


Water Issues Facing the Pecos Basin of Texas

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Introduction

The Pecos River flows through one of the most arid regions of Texas and has historically been an important water resource for the area's inhabitants. Prior to Anglo-American settlement, the river was much wider, deeper and faster-flowing than the trickle of a stream that it typically is today. Settlement of the basin by Anglo-Americans in the early 1800s and settlers' subsequent actions have intensified water supply and quality challenges faced in the region. Managing water supplies in the Pecos watershed is difficult at best and must adjust for limited rainfall in most years, recurring droughts, occasional flash floods, extreme levels of salinity that impair both surface and ground waters and excessive water consumption by saltcedar and other nuisance brush species.

The Pecos River rises out of the Sangre de Cristo Mountains near Santa Fe, New Mexico and flows south through New Mexico until it enters Texas east of the 104th meridian. The river then winds its way southward 418 miles through Texas and encompasses all or part of 17 Texas counties within its watershed and joins with the Rio Grande just above Lake Amistad. The Pecos River, the largest tributary entering the Rio Grande from the United States, is responsible for approximately 11 percent of the flow from the Rio Grande entering Lake Amistad and about 29 percent of the salt load. The Pecos Basin marks the southwestern boundary of the Great Plains and the northeastern fringe of the Chihuahuan Desert. The region's elevation ranges from almost 9,000 feet on the western boundary of the basin in the Davis Mountains to 2,700 feet above sea level near Red Bluff Reservoir and declines to 1,050 feet above sea level near the confluence of the Pecos River and the Rio Grande.

Average annual rainfall in the basin ranges between 10 and 18 inches, but can vary drastically. Flash floods and droughts are a common occurrence in the area; 17 major droughts have been recorded since 1863, including the drought of record that stretched throughout most of the 1950s, while seven major floods have been recorded since 1904. In addition to the Pecos River, other sources of water in the basin include substantial fresh and saline groundwater resources, more than 50 major springs (some have since ceased to flow) and at least five major creeks, as well as numerous smaller tributaries.

Changes in the Water Resources of the Pecos Basin

Archaeological evidence shows that humans have lived in the Pecos Basin for thousands of years, relying heavily on the river for irrigation and drinking water needs. Native Americans who lived in the lower Pecos Basin include members of the Jumano, Pecos, Pueblo, Comanche, Apache, Pawnee, Kickapoo, Kiowa and Shawnee tribes. The Pueblo Indians are the first known settlers of the basin and arrived around A.D. 800, but other peoples are believed to have inhabited the area earlier than them. When the Spanish explorer Antonio de Espejo traveled through what is now Pecos County in the 1500s, he found that Native Americans near San Solomon Springs were using irrigation to grow beans, and other crops.
The first Europeans who traveled through the Pecos Basin region include the Spanish explorer Álvar Núñez Cabeza de Vaca (1530), Francisco Vázquez de Coronado (1540), Fray Augustín Rodríguez (1580) and Antonio de Espejo (1583). De Vaca was so impressed with the size and flow of the Pecos he referred to it as the "great river." Coronado recorded seeing agricultural irrigation systems near where the town of Pecos is presently located. European settlers founded their first settlement in 1636 at San Miguel del Bado in the upper Pecos valley.

When Anglo-American settlers arrived in the mid-1800s, reports suggest the river was up to 100 feet wide, 10 feet deep and exhibited a fast current with only a few places suitable for crossing. Settlers made several attempts to develop the Pecos River, its tributaries, springs and groundwater resources for irrigation. From 1887 to 1914, 10 major irrigation projects were proposed in Pecos, Ward, Reeves, Loving and Crane counties. Most of these attempts were short-lived due to water rights issues and/or problems associated with a lack of water and occasional flooding. From 1914 to 1938, irrigated acreage varied from a low of 14,794 acres in 1934 to a high of 37,493 acres in 1924.

Talks began in 1905 about building a dam near the Texas-New Mexico border to store water for irrigation. In 1934, construction of the Red Bluff Dam finally commenced with seven Texas irrigation districts and the federal Public Works Administration financing the effort. The dam was design to store up to 307,000 acre-feet of water but often suffers from a lack of inflows and significant water losses due to evaporation. Since 1959, more than 1.6 million acre-feet have been released from Red Bluff. Average annual releases from the dam are about 46,000 acre-feet.

After the completion of Red Bluff Dam in 1939 through 1959, farmers irrigated as many as 242,000 acres per year. A maximum of 35,189 acre-feet of surface water was used for irrigation purposes in 1958; groundwater provided the remainder of irrigation waters used. This increase in irrigated farm lands resulted from the completion of Red Bluff Dam and from the development and expansion of widespread groundwater pumping throughout the basin.

From the 1960s until present day, annual irrigated acreage peaked at more than 223,578 acres in 1964, declined to a low of roughly 70,000 acres in 1989 and now totals more than 73,171 acres. Several experts hope that irrigation can make a slight comeback in the Pecos Basin now that New Mexico is providing regular flows to Red Bluff.

