

# **Pecos River Basin Assessment Program**

*Annual Report*  
*December 2005*



# Pecos River Basin Assessment Program

## Annual Report

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Partners  
Texas Cooperative Extension  
Texas Agricultural Experiment Station  
International Boundary and Water Commission Clean Rivers Program  
Texas Water Resources Institute



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# Executive Summary

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The project has achieved significant progress during its first year. Task one, basin assessment, is nearing completion in some subtasks while others are ongoing or have not yet begun. Aerial photography has been captured and put to use, and saline water sources entering the Pecos River have been largely characterized and documented. A large number of historical documents and references concerning the river have been, and will continue to be collected. River flow and economic modeling are currently under way, as well as characterization of tributaries and springs entering the river. Salinity modeling efforts are also ongoing, with assessments of Amistad and Red Bluff Reservoirs nearing completion. The majority of work on aquatic life and habitat inventories is scheduled to begin in 2006. Educational programming has accounted for a large portion of project activity during year one. Informational materials and news stories have been published to increase public awareness of the project and Pecos River issues. The project has also been presented to stakeholders and water resources professionals at a number of meetings. Valuable feedback from stakeholders has been received through meetings and survey responses, and will be used to guide future programming. The project Web site has been developed, and will serve as an outlet for project information and updates. Water quality monitoring of the river by International Boundary and Water Commission (IBWC), in cooperation with the Texas Commission on Environmental Quality (TCEQ) Clean Rivers Program, is ongoing and will continue throughout the duration of the project. Routine water samples have been collected at designated stations along the river, and significant progress has been made towards determining the quantity and fate of water salvage due to saltcedar control. The first year of activity has provided enough information to begin constructing a skeleton of a Watershed Protection Plan for the Pecos River in Texas, which is the overall goal of this project.



# Introduction

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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 in Texas. However, flow in the once great Pecos River has dwindled to a mere trickle due to many causes – both natural and man-induced. Its upper reaches in Texas now resemble a very 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 to local users of the river. No longer does it have a healthy diverse community of aquatic plants, invertebrates, microorganisms, fish and amphibians. The greatly reduced aquatic diversity 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 grazing mismanagement. These factors have allowed introduced plant species, such as saltcedar, to dominate the riparian systems within the watershed.

According to IBWC data, the Pecos River flows account for 11 percent of the stream inflow into Lake Amistad and 29.5 percent of the total salt loading. Salinity in Amistad exceeded 1,000 ppm for a month in 1988, and has fluctuated since. It is important to control salt loading from the Pecos River to the Rio Grande if we are to be successful in keeping salinity of the reservoir below 1,000 ppm.

The decreasing water quality in the Pecos River has negatively affected the Rio Grande. Being an international river, the Rio Grande is relied upon by both Mexico and the United States as a source of water for drinking, irrigation, and industry and as such, it depends heavily upon its major Texas tributary – the Pecos River. 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 is extremely crucial to hundreds of thousands of residents of both Mexico and the U.S.

This project assesses the physical features of the Pecos River basin, facilitates communications with stakeholder groups and landowners in eight neighboring counties, and monitors the water quality of the Pecos River. Through this project a Watershed Protection Plan will be developed to assess current management measures as well as determine what future management measures need to be implemented in the river basin to protect the water quality of the Pecos River.

# Task 1

## Basin Assessment

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### Subtask 1.1 Aerial Photography, Delineation, and Characterization

