
Watershed Protection Plan Development for the Pecos River

TSSWCB Project #04-11

Final Report

August 2009

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Partners

Texas AgriLife Extension

Texas AgriLife Research

U.S. Section of the International Boundary and Water Commission

Texas Water Resources Institute



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Executive Summary

The Pecos River watershed has always been faced with its fair share of water quantity and quality issues. This river flows through one of the driest portions of our country and is a vital source of water for this area's inhabitants. Combined with limited rainfall, human influences have modified the nature of the river and its watershed over time. This combination of factors have led to changes in both water quantity and quality and prompted the need for the development of a plan to restore water quality in the river and watershed alike.

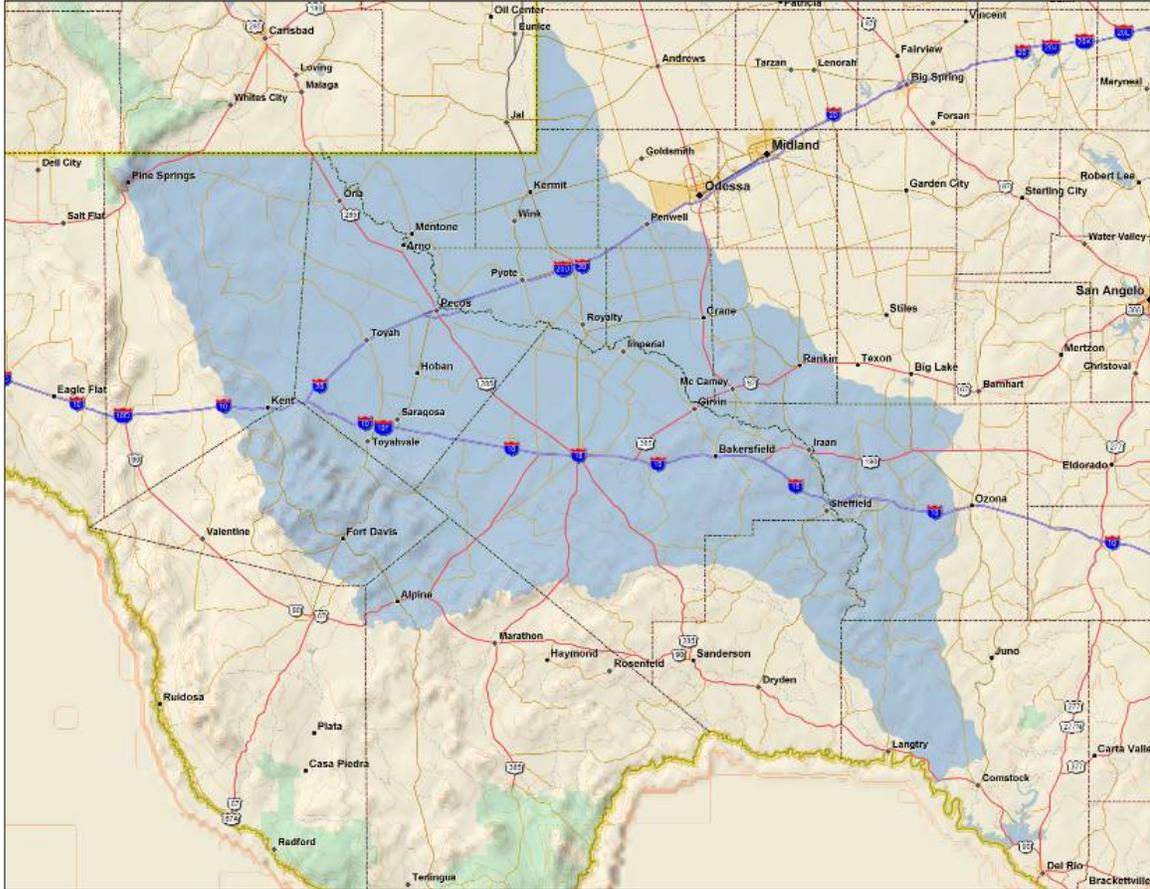
The *Watershed Protection Plan Development for the Pecos River* project was developed and funded in 2004 with three main goals in mind. The primary goal for the project was to conduct a large-scale watershed assessment that provided a 'state of the watershed' overview and identified water quality concerns while identifying their sources. The second goal was to increase the involvement of watershed landowners in better managing their watershed through increased educational programming. The final goal of the project was to combine the findings of the watershed assessment with input from landowners engaged in the educational process and develop a comprehensive watershed protection plan that follows EPA's nine key elements for a successful watershed plan.

The Pecos River Basin Assessment Project is now completed, as all project subtasks have been accomplished. The development, consistency review, publication and distribution of the "Watershed Protection Plan for the Pecos River in Texas" is the culmination of the project. This has served as a crucial first step in restoring the water quality of the Pecos

Throughout the course of the project, many tasks were accomplished. Technical reports were published by Texas Water Resources Institute (TWRI) for each subtask dealing with technical, environmental subject matter and are attached as appendices at the end of the document. Reports include information detailing water quality and quantity issues in the Pecos River Basin such as salinity sources and saltcedar water use, and an economic analysis of local economic effects resulting from decreased salinity levels in the river. In addition, educational materials were published dealing with the historical aspect of human interaction with the Pecos. All project documents and publications are available at the project website: <http://pecosbasin.tamu.edu>

A broad coalition of cooperation and support has been fostered throughout the watershed protection plan (WPP) development process. Many landowners attended numerous public meetings facilitated by project personnel and contributed valuable comments and insight into the development of the WPP. This resulted in the production of a WPP that has been largely endorsed by watershed landowners. The WPP was submitted to the United States Environmental Protection Agency (EPA) for their consistency review in November 2008 and the consistency review letter was received in April 2009. Two proposals were submitted to the Texas State Soil and Water Conservation Board (TSSWCB) for funding through their Clean Water Act Section 319(h) Nonpoint Source Grant Program which is funded by EPA to implement voluntary watershed management measures and enhance

water quality monitoring throughout the watershed. These projects were funded and will begin the implementation process.