Numerous crops flourished in the Pecos Basin because of the expanded irrigation. Pecos cantaloupes, cotton, alfalfa, grapes, forage crops and other vegetables were, and to some extent still are, the primary cash crops grown by farmers in the basin.

Data about groundwater pumping and surface water-use to support agricultural irrigation in the Pecos Basin are only available since 1958. Groundwater use peaked at 777,785 acre-feet in 1964, stayed above 500,000 acre-feet until 1974, and currently is estimated at 176,541 acre-feet. The declining groundwater levels at some sites and the associated costs to pump groundwater from greater depths have caused a decline in groundwater

pumping. Before large-scale irrigation projects were developed in the basin, groundwater inflows to the Pecos River averaged roughly 30,000 acre-feet per year. As many as 50 flowing springs were present in the basin in the mid-1800s and contributed groundwater to the river. Their presence led many people to begin drilling water wells in Pecos and Culberson counties in the 1840s. To date, groundwater pumping and other factors have resulted in less than 10 springs continuing to flow in the region.

Water Resources Challenges Facing the Pecos River of Texas

Major challenges facing the Pecos Basin of Texas include salt loadings that increase the salinity of the Pecos River; the spread of non-native saltcedars that consume significant amounts of water; inefficient irrigation systems and a general lack of water that is often not sufficient to support irrigation or other uses. These problems have persisted for many years and have only been intensified by human influences.

Salinity and Water Quality

Much of the Pecos Basin's salinity stems from natural sources that are remnants of the shallow Permian Sea that once covered the area. When the sea receded thousands of years ago, saline mineral deposits were left in soils and rock formations. Groundwater that is stored in or travels through these geologic salt deposits is largely responsible for drastic increases in salinity within relatively short reaches of the river. Malaga Bend and the stretch just upstream from Girvin have been identified as key areas for saline groundwater intrusion. As a result, salinity levels can be as high as 6,000 milligrams per liter (mg/l) at Red Bluff Dam and 12,000 mg/l near Girvin. Salinity in the Pecos is higher than the 1,000 mg/l safe drinking water standard and is partially causing salinity levels in Amistad Reservoir to approach this maximum drinking water standard.

Saltcedar

Saltcedar trees, introduced to the Pecos Basin of Texas by the U.S. Department of Agriculture in the early 1900s to stabilize streambanks and prevent erosion, have grown out of control and spread from Red Bluff Dam to the confluence of the Pecos River with the Rio Grande. Texas Agricultural Experiment Station studies suggest that up to 2 acre-feet of water can be salvaged by removing one acre of saltcedar. In addition to consuming large volumes of water, saltcedar also worsens water quality. Saltcedars deposit salts below the tree canopy that are excreted through and retained within its leaves. Infestations of saltcedar can also lead to increased erosion and sediment production because understory vegetation is extremely limited in most locations. These effects combine to destroy the valuable riparian grazing and wildlife habitat along all infested waterways greatly affecting both ranchers and ecotourism.

Inadequate Water Supplies

According to Water for Texas 2007, the regionally-based statewide water plan crafted by the Texas Water Development Board, projected water use in the Pecos Basin of Texas (Region F) will total roughly 807,453 acre-feet in 2010 and is expected to reach 825,581 acre-feet by the year 2060. Irrigation accounts for approximately 72 percent of the water demand in 2010. If additional water supplies are not developed and extensive conservation is not implemented, the region will be unable to meet all the water needs for irrigation.

Water for Texas estimates that about 30 percent of the total water needs for irrigation (more than 167,000 acre-feet) may not be met in the region by 2060 unless water is used more efficiently. The implication is that current agricultural irrigation practices may be significantly affected unless more water is found, water is managed more effectively, or other changes in water use are made. Fortunately, Water for Texas suggests that the region could save more than 72,250 acre-feet of water annually through improved water conservation and irrigation management practices by 2060.

Pecos River, before and after saltcedar control

Management Approaches to Address Water Resources Issues Facing Basin

Overall Water Resources Management

In the early days, individuals' or irrigation districts' main philosophy toward river management was to get one's own water first and to not worry about downstream users. Organized irrigation companies began operation in the 1860s with the Comanche Springs Irrigation Company being one of the first. Numerous irrigation projects were started with high hopes of irrigating large tracts of land, but most of these projects never supplied water to the majority of the expected acreage and some companies collapsed before they were started. Legislation passed down by the state of Texas in 1875 and 1889 encouraged the construction and expansion of canals for irrigation and navigation purposes, but did not address management strategies for the river.

Numerous conflicts between Texas and New Mexico have occurred over the use and management of the river's water. In 1948, the Pecos River Compact Commission was established to ensure that Texas and New Mexico work collaboratively to manage the water resources of the basin. The compact commission's main function is to ensure the volume of water flowing to Texas is adequate to meet the terms of the Compact and to meet planned water use. Conflict has continued despite this agreement. In a 1987 lawsuit before the U.S. Supreme Court, New Mexico was ordered to pay Texas $14 million in damages resulting from insufficient water deliveries and to send an agreed amount of water to Texas.

