Upper Pecos Watershed
Wetland Action Plan

Submitted by the Upper Pecos Watershed Association

to:

New Mexico Environment Department

Surface Water Quality Bureau, Wetland Program

Contract ID # 13-667-5000-005

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INTRODUCTION

Purpose and Need

A Wetlands Action Plan is a planning document designed to address wetlands within the boundaries of a specific watershed. Wetlands and riparian areas have ecological, economic, and aesthetic value and serve many vital functions including water purification, storage, pollution prevention, erosion reduction, nutrient capture and recycling and habitat included food shelter and water for many different types of wildlife. . A Wetland Action Plan describes the current status of wetland types, distribution and condition within the watershed. It is recognized as a working document that represents the best information available at the time. This plan also documents and provides information for improving wetland condition, identifies sites that can be protected and/or restored and where additional monitoring and inventory are needed.

The Upper Pecos Watershed Association

The Upper Pecos Watershed Association (UPWA) was originally formed in 2006 by residents in the Pecos watershed who were concerned about environmental issues pertaining to the river. It is recognized as a 501(c) (3) nonprofit organization, and is overseen by a nine-member Board of Directors. UPWA's primary goals are to:

- Protect and improve the health of the watershed
- Address significant ecological and environmental issues in the watershed
- Preserve traditional and cultural uses and benefit the local economy

UPWA has partnered with many organizations in the past and actively continues to do so – with government agencies such as the USDA Forest Service, New Mexico Environment Department, New Mexico Departments of Game and Fish and Transportation, the Village of Pecos and San Miguel County; and with non-governmental groups such as Trout Unlimited, local homeowners' associations, the Friends of Pecos National Monument and the Pecos Community Foundation, for example.

This Wetland Action Plan furthers the goals of UPWA by identifying the wetland resource currently in the Pecos Watershed, their type, condition and strategies to protect or restore these important vegetation communities for the health of our watershed. It also serves to demonstrate UPWA leadership in maintaining the health and vitality of the upper Pecos watershed.

THE UPPER PECOS WATERSHED

Size, Location, Ownership and Demography

The majority of land in the Upper Pecos Watershed is federally owned (Table 1), with private in-holdings located primarily south of the village of Pecos, although there are also significant private lands along the Pecos River within the Pecos canyon, along Cow Creek and in other tributary watersheds.

Table 1. Land ownership and acreage within the Upper Pecos Watershed. Data source: Bureau of Land Management Surface Land Ownership 2012. Accessed via the New Mexico Resource Geographic Information Source Program.

Ownership	Acres (approximate)	Percentage of Land Area in Watershed
Santa Fe National Forest (non-wilderness National Forest land)	164,229	45.7
Private	96,366	26.8
Pecos Wilderness (Santa Fe and Carson National Forests)	84,466	23.5
Pecos National Historic Park	6,363	1.8
State of New Mexico (State Land Office)	4,624	1.3
Bureau of Land Management	2,615	0.64
Department of Game and Fish	992	0.28
Upper Pecos Watershed (total)	359,655	100.0

A map of land ownership within the watershed appears on the following page (Figure 1).

The Upper Pecos watershed is located almost entirely in San Miguel County, New Mexico (Mora and Taos counties contain small portions in the northern edge of the watershed, while Santa Fe county is represented on the southwest corner) The one incorporated municipality is the village of Pecos, but the watershed also includes the unincorporated rural communities of Tererro, Glorieta, Upper and Lower Colonias, North and South San Isidro, Rowe and San Juan, along with dispersed ranches, summer home and recreational cabin owners and other rural residents as well.

The year-round population in the Pecos River valley is about 8,000 people. However, a recreational use assessment has observed that over 1,000 people at any given time may be camping within the Pecos Canyon on busy summer weekends, to say nothing of summer cabin owners or day-use visitors – this confirms that recreational visitation to the Upper Pecos far exceeds the resident population (USFS TEAMS 2008).

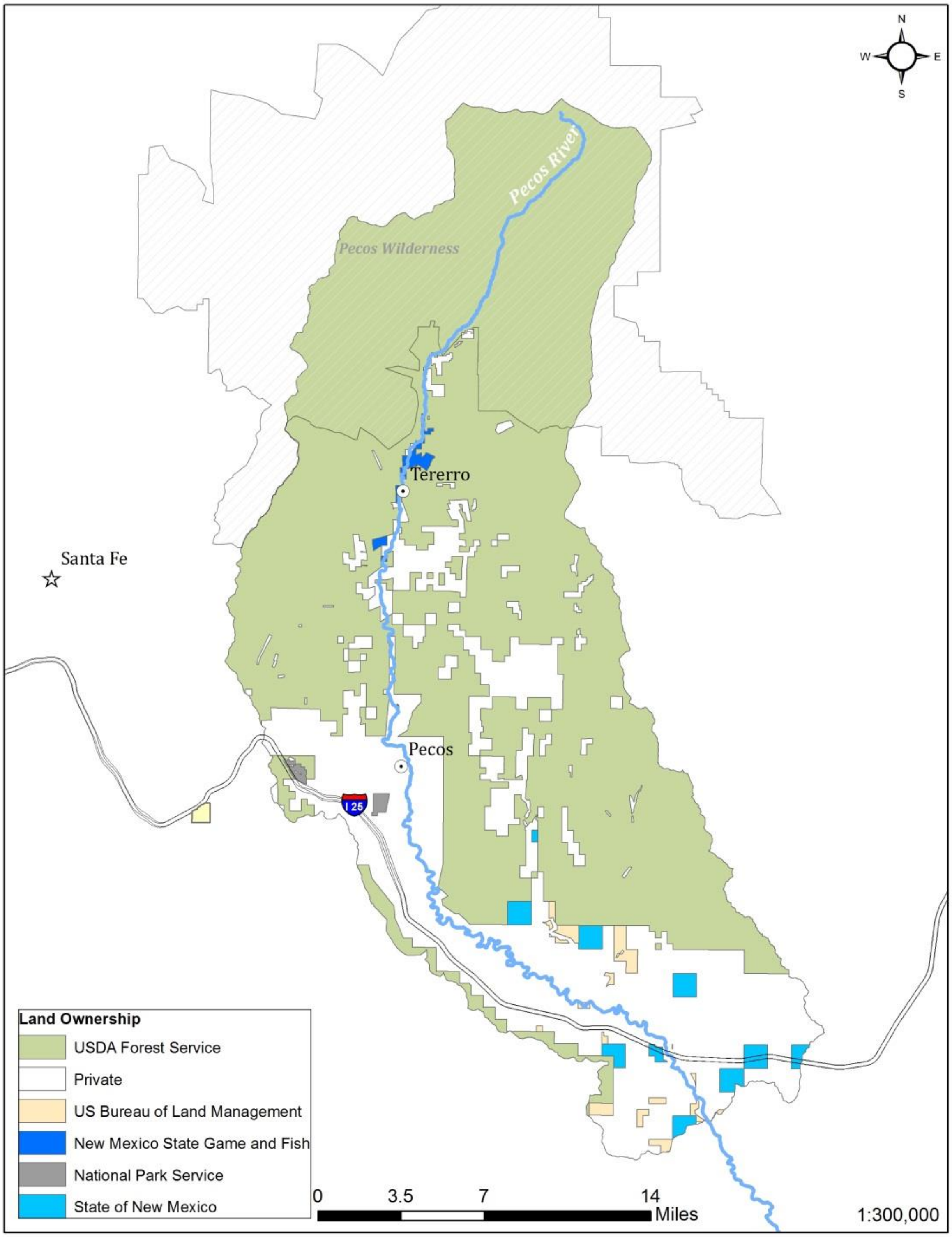


Figure 1. Upper Pecos watershed land ownership. Dta source: Bureau of Land Management Surface Land Ownership 2012. Accessed via the New Mexico Resource Geographic Information Source Program.

Geology

The main core of the Sangre de Cristo Mountains is composed of Pre-Cambrian igneous and metamorphic rocks, resulting from or altered by past volcanic activity (Figure 2). These rocks are overlain by Paleozoic sandstones, shales, and limestones. Prominent sedimentary formations are composed of both marine and non-marine sediment of the Pennsylvanian Era. The steep canyons of the Pecos Valley have been carved through the layers of sedimentary rock, in some cases down to the Pre-Cambrian basement rock. Permian sandstones, conglomerates, and shales are also exposed towards the southern end of the watershed and south of the Village of Pecos.

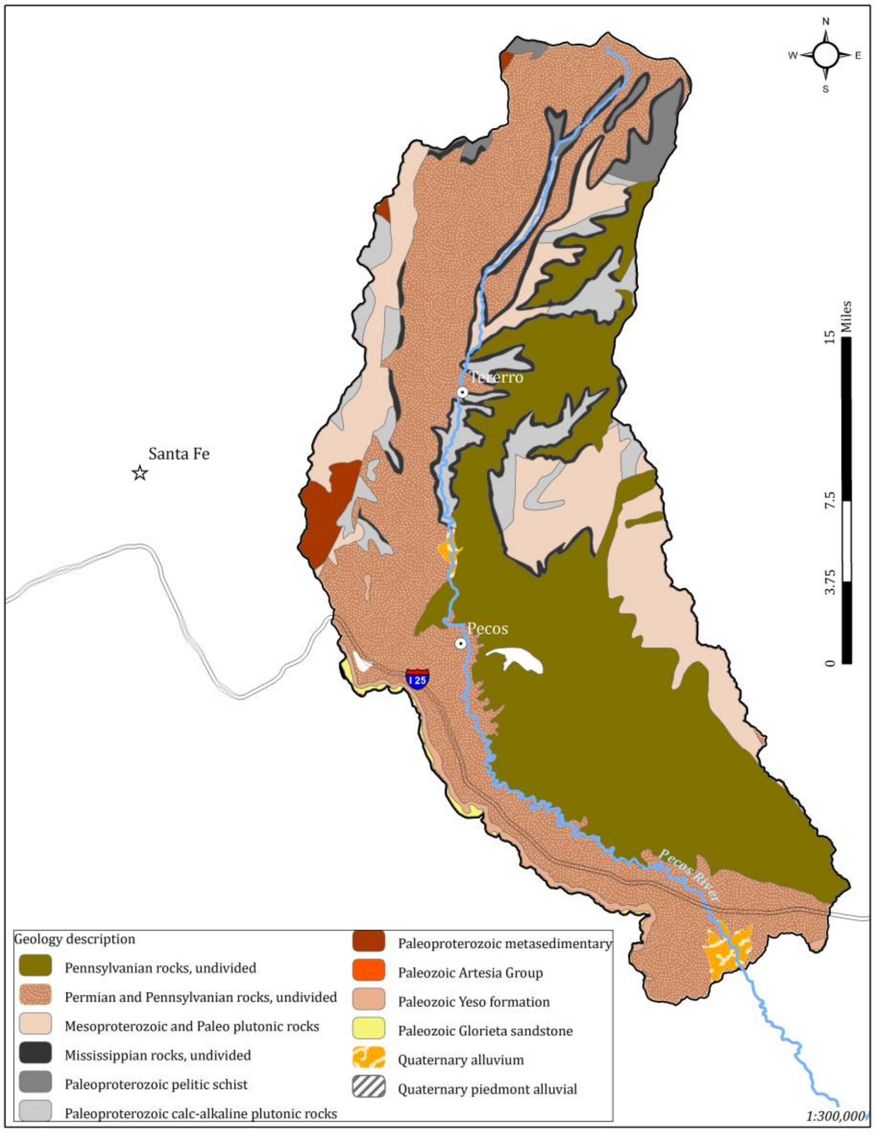


Figure 2. Geologic compostion of the Upper Pecos Watershed. Data source: Digital Geologic Map of New Mexico. Accessed via NM RGIS, 2013.

Bedrock and surficial geology can control water infiltration and discharge on the landscape. Porous strata are likely to be highly permeable to water, absorbing surface water and transferring it to deep underground aquifers or releasing it along fault lines between rock layers. Impermeable rock layers may "perch" water near the surface allowing it to discharge in the form of springs or seeps.