Pecos River Basin of Texas

Introduction

The Pecos River is a greatly depleted western river winding 418 miles through hot, dry, semi-arid landscapes in Texas. It is the largest river flowing into the Rio Grande River in Texas. However, flow in the once great Pecos River has dwindled to a mere trickle as a result of many natural and human causes. The river's upper reaches in Texas now resemble a poor quality creek rather than a river.

Due to the lowered water quality and stream flows, the aquatic community of the Pecos River has been drastically altered according to fishery biologists and local users of the river. No longer does it support the healthy and diverse community of aquatic plants, invertebrates, microorganisms, fish and amphibians that it once maintained; however, isolated areas of the watershed still contain pristine habitat that supports rare aquatic life. Diversity in aquatic life has been negatively affected by changes in river hydrology, riparian community destruction, oil and gas activities, irrigation demands, long and short-term droughts, damming of the river and the desertification of the upland watershed due to over-grazing and extended drought. These factors have allowed invasive plant species, such as saltcedar, to dominate the riparian systems within the watershed.

According to work conducted by Miyamoto et al. (2006), Pecos River flow accounts for 9.5 percent of the total inflow into Lake Amistad and 26 percent of the total salt loading. Salinity in Amistad exceeded 1000 ppm for one month in 1988, and has fluctuated since. This disproportional salt and flow contribution coming from the Pecos River intensifies the need to control this salt load so that salinity levels in the lake can be kept below the 1000 ppm drinking water standard.

Deteriorating water quality in the Pecos River has negatively affected the Rio Grande River by limiting the usability of the river's water and escalating costs to treat water back to a useable level. The Rio Grande is heavily relied upon by both Mexico and the United States as a source of potable, irrigation, recreational and industrial waters downstream from its confluence with the Pecos River. As a result, downstream users of the Rio Grande's waters depend heavily upon flow from the Pecos River to bolster the available supplies downstream. The Pecos River itself is also the lifeblood of many communities within its reaches, providing irrigation water, recreation, and recharge for underlying aquifers. The environmental condition of both the Pecos River and the lower Rio Grande River is crucial to hundreds of thousands of residents of both Mexico and the United States.

This project assessed the physical features of the Pecos River basin, facilitated communications with landowners and other groups in all counties within the watershed, and monitored water quality of the Pecos River. Through this project a WPP has been developed to outline a suite of management measures that, if voluntarily implemented, will improve water quality in the watershed. The plan also highlights areas where further work is needed to better understand certain water quality issues and their sources.

Task 1

Basin Assessment

Subtask 1.1 Aerial Photography, Delineation, and Characterization

Investigator:

Dr. Charles Hart and Dr. Zhuping Sheng

Aerial imagery of the Pecos River from Grandfalls to the confluence of the Pecos River and Rio Grande was captured and processed under contract by Aerial Imagery Services. Using these images, acreage infested with saltcedar was delineated in ArcView. The images differentiate between different densities of saltcedar, treated versus untreated saltcedar, and invasive versus non-invasive vegetation (i.e. saltcedar, mesquite and other native species) within the Pecos Basin of Texas. Remote sensing was used to identify the various characteristics of stream channel locations, saltcedar over-growth and treatment areas and land use. Various maps of Pecos Basin attributes were also created in ArcView using data downloaded from online environmental data sources including the wetland locations in the upper portion of the watershed presented in Figure 1.

Two technical reports were produced as a result of this subtask. As described in Technical Report (TR) 306 (Appendix 1), *Use of Satellite Remote Sensing in Monitoring Saltcedar Control along the Lower Pecos River, USA*, satellite imagery was used as a tool for evaluating the impacts of herbicide treatments on saltcedar and establishing mortality rates for treated areas. TR 300 (Appendix 2), *Geographical Information System Coverage for Characterization of the Pecos River Basin*, describes the GIS the coverage that was developed through this project for the Pecos River. This information was used to develop a baseline assessment of the river's characteristics; especially vegetation in the riparian corridor.

Publications / Reports

Villalobos J., Z. Sheng, C. Hart. 2007. *Geographical Information System Coverage for Characterization of the Pecos River Basin*. Texas Water Resources Institute. TR-300.

Nagihara S., C. Hart. 2007. *Use of Satellite Remote Sensing in Monitoring Saltcedar Control along the Lower Pecos River, USA*. Texas Water Resources Institute. TR-306.

