley known as "Eagle Park", located between Redcliff and Leadville in the Upper Eagle basin, where in 1942 the valley was transformed into a training camp for 10th Mountain Division troops utilized in World War II. Construction of Camp Hale required massive land alteration to transform the area into one of the largest cities in Colorado at the time. The Eagle River was relocated, enlarged and straightened, as were associated riparian and wetland areas cleared and drained in order to make room for the housing, training facilities and relocated highway.

Depletion: The use of water in a manner which makes it no longer available to other users in the same system. For example, immediately below a municipal diversion headgate, the stream depletion is equal to the amount of water diverted. Downstream of return flow from a municipal wastewater treatment plant, the depletion is equal to the amount of water actually consumed by the municipal use that is not returned to the stream.

Domestic Water Use: Water used for household purposes, and for lawn and garden irrigation in residential areas.

Erosive Soils: Local soils prone to slow permeability, rapid surface runoff and minimal vegetative cover due to soil characteristics (soil type example: Pierre Shale, Niobrara formation and Benton Shale). The rate or intensity of erosion of these soils may be influenced by land use (for instance, historic grazing).

Dust on Snow: A phenomenon where winter and spring depositions of desert dust from the Colorado Plateau onto Colorado's mountain snowpacks can dramatically reduce snowcover albedo, advance snowmelt timing, and enhance snowmelt runoff intensity when those dust layers are at or near the snowpack surface. Pristine, new snow reflects as much as 98% of sunlight, but dust-contaminated snow directly absorbs as much as 40-50% of the incoming solar energy striking the snowpack, thereby becoming the dominant source of heat energy causing snowmelt, eclipsing even the energy contributed by very warm air temperatures. (CODOS website, 2010)

Flow Regime: A term used to describe the following characteristics of stream flow and their interactions: magnitude, timing, frequency, duration, and rate of change.

Geomorphic: A term used to describe the scientific study of land forms and the processes that shape them. As it pertains to hydrology, the term describes the processes that affect the form or shape of the surface area of the drainage basin or watershed.

Ground Water: Water sources found below the surface of the earth.

Instream Flow (or minimum instream flow): The amount of stream flow in a stream or river that is recommended to maintain natural resource values such as fish habitat, recreation or water quality. An instream flow water standards is established by the Colorado Water Conservation Board in consultation with the Division of Wildlife, Division of Parks and Outdoor Recreation, and/or agencies of the U.S. Department of Agriculture and Department of Interior that is intended to preserve the natural environment to a reasonable degree (See C.R.S. 37-92-102(3)).

In-Basin Water Diversion: The diversion of water from the Eagle River Basin for use within the Eagle River watershed.

Non-Point Source Pollution: A source of pollution that has a diffuse origin and entrance point to the stream. For example, sediment erosion from a construction site or oil and grease washing off roads in a thunderstorm. In contract, if water from diffuse sources is collected in a pipe and the pipe enters the river, it is a Point Source discharge.

Non-Structural Strategy: A water supply strategy, such as conservation, that does not involve the construction of a dam, reservoir or diversion facility.

Northwest Colorado Council of Governments (NWCCOG): NWCCOG is a voluntary association of county and municipal governments that believes in the benefits of working together on a regional basis. NWCCOG serves 28 member jurisdictions in a 5-county region of northwest Colorado, including Eagle County.

NWCCOG Regional Water Quality Management Plan (208 Plan): NWCCOG has been the designated regional water quality management agency for the region since 1976. In that capacity, NWCCOG's completes and implements a water quality management plan for the NWCCOG Region which includes the Eagle River and Upper Colorado watersheds, in compliance with Section 208 of the Clean Water Act.

Optimum Instream Flow: A flow amount which protects an instream flow value such as fish habitat, recreation, aesthetics, or water quality.

Point Source Pollution: Pollution that comes from a discreet or specified source such as industrial or municipal waste water discharge.

Raw Water: Untreated surface or ground water.

Return Flow: Water returned to the stream after being diverted and used for some "beneficial" use such as irrigation or domestic purposes. Usually return flows occur downstream of the point of diversion.

