

WETLANDS ACTION PLAN for the GALISTEO WATERSHED

**U.S. EPA Cooperative Agreement CD# 976733-01-0(FY2004)
“Planning for Wetlands in the Galisteo Watershed”
And Addendum “Galisteo Pilot Project”**



September 2010

Galisteo Watershed Wetlands Action Plan

Prepared by:

New Mexico Environment Department
Surface Water Quality Bureau
Wetlands Program



And
Earth Works Institute



In partnership with
Galisteo Watershed Steering Committee:

Galisteo Watershed Partnership
Santa Fe County
Santo Domingo Pueblo
US Department of Army, Corps of Engineers
Santa Fe Conservation Trust

Table of Contents

Executive Summary	5
1. Introduction	8
a. Purpose and Need	9
b. Wetlands Action Plan Process	11
2. The Galisteo Watershed	15
a. Geology	15
b. Climate	17
c. Surface Hydrology	18
d. Water Quality	20
e. Vegetation Communities	21
f. Wildlife Habitat	23
g. Occupational History	24
h. Land Use	25
3. Resource Analysis	27
a. Galisteo Watershed Wetlands	27
b. Inventory of Wetland Resources	28
c. Classification of Local Wetland Types	29
d. Wetland Functions and Ecosystem Services	32
e. Baseline Assessment of Wetland Condition	33
f. Wetland Reference Sites	35
g. Threats to Local Wetlands	36
h. Wetland Values and Ecosystem Markets	40
4. Resource Management	45
a. Resource Needs	45
b. Reducing Impacts to Wetlands	45
c. Prioritization of Wetland Restoration Sites	47
d. Wetlands Restoration Design for Selected Sites	49
e. Measures to Protect Wetlands	52

Galisteo Watershed Wetlands Action Plan

f. Strategizing Financing Options	55
g. Monitoring	58
h. Tracking Wetlands Gains, Losses and Condition	60
5. Public Involvement Strategy	62
a. Technical Tools For Reaching the Public	64
b. Informational Programs Focusing on Wetlands	66
c. Student Involvement and Formal Outdoor Education	68
d. Community Stewardship Teams	69
e. Steering Committee and Partnerships	71
6. Accomplishments, Future Goals and Needs, Timeline	74
a. Accomplishments	74
b. Future Goals and Needs	74
c. Timeline	75
7. References	76
8. Appendices	80

Executive Summary

In 2003, the NMED Surface Water Quality Bureau (SWQB) Wetlands Program began the development of a wetland restoration program (Wetlands Action Plan Program), which is part of a larger mission to improve and protect the state's watersheds/water quality. Through the CWA Section 319(h) Program, SWQB provides funding for the organization of watershed groups (federal, state and local agencies, non-governmental organizations, and the public including private landowners formed to manage public watersheds) and a planning process (Watershed Implementation Plans) to reduce the total maximum daily loads (TMDL) of pollutants in their watersheds.

The SWQB Wetlands Program provides incentives and support to these existing watershed groups to develop Wetland Action Plans as an addendum to their watershed plans that delineate goals for protection and restoration of wetlands and riparian areas within these same watersheds.

As a demonstration, this Wetlands Action Plan for the Galisteo Watershed, located in central New Mexico was developed. In the Galisteo Watershed, leadership in watershed planning is provided by Earth Works Institute, a non-profit organization dedicated to watershed planning and protection, our primary partner in this Galisteo Wetlands Action Plan, and also principal author of the Galisteo Watershed Restoration Action Strategy produced in 2005. The process of developing this Wetlands Action Plan included incorporating wetland issues into the 2005 Galisteo Watershed Restoration Action Strategy document and into the work of the Galisteo Watershed Partnership (GWP). Subsequently, the SWQB Wetlands Program and Earth Works Institute (EWI) established a wetlands steering committee for the Galisteo Watershed under the auspices of the GWP, and helped review and incorporate other community planning initiatives for areas in the watershed that were identified as having wetlands potential. The plan also identifies potential wetland restoration projects, a list of priorities and timeline for implementation.

Galisteo Watershed Wetlands Action Plan

We have targeted community planning initiatives as the strategic partnerships that will help mainstream wetlands restoration and protection as part of the normal activities in the watershed. These initiatives include Santa Fe County’s current planning initiatives for the area, identification of areas of Significant Conservation Value as part of “Green Infrastructure” planning for the Galisteo Watershed (Galisteo Watershed Conservation Initiative), efforts related to tamarisk and other non-native invasive species management, a plan for 24 archeological areas developed by BLM based on recent Federal Legislation, the statewide network New Mexico Wildways, and inclusion in the USFWS Partners for Fish and Wildlife Upper Rio Grande priority area among others. The Wetlands Action Plan takes advantage of the opportunity to coordinate wetland restoration with these planning initiatives as steps to establish a long-term, watershed-



Figure 1. Residents, agency representatives, and conservation organizations have formed a collaborative team to discuss the design for the restoration of riverine wetlands in the Village of Galisteo.

Galisteo Watershed Wetlands Action Plan

wide wetlands restoration and protection program. Included in this planning effort is a strategy to track wetlands gains and losses, documentation of existing on-the-ground restoration of wetlands and a plan for monitoring and adaptive management.

The Galisteo Wetlands Action Plan is a watershed approach to wetlands protection and restoration. Strategic partnerships lie at the heart of the strategy that works in the Galisteo Watershed.

1. Introduction

The Galisteo Watershed is a 730-square mile sedimentary basin, located just south of Santa Fe, New Mexico (Figure 2). The Galisteo Watershed is named after the Galisteo Creek, which begins its course on the flanks of Thompson Peak and Glorieta Baldy. These peaks form the southernmost reach of the Sangre de Cristo Mountains, officially the southernmost mountain range of the Rocky Mountains. Other headwater creeks include Grasshopper Canyon, Deer and Apache Canyon Creeks. Each mountain creek valley is about eight miles long, and elevation differences between headwaters at Thompson Peak (10,533 ft) and Glorieta Baldy (10,199 ft) and their confluence at Canoncito (6,937 ft) are significant.

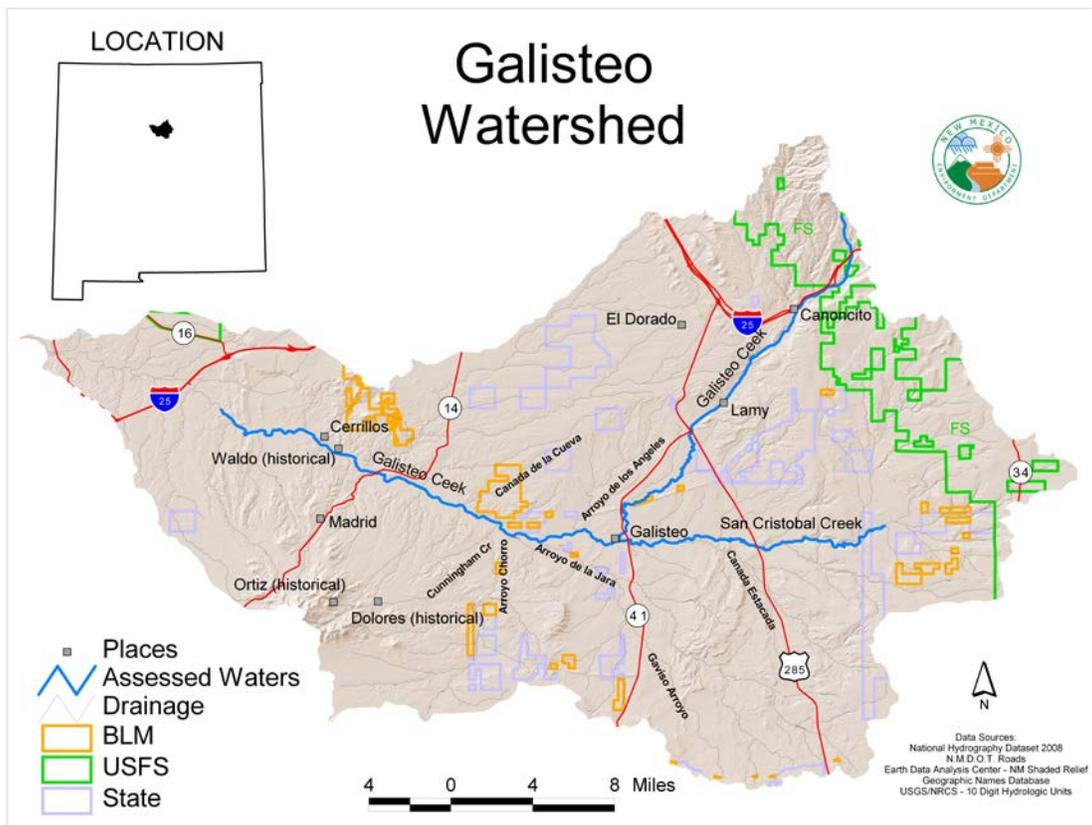


Figure 2. Galisteo Watershed with major perennial drainages, Galisteo Creek water quality assessment reaches, land ownership and geographical features shown.

These headwater creeks merge at upper Canoncito to form the main stem of the Galisteo Creek, which has a channel grade of 2% or less. Elevation differences over the remaining part of the Galisteo Creek (approximately 46 river miles and 38 valley miles) are relatively small ending at the confluence with the Rio Grande at 5,180 feet (WRAS 2005).

Galisteo Watershed Wetlands Action Plan

1.a Purpose and Need

In the past few decades, the landscape of the Galisteo Watershed has gradually been fragmented as a result of property division, highway and railway construction, and the gradual conversion of farms and ranches into residential areas. Fragmentation leads to hydro-modification of water courses, isolation of wildlife, and a reduction of minimally disturbed, contiguous habitat, eventually jeopardizing biodiversity and species survival. It is estimated that the Galisteo Watershed has gradually lost approximately 4,000 acres of wetlands due to land degradation and land use conversion. Of the original 5,000 acres of wetlands (1% of land area) in the 1700s, approximately 1,000 acres remain (0.2% of land area).

Past land use and ongoing urban development have led to accelerated storm water runoff and a flow regime of concentrated peak flows in the Galisteo Creek and its tributaries. As a result, soil erosion and sediment accumulation in the stream and the Galisteo reservoir have increased, while adjacent wetland and riparian ecosystems have been compromised. In many locations, tributaries start as steep headcuts and have carved deep gullies that dewater the landscape. The Galisteo Creek is in most locations 10-25 feet incised below the historic floodplain. Riparian floodplain zones with native cottonwood and willow groves have dwindled, while exotic Russian olive and saltcedar have aggressively invaded the riparian habitat (Figure 3). In many places, originally moist flood plains, productive alluvial fans, springs, wetlands and wet meadows have dried up and made place for degraded, dry sediment flats.

Planning for the restoration and protection of wetlands and riparian areas, river corridors, springs and seeps of the Galisteo Watershed are critical to reverse the gradual degradation and loss of wetland ecosystems and their important landscape functions; to address the impacts of gradual fragmentation of landscapes resulting from (ex)urban development, oil, gas and mineral extraction, and construction of transportation lines (highways and railways (Figure 4)); and to guide future development activities that minimize encroachments, impacts and losses of water resources and wildlife habitat in the Galisteo Watershed and its receiving waters of the Rio Grande.

Galisteo Watershed Wetlands Action Plan



Figure 3. Galisteo Creek wetland in the Village of Galisteo (2004). Overhanging vegetation is primarily exotic Russian olive trees. Project activities have led to the removal of this exotic vegetation and the natural regrowth of willows.



Figure 4. Aerial photograph of Galisteo Creek in the central part of the Galisteo Watershed. The photo shows riparian vegetation patterns that originate from levees constructed by the US Army Corps of Engineers between the 1930s and the 1950s to divert the Galisteo Creek away from the railroad tracks (top of photo). Induced meandering restoration techniques were used to recover stream hydrology, and restore overbank flooding and floodplain function within the confines created by locating railroad tracks adjacent to Galisteo Creek. All land shown in the picture is privately owned.

1.b Wetlands Action Plan Process

The Galisteo Watershed “Wetlands Action Plan” (WAP) is a planning document designed specifically to consider wetland resources within the boundaries of the Galisteo Watershed. Wetlands and riparian areas have ecological, economic, and aesthetic value and serve many vital functions including water purification and storage, and erosion reduction. Riverine wetlands and riparian vegetation store storm water runoff, increasing the duration of stream base flows, reducing flood hazard and peak flows, stabilizing stream banks, thus reducing erosion, and improving wildlife and fish habitat and overall ecological conditions (Figures 4 and 5). Depressional wetlands store water and contribute to groundwater recharge and provide food and habitat for wildlife (Figure 6).

Galisteo Watershed Wetlands Action Plan



Figure 5. Typical riverine wetland habitat of the Galisteo Creek mainstem. Note the main channel has been incised and steep erodible banks are exposed.



Figure 6. The Galisteo Watershed topography is rarely level because of the complex geology of the area.

Galisteo Watershed Wetlands Action Plan

However, the San Cristobal Playa is present near the center of the Galisteo Basin and in wet winters provides important migratory waterfowl habitat along the Central Flyway.

This WAP provides guidance for protecting and restoring wetlands with an emphasis on water quality benefits and ecological integrity, preserving wildlife corridors, and conserving habitats of threatened and endangered species, migratory birds, and other species of concern. This plan is written for community partnerships, state and local institutions, and conservation groups who are involved in the preservation, conservation and restoration of wetlands in the Galisteo Watershed. It can also provide a model for other watersheds and communities because much of this plan is based on findings and lessons learned during the process of restoring and protecting stream corridors, wetlands and riparian areas in the Galisteo Watershed over the past 20 years.

The Galisteo WAP includes descriptive landscape background information and available information for three major planning components (listed below). These planning components help ensure that watershed planning and any other local planning activities adequately address wetland management issues. Not all information is presently available and part of the planning process and future actions is to fill information gaps. The development and refinement of the Galisteo Watershed WAP will be an ongoing process.