Climate

Weather in the watershed is much different in the lower elevations below the Sangre de Cristo Mountains than in the upper elevations in the mountain headwaters. Pacific storms provide most of the winter moisture for the Upper Pecos watershed, with an annual average of 23 inches of snowfall in the village of Pecos. From July through September, moisture primarily from the Gulf of Mexico brings monsoon rains that occur as thunderstorms and often cause short-term flash flooding in the Pecos and its tributaries. In the lower elevations of the watershed, average annual precipitation is about 14 inches, but it can be as high as 44 inches in the higher slopes of the mountain headwaters.

The only long-term weather station within the watershed is located at the ranger station in the village of Pecos at an elevation of ~7,000 feet. Table 2, below, summarizes the climatic information collected at the Pecos weather station, but given the elevation, this weather station represents the drier, hotter portion of the watershed.

Table 2. Climate data for Pecos Ranger Station 1916- 2012. Data source: Western Regional Climate Center. http://www.wrcc.dri.edu/

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max Temp. (F)	47.2	49.9	54.9	63.6	73.4	82.8	85.2	82.0	77.0	67.3	55.0	48.7	65.6
Mean Min. Temp. (F)	14.9	19.1	23.2	30.1	38.2	47.1	52.6	51.3	44.2	33.6	23.0	16.4	32.8
Mean Precip. (in.)	0.74	0.66	0.88	0.83	1.07	1.28	2.88	3.38	1.73	1.18	0.75	0.68	16.05
Mean Snowfall	5.6	4.1	4.4	1.6	0.0	0.2	0.0	0.0	0.0	0.3	2.5	4.8	23.5
Mean Snow Depth (in.)	1	0	0	0	0	0	0	0	0	0	0	0	0

Under the Resource Management section below we discuss the implications of a changing climate on wetland communities within the Pecos watershed.

Surface Hydrology

The upper Pecos River and its tributaries flow through mountainous valleys that can be quite steep in their upper reaches. The highest elevation in the Pecos watershed is over 13,000 feet above sea level and well above timberline. Streams in the upper Pecos watershed consist primarily of Rosgen classification types A and B in the mountainous headwaters (generally above the village of Pecos) and type C below the village. Rosgen types A and B stream channels are found along the higher-elevation stream reaches that tend to run straight and fast in narrow channels through steep, narrow valleys with little sediment and shallow stream bank soil. Their course is largely controlled by the geology and shape of the surrounding valley, and they are not very sinuous. Streams in the lower lying areas are usually Rosgen type C channels, with slower flow rates, more valley floor sediment, and greater sinuosity. Stream reaches, especially those found in the middle and lower elevations, are typically (but not always) bordered by a 30 to 100 foot band of riparian vegetation that includes varying sizes of wetland areas. Streamside wetland communities are found in abundance in lower Cow and Bull creeks and reflect this Rosgen type C morphology.

The flow regimes for both stream types are dominated by snowmelt runoff, followed by smaller, more localized and more unpredictable secondary rises during the summer monsoons.

Water Quality

New Mexico's water quality standards are based on designated uses for streams or water bodies adopted by the New Mexico Water Quality Control Commission. Numerical or narrative standards are developed to provide adequate water quality for those uses. Periodic water quality monitoring by the Surface Water Quality Bureau (SWQB) of the New Mexico Environment Department establishes whether the applicable standards are being met, and if not, the relevant stream reach or water body is listed as "impaired", or not supporting one or more of its designated uses. For impaired water bodies, a "Total Maximum Daily Load" (TMDL) is calculated. TMDLs are a calculation of the maximum quantities of the pollutants causing impairment that a stream could assimilate without causing non-support for its designated uses. As a practical matter, not all impaired stream reaches have TMDLs because the measurements and calculations required for developing TMDLs are a lengthy and ongoing process.

The status of streams in meeting water quality standards is evaluated by SWQB staff, following extensive sampling, approximately every 8 years. Streams in the upper Pecos were sampled in 2010, and several changes were made to the stream reaches listed as impaired (NMED 2012). The following stream reaches (Table 3) are now listed as impaired, for the reasons given:

Table 3. Water quality impairments within upper Pecos watershed

Impaired stream reach	Cause for impairment
Cow Creek (Bull Creek to headwaters)	Temperature
Cow Creek (Pecos River to Bull Creek)	Temperature
Dalton Canyon Creek (Pecos River to headwaters)	Specific conductance
Glorieta Creek (Pecos River to Glorieta Conference Center WWTP)	Nutrients and eutrophication, specific conductance

Macho Canyon Creek (Pecos River to headwaters)	Specific conductance
Pecos River (Cañon de Manzanita to Alamitos Canyon)	Temperature
Willow Creek (Pecos River to headwaters)	Sediment and siltation, specific conductance

Proper functioning wetlands can improve water quality in several ways. Forested and shrubby wetland types adjacent to stream and lakes provide shade to cool the water, while herbaceous wetlands provide effective filtration of surface water during spring runoff and summer thunderstorms. High elevation wetlands store snowmelt and release it gradually, allowing cold water inputs to stream during the summer months.

Vegetation Communities

At the higher elevations of the watershed, from approximately 9,000 feet to tree line at 11,000 feet or more, Engelmann spruce is the dominant plant species, forming the primary forest canopy along with white and sub-alpine fir in about 11% of the watershed. Douglas fir and other mixed conifers are typically dominant between about 8,000 and 10,000 feet, covering about 19% of the watershed area; although a similar conifer mix with a significant fraction of aspen present covers another 5% of the watershed. At elevations between 7,000 and 9,500 feet Ponderosa pine forest is the dominant vegetation type, but it is also very common on south and west aspects at higher elevations. At the lower elevations of the watershed, vegetation is dominated by piñon-juniper and oak woodlands, including areas of grassland and savannahs with more scattered juniper amongst the grass. Wetland communities are found throughout the watershed, but are concentrated on the east side of the watershed, and at high elevation on the west side of the valley. Table 4 below shows the principal vegetation types present in the watershed, and the acreages and percentages of land dominated by each. Wetlands of all types are a very minor component of the landscape, but serve an ecological function greatly outsized from their minor size and distribution.

Table 4. Vegetation communities within upper Pecos watershed. Data from Southwest Regional GAP analysis.

Vegetation Type	Total Acreage	Percentage
Piñon-Juniper Savannah and Woodland	85,328	23.7%
Ponderosa Pine	70,925	19.7%
Mixed Conifer Forest	70,445	19.6%
Spruce-Fir Forest	40,440	11.2%
Subalpine Meadow and Grassland	21,355	5.9%

Aspen Conifer Mixed Forest	17,186	4.8%
Fire Regeneration (oak, aspen, and herbaceous vegetation)	17,089	4.8%
Semi-Arid Grassland	15,593	4.3%
Aspen Forest and Woodland	10,186	2.8%
Riparian Woodland	5,322	1.5%
Gambel’s Oak Woodland	2,895	0.8%
Wetlands	2400	0.7%
Agricultural	1,602	0.4%
Developed Area	1,289	0.4%

Due to a long-standing policy of fire suppression, tree stands in many places are dense, even-aged, and often form a closed canopy. Historically, fire frequency would have been much higher in almost the entire watershed than that seen in recent history. In addition to intentional suppression of forest fires, grazing in the forested areas by cattle, sheep, elk and horses has reduced the grass that would have been the fuel for frequent, low-intensity fires. With less fine fuel to carry ground fires through the forest, tree seedlings have been allowed to survive to adulthood resulting in dense “dog hair” type forests. There is considerable scope for restoration forestry over the coming years throughout much of the watershed. Active restoration of forested communities would have direct effects for wetlands within the watershed. This topic is discussed in more detail in the Resource Management section.

Species listed as Threatened or Endangered

There are two federally endangered species and one candidate species present within our watershed (NMDGF BISON. 2013), including the Holy Ghost Ipomopsis, an endemic plant found here and nowhere else. A brief summary of information about these species follows below.

Figure 3. Holy Ghost Ipomopsis (Ipomopsis sancti-spiritus)

Holy Ghost Ipomopsis (endangered)

The Holy Ghost Ipomopsis is a short-lived perennial plant (very similar to star gilia) that grows to about 2 feet tall and produces showy pink flowers. It is known to exist only in Holy Ghost Canyon, where it is found in open areas within the ponderosa zone. The decline of this species and its restricted population may be a result of decreased fire frequency (hence fewer sunny openings) in forested areas. It now occurs mostly in road cuts and other areas opened up by human disturbance. Increasing the openings within existing ponderosa pine forests would likely increase the amount of open habitat available for the Holy Ghost Ipomopsis, although fire suppression has been the priority of the Forest Service in areas where the Holy Ghost Ipomopsis is currently found.

Mexican Spotted Owl (endangered)

The Mexican Spotted Owl is dependent on old-growth forest and healthy riparian areas. This species' decline is attributed to habitat degradation and habitat loss. It is unclear from published reports if or when Mexican Spotted Owls were found within the watershed, and how numerous they would have been within the upper reaches of the watershed before logging and fire-suppression affected the composition and structure of these forests.

Rio Grande Cutthroat Trout (candidate species for listing as endangered)

The Rio Grande Cutthroat trout (RGCT) is the only salmonid fish native to the Rio Grande (including the Pecos) watershed. For decades it has been out-competed or hybridized with introduced trout (mostly rainbow or brown trout) throughout almost all of its former range. Today, the upper reaches of the Pecos River and the upper reaches of Macho, Dalton, and Jacks Creek still harbor small, pure populations of native Pecos strain RGCT. Restoration of Pecos strain Rio Grande Cutthroat trout to the upper reaches of the Pecos and its tributaries (i.e. above Cowles) has become more urgent than ever with the damage done by the 2011 Los Conchas fire in the Jemez mountains that destroyed several RGCT populations and the current (as of June 2013) Tres Lagunas fire in the Pecos watershed could impact several RGCT streams.

Figure 4. Rio Grande Cutthroat (Oncorhynchus clarki virginalis).

The wetlands of the Pecos watershed also provide habitat for several other at-risk species. Both the Northern Leopard Frog and the Boreal Toad have been severely impacted by decreasing wetland acreage and the chytrid fungus. The New Mexico meadow jumping mouse was collected in the Sangre de Cristo Mountains in the early 1900s by Vernon Bailey. This species is currently being petitioned for endangered species status, as greater than 70% of the known populations have been extirpated in New Mexico (Frey 2009). Protecting what remains and restoring lost wetlands within the watershed would help safeguard populations of these rare and endemic species.

Human Activities and Influences

There is a long history of human visitation and occupation in the Pecos valley, beginning in prehistory. However, the effects of human activities on the watershed and water quality increased dramatically in the 19th and 20th centuries, especially with larger-scale ranching and industrial activities like mining and road construction. Later in the 20th century, there have been significant restoration activities and improvements in water quality, as well. The more significant human effects on the watershed are discussed below.

Mining

The Tererro mine ("Tererro" means mine dump in Spanish) operated at the confluence of Willow Creek and the Pecos River between 1882 and 1939. Mining activities were relatively small-scale from 1882 until 1925, when the American Metals Company took over the mine and expanded both mining and milling operations dramatically. Between 1926 and 1939, the mine produced approximately 2,200,000 tons of lead and zinc ore (Robinson 1995). Ore was transported by aerial tram-cars to the mill in El Molino (near the village of Pecos) for processing. Large amounts of mine tailings were disposed of at three sites, and some tailings at the mine site were dumped into the Pecos River.