Investigator:  
Dr. Charles Hart

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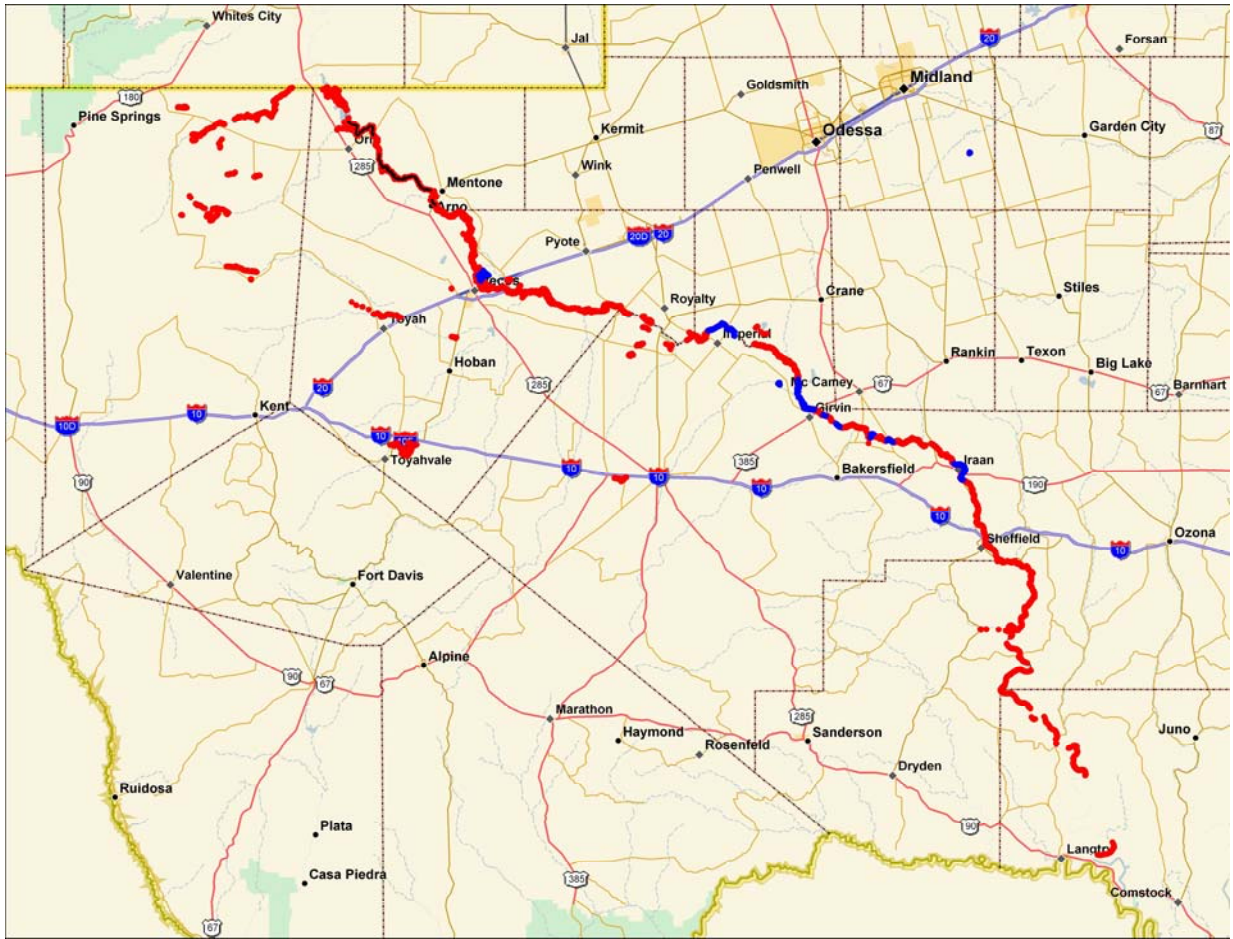
Aerial imagery of the Pecos River from Grandfalls to the confluence of the Pecos River and Rio Grande (214 river miles) was captured and processed under contract by Aerial Imagery Services. Using these images, the amount of acreage infested with saltcedar was delineated in ArcView. The images also differentiate between different densities of saltcedar.

At the end of 2005, a total of 13,497 acres of saltcedar had been treated along the Pecos River and selected tributaries (see following page). Saltcedar acreages were overlaid on existing coverages to determine the area of saltcedar-infested acreage that had not been treated with herbicides through 2005. The analyses show that 1,137 acres of saltcedar have not been treated to date.

The purchased imagery was copied and supplied to task leaders. The aerial photographs were used to delineate watersheds throughout the Pecos River basin, and to identify tributaries that will be sampled in this study. A map of the Pecos River basin from its source waters to its confluence with the Rio Grande is being developed.



*Pecos River Aerial Imagery (Saltcedar in red)*



*Saltcedar sprayed highlighted in red*

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

Investigator: Mike Mecke

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Work on this subtask has focused on (1) obtaining background documents that provide historical information about the Pecos River basin and (2) developing a database.

Most of the background documents collected have been posted to the project Web site in the links section (<http://pecosbasin.tamu.edu/links.php>).

Background documents collected to date include the following:

- TCEQ Fisheries Report
- United States Geological Survey (USGS) biological data on rare and threatened species of the Rio Grande 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)

Most importantly, a historical database of rainfall data, USGS stream discharge data, water quality data and Red Bluff Reservoir release and delivery data has been compiled in Excel format.

