A Water Budget Analysis to Support Sustainable Water Management in the Black River Basin, New Mexico

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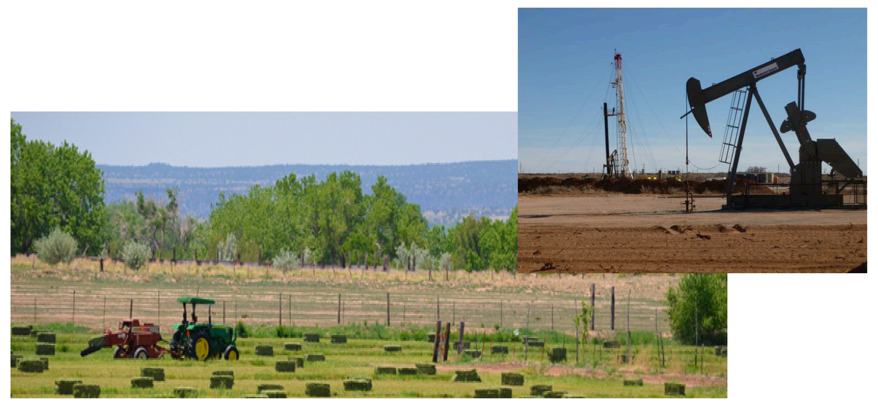
Client: New Mexico Interstate Stream Commission

Background

The Black River Basin in southeastern New Mexico provides important habitat for vulnerable aquatic species, and as a tributary to the Pecos River, plays a role in required water deliveries to Texas. Changes in climate and shifts in water use related to regional oil and gas development may impact species survival and the availability of water for human needs.



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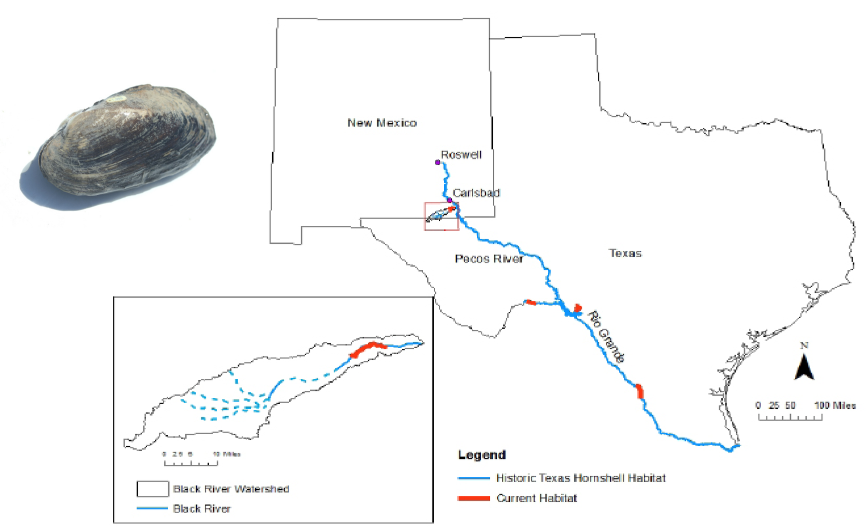
Historic and Current Distribution of the Texas Hornshell

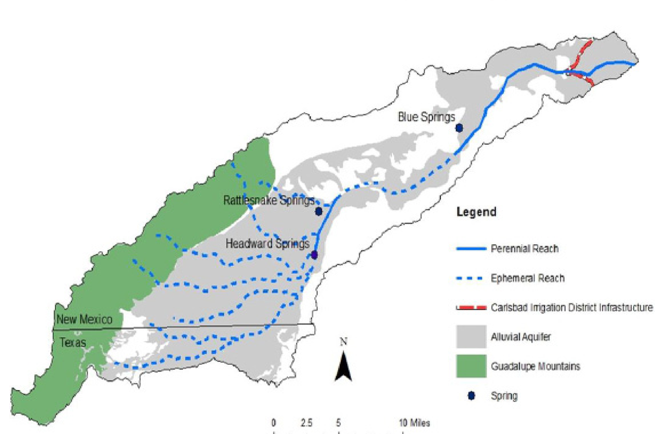


Biological Needs

The Texas hornshell (*Popenaias popeii*), a freshwater mussel, will be considered for listing as threatened or endangered under the Endangered Species Act by 2015. Changes in land use and increased water demand threaten habitat, including effects on natural flow regimes and water quality.

