Sustainable Water Resources and Regional Cooperation: The LCRA-SAWS Water Project

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ABSTRACT

The lower Colorado River basin in Texas and the San Antonio region both face long-term water shortages. Cities, farmers, businesses, recreation and the environment are competing for water supplies as never before. As part of the regional water supply planning process in Texas, the Lower Colorado River Authority (LCRA) and the San Antonio Water System (SAWS) both realized the need to increase water supplies and decided to control their water destiny together. These two neighboring regions have jointly developed an innovative plan to provide ample and reliable water for the long term while protecting the environment.

KEYWORDS

Water, sustainable, bay, river, conservation, water quality, aquatic habitat, groundwater.

INTRODUCTION AND PROJECT OVERVIEW

The LCRA-SAWS Water Project (LSWP) would conserve water, develop groundwater and capture excess and unused river flows to make available as much as 330,000 acre-feet of water a year (295 million gallons a day) for two key regions in Texas. Of that, approximately 180,000 acre-feet of agricultural and other rural water needs would be met in the lower Colorado basin through water use efficiency, stored surface water and supplemental groundwater while up to 150,000 acre-feet of surface water would be transferred to the San Antonio area. Groundwater would not be transferred to San Antonio as part of the project. The general project area is shown in Figure 1.

The LSWP would conserve and develop water in three ways:

- Conserve irrigation water.
- Capture excess and unused river flows.
- Use groundwater for agriculture when surface water is lacking.

The integrated approach to water management – using conservation, river flows and groundwater as a single system – increases efficiency. This collaborative project, which provides a model for trans-basin projects that are environmentally sustainable and protect both rural and urban economies, is now in its second year of detailed studies. A schematic diagram of the proposed project is shown in Figure 2. A summary schedule is shown in Figure 3.