### Subtask 1.3 Aquatic Life and Habitat Inventory

Investigator: Wayne Belzer

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Project leaders have discussed the details of this task with collaborators from the TCEQ and the USGS.

Inventories of aquatic life, and riparian and terrestrial habitats are scheduled to begin on the upper reach of the Pecos River in 2006. This will coincide with an analogous assessment being done on the lower end of the river by the USGS. The majority of funding for this subtask is being provided by the Clean Rivers Program administered by TCEQ.



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

Investigator: Wayne Belzer

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Potential tributaries for study were identified using aerial photography and digital topographic maps.

Texas Cooperative Extension and International Boundary and Water Commission personnel met to discuss potential sampling methodologies. A tentative plan of action was established.

Historical flow and water quality data regarding Pecos River tributaries was studied. The list of sampling sites was refined according to their potential for contributing measurable salts to the river.

Sediment samples were collected at these locations and sent to a laboratory for analysis.

Funding and direction for this subtask are being shared with the International Boundary and Water Commission Clean Rivers Program.

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

Investigator: Dr. Seiichi Miyamoto

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A literature review was completed, and a list of references was developed and distributed to project leaders. This list has also been posted to the project Web site.

Three sets of water quality samples were collected from the Pecos River at nine locations and sent to a laboratory for analysis. Lab analyses were funded by the Rio Grande Basin Initiative.

Texas Clean Rivers Program data was analyzed, and preliminary assessments suggest that there is a considerable inflow of salts into the Pecos River downstream of the city of Pecos.

United States Geological Survey data relating to flows and salinity from 11 major gauging stations along the Pecos River basin was analyzed. Results indicate the dissolution of evaporates 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.

The analyses are described in a draft report, “Reconnaissance Survey of Salt Sources and Loading into the Pecos River,” which will be submitted by TAES to the TSSWCB upon completion.

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

Investigator: Dr. Seiichi Miyamoto

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The research team has analyzed flow and salinity data from the Pecos River and compared this information to salinity levels in Amistad International Reservoir. A draft report, “Influence of Tributaries on the Salinity of Amistad International Reservoir,” has been developed and is currently being reviewed.

Efforts have been made to implement computer modeling activities, including collecting background data about groundwater conditions, rainfall, evaporation, and vegetative conditions. The project will also model the salinity of the Pecos River, and will calibrate and validate modeling results.



*Researchers collecting water samples to test for salinity levels*

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

Investigator: Bill Thompson

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Data for irrigated and dryland crop production budgets were collected.

Production budgets for dryland cotton, furrow-irrigated cotton, pivot-irrigated cotton and alfalfa, drip-irrigated cotton and pecans, and flood-irrigated pecans and alfalfa have been developed.

Historical data about agricultural water use in irrigation districts in the basin was collected.

Information was obtained from onsite visits to three irrigation districts downstream of Red Bluff Dam. The irrigation data will be compared to historical data on the amounts of water released from Red Bluff.



*Pecos River*

## Task 2

### Educational Programming

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#### 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 Cooperative Extension

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An article about the Pecos River basin project titled “Pecos River Struggles” was published in the April 2005 issue of *Ranch and Rural Living Magazine*.

Oral interviews were conducted onsite with several residents of the region to gain their understanding of how conditions in the Pecos River basin have changed over time. These interviews will be used to develop a fact sheet 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 fact sheet will describe:

- Water conditions in the region before Anglo-American settlement;
- The evolution of farming, irrigation and ranching in the basin, and the impacts of these activities on water use;
- Current water use trends; and
- The future outlook for water resources and water use in the basin.

A brochure that presents an overview of the project was developed by staff from Texas Cooperative Extension and Texas Water Resources Institute. A total of 2,000 copies of the brochure were printed and this publication is being distributed throughout the basin.

Project leaders cooperated in the development of a news story that was published in four newspapers throughout the basin – *The Ozona Stockman*, *The Fort Stockton Pioneer*, *The Terrell County News Leader*, and *The Pecos Enterprise*. The article provided general information about the project and asked readers to participate in an online survey.

