Prepared Pursuant to the Clean Water Action Plan and Unified Assessment of New Mexico Watersheds

DRAFT

Mimbres Watershed Restoration Action Strategy (WRAS)

July 2006

Prepared By: Meridian Institute, NM Environment Department and Grant Soil and Water Conservation District
(Under a 319 Grant Administered by Meridian Institute)

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Introduction

This Watershed Restoration Action Strategy, or WRAS, for the Mimbres Watershed of southwestern New Mexico was prepared to assist in guiding decisions for watershed-based restoration activities. This WRAS encompasses the efforts and goals of a diverse group of stakeholders in an effort to improve the overall health of the watershed. It does not mandate a solution and any participation in programs or actions identified in the WRAS are voluntary. The WRAS can facilitate the acquisition of grant funding for addressing sources of impairment. To ensure the long-term effectiveness of grant dollars, it is important that all improvements be maintained and monitored over the long term. This document will evolve along with these efforts.

Mission

The mission of this WRAS is to protect and improve the watershed's health for all users of the Gila River and its tributaries by 1) identifying watershed concerns, particularly those related to water quality; 2) defining desired conditions for the river and its watershed; 3) developing projects and strategies to achieve the desired conditions; and 4) locating the resources to implement such programs. In order to benefit from the collaborative efforts of a broad collection of interest groups in the Mimbres watershed, the WRAS and supporting activities seek to build local interest and involvement in defining the problems and implementing solutions aimed at reducing the impact of priority nonpoint source (NPS) pollution on the watershed.

Rationale for the WRAS

The federal Clean Water Act Plan of 1998 was developed to help meet the goals of the federal Clean Water Act (CWA) through state-led cooperative efforts. These efforts address water quality standards by identifying and prioritizing watersheds of concern. The CWA requires each state to identify surface waters within its boundaries that are not meeting, or expected to meet, water quality standards. In 1998, a statewide taskforce identified 21 out of 83 New Mexico watersheds a Category I, “in need of restoration.” The Mimbres River is designated as a Category I watershed. In the effort to meet CWA's goals, the US Environmental Protection Agency (EPA) requires development of a watershed restoration action strategy, or WRAS, designed to address the various planning, reporting, and funding issues related to restoration activities on watersheds of concern. This WRAS follows guidelines from the *Nonpoint Source Program and Grants Guidelines for States and Territories* (US EPA, 2003), and watershed action plans developed by groups in the Pecos and Santa Fe watersheds of New Mexico (Lower Pecos River Watershed Alliance, 2005; Santa Fe Watershed Association, 2002). The WRAS focuses on protecting water quality or restoring water quality that is currently impaired by high temperatures, fecal coliform and dissolved oxygen, or by some combination of these.

Components of the WRAS

The main objective of this Mimbres River WRAS is to improve the condition of the Mimbres Watershed to meet water quality standards and to restore natural hydrologic function to the

Mimbres River and its watershed. Specific goals and their benefits are numerous and include, but not limited to improving aquatic habitats, improving riparian and upland habitat for terrestrial wildlife, providing the foundations for sustainable economic use, protecting the health and safety of local residents and creating enhanced recreational opportunities for local residents as well as for visitors to the area. Organization of the WRAS addresses water quality issues in the Mimbres River Watershed of New Mexico by 1) defining the current condition of surface water and surrounding uplands in the watershed; 2) identifying areas in need of treatment; 3) defining desired condition for these areas and the remediation strategies that will best achieve such conditions; 4) establishing a schedule for treatment projects; and 5) providing estimates of the funds needed to complete the projects.

What this WRAS includes:

- Explanation of WRAS terms, its purpose, and its structure
- Description and maps of the Mimbres River watershed WRAS key elements:
- A list of existing, specific water quality impairments within the Mimbres watershed and their potential causes or sources (Element 1)
- Estimated NPS load reduction goals (Element 2)
- Planned management strategies aimed at reducing NPS loads and their locations (Element 3)
- Estimated funding and potential funding sources to support the implementation, maintenance, and monitoring of remediation measures (Element 4)
- A public outreach plan that outlines methods for engaging and maintaining involvement by local residents, visitors, and local, state, and federal agencies (Element 5)
- A schedule for implementation of remediation projects (Element 6)
- Descriptions of interim "milestones" by which success in implementing remediation projects can be evaluated (Element 7)
- The criteria used to measure progress in reducing NPS loads and attaining water quality standards (Element 8)
- A description of the monitoring programs by which water quality improvements will be evaluated (Element 9)

Watershed Description

The Mimbres River Watershed is located in the northeast portion of Luna and Sierra counties, central portions of Grant County, and on the eastern edge of Dona Ana County in the extreme southwest portion of New Mexico. Old Mexico in the south, Big Burro Mountains border it on the west, national forest on the north, and Sight and Potrillo Mountains to the east.

The Mimbres River (8-digit Hydrologic Unit Code 13030202) is classified as a closed river basin under New Mexico water quality standards (see New Mexico Water Quality Control Commission, 2006.) General and segment specific numeric and narrative criteria along with designated uses for the Mimbres River and its tributaries are set forth in State of *New Mexico Standards for Interstate and Intrastate Surface Waters*, 20.6.4.13, 20.6.4.803, 20.6.4.804 and 206.4.900 (20.6.4 NMAC, March 2006).

Designated uses for segment 20.6.4.804, which includes perennial reaches of the Mimbres River and its tributaries upstream of the confluence with Willow Springs Canyon [see maps 1 and 2], are:

- high quality coldwater aquatic life
- irrigation
- domestic water supply
- livestock watering
- wildlife habitat
- secondary contact

Bear Canyon Reservoir is situated at the downstream end of Bear Canyon, a tributary within Mimbres River segment 20.6.4.804 (above). Designated uses for Bear Canyon Reservoir are:

- coldwater aquatic life
- irrigation
- livestock watering
- wildlife habitat
- secondary contact

Designated uses listed for segment 20.6.4.803, which includes the perennial reaches of the Mimbres River and its tributaries downstream of the confluence with Willow Springs Canyon [see maps 1 and 3], are:

- coldwater aquatic life
- irrigation
- livestock watering
- wildlife habitat
- secondary contact

Map 3 shows the subwatershed area in which perennial reaches have been positively identified, on the basis of the downstream-most NMED/SWQB sampling location. However, many mapped springs within the Mimbres subwatershed downstream of Willow Springs Canyon lie outside of the boundary drawn around known perennial reaches. At least some of these springs may be sources for other perennial reaches on tributary channels to the mainstem Mimbres. We suggest that additional work to locate currently unidentified perennial reaches within this subwatershed be conducted.

Water quality criteria for perennial streams are more stringent than those applied to ephemeral or intermittent channels. In addition to the classified, TMDL-listed reaches of the Mimbres River and its tributaries listed above, a number of tributary streams in the Mimbres watershed are considered "unclassified" or have been "de-listed;" that is, they are no longer listed for specific TMDLs. In this region, de-listing frequently results from temporary drying of a stream that was once considered perennial, making water quality sampling impossible. Nonetheless, during seasonal runoff events, the de-listed reaches listed below contribute flow and sediment to perennial reaches of the Mimbres River, potentially impacting water quality in the mainstem. They are included here for that reason. Section 20.6.4.900 (NM Water Quality Control

Commission, 2006) gives both the narrative and numeric criteria to protect attainable or existing use for all reaches that are not named in the sections specific to designated reaches. Sections 20.6.4.97 and 20.6.4.98 900 (NM Water Quality Control Commission, 2006) give designated uses and criteria for ephemeral and intermittent waters not classified elsewhere, respectively. Designated uses of these channels include:

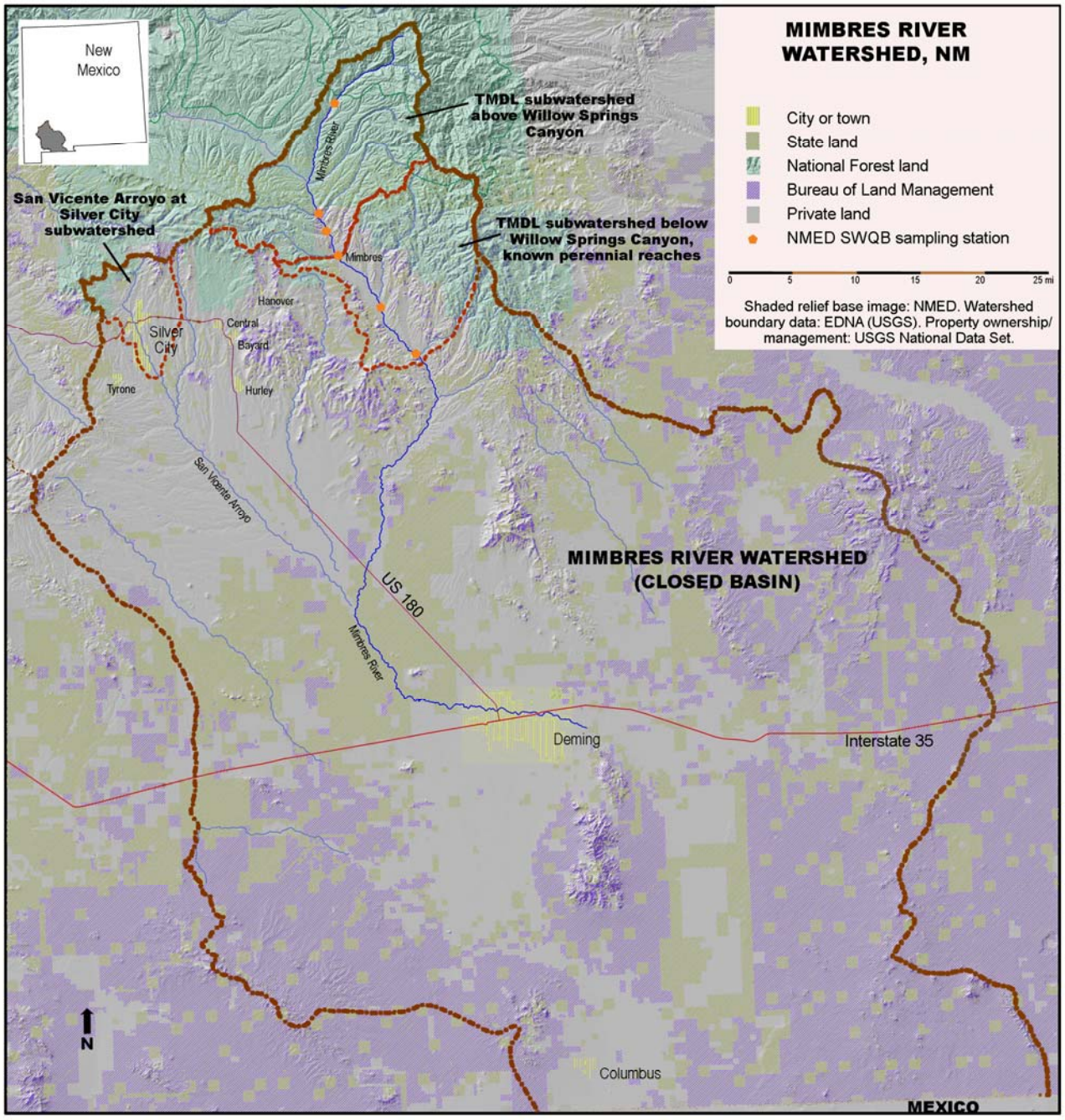
- livestock watering
- wildlife habitat
- aquatic life or limited aquatic life
- secondary contact

Four streams in the Mimbres watershed were delisted between 1998 and 2004:

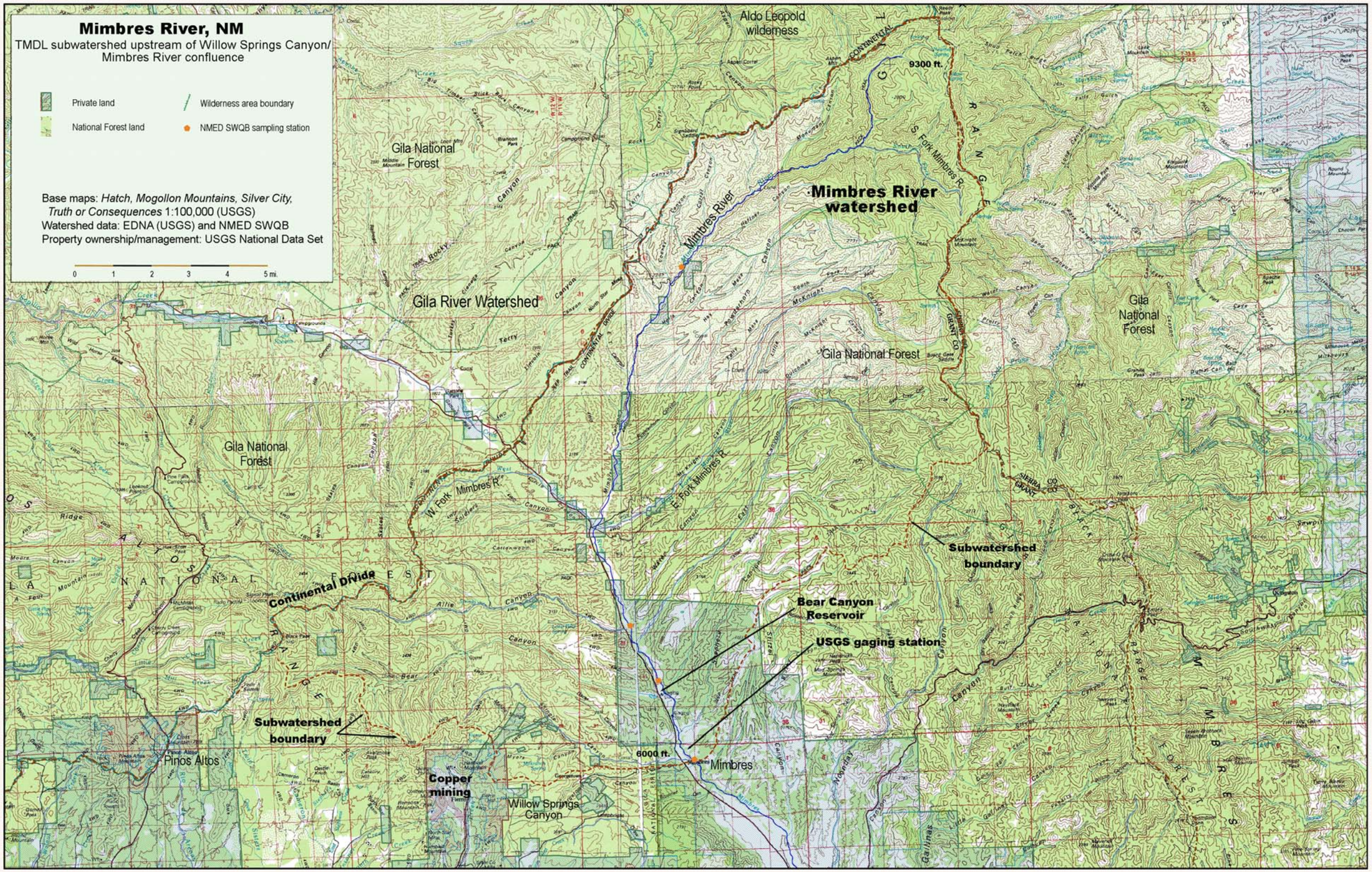
- Cold Springs Creek
- Gallinas Creek
- Hanover Creek
- Hot Springs Creek

Delisting of all of these streams occurred when they were determined to be intermittent or ephemeral channels, and therefore eligible only for criteria applying to the designated uses listed above; the impairments for which they had previously been listed no longer applied. Hanover Creek was delisted as of 1998, and the other three creeks were found to be dry during intensive water quality sampling conducting in 2002 (NMED, 2004.) This may have been a result of the ongoing regional drought.

Another currently unclassified but significant Mimbres watershed drainage is San Vicente Arroyo, with a drainage area of more than 300 square miles (198,000 acres) at its confluence with the Mimbres River about 35 miles downstream of the town of Silver City. San Vicente Arroyo lies within the Mimbres subwatershed downstream of the confluence with Willow Springs Canyon. Three creeks north of Silver City—Silva, Pinos Altos, and Little Walnut Creeks—merge to form the arroyo. Streamflow in reaches of San Vicente Arroyo within the town of Silver City is perennial, fed by numerous springs near the northern town limit. Where the arroyo leaves Silver City, its drainage area encompasses about 30 square miles (18,500 acres), extending north and west to the Continental Divide (see map 3). The arroyo is a prominent hydrologic and historical feature of the town; within Silver City it is famously known as the "Big Ditch." It formed during a series of floods in the late 19th and early 20th centuries that carved a 20-foot deep gully along the town's Main Street. The extremity of these floods is generally attributed to intense surface runoff that followed the denuding of the slopes surrounding Silver City for timber, firewood, and forage.

