

# Management plan for the Rio Cebolla watershed Sandoval County and Rio Arriba County, New Mexico

Noreen A. Breeding<sup>1</sup>

---

**Abstract.**—*The upper 16.8 miles of the Rio Cebolla watershed were studied to identify water-related management concerns. Land ownership is divided among private individuals, the New Mexico Game and Fish Department, and the U.S. Forest Service. Recreation is the predominant activity, particularly fishing and camping. Other major land users are residents of the Seven Springs Community, cattle grazers, and fish hatchery employees. In 1994-95 a program to reintroduce now vanished Rio Grande cutthroat trout into the less accessible reaches of the river was undertaken.*

*Water quality problems include eutrophication of Fenton Lake reservoir, riparian damage, and heavy sediment in the river. As a result, fish productivity is low, fishing is poor, and scenic enjoyment is spoiled. A watershed management plan is proposed to remedy these problems. Implementation of the plan is cost-effective, as the benefit/cost ratio equals 2.5. Benefits are derived from the value of an angler day.*

---

## INTRODUCTION

Delineating the extent of a watershed or drainage basin may be the most appropriate means of defining the area to be managed in protecting water resources. In developing a plan to improve and protect trout habitat in the Rio Cebolla, activities in the entire watershed are considered and the watershed as a whole is taken as the management unit.

## PHYSICAL DESCRIPTION OF THE WATERSHED

The Rio Cebolla is a small perennial stream in the Jemez Mountains of northern New Mexico. It lies in the western section of the Santa Fe National Forest about 70 miles north of Albuquerque. The uppermost 16.8 miles of the river were selected for this project. This segment extends from the source at 9820' in elevation to the dam at Fenton Lake

Reservoir at 7674'. At 2.4% the gradient of the river is gentle. For the amount of activity it supports the river is remarkably small. In 1994 and 1995 stream flow ranged from a low of 3 cfs (cubic feet/second) to a high of 46 cfs. Stream width varied from less than two feet to eight feet; depth from six inches to 18 inches.

The downstream half of the river is situated in a steep, narrow canyon that is 800' deep in places. Meadows occupy about five miles of the confined riparian area there. The slopes and the rest of the valley is densely wooded with evergreen forest. The ridge along the eastern edge of the watershed is the rim of the ancient Valles caldera. For this reason, the rock of the area is primarily volcanic—tuff, rhyolite, andesite, and pumice, and the soil is very porous and highly erodible.

The watershed covers about 47 square miles. Land ownership is shared by three entities, the U.S. government, the N.M. Game and Fish Department, and the members of the Seven Springs Community. By far the largest portion of the land is controlled by the Forest Service. However, the other two entities own important sections of the riparian corridor.

---

<sup>1</sup> University of New Mexico, Geography Department, Albuquerque, New Mexico.

## CURRENT AND PAST LAND USES

In 1798 the area now in the Santa Fe National Forest south of Fenton Lake was deeded to the Canon de San Diego Grant. Sheep grazing was recorded there in the 1870s. From 1920 to 1973 the New Mexico Lumber & Timber Company logged the area extensively. In 1892 Elijah M. Fenton established a homestead and ranch along the river just north of the Grant territory. He began subdividing his land and selling lots in what is now the Seven Springs Community in 1913. In 1930s the N.M. Game and Fish Department purchased land from Fenton for a fish hatchery and reservoir. Fenton Lake reservoir was built in 1946 and the state park surrounding it was created in 1984 to regulate use of the area.

In terms of numbers of participants, recreation is the predominant land use today. Camping and fishing are very popular. There are three campgrounds in the watershed; a developed one at Fenton Lake State Park and two primitive campgrounds, one owned by the Dept. of Game and Fish and the other by the Forest Service. A state fish hatchery is also situated along the river. In 1994 the Forest Service requested that the Game and Fish Dept. reintroduce the Rio Grande cutthroat trout to the Rio Cebolla. It had been the native fish there until it vanished after the introduction of the exotic brown trout. The Game and Fish Dept. are removing all non-native fish from one section of the river into which they will transplant 500-1000 native cutthroats taken from local streams. This project is scheduled to be completed during the summer of 1995.

Another group who have a major impact on the watershed is the Seven Springs Community. It consists of about 50-150 year round residents dispersed among several dozen dwellings located along about two miles of the river. Many of the buildings are closely spaced along the river banks and several occupy wetlands. Cattle grazing is ubiquitous, with the possible exception of the fish hatchery grounds. In the summer of 1994 the National Forest pasture upstream of the Seven Springs Campground was severely overgrazed. Roads also have a major impact because they are numerous, unpaved, and heavily used. State Highway 126 is the major route. It closely parallels the river for about 7 miles, crossing it several times on small bridges.

Forest roads in the canyon bottom were closed to the public north of Seven Springs Campground in 1994 to protect fish and wildlife habitat. Heavy logging took place in the early 20th century, but there is little going on now. The last cut occurred at the head of Barley Canyon in the early 1990s.