1. Resource Analysis

- Inventory of existing wetlands resources in the watershed, GIS coverage
- Classification of local wetland types
- Wetland functions and ecosystem services
- Baseline assessment of wetland condition
- Location of wetland reference sites
- Identification of threats and impairments (stressors) to local wetlands
- Identification of wetland values and ecosystem markets

2. Resource Management

- Prioritization of sites with potential for restoration of ecological integrity
- Development of measures to protect wetlands
- Development of measures to reduce chronic and cumulative impacts to wetlands
- List of proposed projects to protect and restore wetlands
- Strategizing financing options
- Monitoring component to measure success of implemented projects
- Tracking component to track wetlands gains and losses

Galisteo Watershed Wetlands Action Plan

3. Local, Public Involvement Strategy

- Technical tools for reaching the public
- Informational programs focusing on wetlands
- Steering Committee and partnerships
- Identification, organization and mobilization of volunteers
- Identification of grant writers and tracking of funding opportunities

This Wetlands Action Plan will become an addendum to the 2005 Galisteo Watershed Restoration Action Strategy (WRAS). The Galisteo Watershed WRAS is a watershed based plan for the development and implementation of actions that abate non-point source water quality impairments. The Galisteo WRAS considers specific surface water quality problems; identifies sources of contamination causing those problems; and includes a schedule of holistic actions that improve watershed conditions and remove or abate non-point sources of water pollution. A WRAS is a non-regulatory, voluntary approach to perform these actions. Over the course of years, we have found that while restoration measures to address water quality also affected associated wetlands and riparian resources, these resources were not the focus of restoration measures, have not been measured for gains or losses, nor were improvements to associated wetlands in the watershed specifically tracked. In addition, in many cases restoration measures that also improved wetlands were not evaluated on that basis. The SWQB Wetlands Program is providing guidance to facilitate watershed groups throughout the State to develop “Wetlands Action Plans” as an additional component of their WRAS in order to more specifically focus on wetland and riparian resource protection, restoration and monitoring as part of comprehensive and holistic watershed-wide planning.

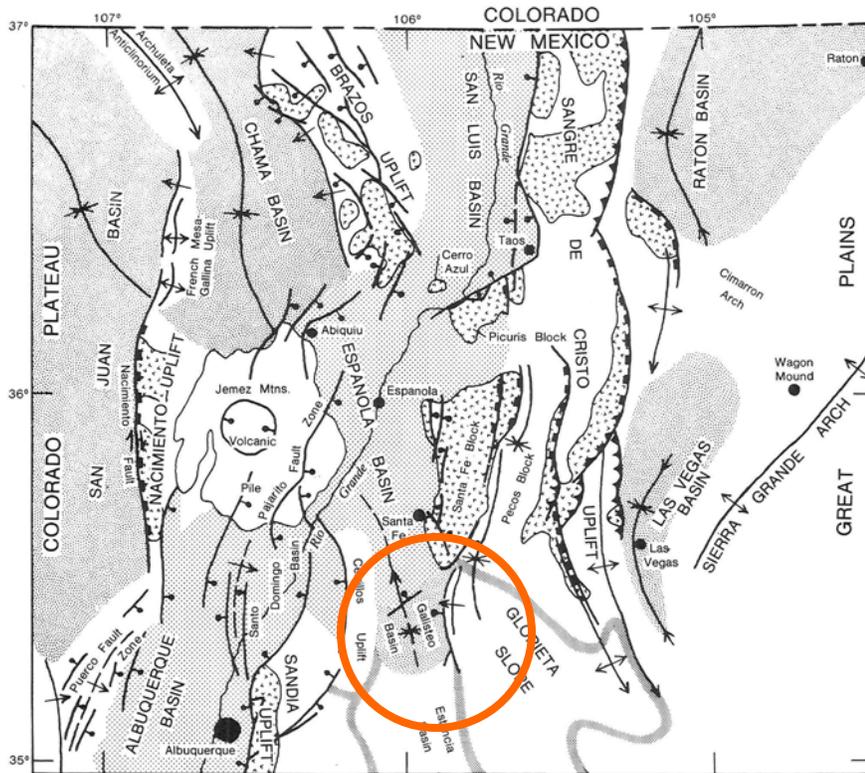
2. The Galisteo Watershed

The following section provides available background information for the evaluation of wetland resources in the Galisteo Watershed.

2.a Geology

The Galisteo Watershed is situated within the Galisteo Basin, a sub-basin of the Espanola Basin. The Galisteo Basin is part of a series of basins along the Rio Grande Rift which is divided into basins by faults (Bauer et al. 1995). In places, the basins are filled with thousands of feet of sediment eroded from surrounding mountains and land masses that existed millions of years ago and captured by a vast inland sea that stretched from the Arctic to the Gulf of Mexico (Martin 2008). However, the geology of the Galisteo Basin is further complicated by tectonic activity (folding, faulting, and volcanic and seismic activity) that occurred during the Laramide Orogeny (Figure 7).

The Galisteo watershed's surface geology largely consists of sedimentary colluvium and alluvium dating from the late Cretaceous and Tertiary era. Geologic sediments in the area are collectively referred to as the Santa Fe group. Tertiary volcanic intrusions have left clearly visible cones and volcanic dykes throughout the landscape, while intrusive activity has created tilted sandstone layers and rock sills that crisscross the drainage system (Figure 8) and that are responsible for creating many of the seeps and springs found in the watershed. Elevations of the watershed range from over 10,000 feet at the headwaters of Galisteo Creek on Thompson Peak in the southern part of the Rocky Mountains, to approximately 5,000 feet at the confluence with the Rio Grande at Santo Domingo Pueblo. The Galisteo Creek runs in the center of the watershed's valley bottom and supports significant areas of riparian and wetland habitat.



EXPLANATION

- | | | | |
|---|---|---|--|
|  | Basins of Rio Grande depression |  | Normal fault--Bar and ball on downthrown side |
|  | Laramide basins |  | Reverse fault--Showing horizontal displacement. Block on upthrown side |
|  | Principal outcrops of Precambrian rocks |  | Thrust fault--Teeth on upthrown side |
|  | Approximate boundary of tectonic elements where not delineated by above symbols |  | Syncline--Showing direction of plunge |
| | |  | Anticline--Showing direction of plunge |
| | |  | Monocline or anticlinal bend |

Map of the major tectonic elements of north-central New Mexico (from Baltz, 1978).

Figure 7. North-Central New Mexico tectonic schematic showing the position of the Galisteo Basin among major tectonic elements (Bauer et al. 1995).



Figure 8. Rock sill diverts the flow of the Arroyo de los Angeles.

2.b Climate

Hot, dry summers and clear, crisp winters are the consequence of the semiarid continental climate that encompasses the Galisteo Watershed (USACE 2006). Information on temperature from the nearest weather station at Cochiti Lake shows an average temperature of 20-30 F at night and 30-50 F during the day in the winter, and 30-60 F at night during the summer and 60-100 F during the daytime summer hours. Because of predominately clear weather, there is considerable daytime warming during the winter, although the nights are usually cold and the temperature often falls below freezing. Cold weather periods are usually brief and are accompanied by brilliant sunshine and low humidity. Consequently during the winter, snowfall melts soon after snow events and except in the high mountains does not have a chance to accumulate. During the summer monsoon season, thunderstorms are generally brief and isolated providing uneven precipitation across the watershed (Figure 9).



Figure 9. Typical summer monsoon isolated thundershower over the Galisteo Watershed.

Average annual precipitation from 1961-1990 for the area shows an average of 10-14 inches per year (USDA NRCS 1998). However, the average annual evaporation rate for the area is about 50 inches per year (Williams 1986). Warm temperatures, moderate winds, large daily solar radiation, and dry air contribute to evaporation rates and conditions that limit infiltration and recharge of stream flow. There can be great variation in annual precipitation due to thunderstorm activity generally occurring during the summer months. Snowfall in the area also varies between the northern and southern boundaries of the watershed due to differences in elevation. The average annual humidity is approximately 43 percent.

2.c Surface Hydrology

The predominant wetland hydrology in the Galisteo Watershed is associated with perennial, intermittent and ephemeral reaches of the Galisteo drainage network. Other hydrologic contributors are seeps and springs and precipitation-fed, depressional wetlands.

Galisteo Creek is predominantly an ephemeral stream. Most of the stream flow is produced by runoff resulting from thunderstorm activity and is characterized by high

Galisteo Watershed Wetlands Action Plan

peaks and relatively small volumes (USACE 2006). Thunderstorm activity, most prevalent during July and August, produces about 70 percent of the annual runoff (Figure 10). Runoff from snowmelt is less significant but important for the Galisteo Watershed. Although measurements have not been taken, observations show that in some years, snowmelt runoff from February through June help saturate the alluvium in the upper and middle portion of the watershed and in some years the Galisteo flows all the way to the Rio Grande for short periods. The period from April through June is generally dry and produces less than 10 percent of the annual runoff from precipitation events (USACE 2006). Additional flow in the Galisteo Creek is contributed by the permanent springs and seeps (except in very dry years) that occur in various locations along the drainage due to the complex geology of the area.



Figure 10. The lower end of Galisteo Creek flows through Santo Domingo Pueblo. This ephemeral portion of Galisteo Creek is shown flowing here after a summer rainfall event in the upper watershed. This area was previously cleared of exotic Russian olive and is now fenced from grazing as a measure to restore wetlands and the riparian area.

Galisteo Creek flows in a canyon from its headwaters to the community of Cañoncito and then flows along the western edges of the tablelands of Glorieta Mesa to the central grasslands and alluvial bottomlands of the Galisteo Basin. There are major arroyos that merge into Galisteo Creek due to a tributary pattern caused by steep slopes. These include the San Cristobal Creek, Arroyo de los Angeles, Arroyo de la Jara, Arroyo

Galisteo Watershed Wetlands Action Plan

Chorro. Other tributaries to the Galisteo Creek include Cañada Estacada, Gavisco Arroyo, Cañada de la Cueva and Cunningham Creek as well as other un-named drainages (Figure 1). Additionally, there are many areas in the watershed with a high density of springs and small, associated wetlands.

Few internally draining depressional wetlands occur within the Galisteo Watershed. The most prominent example is the playa wetland located on the San Cristobal Ranch south of the town of Galisteo (Figure 6). These playas are ephemeral wetlands that fill during the summer thunderstorm season and support a variety of waterfowl and wildlife.

2.d Water Quality

Technically, Galisteo Creek (perennial reaches above Santo Domingo Boundary) is still included in Water Quality Standards segment 20.6.4.121 NMAC which is classified as a high quality coldwater fishery. It is currently listed for temperature and specific conductance exceedences (2010-2012 State of New Mexico CWA§303(d)/§305(b) Integrated List & Report). Galisteo Creek was previously listed for stream bottom deposits. This assessment unit was intensively sampled as part of the Upper Rio Grande II survey in 2001. Galisteo Creek at the town of Galisteo (59% fines) was used as a reference to determine potential stream bottom deposit impairment. Galisteo Creek at Cerrillos had 76% fines and the benthic macroinvertebrate populations were non-impaired. Therefore, stream bottom deposits were removed as a cause of non-support. The specific conductance criterion of 300 umhos was exceeded in 14 of 14 measurements and is included as a cause of non-support. Five of 14 instantaneous temperature readings taken during site visits were greater than 20 degrees C. A thermograph was deployed at Galisteo Creek at Galisteo summer 2003. The temperature exceeded 23 degrees C and exceeded 20 degrees C for greater than four hours. Therefore, temperature is included as a cause of non-support. In 2002 it was determined from SWQB fish surveys that the Galisteo Creek Assessment Unit does not contain a coldwater fishery and is misclassified as a High Quality Cold Water Fishery according to fisheries data. Presently a Use Attainment Analysis is under preparation at SWQB instead of a TMDL to determine the appropriate classification for the assessment unit.

2.e Vegetation Communities

The University of New Mexico, Natural Heritage New Mexico Program conducted an inventory of wetlands/riparian resources and vegetation communities within the Galisteo Watershed in 2009 (Milford et al. 2009) This study primarily used GIS techniques supported by ground-truthing and includes all but the far northeast corner of the study area which is not covered by color-infrared photography. In addition to the location of wetland resources, dominant vegetation was described and high-quality wetland sites were identified. They recognized 7 wetland communities based on vegetation that include Closed Woodland, Open Woodland, Sparse Woodland with Shrubs, Sparse Woodland with Grasses, Shrubland, Herbaceous Wetland, and Herbaceous. These are principally distinguished by percent canopy cover of trees relative to total vegetative cover. Shrublands comprise the greatest amount of area delineated (416 ha); while Herbaceous Wetland had the least (12 ha). Much of the Shrubland community is dominated by salt cedar, with lesser amounts of coyote willow and minor amounts of rubber rabbitbrush (*Ericameria nauseosa*) (Figure 11). Herbaceous Wetlands often occur near impoundments or, in rare cases, as seeps such as within the Cerrillos Hills Historic Park outside of the town of Cerrillos (Figure 12).



Figure 11. Dense tamarisk shrubland occupies perennial reaches and wetlands of Canoncito Arroyo. Photo taken before restoration activities in 2009.



Figure 12. Devel’s Throne Arroyo at Cerrillos Hills Historic Park. Seep supports wetland herbaceous vegetation.

Exotics dominate the mapped riparian and wetland areas. Exotic-dominated stands comprise approximately 57% of the total vegetative cover with mixed and native at 29% and 13%, respectively. Salt cedar-dominated stands are the most common exotic type, comprising 81% of the total exotic-dominated area, followed by Russian olive-dominated stands at 19%. Less than 1% of the exotic-dominant area is categorized as Herbaceous Exotic. Among native-dominated stands, cottonwood was the most common dominant, comprising 50% of the total native area. Less commonly dominant were Herbaceous

Galisteo Watershed Wetlands Action Plan

(35%), Coyote Willow (8%), and Herbaceous Wetland (7%) (Figure 13). More information is included in the report (Appendix A).

In 2006, an assessment of priority wetlands was undertaken by Earth Works Institute, (Vrooman 2006) as part of this planning process. Wetland plants were identified as part of the assessment of each site and plant species lists are available for several locations in that report (Appendix B).



Figure 13. Herbaceous Wetland vegetation community supported by spring on Thornton Ranch

2.f Wildlife Habitat

The Galisteo Watershed is an important ecological transition zone, because it straddles four of eight ecoregions in New Mexico: the Southern Rockies to the north, the New Mexico/Arizona Mountains to the south, the Arizona/New Mexico Plateau (including the Rio Grande corridor) to the west, and the Southwestern Tablelands to the east (Griffith et al. 2006). As an ecological transition zone, the Galisteo Watershed constitutes a landscape-wide wildlife corridor across the “spine of the continent,” as described in the Southern Rockies Wildlands Network Vision (Miller et al. 2003) to the north with the New Mexico Highlands Vision to the south. The Galisteo Creek and its tributaries serve

Galisteo Watershed Wetlands Action Plan

as one of the most important functional wildlife pathways between the ecoregions and as part of a large wildlife migration network between the Southern Rocky Mountains to the north and the New Mexico Mountains to the south. Additionally, wetlands in the Galisteo Watershed constitute a series of stepping stones for migratory water fowl in an alternative eastern flyway route parallel to the Rio Grande corridor. The Galisteo Creek includes several sections of permanent flow. In several permanent and seasonal flow reaches, the Galisteo Creek is habitat to Flathead chub and various kinds of amphibians.

Appendix C lists plant and animal species that are federally endangered, threatened and species of concern. These species are listed by county for each of the counties that are part of the Galisteo Watershed. Of the listed threatened and endangered species, only one - the black footed ferret - may not have a survival or habitat connection during its lifetime to wetlands and riparian areas typified in the Galisteo Watershed.