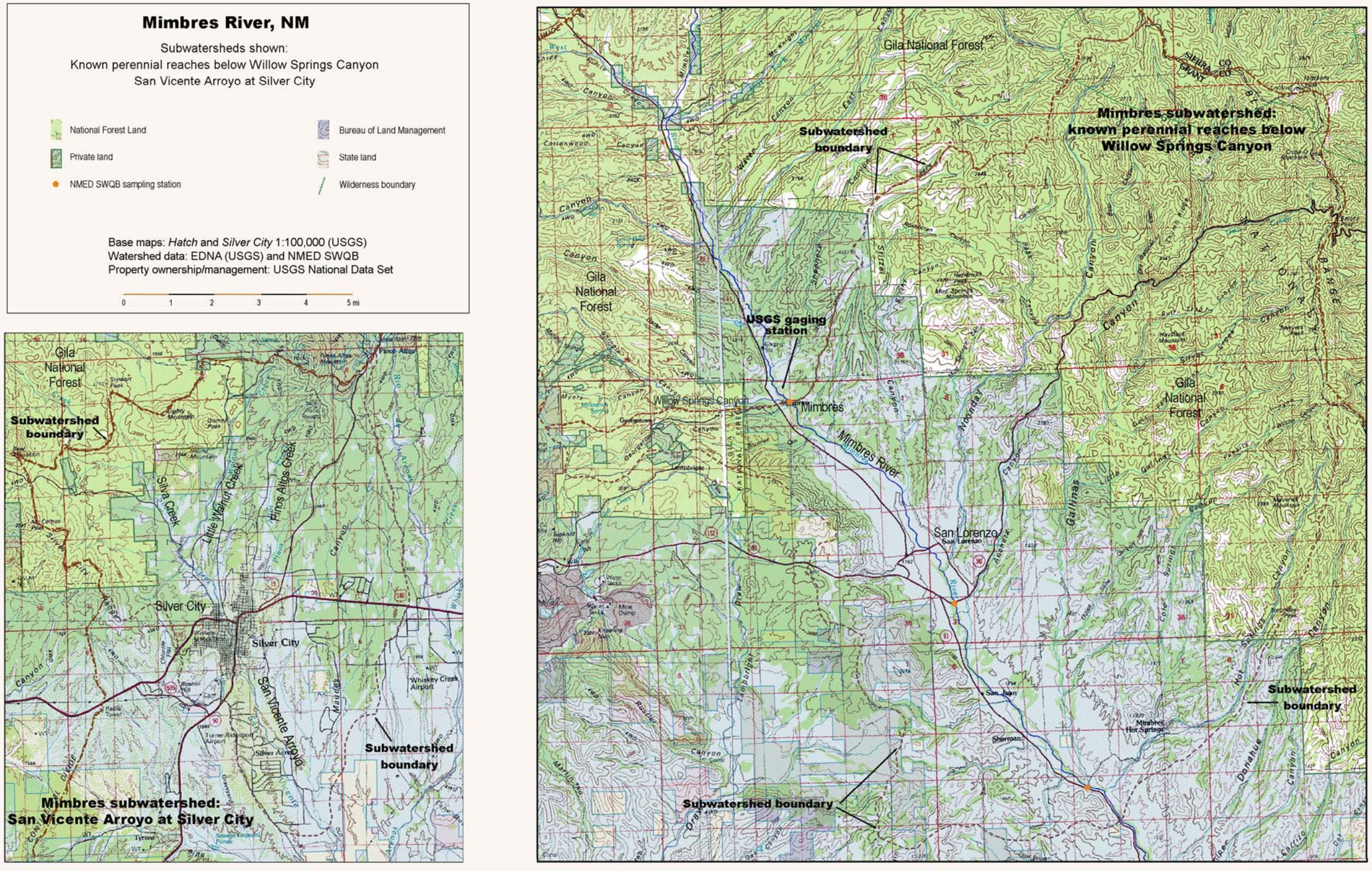


Map 1. Shaded relief map of Mimbres River watershed, showing property ownership/management status and NMED/SWQB sampling stations on mainstem.

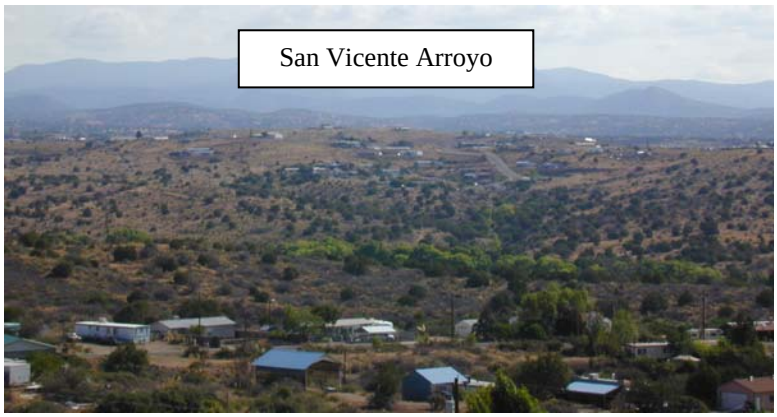


Map 2. Mimbres River subwatershed above Willow Springs Canyon.

Map 2



Map 3. Mimbres River subwatersheds: Below Willow Springs Canyon (right); San Vicente Arroyo at Silver City (left).



The town of Silver City and interested stakeholders have completed some remediation work on the channel, including landscaping and vegetation plantings, to enhance its aesthetic appeal within the town's historic district. One stakeholder group, the Gila Conservation Education Center , has proposed that sections of the arroyo and its tributary creeks be designated as state park lands, to be integrated into a pedestrian and education corridor through the town's historic central district. A potential wetland development is part of the proposal. Additional wetland potential exists on San Vicente Arroyo to the south, where treated effluent from Silver City's wastewater plant is treatment is discharged into the arroyo on a near-daily basis.

Geography and Geology of the Mimbres Watershed

The upper and middle reaches of the Mimbres watershed are located in Omerick ecoregion 23 (Arizona/New Mexico Mountains) while the lower reaches are in ecoregion 24 (Chihuahuan Desert). The elevation range for the various sampling sites in the survey was 7048’ to 4964’. The geology of the upper elevations in the watershed can be generally characterized as volcanic, with deep alluvium deposits situated in the main valley bottom. Elevations range from nearly 10,000 feet in the headwaters to below 4,000 feet in the lower desert. NMED SWQB water quality sampling sites range in elevation from 7048 feet to 4964 feet (see maps 2 and 3).

Soils

Soils in the Mimbres watershed range from very shallow, cobbly clay soils in the northern part of the watershed to deep gently sloping loamy or clayey soils in the south. Specific soil map units found within floodplains and channel areas include:

Paymaster-Ellicott complex

This map unit is on flood plains and alluvial fans. Areas are irregular in shape and are 2 to 200 acres in size. This unit is 60 percent Paymaster sand loam and 20 percent Ellicott gravelly sand. Paymaster soil is deep and well drained. It formed in alluvium derived from mixed sources.

Typically the surface layer is dark, grayish brown sandy loam about 14 inches thick. The substratum to a depth of 60 inches or more is grayish brown and dark grayish brown sand loam. The permeability of Paymaster soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. However, the wind erosion hazard is high. The soil is subject to very brief, but occasionally extreme periods of flooding in July through September.

Ellicott soil is deep and somewhat excessively drained. It formed in alluvium derived from mixed sources. Typically the surface layer is grayish brown gravelly sand about 8 inches thick. The substratum, to a depth of 60 inches or more is grayish brown sand and loamy sand with thin strata of finer textured material. Permeability of the Ellicott soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high. This soil is subject to brief, but occasionally extreme periods of flooding in July through September.

River wash

This map unit is found in intermittent stream channels. Slope is 0 to 3 percent. Areas are long and narrow in shape and are 3 to 150 acres in size. The unit supports little if any vegetation. River wash consists of sand, silt, and gravel that are periodically reworked by water.

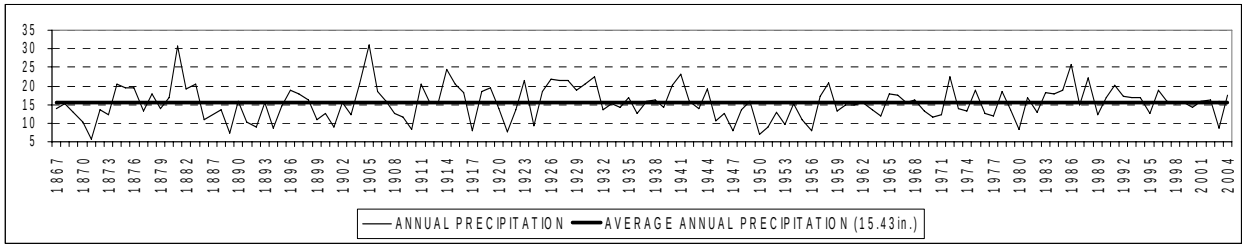
Streamflow: Mimbres River

Regional climatic variability is reflected in the discharge of the Mimbres River and its tributaries. The US Geological Survey operates a streamflow gaging station (number 0847710) just upstream of the town of Mimbres (see map 2). The gaging station is at an elevation of approximately 6000 feet. The contributing watershed area at this location is about 184 square miles. For the period of record, 1978–present, streamflow at the gaging station has been perennial. The average daily mean streamflow for the water years (October 1 through September 30) 1979–2005 was about 19 cfs. There is wide variation in annual maximum (instantaneous peak) streamflows, ranging from nearly 6400 cfs in 1984 to only 14 cfs in 1994. Minimum flows are somewhat less variable. Generally, streamflow calculated at the gaging station reaches its lowest values during the late spring and early fall months. Streamflow during these periods is often in the single digits. Some streamflow is diverted upstream of the gaging station; the upstream-most irrigated cropland in the Mimbres River valley is located in Grant County [see map 2]. The amount of water diverted is unknown, however. Total surface water withdrawals for the Grant County portion of the Mimbres River basin were about 3800 acre-feet in 1995 (Wilson & Lucero, 1998).

Climate

The average annual air temperature is 48 to 55 degrees Fahrenheit. The average frost-free period is 150 to 180 days. The Mimbres lies within a semi-arid region of the southwestern U.S., with the monsoon climate typical of this area. The average annual precipitation for the area (1867-2004) is 15.43 inches, but there is substantial seasonal and inter-annual variability in precipitation.

The following graph reflects the average annual precipitation within the Mimbres Watershed from 1867 to 2004. The average annual precipitation for the area is 15.43 inches.



Land Uses

Historic and current land uses in the watershed include agriculture (both irrigated pasture and rangeland grazing), silviculture, recreation, mining and municipal related activities. By far the largest town in the Mimbres headwaters area is Silver City, in the northwest corner of the Mimbres watershed at an elevation of about 6000 feet. The current population of Silver City is about 10,000 (2004 Census Bureau estimate). Modest urbanization and land use changes are also occurring in much smaller towns within the Mimbres River valley like San Lorenzo, San Juan, and Dwyer. Other small towns—Hanover, Central, Bayard, and Hurley—are clustered around the large open-pit copper mine at Santa Rita, a few miles east of Silver City. Far downstream at an elevation of about 4300 feet is the largest town on the watershed, Deming, population about 14,000 (2004 Census Bureau estimate). Irrigated pasture and croplands are located in the valleys. Coniferous forest, typically of Ponderosa pine, and pinon-juniper woodlands cover higher-elevation areas of the watershed, generally in the north.