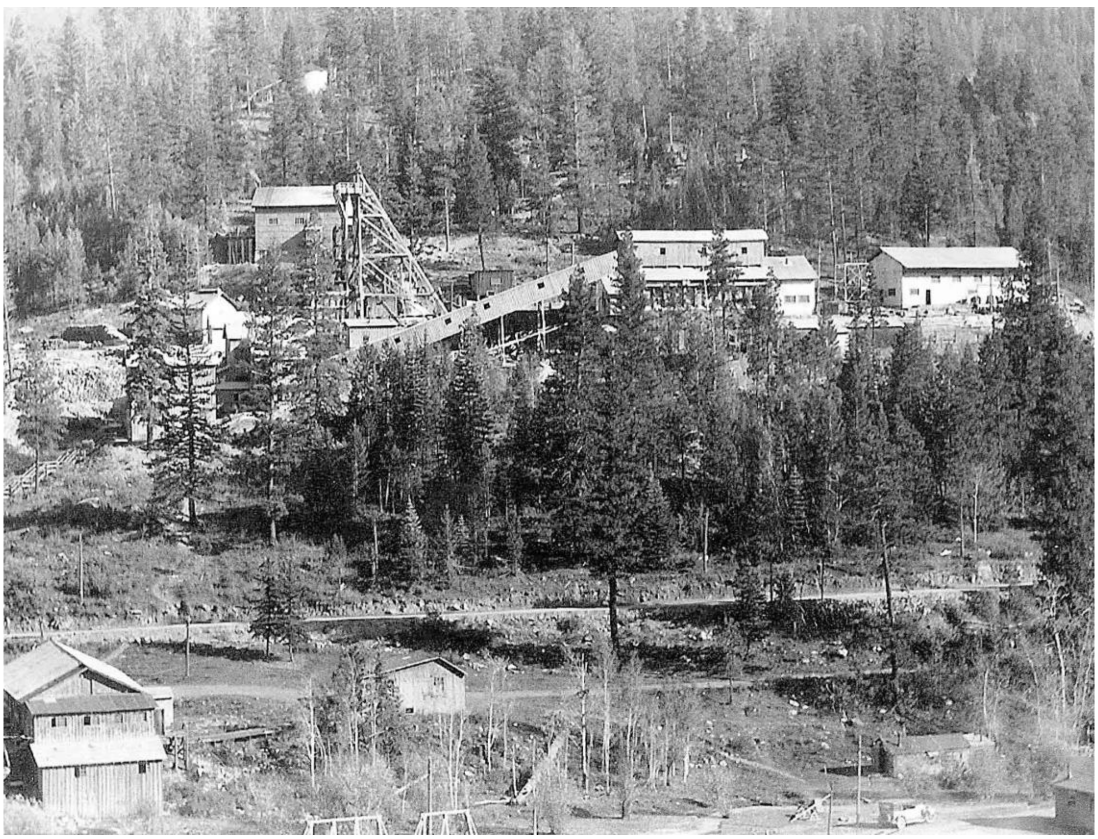


Figure 5. Tererro mining site circa 1930.

In the 1950s, the State of New Mexico obtained the land where the mine and the mill had operated. Mine tailings were used for construction projects between the mine and the Village of Pecos. Additional roads projects, federal and state campgrounds, and the Lisboa Springs Fish

Hatchery also utilized mine tailings in their construction. Mine tailings were also used by residents for an unknown number of undocumented construction projects.

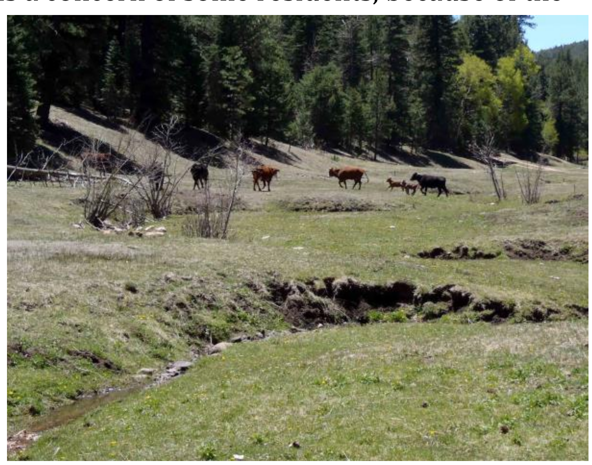
A public meeting was called in Pecos in May 1991 to address problems associated with the contaminants leaching into the streams and rivers of the watershed. A priority of the concerned citizens of Pecos, the State of New Mexico, and the American Minerals Corporation (AMAX) was to work together to remediate the area themselves and avoid listing the area as a federal Superfund site by the Environmental Protection Agency (EPA). The Pecos Administrative Order of Consent (AOC) was signed by representatives of the New Mexico Environment Department, NM Game and Fish Department, NM Highway Department, and the AMAX mining company in December of 1992. The AOC specified a rigorous monitoring and remediation program for the site, which had the effect of preventing the listing of the site as a federal Superfund hazardous-waste cleanup project.

Acequias

There are at least six active acequias within the watershed. Acequias can have positive effects on riparian areas by enhancing the breadth of the floodplain, hydrating the riparian area, and supporting corridors of riparian habitat. They can also discharge into constructed wetlands and other riparian vegetation. However, acequias can also contribute to erosion problems, for instance, where down cutting occurs below head gates.

Logging and firewood harvesting

The Pecos River Forest Reserve was established in 1892, and later combined with the Jemez Forest Reserve to form the Santa Fe National Forest in 1915. However, extensive logging in the area began in the late 1880s to provide railroad ties for the Atchison, Topeka, and Santa Fe Railroad, and later to support the infrastructure of Tererro mine, housing for its employees, and saw timber for other uses. By 1939 the mine closed and logging activities slowed. Some logging occurred in the 1980s, with the Davis-Willow and Dalton Timber sales. Between 1989 and 2003, prescribed burns were conducted in order to reduce fuels and improve habitat for wildlife. Poorly controlled firewood harvesting is a concern of some residents, because of the roads created to get to and remove the firewood.



Livestock grazing

Beginning with Spanish settlement of the region, domestic livestock has used much of the watershed for summer if not permanent range. As livestock density increased, native grass cover in much of the region diminished. Not only did this expose more land surface to the erosive effects of wind and runoff, it likely contributed to breaking a cycle where frequent low-intensity grass fires maintained a more savannah-like landscape favoring grass cover and restraining the density of shrubs and trees. Once grass was grazed to the point it would no longer support periodic grass fires, piñon and juniper cover increased and grass cover decreased. Generally piñon-juniper tree cover does not form a closed canopy, but often its roots are dense enough to prevent grass cover between trees. This results is increased runoff and erosion compared to grassland or savannah.

Livestock grazing became subject to permitting by the Forest Service once it assumed management responsibility over what is now National Forest land, and since the 1960s there has been a trend towards reduction in the grazing levels permitted in the Pecos Ranger District. The level animal stocking in the area was a topic addressed by the Forest Plan Environmental Impact Statement (EIS) in 1987. As of 2013, up to 1954 head of cattle are permitted to graze on National Forest lands, however current use is roughly half that at 984 head.

Recreation

The upper Pecos valley first began to receive recreational use beginning in the early 1920s, with the construction of summer residence cabins in Winsor and Holy Ghost Canyons and "dude" ranches along the main stem of the Pecos River at Tres Lagunas, Cowles, and Los Trigos. This reach of the Pecos River remains one of the most popular fishing locations in northern New Mexico, and in addition to fishing, the area is extensively used for camping, hiking, picnicking, hunting, and off-road vehicle use. Santa Fe National Forest provides seven developed campgrounds, along with one picnic area and extensive dispersed camping. The New Mexico Department of Game and Fish (NMDGF) is responsible for three largely unregulated "free" campgrounds plus two picnic or day-use areas. Because peak summertime demand far exceeds available capacity in developed campgrounds, there is a great deal of unmanaged, dispersed camping in Dalton Canyon and around Tererro and Cowles, as well as sometimes serious overuse of developed areas – especially the less-regulated NMDGF lands.

One of the principal effects of recreational overuse is damage to or complete trampling of native vegetation, especially along stream banks and in riparian areas or meadows. Removal of vegetation along with soil compaction and damage to seedlings, prevents vegetative re-growth and leads to increased streamside erosion and wetland loss.

RESOURCE ANALYSIS

Many different resources were analyzed to determine wetland distribution, size, condition and historic extent within the Pecos watershed. These sources included recent and historic aerial photography, historical inventories and documentation, US Fish and Wildlife Service National Wetlands Inventory (NWI) data and field reconnaissance. Each of these items is discussed below.

Aerial and Surface Photography

The Soil Conservation Service began aerial photography within the watershed in the 1930s. Individual images are available from the Earth Data Analysis Center (http://edac.unm.edu/) in Albuquerque for small a fee. These early aerial photographs, combined with ground based repeat photography, create a picture of the watershed not readily obtained from written reports or other sources. Comparing historic photographs to recent images, a trend emerges of reduced wetland and mountain meadow acreage with a concomitant increase in coniferous species. The confluence of Bull and Cow Creek (Figure 6) is a good example of this trend. The following pages show similar trends at the Pecos NHP, and Dalton Canyon (Figures 7 and 8).

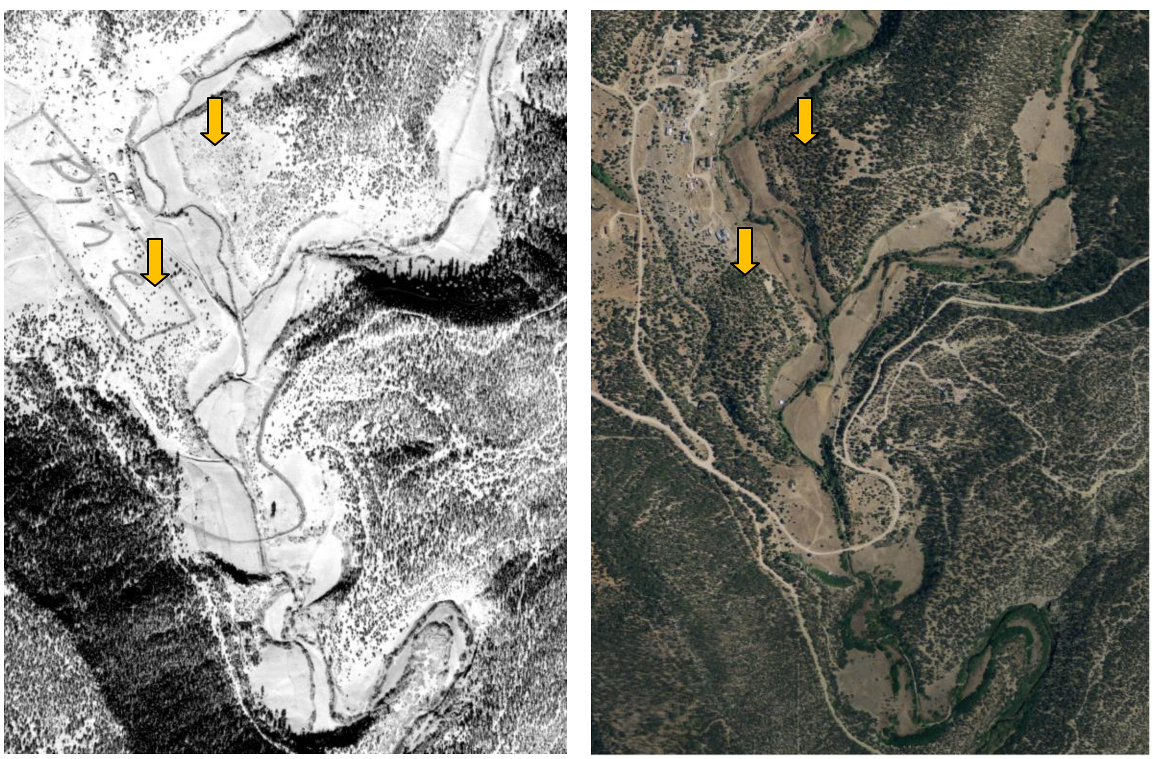


Figure 6. Repeat photograph of Cow and Bull Creek Confluence from 1939 (left) and 2011 (right). Note increased conifer cover on hill slopes and valley bottoms with development encroaching in the floodplain.