Riparian Zone: The banks and adjacent vegetation influenced by the high water table. Plant types associated with riparian zone include but are not limited to cottonwoods, willows, alders, aspens and chokecherry. The presence or absence of these plants does not always indicate a riparian community. Past land use practices may have degraded the vegetation to the point where it does not appear to have riparian characteristics but because of the high water table in the area a change in the land use can quickly restore the riparian community. Conversely, a few characteristic plants may not indicate a true riparian community. For this reason, on site analysis is needed to help make this determination. This definition of riparian was comprehensively compiled from CDOW, NRCS (SCS), USFS, USACE, Colorado State University Range Science Department and Colorado Riparian Association definitions of riparian zone.

Sensitive Areas or Lands: Land or water areas that are sensitive because they could be irretrievably damaged or lost if they are not protected. Wetlands, riparian areas and steep hillsides are examples of sensitive lands that typically do not respond or recover well from disturbance, whether it be a single occurrence or collective.

Shoshone Call/Demand: The water demand associated with the Shoshone Hydroelectric Facility on the Colorado River in Glenwood Canyon. This is one of the most senior water rights on the Colorado that frequently limits upstream diversions in the Eagle River Basin and the Upper Colorado.

Specific Conductance: is a measure of how well water can pass an electrical current. It is an indirect measure of the presence of inorganic dissolved solids, such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron. These substances conduct electricity because they are negatively or positively charged when dissolved in water. The concentration of dissolved solids, or the conductivity, is affected by the bedrock and soil in the watershed. It is also affected by human influences. For example, agricultural runoff can raise conductivity because of the presence of phosphate and nitrate. (See http://bcn.boulder.co.us/basin/natural/wqterms.html#nitrogen)

Surface Water: Sources of water such as lakes, reservoirs, rivers and streams found on the earth's surface.

Takings: Denial of all reasonable use of property, which is further defined by several U.S. and Colorado court cases.

Total Maximum Daily Load (TMDL): A Total Maximum Daily Load, or TMDL, is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards. Under section 303(d) of the Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters

Total Water Management: The exercise of stewardship of water resources for the greatest good of society and the environment (AWWA, 1996).

Trans-Basin Diversion (or Out-of-Basin Diversion): The diversion of water from the Eagle River Basin for use at locations outside of the Eagle River watershed. Trans-Basin diversions are considered 100% consumptive use because no water is returned to the source water basin.

Watershed: A geographic area in which all water drains to a common point or outlet such as a larger stream or river, a lake, an underlying aquifer, an estuary, or an ocean. A watershed is also referred to as a drainage basin. Watersheds exist in a variety of shapes and sizes which result from the influence of climate, rock and soil types.

Water Right: The legal right to use a specified amount of water. Water rights in Colorado are administered according to priority (first in time, first in right). An absolute water right is a right that has been historically applied to a beneficial use. A conditional water right is a right that has not yet been developed or used, but that retains its historical priority. Conditional rights are usually associated with water projects that require years of planning and construction (see also C.R.S. 37-92-103(6)). According to C.R.S. 37-92-103(12), a water right means a right to use in accordance with its priority, a certain portion of the waters of the state by reason of the appropriation of the same.

"Wet" Water: An informal expression that means someone may own authorized water rights ("paper water") but because of the water supply is over-appropriated or the water source is inadequate, the actual water many not be available.

Wetlands: Per 33 C.F.R. Part 328.3(b); C.F.R.5230.3(t)1986, wetlands are "those areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." This is the current definition used by the U.S. Army Corps of Engineers.

