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

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ON THE WEB AT WWW.BREN.UCSB.EDU AND WWW.BLACKRIVERGP.WEEBLY.COM SPRING 2014

INTRODUCTION

The Black River Basin drains over 390 square miles in southeastern New Mexico, supplying water to a range of human and ecosystem needs in the semi-arid Chihuahuan Desert. As the last significant tributary to the Pecos River before the Texas state line, the Black River plays an important role in supporting interstate water delivery requirements in compliance with the Pecos River Compact. Consumptive water use in the basin is primarily for local agriculture and livestock purposes.

As a fully appropriated basin, no new water rights, except for low volume three acre-feet per year (AFY) rights, can be allocated. In response to recent increases in regional oil and gas development, temporary prospecting permits and transfers in purpose of use permits from irrigation to commercial use are being issued. This allows the oil and gas industry to purchase water that was previously used for irrigation. As such, increases in water-intensive hydraulic fracturing processes over the last decade point to further possible shifts in water demand in the region.

Beyond human demands, the Black River Basin supports one of New Mexico's most important regional ecosystems. Home to the highest diversity of native aquatic fauna among second order perennial streams statewide, the basin provides critical habitat for several threatened and endangered species that have been extirpated from their historic ranges, including the Pecos River. One such species is the state-listed endangered Texas hornshell (*Popenaias popeeii*), a freshwater mussel likely be listed under the Federal Endangered Species Act by 2015. The Texas hornshell's dependence on specific flow regimes and water quality make the species vulnerable to shifts in land use and water availability.

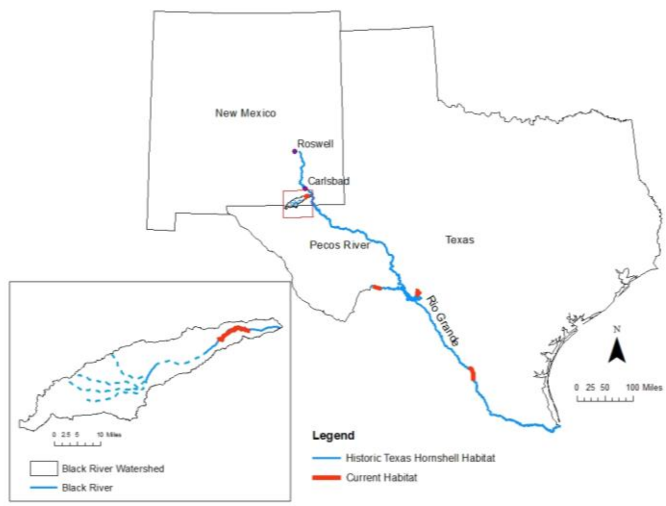


Figure 1: Historic (blue) and current (red) distribution map (above) of the Texas hornshell mussel (shown to the right).

PROJECT GOALS

This project is intended to serve as an important step toward effective water resources management of the Black River Basin, a challenging task given potential endangered species issues, industry development and climate change impacts. A careful assessment of current basin conditions, as well as an analysis of water use and climate changes, was used to generate tools and recommendations to support equitable and environmentally-sound resource management.

METHODOLOGY

A three-phase approach was designed to support effective water resources management and address the challenges presented in the Black River Basin.

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.

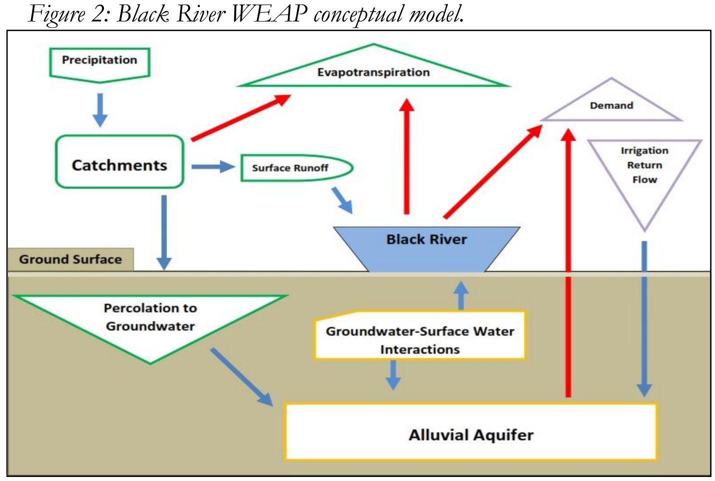
Phase 2) Conduct an analysis of potential management strategies. Develop a water budget forecasting tool using the Water Evaluation and Planning (WEAP) model to identify factors that could affect flow volume and timing and the potential implications of climate change, shifts in use, and selected management strategies.

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

WATER BUDGET FORECASTING TOOL

A basin-specific water budget model using the WEAP software was developed to represent current basin conditions and evaluate potential impacts to streamflow due to changes in water use and climate. Model calibration challenges 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.

Figure 2: Black River WEAP conceptual model.



KEY FINDINGS

Minimum Flows

Disruption of required flow regimes could put the Texas hornshell at risk. Important data is needed to verify the relationship between species density and flow regimes on the Black River. A range of estimated minimum perennial flow requirements between 2 and 4 cubic feet per second (cfs) was evaluated based on historical monthly average 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 and purchase prices, the average annual costs could reach $5,400 or higher for single year leases, or $963,000 for water right purchases depending on the necessary minimum flow threshold and future market conditions. Streamflow deficits and costs could be higher given recent trends that indicate lower than average minimum streamflows, such as what was experienced during 2011-2012.

