Rio Costilla
Watershed Restoration Action Strategy
(WRAS)

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Contents

INTRODUCTION

The Federal Clean Water Action Plan (CWAP) of 1998 was developed to help meet the goals of the Clean Water Act through state-led cooperative efforts. These efforts attempt to identify and prioritize watersheds with water quality concerns. A New Mexico Unified Watershed Assessment (1998) was conducted by a statewide task force in response to the actions mandated in the CWAP. New Mexico's Unified Watershed Assessment identified 21 out of New Mexico's 83 watersheds as "in need of restoration" (Category 1). The Rio Costilla and its tributaries are within a designated Category 1 watershed - the Upper Rio Grande (HUC13020101).

This Watershed Restoration Action Strategy (WRAS) for the Rio Costilla watershed focuses on restoring and protecting water quality that is currently impaired by a variety of factors. The WRAS is a required product of the CWAP process, and has been developed for a variety of planning, reporting, and funding purposes. The structure and content of this WRAS draws from previous Watershed Restoration Action Strategies (WRASs) developed for subwatersheds within the Rio Costilla watershed.

The ultimate goals of this plan are to improve the condition of the Rio Costilla watershed to meet current water quality standards and to restore normal hydrologic function to Rio Costilla and its tributaries. The benefits of meeting these goals are numerous and include the primary objective of improving habitat for the Rio Grande Cutthroat Trout (RGCT). Secondary objectives include improving riparian habitat for other native fish and aquatic species; improved habitat for terrestrial wildlife; providing the foundations for sustainable economic use; and creating enhanced recreational opportunities for people in local communities as well as visitors to the area.

The purpose of a Watershed Restoration Action Strategy (WRAS) is to provide a comprehensive plan for watershed scale restoration. It is developed in collaboration with a community of stakeholders who develop and implement measures to improve water quality and the overall health of the watershed ecosystem. The community of stakeholders defines both the goals and methods of achieving those goals. EPA guidance on the development of WRAS documents defines the following specific requirements.

- An identification of the causes and sources of impairment
- Identification of sources that need to be controlled at the subwatershed level
- An estimate of the load reductions expected for the management measures
- A description of the NPS management measures that will need to be implemented to achieve the load reductions
- An estimate of the amounts of technical and financial assistance needed
- An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation
- A schedule for implementation
- A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

- A set of criteria that can be used to determine whether loading reductions are being achieved over time
- A monitoring component to evaluate the effectiveness of the implementation

WRAS DEVELOPMENT

This WRAS draws extensively from WRAS's developed for subwatersheds within the Rio Costilla watershed. Considerable work has gone into each of these subwatersheds over the past 5 years with support from the 319 (h) program. These subwatersheds include Comanche Creek, Cordova Creek and Sanchez Creek. Each of these efforts involves a different set of stakeholders with different goals and strategies for achieving those goals. Each of these programs is discussed in greater detail below. In addition to the separate subwatershed efforts, a comprehensive program for the restoration of native cutthroat trout has been initiated through a collaborative effort between a variety of parties including the New Mexico Department of Game and Fish, the US Forest Service, and New Mexico Trout.

Development of this WRAS and the various subwatershed WRASs included input from the following agencies and organizations:

- USDA Forest Service
- The Rio Costilla Cooperative Livestock Association (RCCLA)
- The Quivira Coalition
- Bionomics Southwest
- Trout Unlimited
- New Mexico Trout
- New Mexico State Highway and Transportation Department
- New Mexico Environment Department
- New Mexico Department of Game and Fish
- U.S. Environmental Protection Agency

Other cooperating stakeholders include the Valle Vidal Grazing Association, Amigos Bravos, and the Sierra Club. It is hoped and expected that the list of cooperating stakeholders will increase as restoration projects proceed and outreach efforts inform others of activities on the various subwatersheds. While this WRAS defines many of the types of activities that need to be undertaken to restore the Rio Costilla to a high quality cold water fishery, we expect this plan to evolve over time based on input from the many participants and from actually implementing measures on the ground. It is unclear at this time whether a larger Rio Costilla Watershed group is feasible or even necessary to accomplish the goals set forth in this WRAS.

Much more detail is available on the Comanche Creek, Cordova Creek and Sanchez Creek subwatersheds in the individual WRASs developed for these subwatersheds, workplans and final reports (Quivira Coalition 2004, RCCLA 2003)

LOCATION AND WATERSHED SETTING

This document discusses the Rio Costilla watershed and associated sub watersheds within the political boundary of New Mexico. The portion of the Rio Costilla watershed located in north central New Mexico is in the Upper Rio Grande Watershed. The Rio Costilla flows into New Mexico from Colorado on the northwest corner of the Culebra Range. It then flows south and west around the Big Costilla Peak (elev. 12, 739 ft.) and flows back into Colorado just north of the town of Costilla. In total, the river flows approximately 33 miles through New Mexico before reentering Colorado and finally merging with the Rio Grande near the Colorado border. The watershed within New Mexico covers approximately 230 square miles. Six major subwatersheds flow into the Rio Costilla. These are Cordova Creek, Casias Creek, Latir Creek, Ute Creek, Sanchez Creek and Comanche Creek. As mentioned previously, three of these subwatersheds have active work underway (Cordova Creek, Sanchez Creek, and Comanche Creek).

The Rio Costilla watershed has been occupied for over 10,000 years. First inhabited by paleoindians, it was later used by several tribes including the Navajo, Ute, Apache and Comanches as hunting grounds. Spanish settlement brought further exploration and use by trappers, hunters and travelers.