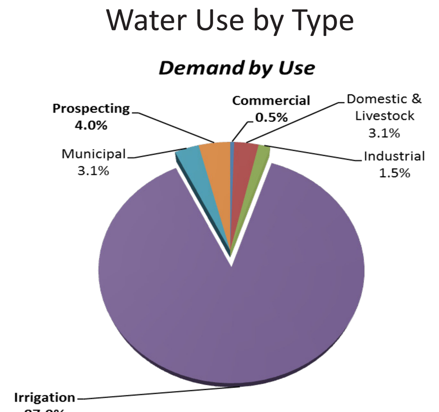
Human Needs

Black River Basin Hydrology



Appropriated water in the basin, totaling 14,874 acre-feet per year, is primarily used for irrigation purposes. Surface water from spring flows and perennial reaches supplies 66% of total use and groundwater from the alluvial aquifer supplies the remaining 34%.

Water Use by Type



Project Goals

The goal of this project was to conduct analysis of current basin conditions, as well as potential changes in water use and climate, and to generate tools and recommendations that support effective, equitable, and environmentally sound water resources management.

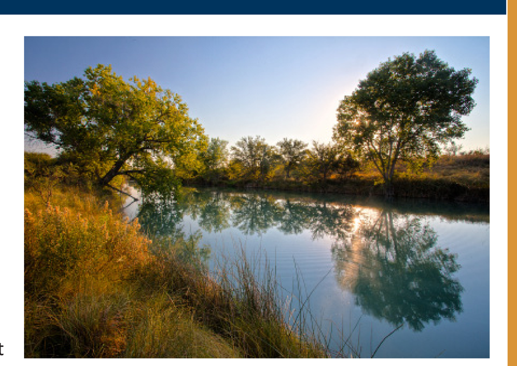
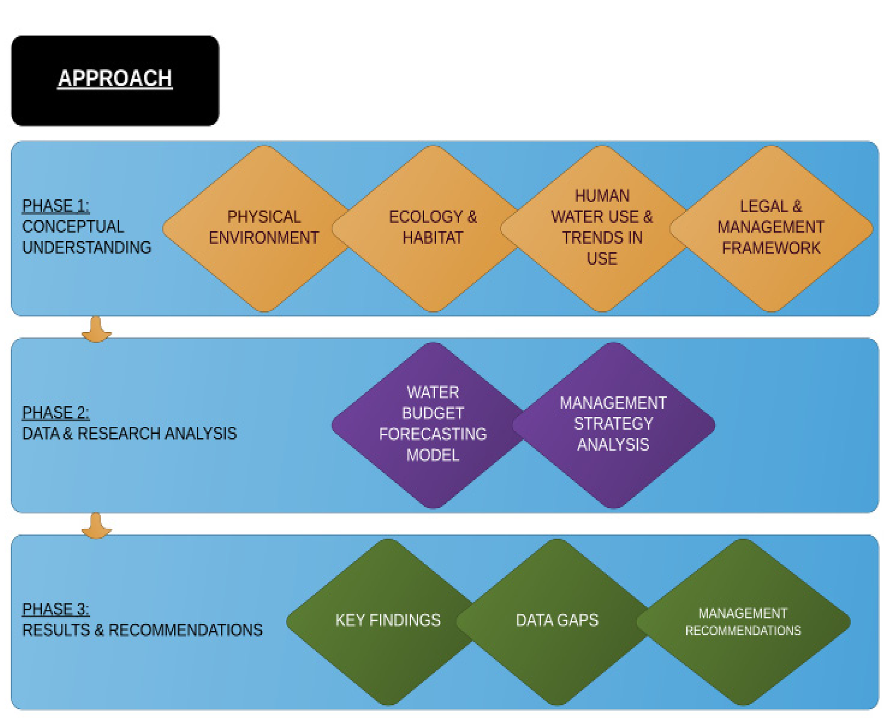