2.g Occupational History

The Galisteo Watershed has a rich and complexly layered history of human population. Research indicates that people may have lived in the Galisteo Watershed as early as 14,000 B.P. The first confirmable population living along the Galisteo Creek was the Clovis Culture around 10,500 B.P. Archaeological and historical research data show that during the last 10 millennia the Galisteo Watershed has been a land of many wandering people. The watershed's historical timeline shows that people have often been attracted to the area by some luring promise. Perhaps it was the promise of big game, fertile floodplains and pastures, turquoise and lead, gold or coal, and of beautiful vistas and the proximity of mountains and the river delta that drew people to the Galisteo Watershed. Paradoxically, however, highly variable water resources, disease, and conflicts of various kinds may have been major reasons for the historical down-turns in the watershed's populations.

In the 1300s, about 18 permanent Puebloan settlements with hundreds of homes each gave shelter to as many as 10,000-20,000 people throughout the watershed. This population dwindled to only a few thousand after the Pueblo revolt in 1680. Spanish settlement continued throughout the 1700's. These settlements lead to the discovery of gold in 1821, in Cerrillos and Madrid. By 1840 an estimated 10% of the State's population resided in the Ortiz Mountains, the country's first Gold Rush site in history. Madrid and Cerrillos boomed, attracting thousands of people from around the world looking to make a fortune in gold. The population grew to around 30,000 during the

height of the mining days in the mid and late 1800s, with high population concentrations in the Madrid and Cerrillos area. This population was decimated to nearly 3,000 by the 1930s (WRAS 2005).

Based on population projections for the Galisteo Watershed, the County Planning Director estimated that the watershed population in 2004 was about 17,000 people spread over about 8,000 households, comprising portions of Santa Fe County and Sandoval and San Miguel Counties.

2.h Land Use

Approximately 69% of the land area in the watershed is privately owned. The San Cristobal Ranch of 81,000 acres is the largest ranch in the watershed, located in the southeastern part of the watershed (17% of the land area of the watershed). Other ranches vary in size from ten-thousands of acres to a few hundred acres.

More than 30% of the land in the watershed is managed by county, state and federal agencies for purposes of public resource management (Figure 1).

- The headwaters of the Galisteo Creek are primarily located on public land managed by the USDA Forest Service (Pecos-Las Vegas Ranger District of the Santa Fe National Forest), and include headwater wetlands, streamside wetlands and springs.
- The Bureau of Land Management (BLM) manages scattered tracts of land throughout the watershed. The BLM lands are leased to ranches for grazing purposes and are managed for archaeological and open space values. Many archaeological sites are located near springs and seeps, some of which still flow.
- The New Mexico State Land Office owns scattered tracts of lands and mineral rights held in trust, the proceeds of which are used to support the State's infrastructure of roads and public schools.
- The U.S. Army Corps of Engineers (USACE) manages an area of approximately 4.5 square miles around the Galisteo Reservoir for sediment and flood control. This area includes several natural wetlands and wetlands created by the reservoir infrastructure.
- The Bureau of Indian Affairs (BIA) on behalf of the Kiwa (formerly known as Santa Domingo) Tribe manages about 30 square miles in the western part of the watershed, which include lower Galisteo Creek and some unique and exceptional wetlands owing to the complex geology of the area.

Galisteo Watershed Wetlands Action Plan

- The U.S. National Park Service (NPS) Pecos National Monument manages about 50 acres of land as part of the historic Glorieta Battle Field in Lower Canoncito, just south of I-25 along Galisteo Creek.
- Santa Fe County owns approximately 6,000 acres of land in five locations as well as a trail along the Santa Fe Southern Railroad tracks for open space conservation and public trail access. Many of the Santa Fe County Open Space sites include wetlands, seeps, springs, riparian areas and buffer.
- The New Mexico State Parks Division manages the Cerrillos Hills State Park (under Santa Fe County Open Space ownership), which includes at least six small springs and wetlands.
- Santa Fe County manages a trail system through several BLM and State Trust Land areas in association with the Thornton Ranch County Open Space Area. These BLM, State and County lands include several small wetlands.

Land use in the watershed also includes (1) residential use in traditional communities, sub-divisions, scattered ranchettes, and individual home sites, (2) small businesses in the arts, hospitality, outdoor recreation, and film production sectors, (3) low-intensity ranching and farming, (4) small scale mining and quarrying, and (5) mine restoration sites. Urban and ex-urban development is concentrated north of Galisteo Creek. In particular, the San Marcos and Gallinas sub-watersheds, covering an area of about 80 square miles, are largely built up in a mosaic of small subdivisions, surrounded by open grassland. Private organizations hold more than 6,000 acres in land under some form of protective easement, such as conservation easements and easements related to archaeological protection.

3. Resource Analysis

3.a Galisteo Watershed Wetlands

Wetlands. Wetlands are “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (USACE 1987). Wetlands should have one or more of the following attributes: (1) at least periodically, the land predominantly supports hydrophytes (plants dependent on saturated soils or a water medium); (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

The upland limit of a wetland is the boundary between land that supports predominantly hydrophytic cover, soil types that are predominantly hydric, and evidence of hydrology that supports wetlands and land with predominantly mesophytic or xerophytic cover, soil that is non-hydric and land that is not saturated or flooded some time during the growing season. The lower boundary between wetlands and deeper water habitat associated with riverine and lacustrine systems lies at 2 meters (6.6 feet) below low water, or the maximum depth at which emergent plants normally grow.

Riparian Areas Riparian areas are also included as part of the analysis of wetland areas. Riparian ecosystems are characterized by phreatophytic and mesophytic vegetation and habitats associated with bodies of water and dependent on existence of perennial, intermittent or ephemeral surface and subsurface drainage. The strict water requirements of wetlands are not as drastic in riparian areas. However, they occupy the same areas of the landscape, may contribute to the same functions within the landscape, and are interdependent, and, therefore, are considered together during the assessment phase of the Wetlands Action Plan development.

Buffers For purposes of long-term protection of wetlands, wetland assessments and Wetlands Action Plans must identify wetland buffer zones. Buffers are non-disturbance areas where natural vegetation is maintained to protect wetlands and riparian areas from the impacts of stormwater floods, pollutants, and solid waste from adjacent terrain (Kusler et al. 2003).

3.b Inventory of Wetland Resources

In New Mexico, many areas and their associated wetlands have not been mapped by the National Wetlands Inventory. Currently National Wetlands Inventory (NWI) digital vector data is not available for the Galisteo Watershed, and 1:100,000-scale scanned (not-geo-referenced) NWI maps 1980's era data do not exist. However a preliminary GIS-based infiltration and runoff model for the Galisteo watershed was developed in 2004 (Earth Works Institute and Santa Fe Conservation Trust, 2007) (Figure 14). This model provided a preliminary estimate of the location of streamside wetlands and riparian resources. However not all wetlands locations are included because of the scale at which mapping was conducted. The 2009 wetlands study by Natural Heritage New Mexico (Milford et al. 2009) produced a preliminary map of wetlands and riparian areas and mapped broad vegetation communities (Figure 15) (Appendix A). This map and the infiltration/runoff model can provide the basis of a future study to complete mapping of wetlands and riparian resources in the Galisteo Watershed.

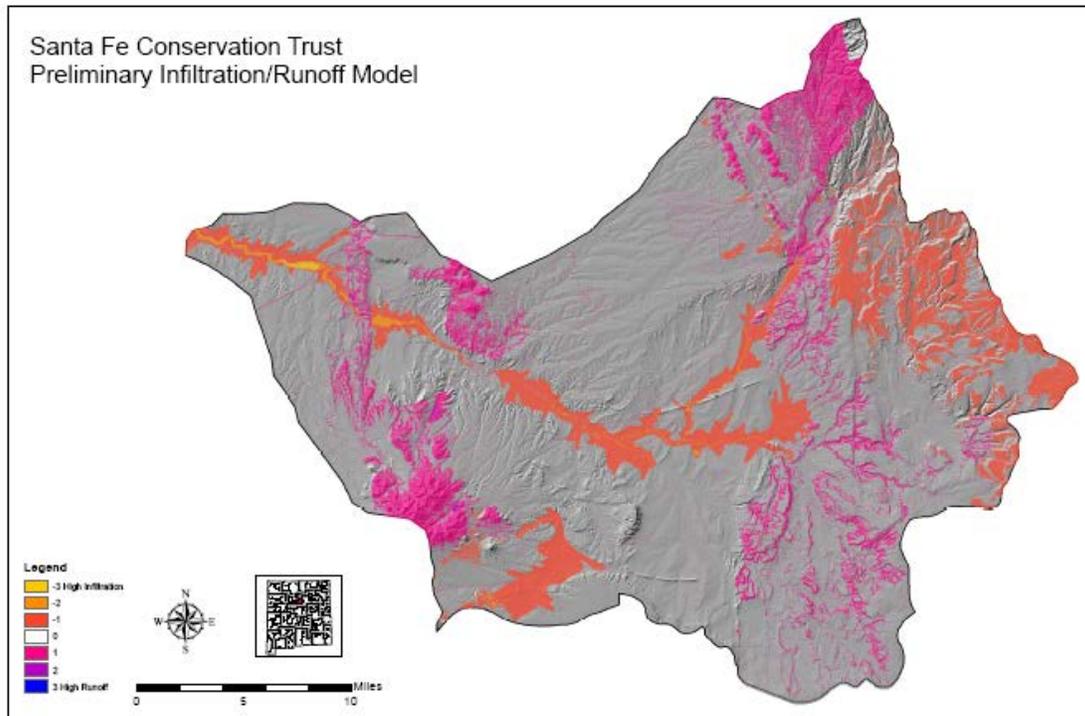


Figure 14. Preliminary Infiltration/Runoff Model. This model was used to produce a Green Infrastructure Plan for the Galisteo Watershed that identified priority areas for conservation, such as wetlands (Earth Works Institute and Santa Fe Conservation Trust 2007).

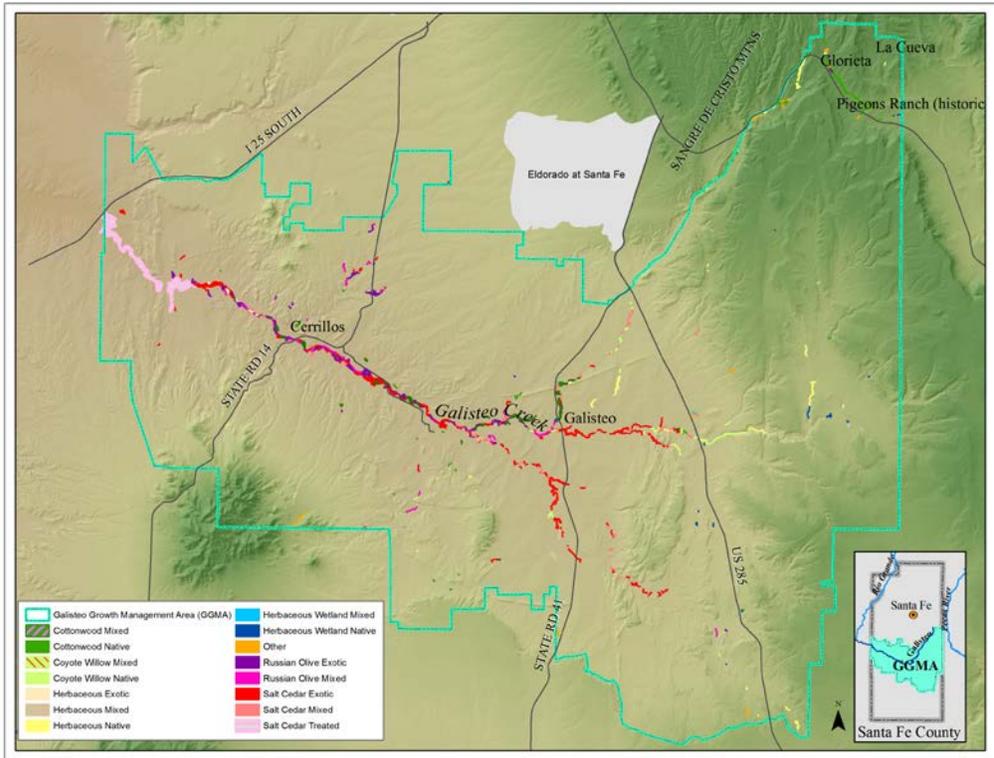


Figure 15. Map of wetland/riparian vegetation communities in the Galisteo Watershed (Milford et al. 2009)

3.c Classification of Local Wetland Types

The SWQB Wetlands Program uses Brinson’s Hydrogeomorphic (HGM) wetland classification (Brinson 1993) for the Wetlands Action Plan process. The HGM classification is based on three fundamental factors that influence how wetlands function, including geomorphic setting, water source, and hydrodynamics. At the highest level of hydrogeomorphic classification, wetlands are grouped into hydrogeomorphic wetland classes. Six hydrogeomorphic classes including depression, lacustrine fringe, slope, riverine, mineral flat, and organic flat occur in New Mexico. Four classes are represented in the Galisteo Watershed.

- Depressional wetlands occur in topographic depressions that allow accumulation of surface water (San Cristobal Playa) (Figure 6). On a topographic map these wetlands would occur within a closed elevation contour. Dominant sources of water are precipitation, groundwater discharge, and interflow from adjacent uplands.

Galisteo Watershed Wetlands Action Plan

- Lacustrine fringe wetlands are adjacent to lakes where the water elevation of the lake maintains the water table in the wetland. There are no natural lakes in the Galisteo Watershed. Finger Lakes are man-made ponds that support adjacent wetlands (Vrooman 2006).
- Slope wetlands normally are found where there is a discharge of groundwater to the land surface (Figure 16). They normally occur on sloping land; elevation gradients may range from steep hillsides to slight slopes. Hydrodynamics are dominated by downslope unidirectional water flow. Slope wetlands can occur in nearly flat landscapes if groundwater discharge is a dominant source to the wetland surface. Headwater wetlands and cienegas are examples of slope wetlands. Flowing seeps and springs that support wetland vegetation are also included in this broad class of wetlands.



Figure 16. Slope wetlands in Upper Apache Canyon drainage.

- Riverine wetlands occur in floodplains and riparian corridors in association with stream channels, (Figure 17) and are the most common wetland class in the

Galisteo Watershed Wetlands Action Plan

Galisteo Watershed. Dominant water sources are overbank flow from the channel or subsurface hydraulic connections between the stream channel and wetlands. Perennial flow is not required (Numerous examples are located along Galisteo Creek)



Figure 17. Riverine wetlands along the upper reaches of Galisteo Creek.