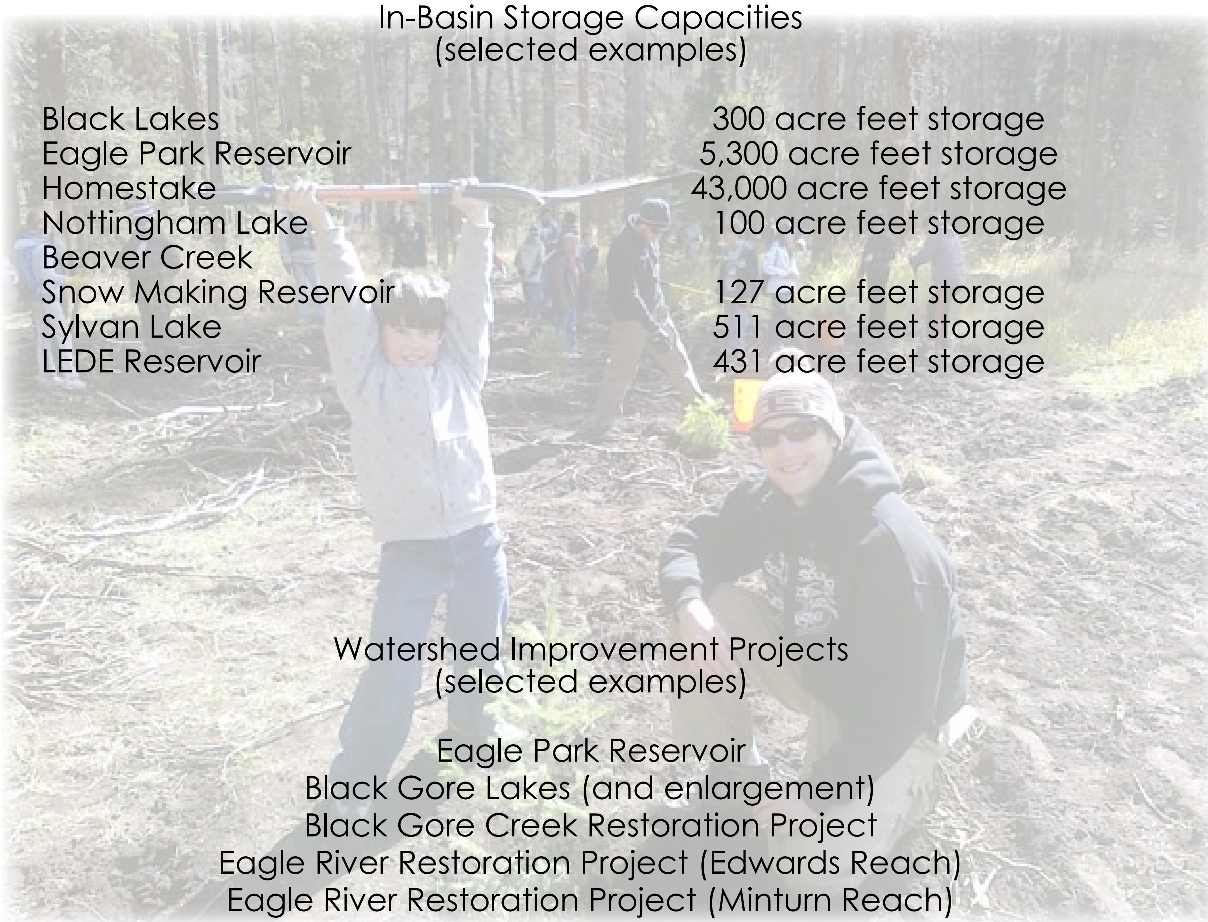
Wetlands Mitigation and Banking: Per federal wetlands regulations, if wetlands are disturbed or destroyed, and equal amount of wetland acres must be enhanced, restored or created, generally in the same watershed. Banking, where permitted by policy, allows purchase of wetland "credits" that are used to fund target wetland restoration projects that may or may not be in the same watershed. As an example, banking credits purchase for wetland losses in Eagle County are often compensated in Grand County (still in the Upper Colorado basin, not in the Eagle River watershed).

Water Facts

Water Conversion Table

1 acre foot of water equals 43,560 cubic feet or 325,581 gallons (Enough water, for example, for a family of four to take one ten minute shower using an average showerhead every day for 8.5 years)

1 cubic foot per second (cfs) equals 450 gallons per minute, or 646,320 gallons per day, or 1.983 acre feet per day, or 59.5 acre feet for 30 days, or 724 acre feet per year (An average showerhead flows at 2.6 gallons per minute)



In-Basin Storage Capacities
(selected examples)

Black Lakes	300 acre feet storage
Eagle Park Reservoir	5,300 acre feet storage
Homestake	43,000 acre feet storage
Nottingham Lake	100 acre feet storage
Beaver Creek	
Snow Making Reservoir	127 acre feet storage
Sylvan Lake	511 acre feet storage
LEDE Reservoir	431 acre feet storage

Watershed Improvement Projects
(selected examples)

Eagle Park Reservoir
Black Gore Lakes (and enlargement)
Black Gore Creek Restoration Project
Eagle River Restoration Project (Edwards Reach)
Eagle River Restoration Project (Minturn Reach)
Eagle River Eagle Mine Superfund Site Mitigation (Gilman/Belden Reach)
Brush Creek Habitat Restoration Project
L.E.D.E acquisition and enlargement project
Piney River Restoration
Red Dirt Creek East Fork Restoration
Stephens Park Restoration Project

References Cited

American Rivers, Americas Most Endangered Rivers: 2010 Edition. Accessed June 20, 2010. http://www.americanrivers.org/assets/pdfs/mer-2010/americas-most-endangered-rivers-2010.pdf

American Water Works Association Research Foundation. 1996. Total Water Management Workshop Summary. Draft. Seattle, Wash., August 18-20. Denver, Colo.: AwwaRF.