Photo Credit: Bureau of Land Management

Methodology



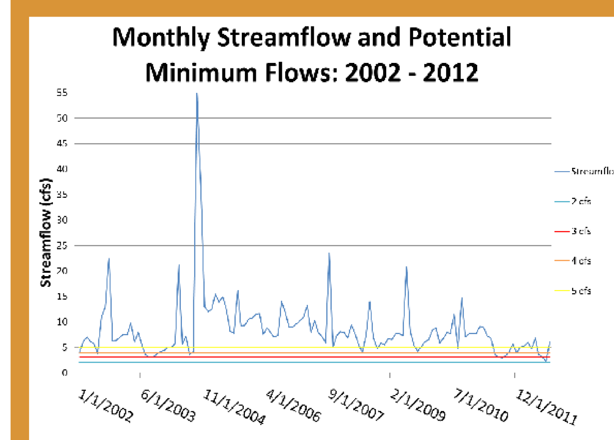
Phase 1: Characterize the physical environment, ecology and habitat quality, current water use and trends in use, as well as the relevant legal and management framework that applies to the basin.

Phase 2: Conduct analysis of potential management strategies. Develop a water budget forecasting tool using the Water Evaluation and Planning (WEAP) system to identify factors that could affect flow volume and timing, as well as the possible implications of selected management strategies.

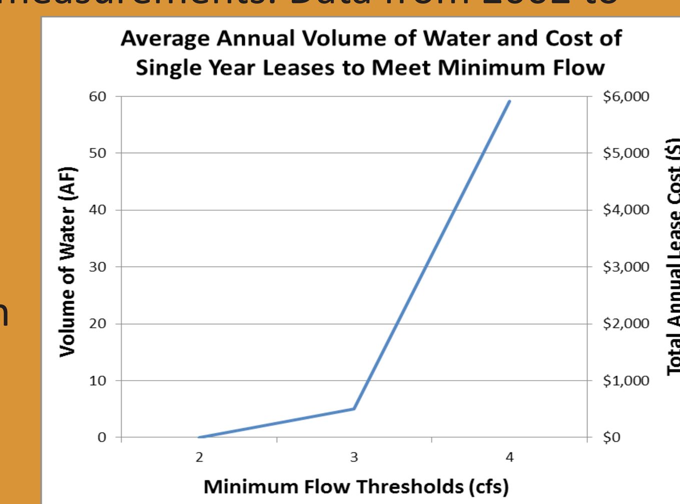
Phase 3: Use findings from Phases 1 and 2 to provide recommendations for prioritized data collection and immediate management actions.

Key Findings

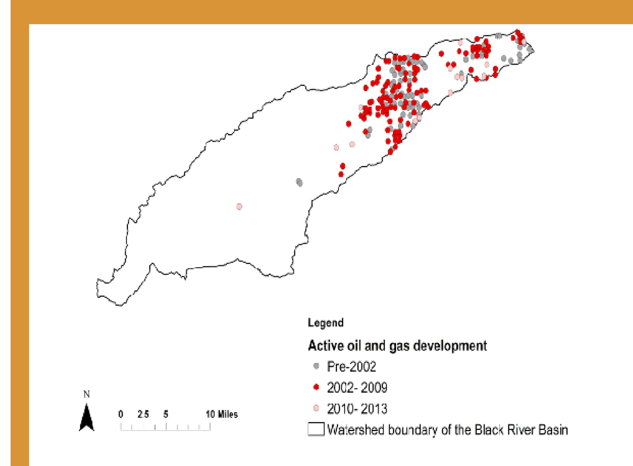
Minimum Flows



Disruption of flow regimes could put the Texas hornshell at risk, calling the need for the collection of important data verifying flow requirements. A range of estimated minimum perennial flow requirements between 2 and 4 cubic feet per second (cfs) was evaluated based on historical flow measurements. Data from 2002 to 2012 was used to estimate the average annual volume of water necessary to meet minimum flow thresholds. Based on current lease prices, costs could reach $6,000 per year or higher depending on the necessary minimum flow threshold and future market conditions. Historically the state has mainly purchased water rights to augment streamflow. However, leases offer a more flexible option.