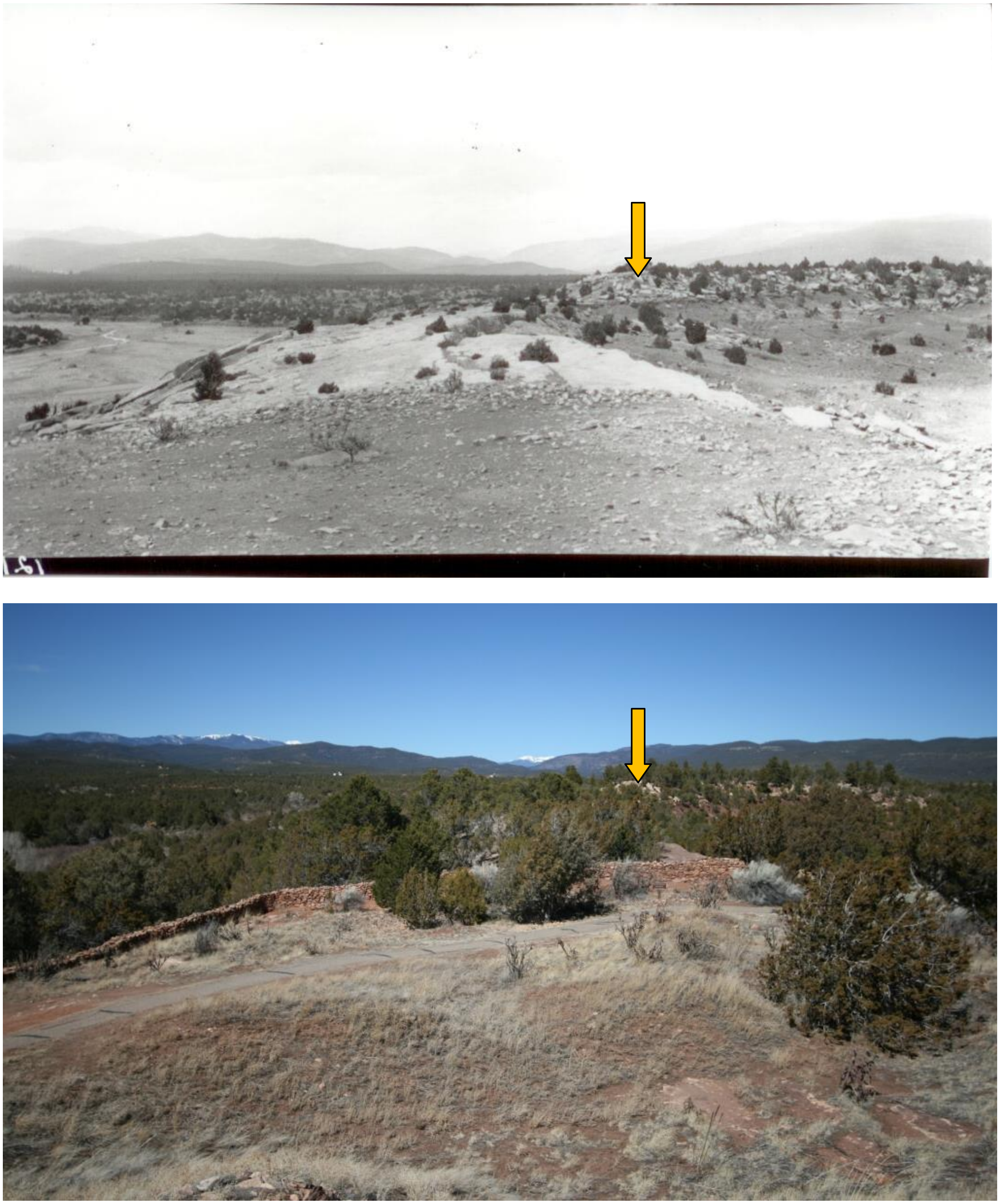


Figure 7. Repeat photography from Pecos National Historic Park. 1915 photograph (top) shows open juniper savannah with Glorieta floodplain on left. Bottom photo (2011) highlights juniper encroachment and diminished floodplain. Arrows serve as landmark reference points. Photo courtesy of Pecos NHP.

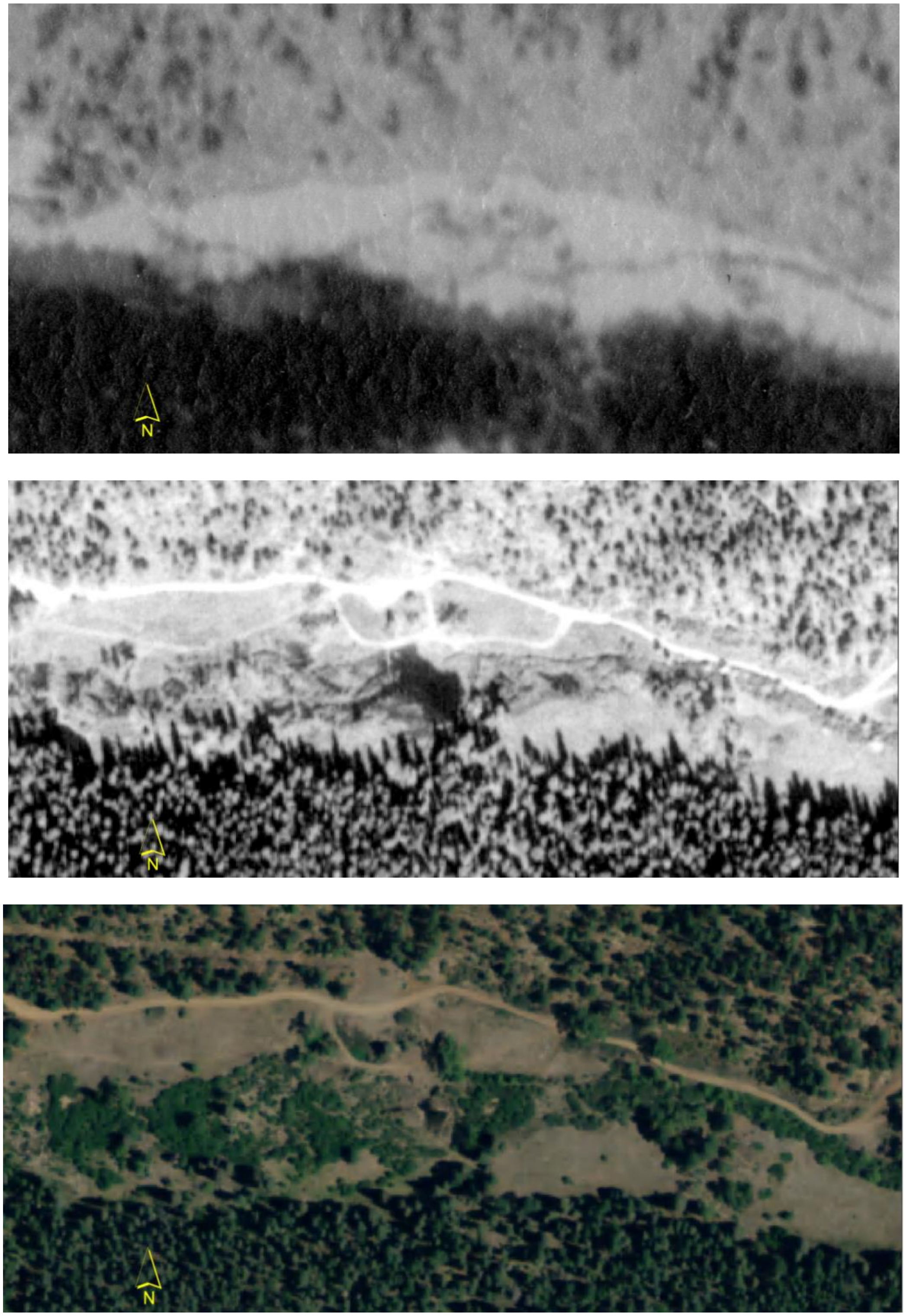


Figure 8. Dalton Canyon repeat photography from 1935 (top) 1996 (middle) and 2011 (bottom). Note open, braided floodplain and hill slopes in 1935, large flood beaver ponds in 1996, and lack of open water in 2011.

Historic Documentation

What could be found regarding historic documentation for Pecos watershed wetlands comes primarily from the New Mexico Natural Heritage program. In a multi-volume publication titled "Handbook of Wetland vegetation Communities of New Mexico" they detail several wetland sites within the upper Pecos watershed. Volume I of this publication gives community descriptions for streamside wetlands within the watershed, while volume II documents references sites and wetland condition. More details can be found in the Wetlands Reference Sites section below. The Pecos National Historic Park has commissioned two riparian inventories along Glorieta Creek and the Pecos River within their boundaries (NPS 1991, 2011). These include descriptions of wetland communities along the river's edge. The Santa Fe National Forest includes generalized wetlands protection in their Forest Plan (USFS 2010), but does not perform regular monitoring or inventory of wetland resources as part of the annual monitoring program.

Available Plant Inventories

There are no known floristic inventories for the upper Pecos watershed. Several plant inventories exist at the site or project scale (see historic documentation above). The presence of a federal listed dicot, the Holy Ghost Ipomopsis has guaranteed frequent surveys of this species which resides in Holy Ghost and Winsor canyons exclusively. In 2012, a roadside inventory of plant species was performed as part of an Environmental Assessment for roadside forest thinning on USFS and State owned lands in the Pecos Canyon. However, this survey was not focused on wetland communities and avoided roadside riparian zones as little thinning was anticipated in these areas.

United States Fish and Wildlife Service National Wetlands Inventory.

The NWI inventory is a national mapping effort by the US Fish and Wildlife Service. The maps are graphic representations of the type, size and location of wetlands and deep-water habitats in the United States. These maps, produced from the analysis of high altitude imagery, collateral data sources and field work, represent reconnaissance level information on the location, type, and size of wetlands habitats.

Within the watershed, wetland mapping is currently in two phases. The USFWS completed a revision of the wetlands along the Pecos River in 2011, while NMED Surface Water Quality Bureau (with St. Mary's University of Minnesota serving as their contractor) has nearly completed wetlands mapping on lands adjacent to the Pecos River corridor. Both mapping efforts are completed to the same national standard. Information included in this wetland plan reflects the revised USFWS NWI mapping and the current mapping effort underway. Small changes can be expected to both wetland acreage and classification, but these would likely not change the overall picture of wetlands within the upper Pecos watershed. Figure 9 on the following page shows mapped wetlands from both mapping efforts.

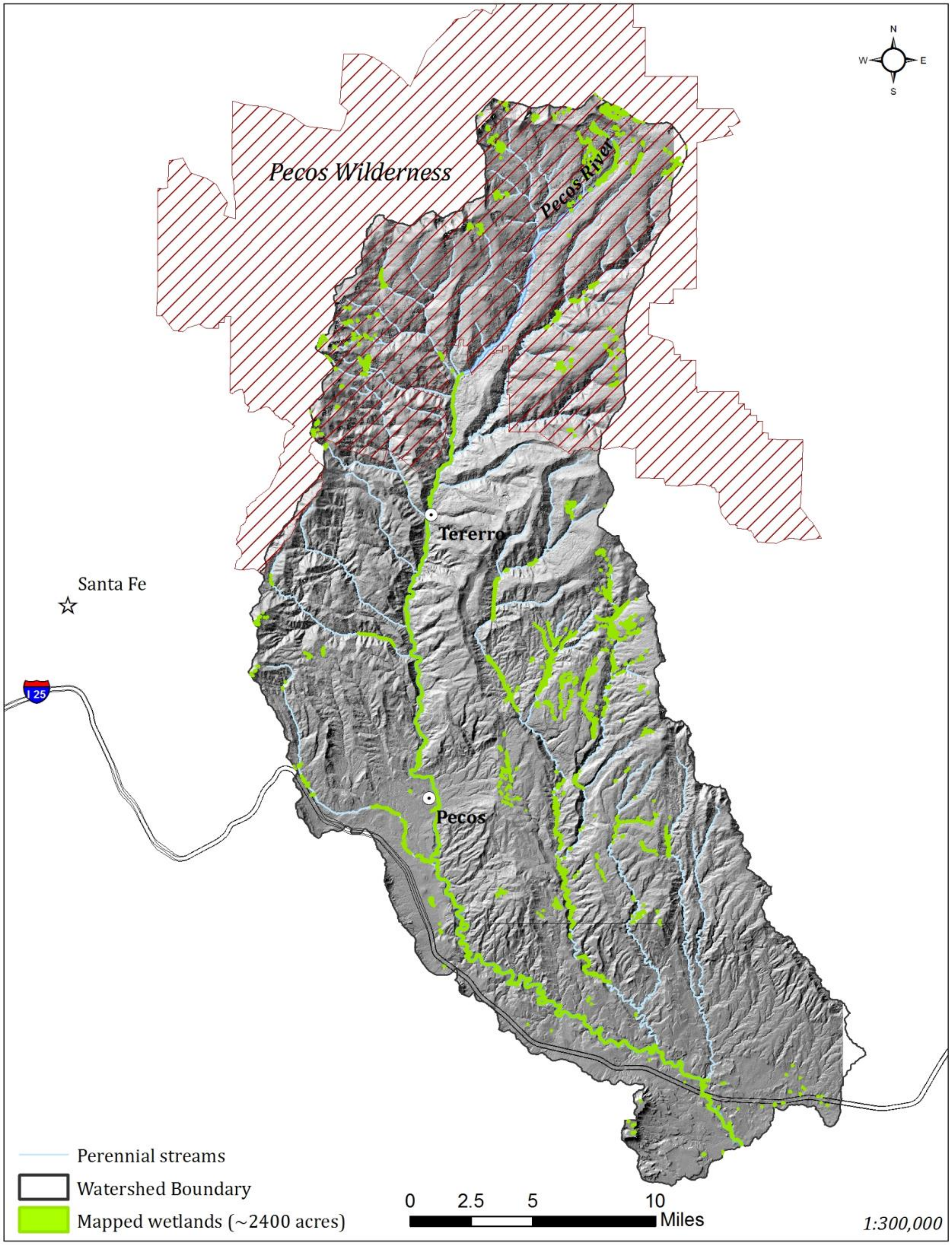


Figure 9. Mapped wetlands within the upper Pecos watershed.