Table 1
Land Uses Within the Mimbres Watershed

Land Use	Dona Ana Sq. Miles	Luna Sq. Miles	Sierra Sq. Miles	Grant Sq. Miles	Total Sq. Miles
Cropland	0.02	43.56	0.38	4.40	48.36
Range	503.05	2,648.50	103.11	816.15	4,070.81
Forest	0.01	8.57	5.43	320.25	334.26
Developed	0.30	11.65	-	3.97	15.92
Water	0.00	0.20	-	0.35	0.55
Other	0.04	1.13	-	14.63	15.80
Total	**503.43**	**2,713.61**	**108.92**	**1,159.75**	**4,485.71**

Much of the land ownership adjacent to the river is private with the exception of headwater reaches that are located within the Gila National Forest. The Nature Conservancy owns a limited number of small tracts along the middle reaches of the Mimbres, which it manages as conservation protection easements. The Bureau of Land Management and the State of New Mexico also own and manage sizable tracts of public lands in the upland portions of the watershed.

A breakdown of land ownership is as follows:

Total surface of the Mimbres Watershed: 4486 square miles
Lands administered by the BLM: 1,475 square miles, 33.4%
Lands administered by the DOD: 5 square miles, 0.1%
Lands administered by the USFS: 327 square miles. 7.3%
Private lands: 1589 square miles. 35.5%
Lands administered by the state trust: 1,061 square miles, 23.7%

Land uses in this watershed consist mainly of rangeland and areas of irrigated cropland-irrigated pastureland in the valleys with some forest and woodlands to the north. The watershed area combines the eastern edge of the Mogollon Rim with the Southern Desertic Basins, Plains and Mountains resource areas. The topography ranges from steep limestone juniper covered hills in the north to mixed brush and mesquite-covered plains to the south.

The Mimbres watershed has approximately 529 farm and ranch operating units. There are about 48 square miles of cropland within the watershed. The primary crops include pastureland, both of native and "improved" grasses, small grains, alfalfa, and other hay crops. There are approximately 4,071 square miles of rangeland area within the watershed. The ranches are primarily cow/calf and wildlife production operations.

Nine Elements of a Watershed Based Plan

Element 1: Water Quality Impairments

An identification of the causes and sources or groups of similar sources that will need to *be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X number of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).*


Unstable arroyo feeding into Mimbres River

The current condition of the Mimbres watershed is the result of the interaction between the natural and human history of the area. The cumulative effects of historic land uses and land management activities in the Mimbres Watershed affect conditions within the watershed, the mainstem of the Mimbres River and associated tributaries. These land uses and activities include: recreation, mining, grazing, road construction, drainage modifications, stream channel modification, fire suppression and residential development. These land uses in combination and individually have caused, altered or contributed to the

watershed's increased runoff volumes and frequencies, sediment transport, and fluvial regimes with subsequent changes in floodplains and their function. Steep slopes, an increase in woody vegetation and decrease in herbaceous vegetation have resulted in an increase in bare ground, all of which contribute to increased discharges from the watershed. These conditions make restoration efforts costly and measurable reduction in impairment loading difficult to evaluate.

Sources of impairments are defined in this WRAS as the current condition of the resource, not acceptable or unacceptable practices in the watershed and channel. The upland resource has experienced an increase in woody species. This loss, as in other areas of the southwest, is the result of past grazing practices, fire suppression and drought. The steep sloped uplands within the watershed are not rich in topsoil and are dominated by sand, gravels and cobbles to support vegetation. Once the already scarce soil resource has been lost, vegetation recovery is either slow or no longer possible without expensive external inputs.

Much of the watershed is private or leased property, and land management is largely dictated by personal choice. Any actions to address water quality issues in the watershed must therefore be completely voluntary.

Water quality impairments on the Mimbres watershed include the following.

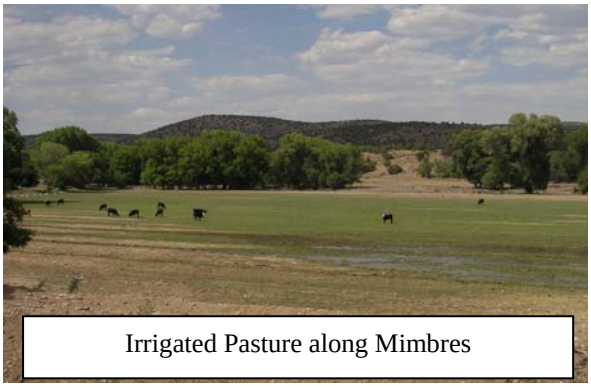
Mimbres River subwatershed upstream of Willow Springs Canyon confluence (WQS 20.6.4.804/AU NM-2804_00): DISSOLVED OXYGEN; TEMPERATURE

Bear Canyon Reservoir (WQS 20.6.4.504/AU NM-2804_00): DISSOLVED OXYGEN, PLANT NUTRIENTS (Note: mercury may also be of concern)

Mimbres River subwatershed downstream of Willow Springs Canyon confluence (WQS 20.6.4.803/AU NM-2803_00):
FECAL COLIFORM; TEMPERATURE

Current Land Uses sited on the 303(d) list that may contribute to causes or sources of impairments in the Mimbres Watershed include:

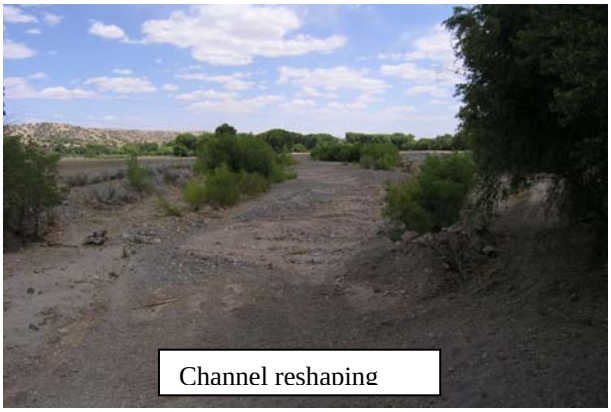
- Irrigated Crop Production
- Grazing by wild and domestic animals
- Dredging and mining activity
- Loss of Riparian Vegetation
- Heavy equipment use to reshape flood prone areas and maintain irrigation berms
- Urbanization: increase in impervious cover
- Unimproved roads, road crossings, and culverts



Irrigated Pasture along Mimbres

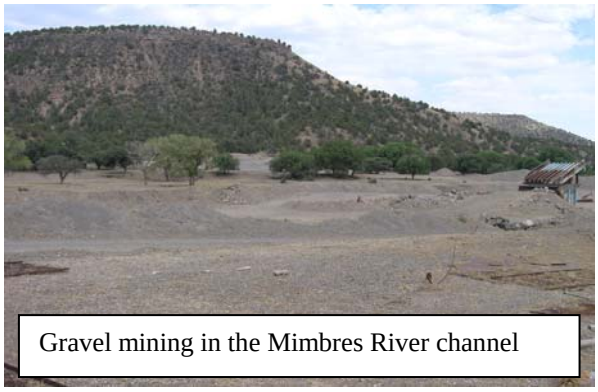
Impairments recognized on the Mimbres reaches, dissolved oxygen, fecal coliform and temperature can result from one or more of the practices listed above. It would be difficult, however, to point to any one of these as the sole cause or source of impairment. Elevated levels of plant nutrients may be derived from irrigated crop

production, using fertilizer for the slow release of nitrogen, phosphorus and potassium. These substances can increase aquatic plant life and aerobic bacteria, decreasing available dissolved oxygen in surface waters. Grass and other vegetative cover also help to filter these materials from surface runoff and groundwater, and their absence accelerates delivery of such contaminants to stream channels. Domestic grazing animals in the watershed can also increase the volume and frequency of discharge into the Mimbres channel due to loss of groundcover. These animals also contribute to increased nutrients and fecal coliform in the river. Increased discharges may alter the channel form creating a more shallow braided reach, thus increasing water temperature and decreasing dissolved oxygen.


Channel reshaping

Some landowners who own riverfront property currently protect their lands and river access by the use of large equipment to reshape the channel. While this achieves their immediate goals, the practice can contribute to channel instability, creating a shallow, braided system within over-widened stream banks. Over the longer term, the resulting channel instability threatens irrigation diversions and pipelines, reduces the productivity of stream bottomlands, and impacts downstream neighbors when heavy sediment loads are deposited during flood events. In addition, channel instability increases the likelihood of recurrent damage requiring continuing investment of time and financial resources for mitigation. When land use practices add to channel instability, they exacerbate the tendency of the region's natural climatic and streamflow variability to create morphological change in stream channels. For example, floods in this region typically exhibit steep hydrographs: that is, streamflow during the beginning and ending stages of the flood rises and falls very abruptly. Flood erosion frequently occurs during the late stages of a flood event due to the rapid recession of floodwaters from wetted fields and streambanks. The flood of record for the period, in December 1984, was typical. Peak streamflow during the flood was calculated by USGS at about 6400 cfs. However, daily mean flow for that date was only 2500 cfs, suggesting a rapid rise, fall, or both, in flood stage. The most recent major flow event, on February 12, 2005, probably peaked well above 2000 cfs (USGS, 2006). Daily mean flow for that date was about 1800 cfs. This flood caused considerable morphological change in the Mimbres River channel around the town of Mimbres and substantial loss of fine-textured field soils, including streambank.