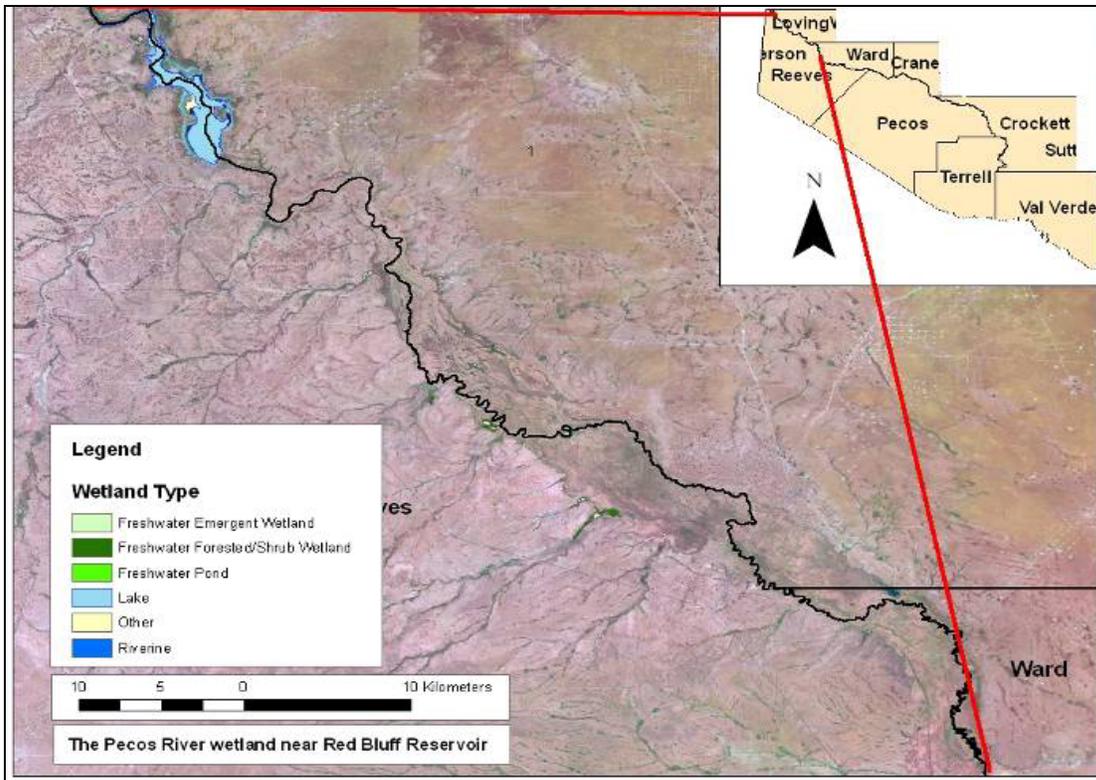


Figure 1. Aerial image of wetlands near Red Bluff Reservoir

Subtask 1.2 Historical Water Quality, Irrigation Delivery, Rainfall, Red Bluff Lake Levels, and Groundwater Monitoring

Investigator: Mike Mecke

Background documents providing current and historical information about the Pecos River Basin were collected and compiled. Basin maps as well and many of the background documents collected have been posted onto the project website in the links section (<http://pecosbasin.tamu.edu/links.php>) and include the following documents:

- Texas Commission on Environmental Quality (TCEQ) Fisheries Report
- United States Geological Survey (USGS) biological data on rare and threatened species of the Rio Grande River border region
- Texas Water Development Board (TWDB) groundwater quality and hydrogeology reports
- TWDB Irrigation surveys
- United States Bureau of Reclamation data on Balmorhea Springs
- TCEQ list of impaired waters

- Texas Parks and Wildlife Department (TPWD) natural resources evaluation report
- USGS stream gage data and information on the Pecos River alluvial aquifer
- TWDB maps and cross-sections of the Pecos River alluvial aquifer
- Draft Far West Regional Water Plan (TWDB)
- TCEQ water rights information for the Pecos River in Texas
- United States Bureau of Reclamation reports about irrigation systems in Balmorhea, Texas, and Carlsbad, New Mexico
- Economic issues associated with preserving habitat for the Silvery Minnow in the Pecos River system (United States Fish and Wildlife Service)
- AQUATOX model training
- United States Department of Agriculture (USDA) irrigation data from 1899
- United States Department of Agriculture Agricultural Research Service (USDA-ARS) Riparian Buffer Effectiveness field tool and model
- TPWD information on vegetation, birds, desert spring fishes, golden algae, prairie dogs, and waterways analysis
- EPA Watershed Training Module
- EPA Watershed Handbook
- Pecos River Compact Strategic Plan

Subtask 1.3 Aquatic Life and Habitat Inventory

Investigator: Wayne Belzer

The USGS was hired as a sub-contractor to conduct an aquatic life and habitat survey of the Pecos River from Independence Creek south to its confluence with the Rio Grande. The USIBWC and TCEQ coordinated and conducted a duplicate survey on the Upper Pecos River above Independence Creek. Data and biological samples from both studies were lab tested and analyzed by the TCEQ. Resulting data includes aquatic habitat and species inventories (Table 1) at seven sampling sites between Red Bluff Reservoir and the confluence of the Pecos River and Rio Grande in Texas. These data and results are published in the subtask technical report.

The study concluded that the upper portions of the Pecos River have been influenced by irregular flows and high salinity values that have suppressed aquatic diversity and species richness. With the introduction of freshwater and regular flows in the Lower Pecos, biological indicators improve even though the habitat does not improve. Previous studies in the river show that little change has occurred over the past 20 years with some degradation in the biological diversity occurring in the upper portion of the Pecos River.

Results from this subtask are presented in greater detail in TR 305 (Appendix 3). This report includes a summary of findings from previous biological surveys conducted in the Pecos. An explanation of sampling, sampling methodology, results from each site and a

brief conclusion are presented along with each sites individual aquatic life and habitate score sheets.

Publications / Reports

Belzer W. 2007. *Aquatic Life and Habitat Inventory Assessment*. Texas Water Resources Institute. TR-305.

Table 1. Biological Index Values by Sample Site (from subtask 1.3 technical report TR-305)

	Pecos River at Orla	Pecos River at Coyanosa	Pecos River at Girvin	Pecos River at Sheffield	Pecos River at Chandler Ranch	Pecos River at Independence Creek	Pecos River at Pandale
Habitat Index	15 – Intermediate	18 – Intermediate	16.5 – Intermediate	22 – High	20 – High	16 – Intermediate	18 - Intermediate
Fish Index	20 – limited	22 – Limited	20 – Limited	18 – Limited	16 – Limited	20 – Limited	30 – Limited to High
Benthic Index Statewide IBI	15 – Limited	25 – Limited	18 – Limited	20 – Limited	25 – Intermediate	38 – Exceptional	31 – High
Benthic Index Chihuahuan IBI	9 – Limited	19 – Limited	19 – Limited	18 – Limited	22 – High	26 – Exceptional	28 – Exceptional
Average Conductivity (mg/L)	11,400	12,230	21,219	12,166	5,096	3,201	2,388

Subtask 1.4 Identify and Characterize the Volume and Quality of Tributaries and Springs

Investigator: Wayne Belzer

The absence of measurable water quantities in Pecos River tributaries precluded the majority of monitoring activities planned as part of this subtask. The subtask technical report (TR-302) (Appendix 4) was based primarily on historical information and sediment samples collected at various tributaries including; Salt Draw, Toyah Creek, Coyanosa Draw, Barilla Draw and Hackberry Draw.