All Project Publications Are Available On The Project Web site  
<http://pecosbasin.tamu.edu/publications.php>

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

Investigator: Texas Cooperative Extension

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The Pecos River Advisory Committee fills the role of stakeholder involvement for the upper Pecos River basin. Plans are under way for holding stakeholder meetings on the lower end of the river. The meetings listed to date can be categorized as follows, per the descriptions listed in the workplan:

**Informational Meetings** – Project personnel presented the project to interested groups at the following events:

- Two Nature Conservancy meetings at the Independence Creek Preserve
- The Texas Clean Rivers Program annual meeting in Midland, Texas
- The Rio Grande Basin Initiatives Conference in Alpine, Texas
- Monthly Pecos River Advisory Committee meetings in Monahans, Texas
- Local radio station interview in Pecos, Texas

**Skill Level Meetings** – The project hosted several Texas Cooperative Extension workshops for ranchers and landowners in Rankin, Monahans, and Ozona.

**Discovery Meetings** – The project hosted a Pecos River Basin County Officials Meeting in Fort Stockton, Texas. County officials and stakeholders throughout the basin were invited to attend this meeting with the goal of getting input and fostering local governmental support for Pecos River projects currently in progress. Attendees were presented a synopsis of all projects, and then asked for their opinions on several issues related to the Pecos River. The questions and resulting answers were as follows:



## **Pecos River Stakeholder Meeting Questions and Answers**

(1) How does the health of the Pecos River affect counties within its basin?

- Economy of the area
- Fish and Wildlife
- Recreation
- Mosquitos
- Adjacent counties
- Quality of water going south
- Water quantity
- Economic development
- Tax base
- Public access

(2) What are practical goals that the project could strive for?

- Future municipal uses
- Community pride
- Fresh water trees
- Agriculture – promoting smaller operations
- Grasses and vegetation
- Education
- Livestock

(3) What obstacles must be overcome for complete restoration of the Pecos River?

- Money – funding
- Salinity
- Lack of communication
- Need inter-governmental agreements
- Time
- Lack of population density
- Lack of cooperation of landowners
- Political power
- Lack of public education
- Personal opinions
- Lack of common goals
- Lack of clear vision
- Lack of public involvement

(4) How can county governments become involved and assist the project, and how can the project improve communications?

- Include the Pecos River in county budget allocations
- Increase public access for county recreation
- Include in regional water plans
- More community involvement from the state down south
- Political clout comes from a unified voice
- Pursue county governments coming together
- Pursuing economic and environmental issues
- Show public benefit
- Private landowners becoming more involved

Offices and organizations in attendance were:

- Pecos County Judge
- Pecos County Commissioner
- Congressman Henry Bonilla representative
- Senator Madla representative
- Pecos River Compact Commissioner
- City of Fort Stockton
- City of Grandfalls
- Pecos County WID #2
- Upper Pecos SWCD #213
- Ward County WID #2
- Reeves County WID #2
- Pecos Valley RC&D
- Red Bluff Reservoir
- Texas Department of Agriculture
- Texas Forest Service
- Texas Cooperative Extension
- Texas Agricultural Experiment Station

A Web-based survey was also 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 has been completed and the results are posted on the Web site.

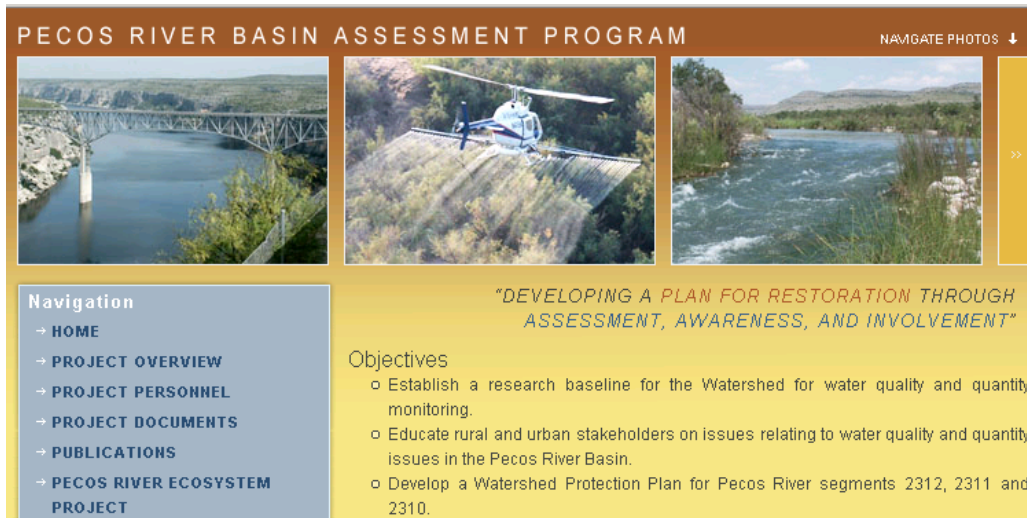
### Landowner Survey Responses

County	No. of Responses
Crane	9
Crockett	6
Culberson	3
Loving	6
Pecos	16
Reeves	6
Terrell	6
Upton	1
Ward	15
Val Verde	9
None	1
<b>Total</b>	<b>51</b>
<b>County Officials</b>	<b>6</b>

