A Wetlands Action Plan for the Lower Rio Grande in New Mexico

ELEPHANT BUTTE DAM TO THE INTERNATIONAL BOUNDARY WITH MEXICO

New Mexico Environment Department
Surface Water Quality Bureau
Wetlands Program

CD #966349-01-0B
(FY 2006)

INTRODUCTION

The mission of the Surface Water Quality Bureau (SWQB) of the New Mexico Environment Department is "to preserve, protect, and improve New Mexico's surface water quality for present and future generations." To assist in achieving that mission, the Watershed Protection Section (WPS) of the SWQB maintains programs designed to address problems with non-point source pollution. An integral componant in addressing non-point source pollution in New Mexico is the development of the WPS Wetlands Program. The primary goal of the WPS Wetlands Program is to protect existing wetlands and to restore or reclaim lost wetlands to watersheds where wetlands have been degraded or lost altogether.

Wetlands serve as natural filters in healthy watersheds and are a vital component of riparian ecosystems. New Mexico contains a wide variety of wetlands including forested wetlands, bottom-land shrublands, marshes, fens, alpine snow glades, wet and salt meadows, shallow ponds, and playa lakes (USGS 1997). Most all of the riparian wetlands and many of the playa lakes of the eastern half of the state are especially important to migratory waterfowl and wading birds. It is estimated that wetland acreage in New Mexico has decreased 33% since the 1780's and is currently only about 482,000 acres or 0.6 percent (USGS, 1997, NMED, 2000). The wetland degradation and loss has been attributed to agricultural conversion, diversion of water for irrigation, overgrazing, urbanization, mining, clear cutting, road construction, streamflow regulation, and invasion by nonnative plants (USGS 1997).

The SWQB has begun efforts to characterize and implement wetlands restoration throughout the state by developing regional plans. Wetland Action Plans are developed to determine the hydrology and ecology of a particular region and identify the potential sites for wetland restoration, and outline the approaches for wetland development.

The Rio Grande in southern New Mexico has been modified to provide a stable water supply for irrigation and reduce the effects of flooding by straightening the channel, reducing the width of the floodplain, and confining the river between levees. The natural features along the river have been altered and wetlands have been significantly reduced. The goal of this Wetlands Action Plan is to present a strategy to increase wetland acreage by restoring existing wetlands and developing new wetlands adjacent to the Rio Grande in southern New Mexico. This Wetlands Action Plan is an update and revision of the original draft and was funded by the United States Environmental Protection Agency (EPA) in partial fulfillment of Clean Water Act Section 104(b)(3) Wetlands Program Development Grant CD #966349-01-0B.

THE EL PASO-LAS CRUCES WATERSHED

Geographic Setting

The geographic area encompasses the entire El Paso-Las Cruces Watershed in New Mexico (USGS HUC unit 13030102) and a small portion of the Caballo Watershed (HUC 13030101) along

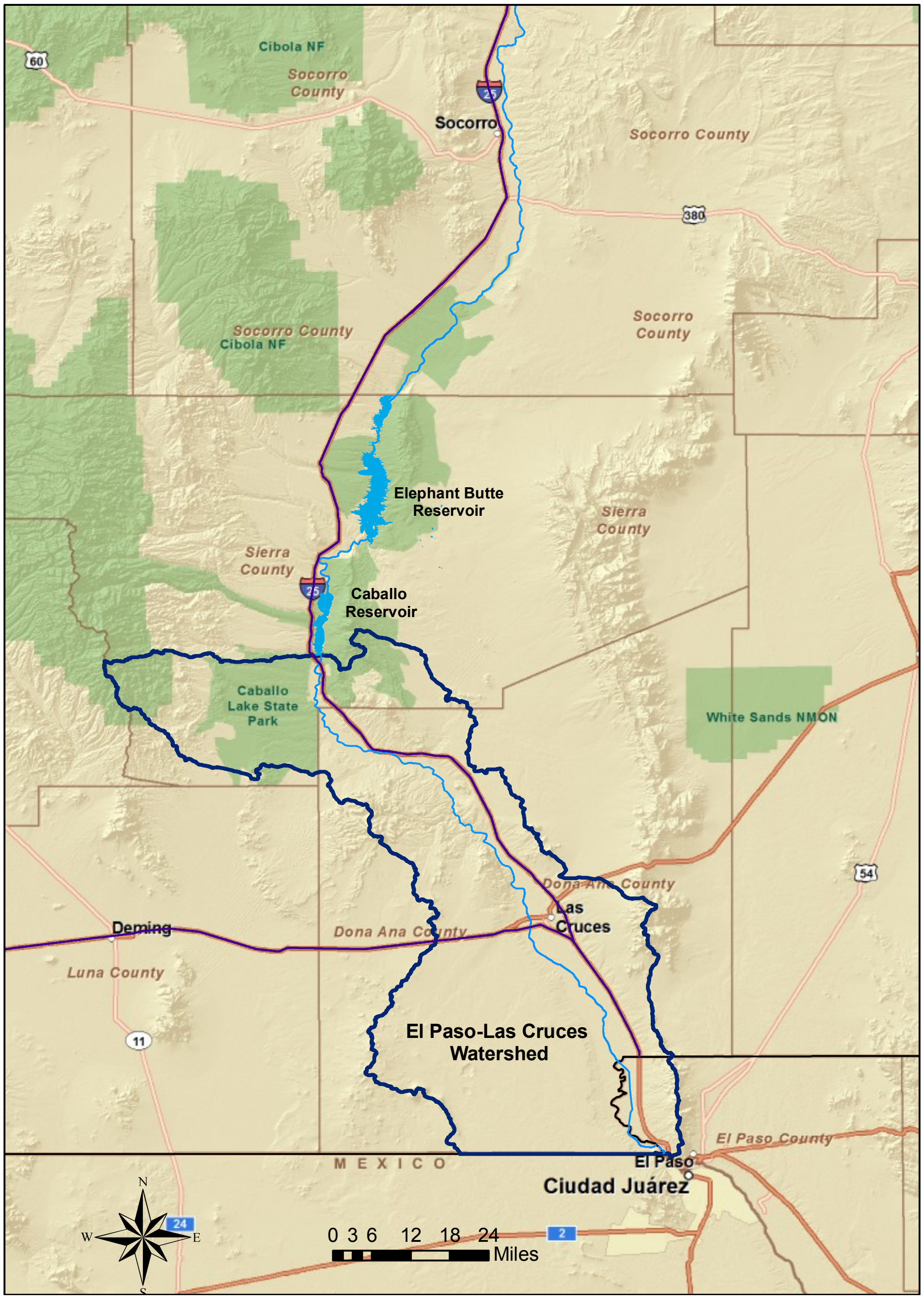

Figure 1. The El Paso-Las Cruces Watershed.