- Mineral soil flats are most common on interfluves, extensive relic lake bottoms, or large floodplain terraces where the main source of water is precipitation. Organic soil flats differ from mineral soil flats, in part, because their elevation and topography are controlled by vertical accretion of organic matter. They occur commonly on flat interfluves, but may also be located where depressions have become filled with peat to form a relatively large flat surface. Water source is dominated by precipitation. Neither mineral soil flats nor organic soil flats have been recognized in the Galisteo Watershed.

In addition, there are examples throughout the watershed of human-made wetlands. In some areas, these artificially induced wetlands replace, impair or compromise the natural

hydrologic regime and associated water and wetland resources. Although these wetlands are the result of anthropogenic activities such as water pumping, impoundment and diversions, they still provide valuable ecological services in an overall arid environment. Examples include wetlands developed or expanded as a result of anthropogenic activities, such as dams, levees, irrigation ditches (acequias), cattle tanks, and mill sites (e.g. Finger Lakes, Galisteo Dam/Reservoir, Arroyo Salado at Beneficial Farm, Galisteo Creek on Cerro Pelon Ranch).

A map showing the classification of all wetlands in the Galisteo Watershed is not available. A classification map would help guide restoration efforts to restore natural wetland attributes to that of the appropriate wetland class.

3.d Wetland Functions and Ecosystem Services

Wetlands can exhibit great variability in terms of their structural characteristics and processes (Mitsch and Gosselink 2007). The objective of classification is to identify groups of wetlands that are relatively homogeneous in terms of structure, process, and ultimately function (Smith et al. 1995). Scientific investigations have shown that wetlands unquestionably perform important environmental functions (Mitch et al 2007) and that different types of wetlands perform different functions or the same functions to various degrees (Johnson 2005). Wetland functions are defined as a process or processes that take place in a wetland (Novitski 1993). Ecosystem functions are processes that are necessary for the self-maintenance of an ecosystem. In a wetland, these functions maintain and sustain the wetland and are essential to the existence of the wetland. Examples of wetland ecosystem functions are primary production, nutrient cycling and decomposition (Kleindl 2005). Wetland functions also influence adjacent ecosystems. For example, riverine wetlands can modify flooding along a river's course; or nitrogen, sulfur, methane and carbon cycles in wetlands can affect air quality. Wetlands can also exhibit variability because of climatic conditions, species composition, soil type, biogeochemistry, and other factors. However, regardless of how they are defined, wetlands within a class (or type) share most common functions.

In 2006, the "Planning for Wetlands in the Galisteo Watershed" Steering Committee conducted review of wetland functions common to classes of wetlands in the Galisteo Watershed (Appendix D). Of the many functions that wetlands provide, wetlands functions determined by the committee to be the most important in the Galisteo Watershed are the following:

Hydrologic Functions:

- 1) Maintenance of Runoff Volume
- 2) Energy Dissipation
- 3) Groundwater Recharge

Water Quality and Biogeochemistry Functions:

- 4) Sediment Retention
- 5) Phosphorus Retention
- 6) Nitrogen Removal
- 7) Heavy Metals and Hydrocarbon Removal
- 8) Carbon Cycling and Sequestration

Biological Functions:

- 9) Vascular Plant Production
- 10) Macroinvertebrate and Fish Production
- 11) Wildlife Habitat
- 12) Waterfowl Habitat
- 13) Biodiversity

Wetlands and wetland functions are of value to people and society. Each wetland function and/or the aggregate of functions can constitute specific values for humans. Wetland ecosystems deliver a wide range of valuable ecosystem services that contribute to human well-being. Linking ecosystem condition and function to services and human well-being, predicting the effects of changes in ecosystem services on human well-being, and improving the identification, quantification, and communication related to functions and ecosystem services was the goal of the Steering Committee review.

3.e Baseline Assessment of Wetland Condition

In order to make informed decisions about protecting and restoring wetland acreage, quality and function, data that describes the baseline conditions at a wetland site is needed. Baseline conditions can represent a starting point in time for trend analyses (e.g., long-term successional studies or impact analysis on a group of wetlands). Baseline data increases in value if the types of data and data collection techniques are standardized and comparable among sites. In addition, goals for the data collection are developed so that the information collected can be used to evaluate parameters that lead to improved wetlands restoration and protection. Baseline assessment of wetland condition gives a

Galisteo Watershed Wetlands Action Plan

starting point in which to determine whether the resource is on an upward, declining trend or if conditions are stable.

In 2006, Earth Works Institute completed an inventory and assessment of a number of wetland areas in the Galisteo Watershed (Vrooman 2006) (Appendix B). The goal of this study was to determine the restoration potential of these sites. The selection of these preliminary sites was based on access considerations. These areas include:

- 1) Rowe Mesa Wetlands and Springs
- 2) Eldorado Wilderness along CR 51
- 3) Arroyo de Los Angeles at the Galisteo Basin Preserve
- 4) Village of Galisteo down to the Junction with San Cristobal Arroyo
- 5) Finger Lakes and Galisteo Creek at Tingle and Barclay Ranches
- 6) San Marcos Arroyo and the Cerrillos Hills Historic Park
- 7) Galisteo Reservoir downstream to the Rio Grande

Additionally, several smaller wetlands and springs were identified and assessed in the headwaters area of the Galisteo watershed as part of this study. Subsequently, a series of isolated wetlands along the I-25 corridor between Glorieta and Canoncito, along the Padre Springs drainage on Glorieta Mesa, on the Galisteo Basin Preserve, and isolated wetlands along Highway 14 between the “Garden of the Gods” (east of Cerrillos) and the community of Madrid have been assessed in 2007 (Appendix B).

The SWQB Wetlands Program is in the process of developing standardized rapid ecological assessment methods of wetland condition, the New Mexico Rapid Assessment Method (NMRAM) (Muldavin et al. In Press). A future goal is to use this methodology to establish reference sets and assess the overall condition of each class of wetlands in the Galisteo Watershed. In addition, presently there is no central repository of wetlands data collected in the watershed. A central repository should be formed where data can be accessed and available for potential restoration and protection activities. Additional

inventory and assessment is needed to complete a baseline assessment of all wetland resources in the Galisteo Watershed.

3.f Wetlands Reference Sites

The primary reason for identifying reference standard sites is the need to compare impacted or degraded sites to a standard set of reference conditions. Reference standard sites typically refer to sites in natural or least-disturbed condition that are used to assess and compare the ecological conditions at other sites. Accurate wetland assessments require that the assessed sites be matched with appropriate reference conditions to establish credible comparisons (Hawkins et al. 2010). Reference sites can also serve as alternatives to standard experimental controls that are seldom available. They provide the assessment criteria used for site evaluations. They can be used to set design standards for mitigation plans or to provide performance criteria to measure project success.

A study to locate wetlands reference standard sites statewide was conducted in 1998 (NMED 1998). No wetlands reference standard sites were identified in the Galisteo Watershed during that study. Natural Heritage New Mexico identified and mapped wetland sites where native vegetation was dominant in 2009 (Milford et al. 2009). They recommended that stands designated as native dominated should receive the highest conservation priority, particularly considering that they occupy a small fraction of the wetland/riparian sites in the watershed. Additional information is needed to determine if these sites can also be considered reference standard sites for restoration of similar sites (Figure 18). Reference wetlands information should include wetland class and natural setting (context), an assessment of the overall condition of wetland hydrology, contiguous wetland area, floristic quality, buffer area and buffer condition, wildlife assemblages, habitat and use, and sustainability based on known threats and stressors.



Figure18. A potential location for identifying reference wetland conditions may exist on the Cerro Pelon Ranch, where there are extensive riverine wetlands along main stem of the Galisteo Creek and at the confluence with the San Cristobal Arroyo.

3.g. Threats to Wetlands

External and internal sources of stress contribute to the overall condition of a wetland area and its ability to perform its associated functions (Collins et al. 2003). Preserving the ecological condition of wetlands so that they can perform their critical functions plays an important role in planning certain land-uses, but also in securing public health conditions, safety and welfare. One of the most prominent threats to water resources in the Galisteo Watershed is development and subdivision of large tracts of private land, mainly ranches. In the past few decades, the landscape of the Galisteo Watershed has gradually been fragmented as a result of property division, highway and railway construction, and the gradual conversion of farms and ranches into residential areas. Fragmentation causes forms of external and internal stress resulting the decline and disappearance of wetland ecosystems. Fragmentation of the landscape leads to hydro-modification of water courses and drying of water sources, isolation of wildlife, and a reduction of minimally disturbed, contiguous habitat, eventually jeopardizing biodiversity and species survival.

Galisteo Watershed Wetlands Action Plan

Additionally, fragmentation degrades potential recreation and view shed qualities of the landscape and its associated wetlands.

Past land use and ongoing urban development have led to accelerated storm water runoff and a flow regime of concentrated peak flows in the Galisteo Creek and its tributaries. As a result, soil erosion and sediment accumulation in the stream and the Galisteo reservoir have increased. In many locations, tributaries start as steep headcuts and have carved deep gullies that dewater the landscape. The Galisteo Creek is in most locations 10-25 feet incised below the historical floodplain (Figure 5). Riparian floodplain zones with native cottonwood and willow groves have dwindled, while Russian olive and saltcedar have aggressively invaded the riparian habitat. In many places, originally moist flood plains, productive alluvial fans, springs, wetlands and wet meadows have dried up and made place for degraded, dry sediment flats.

Railway and highway construction in particular have impacted watershed health. The construction of the railway across the watershed from Glorieta to the Rio Grande in 1880 was in many places installed in or just next to the stream channel of the Galisteo Creek. In many places, the floodplain of the Galisteo creek was cut in half lengthwise, which destroyed the creek morphology and ecosystem. In subsequent flood events the concentrated flood waters caused severe damage to the railway structure, and the Railroad sought to stabilize undercuts and erosion of the railway with concrete bank revetments and large stream modification structures, such as levees and dams. In addition, highway widening, drainage structures, culverts, bridges and other hard infrastructure design have concentrated stormwater runoff throughout the watershed. In many locations, poorly installed culverts have contributed to headcutting and lowering of gully and stream channel levels and contributed to accelerated erosion (Figure 19).



Figure 19. Headcut caused by nearby road culvert dewaterers and dries out local wetland in the Galisteo Watershed.

Another consequence of property development is ground water pumping. Ground water is the principal source of fresh water for homes and businesses and most homes are serviced by private wells. Some communities, such as the Village of Cerrillos, have a community well. Cerrillos water users have a senior water right in the basin. Flows into the San Marcos Springs and its discharge area upstream to the Village of Cerrillos, require protection from up-stream groundwater pumping. In some cases, ground water is pumped from shallow wells and the effects are localized and/or seasonal drops in the local water table. This in turn affects water levels in local wetlands and flow from springs and seeps, as is the case at San Marcos Springs. It also affects the duration of growing season moisture in wetlands that recharge during wet periods and from snow melt.



Figure 20 The Upper San Marcos Arroyo has been severely degraded as a result of uncontrolled development, poor grazing practices, off road vehicle use, stream modification, and groundwater extraction by individual wells.

The number of private wells in the Galisteo Watershed is unknown, but may be more than one thousand. The principal shallow aquifers that are affected by ground water pumping are the alluvial aquifer of the Galisteo Creek from Upper Canoncito down to Cerrillos, and the Ancha formation below it.

Potentially degrading activities in the watershed also include off-road vehicle use, trails and pedestrian access, mowing, landscaping, solid waste dumping, domesticated animal access and resultant wildlife decimation, herbivory, vegetation trampling, soil compaction, and other local activities (Figure 20).

One indication of wetland decline is the increasing encroachment of exotic invasive species as wetland conditions change with external and internal sources of stress. Overall, the encroachment of salt cedar is pervasive. Only in the northeastern portion of the study area, as Galisteo Creek flows southwest from Glorieta prior to its westward flow at

Galisteo, are natives more abundant than exotics. Combined with the results of historical land degradation, the contemporary impacts of poor runoff management and fragmentation are likely to cause an ongoing decline of wetland acreage in the watershed along with habitat for water-dependent plants and animals.

3.h Wetland Values and Ecosystem Markets

Placing a monetary value on wetlands as a function of the services they provide is a challenging and controversial task, and economists have often been criticized for trying to put a “pricetag” on nature (<http://www.ecosystemvaluation.org/essentials.htm>). Many of these goods and services are traditionally viewed as free benefits to society, or "public goods" - wildlife habitat and diversity, watershed services, carbon storage, and scenic landscapes, for example. Lacking a formal market, these natural assets are traditionally absent from society’s balance sheet; their critical contributions are often overlooked in public, corporate, and individual decision-making (Figure 21). As a result, both in our study area and in the United States, resource challenges associated with globalization and urbanization, and the impacts of climate change, pollution, over-exploitation, and land-use change on ecosystem loss and/or the degradation of wetland functions and their values, are poorly translated into monetary losses. (<http://www.fs.fed.us/ecosystems-services/>). However, spending decisions and allocating resources for protecting and managing wetlands must be justified to the community and stakeholders that these resources benefit, and that “pay” for the protection and management of these resources. These types of decisions are based, either explicitly or implicitly, on society’s values. Therefore, economic valuation can be useful, by providing a way to justify and set priorities for programs, policies, or actions that protect or restore wetlands, their functions and ecosystem services. Such values can in some cases be expressed in a dollar amount, while in many cases they do not constitute marketable or monetary values, but rather personal, social, and spiritual ones.



Figure 21. Loss of wetlands and their flood control functions allows for severe bank erosion in this section of the Galisteo Creek. Bank erosion threatens nearby homes and property value.

Wetland functions and their values in specific markets can be expressed as marketable ecosystem services. “Ecosystem services” are natural assets that offer a full suite of goods and services that are vital to human health and livelihood. The “2005 Millennium Ecosystem Assessment” <http://www.maweb.org/en/index.aspx>, (Watson et al. 2005) a four-year United Nations assessment of the condition and trends of the world’s ecosystems - categorizes ecosystem services as:

- **Provisioning Services** *or the provision of food, fresh water, fuel, fiber, and other goods;*
- **Regulating Services** *such as climate, water, and disease regulation as well as pollination;*
- **Supporting Services** *such as soil formation and nutrient cycling; and*
- **Cultural Services** *such as educational, aesthetic, and cultural heritage values as well as recreation and tourism.*

In their book “Rivers for Life,” Sandra Postel and Brian Richter (2003) emphasize the central ecological role of water bodies such as flood plains and wetlands, and cite Vermont researcher Robert Costanza’s (1997) estimate that the annual ecological value

Galisteo Watershed Wetlands Action Plan

of floodplains at a world market value is about \$8,000 per acre, which translates into more than \$11,000 per acre per year at present values in 2010. This would mean that the 1,000 acres of present wetlands and streams in the Galisteo Watershed represent an annual value of at least \$11 million to society, while about 4,000 acres of historical wetlands and floodplain in the watershed have disappeared, at an annual value of \$44 million (based on 2010 values). In contrast, the average cost of a wetlands restoration project funded by EPA to restore approximately 30 acres of New Mexico wetlands (SWQB Wetlands Action Plan Program) is about \$500,000 using low-tech restoration practices, and including the value of in-kind match donations to complete the work and associated planning and outreach activities. This would value restoration of “restorable” wetlands at approximately \$16,700 per acre. Restoring highly degraded wetlands, using high-tech practices, and including future monitoring, maintenance and management would cost considerably more (Figure 22).