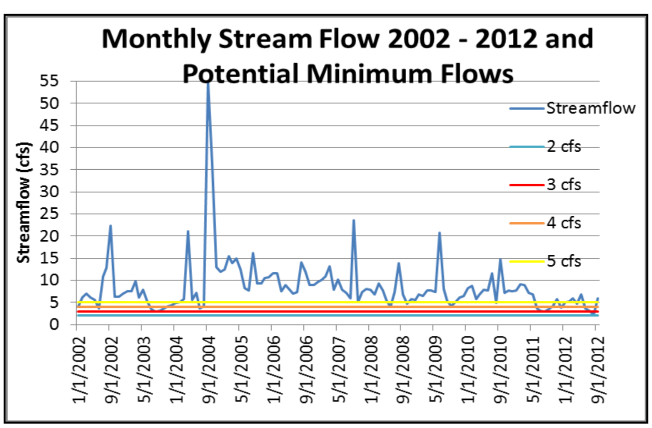


Figure 3: Monthly streamflow shown with potential minimum flow thresholds.

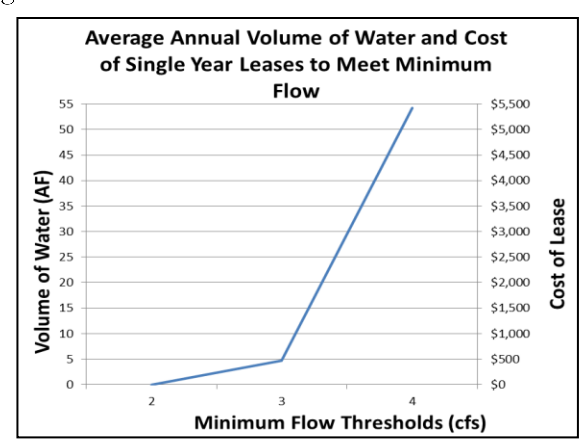


Figure 4: Average annual water quantity and cost of meeting minimum flows with single year leases.

KEY FINDINGS, CONTINUED

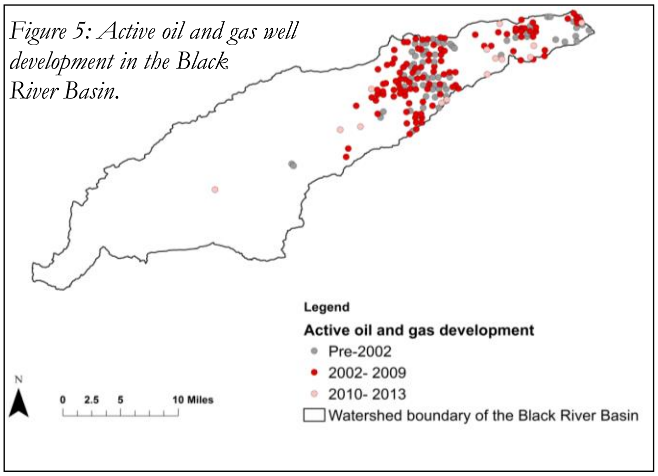


Figure 5: Active oil and gas well development in the Black River Basin.

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 (3 permits per year resulting in 9 AFY 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 operation.

Management Strategy Analysis

A range of over 20 management strategies were explored and ranked based on their ability to increase water in the basin and the associated level of effort -- political and economic – to implement. The degree of uncertainty involved in each ranking was also assessed. The recommended management options outlined 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	💧💧	⬢⬢⬢⬢⬢

Figure 6: Condensed list of ranked management strategies.

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 physical characteristics that determine hydrologic processes and responses to changes in climate.

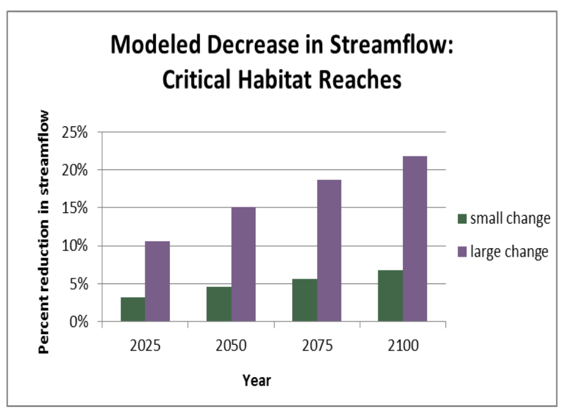


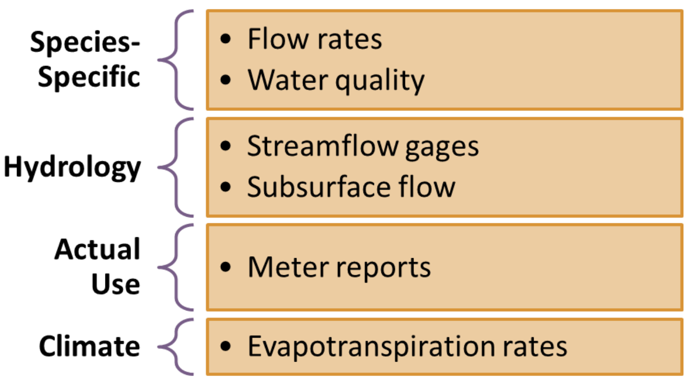
Figure 7: Projected decreases in streamflow by selected years.

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.

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 reuse 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.

Photo source: Todd Carlin, Black River Group Project

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