the Rio Grande between Elephant Butte Reservoir and Caballo Dam. The area is a sub-unit of the Rio Grande watershed and is located in Sierra and Doña Ana counties of South-Central New Mexico (Figure 1). The El Paso-Las Cruces Watershed boundary begins in the Rincon Valley below the dam at Caballo Reservoir, a main stem impoundment of the Rio Grande, and extends south through the Mesilla Valley to the Texas-New Mexico border and the international boundary with Mexico. The watershed encompasses approximately 2,405 square miles. The highest point is 9,669 ft at Sawyers Peak in the Black Range, and the lowest point is approximately 3,725 ft. at the bottom of the watershed in El Paso, Texas. The eastern edge is bordered by the Caballo, Doña Ana, Organ, and Franklin mountain ranges. The western edge of the watershed is bordered by the Mimbres Mountains of the southern Black Range, the Sierra de las Uvas, the Robledo Mountains, and fault block volcanic uplands extending south to the East Potrillo Mountains (Hawley 2004).

Geology

In geologic terms, the El Paso-Las Cruces Watershed is located in the southern part of the Rio Grande Rift. The rift, which extends from Southern Colorado into the Mexican state of Chihuahua, began forming about 30 million years ago and produced a series of closed basins which slowly filled with volcanic ash and alluvial sediments. As the alluvial sediments continued to fill the basins and runoff increased in the surrounding uplifted regions the basins spilled over and became connected to form the ancestral Rio Grande which terminated in southern New Mexico. Eventually, fluvial erosion moved up the Rio Grande through the saddle between the Franklin Mountains and the Sierra Juarez and connected the Rio Grande to the Gulf of Mexico. The El Paso-Las Cruces Watershed lies in two of these ancient basins: the Palomas and Mesilla Basins which are physically separated at Seldon Canyon. Both basins are asymmetrical half grabens characterized by Tertiary-Quaternary Santa Fe Group sediments consisting of unconsolidated gravel, sand, silt and clay. The two basins range from 1 to 5 miles wide and are fairly flat with a downstream gradient of approximately 4ft. /mi (Chronic 1987, Fullerton 2003, Hawley 2004).

Climate

As a result of the size and extent of the watershed and great variability in altitude, the climate conditions vary depending on the location within the watershed. However, the climate in most of the watershed, and in particular along the valley floor and the adjacent low lying uplands, is relatively similar. Precipitation ranges from an annual mean between 8.5 inches and 11.4 inches. Average daily temperatures range from 39^{o} F in December and January to 78.8^{o} F in July. During the winter months low temperatures typically reach the mid 20^{o} F at night while summertime days can have extended days above 100^{o} F.

Historical Description of the Rio Grande in the Project Area

Historically, the Rio Grande in the El Paso-Las Cruces Watershed had a fairly wide floodplain. The channel was meandering, and braided (Stotz, 2000). A map prepared by John Pope in

1854 shows 25 meanders in the 18 mile stretch of the Rio Grande from above Doña Ana to Fort Fillmore (Ackerly 1992). Maps prepared by the Government Land Office in the mid to late 1800's outlining the acequia system of the Mesilla Valley also show a meandering channel and identify several sloughs and a lagoon (Ackerley 1992). Diego Perez de Luxan, a member of the Espejo expedition of 1582-1583, described pools and marshes with associated wetland vegetation along the Rio Grande in both the Mesilla and Rincon valleys (Stotz, 2000). John Russell Bartlett also described similar features in 1849, and documented an oxbow lake in the vicinity of present day Hatch (Bartlett 1965). Marching south from Santa Fe to Mexico during the Mexican American War, Colonel William Doniphan's army camped at a spot in the Mesilla Valley covered with rushes (Bieber 1936)

The river channel and associated aquatic features were constantly evolving. The high sediment load of the Rio Grande in southern New Mexico often led to the plugging of the channel which forced the river to find a new path (Stotz, 2000). This often left behind off channel marshes, and oxbow lakes. The United States Bureau of Reclamation mapped the various known river channels in the Mesilla Valley in 1914 and identified over nine different channels from 1844-1912 (Ackerly 1992). Many of these remnant channels are still visible today.

The Rio Grande was also navigable. While there are limited accounts of the Rio Grande regarding navigation, on September 23, 1874 the Santa Fe Daily New Mexican reported that John Howland and J.T. Hiester floated the Rio Grande from Santo Domingo Pueblo just south of Santa Fe, to Mesilla in the McGuffin; a four ton vessel loaded with four thousand pounds of supplies. The voyage was celebrated as evidence that the Rio Grande could be used for navigation during the part of the year when water levels were sufficiently high (Kelly, 1986).

Colonization and Agricultural Development

Native Americans of the Mogollon culture are the earliest known inhabitants of the area. Petroglyphs and several small village sites which date from 100 BC to 1400 AD have been discovered in the Sierra de las Uvas, and Robledo Mountains (Stotz, 2000). The earliest Spanish explorers mention the Manso Apache, and reports from Don Juan de Oñate's expedition in 1598 describe encounters with the Mansos in the area around present day El Paso, Texas and Dona Aña, New Mexico. The first formal European settlement occurred when the Doña Ana Bend Colony was established in 1843. Within the next 15 years several communities and military outposts were developed in the Rincon and Mesilla valleys; including Mesilla, Las Cruces, Tortugas, Picacho, Fort Fillmore, and Fort Thorn. The principal economic activity in the region was agriculture and to supply water to the crops irrigation systems were built. It is not entirely clear when the first irrigation systems were established, but by 1858 they were extensive enough to warrant surveying and mapping by the Government Land Office (Ackerley 1992).

Today, the Mesilla and Rincon valleys are experiencing rapid growth. As of 2009 the population of Doña Ana County was 206, 419 (US Census Bureau, 2009), and with a population of 95,000, Las Cruces is the fastest growing metropolitan area in New Mexico. While agriculture remains a mainstay of the local economy with such diverse crops as pecans, cotton, onions, alfalfa, corn, and chilé, many of the agricultural lands in the Mesilla Valley are being converted to residential subdivisions.