Figure 1 – Project Area

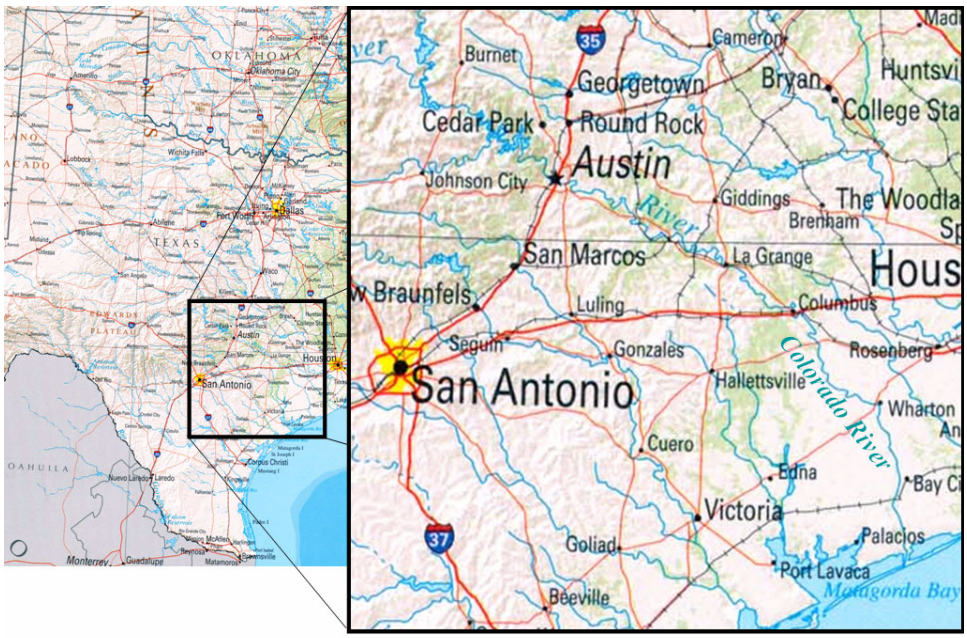


Figure 2 – Project Schematic

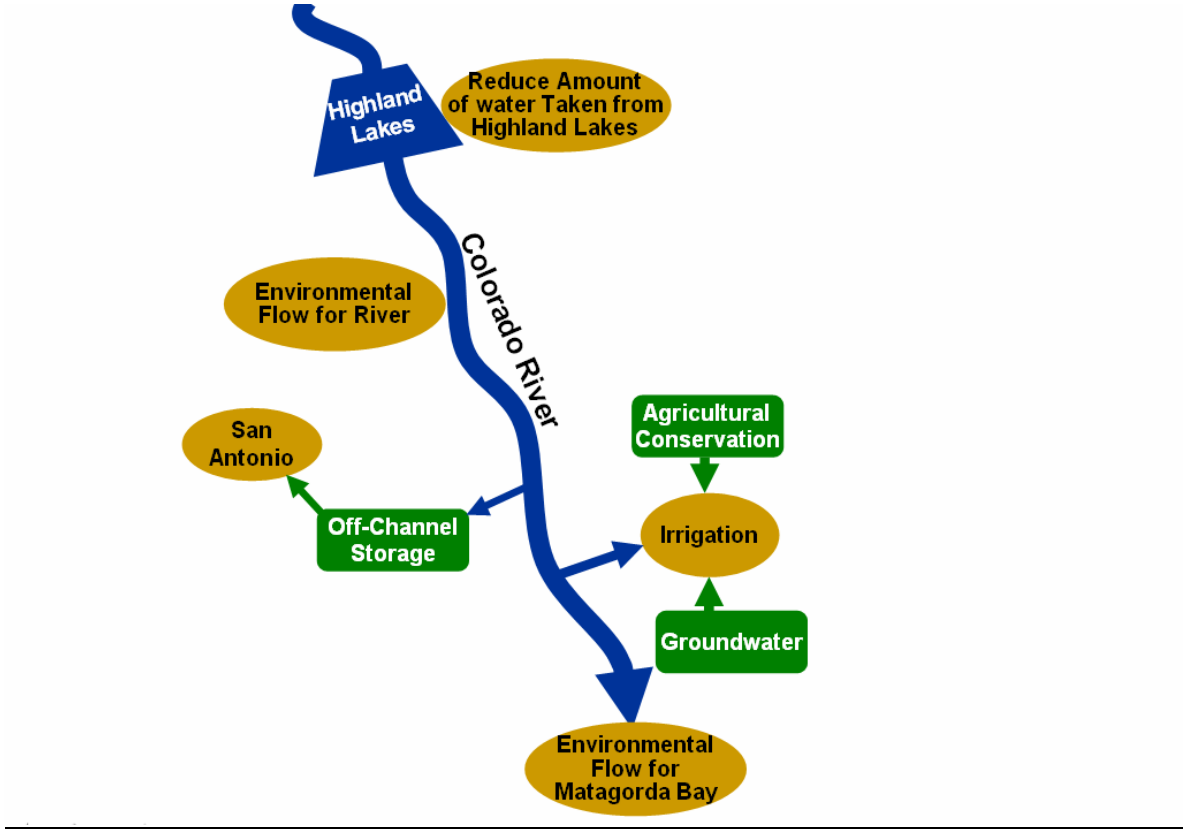
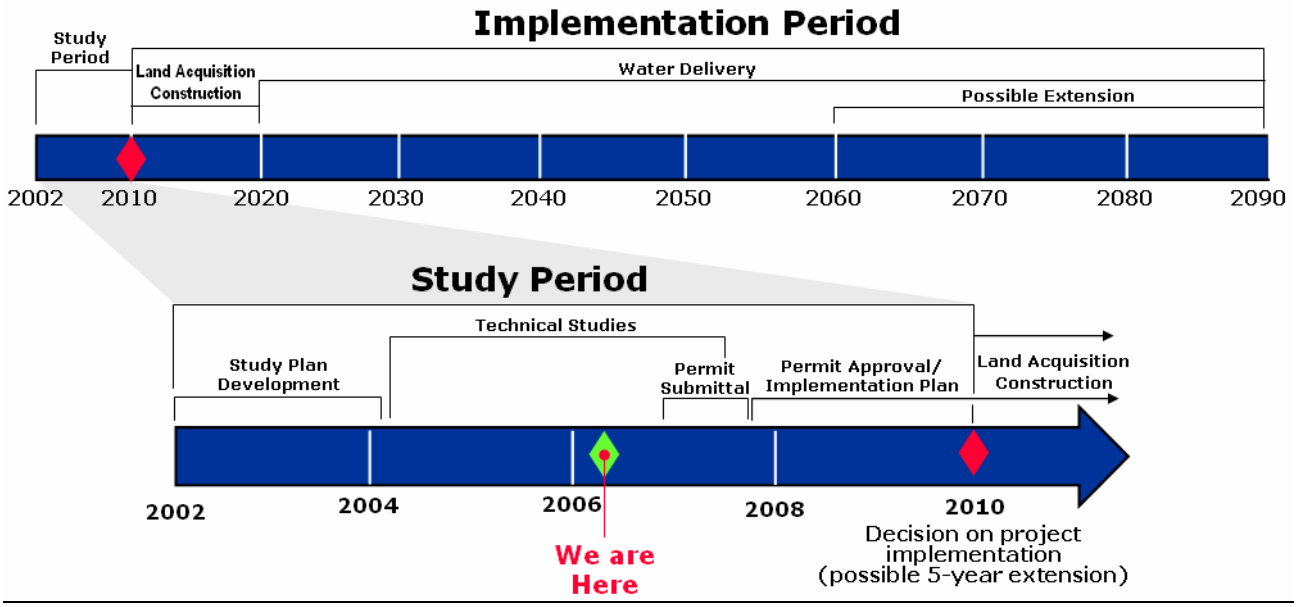


Figure 3 – Project Timeline



The Study Period (including environmental and yield studies, preliminary engineering and permitting) is budgeted for $41.6 million. The total project cost is estimated at over $1 billion.