The land ownership of wetlands within the Pecos watershed is skewed towards private land (Table 5) with a large amount of that total centered on the lower Pecos River and Cow Creek. The Pecos Wilderness contains the second largest acreage of wetlands and these wetlands are currently designated as Outstanding National Resource Waters by the state of New Mexico and receive additional protection from degradation (see Resource Management section). While containing only 4.1% of the total wetland acreage, the Pecos National Historic Park is active in protection and restoring key riparian and wetland areas along the Pecos River and Glorieta Creek.

Table 5. Summary of wetlands acreage by land ownership within Upper Pecos Watershed.

Land Ownership	Mapped Acreage	Percent of Total
Private	1177 ac	48%
USFS Pecos Wilderness	662	27
USFS non-wilderness	431	18
NPS	100	4.1
State	36	1.5
BLM	9.5	0.4
Total	2415	

Most of the major creeks within the watershed have wetlands near or at their origin. These headwater wetlands are vital for absorbing snowmelt and releasing gradually during the summer months. The wetlands associates with these headwaters are mostly contained within the Pecos Wilderness and thus have de-facto legal protections (see page 38 below). However, three notable streams originate in areas outside the wilderness boundary. Glorieta, Cow and Bull Creek all originate within US Forest Service owned lands, but their associated wetlands are not protected under the Outstanding National Resource Water designation that protects wilderness wetlands. Further, Bull Creek has substantial wetland communities near its headwaters that are private owned.

Classification of local wetland types:

The Surface Water Quality Bureau (SWQB) at the NM Environment Department uses the Hydrogeographic classification model (HGM) developed by the US Army Corps of Engineers, Environmental Protection Agency, US Fish and Wildlife Service and others. It is a system that "… is designed to assess wetland and aquatic ecosystems, which are normally characterized in terms of their structural components and the processes that link these components. Structural components of the ecosystem and the surrounding landscape, such as plants, soils, hydrology, and animals, interact with a variety of physical, chemical, and biological processes." (Smith et al

1995). The utility of the HGM system is that it describes how water moves through wetlands on the landscape. With hydrology being the driving force behind wetland creation and maintenance, knowing how the wetland is "built" allows for predictive analysis about how vulnerable a wetland may be to changes in the environment. For example, Depressional wetlands (see below) may be particularly vulnerable because their hydrologic input may be only derived from precipitation. Currently, SWQB is developing a Rapid Assessment model based on the HGM system. Once complete and ground tested, the Rapid Assessment should be able to predict which wetland types may be most at risk and therefore of highest priority for both protection and restoration.

Several HGM wetland classes are found within the Upper Pecos watershed. Identifying and mapping different wetland classes is the first step in baseline assessment. The following wetland class descriptions are courtesy of the Surface Water Quality Bureau and are available for review here: http://www.nmenv.state.nm.us/swqb/Wetlands/types/index.html

Riverine wetlands occur in floodplains and riparian corridors in association with stream channels. Dominant water sources are overbank flow from the channel or subsurface hydraulic connections between the stream channel and wetlands. Additional water sources may be interflow and return flow from adjacent uplands, occasional overland flow from adjacent uplands, tributary inflow, and precipitation.

Figure 10. Riverine wetland type in excellent condition along upper Bull Creek.

Lacustrine fringe wetlands are adjacent to lakes where the water elevation of the lake maintains the water table in the wetland. Additional sources of water are precipitation and groundwater discharge. Surface water flow is bidirectional, usually controlled by water level fluctuations in the adjoining lake. Lacustrine wetlands lose water by flow returning to the lake after flooding, by saturation surface flow, and by evapotranspiration.

Slope wetlands are normally found where there is a discharge of groundwater to the land surface. Elevation gradients may range from steep hillsides to gentle slopes. Principal water sources are usually groundwater return flow, interflow from surrounding uplands and precipitation. Slope wetlands can occur in nearly flat landscapes if groundwater discharge is a dominant water source. They lose water primarily by saturation subsurface, surface flows and by evaporation. Springs are an example of slope wetlands in New Mexico.

Figure 11. Slope wetland type being piped into a livestock-wildlife tank. Wetland is at high elevation within 2000 Viveash fire.

Depressional wetlands occur in topographic depressions with a closed elevation contour that allows accumulation of surface water. Dominant sources of water are precipitation, groundwater discharge and interflow from adjacent uplands. Water normally flows from the surrounding uplands toward the center of the depression. Depressional wetlands may have any combination of inlets and outlets or lack them completely. Depressional wetlands may lose water through intermittent or perennial drainage from an outlet, by evapotranspiration, and if they are not receiving groundwater discharge, may slowly contribute to groundwater. Water levels will most often vary seasonally.

The US Fish and Wildlife Service National Wetland Inventory mapping program also classifies wetlands, but uses a more ‘structural’ approach, grouping wetland types by hydrology and type of vegetation. Table 6, below, displays the most common wetlands types within the Pecos watershed according to the NWI classification system. An interactive wetland map is available through the USFWS at the following website: http://www.fws.gov/wetlands/Wetlands-Mapper.html Brief description of the most common types and representative pictures are included below.

Table 6. USFWS National Wetland Inventory types and acreage found within upper Pecos watershed. Data source: USFWS NWI inventory and NMED SWQB draft wetland map.

Code	ID	ACRES
PEM1B	Palustrine Emergent Persistent Saturated	720
PEM1A	Palustrine Emergent Persistent Temporarily Flooded	525
R3UBF	Riverine Intermittent Unconsolidated Shore Semi-permanently Flooded	386
PSS1A	Palustrine Scrub-Shrub Broad-Leaved Deciduous Temporarily Flooded	199
PEM1C	Palustrine Emergent Persistent Seasonally Flooded	151
PSS1C	Palustrine Scrub-Shrub Broad-Leaved Deciduous Seasonally Flooded	116
PEM1/SS1A	Palustrine Emergent Persistent mixed with Scrub-Shrub Temporarily Flooded	107
PUBH	Palustrine Unconsolidated Bottom Permanently Flooded	26
PFO1A	Palustrine Forested Broad-Leaved Deciduous Temporarily Flooded	24
PUBFh	Palustrine Unconsolidated Bottom Semi permanently Flooded Impounded	19
PUBHh	Palustrine Unconsolidated Bottom Permanently Flooded impounded	18
PEM1Ah	Palustrine Emergent Persistent Temporarily Flooded Impounded	16
PEM1J	Palustrine Emergent Persistent Intermittently Flooded	16
PUSCh	Palustrine Unconsolidated Shore Impounded	12
PEM1Ch	Palustrine Emergent Persistent Seasonally Flooded Impounded	12
PSS1Cb	Palustrine Scrub-Shrub Broad-Leaved Deciduous Seasonally Flooded beaver	10
PUBHx	Palustrine Unconsolidated Bottom Permanently Flooded excavated	9
PEM1F	Palustrine Emergent Persistent Semi permanently Flooded	7
R3USA	Riverine Intermittent Unconsolidated Shore Seasonally Flooded	5
PEM1/SS1Ch	Palustrine Emergent Persistent mixed with Scrub-Shrub Seasonally Flooded	5
All others		31

PEM1B and PEM1A

Over half of the wetlands within the Pecos watershed have been classified as Palustrine Emergent Persistent Saturated or Palustrine Emergent Persistent Temporarily Flooded (PEM1B and PEM1A). These wetlands are dominated by herbaceous perennial vegetation and are hydrated at least 18 days during each growing season. Standing water may be present, but is not a requirement for this wetland type. Wetlands of this type occur in all areas of the watershed, but are most often associated with low lying depressions, drainage bottoms or stream edges.

Figure 12. PEM1B wetland type at mid elevation near Cow Creek.

PSS1A/C

Palustrine Scrub-Shrub Broad leaved Deciduous Temporarily Flooded/Saturated. These are willow and alder-dominated wetlands. They typically are found in river drainages and creek bottoms, but may be found occasionally in isolated wetlands not connected to flowing surface water. These wetlands serve a vital hydrologic function along streams by slowing floodwaters, preventing stream bank erosion, cooling the water via shading and contributing leaf litter to the water which serves as food for aquatic invertebrates. They are also prime habitat for migratory song-birds that use the dense vegetation for nesting and foraging.

Figure 13. Restored low-elevation willow dominated wetland along lower Glorieta Creek within Pecos National Historic Park. Photo credit: Joel Wagner, National Park Service.

PEM1C.

Palustrine Emergent Persistent Seasonally Flooded. This wetland type is generally wetter and less common than the PEM1B/A type, although they share similar vegetation characteristics. This type is wetter for longer periods of time during the growing season. This wetland type is often found at the head of small creeks and serves as the "source" for the water. *Figure 14. PEM1C wetland type near 10,000 feet*

The wetland serves to absorb the snowmelt each spring and gradually release it downstream during the spring and summer.

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Figure 15. PEM1C wetland type along Cow Creek. Note dark green vegetation denoting persistent saturation and wetland vegetation

The current mapping effort represents a Level I effort to collect landscape-level wetland information. This mapping effort is "remote" in the sense that very few of the mapped wetlands are visited in the field either before or after the mapping effort. A follow-up effort to visit mapped wetlands and perform a Level II analysis is the next step once the map is finalized. This Level II effort inventories examples from all wetland classes documents the current condition of the wetland. With the addition of a Level II assessment, even more information is available about which types of wetlands appear to be in the best condition and which types of wetlands are most in need of help. Performing this Level II analysis is seen as a critical step for the Upper Pecos Watershed.

Wetland Functions and ecosystem services

Wetlands of all types perform various and critical functions that help maintain and enhance the physical, chemical and biological characteristics of watershed. Wetland functions can be divided into three broad categories: physical, chemical and biological.

Physical.

Wetlands provide water storage in both short and long term scales. Headwater wetlands, for example, provide for season-long storage of snowmelt and summer rainfall. Their ability to absorb and slowly release water allows for consistent water delivery downstream and also regulates the water temperature. Short term water storage can be seen during flooding events when streambank wetlands capture, slow and temporarily store the water moving downstream. As wetlands perform their physical storage role, they are also removing sediments from the water. This is especially vital in the Pecos watershed as many of the perennial streams are currently under non-attaining status for excess turbidity.

Wetlands also dissipate energy associated with wave action on ponds and lakes and also the margins of streams and creeks. By softening the energy at the interface between land and water, they prevent erosion and stabilize streambanks and lake margins.

Chemical.

Wetlands contribute to the on-going bio-geochemical cycle within the watershed. They capture, store and cycle nutrients, and also have the ability to filter and sequester organic compounds and metals. Within the watershed, there are two good examples of chemical function of wetland communities. A the former Terrero mine site, and also at the El Molina tailing areas constructed wetlands are performing vital filtering roles to keep heavy metals and other mine-related chemicals out of the Pecos River.

Biological.