Land ownership is divided into private 72% and US Forest Service 28% as shown in Figure **. Land cover is divided as follows:

- Forest 80%
- Rangeland 14%
- Barren Tundra 4%
- Agriculture 2%
- Developed 1%

The TMDL Report For the Upper Rio Grande Watershed Part 1 (2004: 19) describes the geology of the watershed as follows:

> The geology of the Costilla Creek watershed consists of a complex distribution of Precambrian metamorphic rocks and tertiary volcanics. Smaller deposits of intrusives, ash flows, and unaltered igneous rocks are also present. Costilla Creek bisects two distinct geologic areas. The area south of the CO-NM State line mainly consists of Precambrian igneous and metamorphic rock of the Sangre de Cristo Range. Metamorphic rocks in this area mainly consist of amphibolites, granite gneiss, and mica schist. The less abundant igneous rocks consist of granitic stocks. The upper portions of the watershed are also highly faulted as a result of Rio Grande rift tectonics. Tertiary volcanics are the predominant rock type in the lower portions of the watershed, north of the state line. These volcanics consist of basalt flows that are interbedded with sands and gravels, which were deposited during periods of erosion between volcanic events. Varying thicknesses of alluvial material cover much of these basalt flows, especially near the base of the Sangre de Cristos.

DEFINING SPECIFIC WATER QUALITY PROBLEMS

The current condition of the Rio Costilla and its tributaries is clearly a product of past human land use within the watershed. Due to management practices initiated within

three tributary subwatersheds, the overall condition of the watershed is, however, in an upward trend. Perhaps the most profound change has occurred in Comanche Creek (listed for temperature) where a major stream channel and road restoration program supported with 319 (h) funds has been underway for the past five years.

Water Quality

The water quality of the Rio Costilla cannot be separated from the condition of its major tributaries. The Rio Costilla and two of its tributaries (Comanche Creek and Cordova Creek) have been monitored as part of the Total Maximum Daily Load (TMDL) process for exceedences of New Mexico water quality standards. The TMDL process is used in "determining and planning a watershed or basin-wide budget for pollutant influx to a watercourse" (NMED Surface Water Quality Bureau web site, 12/2002 http://www.nmenv.state.nm.us/swqb). The TMDL process has identified temperature exceedances in the Rio Costilla and Comanche Creek. Exceedances for temperature, stream bottom deposits, and turbidity were found in Cordova Creek. No TMDL monitoring has been performed on any other tributaries.

Designated uses for the Rio Costilla include: domestic water supply, fish culture, high quality cold water fishery, irrigation, livestock watering, secondary contact and wildlife habitat. All designated uses for the Rio Costilla are fully supported in the reach of the stream from its confluence with Comanche Creek and the Costilla Dam. All designated uses are fully supported below the confluence with the exception of high quality cold water fishery.

Temperature Measurement

A number of factors affect temperature measurements within stream channels. Temperature increases as water levels and flows decrease. Drought, especially prolonged drought such as we experienced in 2000 – 2003, is a significant factor in raising temperatures. Temperatures decrease as stream channels narrow and deepen, develop stable undercut banks and with increasing cloud cover (Radcliff 2004). Vegetation can also play an important role in temperature regulation. Stream reaches that are shaded by vegetation (e.g., willows and cottonwoods) will be substantially cooler that unshaded reaches.

One thermograph was placed in the reach of the Rio Costilla between Costilla and Comanche Creek in 2002 at SWQB Station 39 (on Figure **). A second thermograph was deployed in 2003 at Highway 522 (at Costilla) but data collection from this location was limited due to the river going dry during the measurement period of July and August. Temperatures recorded a maximum of 25.8 C and exceeded the High Quality Cold Water Fishery temperature standard 23% of the time.

Thermograph measurements at two stations on Comanche Creek between May and October of 2002 showed temperatures as high as 27.1 degrees Celsius. This exceeds the 20 degrees Celsius (68 degrees Fahrenheit) standard for the state of New Mexico. It is

much higher than the 17.8 degrees C (64 degrees F) defined by the USFS as the upper threshold for properly functioning habitat for the Rio Grande Cutthroat Trout (2001).

While the temperature exceedances in the Rio Costilla appear to originate in Comanche Creek, they are amplified by the condition of the stream channel below the confluence.

Figure 1 Rio Costilla along NM 196

Contributing Factors

The Final Report for the Rio Costilla and Comanche Creek Demonstration Project (1996) identified a number of factors contributing to non-point source problems in the Rio Costilla and its major tributary Comanche Creek. These factors include:

- Natural and human created changes to the stream channel morphology leading to destabilized stream banks;
- Overgrazing by cattle in meadows and riparian areas;
- Reconstruction and management of Costilla Dam;
- Road crossings and higher use of dirt roads;
- Ski area construction and management;
- Construction of roads within stream channels;
- Irrigation headgates that adversely alter width/depth ratios of stream channels;

A large contributing factor for high water temperatures is the lack of vegetation both on the Rio Costilla and its principal tributaries to shade the water. This lack of vegetation – primarily willows and cottonwoods – is due primarily to over grazing by both livestock and elk and unstable stream channel morphology. Removal of vegetation and stream channelization for road construction also is a likely factor in removing shade and increasing exposure of stream channels. Lack of streambank vegetation has been proven to dramatically increase water temperatures in streams. In addition to temperature, vegetation provides cover from predators and greater food supplies for trout. Vegetation removal in both upland and riparian areas can be attributed to long-term grazing pressure

by both wildlife and domestic livestock. In addition to grazing, logging, and mining have had major influences on the structure of the geologic and biologic landscape that have major influences on water quality.

While the loss of riparian vegetation has a major impact on water temperature and sediment, other factors also play a major role in determining the quality of habitat for native cutthroat trout and other aquatic species. These factors include:

"1) “Hillslopes with unconsolidated soils showing rivulets that contact the stream channel.
"2) Destabilization of stream banks in lower, middle and upper reaches.
"3) Cattle are grazed annually throughout the Comanche Creek basin.
"4) Tributaries to Comanche Creek which all transport fine sediment.
"5) Road-cuts and road-banks that have unconsolidated soils.
"6) Culverts and bridges that alter flow and increase erosion.
"7) Roads without waterbars which allows fine sediment to be transported down the road surface
"8) Headcutting in Comanche Creek and tributaries that increase erosion.”
(NMED 1996:29-30)

Figure 2. Road Cut Beginning to Revegetate

Effects On Values

Beaver

Abandoned beaver dams are found in the headwaters of Comanche Creek and associated tributaries. Photos of Comanche Creek from the 1890s show no woody vegetation along the creek at all. However, the establishment of woody plant species such as willow is

possible and could contribute to the establishment of beaver in the main channel of Comanche Creek. Establishment of beaver would greatly accelerate the recovery of the Comanche Creek stream trout and riparian habitats.