The Rio Grande Project

The future of agriculture in the El Paso-Las Cruces Watershed was not always certain. Following the Civil War, agricultural growth in the San Luis Valley in southern Colorado, and along the middle Rio Grande in New Mexico, placed increasing demands on the waters of the Rio Grande. Downstream users in New Mexico and West Texas were getting less and less water. At times the Rio Grande would dry up altogether.

Beginning in the late 1800's fields in the Rincon and Mesilla valleys began to dry up. In 1902, while on a trip through the Mesilla Valley, Bishop Henry Granjon described dry ditches, fallow and withered fields, and abandoned gardens (Ackerly 1992). Similar problems were occurring downstream as well. Thus, the Rio Grande Dam and Irrigation Company (RGDIC) was formed by Dr. Nathan Boyd of Las Cruces with the intention of building a dam to capture spring runoff water for use later in the season (Kelly, 1986). However, the RGDIC had no intention of sharing any captured water with its downstream neighbors in either Texas or Mexico.

As a result of the lack of water reaching Mexican farmers, the Mexican government filed a note of protest with the United States Secretary of State on March 21, 1895 claiming a violation of the treaty of Guadalupe-Hidalgo. There was a second issue as well. Since the Rio Grande had become the border between the United States and Mexico, it's propensity to frequently move laterally and change position had become a territorial boundary issue. All parties agreed that a dam was a reasonable solution to store water for later use and stabilize the boundary between the two countries by reducing the impacts of flooding. President Theodore Roosevelt signed a proclamation on a Convention between the United States and Mexico for Equitable Distribution of the Waters of the Rio Grande on May 21, 1906. Article I of the proclamation outlined a proposed dam for the storage and subsequent delivery of 60,000 acre-feet of water annually from the United States to Mexico at the head of the Acequia Madre above Juarez, Mexico. On March 4, 1907 the United States Congress appropriated an initial $1,000,000 to the Rio Grande Project to build a dam and associated distribution system, and on June 3, 1913 the first concrete was poured for what would later become Elephant Butte Dam.

Today, the Rio Grande Project includes Elephant Butte and Caballo Dams, 6 diversion dams, 141 miles of canal, 462 miles of laterals, and 457 miles of drains, that provide irrigation water for over 4,000 farms consisting of more than 150,000 acres. There are also over 50 flood control structures on tributaries to the Rio Grande in the El Paso-Las Cruces Watershed that are not part of the Rio Grande Project.

Reservoir Operations

While the primary directive is to store water to release for irrigation, the U.S. Bureau of Reclamation (BOR) also operates a 24,300-kilowatt hydroelectric power generating station at Elephant Butte Dam. Since electric power generation is not the primary purpose of the reservoir, water releases have historically been governed by irrigation demands. Although the management program has been modified during periods of drought, annual water releases through Elephant Butte Dam generally begin in January or February, and continue through the end of the growing season in September or October. During the fall months, water releases are minimized, and the power plant is shut down for maintenance. This not only facilitates river channel maintenance between Elephant Butte Reservoir and Caballo Reservoir, but maintenance of the river channel, drains and ditches below the reservoirs.

Rio Grande Canalization Project

On February 1, 1933 a convention was struck between the United States and Mexico to construct and maintain the Rio Grande Rectification Project. The project straightened, stabilized, and reduced the length of the Rio Grande from 155.2 miles to 85.6 miles along the Texas-Mexico border. The Rio Grande Canalization Project was subsequently authorized on June 4, 1936 which straightened, stabilized and shortened the Rio Grande from Caballo Dam to the Texas border. Both projects were constructed and are maintained by the International Boundary and Water Commission (IBWC).

The Rio Grande from Caballo Dam to the Texas state line currently has a channel width ranging from 110 to 500 feet. The floodplain ranges from approximately 50 to 2,100 feet in width. The project is designed to provide an operational carrying capacity ranging from 2,500 cubic feet per second (cfs) above Leasburg Dam to 1,200 cfs at El Paso, Texas, and a design flood peak capacity of 20,000 cubic feet per second (cfs) below Leasburg Dam attenuating to 17,000 cfs at American Dam in El Paso. The levees range from 3 to 15 feet high, and have a total length of 130 miles. The levees on the west side are 57 miles long while the east side levees are 73 miles long. In the 8.6 mile reach through Selden Canyon the river is relatively confined and no channel control works were constructed (Fullerton, 2003).

El Paso-Las Cruces Watershed Hydrology

The IBWC began collecting flow data from the Rio Grande in the El Paso-Las Cruces Watershed in 1889. Estimating the hydrology of the Rio Grande prior to this time is difficult. However, Ackerly (1999) was able to estimate the hydrology from 1480-1895 using tree ring data correlated with flow data collected on the Rio Grande upstream of Elephant Butte Reservoir at San Marcial. Although Ackerly was not able to reconstruct the annual flow regime, he concluded that current estimates of availability and annual water supply are 13% greater than the long term average. He also concluded that both the potential for drought and flooding was underestimated and not reflected by the data collected since 1889. While the flow data collected at San Marcial may not present an accurate picture of overall long term trends in flow regime, they do provide useful information on the expected annual flow regime. In addition, by comparing data collected before and after the construction of Elephant Butte and Caballo dams, clear patterns emerge on the change of the annual flow regime following construction of the dams.

Historic flow data collected at San Marcial from 1899-1964 (following 1964 the gage was

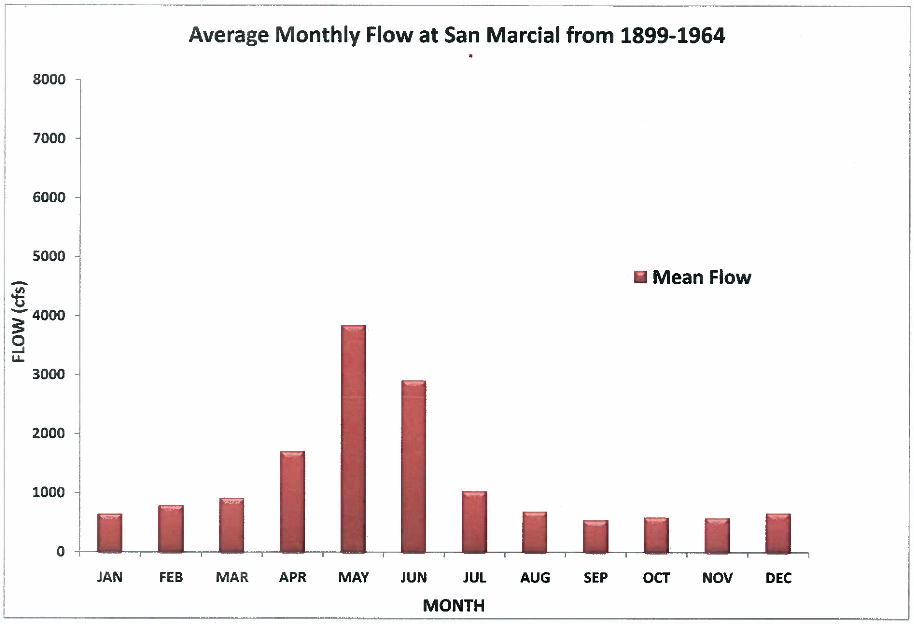

Figure 2. Average monthly flow in cfs at San Marcial 1899-1964.