## METHODOLOGIES USED TO LOCATE SITES OF EROSION AND SOURCES OF WATER POLLUTION

GIS (Geographic Information Systems technologies) were used to delineate the watershed boundary from which watershed area and river length were calculated. Slopes were also categorized by steepness. By overlaying roads and other land uses with slopes and water courses potential sites for erosion and water pollution were pinpointed. Only one road crosses a slope steeper than 60%. By creating buffer zones of varying widths along the river, it was shown that many roads and residences occupy the riparian corridor.

Water samples were collected at five sites along the river ten times in twelve months. They were chemically tested for concentrations of nitrate nitrogen and phosphorus. Results show that nitrate nitrogen levels are not particularly elevated. However, phosphorus levels frequently exceeded the New Mexico standard for a high quality cold water fishery of 0.1 mg/l. As readings at none of the sites was consistently higher than readings at the other sites, pollution sources appear to be non-point. Nitrate is not a major source of nitrogen in the Rio Cebolla. Further testing might find ammonia to be a significant nitrogen source.

The author has walked the length of the river and many side canyons in the study area and visited the watershed in all seasons of the year. The results of heavy use by humans and cattle are widely evident. Riparian vegetation and stream banks are damaged in many areas. Roads are very dusty. The soil is fragile and high erodible. The reservoir is thick with algae during the summer.

## WATER QUALITY PROBLEMS

Fenton Lake reservoir regularly suffers from eutrophication. Algae blooms occurred in 1982 and 1988. The water is shallow and consequently warm

in the summer. Levels of dissolved oxygen at this time of year are low and pH is often greater than ten. Macrophyte growth along the shoreline is dense. Shallowness is due to the natural morphology of the reservoir site, rather than to excessive sedimentation. Sedimentation rates appear to be low.

Sediment smothers the stream bed of the Rio Cebolla in many stretches. There is also a lot of riparian damage. Banks are denuded and broken down due to camping, roads, building construction, and overgrazing.

Fish are, at present, the beings most adversely affected by the water pollution. Their productivity in the watershed is relatively low. The lake cannot be stocked in the summer because pH shock kills fish added to the water. The riparian damage and excessive algae and dense macrophytes in the reservoir create unpleasant experiences for people.

## WATERSHED MANAGEMENT PLAN

Because of heavy watershed use and obvious degradation of fish productivity, water quality, and riparian areas, there is need for a management plan that will provide protection for the watershed from further abuse. This is especially true as no watershed wide plan exists now. The goals of the plan would be to ensure the success of the Rio Grande cutthroat trout reintroduction program while protecting riparian areas to permit them to recover, and improving water quality. Preservation of the 'natural' qualities of the area for future users is another goal.

The suggested implementation strategy for the plan would be to form a volunteer coalition of watershed users, landowners, and Forest Service and Game and Fish Department representatives. The coalition would have the responsibility for developing a watershed management plan, implementing improvements, acquiring funding, and employing a part-time administrator to keep the plan on schedule.

Recommended components of a watershed management plan for the Rio Cebolla are listed below. This plan would be in effect for 20 years.

- Complete the Rio Grande cutthroat trout reintroduction and, after 5 years, extend the range of these fish downstream.
- Close roads in riparian areas.

- Exclude cattle from riparian areas.
- Convert Seven Springs Campground to a pedestrian day use area north of the fish hatchery.
- Create a 10 meter wide buffer zone along the river for use of anglers and pedestrians only.
- Delineate a 60 meter wide buffer zone along the river inside of which roads and new construction would be prohibited.
- Gather water quality data continuously to monitor changing conditions.

## BENEFIT/COST ANALYSIS OF MANAGEMENT PLAN

Benefit/Cost analysis can help determine the effectiveness of management plans. In this case, benefits are derived from income from anglers. The value of an angler day is \$57.60 as determined by the Travel Cost Method (TCM).

**Travel Cost = (Distance X Cost of Operating Vehicle) + (Travel Time X Cost of Time)**

**\$57.60 = (140 miles X \$0.29/mile) + (4 hours X \$4.25/hour)**

The distance from Albuquerque to Fenton Lake round trip is 140 miles. About 4 hours are required to drive this distance. Minimum wage was used as the value of travel time.

It is estimated that there will be about 10,000 angler days on the Rio Cebolla in 1995. After 5 years, with the management plan in place, trout productivity should increase by 200%. The number of angler days should increase at the same rate. Over 20 years, the value of angler days with the plan would exceed the value of angler days without the plan by \$2,541,000 using an 8% discount factor, as shown in Tables 1 and 2.