Bare ground has replaced former herbaceous and shrub cover due to encroachment by woody upland vegetation, historic intensive grazing practices, fire suppression, mining and periodic drought. The steep sloped uplands within the watershed are not rich in topsoil. Where the primary soil resource has been lost, recovery is slow in this climate. Rates of runoff over exposed soils are higher than from any other cover type, contributing to periodic high-intensity floods in the Mimbres River and its tributaries. In addition, some stream bottomlands are undergoing development into subdivided parcels with greater impervious cover that also contributes to increased rates of runoff and channel discharge.



Gravel mining in the Mimbres River channel

Elevated discharges may alter the channel form creating a more shallow braided reach, thus increasing water temperature and decreasing dissolved oxygen. Any dredging or mining activity using heavy equipment within the channel reach alters a number of physical properties that contribute to increased temperature and reductions in dissolved oxygen. Riparian vegetation has a strong influence on channel form and function. The root systems of many species help to stabilize alluvial channel banks, and the shade cover provided by woody species lowers water temperatures, increasing the availability of dissolved oxygen in the water. Its absence, conversely, destabilizes channel banks, increases temperatures, and lowers dissolved oxygen availability.

Residential Development with private hangers and landing strip

Numerous landowners whose domestic wells are hydraulically connected with the Mimbres River channel have noted problems with fecal coliform in their water supply. Current conditions in the watershed indicate that coliform bacteria may be a result of septic leach associated with increased urbanization of the river bottomlands, old or 'out of compliance' septic pools, and/or poorly designed leach fields. However, due to excessively steep slopes and current range conditions, livestock or recreational animals may be confined to floodplains and terraces, thus creating an additional potential source for coliform. (Fecal coliform sources could not be determined in our evaluation of watershed field conditions.) Sampling and analysis to determine the source(s) of fecal coliform in groundwater and surface flows is needed.

The bottomlands have been affected by greater urban use and subdivided parcels are now a major land use in the portion of the watershed above the crossing with Highway 152. Driveways and roads associated with this land use increase impervious surfaces that contribute to the larger discharges into the channel and floodplain.

Roads for forest management, recreation, logging, grazing allotment access and other purposes cover a total of 7400 "inventoried" miles on the Gila National Forest (GNF). In addition to unsurfaced roads on Forest Service land, there is an extensive informal dirt road system on private lands. Road density averages on forest lands are 1.54 mi per square mile (USDA Gila National Forest, 2003). The Forest analyzed condition, economic benefit, and potential hazards created by 724 miles of forest roads in late 2002 (USDA GNF, 2003). Among a number of indices assessed in the report are various parameters associated with the roads' potential effects on water quality and stream condition. The report notes that roads can have several effects on the hydrology of a watershed. These can include interception of rainfall directly on the road surface and cut banks, expansion of the channel network, conversion of subsurface flow to surface flow,

concentrating of flows, [and] diversion of water from normal flow paths...Road-stream crossings have the potential to directly and indirectly affect local stream channels and water quality. These crossings can be a major source of sediment to streams...Higher volumes of traffic and an increased density of non-paved roads, additionally, add to the negative impacts that sedimentation may cause to water quality and fish and macro-invertebrate habitat. [pp. 34-36] Loss of trees and woody riparian species, within the road corridor and adjacent to streams, can potentially reduce shade coverage, expose surface waters to more sunlight, and increase water temperatures. [p.38]
They assigned one of two possible values in their rating for risk to watershed condition (potential impacts on water quality and inherent erosion hazard): HIGH – The road management situation will hinder attainment of state water quality standards. The road density is greater than 3 mi/mi2. Road has drainage features directly connected to the stream network. Road is within a stream's 100-year floodplain, within 200 feet of a stream or within 200 ft. of a stream's associated 100-year floodplain. Road exists in sensitive soils subject to surface erosion and/or mass movement. Road is on a cross slope exceeding 40%. LOW – State water quality standards can be achieved through assigned road management standards. Road is located mostly in inherently stable soils and is on a cross slope less than 20%. Road is greater than 300 feet away from stream channel and its associated 100-year floodplain.

Road issues fall into the following categories:

- Poor drainage due to lack of water bars.
- Poor drainage due to entrenchment of roadway
- Water bars and drain spurs that have filled with sediment and are no longer functional
- Water bars that have breached and are channeling water along the roadway to the next water bar.
- Improperly located roads typically in valley bottoms.
- Informal roads created either to access new areas for woodcutting, hunting or rock collecting.

Element 2: Load Reduction Estimates

An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).

Our recognized impairments; fecal coliform, dissolved oxygen and temperature will be at best difficult to reduce. Because the sources of water quality impairments in the Mimbres watershed are derived from both upland and near-channel sources, only concerted efforts over time and substantial geographic scale will significantly reduce contaminant loads in the Mimbres River and its tributaries. The watershed-wide scale of impacts, both from uplands and near-channel sources, implies that measurable improvements in watershed function and water quality are likely to occur only over a long time frame and substantial geographic scale. Therefore, the

WRAS assumes that both early and longer-range remediation and management practices, and careful monitoring of results, will allow efforts to be evaluated and modified over time. Individual treatments measures and expected responses are given below. NPS management measures are described in Element 3 below.

Mitigation measures to decrease water temperatures are expected to achieve an 8% decrease in temperature within treated reaches, over the long term. For dissolved oxygen, we expect measures to achieve an increase of 5%, again, over the long term. Until the source(s) of fecal coliform contamination are adequately identified, it is impossible to project the load reductions to be achieved. The management measures to address coliform bacteria contamination from leaking septic systems, for example, will vary greatly from those adopted to slow runoff of animal waste into stream channels. However, management measures used to address the other contaminant issues—temperature, plant nutrients, and dissolved oxygen—will probably have positive effects on animal waste runoff, as well. Likewise, the source(s) of plant nutrients into Bear Canyon Reservoir are not well understood; a reduction to TMDL levels may require a number of years.

Coliform bacteria may be a result of septic leach associated with increased urbanization of the river bottomlands and old or 'out of compliance' septic pools and/or poorly designed leach fields as well as domestic livestock including horses and cattle. Landowner education about the potential effects of sewage and livestock runoff on water quality is currently the only means to address the issue of fecal coliform impairment. Discussion on the issue at stakeholder meetings produced a defensive reaction on the part of some residents who felt they were being singled out unfairly. Currently there are no direct regulatory or programmatic solutions to this issue. One solution to the domestic sewage issue is the development of a sewage treatment facility within the Mimbres valley. For many reasons, including fiscal limitations, this solution may not be forthcoming soon.

Bank and overflow treatments will be subject to extreme flood conditions and designs will be limited to engineered practices that have the ability to survive such flood flows. Riparian areas that are affected by agriculture practices have not been identified by stakeholders since these practices are economic choices and may affect overall stakeholder input. Given the reluctance of most stakeholders to utilize 319(h) funds, it is doubtful at this time, if on the ground practices will be implemented to create buffer systems between the river and agricultural land. Modifying agriculture practices within the Mimbres mainstem is voluntary. Education will be the primary means for creating change in this area.

Element 3: NPS Management Measures

A description of the NPS management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

Upland Treatments

The Mimbres District, Gila National Forest has on-going forest thinning program in the upper-most Mimbres Watershed, partially funded through previous 319(h) grants. The NMED will continue to assist where needed to provide the Gila National Forest with supplemental funding for additional thinning projects. This monitoring will enable the Mimbres Watershed Planning group to calculate an estimated load reduction based on watershed discharges or overland flow, its relationship to the fecal coliform impairment and channel stability, and its relationship to channel form and temperature.

The Bureau of Land Management (BLM) has been developing on the ground practices in lower portions of the watershed for the last three years to rehabilitate grasslands from encroaching brush species such as juniper, creosote and mesquite. BLM managed grasslands will be treated mainly through prescribed grazing management. Chemical herbicides will be used for controlling noxious weeds and utilizing a 0.5-mile buffer between stream channels using pelleted Tebuthiruon in brush control will provide additional protection of perennial streams. Prescribed fire will be used to maintain these treatment areas where grass fuel are sufficient to achieve proper burning technique. Approximately 677,690 acres of BLM managed lands have been scheduled for prescribed burning and 1,080,530 have been targeted for herbicide control. The Natural Resource Conservation Service (NRCS) in Deming has approached NMED SWQB in Silver City regarding the continuation of these grassland treatments on private property to increase the contiguous area of BLM treatments. These areas are all within the Mimbres River subwatershed downstream of Willow Creek Canyon (see map 1), although targeted areas are not delineated on the map.

Stream Bank Stabilization

NMED SWQB, Silver City, is currently working with the Silver City NRCS office to implement projects utilizing a combination of NRCS EQIP and 319 funding on private lands within the Mimbres watershed. Initial projects under development include construction of silt fencing on the mainstem Mimbres channel, brush thinning, and gully control work in the subwatershed upstream of Willow Creek Canyon. Proposed treatments on private properties include gully plugging to control runoff on approximately 1100 acres and approximately 2.5 miles of stream bank stabilization fencing to control bank instability and decrease the width to depth ratio of the Mimbres mainstem. Future projects under discussion include installation of infiltration galleries or cross-vane weir structures for irrigation diversions to decrease the channel destabilizing use of heavy equipment to maintain diversion berms.