Figure 22. Tamarisk removal at Canoncito Arroyo. Tamarisk is pulled with heavy equipment and then stacked and hauled out of the open-space area by hand.

Wetland functions that may lead to marketable ecosystem services in the Galisteo Watershed address all four categories of ecosystem services identified by the 2005 Millennium Ecosystem Assessment. Wetland functions and values considered important

Galisteo Watershed Wetlands Action Plan

to the community by the Steering Committee for the Galisteo Watershed are summarized in Appendix D. The following wetland functions appear currently to have the highest likelihood for future payment for ecosystem services:

- Production of specialty products for local or regional markets – a provisioning service: once wetlands are well-established and well-managed, it is possible that stewards can occasionally sell wildlife harvesting (hunting) permits and plant product collection permits (example: edible cattail tubers and pollen).
- Water quality improvements – a provisioning and regulating service: for development projects or road improvement projects that require CWA Section 404 compliance, in some cases, existing wetlands or potential restoration sites may assist these projects in achieving compliance. The projects could potentially be charged to pay for wetland improvements and stewardship that help ensure their compliance (wetlands banking or In Lieu Fee).
- Flood control (as required by the SF County flood plain management code) – a regulating service: for projects that require County flood plain management compliance. In some cases, existing protecting and restoring wetlands may assist these projects in achieving compliance. The projects could potentially be charged to pay for wetland improvements and stewardship that help ensure natural flood management and their compliance.
- Alluvial aquifer recharge (as encouraged by SF County SLDP) – a supporting service: once alluvial aquifer recharge can be modeled and estimated, it may be possible to value the deferred costs to downstream well owners for investments in well production improvements. Likewise, for downstream property owners it may be possible to calculate their savings on maintenance of structures and land due to reduced erosion damage from flows and flooding.
- Biodiversity (habitat protection or creation for listed threatened and endangered species) – a supporting service: once wetlands are well-established and well-managed, it may be possible to identify newly created critical habitat for threatened and endangered species that may offset biodiversity losses elsewhere in the State. Hence, local, voluntary markets for biodiversity or wetland offsets, or official trading schemes of (“banked”) biodiversity or wetland values (biodiversity or wetland mitigation) may lead to funds for wetland stewardship and further restoration or development in the Galisteo Basin.
- Carbon sequestration (carbon trading) – a supporting service: once wetlands are well-established and well-managed, it may be possible to identify carbon stored in the wetland soils and any values associated with additional carbon that can be stored in the wetlands as part of local, voluntary carbon banking/trading initiatives or even (inter)national carbon trading markets.
- Cultural heritage, recreational and educational values – a cultural service: it is conceivable that in the near future private and public entities associated with wetland stewardship can charge fees from users or request in-kind support from certain interested parties for recreational or educational tours, information sources, educational workshops, research projects, arts projects, etc.

The University of North Carolina Environmental Finance Center offers several

Galisteo Watershed Wetlands Action Plan

workshops and manages an informative website on sustainable financing strategies for wetlands. Although this information is geared to State and tribal wetland programs, there are also innovative tools, strategies and informative messages that can be used by watershed stakeholders such as in the Galisteo Watershed.

4. Resource Management

Sustainable, healthy and productive landscapes are critical for providing essential functions and ecosystem services, and for sustaining and supporting rural and urban communities that rely on these functions and benefits. Resource management includes collection, interpretation and distribution of comprehensive information to community leaders and agencies that will help support efforts to prevent and reverse land practices that exploit, degrade and destroy wetlands. Resource management also involves a set of actions and decision-making concerned with the conservation, restoration and protection of wetland resources. Of particular importance in wetland management are the understanding of the nature, extent, vulnerabilities, and services of the resource and the processes that help conserve and appropriately allocate the resource when necessary. In the Galisteo Watershed, wetland resources are not common and are dwindling from past land use practices. Potential threats and continuing pressure have the ability of eliminating existing wetlands further. It is therefore critical that sustainable development and environmental protection are major goals of a good management strategy. The probable consequences of human interaction with wetlands must be considered to restrict and prevent environmental damage. Resources should be managed with local, regional and nationwide affects in mind, such as the case of migratory bird flyways and wildlife corridors. Sustainability of the resource and its functions and services is the management goal for the Galisteo Watershed.

4a. Resource Needs

The need for basic information that can help with managing wetlands resources is a recognized outcome of this planning process. It is also important to understand where threats and potential impairments are likely to have the greatest consequences to wetlands and riparian resources including the loss of functions and the impacts to flora and wildlife that depend on the resource. Information gaps have been identified in Section 3 that make it problematic to systematically prioritize, protect and restore wetlands. These important information gaps are basic and include mapping, baseline assessment and classification of existing wetlands, and identification of reference sites. An immediate priority is to fill the information gaps as future funding or opportunities become available.

4.b Reducing Impacts to Wetlands

Despite the recent initiatives, wetlands and any other surface waters receive very little attention in the form of active management, protection, restoration, and code enforcement

Galisteo Watershed Wetlands Action Plan

throughout Santa Fe County. As a result, wetlands are still subject to erosion from flashfloods and impacts from nearby roads, trails and buildings, degradation by four-wheel vehicle access, livestock and horse grazing, and encroachment of invasive plant species.

This planning initiative also revealed that wetland degradation is potentially related to groundwater extraction in relation to (sub)urban development in upstream aquifers. Residents in the Village of Galisteo have repeatedly expressed concerns about ongoing and/or planned groundwater extraction from wells upstream from the Village. Water wells in Lamy, planned wells at Saddleback Ranch, Vista Clara Ranch, and the Galisteo Basin Preserve (former Thornton Ranch) are cases in point for Galisteo. Similarly, residents in the San Marcos and Cerrillos area as well as several professional hydrologists share a concern for gradual groundwater depletions and well degradation in the San Marcos and Cerrillos area as a result of the ongoing groundwater usage in the Eldorado subdivision. The County's moratorium on new water drilling in Eldorado and the severe concerns expressed about the Galisteo Basin Preserve's water sources are directly related to the anticipated water shortages – and experienced already during dry years - in the western part of the Galisteo Watershed. These observations have led to a special geohydrological study in a follow-up project “Comprehensive Wetland Restoration and Protection in Santa Fe County” (2007).

A wetlands condition assessment helps identify stressors that are impacting or are responsible for wetland degradation. Watershed wide chronic sources of stress have been identified in section 3.g of this plan. Additional direct identification of stressors on an individual wetland can be made by the use of a stressor checklist that includes all potential direct or indirect sources of stress to the ecological condition of the wetland. The result is the present state or condition of a wetland and cumulative list of known stressors to help predict the causes of degradation or the potential affects that a future land use or activity may have on the wetland in question. Restoration measures can then be focused on reduction of sources of stress as well as corrective actions that will help the wetland area become more resilient to future traditional and new sources of stress.

4c. Prioritization of Wetland Restoration Sites

The Steering Committee for the “Planning for Wetlands in the Galisteo Watershed” conducted a prioritization procedure for potential wetlands restoration sites. This prioritization process was applied to wetlands that were likely to be of high value to the local communities, to receive community support for restoration, and to be most accessible for restoration. The prioritization process was not applied to all wetland resources since not enough information was available watershed-wide. The prioritization process followed a flow decision model (Appendix E). The Steering Committee developed a spreadsheet with basic information for each wetland, such as acreage, expected restoration costs and costs per acre. The spreadsheet also included a set of primary criteria in order to rank wetland sites by order of priority for treatment. These criteria included:

1. Wetland function – The functions identified as having high priority were considered, not including the phosphorus retention function since not enough data was available to rank this function.
2. Estimated wetland value to society (of wetland ecosystem services); expressed in high-medium-low
3. Cumulative, landscape wide value of restoration (i.e. the impact value of any local restoration work)
4. Landowner interest and support
5. Community preferences/support
6. Feasibility of implementation
7. Protection and buffer zone development (e.g. through conservation easements or a local government ordinance)
8. Maintenance and follow-up feasibility/likelihood
9. Financial self-sufficiency of wetlands over time

To determine the final prioritization of each wetland site a qualitative scoring of three categories (high, medium, low) was applied to express the sum of values for the nine prioritization criteria for each site. Additional considerations were listed below the evaluation of priorities to describe additional conditions of the wetlands and their restoration potential. These considerations included cumulative landscape-wide values, such as:

- Threatened conditions of the wetland

Galisteo Watershed Wetlands Action Plan

- Presence of threatened and endangered plant/animal species
- Habitat contiguity with other riparian areas
- Entry experience
- Rarity of conditions
- Buffer function (enhancing open space adjacent to development)

Additionally, project implementation related considerations and conclusions were listed:

- Field monitoring accomplished with schools
- Potential to include the project as a pilot site in the Galisteo Watershed Conservation Initiative (GWCI)
- Proposed action steps and partners
- Suggested sources of funding

The spreadsheet and analysis for prioritization of wetlands restoration sites is included in an Appendix E.

During the restoration process of priority wetland sites the project steering committee learned that two other criteria regarding project feasibility should be included in the lists above:

- Legal status of the property and property title. Any wetland restoration project will run into delays or legal complications if the property title is disputed or encumbered in some way and/or if the property (or its owner) is in litigation over the property.
- Landowner and stakeholder understanding and agreement about their responsibilities, and the expected outcomes in relation to personally held values regarding, for example, increased wildlife use, responsibilities for ongoing monitoring and potential maintenance, or the perceptions of the wetland restoration by neighbors and downstream water users.



Figure 23. Earth Works Institute’s 4C crew chip branches of invasive Russian olive harvested from the Escalante Spring area in the Cerrillos Hills State Park in the spring of 2010.

4.d Wetland Restoration Design for Selected Sites

The project “Planning for Wetlands in the Galisteo Watershed” includes the design of several sites (Vrooman 2006) (Appendix B) and implementation of three demonstration wetland restoration sites. The selection of the demonstration restoration wetland sites was based on the prioritization exercise described in the Section 4.c. In addition to the demonstration restoration sites that were part of the project “Planning for Wetlands in the Galisteo Watershed,” Earth Works Institute collaborated with several third party partners to pursue implementation of all additional wetlands projects that were identified in the wetland assessment report of 2006.

Wetland restoration designs were completed and many already implemented for the following sites. Table 1 gives restoration and buffer acreage.

1. Canoncito Arroyo (Eldorado Community Preserve; a.k.a. Eldorado Wilderness) – implemented in 2007-2010 (including work completed and scheduled for

Galisteo Watershed Wetlands Action Plan

- completion under the New Mexico River Ecosystem Restoration Initiative)
2. Galisteo Creek (in the Village of Galisteo) – implementation pending outcome of a land dispute (work scheduled to be implemented in 2010-2011 under the New Mexico River Ecosystem Restoration Initiative)
 3. San Marcos Arroyo (San Marcos Pueblo archaeological site) – implementation cancelled due to insufficient funds to produce the desired outcome at this very sensitive archaeological and wetland site.
 4. Galisteo Dam reservoir – restoration implemented in 2007 by the US Army Corps of Engineers
 5. Southwest Arroyo (Galisteo Basin Preserve) – restoration implemented in 2007-2008 with funding from Commonweal Conservancy and the State of New Mexico through Santa Fe Conservation Trust
 6. Oxbow wetland on Cerro Pelon Ranch (Village of Galisteo) – thinning of invasive species implemented by the landowner in early 2008 with a follow-up removal treatment in May 2009. Follow-up treatment will be necessary to reduce re-sprouting from remaining root systems.
 7. Miners’ Spring (Cerrillos Hills State Park) – restoration implemented in 2008 with funding from Santa Fe County
 8. Shooting Gallery Arroyo (Cerrillos Hills State Park) – restoration implemented in 2009-2010 with funding from Santa Fe County
 9. Escalante Spring (Cerrillos Hills State Park) – demonstration restoration scheduled for 2010 with funding from Santa Fe County and Wetlands Program Development Grant.
 10. Arroyo de los Angeles wetlands and Galisteo Spring wetlands (Galisteo Basin Preserve) – restoration implemented in summer 2008 with funding from the State of New Mexico River Ecosystem Restoration Initiative
 11. San Marcos Arroyo (private land west of Highway 14) – removal of invasive species and planting of native trees implemented in 2008 with funding from the US Fish & Wildlife Service; demonstration channel rehabilitation scheduled in 2010 with funding from Wetlands Program Development Grant.
 12. Finger Lakes wetlands (on 3-Horse Ranch, near Cerrillos, New Mexico) – arroyo channel, wetland and wet meadow rehabilitation completed in 2009 with funding from the State of New Mexico River Ecosystem Restoration Initiative
 13. Padre Springs wetlands and wet meadows (on the Holian property, as part of the Ranch at Padre Springs on Glorieta Mesa, Glorieta, New Mexico) – upland road, arroyo and pond restoration work completed in 2008 with private funds. Further

Galisteo Watershed Wetlands Action Plan

stream, wetland, and wet meadow rehabilitation and wildlife drinker systems installation scheduled for 2010-2011 with private funding and state and federal grants.

14. Romero Springs and Arroyo (Community of Valencia, along I-25, west of Glorieta, New Mexico) – spring and stream restoration scheduled for 2010-2011 with funding from the State of New Mexico River Ecosystem Restoration Initiative.

Wetland Site:	Bene- ficial Farm	Eldorado Wilderness	Galisteo Basin Preserve all areas	Galisteo Village	Finger Lakes	San Marcos West	Galisteo Dam	CHHP project area	TOTAL
Wetland and riparian area in 2005	0.24	0.60	1.00	9.42	0.33	1.00	0.30	0.1	12.99
Wetland/riparian area gained after treatment	N/A	0.31	1.20	1.50	1.95	2.50	65.70	1	74.16
Wetland/riparian area improved, protected	N/A	0.91	2.20	10.92	2.28	3.50	66.00	1.1	86.91
Buffer in 2005	N/A	4000.00	0.00	0.00	0.00	0.00	?	0	4000.00
Buffer area gained or improved/protected	N/A	4.00	300.00	17.00	400.00	4.50	2500.00	2	3227.50
Wetland area affected	0.00	0.91	2.20	10.92	2.28	3.50	66.00	1.1	86.91
Total area affected	0.00	4.91	302.20	27.92	402.28	8.00	2566.00	3.1	3314.41

Table 1. Initial wetland sites identified in 2005/2006 and protected and restored between 2006 and 2010 through various projects (table has been updated in 2010 from the original version of 2007). All figures are estimates based on best available data (in acres).