Competing Water Uses



Water use is shifting in response to increasing regional hydraulic fracturing for oil and gas production. This has resulted in: 1) increases in temporary consumptive use permits of up to 9 acre-feet (AF) per year per well, and 2) increases in change in purpose of use permits from irrigation to commercial use. Approximately 12% of the total volume of water allocated in the basin is under active change in purpose of use permits. Average water use associated with hydraulic fracturing ranges from approximately 4 to 11 AF per well.

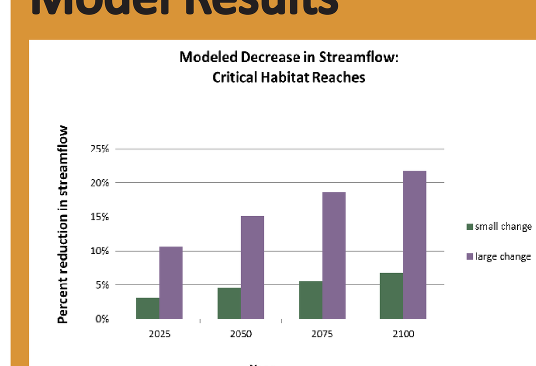
Management Strategy Analysis

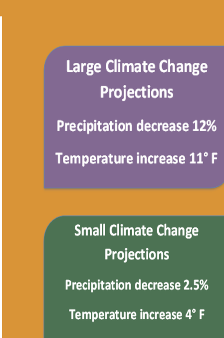
A range of over 20 management strategies were explored and ranked based on the ability to increase water in the basin and level of effort -- political and economic -- to implement. The degree of uncertainty associated with each ranking was also assessed. A condensed list is shown to the right. The four recommended management options highlighted in blue are discussed in further detail in the "Recommendations" section.

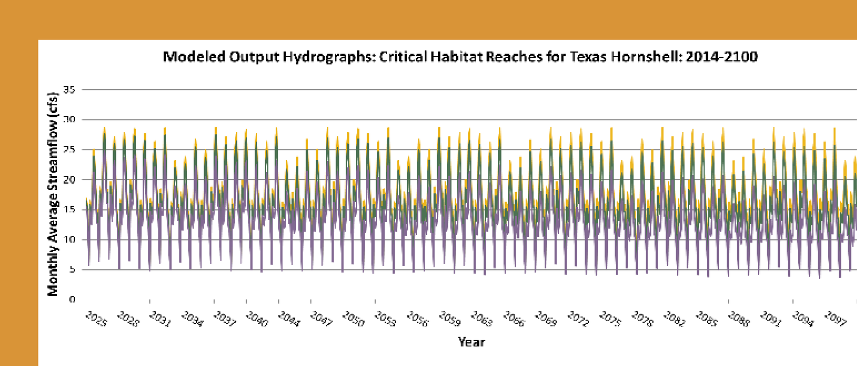
Government Driven Strategies	Potential to increase water in system	Level of effort to implement
Strengthen right of instream flow as a beneficial use through administrative practices / legislation	●●●●	● / ●●●●●
Public purchase and/or lease of water rights expand use of the NM Strategic Water Reserve	●●●●	●●
Office of the State Engineer administrative changes	●●●●	●●
Aquifer storage and recharge	●●●●	●●●●
Mitigation tax on oil and gas industry	●●●	●●●●
Changes to existing conservation tax	●●	●●●●
Set minimum flow requirement	?	●●●
Remove forfeiture doctrine	?	●●●●●

Private Sector Driven Strategies	Potential to increase water in system	Level of effort to implement
More efficient irrigation	●●●●	●●●
Rotational use or shortage sharing agreements administered through a local groundwater district	●●●	●●●
Private purchase and/or lease of water rights	●●●	●●●●
Mitigation banking	●●	●●●
Increase recycling and/or reuse of produced water	●●	●●●
Water purchasing clearinghouse for oil and gas	●●	●●●●●