The costs of the watershed management plan belong to 7 main categories. During the first year, the cutthroat trout reintroduction program must be paid for. After the fish become established in 5 years, this expense will recur as native trout territory is expanded downstream. The Forest Service will lose income from grazing when cattle are excluded from riparian areas. This will amount to \$1.98 per AUM for 168 cattle for 2 weeks per year. The price of fence materials for a 3.5 mile long, 10 meter wide buffer zone along the river is another

**Table 1 .-Value of fishing with watershed management plan (8% discount).**

Year	Number of angler days	Value of an angler day	Annual value of (000)	Present value of (000)
1995	10,000	\$57.60	\$576	\$576
1996	10,000	\$57.60	\$576	\$533
1997	10,000	\$57.60	\$576	\$494
1998	10,000	\$57.60	\$576	\$457
1999	10,000	\$57.60	\$576	\$423
2000	10,760	\$57.60	\$620	\$422
2001	11,578	\$57.60	\$667	\$420
2002	12,457	\$57.60	\$718	\$419
2003	13,404	\$57.60	\$772	\$417
2004	14,422	\$57.60	\$831	\$416
2005	15,518	\$57.60	\$894	\$414
2006	16,698	\$57.60	\$962	\$412
2007	17,967	\$57.60	\$1,035	\$411
2008	19,332	\$57.60	\$1,114	\$409
2009	20,801	\$57.60	\$1,198	\$408
2010	22,381	\$57.60	\$1,289	\$406
2011	24,082	\$57.60	\$1,387	\$405
2012	25,912	\$57.60	\$1,493	\$403
2013	27,881	\$57.60	\$1,606	\$402
2014	30,000	\$57.60	\$1,728	\$400
Total	333,194		\$19,192	\$8,649

Notes:

Discount rate for present value = 0.08

Annual discount factor = 1.08

Increase in angler days = 200%

**Table P.-Value of fishing without watershed management plan (8% discount).**

Year	Number of angler days	Value of an angler day	Annual value of (000)	Present value of (000)
1995	10,000	\$57.60	\$576	\$576
1996	10,000	\$57.60	\$576	\$533
1997	10,000	\$57.60	\$576	\$494
1998	10,000	\$57.60	\$576	\$457
1999	10,000	\$57.60	\$576	\$423
2000	10,000	\$57.60	\$576	\$392
2001	10,000	\$57.60	\$576	\$363
2002	10,000	\$57.60	\$576	\$336
2003	10,000	\$57.60	\$576	\$311
2004	10,000	\$57.60	\$576	\$288
2005	10,000	\$57.60	\$576	\$267
2006	10,000	\$57.60	\$576	\$247
2007	10,000	\$57.60	\$576	\$229
2008	10,000	\$57.60	\$576	\$212
2009	10,000	\$57.60	\$576	\$196
2010	10,000	\$57.60	\$576	\$182
2011	10,000	\$57.60	\$576	\$168
2012	10,000	\$57.60	\$576	\$156
2013	10,000	\$57.60	\$576	\$144
2014	10,000	\$57.60	\$576	\$133
Total	200,000		\$11,520	\$6,108

Notes:

Discount rate for present value = 0.08

Annual discount factor = 1.08

Increase in angler days = 200%

**Table 3: Benefit/cost analysis of watershed management plan**

	8% Discount	4% Discount
<b>Benefits:</b>		
Angler Income	\$2,541,000	4,327,000
<b>costs:</b>		
Cutthroat Trout Program	\$30,000	30,000
Lost Grazing Income	1,764	2,351
Administration	265,090	353,349
Fence materials for 10 meter buffer	14,434	14,434
Water Quality Monitoring	26,509	35,335
Cutthroat Trout Expansion	19,662	24,184
Parking Lot	370,370	384,615
<b>Total</b>	<b>\$727,829</b>	<b>844,268</b>
<b>Net Benefits (Benefits - Costs) =</b>	<b>1,813,171</b>	<b>3,382,732</b>
<b>Benefits / Costs:</b>	$1,813,171 / 727,829 = 2.5$ at 8% discount or	$3,382,732 / 844,268 = 4.1$ at 4% discount

cost. Volunteer labor will be used to erect the fence. The salary of a part-time administrator over 20 years and the purchase of water quality monitoring supplies and laboratory fees are additional costs. The largest single expense will be for closing the Seven Springs Campground, removing unwanted structures, and constructing a trail head parking lot for day users just north of the fish hatchery. Table 3 displays the benefit /cost analysis of the watershed management program. The final benefit/cost ratio of 2.5/1 indicates that benefits will exceed costs in monetary terms by a factor of 2.5 times (at an 8% discount).

## **CONCLUSIONS**

With study of the Rio Cebolla watershed and development of a management plan, several

conclusions have become apparent. Upstream of Fenton Lake dam the watershed is subject to heavy use from campers, anglers, a fish hatchery, cattle, and residents. As a result, water quality and riparian health are definitely degraded. However, measures to halt and reverse degradation, such as outlined in the management plan, would be cost effective as well as providing multiple non-priced benefits to users. To be successful, preventive measures are needed now to slow down decline. Action, rather than study, is needed at this point, although study should continue. Finally, a watershed-wide management plan with participation by representatives of all user groups would be much more effective than several uncoordinated plans developed by individual groups for unconnected segments of the watershed.