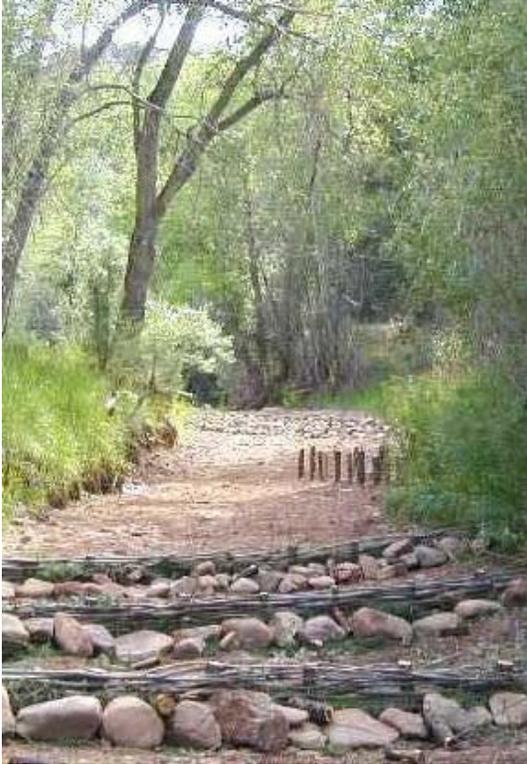


Figure 24. “Pole baffle” (back) and “wicker weirs” (front) installed to capture sediment and recreate riffle/pool sequence and meanders in Galisteo Creek.

4.e Measures to Protect Wetlands

Between 2005 and the present, the “Planning for Wetlands in the Galisteo Watershed Project” facilitated and expanded efforts to create, restore, and protect wetlands in the Galisteo Watershed. Already during its lifetime, the project succeeded in bringing wetland protection under the attention of the public, incorporating wetland planning and protection in local (County) planning initiatives, in generating a broad variety of spin-off initiatives and helped accomplish the restoration and protection of a large number of wetlands, riparian areas, and buffer zones in the Galisteo Watershed and in other locations throughout Santa Fe County (more than 100 acres in total). In dialogue with various partners, Earth Works Institute identified several protection measures as a result of the process of implementing the “Planning for Wetlands in the Galisteo Watershed Project.” partners such as Commonweal Conservancy, Santa Fe Conservation Trust, Santa Fe County government, and private landowners have established conservation easements, imposed deed restrictions on development, established buffer zones, and purchased properties for conservation purposes.. Additional measures include:

- Incorporating wetland issues into the work of the Galisteo Watershed Partnership.
- Inclusion of wetland planning in the Santa Fe County 2010 Sustainable Land

Galisteo Watershed Wetlands Action Plan

- Development Plan and Code and the 2008 “Oil and Gas Element” to the Land Use Code.
- Inclusion in a watershed-wide Green Infrastructure plan and prioritization plan for open space and wetland restoration and protection (This plan also provides for the protection of buffers around wetlands).
 - Development of wetland outreach and education programs and materials that inform the public of the functions and values of wetlands and ways to get involved in wetlands protection (Jewels of the Southwest booklet) (Appendix F).
 - Creating community consensus on how existing and potential wetlands might be protected and how a protective buffer zone around these wetlands might be established through conservation easements
 - Postponement through a County-wide moratorium and possible abandonment of oil and gas drilling in and around wetlands in the Galisteo Watershed, and the establishment of a County Oil & Gas ordinance that regulates and restricts oil and gas development throughout Santa Fe County.
 - Leverage of nearly \$650,000 for wetland restoration in the Galisteo Watershed and more than \$500,000 in other parts of Santa Fe County between 2007 and 2012 that includes additional protection measures through establishment of buffers, landowner agreements and conservation easements.
 - Ongoing discussions with floodplain managers regarding wetlands and riparian areas and the need to restore and protect natural ecosystems in floodplains through local development ordinances.
 - Inclusion of New Mexico Department of Transportation in the design and implementation of restoration projects near transportation corridors.
 - “Watchdog” involvement that assures that appropriate regulatory tools such as CWA Section 404 permitting process is adequately used, includes conditions that restricts inappropriate activities, and is enforced.

Other direct protection measures are through the use of best management practices and can be implemented by local government, homeowners associations, concerned citizens groups, private landowners, school groups and others. For example, off-road vehicle access can be prevented by using post and cable barriers (Zentner 1994). Pedestrian and pet access can be directed, discouraged, or eliminated through placement of fences or signage. Common use boardwalks can be constructed over marshlands and in-stream

Galisteo Watershed Wetlands Action Plan

restoration structures can serve dual uses as low water crossings to reduce degradation of streambank and river channel wetlands from recreational activities (Buchsbaum 1994).

Regulatory measures also provide protection of wetlands such as permit requirements of Clean Water Action Section 404 and Section 401 Certification, and Santa Fe County Ordinances. Permits issued for development around wetlands and buffers should include conditions requiring the permittee to inform future lot owners of restrictions on the use of wetlands and buffers located on or abutting their lots. Deed restrictions can be placed on lots, and permit conditions should require similar disclosure to subsequent lot owners (Osmond et al. 1995).



Figure 25. Approximately 12,000 acres of open space is being gradually protected in the Galisteo Basin Preserve, a conservation and stewardship development project in the heart of the Galisteo Watershed. Each year, new conservation easements are added to assure the protection of open land and night sky in the Preserve, while community members are invited to educational events, such as this campfire story telling event in July 2010.

4.f. Strategizing Financing Options

The project “Planning for Wetlands in the Galisteo Watershed” was funded through a wetlands grant from the US Environmental Protection Agency and managed by the New Mexico Environment Department, Surface Water Quality Bureau. The federal funding amount of \$140,230 was awarded in 2005. However, the project, its partnerships and its products leveraged more than 8 times this amount (over \$1 million) through many additional local, state, private and federal funding sources and in-kind and matching contributions. Funding sources and funds leveraged to date included:

- State of New Mexico – Galisteo Watershed Conservation Initiative (through Santa Fe Conservation Trust) – Southwest Arroyo on Galisteo Basin Preserve: \$50,000
- State of New Mexico – River Ecosystem Restoration Initiative (RERI) – Arroyo de los Angeles and Galisteo Spring: \$167,094
- State of New Mexico – River Ecosystem Restoration Initiative (RERI) – Restoring Riparian Health in Critical Ecological Areas in the Galisteo Creek Watershed: \$27,464
- Santa Fe County (Open Space and Trails Division) – Cerrillos Hills springs: \$17,500
- Commonweal Conservancy for the completion of Southwest Arroyo Wetlands: \$2,000
- US Army Corps of Engineers – Galisteo Dam reservoir: amount unknown
- US Fish & Wildlife Service – Partners for Wildlife Program (through EWI) – in the Canoncito area: \$6,000, and at San Marcos Arroyo: \$16,450.
- Los Alamos National Laboratories Foundation (through EWI) – for Canoncito Arroyo area: \$15,000
- Eldorado Community Improvement Association: \$6,500
- UNM students and faculty: \$31,000
- EWI staff in-kind contributions: more than \$9,000
- Private individuals, businesses and landowners’ in-kind contributions: more than \$5,500
- State of New Mexico - Galisteo Springs Conservation Easement through Natural Heritage Conservation Act (awarded to New Mexico Department of Cultural Affairs and Santa Fe Conservation Trust): \$350,000.
- EPA Wetlands Program Development Grant for Wetlands Protection and Restoration in Santa Fe County: Federal and matching funds including \$100,000 Santa Fe County match for restoring Open Space wetlands: \$465,930
- EPA Region 6 Galisteo Pilot: \$10,000

Galisteo Watershed Wetlands Action Plan

Potential future match sources for federal funds include:

Committed or awarded matching funds:

- State of New Mexico – River Ecosystem Restoration Initiative (RERI) – Finger Lakes, Valencia wetlands, Canoncito Arroyo wetlands, and Village of Galisteo wetlands: more than \$385,000 in 2009-2012
- Santa Fe County wetland restoration work in 2009 in the Cerrillos Hills (\$19,755) and ongoing Russian olive removal (amount unknown)

Potential matching funding sources:

- New Mexico State Legislature
- New Mexico Department of Transportation (wetland mitigation funds for Galisteo Village)
- New Mexico Water Trust Board
- State Parks Division protection of wetlands in the Cerrillos Hills
- School and college programs
- Landowner contributions and value of conservation easements donated to protect wetlands
- An innovative program called “Green Burial” at the Galisteo Basin Preserve where participants can buy burial or cremation rights with a portion of the costs earmarked for conservation easements and restoration projects on the remainder of the open space land.

Future Funding Opportunities for Wetland Development, Restoration and Protection

Future funding opportunities for wetland development, restoration, and protection in the Galisteo Watershed include:

1. Grants and contracts (as part of Federal, State, and local government, conservation and restoration programs)
2. Internal government agency funds (add-on or matching funds)
3. Mitigations funds (USACE or other governmental mitigation funds)
4. Developer funding (as part of an urban development project)
5. Private investments
6. Payment for ecosystem services schemes
7. Memorials and foundation funds

Galisteo Watershed Wetlands Action Plan

1. Grants and contracts (as part of Federal, State, local government, conservation and restoration programs)

Funds acquired for wetlands in the Galisteo Watershed to date (2000-2010):

- EPA – NMED/SWQB – Wetland Program Development Grants
- State of NM – NMED/SWQB – River Ecosystem Restoration Initiative grants
- State of NM – YCC grant
- State of NM – appropriation to OSE/ISC for GWCI demo project
- USFWS – Partners for Fish and Wildlife grants
- Santa Fe County Open Space Division – Professional Services PO
- National Association of Counties – 5 Star Restoration grant

Additional funding sources for future consideration:

- NM Water Trust Fund (Water Trust Board) / NM Finance Authority: only if certain conditions are met, such as the possibility to repay a 20% loan as part of the financing; the possibility for public agencies to manage WRB/NMFA funding; the availability of an approved “water conservation plan” at the applicant agency (State of NM, SF County, or Soil & Water Conservation District)
- New NMEMNRD funding from NM Cultural Heritage & Land Conservation Act of 2010
- A County Special Overlay District, along with specific financial allocation clauses
- State and/or Federal Legislative appropriations

2. Internal government agency funds for wetlands in the Galisteo Watershed (add-on or matching funds)

Funds acquired to date

- USACE – internal funds for Galisteo Dam restoration
- SF County Open Space Division – internal funds for matching contributions to wetland restoration
- SF County Land Use Division – internal funds for wetland study
- New NMEMNRD funding from NM Natural Heritage Conservation Act of 2010

Additional funding sources for future consideration

- Internal NMED funds
- Internal NMDOT funds

3. Mitigations funds (USACE or other government mitigation funds)

Funds acquired to date: None

Additional funding sources for future consideration:

- USACE mitigation funds in relation to NMDOT bridge building in Galisteo and other projects in the region.

Galisteo Watershed Wetlands Action Plan

4. Developer funding (as part of an urban development project)

Funds acquired to date

- Commonwealth Conservancy

Additional funding sources for future consideration: TBD

5. Private investments

Funds acquired to date

- Individual private landowners

Additional funding sources for future consideration: TBD

6. Payment for Ecosystem Services

Funds acquired to date: None

Additional funding sources for future consideration: TBD

7. Memorials and Foundations

Funds acquired to date: None

Additional funding sources for future consideration:

- Galisteo Basin Preserve Green Burial Program

Considering wetland ecosystems, and their ecological functions, as natural assets with economic and social value can help promote conservation and more responsible decision-making. Additionally, conservation and planning of highly functioning wetland ecosystems that are used by design to fulfill a broad spectrum of ecosystem services that contribute to economic returns and community well-being has the potential to stimulate market-based conservation and stewardship.

4.g. Monitoring

Monitoring wetland restoration work helps identify wetlands impacts, degradation and stressors, and measures success of implemented wetland restoration and protection projects. Additionally, monitoring data can be analyzed to be used in data to action reports for educational purposes, for adaptive management, and in future wetland restoration and protection actions.

Project monitoring initiatives for wetland restoration projects in the Galisteo Watershed include those developed for “Planning for Wetlands in the Galisteo Watershed” project:

- Monitoring plan

Galisteo Watershed Wetlands Action Plan

- Project Quality Assurance Project Plan (PQAPP) written and approved
- Monitoring findings, report to date, and photo series
- Findings and observations by students

The SWQB has established three water quality monitoring sites on Galisteo Creek as part of an intensive water quality survey of the Upper Rio Grande Watershed conducted in 2002. The survey results were assessed with respect to State of New Mexico water quality standards. Relevant survey data and the assessment are available from the SWQB.



Figure 26. Students assist with field assessments and monitoring of project accomplishments. This student of Charter School 37 participated in field monitoring of the Southwest Arroyo on the Galisteo Basin Preserve in 2007.

Galisteo Watershed Wetlands Action Plan

Future monitoring needs include:

- GIS analysis of wetland extent using satellite imagery comparing change from images taken in 1995, 2000, 2005 and 2010. This would give us ideas of the historic trends in increasing or decreasing extent of wetlands in the basin.
- A GIS analysis of key wetland sites such as reference standard sites and those based on criteria such as rare, unique in key corridors for migratory birds or other species of wildlife.
- Rapid assessment of wetland condition of a representative sample of all classes and subclasses of wetlands in the Galisteo Watershed. This would provide information about which wetland subclasses are the most impaired and help select potential sites for restoration.
- Intensive vegetation sampling at key wetlands and reference standard sites to support the GIS image analysis. These data would provide more detailed information on the types and distribution of wetland plants and plant communities found at these sites.
- Fluvial geomorphology data that shows the trends on increased or decreased access of arroyo and stream flows to overbank flooding. Looking at movement of headcuts below and in wetlands will help pinpoint where restoration interventions will have the greatest impact.
- Uploading photos and reports with monitoring data for wetland locations on a statewide water or wetlands data collection website such as www.Watershedwiser.org.