renamed and flow was determined by two separate gages) clearly depict a period of spring runoff from April-June, with peak flows occurring in May (Figure 2). The average monthly flow data collected directly below Elephant Butte Dam from 1916-2005 depict a gradual increase in flow from February through June, with a slow decline beginning in August (Figure 3). While not the typical hydrograph for a stream receiving spring runoff as depicted at San Marcial, it is similar. However, this actually depicts the flow regime into Caballo Reservoir and is not an accurate depiction of the flow received by the El Paso-Las Cruces Watershed. The average monthly flow from Caballo Reservoir depicts a completely artificial hydrograph with a steep increase in March followed by a fairly stable discharge through August (Figure 4). There are no tributaries carrying spring runoff into the Rio Grande below Elephant Butte and Caballo reservoirs. The data clearly show the reservoirs have prevented spring runoff and their subsequent channel and riparian habitat forming flows from entering the El Paso-Las Cruces Watershed. The same is true for any summer thunderstorm runoff entering the Rio Grande above the reservoirs.

While the dam at Elephant Butte has prevented spring runoff from entering the Rincon and Mesilla valleys, it has not entirely prevented runoff from summer thunderstorms. There are numerous ephemeral tributaries below Caballo Reservoir that deliver stormwater flows from oftentimes intense local thunderstorms during the summer monsoon season from July through September. There have been over 33 flood flows that have been recorded at the gauge in El Paso after 1915 exceeding 4,000 cfs, and over 18 flows exceeding 5,000 cfs (Figure 5).

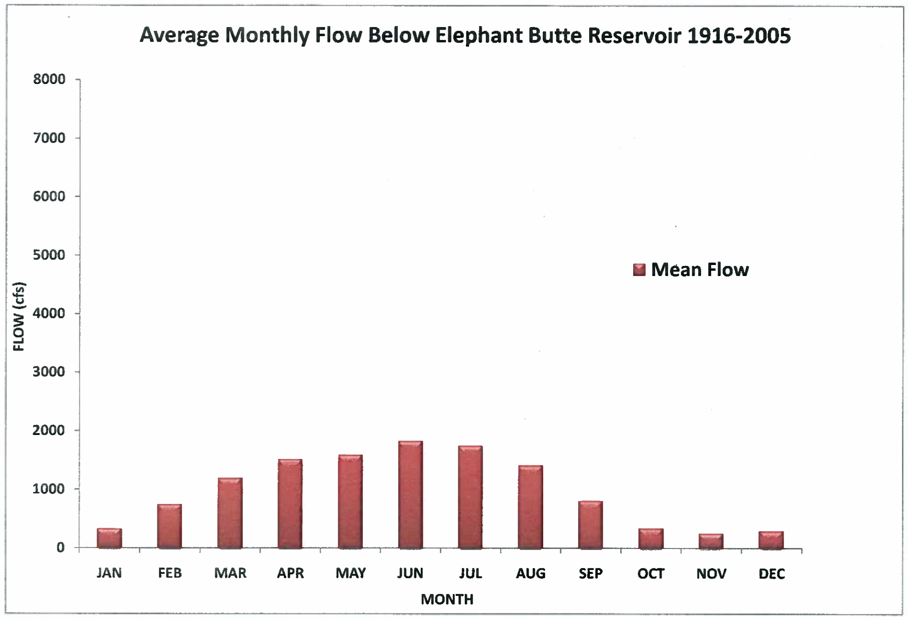

Figure 3. Average monthly flow in cfs below Elephant Butte Reservoir 1916-2005.

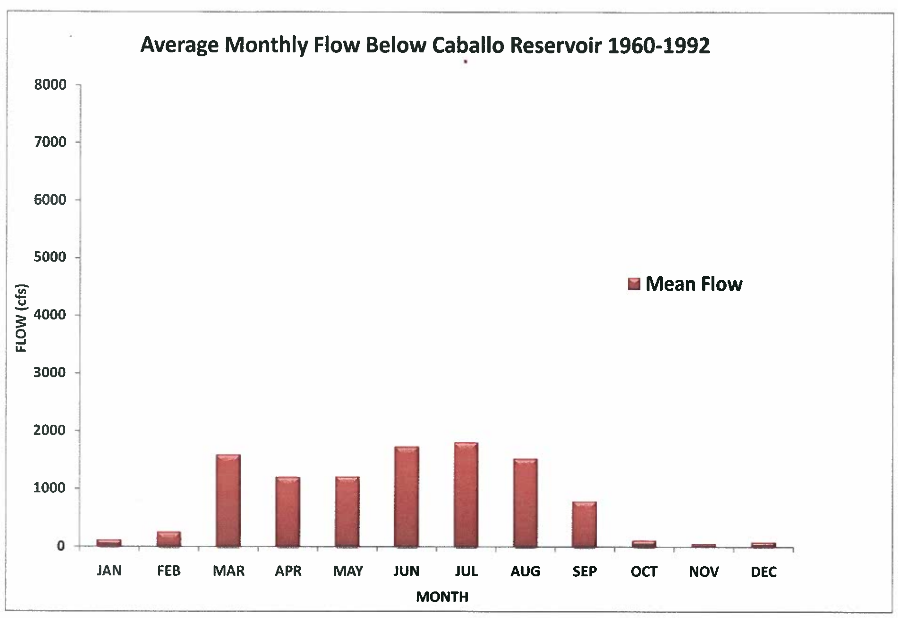

Figure 4. Average monthly flow in cfs below Caballo Reservoir 1960-1992.