Results of the sediment analyses showed that none of the tributaries possess high concentrations of surface salt, suggesting they have little affect on the salt loading in the Pecos River during high rain events. Toyah Creek did exhibit high sulfate content in the soil and as a result may possess a slight possibility for adversely affecting water quality during a storm event. Any impact would be short lived as it would be purely driven by storm flow. The report suggests that subsurface flow from Salt Draw and Toyah Creek may be contributing salts to the Pecos River in its upper portion of Texas. Routine monitoring data collected on the lower Pecos River, Independence Creek, and in Amistad

Lake show that perennial streams and springs introduce freshwater in these reaches thereby reducing salt concentrations prior to the Pecos River entering Amistad Lake.

Publications / Reports

Belzer W., C. Hart. 2007. *Identifying and Characterizing the Volume and Quality of Tributaries and Springs*. Texas Water Resources Institute. TR- 302.

Subtask 1.5 Identify and Characterize Saline Water Sources Entering the Pecos River

Investigator: Dr. Seiichi Miyamoto

Extensive work went into this subtask as elevated salinity is one of the most pressing water quality issues facing the Pecos. Salt is a naturally occurring phenomenon in the Pecos watershed as it was once covered by the Permian Sea and is now home to substantial amounts of Permian evaporates (Figure 2) left behind eons ago. This task began with a literature review that summarizes prior salinity characterization work done on the Pecos and was supplemented by analyzing additional sets of water quality samples from the Pecos River at nine locations. Texas Clean Rivers Program (CRP) data was analyzed, and assessments suggested that there is a considerable inflow of salts into the Pecos River downstream of the city of Pecos.

USGS data relating to flows and salinity from 11 major gauging stations along the Pecos River basin were analyzed. Results indicate that dissolution of evaporites from the Permian age is the major source of salt in the river. The analyses also suggest that most of the salt loadings into the Pecos River in Texas occur upstream of Red Bluff Reservoir in New Mexico. Finally, the analysis suggests that high flow events in the Pecos River still occur often enough to ensure that excessive levels of salinity are not found along riverbanks of the region.

This work culminated in the development of three technical reports that discuss the river's hydrology, water balance, known sources of salts in the basin, areas where additional evaluation is needed to identify the sources of salts and salinity control options.

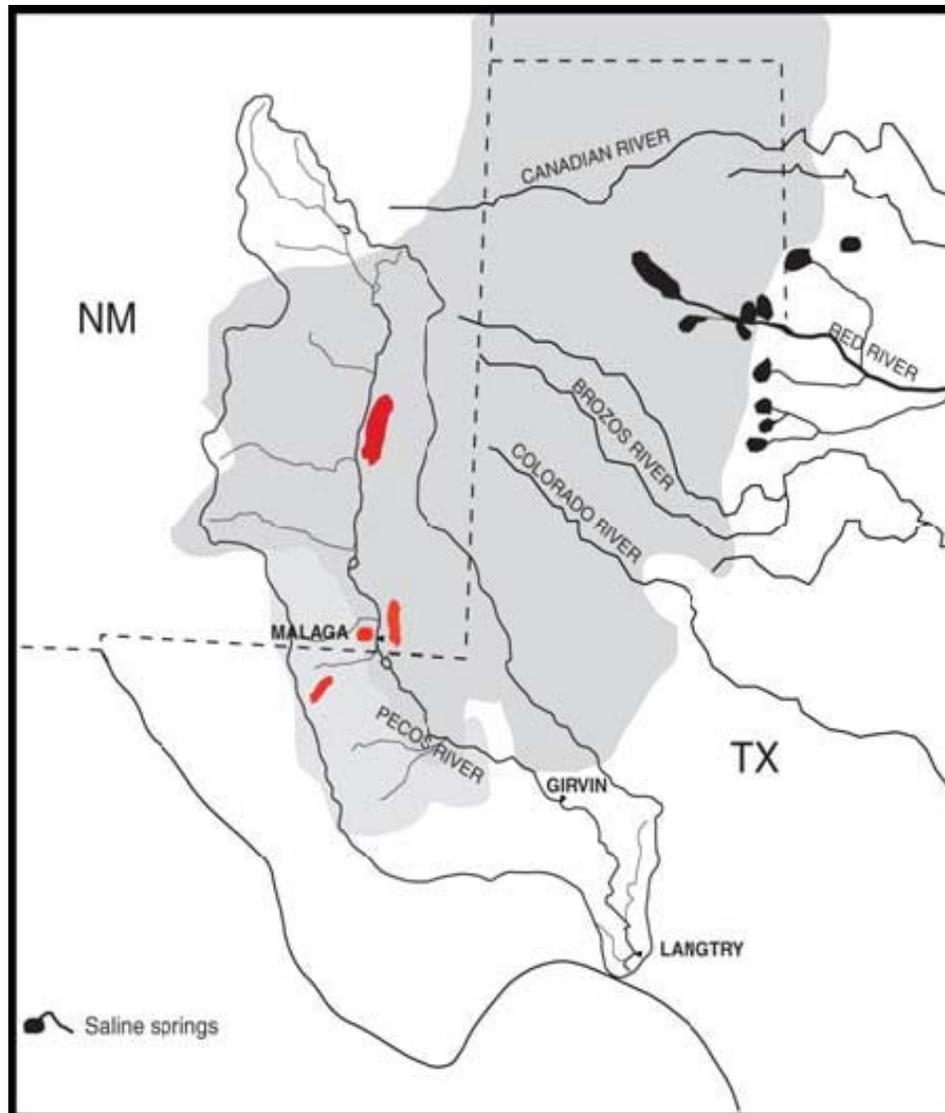


Figure 2. Permian evaporites in the Pecos River watershed (red denotes evaporites located in the Pecos watershed)