4.h Tracking Wetlands Gains, Losses and Condition

Tracking wetlands gains, losses and condition is a real need not only in the Galisteo Watershed but statewide. The Santa Fe County Sustainable Land Development Plan (Santa Fe County 2010) is a guiding document incorporating local community values, goals and strategies on how to best manage and sustainably utilize the County's limited natural, economic, and cultural resources, and serves as a guide for smart growth and development for all residents and businesses in the County. The reason that tracking wetlands gains and losses is critical is primarily to prevent further losses of wetland acreage and their associated ecosystem services and functions. In addition, historic loss of wetlands precludes allowing the status quo or simply the remaining wetlands as the sustainable condition. Rather the long-range sustainable goal would include annual gains

Galisteo Watershed Wetlands Action Plan

in wetland acreage. Losses or gains in turn affect other initiatives, such as NM Wildways, an initiative to preserve wildlife and migration corridors that are of national as well as regional significance, and the protection of all aquatic systems in the watershed. A potential strategy for tracking wetlands trends includes the division of subsheds or geographic subregions and tracking wetlands trends in these areas, then local types and then subclasses within each type. Baseline for tracking would include GIS coverage and intensive ground-truthing. This is especially critical since many spring-fed wetlands, wetlands associated with arroyos and confined drainages will be too small (<0.1 acre) to pick up using GIS methods. Yet these small wetlands serve as “watering holes” and sustain local flora and fauna and their losses would substantially affect the local ecosystem. In order to develop and maintain a Wetlands Tracking System for the Galisteo Watershed, the following list of needs must be met.

- Tracking Project Design - A design for tracking that could be incorporated into the SLDP implementation. This would include GIS capabilities along with a strategy for ground-truthing and including wetlands not visible remotely.
- Web-based Database - for entering wetlands data, sharing with stakeholders and the public and for creating and publishing tracking reports.
- Entity to Manage and Implement the Design – This could be Santa Fe County or an environmental non-profit such as Earth Works Institute in combination with local citizen’s groups and volunteers and the NMED Wetlands Program.
- Landowner agreements - to enter land to ground-truth especially the more important and significant wetlands in the landscape

Small wetlands are harder to pick up, whereas for wildlife, landscape diversity and ecological value the smaller wetlands are significant across the landscape. In general the bigger wetlands are located on private and tribal lands. Ground-truthing should not only include size but condition of the wetland areas. Condition assessment is discussed in Section 4.b.

5. Public Involvement Strategy

Public Involvement and Education/Outreach have long been at the heart of environmental success and sustainable management in the Galisteo Watershed. Earth Works Institute (EWI) has been a community leader and provided direction and guidance in the Galisteo Watershed for coordination and support of these efforts (Figure 27). Community planning initiatives are targeted as the strategic partnerships that will help mainstream wetlands restoration and protection as part of the normal activities in the watershed. Coordination of these initiatives with wetland restoration and protection efforts are the stepping stones to establish a long-term, watershed-wide wetlands restoration and protection program.



Figure 27. Kina Murphy of Earth Works Institute explains the objectives of wetland restoration in the Shooting Gallery Arroyo in the Cerrillos Hills State Park during a tour for community members in 2009.

Other initiatives include the creation and use of technical tools to increase the knowledge base and availability of wetland information, and the use of a number of platforms and initiatives to increase understanding of the benefits of wetlands restoration and protection.

Activities for wetland restoration and protection in the Galisteo Watershed have

Galisteo Watershed Wetlands Action Plan

included:

- Public outreach and education through signage, a brochure, website information, preparations for a technical field guide, conference presentations, workshops, media relations, and associated activities for wildlife conservation
- Student involvement and formal, outdoor education in area schools
- Mobilization, organization, technical support to, and motivation of Community Stewardship Teams
- Volunteer involvement in the project steering committee, monitoring, volunteer restoration initiatives, and matching support
- Broad-based institutional support



Figure 28. Students from Eldorado Elementary School have been participating for many years in outdoor classroom learning in the Edorado Community Preserve, where they adopted the wetland area and surrounding buffer zones.

5.a. Technical Tools for Reaching the Public

Watershed signs and interpretive wetland signs

In 2008, SWQB Wetlands Program's contractor Earth Works Institute (EWI) initiated the placement of educational road-side signs throughout the Galisteo watershed that indicate stream crossings and watershed boundaries. EWI received support for the signage from Santa Fe County and NMDOT. In the near future more signs are expected to be placed along the Interstate 25 through the services of the New Mexico Energy, Minerals and Natural Resources Department's Forestry Division (NMEMNRD), which is replicating the initiative statewide.

The watershed sign project is a state-wide collaborative initiative. Initially spearheaded by the Santa Fe Watershed Association and EWI in 2007, other partners included the Santa Fe Conservation Trust, City of Santa Fe, Santa Fe County, SWQB, and later the NMEMNRD and NMDOT. SWQB produced the standardized, striking, blue-white sign imagery. Sign production was contracted to P&M Signs in Mountainair. Funding for the signs in the Galisteo watershed was shared between EWI, Santa Fe County, and NMDOT.

In 2009, an interpretive sign (Figure 29) was installed at the Canoncito Arroyo wetlands in the Eldorado Wilderness as part of the Galisteo Pilot Project (EPA Pilot Project awarded to SWQB Wetlands Program). The sign offers visitors a summary of wetland functions and values, restoration techniques and suggestions how to get involved in wetland stewardship initiatives. The sign also includes a map of the Eldorado Community Preserve. The sign is mounted in a kiosk which has additional space for other information, such as student work in the area or activities of the Eldorado Community Improvement Association (ECIA).



Figure 29. Kiosk and interpretive sign placed along a trail in the Eldorado Community Preserve in the fall of 2009.

Wetland Brochure

SWQB Wetlands Program and EWI jointly developed an 8-page, full-color information brochure which describes wetland functions, wetland values, threats to wetlands, and wetland protection strategies for the Galisteo Watershed (Appendix F). It also lists government agencies and conservation organization that provide assistance with wetland restoration and protection. The brochure was printed in late 2008, broadly disseminated throughout 2009, and reprinted in 2010 through the “Planning for Wetlands in the Galisteo Watershed” Project.

Web info

In 2008, EWI rebuilt its website and included descriptions of wetlands projects in the Galisteo Watershed. EWI also included wetland project announcements in the website for the Galisteo Watershed Partnership and in its monthly electronic newsletters and activity bulletins. The Galisteo Wetlands Restoration Project is also described on the SWQB Wetlands website.

Technical Field Guide

An educational Technical Field Guide about wetland restoration and stewardship is currently under production. The field guide will complement a technical field guide for wetland and bosque vegetation management in New Mexico produced by NMED-SWQB in early 2010 as well as a series of land stewardship documents produced by Earth Works Institute.

5.b. Informational Programs Focusing on Wetlands

Events and Workshops

Community outreach and involvement relies on an assortment of events to get the word out to the public, to potential supporters and funders, and to local community organizations and interested citizens. In 2005, EWI and NMED-SWQB Wetlands Program hosted a Wetland Delineation workshop for staff from local, state and federal agencies and conservation organizations involved with wetland protection. This effort showed to participating agencies the interest and commitment within the Galisteo Watershed for restoring and protecting wetlands. EWI and NMED Wetlands Program staff regularly give presentations, poster sessions and manage booths at conferences, festivals and workshops to distribute information to stakeholders and the general public. Some of these local venues include the biennial New Mexico Watershed Forum and the annual Quivira Coalition Conferences and venues such as Santa Fe River Festival, Earth Day and the local farmer's market. NMED Wetlands Program also presents nationally at EPA and other group sponsored conferences. EWI also provides project outreach via meetings of the Galisteo Watershed Partnership and in connection to the wildlife conservation efforts in the Galisteo watershed.



Figure 30. Participants at Wetland Delineation Training at Galisteo Creek.

Between 2006 and 2010, annually EWI organized a series of walks, workshops and work days at various wetland sites, such as at the Eldorado Community Preserve (Canoncito Arroyo), Galisteo Village, Galisteo Basin Preserve (Arroyo de los Angeles), San Marcos Arroyo, 3-Horse Ranch, and in the Cerrillos Hills. The walks, workshops and work days were crucial in mobilizing local Community Stewardship Teams of residents, school groups, and conservation organizations. The events helped educate people about wetland functions and needed wetland restoration work. Workshops focused on wetland botany, planting techniques, removal of non-native species, wetlands monitoring, open space functions, wildlife, and hands-on restoration work. Currently a number of these teams conduct wetlands monitoring, planting days, plant maintenance and watering and other restoration efforts on a regular basis.

Public News Media

Since the inception of the project, news about the wetlands assessment, planning, and pilot restoration work in the Galisteo Watershed has been shared with the media. This has generated several articles about wetlands in local newspapers as well as radio

interviews on local radio networks.

Wildlife Conservation Initiatives

In 2008, EWI coordinated the development of a Galisteo Watershed Wildlife Corridor Group under the auspices of the Galisteo Watershed Partnership. The Wildlife Corridor group and the Galisteo Watershed Partnership included many residents, community groups and conservation organizations that are also part of the community groups described above. This watershed-wide wildlife conservation initiative led to a statewide coalition of partners, the New Mexico Wildways coalition, which seeks to protect existing wildlife habitat and migration pathways through the Galisteo Watershed as part of a wildlife corridor along the spine of the continent from Alaska to Mexico. The Galisteo Creek and its associated wetlands play a crucial role in this continental wildlife corridor. EWI and the Galisteo Watershed Partnership will continue to collaborate with partners to restore and protect wetland functions to enhance wildlife habitat and corridor functions in the watershed.

5.c. Student Involvement and Formal Outdoor Education

Outdoor Education in Area Schools

Three local schools have been involved in outdoor education in association with wetland restoration and protection in the Galisteo Watershed. EWI provided outdoor education services to El Dorado Community School in Eldorado, Turquoise Trail Elementary School in the San Marcos District and Charter School 37 (Tierra Encantada Charter School) in Santa Fe. Other educational organizations in the area, such as the Santa Fe Botanical Garden, will continue to offer outdoor education in association with wetlands in the Galisteo Watershed to area schools in the future.

Eldorado Community School and Eldorado Community Preserve

El Dorado Community School (ECS) developed a Green Team for environmental awareness education and the development of outdoor classroom areas. The school's fifth grade class adopted the Canoncito Arroyo Wetlands in the Eldorado Wilderness (community open space area) as one of its outdoor classroom areas. Students participated in outdoor environmental education events, tree planting, bird identification, and installation of bird boxes.

Turquoise Trail Charter School

Turquoise Trail Elementary has been involved with Santa Fe County and the Cerrillos

Galisteo Watershed Wetlands Action Plan

Hills Park Coalition in outdoor classroom events and the production of educational outdoor signage in the Cerrillos Hills State Park. Additionally, students from this school received outdoor education in the Santa Fe River wetlands west of the municipal sewage treatment facility as part of EWI's Earth Action Education program.

Tierra Encantada Charter School

Under supervision of EWI staff, high school students from Charter School 37 (now Tierra Encantada Charter School) participated in restoration work of trails stream banks, and road sides at several sites upstream of the wetlands along the Arroyo de los Angeles drainage on the Galisteo Basin Preserve.

University of New Mexico

As of 2001, annually, the UNM Community & Regional Planning program supported the SWQB Wetlands Program/EWI to engage students in field learning through site assessments at various riparian and wetland sites, followed by a public presentation of their findings. Students have conducted assessments of the riparian and wetland areas in Canoncito, Galisteo, San Marcos Arroyo, and the Cerrillos Hills.

5.d. Community Stewardship Teams

EWI has played a leadership role in the area for the organization of residents, landowners, community groups, schools, and conservation organizations in Community Stewardship Teams (CST). These CSTs are designed to engage in a variety of activities as public service to protect wetlands and open space resources. CSTs in various forms are in place for wetlands in the Eldorado Wilderness (Canoncito Arroyo Wetlands), Galisteo Creek in the Village of Galisteo, springs and wetlands in the Cerrillos Hills State Park, and the 3-Horse Ranch (Finger Lakes area). There is also community engagement for the San Marcos Arroyo wetlands, but not in the form of a CST.

Eldorado

The Eldorado Community Improvement Association's (ECIA) Conservation Committee serves as the CST for the wetlands in the Eldorado Wilderness. EWI staff participates on the committee and interacts with the committee for workshops and workdays. EWI, in association with the ECIA Conservation Committee, conducted workshops and workdays on trail maintenance and repair and restored a trail crossing at the bottom of the wetlands area to protect the wetland resource. In collaboration with the committee, EWI also organized botany and restoration workshops to motivate the local community to

Galisteo Watershed Wetlands Action Plan

contribute to long-term wetland health.

Galisteo Basin Preserve

EWI has an ongoing collaborative relationship with Commonweal Conservancy, a non-profit conservation development organization in Santa Fe which is developing 12,000-acre land conservation program around a concentrated new village development project in the Arroyo de los Angeles drainage, called the Galisteo Basin Preserve (GBP). EWI and Commonweal Conservancy developed a conceptual plan for the development of a Community Stewardship Organization (CSO) which will be in charge of the long-term, landscape wide management of the GBP. In 2008, the conceptual CSO consisted of Commonweal Conservancy staff and EWI staff, working in conjunction with contractors for road management, erosion control, drainage planning, and managed grazing.

Galisteo

In 2007, EWI organized residents in the Village of Galisteo form a CST as a sub-committee of the Galisteo Community Association. This CST has been meeting monthly throughout 2008 and addressed issues related to the wetlands, trails along the Galisteo Creek, wildlife habitat along the Creek, and local educational events. The CST continued working on these issues in 2009 and 2010.

Cerrillos Hills State Park

EWI collaborated with Santa Fe County's Open Space and Trails Division, which owns the Cerrillos Hills Historic Park (now Cerrillos Hills State Park), and members of the Cerrillos Hills Park Coalition to coordinate spring and wetland restoration projects in that area. EWI, County officials, and Coalition members participated in numerous meetings and walks to plan and review wetland restoration projects and reach agreement on restoration techniques, trail alignments, and public education. In mid 2009, the State Parks Division assumed daily management responsibilities for the park. The local Coalition will continue to operate in an advisory capacity to the State Parks and County Open Space agencies. Restoration and stewardship work has been completed for the Miner Spring. Projects are underway for the Shooting Gallery Arroyo wetlands and the Escalante Spring.

3-Horse Ranch

In 2009, EWI organized a local CST for the new 3-Horse Ranch and Cash Ranch subdivisions, which surround and include the wetlands and wet meadows of the Finger

Galisteo Watershed Wetlands Action Plan

Lakes along the Galisteo Creek. The community is still developing after a series of land sales in 2006-2007 that created the subdivisions. The emerging community initially bonded in its successful fight against exploratory oil and gas drilling on their land in 2007-2008. However, the once looming oil and gas exploration also scattered the interest of many of the new property owners. Only three of more than ten have pursued construction projects and may eventually move to this land. Many others have begun searching for buyers for their properties. Despite these adverse circumstances, EWI has mobilized the landowners in a fledgling CST, strengthened by initiatives regarding wildlife habitat conservation.

San Marcos Arroyo

The wetland sites in the San Marcos Arroyo are owned by several private landowners. The arroyo wetlands upstream from the Highway 14 bridge, which runs across the San Marcos Arroyo, are owned and managed by The Archaeological Conservancy (with partial ownership by the State of New Mexico) as part of the San Marcos Pueblo site. The wetlands downstream from the bridge are owned by private individuals. EWI worked with all parties involved, including the NMDOT, the USFWS and WildEarth Guardians (contractor), to work out details for planned Russian olive thinning on both sides of the bridge. The State of New Mexico has received funding for channel reconstruction work on the west side of the bridge with the purpose of increasing water retention in the wetlands downstream. This work is scheduled to be implemented in late 2010.