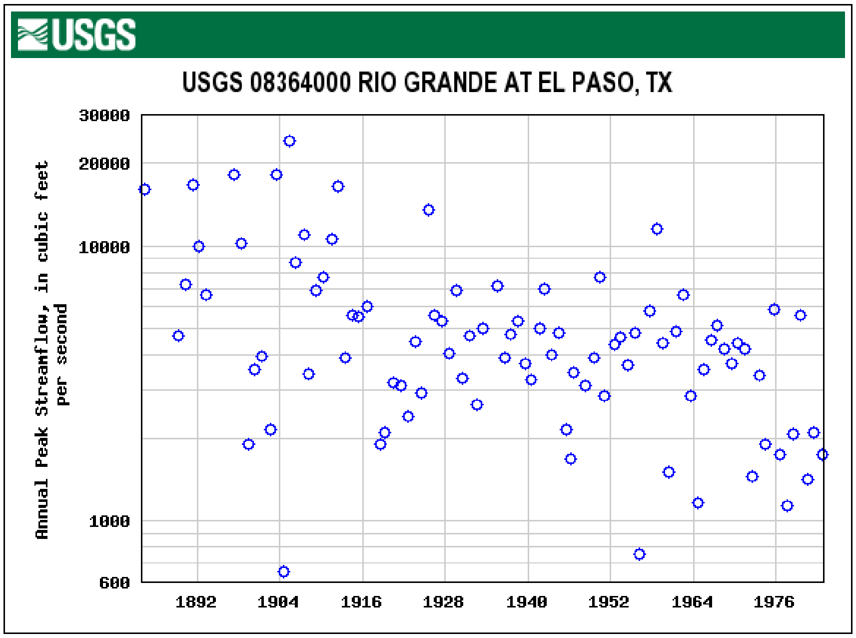

Figure 5. Peak discharge in the Rio Grande El Paso Texas 1884-1982.

Water Rights

The critical component of any wetland is water. Water in southern New Mexico is not just a resource, but a precious commodity in short supply. Water in most of the Western United States, including New Mexico, is governed by the doctrine of prior appropriation. The Colorado Doctrine, operates under the principle of "first in time, first in right", and grew out of a system of land disposition in Mexico in the mid 1800's. The Colorado Doctrine holds that the first person to put the water to beneficial use has priority rights to the water.

Beneficial uses in New Mexico include municipal, industrial, domestic, irrigation, and livestock watering. Under New Mexico law, water rights may be sold, willed, or transferred to other users. If a user no longer needs their water, it can be transferred to another user who will put it to a beneficial use. The priority date for all surface water in the Rio Grande Project, and therefore the Rio Grande in the El Paso-Las Cruces Watershed, is 1906. As a result, all water in the Rio Grande in the El Paso-Las Cruces Watershed is fully appropriated, and any surface water diverted for wetland projects will need to be purchased or transferred to the owner of the land where the project is located if prior rights do not already exist. The depth and complexity of water rights on the lower Rio Grande and how they relate to development of restoration projects such as wetlands are beyond the scope of this document. For a detailed account of water rights as they pertain to the Rio Grande in the El Paso-Las Cruces Watershed two excellent references are available; the *New Mexico Lower Rio Grande Regional Water Plan* (Terracon 2004), and *Water for River Restoration: Potential for Collaboration Between Agricultural and Environmental Water Users in the Rio Grande Project Area* (King and Maitland 2003).

Water Quality

Following a water quality survey in 2004, NMED listed the 105 mile reach of the Rio Grande from Percha Dam (one mile below Caballo Dam) to the international boundary with Mexico as impaired with the bacteria *Escherichia coli* (*E. coli*). Wetlands have been shown to sequester environmental contaminants such as metals, excess nutrients, and *E. coli*. The restoration and creation of wetlands to the El Paso-Las Cruces watershed has the potential to improve water quality by reducing excess nutrients and *E. coli* bacteria. Secondary potential benefits of wetlands include increasing wetland habitat for wildlife, increased biodiversity, and an expansion of areas available for wildlife viewing and recreation.

FLORA AND FAUNA

While a small portion of the El Paso-Las Cruces Watershed is located on the eastern slopes of the Black Range in the Level IV Ecoregions; 23(c) Montane Conifer Forests and 23(e) Conifer Woodlands and Savannas, the majority of the watershed is located in the northernmost portion of the Chihuahuan Desert in Ecoregions; 24(a) Chihuahuan Basins and Playas, 24(b), Chihuahuan Desert Grasslands, 24(c) Low Mountains and Bajadas, and 24(f) Rio Grande Floodplain (Omernik et. al). The upland vegetation of Ecoregion 24 is typical of desert grassland and arid shrubland containing honey mesquite (*Prosopis glandulosa*), creosote bush (*Larrea tridentata*), lechuguilla (*Agave lechuguilla*), various yuccas (*Yucca sp.*), ocotillo (*Fouqueiria splendens*), cholla (*Cylindropuntia sp.)*, bush muhly (*Muhlenbergia porteri*), tobosa (*Hilaria mutica*), and blue, black and sideoats grama grasses (*Bouteloua sp.*) (Elmore and Janish 1976, Omernik, 2006). Typical riparian vegetation includes: Rio Grande cottonwood (*Populus deltoides*), coyote willow (*Salix exigua*), Gooding's willow (*Salix gooddingii*), seepwillow (*Baccharis salicifolia*), screwbean mesquite (*Prosopis pubescens*), Torrey's wolfberry (*Lyceum torreyi*), four winged saltbush (*Atriplex canescens*), arrowweed (*Pluchea sericea*), inland saltgrass (*Distichlis spicata)*, alkalai sacaton (*Sporobolus aroides*) and numerous smaller flowering annual plants. Typical wetland plants include: broad-leafed cattail (*Typha latifolia*), hardstem bulrush, or tule (*Schoenoplectus acutus*), giant bulrush or chairmakers bulrush (*Schoenoplectus americanus*), baltic rush (*Juncus balticus*), scratchgrass (*Muhlenbergia asperifolia*), and yerba mansa (*Anemopsis californica*). Non-native species typical of disturbed areas include bernuda grass (*Cynodon dactylon*), Russian thistle (*Echinops exaltatus*), kochia (*Kochia scoparia*), and saltcedar (*Tamarix Chinensis*) (N. Stotz, 2000, Omernik 2006).