TR 291, *Reconnaissance Survey of Salt Sources and Loading Into the Pecos River*, describes large-scale sources of salt, estimates salt loadings from various reaches of the river and develops a “water and salt balance” that summarizes the impacts of salinity on the Pecos (Appendix 5). The second report, TR 298 is entitled *Water Balance, Salt Loading, and Salinity Control Options of Red Bluff Reservoir, Texas* and discusses the different factors influencing Red Bluff Reservoir and explores management options for the lake that have potential to alleviate the impacts of salts in the lake and downstream as well (Appendix 6). The last technical report developed focuses on the middle portion of the Pecos River; from Malaga New Mexico to Girvin, Texas. This report is entitled *Hydrology, Salinity, and Salinity Control Possibilities of the Middle Pecos River: A Reconnaissance Report (TR 315)* discusses spatial and temporal changes in salinity throughout the river and estimates the influences of these sources of salts, how much each source contributes and potential management strategies for each (Appendix 7).

Despite the extensive efforts undertaken by this task, much is left to be discovered and understood. Prior to implementing practices to address salinity loading in many of these reaches, extra work will be needed to verify the source of salts as well as to conduct feasibility studies for selected management scenarios.

Publications / Reports

Miyamoto S., F. Yuan, S. Anand. 2005. *Reconnaissance Survey of Salt Sources and Loading Into the Pecos River*. Texas Water Resources Institute. TR-291.

Miyamoto S., F. Yuan, S. Anand. 2007. *Water Balance, Salt Loading, and Salinity Control Options of Red Bluff Reservoir, Texas*. Texas Water Resources Institute. TR-298.

Miyamoto S., S. Anand, W. Hatler. 2008. *Hydrology, Salinity, and Salinity Control Possibilities of the Middle Pecos River: A Reconnaissance Report*. Texas Water Resources Institute. TR-315.

Subtask 1.6 Simulate Flow and Salinity of the Pecos River for Evaluating River Management Options

Investigator: Dr. Seiichi Miyamoto

Salinity levels in the International Amistad Reservoir are of great concern for millions of people downstream who utilize this resource as irrigation and potable water. The Pecos, being one of the saltiest western rivers in the U.S. is a major source of salt contribution to the reservoir. This task was carried out as a means to evaluate the influences of Pecos derived salts on the overall salinity of the International Amistad Reservoir. In evaluating these effects, the flow and salinity of the Pecos River was simulated and evaluated utilizing background data on groundwater conditions, rainfall, evaporation, and vegetative conditions. The task final report (TR-292) explores the sources of salinity entering the Pecos and provides insight into their relative contributions as compared to other sources (Appendix 8). Additional work related to this subtask included the completion of a reservoir simulation model of Red Bluff Reservoir, streamflow and salt routing simulation using the ROTO model, and completion of riparian zone simulations.

Publications / Reports

Miyamoto S., F. Yuan, S. Anand. 2006. *Influence of Tributaries on Salinity of Amistad International Reservoir*. Texas Water Resources Institute. TR-292.

Subtask 1.7 Economic Modeling of the Pecos River Basin and Assessment of Saltcedar Control Activities

Investigator: Bill Thompson

The original objective of Subtask 1.7 was to measure the economic impact of *Tamarix* spp. (saltcedar) control along the Texas portion of the Pecos River. As work progressed on other project tasks, the scope of the economic analysis evolved to evaluate the expected economic impacts of potential salinity control measures on the Pecos River above Red Bluff Reservoir.

Irrigation storage and delivery data from the Red Bluff Water Power Control District (RBWPCD) was analyzed and the 2005 water delivery volume was used as a representative level of available irrigation water. Estimates of current cropping patterns for the irrigated lands within the 7 sub-districts of the RBWPCD were established. Data collected from the Carlsbad Irrigation District of New Mexico were reviewed to establish two estimated alternative cropping patterns under a reduced salinity environment. The differences in the value of farm production between the baseline scenario and the two alternative cropping patterns were entered into an economic model for the six county upper Pecos River basin. Results from this effort are included in the subtask technical report (TR-348), listed below and available at the project website (Appendix 9). In their simplest terms, economic gains can be realized by implementing salinity control measures as long as their costs are less than their benefits.

Publications / Reports

Thompson, B. *Economic Impacts of Salinity Control Measures for the Upper Pecos River Basin of Texas*. Texas Water Resources Institute. TR-348.

Task 2

Educational Programming

Subtask 2.1 Publish Written Informational Materials to Educate Private Landowners, Stakeholders, and Policy Makers about the Pecos River basin and the Effects of Saltcedar

Investigator: Texas AgriLife Extension Service

A brochure that represents an overview of the project was developed in an initial effort to notify the public of the project and provide general information regarding activities and goals. A total of 2,000 copies of the brochure (Appendix 10) were printed and many were distributed throughout the basin. A one-page project summary was also developed in the early stages of the project for use as a handout in initial contacts with the public in the watershed (Appendix 11).

Oral interviews were conducted onsite with several residents of the region to gain their perspectives on how prior conditions in the Pecos River basin have changed over time. These interviews were used to develop a historical document that presents information about how water use and water quality in the basin have evolved since the beginning of Anglo-American settlement in the 1800s; the document is titled “The Influence of Human activities on the Waters of the Pecos Basin of Texas: A Brief Overview” and was printed as TWRI Scientific Report (SR) 2006-03 and distributed at meetings in the watershed (Appendix 13). In addition, a complementary condensed version of this document titled “Water Issues Facing the Pecos Basin of Texas” (Appendix 12) was drafted and printed.