Bank and overflow treatments will be subject to extreme flood conditions and designs will be limited to engineered practices that have the ability to survive such flood flows. Additional riparian areas affected by agriculture practices will be identified over time, and where possible, creation of buffer systems to intercept runoff from agricultural fields will be prioritized. Where appropriate and desired, management practices aimed at slowing runoff and improving soil infiltration rates and streambank stability will be introduced.

Private property owners have also approached the NMED Silver City Surface Water Quality office for a variety of land practices; however, education will be the largest effort to help explain and demonstrate how individual practices affect the listed impairments. In time, private individuals can reapply for 319(h) or combined funds to target needed improvements that have a direct relationship to water quality. Two practices that are to be planned and implemented with 319(h) funds are the NRCS Streambank Stabilization Fence and gully control using critical area treatments. These projects will be regarded as demonstration projects for local residents and outside groups to show the benefits of restoration. Photo documentation, one of the monitoring methods in our established protocol will be employed with these practices to show increased stabilization.

Landscape Fire Management

Fire has historically been a natural disturbance process in ecosystems such as the Mimbres. Other natural and human disturbance processes such as drought, grazing, woodcutting, road construction and use also play a major role in determining the health of the Mimbres Watershed. Prior to European settlement and fire suppression activities, the frequency of fire in the Mimbres ranged from 3 – 40 years. Ponderosa pine fires were the most frequent – occurring from 3 – 10 years and fires in grasslands and pinon-juniper savannahs and woodlands the least frequent. Fires had the effect of removing understory growth of both shrubs and young trees. The lack of fire can be seen today in the dog hair thickets found in much of the woodland and ponderosa pine areas. A number of species require fire for nutrient cycling, for seed scarification and seedbed preparation. Many species, such as ponderosa pine, require fire for spacing to be maintained and for protection from extreme, destructive fires.

Extreme fires produce a number of undesirable consequences. The intense heat produced by moderate-severity fire, or flames that reach buds, can damage or kill mature trees. Severe surface or crown fires generally kill interior ponderosa pine of all size classes, although some saw timber-sized trees might survive severe surface fire. The intense heat produced in crown fires often sterilizes the soil making the reestablishment of vegetation difficult and slow. Soils are more exposed and for a greater length of time thereby increasing the likelihood of erosion. Heavy accumulations of litter at the base of trees increase the duration and intensity of fire, making trees more susceptible to scarring. Resin deposits around an old "cat-face" may increase bark flammability and promote further injury

Single burns will not likely provide long term, sustainable results. Instead, a program of regular low intensity fire is most desirable to maintain open forest and woodland areas with low to moderate under story biomass. Pine needles and other litter tend to accumulate over time, choking out grasses and increasing fire hazards. In addition, woody shrubs that are easily killed by fire germinate readily from seed and may require reburning before the new generation matures and produces viable seed. Managed fires are expensive, unmanaged fires are even more expensive. While a return to a more natural fire regime would be desirable from an ecological perspective, the constraints of financial resources and increasing development may limit the use of managed fire in the Mimbres. With a mixture of management approaches over time, however, a large destructive fire will hopefully be avoided.

Fire will be a critical tool if large-scale landscape restoration and management is to be implemented in the Mimbres. However, the increasing residential development within the watershed, makes the watershed less and less tolerant of large-scale fire as a treatment/restoration tool.

Wildfire Management

Coordination and development of a wildfire fire management strategy between the Forest Service public land and private landowners is a desirable but challenging goal. Development of a regional fire management map patterned after the Malpais Borderlands Group in southwestern New Mexico and southeastern Arizona may be a useful first step in this process. The map documents and facilitates how various types of wild fires will be managed especially in areas that have the potential to cross from one property owner to another. Development of the map requires agreement between property owners and managers on the management of specific types of fires in specific locations. These agreements are documented on the map that is used by an Interagency Zone Fire Dispatch.

Without a prearranged fire management plan or strategy, the Zone Fire Dispatch is responsible for making appropriate decisions regarding the dispatch of fire fighting resources depending on a variety of factors. These factors include natural hazards, risks to private and public property, season, and the availability of fire fighting resources and other fires within the Zone or region. If dispatchers fail to make appropriate dispatch decisions, they, or the agency can be liable for damages. As a result, development of a comprehensive plan will require careful consideration of many factors and extensive coordination between all parties involved.

A fire management strategy might include three categories of fire management:

1. Suppress. This option might be selected if property owners do not consider fire to be an appropriate land management tool or around areas with expensive infrastructure or habitation.
2. Consult with owner to address time dependent special concerns. These concerns might be seasonal or that a pasture is being rested to provide feed during the next growing season. Fires occurring during the hot dry months following spring cool season growth could cause more damage than good if allowed to burn too hot. Consultation between the dispatcher and property owner would determine if the fire should be suppressed, contained or controlled.
3. Contain and control is an option for landowners who believe fire is an appropriate restoration tool in almost all conditions. The contain and control strategy allows a wildfire to burn a larger area with containment provided by an easily defensible location such as a road or other natural barrier. When fire reaches the predetermined location, it is monitored until it is out and can be declared out. Generally this is the lowest cost suppression alternative, but not always.

The Dispatch Agreements are displayed on a map. The three categories are displayed by color code. Land ownership is delineated and the owners name and prime phone number are listed. There are two versions of the map. A landowner map has all involved agencies names with

responsible individual name and phone number. The Zone Dispatch and fire agency map has the land-owners name, prime phone number and alternative phone numbers.

When a fire occurs, other than suppress immediately, landowners, the dispatcher and agency personnel communicate quickly to develop containment and control strategies. A qualified Incident Commander is assigned and identifies a containment location and strategy along with acreage and cost estimates and resources needed to monitor and ensure containment as planned.

Prescribed Burn Strategy

In many situations, fire is desired as part of an integrated approach to improving ecosystem health. Prescribed fires are pre-planned at a specific location, burning condition, and funding source. Prescribed fires are not funded by fire suppression funds. Prescribed fires often need some form of pretreatment to insure a controlled, low intensity burn. These pretreatments may include thinning understory trees and leaving the trunks on the ground to reduce fuel load and to keep fires from crowning. Fires in meadow areas may require rest to build sufficient fuel to carry a fire. Prescribed fires require coordination with the New Mexico Environment Department Air Quality Bureau. Picking appropriate times when smoke is more readily dissipated in the atmosphere and limiting the size of the burn areas can mitigate smoke related impacts and concerns. Prescribed fires generally produce less smoke load than wildfires by spreading the burning over a longer time period. Prescribed fires also provide for greater protection of historic and cultural resources. Prescribed fires, being cooler, also produce fewer of the finest particles that are most harmful to human health.

Pre and Post Fire Strategies

As mentioned above, fire frequency has been reduced since European settlement. This reduction in frequency has led to an increase in tree cover and density and an increase in fuels both on the ground and standing. Where heavy fuel loads occur near sites of concern, near valuable infrastructure, or to the extent that prescribed fire can't be safely carried out or ecological damage may occur, some form of mechanical thinning or other fuels reduction will be needed as a pre-fire treatment. Likewise, where trees have established in grasslands, they may now be too large to be controlled by grass fires. Also, they may have out competed grasses- especially during drought conditions – to the point where grass is ineffective in carrying a fire. Cutting these trees down will allow for more fine fuel growth and will provide slash to enable prescribed burning. Rest from grazing will also allow the last growing season fuels to be available to carry a fire.

Regular prescribed burns have proven in many areas to be effective in reducing fuel loads and enhancing both diversity and production of grass and shrubs. Positive effects are generally seen in 3-5 years. The growth of fine fuels (i.e., grasses and shrubs) support low intensity maintenance fires in the future.

During the first years following a fire, there is a greater risk of increased erosion from bare hillsides. With low to moderate intensity fires, however, not all litter is removed from the soil

surface. This litter protects the soil from increased erosion. The relatively flat terrain found on the Mesa makes increased erosion caused by fire a relatively minor concern.

Roads

Specific actions to improve the condition of roads and reduce the production of sediment from two track roads in the Mimbres include:

- Work with the US Forest Service Ranger District office to update and prioritize road conditions.
- Provide training to road users on low maintenance road construction and how to prevent damage to two track roads.
- Maintain key travel roads to ensure proper functioning of waterbars and other drainage
- Relocate roads to improve drainage.
- Close roads experiencing high levels of erosion and gullying

Element 4: Funding Needs and Sources

An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

The purpose of this WRAS is to enable agency personnel and willing landowners to locate the resources—technical and financial—that enable them to adopt remediation and management practices to improve the economic and ecological viability of their lands over the longer term. NMED will continue to work with other agencies on the Mimbres watershed to achieve this goal.

It is the intent of any watershed plan to identify opportunities where limited funds can be used for the greatest benefit. Restoration of severely damaged areas can often involve high up front costs and subsequent high maintenance costs over time. Management of areas in relatively good condition can often result in maintaining functions at a relatively low cost. The challenge is to find where in the watershed, the greatest benefits can be realized over time for the least cost. In order to achieve cost effective restoration and long-term management in the Mimbres, a holistic approach will be used to unite residents within the watershed through educational developments, demonstration projects and forums.