Fuana are typical of the northern Chihuahuan Desert. Prominent mammals include: coyote (*Canis latrans*), striped skunk (*Mephitis mephitis*), spotted ground squirrel (*Spermophilus spilosoma*), desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), desert pocket gopher (*Geomys bursarius arenarius*), pronghorn antelope (*Antilopcapra americana*), common raccoon (*Procyon lotor*), American beaver (*Castor Canadensis)*, common muskrat (*Ondatra zibethicus*), javalina (*Tayassu tajaca*), mule deer (*Odocoileus hemionus*), mountaim lion (*Felis Concolor*), bobcat (*Lynx rufus*) and numerous rodents and bats. Many of these species depend on the riparian corridor and the associated habitats for food, and water.

The riparian corridor plays an important role for birds as well. Of the approximately 351 species of birds found in the Chihuahuan Desert 134 species or 38% occur only within the riparian corridor in floodplain, marsh, open water or shoreline habitats and many of these utilize the riparian areas exclusively for breeding (Stotz, 2000). The National Audubon Society also recognizes the riparian habitat at, above, and below, Caballo Reservoir as an Important Bird Area (IBA). The IBAs are recognized as sites that provide essential habitat for one or more bird species. A typical IBA includes sites for breeding, wintering and migratory birds. The Rio Grande in southern New Mexico provides critical habitat for numerous migrating neo-tropical birds. Threatened and endangered avian species in Doña Ana and Sierra Counties include the Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (FEIS Upper Rio Grande Basin Water Operations Review, 2007 USACE, USBOR, NM ISC). Other sensitive riparian species include the Yellow-billed Cuckoo (*Coccyzus americanus*), a candidate for federal threatened and endangered listing, and the state threatened Bell's Vireo (*Vireo bellii*). For a comprehensive list of birds found within the Chihuahuan Desert see Historic Reconstruction of the *Ecology of the Rio Grande/Rio Bravo Channel and Floodplain in the Chihuahuan Desert* (Stotz, 2000).

There are 36 species of fish known to have occurred within the reach from Caballo Dam to El Paso, Texas (Stotz, 2000). Of these 36 species, 15 are introduced and 14 of the species have been extirpated from the reach. Much of the problems associated with species survival can be attributed to loss of habitat, regulation of flows and competition from non-native species.

WETLAND PROJECTS

A collaborative effort by the World Wildlife Fund (WWF), Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, The Nature Conservancy, PRONATURA Noreste, and the Instituto Tecnologico y Estudios Superiores de Monterrey, developed a biological assessment of the Chihuahuan Desert in the United States and Mexico in 2001. The assessment determined the most endangered habitat in this sub-region to be the Rio Grande and its riparian area. The Rio Grande within the El Paso-Las Cruces watershed is listed as a freshwater and terrestrial priority site by the collaboration because it has portions that still support native fauna, and for the areas restoration potential (Dinerstein et. al., 2000).

There are several types of wetland features that would be suitable for the El Paso-Las Cruces Watershed. These include oxbow lakes, ponds, marshes, and wet meadows. Since water is the primary resource needed to develop a wetland, a general concept for development should hinge on the source of water needed for development. Based on this concept the following four approaches have been identified.

1. *Establish conservation easements or purchase land and water rights to protect existing wetlands and develop new wetlands*. There are currently areas in the El Paso-Las Cruces Watershed which contain wetlands. Remnant marshes, wet meadows and over banking flood areas can

be found in Selden Canyon. The opportunity to establish conservation easements in existing areas should be researched, the watershed should be surveyed for potential areas, and land ownership determined. It might be possible for privately held conservation organizations (i.e. groups such as the World Wildlife Fund or The Nature Conservancy) to purchase land outright, or negotiate land swap deals between public entities such as the BLM, or the New Mexico State Land Office.

2. *Utilize drains as water source for development of wetlands.* King and Maitland (2003) developed an approach to include the construction of wetlands utilizing drains as a water source, and creating conservation easements with landowners adjacent to the drains. The development of aquatic features such as ponds or marshes utilizing the drainage system could be modeled after the Mesilla Valley Bosque State Park. The park began as a collaborative effort between the Southwest Environmental Center (SWEC), the Elephant Butte Irrigation District, the City of Las Cruces, and the New Mexico Department of Game and Fish. Utilizing federal Clean Water Act (CWA) 319(h) restoration funds SWEC constructed a pond adjacent to the Picacho Drain in Mesilla. New Mexico State Parks took over operation of the site, and has continued restoration of the area by removing invasive plant species and expanding the wetland area. The park has a visitor's center, interpretive trails, wildlife viewing stations, and several different wetland features including the original ponds and riparian wet meadows along the river.

3. *Created wetlands associated with Waste Water Treatment Plants (WWTP).* Creating wetlands utilizing waste water treatment plant effluent has several advantages. First, a WWTP can provide a reliable steady supply of water even during times of drought. Second, wetlands have also proven to be an efficient and cost effective method of removing excess nutrients and *E. coli* from effluent. Third, they can provide local government a facility to promote conservation education and water reclamation.

4. *Development of wet meadows utilizing storm-water.* The topic of over-banking flow is a controversial one. There is presently no mechanism to employ Rio Grande Project water for the purpose of simulating spring flooding. However, it may be possible to capture summer thunderstorm flow within the El Paso-Las Cruces Watershed, by lowering the floodplain level in un-canalized sections. Areas along the floodplain could be lowered to an extent that would only capture thunderstorm flood flows, but would not capture project water. If done correctly, allowing floodwaters to spread across the floodplain would dissipate energy and water from flood events, and reduce the potential for structural damage downstream. In addition, water capture would recharge the water table As a consequence, it would also capture sediments as the water spread out over the floodplain. This may be problematic and if areas become filled with sediment, other areas would need to be constructed. Because of the variability associated with flood events, a pilot project is recommended to explore the feasibility of employing these techniques in the El Paso-Las Cruces Watershed.

Recent Restoration Efforts

Broad Canyon Ranch

Broad Canyon Ranch is located in the Seldon Canyon reach of the Rio Grande in the El Paso-Las Cruces Watershed. A loose consortium of partners including the World Wildlife Fund, The Trust for Public Lands, The Nature Conservancy, and New Mexico State Parks worked together to purchase the ranch in 2008. It was purchased for $1.65 million with a combination of state ,federal and private funds including $400,000 from the Doris Duke Charitable Foundation and the Nature Conservancy. The ranch is currently managed by New Mexico State Parks and consists of 783 acres with 1.5 river miles, and floodplain, wet meadow and open water habitat including a 30 acre wetland pond known locally as Swan Pond.