Trout

The Rio Grande Cutthroat Trout (*Oncorhynchus clarki virginalis* – Figure 5) is the State Fish of New Mexico and once occupied nearly all mountain streams over 5,500 feet elevation in northern and central New Mexico (www.truchas-tu.org, March 2003). The species is now only found in isolated tributary streams, its numbers gravely reduced by habitat degradation, predation from exotic fish, and inter-breeding with other species.

Figure 3 Cutthroat Trout

(photo courtesy Frank Weissbarth, from www.truchas-tu.org)

These small, isolated populations are subject to genetic inbreeding, and cannot constitute a genetic "bank" able to repopulate larger watersheds following catastrophes such as wild fires or floods. Because the Rio Grande Cutthroat Trout evolved as part of the ecosystem of Northern New Mexico, its recovery is important to the creation and maintenance of a resilient and responsive native ecosystem in the Comanche Creek watershed. Rio Grande Cutthroat Trout predominate in the upper reaches of the Comanche Creek watershed, while most trout in the lower reaches appear to be a cross of Rainbow Trout (*Oncorhynchus mykiss*) with Rio Grande Cutthroat. A recent population survey by NMGF (2001) in Comanche Creek shows lower overall trout numbers in the middle reach than in either the upper or lower reaches. High stream temperatures are a major contributor to degraded habitat for the Rio Grande Cutthroat Trout. Recent temperature data collected by the USFS show that stream temperatures are acceptable in the box canyon of the upper reach, but worsen as the creek leaves the canyon and enters the open meadow areas of the middle reach where there is more direct sun exposure.

Healthy trout habitat requires a number of components. Ample vegetative cover provides protection from predators, a source of food, and cooler temperatures. These areas are provided in deep pools, undercut banks and shaded areas. Healthy watersheds with stable

channel morphology, riparian vegetation, high quality water will support a rich benthic macroinvertebrate community which in turn will support native fish populations. Less favorable conditions tend to favor non-native fish species who compete for scarce resources.

Elk

Hunting and observation of elk provide unique and compelling recreational opportunities for local communities and visitors alike. The upper portion of the Rio Costilla watershed is home to one of the larger elk populations in New Mexico. Last surveyed by NM Game and Fish in 2000, the herd numbers close to 2,500 individuals. The population structure shows 35 bulls per hundred cows, and 47 juveniles per hundred cows. The herd has increased slightly in population over the last several surveys. These elk range across the Comanche Creek watershed throughout the summer, but spend most winters on the eastern side of the mountains (Michael Catanach, NMG&F, personal communication, 2003). Grazing and browsing of riparian vegetation along Comanche Creek by elk, in addition to that by cattle, may contribute to TMDL exceedences of temperature and geomorphological instability, but the differences, if any, in the two species' impacts are not yet clear.

Forest Health

Years of fire suppression and restrictions on harvesting timber have created a stagnant forest of dense, doghaired thickets and a well developed fire ladder on both private and public lands. Historic overgrazing by cattle and now by elk has caused the influx of early invader and opportunistic plant species to predominate the plant community. This species mix and density is out-competing both forage and prime timber species leaving a barren and dry soil beneath the tree canopy, which accelerates the rate of various forces of soil erosion.

MONITORING AND ASSESSMENT ACTIVITIES

Water Quality

Formal, ongoing monitoring activities within the subwatersheds of the Rio Costilla have been ongoing since 2000. As part of the development of the TMDL, thirteen water sampling stations were established within the watershed (figure **). Grab samples were collected and tested. The results of these samples were reported in a water quality survey report. Two years of data were collected by the USFS in 1983-84 on watershed recreation and range (Moir and Williams 1985).

Upland Conditions

An initial assessment of upland conditions in the Comanche Creek watershed was conducted by The Quivira Coalition with support from the USDA Forest Service in conjunction with S319(h) Project (FY-01Q). The assessment consisted of a one-day

horseback trip through the upper Valle Vidal and Comanche Creek watershed followed by a three-day assessment on foot. This assessment followed the procedures outlined in *Interpreting Indicators of Rangeland Health, Version 3* (Pellant et al. 2000). The assessment report is included in this document as Appendix 1. This preliminary assessment determined that the majority of uplands are in good condition with clear signs of improvement; however, there are upland areas in need of additional management. Assessment activities in the Cordova Creek watershed included:

- A three day land health assessment of all ski runs and roads within Ski Rio;
- A one-day evaluation of drainage conditions along the upper reaches of Cordova Creek;
- An engineering survey of the creek channel adjacent to NM 196.

An upland monitoring protocol was implemented by The Quivira Coalition in October 2001 based on the USDA Jornada Experimental Range's Rangeland Monitoring Protocol ("Jornada Protocol"; Herrick et al. 2000). The objectives of the upland monitoring efforts are**:**

- Determining the stability of the watershed associated with Comanche Creek and its tributaries;
- Assessing contributing factors to accelerated erosion with emphasis on closed and open roads and grazing impacts;
- Determining if proposed treatments are effective in slowing erosion to acceptable levels.

Baseline data using the Jornada Protocol have been collected from eleven upland monitoring points. Digital Orthophotographic Quarter Quadrangle (DOQQ) maps were used in conducting the initial assessment and the monitoring. These and Digital Elevation Models (DEMs) serve as the base maps for GIS layers of the monitoring locations (see Map C) and other information.