The Grant Soil & Water Conservation District currently has approximately 80 cooperators in the Mimbres Watershed. The cooperators, who are agricultural producers, are eligible to receive technical and financial assistance from USDA, Natural Resources Conservation Services in the form of Farm Bill funding. The Environmental Quality Incentives Program (EQIP) was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help

to assist eligible participants install or implement structural and management practices on eligible agricultural land.

The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP USDA's Natural Resources Conservation Service provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed.

The Mimbres Watershed was one of 220 watersheds nationwide selected to participate in the Conservation Security Program (CSP). CSP is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. Working lands include cropland, grassland, prairie land, improved pasture, and range land, as well as forested land that are an incidental part of an agriculture operation. The program is available in all 50 States, the Caribbean Area and the Pacific Basin area. The program provides equitable access to benefits to all producers, regardless of size of operation, crops produced, or geographic location. The Farm Security and Rural Investment Act of 2002 (2002 Farm Bill) (Pub. L. 107-171) amended the Food Security Act of 1985 to authorize the program. CSP is administered by USDA's Natural Resources Conservation Service (NRCS). "While conservation incentives programs and technical assistance to farmers and ranchers date back to the Dust Bowl days of the 1930s, CSP represents the first time agricultural producers are being paid not just to fix a problem, but in recognition of their ongoing stewardship and to maintain and further enhance that conservation commitment." said Rosendo Treviño III, state conservationist for USDA's Natural Resources Conservation Service.

The Grant Soil & Water Conservation District also has an established MOU with the Gila National Forest, Bureau of Land Management, USDA Natural Resources Conservation Services, and the New Mexico State Land Office. These working with different agencies and our work with private property owners will help to facilitate on-the-ground work within the watershed.

Since 2001, the Grant Soil & Water Conservation District has acquired grant funding through the New Mexico Energy, Minerals and Natural Resources Department, Forestry Division for the purpose of assisting landowners in thinning trees on private property to improve fire safety in the Wildland/Urban Interface. In the past four years there have been 256 landowners approved to treat 845 acres. Of these, 730 acres of thinning have been completed. It is anticipated that the remaining 115 acres will be completed by December 2005. These treatments have used $562,736 federal grant dollars and been matched by in-kind and cash totaling $409,732. In 2006 an additional $250,000 has been awarded to be used in Grant County and it is anticipated that an additional 300 acres will be treated with this funding. This funding and treatment is entirely within the Mimbres Watershed in Grant County.

Element 5: Education and Public Outreach

An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

Since education involves a working relationship with landowner/users, much of our efforts to enhance understanding have taken place with individuals that own or use property along the channel. From the first meeting introducing the 319(h) program to resident stakeholders, it was apparent That education would be a central component and challenge of any watershed restoration and manage effort in the Mimbres Watershed.

The development of successful Partnerships and a common vision based on collaborative approaches to watershed health are critical to long-term success but will be difficult to achieve. For example, many of the residents who attended meetings did Not understand the need for improvements nor could they visualize a reduction in impairments such as fecal coliform or temperature by upland and channel treatments. Many did not relate water temperature to fishery health. Some residents felt that relating coliform bacteria to animal waste singled out the agriculture community. In short, many residents do not understand the need for restoration.

Education will need to focus on funding opportunities for restoration and identifying ecological opportunities on private property that not only protect and enhance ecological values but land values as well. Individual property rights and the sense that what one does on one's property is nobody else's business are strong beliefs among residents of the Mimbres watershed community. To the extent these attitudes prevail, little collaborative restoration or large-scale improvement is likely to occur. Any action in the near term will depend on individual property owners working on their own parcels and hoping the actions of upstream users do not impair any restoration actions taken.

Currently, the planning team is coordinating efforts with the Grant Soil and Water Conservation District and is utilizing the expertise of their project coordinator in order to further enhance the working relationships between landowners and the planning team. Educating stakeholders about the benefits of collaboration will be a long-term process.

The most effective education tool is on the ground demonstration combined with tours to give property owners access to see the effects of projects on the ground. Holding workshops or other educational events is not likely to draw many private landowners.

It is expected that for further refinement of the WRAS, a WRAS Subcommittee of diverse stakeholders will be critical to the implementation of best management practices and monitoring protocols. The Final WRAS will be disseminated broadly in order to further educate Mimbres Watershed Stakeholders about the document, its benefits and about future projects.

WRAS Subcommittee Members should include representation from the following agencies and stakeholders:

- US Forest Service
- BLM
- NM State Forestry
- NRCS
- NM Environment Department

- Grant Soil & Water Conservation District
- Grant County
- Conservation Organizations
- Land Owners
- Others

Element 6: Implementation Schedule

A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

The planned practice schedule is based upon stakeholder's input and prioritization of expected desirable results. Since federal lands are subject to Decision Memos, Categorical Exclusions, and resource surveys under the National Environmental Protection Act (NEPA), scheduling will be influenced by the federal management agencies' budgets and priorities. The chart below lists planned practices with estimated time frames and areal or linear extent for each.

Table 3
Schedule and Scope of BMP Implementation

PRACTICE	SCHEDULE	ACRES/LINEAR FEET
Riparian planting	2007	1000 feet
Upland thinning	On-going	
Prescribed burning	On-going	50,000 acres
Streambank stabilization	2006-2007	12,500 feet
Brush control/grassland rehabilitation	2006-2010	13,000 acres
Permanent diversion structures	2008	1
Gully/critical area control	2006-2007	1100 acres

Element 7: Milestones

Measurable milestones focus on goals and responsibilities to control, abate, and prevent Non Point Source pollution within the Mimbres Watershed. A list of applicable BMPs within each subwatershed area is provided in the matrix beginning on page 32. The table also identifies potential stakeholder partners for each measure. An important short-term goal for the Mimbres Watershed is developing, securing funding, and implementing an on-the-ground project to encourage stakeholder participation. The Grant Soil and Water Conservation District, Natural

Resource Conservation Service, and Black Range RC&D will provide additional technical support and funding (when possible) to assist the private landowners with project development funding, and implementation of BMPs.

Element 8: Criteria to Determine Load Reductions

The SWQB Parameters of Concern are temperature, fecal coliform, and dissolved oxygen. Criteria for determining load reductions will include both direct and indirect methods. Direct methods are the best criteria for determining load reductions.

Temperature load - The direct method for determining temperature load reduction would require the deployment of temperature data loggers for measuring water temperatures. Data collected would consist of hourly measurements from May through September. This method of data collection is preferred by the SWQB for intensive water quality surveys and can be used for regulatory assessment and development of TMDLs. Indirect methods of determining temperature load reduction would require estimating temperature reduction based on the effect of increased riparian canopy cover or decreased width/depth relationships in selected stream channel reaches.

Fecal coliform load - The direct method for determining fecal coliform load reduction would require intensive water quality sampling and chemical analysis as performed by the SWQB and State Laboratory Division (SLD). This type of direct method would be best conducted by the SWQB and SLD as part of their regular monitoring schedule for New Mexico surface waters. The indirect method of determining fecal coliform load reductions is to estimate the reduction based on reduction in erosion and stream sediment load. Any on-the-ground project proposal using an indirect method to determine load reductions resulting from BMP implementation would need to outline the method and the rational for using the method.

Dissolved oxygen loads – The direct method for determining dissolved oxygen load reductions would require the use of dissolved oxygen meters similar to those used by the SWQB for intensive water quality surveys. An indirect method would employ the measurement of the relative increase in canopy cover or shading.

Plant nutrient loads – The direct method uses sampling and measurement of nitrogen and phosphorous and of aquatic plant production to evaluate reductions in plant nutrients delivered to the stream channel. Indirect methods include measurements of diurnal fluctuations of dissolved oxygen and/or pH (indicators of aquatic plant production), or a measured increase in the area of buffer zones between agricultural areas and streambanks. Increased buffer zone area is assumed to increase the capacity of soils to filter excess plant nutrients that may be derived from agricultural production (fertilizer application, for instance).

Element 9: Monitoring

A monitoring component to evaluate the effectiveness of the implementation efforts over *time, measured against the criteria established under item (h) immediately above.*

Monitoring strategies under this watershed plan will be designed to: 1) evaluate the effectiveness of converting poor condition lands to a more productive, stable state due to the inordinate amount of up-front cost and maintenance required; 2) utilize the watershed plan to identify practices that maintain fair- to good-condition lands in static condition with little cost and maintenance required to keep those lands in a stable state. Estimated load reductions will be directly monitored using SWQB monitoring and assessment protocols, the same tools used to ascertain impairments and established TMDLs.

The monitoring component is becoming established in the Gila National Forest on other currently funded projects. We are standardizing the method for estimating runoff and sediment detachment using the line intercept transect with clipped plots to estimate percent bare ground, frequency and composition of herbaceous species, estimated pounds per acre of each herbaceous species and soil movement by the hill slope erosion model. Range sites are selected using soils information, the departure of each site from estimated vegetation potential, slopes, soil hydrologic class, all of which will be able to estimate runoff discharges and the affect the plant community on estimated discharges. Physical properties of the channel will be measured to plot and estimate the affects of upland and channel treatments to width and depth ratios and channel slope. Much of the estimated load reductions will be directly monitored using the Surface Water Quality Bureau monitoring and assessment protocol; the tool used to ascertain impairments and established TMDLs.