View of Broad Canyon Ranch from the uplands in 2006. The Rio Grande can be seen on the left, while Swan Pond is to the right. The grey area in between is standing dead salt cedar post treatment.

The Sierra Soil and Water Conservation District and the Jornada RC&D began work at Broad Canyon Ranch in 2004. This primarily involved removal of dense stands of salt cedar from the floodplain with both herbicide and mechanical treatment. Prior to final acquisition by New Mexico State Parks, a conceptual restoration plan began to be developed by a collaboration of stakeholders which included state and federal agencies and NGOs. In April 2009, a two day Wetland Review was conducted to discuss the vegetation, soil characteristics, water quality, and restoration approaches at the ranch. The outcome was a draft restoration plan with both short and long term goals. Work began implementing this plan in the winter of 2009-2010. Initial efforts focused on the removal of salt cedar from the floodplain by conducting a follow-up treatment on the 2004 efforts and expanding the area of restoration. This was followed by pole plantings of Rio Grande cottonwood, coyote willow, and Gooding's willow. Response was immediate and included passive recruitment of baltic rush, American cattail, and inland salt grass. Additional work included the installation of monitoring wells to monitor water quality and groundwater depth to provide an understanding of the shallow groundwater characteristics. This work is continuing to be conducted under a collaboration between New Mexico State Parks, the U.S. Fish and Wildlife Service, the Sierra Soil and Water Conservation District, the Jornada RC&D, the New Mexico Audubon Society, and the New Mexico Interstate Stream Commission.

Mesilla Valley Bosque State Park

Mesilla Valley Bosque state Park is New Mexico's newest state park and is located on the west bank of the Rio Grande within the town limits of Mesilla. The park consists of 307 acres with a combination of ownership including 13 acres owned by New Mexico State Parks, 100 acres within the floodway leased from the IBWC, 52 acres owned by the New Mexico Department of Game and Fish, and 142 acres under conservation easement from Harris Farms LLC.

Docent class examining recent sprouts of hardstem bulrush at Mesilla Valley Bosque State Park..

The park habitat varies from desert shrub upland to marshland and Rio Grande floodplain. Much of the park has a very shallow groundwater table which has led to a patch work of wet meadow habitat interspersed with non-native woodlands. In addition, there is an agricultural drain owned by the Elephant Butte Irrigation District that runs through the center of the park and provides water for a constructed marsh.

The park is currently undergoing a restoration effort funded by CWA 104(b)(3) monies which includes removal of salt cedar from over 30 acres, pole plantings of Rio Grande cottonwood, coyote willow, and Gooding's willow, ground treatments to encourage native wetland plant establishment, and development of a long range adaptive management plan to ensure project success and future development. In addition to these on-the-ground efforts, a docent training program was developed to train park volunteers on all aspects of the park including; historic Rio Grande floodplain conditions, the collaborative efforts to create and maintain the park, the importance of wetlands to desert ecosystems, elements of wetland restoration, identification of riparian and wetland vegetation and identification of avian wildlife dependent on riparian and wetland habitat that may be encountered at the park.

Seldon Drain Test Bed

The Seldom Drain Test Bed project is located in an agricultural drain owned by the Elephant Butte Irrigation District. The project was an experimental design with multiple goals of creating riparian habitat, mitigation of *E. coli* bacteria, improved flood protection, and capturing stormwater runoff. Funding was provided by the state of New Mexico legislative capital outlay funds through the River Ecosystem Restoration Initiative. The project was completed in 2009, and consists of widening the existing drain to include an overbank terrace, installation of flow control structures, and development of riparian habitat on the newly created terrace.

While initial vegetative establishment include weedy species such as kochia, Russian thistle and star nightshade, this was followed by establishment of cottonwood, coyote willow, wolfberry, and cattail. Bird counts are being conducted and the first count observed 21 species, including migratory waterfowl, and riparian neo-trpoical birds.

Mims Lake

Mims Lake is an oxbow lake adjacent to the western bank of the Rio Grande downstream of Elephant Butte Dam approximately two miles northeast of the town of Truth or Consequences. It comprises over 100 acres of open water and wetland habitat and is the single largest feature of its type between Elephant Butte Dam and the international boundary with Mexico. The lake and surrounding area is privately owned by two individuals and a development corporation. The Sierra Soil and Water Conservation District has conducted removal of dense stands of salt cedar in the past and conducted limited follow-up treatments and pole plantings were soil conditions were suitable. Soil conditions have restricted the success of the plantings, and efforts have also been constrained by inadequate funding. Future efforts should be aimed at obtaining adequate funding for the development of a restoration plan that includes an assessment of soil conditions, the potential for establishment of native plants, and an outreach and education component. All three major landowners and other interested local stakeholders should be invited to be involved in this process.

Side cove at Mims Lake.

Currently Planned Wetland Projects

La Mancha Wetlands

The La Mancha Wetland project is being developed by the SWEC in cooperation with the IBWC. The project will consist of a small excavated pond of sufficient depth to intercept ground water with permanent open water and shallow areas with emergent aquatic vegetation. The pond will be connected to the river through a gated open channel that will allow flow of water into the pond at river flows greater than 1,200 cfs, but maintain water within the pond as river flow drops. The concept is to create a side channel that holds permanent water, but has seasonal connection to the river. The goal of the project is to create habitat for native fish including gizzard shad, river carpsucker, blue catfish, longnose gar and flathead catfish. Longnose gar is currently not found in this reach of the river and the hope is to re-establish the species.

Sunland Park WWTP

A project to construct a wetland at the Sunland Park Wastewater Treatment Facility is in its exploratory development phase. The proposed wetland would polish the city's treated wastewater and provide wetland riparian habitat. Current tasks include; identifying available land resources, permit requirements, developing a set of alternative approaches, selecting appropriate design criteria, and assessing potential funding sources.

Additional Riparian and Wetland restoration Plans

The Rio Grande Riparian Ecological Corridor Project

The Rio Grande Riparian Ecological Corridor Project Comprehensive Plan: *A Rio Grande Renaissance Our River's History, Culture and Diversity* (2004). was produced by the City of Las Cruces with a Sustainable Challenge Grant from the U.S. Environmental Protection Agency and seeks to produce a comprehensive plan for development along an 11 mile stretch of the Rio Grande in the vicinity of Las Cruces. The goals are to: preserve, enhance and restore riparian and aquatic habitat, preserve farmland and open space adjacent to the Rio Grande, create a multi-use recreational trail system, promote ecotourism, and educate the public about the ecological, cultural, and historic importance of the Rio Grande Corridor.