Upland monitoring points were chosen according to a monitoring design defined to fit the priorities of the project. The following detailed site data were collected at each of the monitoring sites:

1. Photo points – permanent photo points allow qualitative monitoring of vegetation and landscape changes through time.
2. Line-point intercept for vegetative cover and composition – this is a rapid, objective way of assessing ground cover consisting of vegetation, litter, rocks, and biotic crusts, and involves recording the types of cover encountered at regular points along each monitoring transect.
3. Gap intercept or substitution of measurement to nearest perennial plant – gap intercept measures the proportion of a monitoring transect covered by plant canopy. Spaces greater than 20 centimeters are considered gaps.

The results of this monitoring are included in the Baseline Monitoring Report included here as Appendix 2. These monitoring sites will be re-recorded in September or October of 2004 and revisited at least every three years. Reference photos will be taken annually at each monitoring site (Figure 13).

In addition to the upland monitoring recently done by The Quivira Coalition, the Valle Vidal Grazing Association informally monitors forage amounts as part of their grazing operations.

Figure 4. Upland Monitoring Photo Point in Upper Comanche Creek Watershed

Geomorphologic Conditions

In 2001 Trout Unlimited completed a design for monitoring trout habitat and collected baseline monitoring data (Pittenger 2001, 2002) in Caommance Creek. This study identified excessive fine sediment, high water temperatures, and lack of adequate pool depth and cover as the major factors limiting Rio Grande Cutthroat Trout populations in Comanche Creek. Based on these findings the monitoring for trout habitat (separate from trout populations) will focus on measuring three habitat variables: (1) channel cross section; (2) stream bottom deposits; and (3) bank erosion. Three sites in the middle reach of Comanche Creek were recorded in the baseline monitoring for this project. Two sites (Treatment A and Treatment B) are within the cattle/elk exclosure and the cattle exclosure, respectively. The control site, subject to grazing by both cattle and elk, is located between the two treatment sites.

In May 2002 The Quivira Coalition, in association with Resource Management Services, Bionomics Southwest, and Bill Zeedyk, recorded the streambanks along both sides of the lower reach of Comanche Creek with a Trimble XRS GPS unit (submeter accuracy). This work also located willow colonies to be protected with exclosures constructed later

that season, and places where future in-stream structures will be constructed. The locations of the present exclosures were also recorded (see Map D). These data will serve as a baseline of stream form and need to be recollected as BMPs are implemented and changes begin to occur. As an adjunct to this effort historical aerial photographs (from the 1970s and 1981 – before transfer of the land to the USFS) were scanned and georeferenced into a GIS layer.

Riparian and Fisheries

In a fish population survey of trout in Comanche Creek performed in 2001, the New Mexico Department of Game and Fish found that the lower reaches of Comanche Creek were dominated by a rainbow/cutthroat trout cross (*Oncorhynchus mykiss/Oncorhynchus clarki*) while Rio Grande Cutthroat dominated the upper reaches. This same survey found that the middle reach of Comanche Creek, from Holman Creek downstream to Little Costilla Creek (refer to Map B), had noticeably reduced fish numbers when compared with the lower reach, between Little Costilla Creek and the Rio Costilla (NM Game and Fish 2001). In general, low fish numbers in this middle reach are an indicator of reduced habitat condition there. The report noted that the gradient in the middle reach decreases from upstream, causing water to slow and increase in temperature, and increased sediment (aggradation) was noted along the stream channel in this reach. The Forest Service also completed stream habitat surveys in Comanche, Middle Ponil, and McCrystal Creeks and the Rio Costilla in 2005.

It is desirable that all monitoring data be compiled in a GIS system, and that all monitoring information may be stored in a single location. The Quivira Coalition currently maintains a GIS compilation but it does not yet contain data from all members of the Working Group.

RESTORATION ACTIVITIES IN SUBWATERSHEDS

The 319(h) program has served as an important catalyst for restoration work within three major tributaries of the Rio Costilla. Each of these projects is summarized below. In addition to the Clean Water Act funded work, a related program by the New Mexico Department of Game and Fish and the US Forest Service to restore and protect Rio Grande Cutthroat trout habitat and population genetics is described.

Comanche Creek

Comanche Creek contributes 27,430 acres or 43 square miles to the Rio Costilla Watershed (Pittenger 2002). The headwaters of Comanche Creek lie at an elevation of roughly 10,400 feet. It flows north for 11.80 miles to empty into the Rio Costilla at an elevation of 8,940 feet. Spring runoff constitutes the peak flow of Comanche Creek, which usually occurs in May and June. The fall and winter months see the creek at its lowest (Pittenger 2002). Comanche Creek discharged 5.4 cubic feet per second in May 2000, 1.6 cubic feet per second in July, and 1.4 in October (NMED 2000a).

Comanche Creek from the headwaters to its confluence with the Rio Costilla is located on land managed be the US Forest Service. A WRAS for restoration activities within this section was prepared in 2002. The Comanche Creek Working Group (CCWG) was established in 2001 to integrate the efforts of several organizations interested in the restoration of Comanche Creek and Rio Grande Cuthroat Trout. The CCWG consists of:

- The Quivira Coalition
- The US Forest Service
- The NM Department of Game and Fish
- The New Mexico Environment Department
- NM Trout
- Trout Unlimited

Two EPA 319(h) grants have supported a variety of restoration efforts within Comanche Creek and surrounding upland areas since 2001. As of September 2005 a total of 171 treatments have been installed in within the Comanche Creek watershed. A brief summary of these restoration efforts follows.

Stream Channel Restoration

There have been a variety of efforts to stabilize and improve habitat along Comanche Creek and they have resulted in mixed levels of success. Revetment structures and small wood and rock in-stream habitat structures installed in the mid to late 1980s (see Figure 5) failed rapidly. Failure most likely was due to improper design, placement, and construction relative to channel characteristics, so they could not withstand heavy stream flows during spring and summer rain events.

Figure 5 Revetment Structure in Comanche Creek built in the late 1980s

Stream channel restoration has been the focus of a number of workshops organized by the Quivira Coalition. The primary focus of these workshops has been to install in-stream vanes and baffles to move water into or away from eroding banks in order to increase the meander of the stream channel. Restoration efforts have focused on the lower reach of

Comanche Creek from Little Costilla to the confluence of Comanche Creek and Rio Costilla. A total of seventeen high priority vanes have been installed under Clean Water Act Section 404 permits.