Current Management Efforts

The Pecos Basin Assessment Program is now working with several agencies, organizations and stakeholders in the Pecos Basin to develop a watershed protection plan for the basin. The goal of this effort is to develop a comprehensive management plan to improve water quality and quantity in the river basin. Agency partners collaborating in this effort include the U.S. Environmental Protection Agency, Texas State Soil and Water Conservation Board (TSSWCB), Texas Cooperative Extension, the Experiment Station, Texas Water Resources Institute (TWRI), International Boundary and Water Commission (IBWC), Texas Commission on Environmental Quality (TCEQ) and Texas Clean Rivers Program. The Texas Nature Conservancy and other environmental organizations are also collaborating with this program.

IBWC, TCEQ's Clean Rivers Program, the Texas Parks and Wildlife Department, and the U. S. Geological Survey are conducting ongoing programs to monitor the water quality and biology of the Pecos River. Monitoring aquatic species present in the Pecos River will provide insight for assessing the effects of point and nonpoint sources of pollution such as nutrient enrichment, salinity and sedimentation. This information can also be used to develop plans to protect threatened and endangered species in the region and to increase the diversity of aquatic species in the Pecos River.

The Texas Nature Conservancy is working with private landowners to acquire, protect and manage critical habitat in the lower reach of the Pecos River near its confluence with Independence Creek. Efforts include removing saltcedar to increase flows, improving wildlife habitat and implementing education projects.

Pesticide spray to remove saltcedar

Salinity and Water Quality

The compact commission has supported efforts to reduce salt loadings to the Pecos River by supporting programs to mine and recover sites at Malaga Bend in southern New Mexico. Malaga Bend is a major input of salt loadings to the Pecos River and water quality in the river may be improved if salts can be removed from this area.


Saltcedar invades Pecos river banks

The Experiment Station, as part of the Pecos Basin Assessment Program, is identifying and locating specific sources of highly saline water that flow to the Pecos River, including saline groundwater formations. Sites are being studied from Red Bluff Dam south to Fort Stockton. Once the sources of saline loadings are identified, researchers can use this information to develop targeted strategies to prevent saline waters from entering the Pecos River.

TCEQ continuously monitors water quality at two sites in the Upper Pecos River. Parameters for which data are gathered include chlorides, sulfates and dissolved solids. Periodic water quality samples are also collected by TCEQ and its partners through the Clean Rivers Program.

Managing Saltcedar

The U.S. Bureau of Reclamation manages the Pecos River Basin Water Salvage Project, which has cleared more than 53,000 acres of saltcedar from riparian areas along the Pecos River in Texas and New Mexico. The USDA Natural Resources Conservation Service now offers 75 percent cost-sharing to landowners who want to remove saltcedar from their properties in the Pecos Basin through the Environmental Quality Incentive Program (EQIP). In addition, TSSWCB offers an additional 25 percent cost-sharing program to landowners to help pay for costs not covered using EQIP funds.

Extension and the Experiment Station are carrying out several research studies and demonstration projects to determine the volume of water saltcedars consume, the effects of clearing saltcedar on the hydrology of

the watershed and the effectiveness of various methods to clear nuisance brush populations. Aerial application of a chemical known as imazapyr by helicopters has proven quite effective in killing large areas of saltcedar quickly and at a relatively low cost as compared to other conventional treatment methods. To date, over 12,000 acres of saltcedar have been treated through this project. The Experiment Station is also using digital maps to develop a clearer picture of the spread of saltcedar, to map areas where saltcedar has been sprayed and to identify specific sites where targeted clearing programs can be most successful in the future.

USDA's Agricultural Research Service is working with scientists from the Experiment Station and Extension to investigate whether biological controls such as insects that feed only upon saltcedar can provide an ecological method to control this brush species. *Diorhabda elongata* is the species of beetle that is currently being tested in the basin.

Inadequate Water Supplies

As part of the Pecos Basin Assessment Project, Extension specialists are gathering historic and current data on agricultural water use and cropping patterns. They will create computer simulation models that simulate how various crop mixes respond to waters with varying levels of salinity and how increased water supplies from brush clearing and other measures may affect the overall agricultural economy of the region. This information can be used to identify opportunities for water savings regarding water resources, irrigation management and crop selection and to identify which uses of water represent the most economically sound management strategies for the region. Research is on-going at the Pecos sub-station to discover alternative crops and cropping methods which better tolerate salinity and improve water use efficiency.

Extension, TWRI and other groups are meeting with stakeholders to determine if non-conventional sources of water might be developed to address future shortages. Some strategies being considered include increased use of rainwater harvesting, treatment and use of saline groundwater and oilfield-produced water and wastewater reuse.

Concluding Remarks

The Pecos Basin of Texas is faced with several water resources challenges including water quality concerns and water supply shortages. By working with stakeholders and carrying out research and demonstration projects in association with agency partners and the private sector, the Pecos Basin Assessment Program is developing a watershed management plan that will provide a guide for how the limited waters of this region can be preserved, protected and used most effectively.

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EPA
United States Environmental Protection Agency