Armstrong, J. (2000). Biological Survey of Eagle County, Colorado: Conservation Plan and Implementation Strategies. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

BBC Research & Consulting, September 26, 2008, The Economic Impacts of Hunting, Fishing and Wildlife Watching in Colorado, Prepared for the Colorado Division of Wildlife. 24 p.

Colorado Dust on Snow (CODOS) Program, website information accessed June 11, 2010, http://www.snowstudies.org/codos1.html

Colorado Foundation for Water Education (CFWE), Spring 2009, Colorado's Water Supply Future: Cooperation vs. Competition, 37 p.

CDPHE, 2009, Annual Report to the Colorado Legislature and Water Quality Control Commission Fiscal Year 2008-2009, 21 p.

Colorado River Outfitters Association (2009). Commercial River Use in the State of COLORADO 1988-2009. CROA, Buena Vista, CO.

Colorado State Demography Office, Draft 2009 County and Municipal Estimates of Population and Households. Accessed May 25, 2010. http://dola.colorado.gov/dlg/demog/pop_cnty_estimates.html

Colorado State University, Engineering Research Center (2005). Eagle River Inventory and Assessment. Colorado State University, Fort Collins, CO. 322 p.

Colorado Water Conservation Board (2010). Draft Colorado Water Availability Study Final Report. Accessed June 2, 2010. http://cwcbweblink.state.co.us/weblink/0/doc/140137/Electronic.aspx?searchid=7554ad3c-6d64-44b9-9bfa-38aff0847db7

Colorado Water Quality Control Division, 1989, Colorado nonpoint assessment report—1989 addendum: Denver, Colorado Department of Health, 189 p.

Eagle County (1996), Eagle River Watershed Plan

Eagle County (2005), Eagle County Comprehensive Plan

Eagle County, GIS Department "Rivers and Roads" draft map, June 25, 2009.

Eagle County Press Release (2010) accessed July 5, 2010. Viewable at http://www.eaglecounty.us/Attorney/News/Water_Court_case_reaches_settlement/

Eagle River Watershed Council, 2010 State of the Rivers Open House Public input summary

Flemming, Scott, personal communication, 2010

Gallegos, Lana, personal communication, 2010

Grand Junction Sentinel, (May 24, 2010),State's two halves try to reconcile competing interests in Shoshone, accessed May 30, 2010, http://www.gjsentinel.com/news/articles/states_two_halves_try_to_recon/

Grand River Consulting and GEI Consultants, 2004, Wolcott Reservoir Feasibility Assessment, Phase I Investigation, 102 p.

Grove, Matt, USFS, personal communication, 2010.

Hall, 2010, Federal Science Advisory Board Review of EPA's Simplified Nutrient Criteria Development Methods and Related Federal Initiatives: What Happens Next?, Colorado Water Congress 2010 Annual Convention, January 27, 2010.

Ivey, L., Terra Cognito GIS, (December 15, 2009), Eagle County Build Out and Visualization Report Residential Build-Out Results, Accessed on May 5, 2010, http://www.eaglecounty.us/Planning/Long_Range_Planning/Build_Out_Analysis/

M TRIP LLC, Vail Lodging Inventory Study, December 2008 (Final Report Update July 16, 2009). Accessed July 5, 2010. http://www.vailgov.com/docs/dl_forms/Vail_Transient_Inventory_Study_Final_Report_update071609.pdf

Mausolf, Sarah, Steamboat Today, Eagle County man on front lines of beetle battle, accessed July 19, 2010, http://www.steamboatpilot.com/news/2010/jul/18/eagle-county-man-front-lines-beetle-battle/