An assessment of the lower and middle reach of Comanche Creek was conducted in 2005. A total of 89 vane structure locations were identified for the middle reach. Nine of these were determined to be high priority and will be installed in July 2006. Other types of treatments planned for the middle reach include:

- Installing one rock dams;
- Constructing a new channel in select locations to enhance meandering; and
- Removing culverts

Elk/Cattle Exclosures

Grazing primarily from winter elk and partly from cattle had removed most of the historical willow vegetation along Comanche Creek. Cattle exclosures and separate elk/cattle exclosures constructed in the 1980s and 1990s were effective, but are now need repair or replacement. Three large exclosures were constructed in the mid-1980s that together enclose roughly 85 acres. One has been successful at regenerating aspen. These exclosures, in the middle reach, extend up the slope, away from the creek and as an unintended consequence also prevent trail formation by cattle. Some elements of these exclosures have been maintained or replaced with non-design elements that have rendered them less effective. With improvements in replacement materials and sustained maintenance these exclosures will continue to be effective.

In 1991 the New Mexico Environment Department and Carson National Forest cooperated in using a 319 grant from the U.S. EPA to stabilize erosion along Comanche Creek (NMED 1996). Five small, point-bar exclosures installed in 1994 remain in place and have been successful at propagating woody vegetation, especially willows. Efforts to plant cottonwood poles have had little success. Small structures have proven to be both effective in preventing elk from grazing and require less maintenance overall. Elk exclosures are now designed to withstand a 10-year flood event. Numerous cottonwood and willow volunteers have sprouted and survived within these exclosures helping to stabilize and re-establish the natural meander pattern of Comanche Creek. Riparian vegetation serves two purposes. First it stabilizes stream banks and protects them from erosion. Second, it shades water and making it cooler and therefore more suitable for fish and other aquatic organisms.

While limited in scope, the exclosures have demonstrated the potential effectiveness of these structures in restoring riparian vegetation - primarily willows – to the banks of Comanche Creek.

Initially, fifty five elk exclosures were planned for the lower reach of Comanche Creek. To date forty-four structures have been redesigned and reconstructed.

Figure 6 Young aspen growing within large elk exclosure.

Figure 7 Pipe gate on large exclosure – this gate is too low to effectively exclude elk

Figure 8Woody riparian vegetation growing within a cattle/elk exclosure built in the 1990s

(photo taken August 2002)

Roads

Roads are a major contributor to sediment and increased runoff during precipitation events. Over 300 miles of roads were constructed in the Comanche Creek watershed

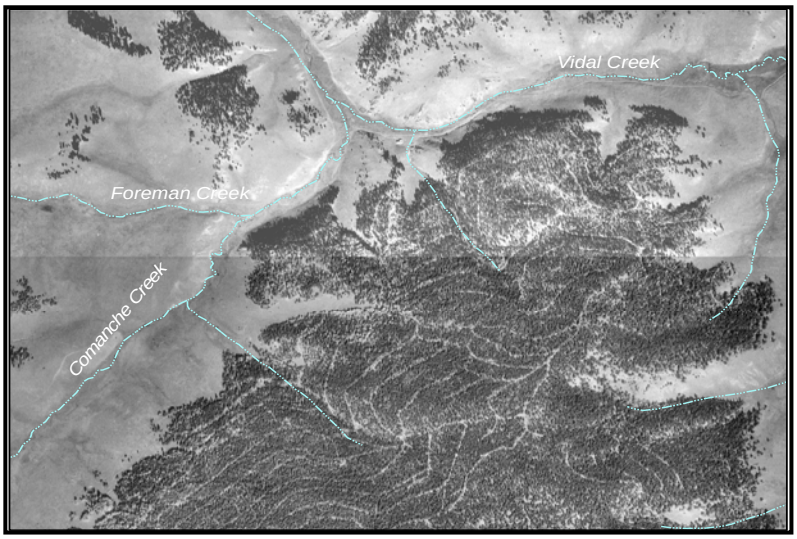

Figure 9 Roads from jammer logging near the confluences of Comanche Creek with Forman and Vidal Creeks. DOQQs from the late 1990s courtesy of USFS Carson National Forest. The line across the middle of the picture is the join between two aerial photographs.

A complete survey of major roads has been conducted within the Comanche Creek watershed. Initial condition and treatment recommendations have also been made. Approximately 11.7 miles of high priority roads have been stabilized with improved

drainage, rolling grades, dips, waterbars, and culverts either removed or cleaned. Another 1.2 miles of road have had full bench recovery i.e., restoring natural contours.

Upland Restoration

While upland conditions in the Valle Vidal are generally in good condition, there a number of areas contributing sediment to Comanche Creek. Sediment is most often produced from headcuts and erosion gullies that are the product of past human activity. Stabilization of headcuts and water harvesting and retention in gullies through the construction of one-rock dams has been the focus of upland treatments. Headcuts and gullies have been treated through volunteer workshops in Chuckwagon and adjacent unnamed tributary drainages. Wet meadow restoration work including a headcut control structure, work ditch and one rock dams have been completed on Holman Creek. La Belle Creek has been surveyed and a number of headcut and restoration opportunities identified.

Rio Grande Cutthroat Trout

The Rio Grande cutthroat trout originally occupied nearly all mountain streams over 5,500 feet in northern and central New Mexico. Due to habitat degradation, predation from exotic fish, and inter-breeding with Rainbow trout, they have now disappeared from all but the smallest, most isolated tributary streams. So far, the RGCT has escaped listing as an endangered species, primarily due to formal restoration plans by the New Mexico Department of Game and Fish and the U.S. Forest Service, and to the progress of a single major restoration project on private land. The New Mexico Department of Game and Fish have been actively working on the development and implementation of a program to restore native Rio Grande Cuthroat Trout (RGCT) to the Rio Costilla and its tributaries (NMDGF, 2002). Based on surveys conducted by NMGF in 2000 and 2001, RGCT are present in six creeks within the Rio Costilla watershed. These include: La Cueva Creek, Powderhouse Creek, Rio Costilla (above the confluence with Comanche Creek), Comanche Creek, and Vidal Creek. Because RGCT readily breed with nonnative species such as rainbow trout thus diluting the reproductive output and population viability of the sub-species.

