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.

Biological Needs
The Texas hornshell (Popenaias papulifera), 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
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%.

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

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 minimal 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.

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.

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 uncertainty exists concerning possible changes in climate, as well as the ability of the model to accurately represent the primary 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. Modeling 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.

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.

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.
2) Improve administration of water rights through the New Mexico Office of the State Engineer.
3) Create rotational or shortage sharing agreements administered by a local groundwater district.
4) 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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