The most obvious expression of the biological function of wetlands lies in the often luxurious vegetative growth that contrasts so starkly with the adjacent upland plants. Wetlands typically support much high plant biomass and often a higher species richness then non-wetland communities. This biomass and plant species diversity, in turn, supports numerous species of invertebrates, fish, birds and mammals that utilize wetlands for food, shelter, nesting, and water.

Baseline Assessment of Wetland Condition as currently known:

Currently, there is no watershed-wide assessment of wetland conditions. There have been several isolated studies and reports, but no comprehensive assessments. The New Mexico Natural Heritage program included several Pecos watershed wetlands in their wetlands reference site report from 1998 (see Wetland Reference Sites below). In 2011, the National Park Service performed a riparian condition assessment for 3 reaches of the Pecos River and lower Glorieta Creek within the Park boundaries. Results from the study indicate proper function condition for the Pecos River but Glorieta Creek was rated as “functional, but at risk of downward trend” (NPS 2011). The US Forest Service is the single largest manager of wetlands within the watershed. However, they do not have an active wetland monitoring program, nor is one mandated under their Forest Management Plan (USFS 2010).

Wetland Reference Sites

Wetland reference sites are valuable for gathering baseline data about wetlands in the absence of certain environmental stressors such as invasive species, grazing, logging, hydrologic manipulation, and development. They are invaluable as references for restoration activities and to compare other wetlands in terms of their condition and function. In 1998 the New Mexico Natural Heritage Program established three wetland reference sites along the upper Pecos River (Bradley et al 1998) (Figure 16). They inventoried both hydrologic and vegetation factors and rated each wetland on an A to F scale.

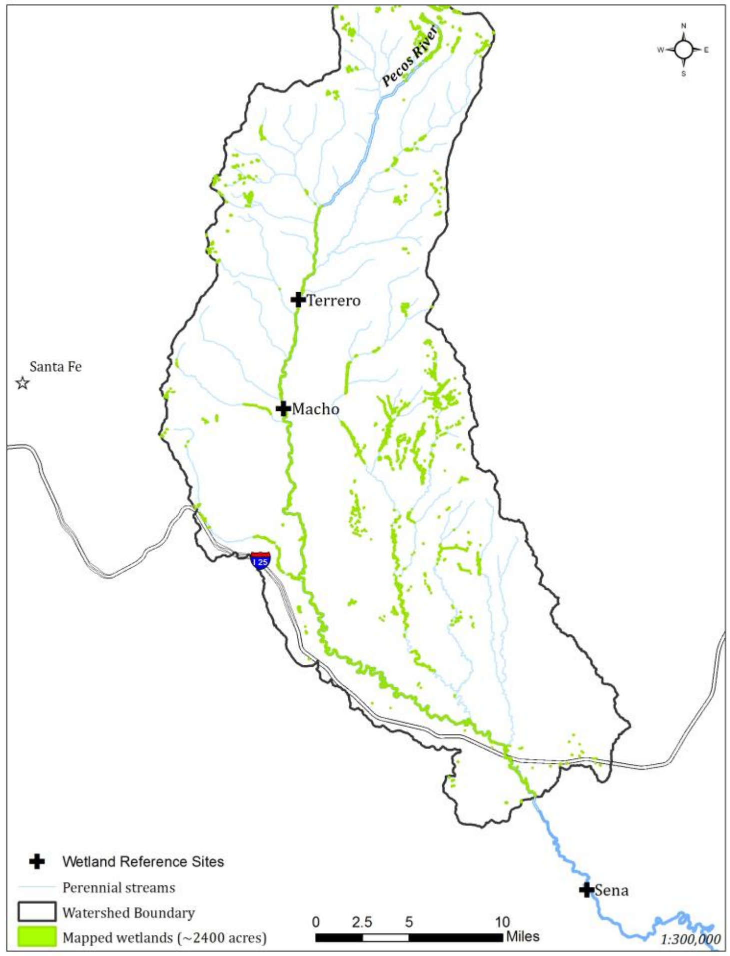

Figure 16. Location of NMHP wetland reference sites.

The uppermost reference site is just north of the Tererro general store. It was graded B+; "Overall, direct impacts are minimal and wetland communities are in good condition." Moving downstream, the next reference site is near El Macho. This site was grade B and described as "Overall, wetland communities are undisturbed, diverse, and well-developed. The hydrologic regime of the site is affected by upstream mine activity, the highway, and irrigation diversions. Finally, the Sena site lies just outside of the defined limits of the upper Pecos watershed boundary, but it does, nevertheless, give insight into the condition of the lower portion of the watershed. Sena was rated C+; "Impacts to this site are fairly extensive and affect community condition. Threats to this site include Russian olive encroachment and further fragmentation from agriculture." These three wetland reference sites show a trend toward decreasing wetland condition moving down the watershed as human development and pressures on the river increase and accumulate. These three wetland sites have not been reevaluated since their original inventory in 1998 (Esteban Muldavin, personal communication).

Additional wetland reference sites would be very useful, especially for wetlands types not associated with the major streams and creeks within the watershed. High elevation isolated wetlands of the slope or depressional type within the Pecos Wilderness would round out the picture of wetland condition and function within the watershed.

Identification of threats to wetlands

Threats to wetlands occur at both the landscape scale and also at the individual wetland scale. While the scale distinction is important in terms of management and protection, it should be noted that it is a somewhat arbitrary distinction as both scales interlink. At the landscape scale multi-year drought, warming temperatures, and an overstocked forest are working together to diminish the size and extent of wetlands. New Mexico is currently in a record setting drought. The past two years have been the driest period in New Mexico since record keeping began. The decade ending in 2009 recorded one-third of all the record-breaking high temperatures at the Pecos Ranger station (Figure 17). Drought is a common and episodic condition in the southwest and has both direct and indirect effects on wetland vegetation. Direct effects include reduced precipitation within the watershed leading to shrinking wetlands, both individually and in aggregate.

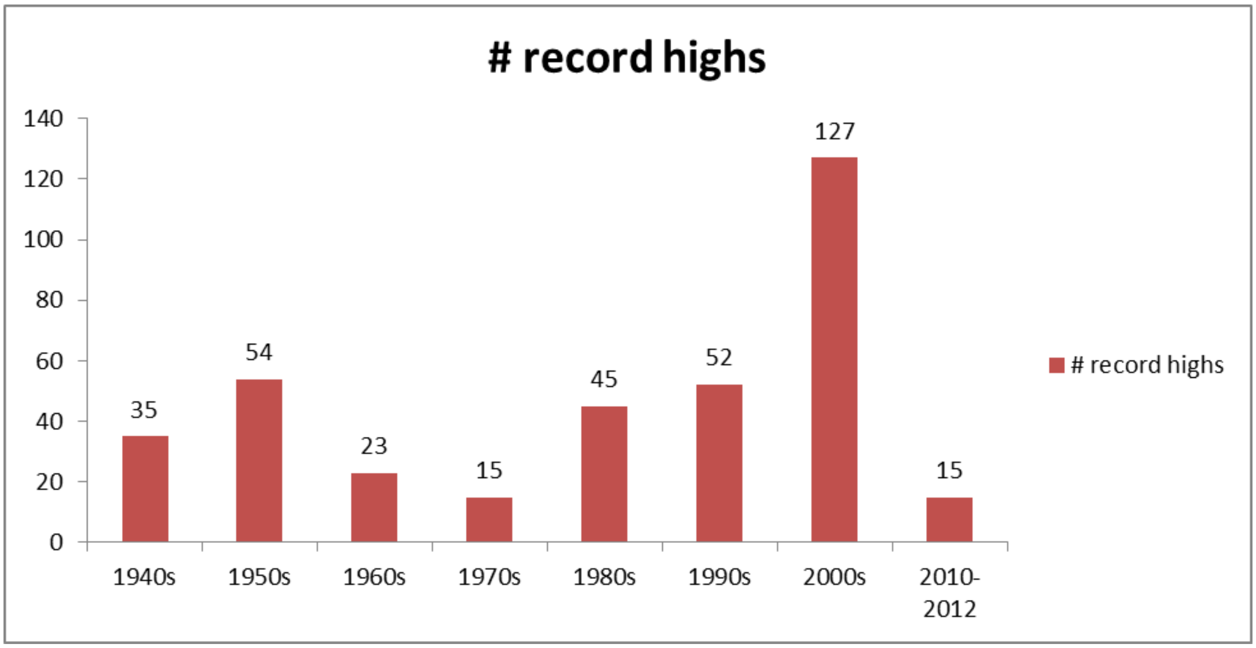

Figure 17. Distribution of record high temperatures by decade from the Pecos weather station. Data source: Western Region Climate Center.

Indirect effects of drought and warmer temperatures can be more subtle and difficult to anticipate or predict. During periods of drought, flash floods during summer rainstorms carry more erosional force because much of the upland vegetation that would intercept raindrops and capture surface runoff are lacking. It is flooding that does the work, but drought that serves as a multiplier. As floodplains become incised, water is concentrated into a single channel increasing the velocity and erosive power. Once the channel is disconnected from the former floodplain and it's wetland vegetation, the floodplain becomes a relict, unable to regenerate and eventually transitions to mesic or upland vegetation.

Another landscape-level extensive threat to wetlands within the Pecos watershed is the increased coverage of conifer species, particularly at lower and mid elevations. Conifer trees at higher elevations perform an important watershed function of trapping snow and facilitating a gradual snowmelt each spring. Conifers at mid elevation (mixed species, with Ponderosa pine being dominant) do not perform this role. Forests and woodlands at this elevation were typically open canopy with large areas of herbaceous species in the interspaces. Conifer species, in contrast to nearly all other forest vegetation, are photo synthetically active year round, moving water from below ground to the atmosphere through evapotranspiration. Across a landscape, this effect can be profound. Studies show that removing a minimum of 15 percent of coniferous canopy will increase water yield and that increased thinning is roughly correlated with increased yield (Stednick 1996). Historic photographs from the Pecos region do show a pronounced increase in conifer cover particularly at lower elevation.

Overstocked forests are also more prone to catastrophic wildfires. Fire return intervals for Ponderosa pine forest range from 5 to 30 years. Piñon-juniper forest are typically more variable, but likely saw fire every 5- 50 years in open savannah types, but much longer (>200 years) in persistent woodland types associated with rocky substrates (Romme et al 2009). Frequent but less intense fires promoted herbaceous ground cover, which prevented soil erosion and allowed for precipitation to effectively percolate into the soil, reducing evaporative losses and recharging ground water. With the vast, unregulated public lands grazing of the late 1800s and early 1900s much of this grass cover was removed and along with it the frequent, low intensity wild fires. Without fire and with reduced competition from grasses, seedling conifer species thrived and whole forest grew into "dog hair" thickets of small diameter trees closely spaced to each other. Crown fires have become common in these overgrown forests, as demonstrated by the Viveash fire in 2000, and the Los Conchas fire in 2011.

<u>Localized threats</u>

Localized threats and stressors to wetlands include improperly designed roads and trails that dewater or compact wetlands, destruction from recreational vehicles, improperly managed grazing, invasive species and localized draining of wetlands (rare).

Road Development

Roads and trails should be built to avoid wet areas whenever possible. Road cutting through wet areas, particularly on hill slopes, can intercept surface and groundwater moving downslope (Figure 18). Water caught on the road is conveyed down the road, gathering velocity. If it

Figure 18. Slope type wetland at high elevation wetland with poorly sited road cutting bisecting the water flow.

cannot be suitably discharged into an open sink or depression, the water will often form its own outlet causing head cutting and erosion at the outlet, as well as downstream.

Improperly Managed Grazing

Grazing wetland vegetation is a common practice in the arid west as wetlands are generally more productive and recover more quickly than adjacent upland vegetation. Overgrazing and damage occur when a plant is grazed repeatedly without sufficient time to recover from initial defoliation. Repeated overgrazing leads to decreased plant vigor and can eventually kill the plant. Wetlands that lack their typical vegetation cover can be quickly eroded away from water and wind and can quickly convert to uplands. Given the relatively low level of public land grazing recently (Livestock Grazing section above), grazing impacts are likely minor and isolated to small individual wetlands. However, the situation on private lands may be dramatically different. Pastures with wetlands on private lands may be under increasing grazing pressure given the record drought and the high price of hay.