The NMDGF has reintroduced RGCT along 18 miles of stream and four lakes within the boundary of Vermejo Park above the Costilla Dam. The reintroduction effort involved the removal of non-native fish, placing fish barriers and then returning the RGCT to the streams. In total, NMGF plans to restore a total of 150-170 miles of stream and 26 lakes to RGCT habitat. This effort will involve the combined efforts of Vermejo Park Ranch, the Carson National Forest, the Rio Costilla Livestock Association, and the Interstate Stream Commission. The analysis and the permits are completed for the temporary fish barrier on Comanche Creek. The engineering package is being put together the first quarter of the new fiscal year (FY06, October 1). The construction will be dependent on the logistics of the Costilla restoration, funding and water

flows. The earliest construction could be expected would be Aug/Sept of 2006 although that would be difficult to meet.

In 1991 the New Mexico Environment Department and Carson National Forest cooperated in using a 319 grant from the U.S. EPA to stabilize erosion along Comanche Creek (NMED 1996). Five small, point-bar exclosures installed in 1994 remain in place and have been successful at propagating woody vegetation, especially willows. Efforts to plant cottonwood poles have had little success. However, small exclosures constructed to protect existing willow plants provided a safe haven for the natural regeneration and establishment of cottonwoods and willows in the lower reach of Comanche Creek (Figure 9). Numerous cottonwood and willow volunteers have sprouted and survived within these exclosures helping to stabilize and re-establish the natural meander pattern of Comanche Creek.

Water-barring or obliteration of roads has been done in the past 3 years, though it is still not known which roads contribute the most sediment (Figure 10).

Figure 10 Water bar on old road in Comanche Creek Watershed

In 2001 a 319 grant from the U.S. EPA was secured by the Quivira Coalition (S319[h] Project FY-01Q). In August and September of 2002, as part of this grant, the existing exclosures were maintained and new small elk exclosures were constructed (Figure 11). Some willow pole planting was also done at this time.

Cordova Creek

Cordova Creek is located within the Sangre de Cristo Land Grant in the Sangre de Cristo Mountains which is situated in the north central part of New Mexico. The upper reaches of the Creek where erosion is most severe is located on private property owned by Ski Rio. The property consists of 3000 acres of which 910 acres are developed. The top portion of Cordova Creek watershed lies within Ski Rio property. Seven miles of creeks make up the headwaters within the Ski Rio portion of the watershed. Cordova Creek

drains approximately six square miles of watershed above the Ski Rio Day Lodge. Cordova Creek is a tributary to Rio Costilla within the upper Rio Grande watershed.

Seven miles of creeks make up the headwaters within the Ski Rio portion of the watershed. Cordova Creek drains approximately six square miles of watershed above the Ski Rio Day Lodge. Cordova Creek is a tributary to Rio Costilla within the upper Rio Grande watershed.

Slopes have been contoured and cleared for ski runs, and long much of its length, Cordova Creek has been modified from its original position y to make room for ski runs. Vegetation has been inadequately reestablished to prevent rills and gullies from forming on ski slopes. Up to a million gallons of water from snowmaking can be applied to the slopes in the form of snow in one application. The normal channel capacity of Cordova Creek is not adequate to carry the additional runoff from snowmaking, resulting in accelerated stream bank and bed erosion. Riparian vegetation has been

Figure 11 Erosion Along Ski Run On Ski Rio

removed or has been lost through severe erosion of Cordova Creek banks. The remaining riparian vegetation is in jeopardy because of down cutting of the stream and loss of floodplain function. Logs and wood debris left over from slope clearing remain within Cordova Creek channel and in some places is exacerbating the erosion problem. Because of increased slope runoff, culverts have become undersized and are creating severe headcuts and gullies.

Figure 12 Culvert Opening Almost Plugged

Figure 13 Roads and Ski Runs Have Altered Drainage

Cordova Creek has been monitored as part of the Total Maximum Daily Load process for exceedances of New Mexico water quality standards and has been listed on the 303d list for turbidity, stream bottom deposits, and total phosphorus. Non-point source contributions are associated with these exceedances. Pollutant source summary lists removal of riparian vegetation, streambank modification/destabilization, resort development, land development and recreation as some of the contributing sources. The BMPs proposed for this project will address these non-point sources to significantly reduce pollutant loadings in the headwaters of Cordova Creek. These BMPs include revegetating slopes, constructing water bars on slopes to areas where water will be most beneficial, and changing the characteristics of the creek to improve its stability and provide a cold water fishery habitat. The Creek will also be assessed for level of departure and restored to the extent possible to a functioning high quality cold-water fishery.

In addition to the erosion on Ski Rio slopes, substantial erosion results from unstable banks along NM 196. NM 196 was originally constructed in the Cordova Creek channel.

In order to build the road, extensive cuts and fills were constructed. These cuts and fills remain unvegetated and therefore highly susceptible to erosion during rain events.

High runoff during 2005 damaged the top half of the snow-making pond and has plugged most of the culverts running under the base of the ski area. Much of the material from the pond was carried downstream.

Figure 14 Bank Erosion Along NM 196

The New Mexico State Department of Transportation (NMDOT) has initiated a study to evaluate possible new locations for the road and to provide for at least an interim solution to the drainage issues along NM 196. A geomorphological survey was completed by the NMDOT in August of 2005. This survey will provide the data necessary to design and construct slope stabilization, energy dissipation structures within the creek channel alongside the roadway and to improve flows at road crossings.