A copy of *A Rio Grande Renaissance Our River's History, Culture and Diversity* (2004) can be obtained from the City of Las Cruces Community Development Department, 700 N Main St. Las Cruces, New Mexico, or by mail City of Las Cruces Community Development Department, PO Box 20000, Las Cruces, New Mexico 88004.

IBWC Conceptual Restoration Plan

The IBWC commissioned the U.S. army Corps of Engineers, Albuquerque District to produce a riparian restoration plan for the 105 mile reach of the Rio Grande from Percha Dam to American Dam in El Paso, Texas. The resulting document entitled *Conceptual Restoration Plan and Cumulative Effects Analysis, Rio Grande—Caballo Dam to American Dam, New Mexico and Texas* contained the restoration objective of "the partial improvement of degraded natural river functions and values".

Preliminary analysis involved an assessment of baseline conditions to include, geomorphology, hydrologic analysis, flow regime analysis, sediment continuity analysis, and ecological conditions. The baseline ecological condition analysis included functions of riparian and wetland vegetation, plant communities within the study area and relative habitat value. Selection criteria were then developed to provide a framework in which to identify potential restoration sites. The overarching criteria was to "meet the restoration objectives of enhancing ecological diversity, improving riparian and channel functionality, and expanding native habitat in a manner that does not jeopardize water delivery requirements and public safety." The resultant effort identified 30 sites with restoration potential which included prescriptions to remove native vegetation, planting native vegetation, bank shaving, floodplain excavation, floodplain area connections with small excavated channels, bank destabilization, construction of inset floodplains, flow augmentation from irrigation canals and drains, and reconfiguration of wasteways to enhance wetland areas.

The *Conceptual Restoration Plan and Cumulative Effects Analysis, Rio Grande—Caballo Dam to American Dam, New Mexico and Texas* can be found at http://www.ibwc.gov/EMD/Canalization-Webpage/RestPlanMarch2009.pdf.

THE COLLABORATIVE PROCESS

Successful development of wetlands in the El Paso-Las Cruces Watershed will require a collaborative process. This process is evident in several of the successful projects previously mentioned. Cooperation between the agencies in charge of water delivery, maintenance of the channel and distribution systems (EBID and IBWC), and the planners and facilitators of any restoration project, is essential along this reach of the Rio Grande. A critical step in wetland development will be to engage the EBID and IBWC and as many of the potential stakeholders as possible in the beginning of this process to open lines of communication and build an atmosphere of trust. The EBID in particular can provide invaluable knowledge of the distribution system, and of the possible legal, physical, and political constraints involved in developing wetlands in the El Paso-Las Cruces Watershed. Additional stakeholders include; the City of Las Cruces, Doña Ana County, the Doña Ana Soil and Water Conservation District, the Caballo Soil and Water Conservation District, the Mesilla Valley Audubon Society, the U.S. Bureau of Reclamation, U.S. Bureau of Land Management, and private citizens.

REFERENCES

Ackerly, N.W. 1992. *Irrigation Systems in the Mesilla valley: An Historical Overview.* Center for Anthro pological Research. New Mexico State University, Las Cruces, NM

Ackerley, N.W. 1999. *Paleohydrology of the Rio Grande: A first Approximation. In* Proceedings of the 44th Annual New Mexico Water Conference: The Rio Grande Compact: It's the Law!, ed. C.T.Ortega Klett, Las Cruces, NM New Mexico Water Resources Research Institute.

Bartlett, J.R. 1965. *Personal narrative of explorations and incidents in Texas, New Mexico, california, and Chihuahua connected with the United States and Mexican Boundary Commission during the years 1850, '51, '52, and '53.* Volume I. Chicago: Rio Grande Press.

Bieber, Ralph 1936. *Marching With the Army of the West, 1846-1848.* A.H. Clark Company, Glendale, CA.

Chronic, H. 1987. *Roadside Geology of New Mexico.* Mountain Press Publishing Co., Missoula MT.

Dinerstein, Eric, David Olson, Jennifer Atchley, Colby Loucks, Salvador Contreras-Balderas, Robin Abell, Eduardo Inigo, Ernesto Enkerlin, Christopher Williams, and Guillermo Castilleja, 2000. *Ecoregion-Based Conservation in the Chihuahuan Desert: A Biological Assessment.* World Wildlife Fund, Comision Nacional para el Conocimiento y Uso de la Biodiversidad, The Nature Conservancy, PRO NATURA Noreste, and the Instituto Tecnologico y de Estudios Superiores de Monterrey. October 2000.

Elmore, F., and J.R. Janish 1976. *Shrubs and Trees of the Southwest Uplands.* Southwest Parks and Monu ments Association, Tucson, AZ.

Fullerton, William, David Batts, and Tetra Tech, Inc., 2003. *A Framework for a Restoration Vision for the Rio Grande: Hope for a Living River.* The Alliance for Rio Grande Heritage (ARGH) and World Wildlife Fund (WWF). May 2003.

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

Kelly, P. 1986. River of Lost Dreams: Navigation of the Rio Grande. University of Nebraska Press, Nin coln, NE.

King J.P. and J. Maitland, 2003. *Water for River Restoration: Potential for Collaboration between Agricultural and Environmental Water Users in the Rio Grande Project Area.* World Wildlife Fund Chihuahuan Desert Program. July, 2003

New Mexico Environment Department. 2000. *Wetlands Conservation Plan.* New Mexico Environment Department, Surface Water Quality Bureau, Santa Fe, NM.

Stotz, N.G., 2000. *Historic Reconstruction of the Ecology of the Rio Grande/Rio Bravo Channel and Floodplain in the Chihuahuan Desert.* A Report Prepared for the World wildlife Fund Chihuahuan Desert Program.

Terracon, John Shoemaker and Associates, Inc., Livingston Associates, LLC, Inc., Zia Engineering and Environmental Inc., and Sites Southwest, 2004. *The New Mexico Lower Rio Grande Regional Water Plan.*

Untied States Census Bureau, 2009 (http://quickfacts.census.gov/qfd/states/35/35013.html).

USGS, 1997. National Water Summary on Wetland Resources. (http://water.usgs.gov/nwsum/WSP2425/state_highlights_summary.html).

USACE, USBOR, NMISE, 2007. Final Environmental Impact Statement Upper Rio Grande Basin Water Operations Review, 2007. (http://www.spa.usace.army.mil/urgwops/finaleis.asp).