Current activities on forest lands with 319(h) monies include a particular monitoring protocol that measures relative basal cover compared to bare ground, with the incorporation of the hill slope erosion model. We are also standardizing the method for estimating runoff and sediment detachment using the line intercept transect with clipped plots to estimate percent bare ground, frequency and composition of herbaceous specie, and estimated pounds per acre of each herbaceous specie. This monitoring will enable the Mimbres group to ascertain an estimated load reduction based on watershed discharges or overland flow. Physical properties of the channel will be measured to plot and estimate the effects of upland and channel treatments on width to depth ratios and channel slope.

Both NRCS and BLM have monitoring protocols to measure the improvement of brush control and will be able to estimate increased infiltration and decrease in runoff discharges. Range sites are selected using soils information, the departure of each site from estimated vegetation potential, slopes, soil hydrologic class, all of which will be used to estimate runoff discharges and the effect of existing plant communities on estimated discharges. Photo documentation, one of the monitoring methods in our established protocol, will be employed with these practices to show increased stabilization.

Table 4
Ongoing Monitoring Activities

Project/Target System(s)	Lead	Area	Data	Indicators	Ecological Factors
Woody riparian vegetation change: Riparian plant community mosaic	Skartbedt, TNC	Mimbres River and tributaries	% cover by major specie. Channel slope	% cover of major specie	Plant community composition and structure
Jornada rangeland health assessment and monitoring	JER, TNC	Mimbres River, Gila River	Various Hydrologic, biotic, soils, quantitative and qualitative	Multiple	Hydrologic function, soil stability, biotic integrity (plant community composition and structure)
Riparian forest response to flood pulse	Jacobson, TNC	Mimbres River, Gila River	Groundwater elevation. Various measures of plant physiology. Forest composition and structure	Multiple	Flow regime. Nutrient dynamics.Woody plant recruitment
Fish and amphibian population sampling in stream system	NMDGF, GNF, USFWS	Mimbres River, Gila River: Mainstem and tributaries	# and sizes of individuals. Reproductive condition.	Population size and Structure. Reproductive success	
Rangeland condition surveys. Mid-elevation upland plant community	GNF	Portions of Gila and Mimbres sites within the Gila National Forest	Plant specie diversity. % cover by specie	Grassland/woodland Structure and composition	Hydrologic function, soil Stability, biotic integrity (plant community composition and structure)
Channel morphology, water quantity and quality	USGS, NRCS, BOR, NMED	Limited studies on the Mimbres mainstem	Discharge, turbidity, channel shape	Discharge, turbidity, channel shape	Sediment budget, temperature regime, flow regime, fluvial geomorphology
Repeat photography on the Mimbres riparian zone	TNC, NMED	Mimbres mainstem	Permanent photo points	Qualitative measurers of riparian forest structure And composition of channel morphology	Plant community, composition and structure

ABBREVIATIONS

BOR – Bureau of Reclamation
Jacobson – David H. Smith Fellow
Peter Jacobson – Grinnell College
JER – Jornada Experiment Range
NMDGF – NM Game and Fish
NMED – NM Environment Department
NRCS – USDA Natural Resource Conservation Service
Skartbedt – Peter Skartvedt
USFWS – US Fish and Wildlife Service
USGS – US Geological Survey
TNC – The Nature Conservancy

IMPAIRMENTS, SUGGESTED MANAGEMENT PRACTICES, AND POTENTIAL PARTNERS: MIMBRES RIVER WATERSHED

Impairment: **Fecal coliform** **Identified in:**	**BMPs**	**Potential Partners**
Subwatershed downstream of Willow Springs Canyon	Identify leaking septic systems, if any	Grant County, NMED, Property Owners
	Develop and implement sampling Strategy for fecal coliform in Tributary channels and mainstem To identify source(s): human, livestock other	NMED/EPA Property owners Grant County USFS BLM
	Develop and implement Remediation strategies which may include:	
	Replacement of leaking septic systems	Grant County Property owners
	Development of water treatment facility. Potential wetland sites identification, design, construction or remediation (improve filtration capacity)	NMED/EPA NRCS BLM US Forst Service Grant SWCD Conservation organizations Property owners
	Grassland remediation and recovery (improved filtration and infiltration capacity)	NRCS NMED US Forest Service Grant SWCD Conservation organizations NM State Forestry Property owners
	Riparian cover remediation (improved filtration and infiltration capacity)	NRCS NMED US Forest Service Grant SWCD Conservation organizations NM State Forestry Property owners
	Education/outreach: Inform property owners of impairment sources, funding/technical support available, liaison with appropriate agencies	NRCS NMED US Forest Service Grant SWCD Conservation organizations NM State Forestry Property owners

Impairment: **Dissolved oxygen** **Identified in:**	**BMPs**	**Potential Partners**
Subwatershed upstream of Willow Springs Canyon, including Bear Canyon Reservoir	Improve herbaceous cover to decrease surface runoff, improve uptake of nutrients, and increase soil infiltration/base flow by:	
	Tree/brush thinning projects/prescribed burning	NMED/EPA NRCS Property owners Grant SWCD US Forest Service NM State Forestry Conservation Organizations
	Reseeding of native grasses, uplands	NMED/EPA NRCS Property owners Grant SWCD US Forest Service NM State Forestry Conservation Organizations
	Reintroduction of riparian herbaceous cover	NMED/EPA NRCS Property owners Grant SWCD US Forest Service NM State Forestry
	Grazing management	NRCS US Forest Service Grant SWCD Property owners
	Decrease stream water temperatures by: Riparian cover remediation to improve shade cover, including plantings, grazing management, road improvements	NRCS NMED US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners
	Decrease stream channel widths with channel stabilization measures, including revetment fencing and riparian vegetation	NRCS NMED US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners
	Decrease sedimentation in streams from roads, surface runoff, irrigation diversion maintenance, including replacement of temporary berms with infiltration galleries	NRCS NMED US Forest Service Grant SWCD Conservation Organizations

		NM State Forestry Property owners
	Education/outreach: Inform property owners of impairment sources, improved management practices, funding/technical support available. Provide liaison with appropriate agencies	NRCS NMED US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners
Impairment: Temperature **Identified in:**	**BMPs**	**Potential Partners**
All perennial reaches of Mimbres River and its tributaries	Riparian cover remediation to improve shade cover, including plantings, grazing management, road improvements	NRCS NMED US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners
	Decrease stream channel widths with channel stabilization measurers, including silt fencing, revetment fencing, and plantings of riparian vegetation (herbaceous and woody species)	NRCS NMED US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners
	Decrease sedimentation in streams from roads, surface runoff, gravel mining operations, irrigation diversion maintenance, including replacement of temporary berms with infiltration galleries	NRCS NMED US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners
	Remediation of gully networks to decrease sediment delivery to streams during runoff events: stabilization; sediment traps; re-establishment of appropriate vegetation in gullies	NRCS NMED US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners
	Improve soil infiltration and moisture storage through improvements in herbaceous cover (tree/brush/thinning; re-establishment of native herbaceous cover)	NRCS NMED US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners
	Education/outreach: Inform property owners of impairment sources, improved management practices, funding/technical support available. Provide liaison with appropriate agencies	NRCS NMED US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners

Impairment: Plant nutrients Identified in: Bear Canyon Reservoir	**BMPs**	**Potential partners**
	Increase upland and riparian herbaceous cover to improve uptake of nutrients by soils (reseeding, woody species thinning, replanting of riparian species)	NRCS NMED/EPA US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners
	Agricultural practices (fertilizer) management	NRCS Grant SWCD Property owners
	Education/outreach: Inform property owners of impairment sources, improved management practices, funding/technical support available. Provide liaison with appropriate agencies	NRCS NMED/EPA US Forest Service Grant SWCD Conservation Organizations NM State Forestry Property owners
Unidentified impairments in: Perennial reaches of Mimbres River and tributaries downstream of Willow Springs Canyon	**Identification and Remediation**	**Potential Partners**
	Conduct sampling for water quality impairments on other known perennial reaches, including San Vicente Arroyo (Silver City)	
	Identify other perennial reaches (including spring outlets) through stakeholder contacts, GIS evaluation, other research; establish sampling sites	
	Contact potential partners	NRCS NMED US Forest Service BLM County Government City Government Appropriate SWCD as above
	Evaluate any identified impairments and construct remediation plans (typically, similar to BMPs already identified)	

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POTENTIAL PROJECTS

Proposed Actions	Property Location	Landowner	Address	Phone
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Erosion control	Mimbres watershed	Kenneth & Alison L.	19 Kiva Drive Mimbres, NM 88049	313-3020
Erosion control	Mimbres watershed	Rick Purdy		501-3490
Erosion control	Mile Marker 12 Hwy 35	Teresa Zydorski		536-3626
Erosion control structures and Streambank stabilization	Gallinas Creek W. of Iron Bridge	Dave Smee	PO Box 59 Mimbres, NM 88049	536-3778
Erosion control structures and Streambank stabilization	San Lorenzo	Susan Wilger		536-2906
Erosion control structures for head cuts	164 Royal John Mine Rd.	Cynthia Coleman	HC 71, Box San Lorenzo, NM 88041	536-9614 or 536-3099
Inventory of landowners on the Mimbres River	Mimbres watershed			
Juniper control/eradication	Mimbres watershed	Tom McDermott	4392 So. US Oshkosh, WI 54902	
Permanent irrigation diversions		Ron Strain		
Prescribed burns		John Vontress		
Salt cedar eradication		Neal Overman		536-3164
Sediment control		Dan Rinalde		
Sediment control		Pat Young		536-2898

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