Sanchez Creek

Sanchez Creek is located within the Rio Costilla Cooperative Livestock Association (RCCLA) Ranch. Sanchez creek flows from south to north where it joins the Rio Costilla, east of Amalia. The stream does not flow year round. The RCCLA Ranch is 80,000-acres, formerly the Carlos and Narciso Beaubian Land-grant. The Ranch is managed by the RCCLA which consists of a board and 182 members who are direct descendants of the original land grant owners.

The Sanchez Creek WRAS describes the water quality issues as follows:

"Over the past twenty years, Sanchez Creek has gone from a perennial stream to a seasonal seep, recently drying out shortly after the mid-summer rains. Historically, timber population density on this watershed had been managed by natural fires, harvesting of firewood for community use, removal of timber by local sawmills and by grazing of deer, elk, sheep and cattle. The last twenty years have brought in a significant cultural change in which virtually no woody material has been removed from this area.

In this time period, the population density of indigenous species of trees has increased to the point that sunlight and moisture are increasingly being excluded from the soil surface. Grass has been reduced to riparian areas and alluvial meadows. Invader species such as rabbit brush, sagebrush, juniper and Piñon have encroached into previously open meadows. This is creating a fire ladder connecting the meadow bottoms to the mountaintops with trees up to 60 feet tall making the entire area susceptible to a wildfire that can destroy the stream and the entire watershed.

Because of the problem of a reduction of groundcover by exclusion of sunlight and redution of soil moisture, spring runoff and seasonal flash flooding are causing surface soil erosion. This eroded topsoil is being transported into Sanchez Creek periodically and temporarily affecting the quality of surface water moving between the Sanchez Creek and the Rio Costilla Creek." (Sanchez Creek WRAS, 2004)

Actions to address these conditions include:

1. removal of woody vegetation (sagebrush and pinyon) from the EL Poso area to restore native grassland vegetation;
2. forest thinning to remove small diameter trees and other woody vegetation to promote soil stabilizing ground cover vegetation and to reduce the risk of crown fires.
3. Wet meadow improvement through the forest thinning and drainage/erosion control improvements.

Figure 15 Road Crossing on Sanchez Creek

Latir Creek

Currently no activities are occurring or planned on Latir Creek. Latir Creek is experiencing many of the same issues associated with other subwatersheds such as sediment from roads, over grazing, and deteriorating forest health.

PUBLIC INVOLVEMENT AND OUTREACH

The goal of the public involvement process is to ensure a multifaceted, proactive and responsive interaction among the working group, the public, and resource agencies. Public involvement within the Rio Costilla Watershed has focused on activities within specific subwatersheds. By far the highest level of public involvement has been on Comanche Creek which is public land and an area of high public interest. Other restoration projects have had much less public involvement due to the work being preformed primarily on private land.

Restoration of Comanche Creek involves the efforts of a number of organizations including the Carson National Forest, New Mexico Trout, Trout Unlimited, and the Sangre de Cristo Fly Fishers, along with the State Department of Game and Fish, for restoration of habitat for the Rio Grande Cutthroat Trout and other native fish species, and the New Mexico Environment Department (NMED) for riparian restoration.

Outreach

The target audiences for outreach are people in surrounding communities, recreationists, and interested parties throughout the region who could easily be considered "stakeholders" with vested interests in the continued health and viability of the Rio Costilla watershed. Outreach efforts focus on informing individuals and groups, including school children, about stream and watershed restoration in general, with activities in the Rio Costilla watershed as an example. Most of this audience is not expected to become directly involved in restoration activities, but can learn about the ecological processes involved with restoration through these materials. However, these outreach tools can also serve as a 'gateway' for those who would like to become directly involved with projects on Comanche Creek or in other watersheds.

Outreach Tools

- Printed Material – brochures and fliers, news releases, articles in media, working group member organization newsletters, etc..
- Video(s)
- Posters and other presentations at related professional conferences, fairs, etc.
- Talks by project personnel to interested groups in Taos and other communities in New Mexico or other regions with similar issues
- Talks and presentations to school groups
- Signage – for those recreationists who might visit the watershed but not be involved in restoration activities

Involvement

The target audience for public involvement strategies are those groups and individuals who are interested in and committed to being actively engaged in planning and on-the-ground restoration activities. This includes neighboring landowners, permittees, and all the stakeholders listed as already being active in the restoration of this watershed.

Involvement Tools

- Field Trips – tours of the watershed to present the problems, what has been done in the past and what is currently being done
- Workshops – learning opportunities related to the techniques and concepts being used in the watershed. These might be classroom based or outdoors and might be combined with field trips or work days.
- Workdays – with or without a specific educational component, workdays provide structured and supported (i.e. lunch and water) opportunities for groups to participate in implementing techniques – building structures, collecting data, etc.
- Volunteer Monitoring Program – conducted by project staffs (agency or n.g.o.), will provide training and field experience for those interested in learning how to plan, develop, and implement short and long term monitoring programs.

Public Outreach and Involvement Activities to Date

To a great extent, the progress currently being made on subwatersheds is the result of outreach and collaborative efforts by involved stakeholders. An active, ongoing outreach and education program has been implemented in Comanche Creek since 2001. This effort has been coordinated primarily by the Quivira Coalition with substantial support from the groups listed above.

Figure 16 Horseback Field Trip, Valle Vidal

The Quivira Coalition (see www.quiviracoalition.org) has organized and hosted a #### workshops on riparian restoration and will continue to organize and coordinate educational activities. Quivira has produced ### newsletters on related subjects (The Quivira Coalition 2002a; The Quivira Coalition 2002b). In addition, The Quivira Coalition will produce a brochure on watershed restoration and management specifically related to issues found in the Rio Costilla and Comanche Creek watersheds. Interpretive signs have also been created for educating members of the public who visit the area about the restoration activities underway.

Photo of sign

The NMED has presented posters on Comanche Creek activities at related professional meetings throughout the region.