A letter and a one-page project publication were drafted during year 2007 and sent to landowners and other interested parties. These documents outlined upcoming project activities and proposed management measures to be included in the first draft of the WPP, and were mailed to approximately 1,000 recipients throughout the Pecos River Basin in Texas. A WPP information packet containing a power point presentation and frequently asked questions (FAQ) list was sent to all County Ag Extension Agents in the Pecos Basin. A letter announcing the public release of the WPP and the WPP FAQ were also sent to the same list of landowners and other interested parties in the Pecos Basin.

As part of the widespread information and WPP distribution effort, articles appeared periodically in local newspapers and statewide agricultural news outlets announcing project updates and the public release of the WPP.

Publications / Reports

Hart, C., R. Jensen, W. Hatler, M. Mecke. *Water Issues Facing the Pecos Basin of Texas*. Abbreviated version of SR-2006-03.

Jensen, R., W. Hatler, M. Mecke, C. Hart. 2006. *The Influence of Human Activities on the Water of the Pecos Basin of Texas: A Brief Overview*. Special Report-2006-03. Texas Water Resources Institute publication.

News Releases / Media Publications

Byrns, S. 2005. *New Study to Focus on Pecos River*. Press release to Pecos Basin newspapers and statewide agricultural news outlets.

Byrns, S. 2006. *Public Feedback Sought at Pecos River Meetings*. Press release to Pecos Basin newspapers and statewide agricultural news outlets.

Byrns, S. 2007. *2nd Public Comment Period Set for Pecos River Watershed Protection Plan*. Press release to Pecos Basin newspapers and statewide agricultural news outlets.

Byrns, S. 2007. *More Input Needed on Pecos River Watershed Protection Plan*. Press release to Pecos Basin newspapers and statewide agricultural news outlets.

Byrns, S. 2008. *Pecos River Watershed Protection Plan's Second Public Comment Period Ends*. Press release to Pecos Basin newspapers and statewide agricultural news outlets.

Byrns, S. 2008. *Pecos River Watershed Protection Plan Readies for Third Round of Public Review*. Press release to Pecos Basin newspapers and statewide agricultural news outlets.

Mecke, M. 2005. *Pecos River Struggles: The Health of the Rio Grande River Basin*. Ranch and Rural Living, April 2005 edition.

TWRI. 2007. *Saving a Dwindling River*. tx: H20; a publication of the Texas Water Resources Institute. Spring 2007 edition.

All Project Publications Are Available On The Project Website

<http://pecosbasin.tamu.edu/publications.php>

Subtask 2.2 Educational Meetings of Interested Parties for Input and Organizational Support

Investigator: Texas AgriLife Extension Service

A large number of meetings at which project activities were discussed were held or attended by project personnel. These meetings may be categorized as informational, skill level, discovery, or public comment. In addition, a Web-based survey was developed to gather stakeholder perceptions of water resources challenges in the Pecos River basin. Postcards were mailed to 565 landowners along the Pecos River, newspaper articles were published, and a radio interview was conducted to encourage participation in the survey. A paper copy of the survey was also sent to county officials located in the basin. The survey results were posted on the project website and are included in the WPP.



Public meeting in the Pecos River watershed

Informational Meetings – The objective of these meetings was to inform landowners, operators and other interested parties about conditions within the Pecos Basin and provide an overall summary of project goals.

- Two Nature Conservancy meetings at the Independence Creek Preserve
- The CRP annual meeting in Midland, Texas
- Monthly Pecos River Advisory Committee meetings in Monahans, Texas
- Big Bend Native Plant Society meeting in Fort Davis, Texas
- Texas Riparian Association meeting in Fort Davis, Texas
- The 2005, 2006 & 2007 Rio Grande Basin Initiatives Conference

- Pecos County Ag Day in Fort Stockton; over 200 brochures were handed out
- Crockett Soil and Water Conservation District (SWCD) board meeting in Ozona, Texas
- Pecos River historical conference at the River Systems Institute in San Marcos, Texas

Skill Level Meetings – The objective of these meetings was to provide landowners/managers with new skills or acquaint them with new technologies regarding watershed management.

- Land management workshops were held in Rankin, Monahans and Ozona, Texas
- Rangeland Watershed Monitoring Workshop in Odessa, Texas

Discovery Meetings – The objective of these meetings was to solicit input from landowners, operators, local policy makers and other interested parties regarding the development of the WPP.

- Pecos River Basin County Officials meeting in Fort Stockton, Texas
- Loving County Courthouse in Mentone, Texas - 2006
- Community Center in Imperial, Texas - 2006
- Community Center in Iraan, Texas - 2006
- Independence Creek Nature Preserve near Sheffield, Texas

Public Comment Meetings – The objective of these meetings was to present the WPP and allow interested parties to comment and propose edits on its contents.

- Loving County Courthouse in Mentone, Texas - 2007
- Community Center in Pecos, Texas - 2007
- Community Center in Imperial, Texas – 2007
- Civic Center in Iraan, Texas – 2007
- Dink Wardlaw Ag Complex in Del Rio, Texas – 2007
- Crockett SWCD in Ozona, Texas
- Devil’s River SWCD in Del Rio, Texas
- Rio Grande – Pecos River SWCD in Sanderson, Texas
- Sandhills SWCD in Odessa, Texas
- Trans-Pecos SWCD in Fort Stockton, Texas
- Upper Pecos SWCD in Pecos, Texas
- Community Center in Pecos, Texas – 2008
- Community Center in Imperial, Texas – 2008
- Community Center in Iraan, Texas – 2008
- Texas AgriLife Extension Crockett County office in Ozona, Texas – 2008
- Dink Wardlaw Ag Complex in Del Rio, Texas – 2008
- Community Center in Pecos, Texas – 2009
- Community Center in Imperial, Texas – 2009
- Community Center in Iraan, Texas – 2009
- Texas AgriLife Extension Crockett County office in Ozona, Texas – 2009