Invasive Species

Woody invasive species like tamarisk and Russian olive are serious problems in riparian and wetland communities throughout the west. In the Pecos watershed their distribution is confined to the lower third of the watershed. Tamarisk is known to have higher evapotranspiration rates then native wetland species and move more water out of the ground to to the atmosphere (Nagler &Thompson 2003). It can also profoundly alter soil conditions where it grows. Tamarisk will exude the salts found in groundwater onto the small leaves of the plant. When these leaves drop and accumulate on the ground, the salts concentrate over time creating soil conditions that are inhospitable for many native wetland trees and shrubs (Di Tomaso 1998).

Invasive herbaceous species like reed canary grass and purple loosestrife are adapted to the conditions found in the Pecos watershed but, so far, have not been found. These species could easily dominate certain wetland types within the watershed and should be controlled when first detected. An excellent resource for both identification and control of invasive species in New Mexico can be found at:

http://www.nmda.nmsu.edu/wp-content/uploads/2012/04/troublesome_weeds_nm.pdf

Print versions of this document are also available from the New Mexico Department of Agriculture.

Identification of wetland values and ecosystem markets

The Upper Pecos Watershed Association is striving to identify wetland values in the Pecos watershed. Discussion with board members and during collaborator meetings produced the following list of wetland values.

- Clean water. Many summer home users obtain domestic water from spring or seeps that are nearby their homes. Additionally, clean water sustains the watershed's important and much loved trout streams and creeks.

- Recreation. The economy of the town and community of Pecos is driven in large part by the outstanding recreation opportunities on public and private lands within the watershed. These include hunting and fishing, hiking, camping, bird watching, nature observation, and photography. While most of these activities could happen in the absence of wetlands, UPWA recognizes that the quality of experience (and therefore the economic vitality of the community) is enhanced when the public sees vibrant, healthy streamside vegetation and wet mountain meadows in good condition.

- Agriculture. The Pecos watershed has a long history of irrigated agriculture, predating European settlement. Acequias still convey water to pastures and farms along the Pecos River. This irrigation system is dependent on a properly functioning watershed and wetlands play a vital role in that function.

- Habitat. The Pecos watershed is home to several threatened and endangered species. Additionally it also supports large quantities of watchable wildlife, while wildlife hunting contributes substantially to the local economy. Wetlands play a vital habitat function to sustain populations of many, many plant, animal and invertebrate species.

Data gaps and missing information

This planning effort highlighted the relatively small amount of ground-based data that exists on wetlands within the Pecos watershed. This isn't the first planning effort to run into a lack of information. In the San Miguel County Comprehensive plan the community members expressed the following "wish-list" in terms of natural resource protection:

- Hydrological reports and studies
- Water conservation
- Relate new growth to water availability
- Water rights banking

The lack of information regarding the "plumbing" of the Pecos watershed and how surface water and groundwater interact and move through the valley to recharge springs, wetlands, creeks and rivers is a major data gap. For example, the highest density of mapped wetlands occurs in the Cow and Bull Creek drainages. No coincidentally, this area has some of the highest density of ex-urban development within the valley. This raises specific questions regarding the effect of private wells and water use on adjacent wetlands. Additionally, little information is known about the current condition of most wetlands within the watershed. Condition assessments are a first step in prioritizing wetland protection and restoration, and currently the available information is near zero.

In summary, this planning effort discovered the following gaps that would be important next steps in furthering wetland protection within the Pecos watershed.

- What effect, if any, are domestic water wells and ex-urban development having wetland resources?
- Why is there a heavy concentration of wetlands within the Cow and Bull Creek drainages but little on the west side of the watershed?
- What is the current dependence on surface water seeps and springs for domestic water use
- What is the value of outdoor recreation within the Pecos watershed and how do wetlands contribute?

RESOURCE MANAGEMENT

The Pecos watershed is collectively owned by a great number of private individuals along with several state and federal agencies. Obviously each landowner may have different expectations and requirements for wetland management. The National Park Service is primarily a preservation organization with a mandate to maintain landscape and cultural sites “unimpaired for the enjoyment of future generations.” The National Forest is a multiple use organization with no intrinsic mandate to preserve the landscape or resources, but rather to “sustain the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of present and future generations.” Private land owners may elect to manage wetlands for preservation, while others may see them as productive, “working lands” best used for grazing or haying. Implicit in these differences is an understanding that resource management must be flexible and be tailored to site specific and owner specific requirements.

Resource management covers a broad array of activities including inventory, monitoring, and assessment of condition, protection, restoration and on-going maintenance.

Wetland Management and Prioritization

With over 1,000 mapped wetlands covering 2400 acres, it is important to prioritize wetland protection and restoration to areas deemed “high value”. While value is a subjective term, it reflects the sentiments expressed during planning meetings that some wetlands sites are more important than others and warrant priority protection or restoration. The Upper Pecos Watershed Association believes priority should be given to public lands that connect most frequently with residents and visitors. These areas include the many roadside trout streams and lakes within the watershed. Of secondary importance are the more remote backcountry areas where visitation impacts are greatly reduced. Private lands, while widespread in the lower portion of the watershed are ranked as third priority. The following list reflects priority themes that have been used to assign value to wetland protection and restoration:

1. Wetland sites that serve to provide drinking water to community members
2. Wetlands in poor condition on public lands
3. Wetland sites that provide valuable streamside habitat and help maintain healthy rivers and the opportunity for outdoor recreation
4. Wetlands that serve to improve water quality along impaired reaches of streams within the watershed

While this value lists helps guide decision making, it does not necessarily address site specific projects, required management actions, environmental compliance issues and other considerations that must be made when determining the feasibility of proceeding with protection or restoration.

Measures to protect or restore wetlands

Protecting extant wetlands is much cheaper and easier then attempting to restore them once they become modified, degraded or destroyed. Consequently, protection should be the first priority when considering how to best allocate finite financial and personnel resources on wetland management.

Legal protections can occur at all levels of government, but are typically associated with the Federal government and specifically the Environmental Protection Agency. The Clean Water Act protects jurisdictional wetlands (those wetlands occurring within "waters of the US" and meeting the US Army Corps of Engineers (USACE) standard for wetlands). However, not every wetland is "jurisdictional". Many isolated wetlands not hydrologically connected to streams and creeks are not considered jurisdictional. Many wetlands do not meet the hydrologic, vegetation or soil characteristics necessary to meet the USACE standards. These wetlands, while not federally protected, still serve important habitat, hydrologic and water quality functions.

States and local governments may elect to afford protection to wetlands not currently covered at the federal level. These protections may occur through zoning ordinances, required in-kind mitigation if wetlands are developed or destroyed, or other environmental regulations. Within the Upper Pecos watershed all wetlands occurring within the Pecos Wilderness are designated as Outstanding National Resource Waters by the state of New Mexico. These wetlands receive additional protection from the state in order to prevent degradation of their water quality.

At the local level, the San Miguel County plan currently has no protection for wetlands. The ten-year plan expires in 2014 and could be updated to include specific protections for wetlands. Such language is already in place for several adjacent communities within Santa Fe County.

The small, traditional communities of La Cienega and La Cieneguilla expressed protection for wetlands in their community plan thusly (taken from the La Cienega/La Cieneguilla Community Plan 2012)

"The protection and maintenance of community assets including but not limited to wetlands, open spaces, springs, watercourses, riparian areas, agricultural lands, acequias, traditional community centers, archeological sites, historical and cultural sites and multi-generational family housing compounds should be interpreted as intrinsic community values that must be considered when reviewing all land use and development proposals. "(pg.18)

AND

*"Prior to development of new riparian areas and wetlands in the Planning Area, applicants shall demonstrate adequate water rights and/or source(s) of water to meet consumptive needs of the riparian area or **wetlands**, and that the project will not negatively impact prior beneficial uses or traditional uses of water resources, in accordance with State Engineer's Office regulations. "(pg. 47)*

The village of Galisteo and surrounding community declared that wetlands and riparian areas are "Restricted Areas" where development will be severely restricted (Galisteo Community Planning Committee 2012).

Measures such as these could help protect critical wetland areas along rivers and creeks within the Pecos watershed and can help sustain the important habitat functions that drive so much of tourist visitation and business development.

While protection is relatively straight forward in terms of planning and zoning requirements, restoration of wetlands is not as well codified. Offsetting wetland development or destruction by restoring or creating new wetlands is the most common conduit through which to achieve wetland restoration. However, issues arise regarding finding interested landowners, achieving a "match" in terms of wetland type and function, and ensuring follow-up maintenance and monitoring restoration sites.

Restoration of wetlands can be a minor or major undertaking depending on the level of degradation that has occurred. The single largest determinant in how difficult or easy the restoration process will be is the hydrology. Sites that maintain their hydrology despite impacts to their vegetation will usually respond very quickly once the stressor has been removed or reduced. Grazing in wetlands is a classic example of a where slight modifications in stocking rates or timing of grazing can dramatically reduce the impact and preserve the wetland. Grazing wetlands areas during the dormant season is an easy way to still utilize existing forage, but allow wetland areas to provide habitat and hydrologic functions. Fencing is also a permanent solution to protecting wetlands in decline due to trespass or grazing.

Wetlands that have their hydrologic component will require much more effort and expensive to restore. Hydrologic loss can occur due to water being diverted by roads, ditches or levees that constraint and reroute creek channels. Additionally, soil compaction from livestock, hiking, vehicles or other recreation uses can compress soils and prevent water from percolating into a soil, but instead run off the soil. Fixing these impacts often requires mechanized excavation or ripping to reestablish former flow patterns or break up soil compaction.

List of Proposed Projects to Protect and Restore Wetlands

Given that the current Level I mapping effort is not yet complete and a Level II ground inventory of wetlands has not yet been scheduled (see page 29) , the first priority would be to initiate a thorough inventory of mapped wetlands, using the priorities stated on page 37 to focus the effort.

Putting that aside for the moment, planning discussions for this document identified several projects that are of interest to the local community. These project are "grass-roots" in the truest sense, in that they came from the observation and concerns of Pecos areas residents.

- *Grass Mountain Wetland Spring*. This small wetland (Figure 19) near the Grass Mountain summer homes serves as domestic water supply for several home owners. There is a small concrete collection box and a pipe to move the water to the road. Currently, the wetland is in good condition, but there is dispersed camping nearby and reports of ORV trespass through the wetland. This project would require simple pipe fencing to prevent damage to the spring and collection point.

Action Items:

1. Secure permission from the USFS to fence the area (the area was fenced at one time, so this shouldn't be an issue).
2. Secure funding to purchase fencing materials.
3. Coordinate installation using volunteers.

Figure 19. Surface water spring and associated wetland near Grass Mountain Summer Homes. This spring serves as a household water supply for many residents.

💧 *Dalton Canyon Beaver Ponds.* Dalton Canyon historically supported a population of beavers who maintained a series of ponds. (Figure 8, page 20). Aerial photograph analysis has shown that in the past 15 years the ponds have gradually diminished. Site visits in May 2013 demonstrated that there is little recent beaver activity in the vicinity of the ponds or further downstream.

Action Items:

1. Collaborate with the USFS Pecos Ranger District as they have already secured environmental compliance for improvements within the Dalton Canyon Dispersed Camping Area.

2. Determine the cause of the beaver decline. This is likely due to reduced water volume in Dalton Canyon which may be affected by developments upstream.

3. If adequate water is available, but food is lacking a potential solution may be to lightly thin the area of encroaching junipers and replant willow within the riparian corridor utilizing volunteers. The Truchas Chapter of Trout Unlimited has been interested in rehabilitating portions of Dalton Canyon and would be likely project proponents and participants.

🌢 *El Molino Arroyo.* The El Molino arroyo is a small drainage that parallels state highway 223 on the east side of the village of Pecos. It has a small isolated wetland near its origin and the arroyo itself is seasonally flooded during the summer. Water moving down this arroyo in addition to run-off from the highway generates large amounts of sediment that is deposited into the Pecos River within the village. This section of the Pecos River is listed as non-attaining by the NMED and repairing the arroyo and reestablishing the wetland vegetation along the bottom of the arroyo would help mitigated some of the sediment deposit.

Action Items:

1. Coordinate with Land Owners. This arroyo spans both private and public land. The confluence of the arroyo and the Pecos River lies on private land, while the upstream portions and small wetland are US Forest Service Property.