5e. Steering Committee and Partnerships

Project Steering Committee

At the start of the project “Planning for Wetlands in the Galisteo Watershed”, SWQB Wetlands Program and EWI formed a project steering committee including representatives from Santa Fe County, Santa Fe Conservation Trust, Santo Domingo Pueblo, US Army Corps of Engineers, and several private landowners. Between 2005 and 2008, the steering committee met several times per year to coordinate project activities. The goal of having a steering committee is to involve representatives from interested groups in the decision-making for project implementation.

Voluntary Restoration Actions

Several landowners have stepped forward to request assistance with voluntary restoration and stewardship activities. This has led to add-on projects funded through the NM River Ecosystem Restoration Initiative, USFWS Partners for Wildlife grants, and private

Galisteo Watershed Wetlands Action Plan

funding. Voluntary restoration initiatives included those on the Galisteo Basin Preserve, 3-Horse Ranch, San Marcos Arroyo (west of Highway 14), Romero Arroyo (Valencia), and in the Padre Springs on the Holian property (part of the Ranch at Padre Springs subdivision). Additionally, the US Army Corps of Engineers voluntarily restored and protected several wetlands in the Galisteo Dam reservoir as part of an initiative to remove tamarisk in the reservoir between 2007 and 2010.

Matching Support

Most of the education and outreach activities, voluntary restoration actions, and school-based projects have provided significant matching support to the initial EPA/NMED investments in planning and restoring wetlands in the Galisteo watershed. Matching contributions, both in-kind and through grants and other funds, have been nearly 8 times the initial federal investment of \$140,000. Matching contributors are then able to spread the word about project activities.

Institutional Support

The wetland restoration and protection planning activities in the Galisteo watershed have mobilized a large number of parties. The project received institutional support from:

- Santa Fe County
- UNM
- USACE
- NMDOT
- NMED – River Ecosystem Restoration Initiative
- NM State Parks Division
- NM Department of Cultural Affairs, Historic Preservation Division
- Archaeological Conservancy
- Santa Fe Conservation Trust
- Commonweal Conservancy
- State Land Office
- BLM
- US Forest Service
- USFWS – Partners for Wildlife Program

6. Accomplishments, Future Goals and Needs, Timetable

6.a. Accomplishments

Several protection measures were identified and put into place as a result of the process of creating this Wetlands Action Plan. These measures include:

- Inclusion of wetland planning in the Santa Fe County 2010 Sustainable Land Development Plan and Code and the 2008 “Oil and Gas Element” to the Land Use Code.
- Completion of report Wetland Assessment and Plan
- Completion of a watershed-wide Green Infrastructure plan and prioritization plan for open space and wetland restoration and protection
- Completion of an analysis of wetland functions and wetland values
- Completion of the development of wetland outreach and education programs and materials
- Completion of detailed assessments and designs for three pilot restoration sites
- Completion of restoration work on one pilot site
- Completion of many spin-off sites identified in the assessment and plan
- Postponement or possible abandonment of oil and gas drilling in and around wetlands in the Galisteo Watershed
- Leverage of nearly \$650,000 for wetland restoration in the Galisteo Watershed and more than \$500,000 in other parts of Santa Fe County between 2007 and 2012.

6.b. Future Goals and Needs

- Ongoing restoration and protection of wetlands according to prioritization in the Green Infrastructure plan for the Galisteo Watershed and in the Santa Fe County Sustainable Land Development Plan/Code and the County’s Open Space plan updates
- Continued work with private landowners and NMDOT on wetland restoration and conservation easements to create protective buffers
- Expected wetland protection acreage by 2013 may reach more than 40,000 acres, including all conservation easement lands to date (more than 21,000 acres, not including Galisteo Basin Preserve), the Cerrillos Hills State Park (potentially 3,000 acres), the Eldorado Community preserve (4,000 acres) and the Galisteo

Galisteo Watershed Wetlands Action Plan

Basin Preserve (12,000 acres). The expected acreage of protected and restored wetlands will reach over 100 acres.

- Detailed wetland assessment and mapping for the Galisteo Watershed
- Development and implementation of a monitoring and trends network of stream, springs and wetlands across the Galisteo Watershed
- Support for ongoing monitoring through Community Stewardship Teams at project sites
- Financial assistance for ongoing wetland restoration, development and protection on private and public lands
- Ongoing institutional and community support for wetland stewardship

6.c. Timeline

2010

- Complete restoration of 30 acres of wetlands and riparian areas throughout the Galisteo watershed (Canoncito Arroyo, Shooting Gallery Arroyo, Escalante Spring, Galisteo Creek in the Village of Galisteo, Padre Springs area)
- Success monitoring of restored sites
- Application for financial support for ongoing stewardship work and monitoring
- Participate in Use Attainment Analysis for Galisteo Watershed
- Outreach to build capacity among Community Stewardship Teams

2011-2012

- Restoration of 10-30 acres of wetlands and riparian areas throughout the Galisteo watershed (Galisteo Creek in the Community of Valencia and in the Village of Galisteo; more work in Padre Springs area)
- Success monitoring of restored sites
- Application for financial support for ongoing stewardship work and monitoring: Development of pilot projects for Payment for Ecosystem Services (PES)
- Explore development of an “In Lieu Fee Program” in collaboration with Earth Works Institute and the Corps of Engineers
- Explore ways to complete mapping and classification of wetland resources. Participate in statewide mapping consortium.
- Outreach to build capacity among Community Stewardship Teams

Galisteo Watershed Wetlands Action Plan

- Complete Technical Guide for Wetlands

2013 and Beyond

- Restoration of more acres of wetlands and riparian areas throughout the Galisteo watershed (sites TBD)
- Success monitoring of all restored sites
- Application for financial support for ongoing stewardship work and monitoring: Implementation of pilot projects for Payment for Ecosystem Services (PES)
- Testing and implementation of an In Lieu Fee Program
- Identification of key wetland sites for reference standard, rare and endangered species, waterfowl and other important habitat features
- Condition assessment of wetland subclasses in the watershed
- Development of trends monitoring initiative involving County and private citizens
- Training volunteers to monitor wetland sites
- Development of database and website
- Continue to promote and add conservation easement acreage for wetlands and buffers
- Continue to participate in local community planning initiatives that help protect wetland resources
- Continue to work with County and city floodplain managers to coordinate activities that protect and restore floodplains
- Continue groundwater studies for affects on local springs and seeps
- Outreach to build capacity among Community Stewardship Teams
- Continue to define and safeguard wetland buffers through conservation easements or by local government ordinance to maintain their function and permanence.

7. References

Bauer, P.W., Kues B. S., Dunbar N. W. Karlstrom K. E., and Harrison B. (eds) 1995, Geology of the Santa Fe Region, New Mexico Geological Society, Forty-Sixth Annual Field Conference, September 27-30.

Benedict, M.A. and McMahon E. T. 2006. Green Infrastructure: Linking Landscapes and Communities, The Conservation Fund, Island Press, pp 142-146.

Biota Information System of New Mexico (BISON-M). New Mexico Department of Game & Fish. www.bison-m.org/

Bradley, M., Muldavin E., Durkin P. and Melhop P. 1998. Handbook of Wetland Vegetation Communities of New Mexico, Volume II: Wetland Reference Sites for New Mexico, New Mexico Environment Department, Surface Water Quality Bureau and University of New Mexico, Natural Heritage New Mexico.

Brinson, M. M. 1993. A Hydrogeomorphic Classification for Wetlands, prepared for U.S. Department of Army, Corps of Engineers, Technical report; WRP-DE-4, 110 p.

Buchsbaum R. 1994. Management of Coastal Marshes, in Kent, D.M. 1994, Applied Wetlands Science and Technology, CRC Press, Boca Raton, Florida, p.331.

Collins, J.N., Stein E., and Sutula, M. 2003. California Rapid Assessment of Wetlands, San Francisco Estuary Institute, Oakland, California and the Southern California Coastal Water Research Project, Westminster, California, 141 p.

Costanza, et al. 1997. The Value of the World's Ecosystem Services and Natural Capital, Nature 387:253-260 (1997).

Earth Works Institute 2005. Watershed Restoration Action Strategy for the Galiseo Creek Watershed, An Adaptive Management Plan for the Ecological Health of the Galisteo Watershed, In partial Fulfillment of CWA Section 319(h), New Mexico Environment Department, Surface Water Quality Bureau.

Earth Works Institute and Santa Fe Conservation Trust 2007. An Open Space

Galisteo Watershed Wetlands Action Plan

Conservation Plan for the Galisteo Watershed, Galisteo Watershed Conservation Initiative (Draft).

Environmental Law Institute 2008, Planner's Guide to Wetland Buffers for Local Governments, ELI Project Number 0627-01, Washington, D.C. Island Press.

Griffith, G. E., Omernik, J. M., McGraw, M. M., Jacobi, G. Z., Canavan, C. M., Schrader, T. S., Mercer, D., Hill, R., and Moran, B. C. 2006. Ecoregions of New Mexico (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,400,000).

Hawkins et al. 2003. Protection of Wetlands in an Urbanizing Watershed, Society for Wetland Scientists.

Johnson J. B. 2005. *Hydrogeomorphic Wetland Profiling: An Approach to Landscape and Cumulative Impact Analysis* (US EPA Jan. 2005) (EPA/620/R-05/001).

Kleindl, B. 2005. HGM for Colorado and Rio Grande Headwater Riverine Wetlands, Power point presentation for Jicarilla Apache HGM development, December 2005, Durango, NM.

Kusler, J. et al. 2003 A Guidebook for Local Governments: Wetlands and Watershed Management, Association of State Wetland Managers, Berne, New York.

Martin, R. 2008. The Geology Behind the Galisteo Basin, Santa Fe New Mexican article, posted Sunday January 20, 2008, www.santafenewmexican.com.

Milford, E., Neville, T., and Muldavin E. 2009. Galisteo Watershed: Wetlands Map for the Santa Fe Growth Management Strategy, Natural Heritage New Mexico Publ. No. 09-GTR-336. Natural Heritage New Mexico, University of New Mexico, Albuquerque, NM. 12 p.

Miller and Zedler, 2003 Responses of Native and Invasive Wetland Plants to Hydroperiod and Water Depth, *Plant Ecology*, Vol 167, pp 57-69.

Mitch, W.J. and J. G. Gosselink 2007. *Wetlands*, 4. ed. New York: John Wiley and Sons.

Galisteo Watershed Wetlands Action Plan

Muldavin et al. (In Press) New Mexico Rapid Assessment of Wetlands Method – Upper Rio Grande Watershed, New Mexico Environment Department, Surface Water Quality Bureau Wetlands Program, Santa Fe, New Mexico.

National Research Council 1995 Wetlands, Characteristics and Boundaries (National Academy Press, 1995); Mitch, et al., Wetlands (John Wiley and Sons, Inc. 2000).

New Mexico Environment Department Surface Water Quality Bureau, 2010, 2010-2012 State of New Mexico CWA§303(d)/§305(b) Integrated List & Report, NMED April 13, 2010 Water Quality Control Commission.

Novitzki, R. P., Smith R. D. and Fretwell J. D. 1993. Restoration, Creation, and Recovery of Wetlands, Wetland Functions, Values, and Assessment in National Water Summary on Wetland Resources, United States Geological Survey Water Supply Paper 2425.

Osmond, D.L., D.E. Line, J.A. Gale, R.W. Gannon, C.B. Knott, K.A. Bartenhagen, M.H. Turner, S.W. Coffey, J. Spooner, J. Wells, J.C. Walker, L.L. Hargrove, M.A. Foster, P.D. Robillard, and D.W. Lehning. 1995. *WATERSHEDSS: Water, Soil and Hydro-Environmental Decision Support System*, <http://h2osparc.wq.ncsu.edu>.

Postel, S. and B. Richter. 2003. Rivers for Life. Managing Water for People and Nature. Island Press.

Santa Fe County 2010. Sustainable Growth Management Plan Draft, SGMP 11.01.10, www.santafecounty.org.

Smith D. R., Ammann A., Bartoldus C., and Brinson M. M., 1995. An approach for Assessing Wetland Functions Using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices, Technical Report WRP-DE-9, US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, NTIS No. ADA307 121.

Tiner, R.W. (editor). 2002. Watershed-based Wetland Planning and Evaluation. A Collection of Papers from the Wetland Millennium Event (August 6-12, 2000; Quebec City, Quebec, Canada), Association of State Wetland Managers, Inc., Berne, NY, 141 pp.

USDA Forest Service 2010 **Ecosystem Services**,

Galisteo Watershed Wetlands Action Plan

<http://www.fs.fed.us/ecosystems/services/>

US Army Corps of Engineers 2006. Environmental Assessment for the Galisteo Dam and Reservoir Salt Cedar Eradication Project, Galisteo Creek, Santa Fe County, New Mexico, Albuquerque District, March 7, 2006.

Vrooman, S. S. 2006. Assessment and Plan for the Creation, Restoration and Protection of Wetlands in the Galisteo Watershed, prepared for “Planning for Wetlands in the Galisteo Watershed” NMED Contract #05-667-5000-0013, Earth Works Institute, July 2006.

Watson et al. 2005. Ecosystems and Human Well-being: Wetlands and Water Synthesis, Millennium Ecosystem Assessment, World Resources Institute, Washington, D.C.

Williams 1986. New Mexico in Maps. University of New Mexico Press, Albuquerque, New Mexico.

Zentner J. 1994. Enhancement, Restoration and Creation of Freshwater Wetlands. Chapter 7 in D.M. Kent ed. 1994. Applied Wetlands Science and Technology, CRC Press, Boca Raton, Florida.

Galisteo Watershed Wetlands Action Plan

APPENDIX A
GALISTEO WATERSHED:
WETLANDS MAP FOR SANTA FE GROWTH MANAGEMENT STRATEGY

APPENDIX B
ASSESSMENT AND PLAN FOR THE CREATION, RESTORATION AND
PROTECTION OF WETLANDS IN THE GALISTEO WATERSHED

APPENDIX C
FEDERALLY THREATENED, ENDANGERED
AND SPECIES OF CONCERN BY COUNTY
GALISTEO WATERSHED

APPENDIX D
STEERING COMMITTEE REVIEW OF WETLAND FUNCTIONS

APPENDIX E
DECISION TREE FOR WETLAND RESTORATION
PRIORITIZATION PROCESS

APPENDIX F
JEWELS OF THE SOUTHWEST
WETLANDS OF THE GALISTEO WATERSHED
OUTREACH BROCHURE