The Truchas Chapter of Trout Unlimited (TU) (see www.truchas-tu.org) organized a stream geomorphology workshop in 2002. The Truchas Chapter provides periodic updates on the Comanche Creek restoration work on its web site and in its newsletters. The Truchas Chapter has also included posters on Comanche Creek activities at its general meetings and at sportsmen's conclaves. TU will continue to support the Comanche Creek work and Rio Grande Cutthroat Trout reintroduction efforts through public outreach activities.

A grazing workshop was organized for the RCCLA members in 2004 but cancelled at the last minute. RCCLA members have attended other workshops sponsored by the Quivira Coalition at other locations (e.g., Grazing Management held at the Jemez Pueblo).

The Best Management Practices (BMPs) proposed for the watershed will address non-point sources to significantly reduce pollutant loadings along Comanche Creek and its tributaries, and to reduce water temperature within Comanche Creek itself. These BMPs include revegetating disturbed areas, constructing water bars on slopes and closed roads to direct water to areas where water will be most beneficial, and restoring the geomorphological character of the creek to improve its stability and provide a high quality cold-water fishery habitat

DESIRED WATER QUALITY GOALS AND ACTIONS TO BE TAKEN

Current Goals

Four goals apply to efforts to improve water quality in the Rio Costilla. The projects implemented under this WIP will address:

- Reduction of temperature through stream bank revegetation and structural changes in major tributaries such as Comanche Creek;
- Sediment reduction through sediment retention;
- Vegetation and habitat improvement, both in uplands and in riparian/wetland areas;
- Restoration of geomorphologic stability; and
- Support and promotion of other watershed factors through public awareness, promoting economic development, and improved resource management.

These goals will be achieved through a variety of specific activities listed below:

- Improved water distribution through the proper grading and drainage of active and abandoned roadways;
- Improved management of cattle currently grazing on the Valle Vidal property;

- Riparian restoration with selective fencing and continued use of a herding grazing management strategy;
- Repair, relocation, removal, or supplementation of culverts to obtain proper water distribution in tributaries;
- Public workshops on grazing management and erosion control;
- A watershed archive/reference library housed in a single location that contains all reports, plans, photos one copy at least, and other information relevant to management of the Rio Costilla watershed.

Project Management and Coordination

As mentioned, work in Comanche Creek has been the most active and has shown the greatest results over the past five years. Actual project implementation has historically been coordinated by Forest Service personnel. Recently, however, The Quivira Coalition has coordinated efforts funded by their 319 grant, and many projects initiated by member organizations of the Working Group, while the Forest Service coordinates all other activities. Forest Service involvement has been positive, fully participatory and all indications are that the Forest Service will remain a key partner in the full success of restoration of the Comanche Creek watershed. The Forest Service continues to endorse efforts of the Quivira Coalition to coordinate and involve all key Stakeholders in the Comanche Creek watershed and it is expected that the existing relationship with Quivira Coalition and the Working Group will continue.

While there is certainly an enormous amount of work that still needs to be completed within Comanche Creek, the potential for watershed improvements is at least as great on the remaining private lands. As noted earlier, the majority of land within the Rio Costilla Watershed is privately owned (72%). Management of projects on these private lands are the responsibility of private land owners. The RCCLA and Ski Rio have taken the initiative to seek funding and implement projects on these private lands. The Ski Rio restoration activities were postponed until legal issues could be worked out between the owners but are likely to continue as soon as these are settled. The New Mexico Department of Transportation has also taken the initiative to take corrective action on NM 196 which is a public facility located on a private land easement. All these efforts have the potential to greatly improve the water quality within the Rio Costilla. There are already signs of increasing development in the area. The beautiful scenery and outstanding fishing opportunities will increasingly draw in people who are interested in maintaining and enhancing these values. Certainly the largest private land owners RCCLA and Ski Rio have become involved. The next challenge is to increasingly involve the smaller land owners, especially those who own properties along the Rio Costilla itself.

Future Actions

Implementation of the restoration plan will focus on the following categories of actions that are necessary to restore water quality and healthy watershed function in the Rio Costilla watershed:

Public Outreach

- Identify private property owners who might be interested in implementing conservation/restoration measures.
- Provide coordination support to assist in the planning and implementation of BMPs.
- Provide coordination support to assist in the planning and development of monitoring programs.
- Provide coordination support to assist in the development and implementation of the Watershed Restoration Action Strategy.
- Support volunteer days.
- Provide professional engineering support for the development of BMPs.
- Develop education materials and a newsletter.

Implementation of Best Management Practices

- Conduct additional road surveys
- Implement wet meadow restoration
- Perform earthwork, including road maintenance or recontouring, construction of appropriate erosion control structures to stabilize cut and fill slopes where appropriate, and reconstruction, removal or supplementation of culverts where they have failed or are causing additional erosion problems
- Construct sedimentation traps and apply slope stabilization methods on cutbanks for roads and ski runs
- Implement stream restoration/stabilization projects
- Implement forest thinning and prescribed burns
- Construct exclosures within Comanche Creek and other grazed areas to improve the vegetation condition in riparian habitats.
- Develop and implement noxious weed controls esp. for Canada Thistle.
- Work with grazing associations to minimize impacts to riparian, wetland, and wet meadow vegetation.
- Design and construct an in-channel fish barrier along Comanche Creek.
- Construct gabion structures and other erosion control structures in cut and fill areas along roadways.
- Implement additional fisheries management to maximize habitat opportunities for Rio Grande Cutthroat Trout.
- Implement additional road closures with water bars and sediment traps.

Permitting and Compliance

- Undertake appropriate cultural resource field surveys and undertake consultations with the State Historic Preservation Officer to satisfy National Historic Preservation Act, Section 106 requirements.
- Complete National Environmental Policy Act (NEPA) requirements for all proposed BMPs.

- Complete all necessary permitting such as US Army Corps of Engineers Section 404/401 Permits.

Data Gathering and Monitoring

- Conduct a fisheries assessment.
- Measure flow and monitor water quality in various segments of the Rio Costilla
- Conduct macroinvertebrate monitoring.
- Conduct a basin wide analysis of physical characteristics using remote sensing infrared technology.
- Establish photo points for key locations.