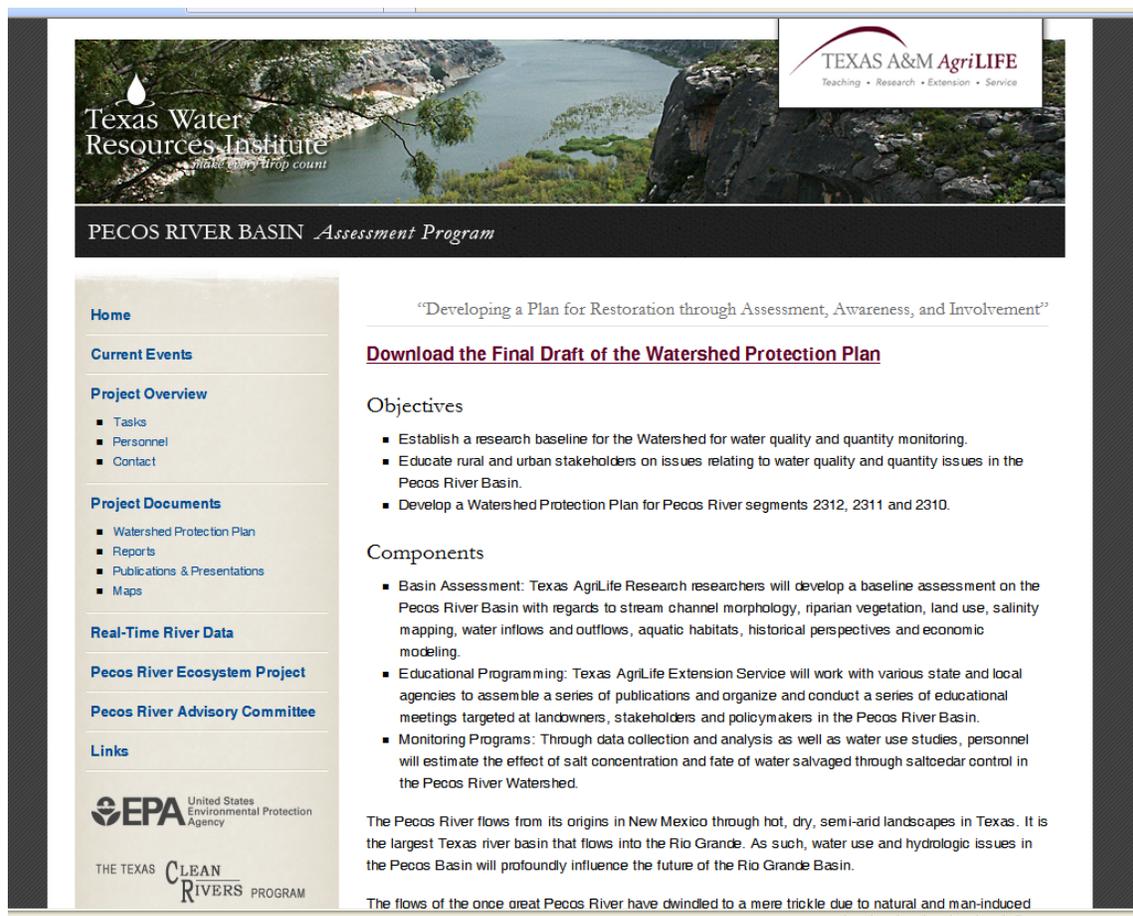
Subtask 2.3 Develop a Website for Dissemination of Information

Investigators: Texas AgriLife Extension Service
Texas Water Resources Institute

Accomplishments

The project website, <http://pecosbasin.tamu.edu>, was developed, continually maintained and updated throughout the course of the project. The website features a Current Events page where ongoing news and events related to the Pecos River are posted, links to downloadable real-time Pecos River monitoring stations, downloadable versions of the WPP, and a link to submit WPP comments online. The website also includes a user-friendly version of the project workplan, project documents, biographical sketches of project leaders, and links to related information. All project reports, publications and activities are also posted on the website.

Since tracking began in 2007, a total of 14,098 unique users have visited 48,325 pages on the project website.



Screen shot of Pecos River Basin Assessment Program website

Task 3

Establish a Monitoring Program

Subtask 3.1 Develop a QAPP for Sampling Protocol

Investigators: Wayne Belzer and Kevin Wagner

A Quality Assurance Project Plan (QAPP) was developed in year 1 for subtasks 1.3, 1.4, 1.6 and 3.3. The QAPP outlined protocols that would be followed for collection, transportation and laboratory analyses of collected field samples. The document also described computerized models to be used in the project and detailed the procedures to be followed regarding data storage and backup.

Subtask 3.2 Water Quality Monitoring, including Total Dissolved Solids (TDS), Total Suspended Solids, Potential Hydrogen (pH), Dissolved Oxygen (DO), and Electrical Conductivity (EC)

Investigator: Wayne Belzer

Routine water quality samples have been, and continue to be collected at established locations along the Pecos River as part of the CRP, which is administered by the TCEQ and the USIBWC. These data were used for analyses conducted under other subtasks of this project and may be downloaded by following the corresponding links at the project website.

Subtask 3.3 Quantity and Fate of Water Salvage as a Result of Saltcedar Control

Investigators: Dr. Charles Hart, Dr. Zhuping Sheng,
Alyson McDonald

A demonstration site on the Pecos River with shallow groundwater wells containing pressure transducer data loggers was established and maintained. The purpose of this demonstration was to estimate water loss on a one-mile reach of river infested with saltcedar, as compared with an adjacent one-mile reach where saltcedar was chemically treated. Thirteen additional boreholes were excavated and sampled; three of which were used to monitor the piezometric surface of the underlying groundwater. The wells and

boreholes were also used to estimate the fate of salvaged water resulting from chemical saltcedar control.