Model Results



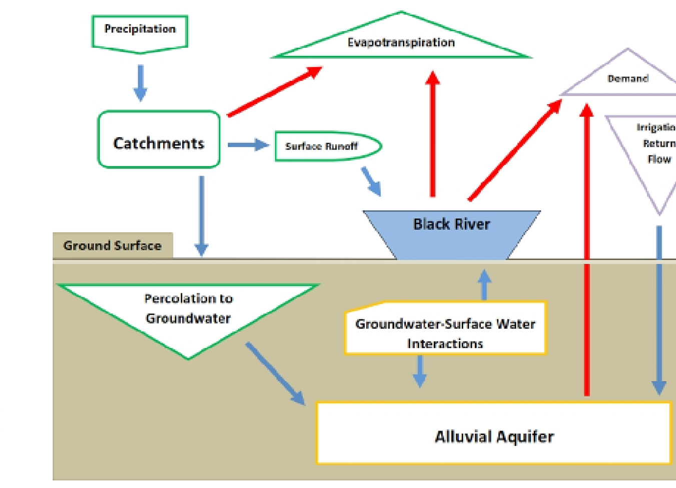




A range of climate change scenarios based on projections from the U.S. Global Change Research Program were used in addition to scenarios reflecting possible changes in use. Given the largest projected changes in climate, model results indicate a reduction in streamflow of 15% by 2050 and 22% by 2100 for the critical Texas hornshell habitat reach. Similar trends are seen in the reach that contributes to interstate compact compliance through discharges to the Pecos River. However, significant uncertainties exist concerning possible changes in climate, as well as the ability of the model to accurately represent the physical characteristics of the basin that determine hydrologic processes and responses to changes in climate.

Water Budget Forecasting Model

A basin-specific water budget model using Water Evaluation and Planning (WEAP) software was developed to represent current basin conditions and evaluate potential impacts to streamflow due to changes in use and climate. Model calibration revealed the importance of key hydrologic processes including subsurface flows and groundwater-surface water interactions, highlighting the need for better representation through more sophisticated modeling efforts in the future.



Recommendations

Effective basin management requires both prompt efforts to obtain additional data as well as the implementation of management strategies that are likely to reduce stress on water supplies and increase understanding of human impacts within the basin.

- Species-Specific
  - Flow rates
  - Water quality
- Hydrology
  - Streamflow gages
  - Subsurface flow
- Actual Use
  - Meter reports
- Climate
  - Evapotranspiration rates

Data Collection

Essential data on species-specific needs, hydrology, actual water use, and climate in the basin is needed to continually inform management policies, support water distribution among users, and ensure habitat quality necessary to sustain the Texas hornshell and other vulnerable species.

Management Strategies

1) Strengthen the right of instream flow as a beneficial use and improve implementation of the Strategic Water Reserve.

The Strategic Water Reserve (SWR) was created in 2005 by the New Mexico State Legislature to establish a pool of publicly held water rights to keep the state's rivers flowing for the benefit of endangered species and interstate compact deliveries. Increased state funding and incentives to encourage public and private participation in instream flow acquisitions would improve the effectiveness of the SWR.

2) Improve administration of water rights through the New Mexico Office of the State Engineer.

Shifts in administrative practices, such as improved implementation and enforcement of metering requirements and adjustments in permitting mechanisms, offer an opportunity to gain additional information about how water is used and to enable more responsive regulation.

3) Create rotational or shortage sharing agreements administered by a local groundwater district.

State regulations allow for water users to find local solutions for water distribution in times of shortage. In the case of a minimum flow requirement resulting from a species listing, these agreements would grant local stakeholders more flexibility to collectively manage the resource.

4) Increase recycling of produced water from oil and gas development through government or market based incentives.

New technological advancements may allow for the treatment of produced water for re-use in oil and gas operations. This would alleviate stress on fresh water supplies, lower environmental risks associated with the transportation and disposal of produced water, and reduce producer costs of obtaining fresh water.

Acknowledgements

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