Merriman, Dan, Janicki, Anne M., Colorado's Instream Flow Program- How It Works And Why It's Good For Colorado, 2005.
Merry, Ray, personal communication, 2010.
Natural Resources Conservation Service (NRCS), Colorado River Watershed Office, (2010), Final Report on Watershed Input Forum, March 31, 2010 meeting in Gypsum.
NWCCOG, 2002, 2002 Eagle River Water Quality Management Plan
NWCCOG, 2002b, 2002 Upper Colorado River Water Quality Management Plan
Office of Governor Bill Ritter, Press Release. Accessed May 25, 2010. http://www.colorado.gov/cs/Satellite/GovRitter/GOVR/1208597677100
Ray, A., Barsugli, J., Averyt, K., Wolter, K., Hoerline, M., Doesken, N., Udall, B., Webb, R., 2008 Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation. Colorado Water conservation Board.
Rocky Mountain Rail Authority "High Speed Rail Feasibility Study: Executive Summary", March 2010, Transportation Economics & Management Systems, Inc. Accessed June 12, 2010. http://www.rockymountainrail.org/documents/RMRAExecutiveSummary-FINAL.pdf
Rupert, M. Plummer, N., 2009, Ground water quality, age, and susceptibility to contamination, ERW valley fill aquifer, north-central Colorado, 2006-2007: U.S. Geological Survey Scientific Investigations Report 2009-5082, 59 p.
Spahr, N.E., Boulger, R.W., and Szmajter, R.J., 2000, Water Quality at Basic Fixed Sites in the Upper Colorado River Basin National Water-Quality Assessment Study Unit, October 1995–September 1998, U.S. Geological Survey Water-Resources Investigations Report 99–4223, 63 p.
Steltzer, H., C, Landry, T. H. Painter, J. Anderson, and E. Ayres. 2009.Biological consequences of earlier snowmelt from desert dust deposition in alpine landscapes. Proceedings of the National Academy of Sciences. 106: 11629-11634, doi_10.1073_pnas.0900758106.
Udall, Brad, April 9, 2010, Projected Climate Change Impacts on our Water Resources, University of Denver School of Law, Water Law Symposium proceedings.
Upper Eagle River Regional Water Authority Press Release (November 29, 2007). http://cwcb.state.co.us/NR/rdonlyres/C6B92D85-C621-4DD5-B4BF-EBBDE34B12B8/0/27d.pdf
Urban Land Institute Advisory Services Panel (2006), Eagle County Colorado: A Regional Approach to Affordable Housing, accessed on May 12, 2010. http://www.economiccouncil.biz/doc/toc.asp?assn_id=12818&link_id=78670
USEPA, STORET Data Warehouse accessed June 12, 2010, http://www.epa.gov/storet/dw_home.html
USGS Colorado-Water Quality Data Repository accessed June 10, 2010, http://rmgsc.cr.usgs.gov/cwqdr/index.shtml
Vail Resorts, 2010, Beaver Creek, accessed July 14, 2010, http://www.vailresorts.com/CORP/info/beaver-creek.aspx
Weaver, Bob, personal communication, 2010.
Williams, C.A, Moore, J.L., and Richards, R.J. 2010 (in press), Assessment of Surface-Water Quantity and Quality, Eagle River Watershed, 1947–2007.
Willy Powell, personal communication, 2010.
Wright Water Engineers, 2009, 2009 Water Quality Monitoring for Frost Creek PUD and Salt Creek Equestrian Center Parcel: Prepared for Adam's Rib Recreation Area, Eagle Colorado, Report Number 721-002-1150
Wynn and others, 2001, Wynn, K.H., N.J. Bauch, and N.E. Driver, 2001, Gore Creek Watershed, Colorado–Assessment of Historical and Current Water Quantity, Water Quality, and Aquatic Ecology 1968- 98: U.S. Geological Survey Water-Resources Investigations Report 99–4270, 72 p.
Zuellig, Robert, written communication, 2008.

Eagle River
Watershed Council, Inc.

The Eagle River Watershed Council is a community non-profit 501(c)(3) corporation, established in 2004.

"The vision of the Eagle River Watershed Council is to protect and enhance the high quality natural, scenic and economic values that our rivers and tributaries provide our citizens, visitors and wildlife population. In doing so, we seek to promote the interconnected conservation values the watershed represents to diverse interest groups that benefit from its continued health and well being and leave a natural resource legacy to future generations."