Well profile data were collected from bore holes in an effort to determine the hydraulic properties of shallow aquifers. Profiles from 2 sites were verified and finalized as well. Water level monitoring data was assessed to determine the relationship between surface water and groundwater and was also analyzed using statistical methods. Land surface and groundwater surface profile data, as well as water quality data were evaluated and interpreted. The Bouwer and Rice method was used to analyze slug test data and calculate saturated hydraulic conductivity, and groundwater surface profile data was evaluated and interpreted. Combined, these analyses illustrated the influences of saltcedar on water availability in shallow aquifers adjacent to the Pecos River. TR 304 summarizes the findings of this task and is presented as Appendix 14.

A presentation on monitoring data was made at the American Geophysical Union Conference in San Francisco, CA in December of 2005. Another presentation on this topic was also presented at the Rio Grande Basin Initiative Annual Conference, March 29, 2006. A paper discussing this subtask was also presented at the International Conference on Hydrological Sciences for Managing Water Resources in the Asian Developing World June 8 – 10 in China.

Publications / Reports

Sheng, Z., A. McDonald, C. Hart, W. Hatler, J. Villalobos. 2007. *The Fate of the Water Salvaged through Saltcedar Control on the Pecos River: Surface Water and Groundwater Interaction*. Texas Water Resources Institute. TR-304.

Note: Publications below are not project deliverables although they are germane to the project

Hart, C., L. White, A. McDonald, Z. Sheng. 2005. *Saltcedar Control and Water Salvage on the Pecos River, Texas, 1999-2003*. Journal of Environmental Management 75:399-409.

Hatler, W. 2008. *Water Loss and Potential Salvage in Saltcedar (Tamarix spp.) Stands on the Pecos River in Texas*. M.S. thesis. Tarleton State University, Stephenville, TX. 93 p.

Hatler, W., C. Hart. 2009. *Water Loss and Salvage in Saltcedar (Tamarix spp.) Stands on the Pecos River, Texas*. Invasive Plant Science and Management 2:309-317.

Task 4

Watershed Protection Plan

Subtask 4.1 Develop Annual Reports and a Final Report Summarizing Basin Assessment, Educational Programming, and Monitoring

Investigator: Texas AgriLife Extension Service
Texas Water Resources Institute

Accomplishments

Three annual reports were completed summarizing all project activities in 2005-2007. In addition, this project final report provides a narrative synopsis of activities that occurred throughout the duration of the project. The annual report for 2008 was omitted as the project was slated to conclude in 2007. Delays in WPP development, review and approval have prompted the extension of the project through March 2010; however, annual reports were not developed during these years. These reports are available for download at the project website and are presented in this report as Appendices 15, 16 and 17.

Publications / Reports

Annual reports available online at: <http://pecosbasin.tamu.edu/assessment-program>

Subtask 4.2 Produce the Final Watershed Protection Plan for the Pecos River Segments 2312, 2311, and 2310

Investigator: Texas AgriLife Extension Service
Texas Water Resources Institute

The *Watershed Protection Plan for the Pecos River in Texas* was developed based on project subtask findings and public comments received throughout the course of this project in accordance with EPA's nine elements of watershed protection planning. Several series of public meetings held throughout the watershed were conducted in 2007 and 2008 to discuss the WPP and receive further public comment. These comments and suggestions were incorporated into the WPP resulting in two printed revisions of the document. The final draft was submitted to TSSWCB and EPA for consistency review in November 2008 and the consistency review letter was received in April 2009. The WPP was printed in August 2009 and distributed to the public in December 2009. The WPP distributed to local landowners is presented in this report as Appendix 18. The document includes a detailed plan for addressing overall water quality and quantity, and biological

diversity. Two implementation projects are now underway to begin implementing portions of the WPP that will help restore water quality.

Water quality/quantity issues identified for the Pecos include elevated salinity levels, suppressed dissolved oxygen (DO) concentrations, elevated sediment loading potential, excessive golden algae blooms, decreased flow and concerns for elevated nutrient levels. Each of these issues is inherently complex and is exacerbated by the fact that each individual issue directly affects the other. For example, the Pecos River between the approximate locations of Pecos and Girvin is listed on the *Texas Water Quality Inventory and 303(d) List* as being impaired for suppressed DO levels. Of the five issues besides suppressed DO listed above, four of them directly affect in-stream DO levels. Increasing salinity decreases the oxygen saturation potential for water, increased sediment loading increases the sediment oxygen demand, decreased flow reduces the turbulence of a stream and leads to higher water temperatures and elevated nutrients can cause excessive plant growth and subsequent organic material. Although DO is the only true impairment in the Pecos River, it was not the primary focus of this WPP. The WPP was developed as a project to assess the overall health of the watershed and pay special attention to salinity levels and saltcedar infestations. The DO impairment did not arise until the *2008 303(d) List* was released in the summer of 2008 after project work, exclusive of finalizing the WPP and continue to engage watershed landowners, was complete.

As a result, some suggestions on ways to restore DO levels were mentioned in the WPP, but the primary recommendation was that further assessment be conducted on the causes and sources of the DO impairment prior to implementing attempted management measures. In addition to this, the WPP discusses many management measures that will improve water quality and watershed health when implemented. Saltcedar and upland brush control are addressed in the WPP as being a suitable management measure to increase biodiversity and reduce water losses due to evapotranspiration. Water Quality Management Plans will be used as the primary tool to implement land management practices near riparian areas. The complete WPP is presented in this report as Appendix 18.

Publications / Reports

TWRI, AgriLife Extension. 2008. *A Watershed Protection Plan for the Pecos River in Texas*. <http://pecosbasin.tamu.edu/media/1923/PecosRiverWPP.pdf>



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