### Subtask 2.3 Develop a Web site for Dissemination of Information

Investigators: Texas Cooperative Extension  
Texas Water Resources Institute

The project Web site, <http://pecosbasin.tamu.edu>, has been developed. It includes a user-friendly version of the project work plan, project documents, biographical sketches of project leaders, and links to related information. Ongoing activities and project updates are posted to the Web site.



## Task 3

### Monitoring Program

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#### Subtask 3.1 Develop a QAPP for Sampling Protocol

Investigators: Wayne Belzer and Kevin Wagner

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A draft of the QAPP covering subtasks 1.4, 1.6, and 3.3 has been developed and is in the review process. The final version will be submitted to the Texas State Soil and Water Conservation Board and the Environmental Protection Agency for approval.

A separate QAPP drafted by International Boundary and Water Commission personnel has been approved by the Texas Commission on Environmental Quality. This will cover Clean Rivers Program work being done on subtasks 1.3 and 3.2.

#### 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

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Routine water quality samples are collected at established locations along the Pecos River as part of the International Boundary and Water Commission Clean Rivers Program.

Initial data analysis has been completed as described in subtasks 1.5 and 1.6 of this report.



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

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

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**Enhancement of field monitoring networks** - A study site on the Pecos River with shallow groundwater wells containing pressure transducer data loggers was maintained. The purpose of this study is to estimate water loss on a one-mile reach of river infested with saltcedar, as compared with an adjacent one-mile reach where saltcedar has been chemically treated. Thirteen additional boreholes have been excavated and sampled. Three of the boreholes are being used to monitor the piezometric surface. Six additional monitoring wells were installed.

**Development of profiles of test sites** - Land surface and piezometric surface measurements were made in January, March and August 2005, and preliminary analyses of these data have been conducted. Two staff gauges were installed for river level measurements and as reference points for profiling. Water quality (TDS, EC, pH and Temperature) was measured in monitoring wells and the Pecos River in January and August 2005. Additional profile data were collected to provide information needed for a better understanding of temporal and spatial variations of interaction between surface water and groundwater.

**Measurement of river flows and water quality** - In March 2005, flow measurements were conducted using a release of water from Red Bluff Reservoir. The research team had planned on measuring the flow of the river during the third quarter. However, the flows of the river have been unusually swift (between 200 and 400 cubic feet per second or cfs), while the equipment and field conditions can only allow us measure at low flow rates (55 cfs or less). Similarly, conditions in the river basin have not allowed the sampling of water quality in boreholes to be carried out. The best conditions to conduct borehole tests are those in which the river is rapidly rising or falling and that has not been the case at the field sites used in this part of the study.

**Test of permeability of soils** - Preliminary measurements of hydraulic conductivity of soils collected from the test sites were performed at the Texas Agricultural Experiment Station laboratory in El Paso. Additional soil permeability tests have been initiated.

**Analysis of water level monitoring data** - Water level monitoring data provide more detailed information about the direction of groundwater flow. The piezometric surface monitoring data will also provide insights about how flows in the river are correlated to groundwater flows in the alluvial aquifer and floodplain. Conventional correlation between the river level and groundwater levels in monitoring boreholes were conducted for data collected for April through July. Water levels in the monitoring wells next to the river reflect well the stress of the river. Time lags were identified, which varied with stresses in the river and its distance from the river. Time series analysis of the monitoring data is in progress. It is anticipated that a better relationship between the river and borehole water levels shall be established.



*Collecting water levels and water quality data from a monitoring well*



*River flow measurement using sonic FlowTrac*



*River flow measurement at Pecos River study site*

## Task 4

### Watershed Protection Plan

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The Watershed Coordinator attended EPA's "Watershed Partnerships: Collaboration for Environmental Decision Making" held in Aurora, Colorado from November 8 – 19, 2004.

Work has begun on developing the first draft of the *Watershed Protection Plan for the Pecos River*.



*Pecos River*



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