2. Next steps depend on the landowners willingness and interest in working on the site and determining exactly what should be done.

🌢 *Glorieta Creek Levee Removal*. This project is within the Pecos National Historic Park and would remove a section of levee on Glorieta Creek that is currently constraining the creek into an artificially narrow and straight channel. The Park Service completed an adjacent restoration project in 1999 which is currently flourishing. Removing the levee will permit more natural channel development and increase the wetland buffer along the creek. This project is scheduled for completion in 2013 or 2014 (Joel Wagner, NPS. Personal communication).

🌢 *Pecos River at the Rio Mora*. This project was identified in the Watershed Based Plan as a high priority. It sought to narrow and deepen the Pecos River just upstream from the confluence with the Rio Mora. The narrow channel would allow for overbank flooding of a reconstructed stream bank and promote additional shrubby wetland vegetation along the trampled banks for this popular fishing spot. With funds from the New Mexico Community Foundation this project was completed in 2012 (Figure 20, next page).

🌢 *Los Alamitos Wetland*. This is a severely degraded wetland on private property within the town of Pecos. It is used as pasture for several horses. The site is centered on Alamitos

Creek which drains into the Pecos River within the village. This site is downstream from the reclaimed tailings further upstream.

Action Items:

1. Contact land owner and discuss the nature of the problem.
2. Assist the land owner, if interested, in secure money to fence off the area, or locate alternative pasture during the growing season.

Figure 20. Streambank and riparian habitat improvement along the Pecos River near the Rio Mora confluence. Stream was narrowed, creating a wider planting zone for riparian vegetation.

- *Viveash Mill Site.* Located west of the Village of Pecos, this abandoned saw mill on private land is adjacent to the Glorieta Creek floodplain. Based on initial field visits, it was observed that earthen material may have been pushed into the wetland to create a larger yard space.

Action Items:

1. Contact land-owner to secure permission discuss the area and history of the site.
2. Determine what, if any, wetland losses may have occurred.

Potential Financing Options

Money to protect and restore wetlands can come from both government and non-governmental sources. The Environmental Protection Agency and the US Fish and Wildlife Service are the primary federal agencies who fund wetland projects. However, plenty of other small grants and matching funds can be secured from both federal and state government. On the private side, many environmental advocacy and sporting groups support grass roots restoration efforts to protect and restore wetland and riparian habitats. The list below, while not exhaustive, is a good cross section of available sources. The Upper Pecos Watershed Association has a track record of securing funds for various projects via many of the sources listed below. They are willing and able to guide interested individuals and land-owners through the process.

<u>Federal Funds</u>

Environmental Protection Agency

- Clean Water Act Section 319 Watershed Restoration Grants
- Clean Water Act Section 104 (b)(3) Wetland Grants
- Environmental Education Grants

Natural Resource Conservation Service

- Environmental Quality Incentive Program (private lands cost-matching)
- Wildlife Habitat Incentive Program
- Wetland Reserve Program

US Fish and Wildlife Service

- Partners Program Grants (Private Lands)
- North American Wetland Conservation Act

US Forest Service

- Collaborative Forest Restoration Program
- Collaborative Forest Landscape Restoration Program

State of New Mexico

- River Ecosystem Restoration Initiative Grants (not currently active)
- NM Game and Fish Department (potential matching monies for other grants)
- New Mexico Community Foundation - NM River Conservation & Restoration Fund
- New Mexico Water Trust Board Grants

Non-Governmental

- William Kinney Watershed Protection Foundation
- Maki Fund
- Patagonia 1% for the Planet Grant and World Trout Initiative
- Western Native Trout Initiative
- Orvis Conservation Grant Program
- National Fish and Wildlife Foundation grants
- Trout Unlimited

Monitoring Recommendations for implemented projects.

"Not everything that counts can be counted, and not everything that can be counted counts."

William Cameron.

Post treatment monitoring is often given little, if any, thought or consideration. This is unfortunate because each restoration project has the potential to inform and improve the next. Monitoring, even informally, can help guide future restoration efforts and prevent repeating costly mistakes in both the design and construction.

Given that little money is set aside for short and long term monitoring of restoration projects, it is important to pinpoint exactly what is important to monitor and what results in needless information.

A fundamental question to ask before any monitoring program can be written or implemented is... "What do I need to find out?" This answer to this question should relate directly to the impetus for the project. Hopefully the project was initiated due to some observed condition within the wetland. Observed conditions may include: invasive species have begun encroaching, head cuts are beginning to advance up the drainage, and/or a wetland is drying out. These observations are indicators of wetland function and condition, and these observations or indicators become the rationale for funding and completing a project. Monitoring is the check-and-balance on to ensure that the management action was successful. More simply, this is often called "adaptive management" wherein problems are observed, solutions designed and implemented with predictions of post-treatment outcomes, and monitoring to verify or counter the predictions.

Generally speaking, monitoring should include both vegetative and hydrologic components. Some projects many only require one kind of monitoring. A project to remove Russian olive from an otherwise functional wetland may only require casual, annual monitoring for presence/absence detection of Russian olive. However, a project involving restoration of a ground-water maintained wetland may require installation of wells to monitor water levels throughout a season for multiple years. At a minimum, all projects should include repeat photography at fixed points and a description of present condition

Tracking Gains and Losses.

Tracking wetland gains and losses is vital to prevent the slow, almost imperceptible loss of wetland habitats throughout the Pecos watershed and beyond. Many small, isolated wetlands are shrinking in size as our state-wide drought continues unabated. Others are being quietly lost to development or agriculture. Once gone, it is expensive and difficult to bring them back.

Large, expansive wetlands associated with lakes or rivers can be readily evaluated via aerial photographs. However, small seeps, springs and other isolated wetlands that are vital for their habitat and water storage function may be invisible on most aerial photographs and can only be evaluated on the ground. Land management agencies will likely not be able to systematically monitor wetlands across a landscape every two or three years. However, it may be possible to enlist a cadre of individuals to do the work.

Recruiting interested volunteers to monitor wetlands may the easiest way to get watershed wide tracking of wetland size and condition. Several significant natural resources are currently monitored with the help of ordinary citizens. Since 1966 the US Geological Survey has administered the Breeding Bird Survey program that relies on volunteers to survey 4,100 areas each year using a standard survey protocol. Likewise, a new nation-wide phenology monitoring program was initiated in 2009. Closer to home, the Santa Fe National Forest maintains a dedicated staff of volunteers who monitor archeological sites to document site conditions and report any damage or impacts. A program to enlist volunteers to track wetland gains and losses could be implemented within the Pecos watershed and around the state. Given that wetlands are often focal points for recreation (fishing, backpacking, hunting, hiking, etc.) it seems reasonable that concerned individuals would be willing to provide a quick inventory of wetland condition during their recreation. Protocols would need to be standardized and efforts should be coordinated by some central authority, like NMED, but there does seem to be enough existing examples to guide the development of a “wetland watchdogs” program.

Public Involvement Strategy

The Upper Pecos Watershed Association has a long track record of community outreach, and is ideally positioned to serve as a community coordinator and clearinghouse for wetland protection and restoration activities within the Upper Pecos Watershed. UPWA is the only existing organization involving all the public and private stakeholders in the area, and we have a respected and successful track record of implementing restoration projects as well as encouraging participation in environmental planning by agencies, non-government community groups, and individuals.

The UPWA also facilitates meetings of the Pecos Canyon Collaborative Group (PCCG), a loose association of agency representatives, and stakeholders within the valley. This allows the UPWA to be the conduit through which the public is involved in nearly every step of the wetland protection and process. Having completed many projects to improve the watershed, UPWA has developed a “system” of public involvement that will undoubtedly work for wetland specific projects as well. In a nutshell, the process proceeds as described below:

Identification of wetlands in need of protection or restoration. During monthly meetings, collaborators, stakeholders and the general public can discuss areas that have been observed that may need protection. With most major land owners and land managers in attendance, these reports carry much more weight and can be immediately evaluated by a knowledgeable group.

Facilitation between project proponents and agencies. UPWA will continue to serve as a go-between for projects on public land and the project proponents that would like to work on a wetland.

Grant Funding and Volunteer Base. UPWA maintains a large volunteer database with groups and individuals willing to provide time, materials and technical expertise to help offset some of the costs of wetland protection and restoration.

Post Project Monitoring. In the past, UPWA has utilized volunteers do perform significant amounts of volunteer monitoring for restoration projects. This provides valuable education for the public on the importance of wetland communities and also helps lower the costs of projects, allowing more work to be done for less money.

Collaboration and Partnerships

Many local organizations (including some of those mentioned above), as well as individuals, have partnered with UPWA the past in activities beyond regular meetings, and are committed to continuing collaboration. We are confident most will continue as active participants in as we look to protect and restore wetlands within the watershed. Personal conversation with UPWA members, staff, and/or Board members has been the most effective way of encouraging involvement in our small community in the past, and we will enthusiastically continue these efforts. The table below lists major organizations, businesses, and agencies that are already active collaborators.

Table 7. UPWA Collaborators and Partners

Partner entity	Representation	Contribution	Contact person
San Miguel County	County government	Inclusion of wetland protection into zoning.	Alex Tafoya 505.454.1074
Trout Unlimited, Truchas Chapter	Anglers and outdoors-people	Project proponents, volunteerism, technical expertise and funding.	Toner Mitchell 505.995.8114
Holy Ghost Homeowners' Assn.	Homeowners in Holy Ghost Canyon	Project proponents, volunteerism.	Kelly Andrews 505.992.2927
Village of Pecos	Municipal government	Project proponents, planning and funding.	Tony Roybal 505.757.6591
Tierra y Montes Soil and Water Conservation District	Landowners; conservation practitioners	Project proponents, volunteerism.	Frances Martinez 505.425.9088
Pecos Valley Community Foundation	Local community support NGO	Project funding and promotion.	Joyce Powell 505.757.3211
USDA Forest Service, Pecos/Las Vegas Ranger District	Federal land managers for large fraction of watershed and recreation areas	Permitting, planning, monitoring, project proponents and funding.	Steve Romero 505.757.6121
NM Environment Department, Surface Water Quality Bureau	Funding agency for Watershed-Based Plan; water quality regulators	Permitting, planning, project proponents, funding and montiroing.	Neal Schaeffer 505.476.3017
NM Department of Game and Fish	Managing agency for many recreation sites in Pecos Canyon	Permitting, planning, project proponents, funding and montiroing.	Jim Hirsch 505.757.3841
Friends of the Pecos National Historic Park	Community group supporting local National Historic Park	Permitting, planning, project proponents, funding and montiroing.	Bill Zunkel 505.310.0920

The Upper Pecos Watershed is justifiable proud of our accomplishments in protecting the water and land while serving our community members. The table below lists many of the projects that UPWA has assisted with. We feel that this plan is yet another step forward in unceasing drive to improve the condition and value of the Upper Pecos Watershed for visitors and residents alike. We would like to thank our many supporters and collaborators and the Surface Water Quality Bureau for secure funds to develop this Wetland Action Plan.

Table 8. Wetland restoration and related projects that UPWA has managed or collaborated on.

Project	Goal	Partners	Date Completed
Frog Pond	Protect a roadside wetland from off-road vehicle damage	US Forest Service, NM Depart. of Game and Fish. NM Dept of Transportation	2010
Hwy 63 Guard Rail	Protect the wetland buffer along the Pecos River from vehicle damage	US Forest Service, NM Depart. of Game and Fish. NM Dept of Transportation	2012
Bert Clancy Campground	Redevelop this state-owned campground to limit vehicle damage to the existing vegetation.	NM Department of Game and Fish	2012
Rio Mora Campground	Redevelop this state-owned campground to limit vehicle damage riparian areas.	NM Department of Game and Fish	2013
Pecos River Habitat and Riparian Restoration at Mora Recreation Area	Restore 250 meters of Pecos River and riparian vegetation.	NM Dept. of Game and Fish, US Forest Service, NM Community Foundation.	2013
The "Hatchistery"	Restore and expand wetlands along the Pecos River near Lisboa Springs Hatchery and Monastery Lake.	NMED (RERI), NM Dept of Game and Fish, Private Individuals.	2010

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