Specific legislative criteria (Texas Water Code, § 222.030) must be met before any water is transferred from the Colorado basin. These include the following requirements:

- Colorado River basin interests must benefit and be protected.
- Freshwater inflows into Matagorda Bay must be adequate to maintain its health and productivity.
- Colorado River instream-flow protection must be provided.
- A broad public and scientific review process must take place.
- San Antonio must continue to practice stringent conservation measures.
- Water levels in Lake Travis and Lake Buchanan must benefit.
- The Project must be consistent with Texas' regional water plans.

The stakeholder involvement program includes an active Advisory Group, several Sub-Advisory Groups, public meetings, presentations, open houses, project web site (www.lcra.org/lswp), video and informational materials. An independent Science Review Panel, led by Andy Sansom of Texas State University, regularly reviews project scopes and deliverables and provides feedback to the team at workshops and via written comments.

If it is determined that there is not sufficient water to meet needs in both/either basin, or if federal or state environmental requirements are not met, the LSWP will not move ahead. SAWS is funding the LSWP based on its Agreement with LCRA. During the Study Period, if a decision is made not to proceed, the costs incurred up to that point will be shared equally by SAWS and LCRA.

METHODOLOGY

An intensive public scoping process in 2003 and 2004 identified the following studies to help address state and federal permitting requirements as well as the legislative criteria.

- Agricultural conservation in key irrigation districts
- Groundwater for agriculture
- Colorado River and off-channel storage facility water quality
- Colorado River flow relationships to aquatic habitat and State threatened species (blue sucker)
- Matagorda Bay health evaluation
- Surface water availability assessment
- Facility siting and design and how the environment might be affected
- Social and economic benefits and costs

Several of study issues and approaches are summarized below.

Matagorda Bay

The Colorado River flows into Matagorda Bay, which is connected to the Gulf of Mexico. An innovative approach for measuring the health and productivity of Matagorda Bay has been developed and is being implemented, characterized by evaluating changes in inflow, habitat and biology. The inflow analysis includes inflows from the Colorado River as well as coastal basins that receive return flows from rice irrigation. The presence of the Gulf Intra-coastal Water Way between these freshwater sources and the bay complicates the analysis of the volume and timing of inflows. A hydrodynamic and salinity model of the bay (using the RMA model series) is being developed. In addition, the alternately wet and dry marsh areas are being modeled to support the habitat analysis and linked to the RMA open-bay model. The habitat model considers factors such as salinity, water depth, vegetation, location/access, and food sources. The analysis also includes statistical modeling of abundance of key species as related to freshwater inflows, salinity and habitat.

Water Availability and Yield

Water availability and yield is being estimated based on complex evaluations of irrigation demands, conjunctive groundwater use for irrigation, use and modification of multiple existing and requested water rights, and optimization of the operation of the entire LCRA system of reservoirs. An entire study (Agricultural Conservation) is devoted to developing water saving approaches for the irrigation districts and rice farmers, including development of a high-yielding rice variety. When sufficient surface water is not available, conjunctive groundwater use would help satisfy irrigation demands. LCRA controls the operation of the Highland Lakes on the Colorado River, as well as a significant portion of the water rights in the basin. Construction of off-channel storage facilities as part of the LSWP allows the diversion of river water when available, allowing additional needs to be met, including San Antonio's. In order to supplement the monthly Water Availability Model (WAM), a RiverWare daily model of the Colorado River is being developed to help design efficient facilities and develop a more detailed operational plan for the system.

Colorado River Habitat and Water Quality

One potential outcome of the LSWP is a change in river flow volume, timing and duration. This study is specifically evaluating this issue by relating river flow to the quality and quantity of river habitat for various aquatic species using detailed instream hydraulic models for ten representative river reaches. In addition the blue sucker, a state threatened species, is being studied and 30 tagged specimens tracked. The state's existing QUAL-TX water quality model has been extended downstream to the bay and updated to provide information on the water quality implications of changing flow regimes in the river. Low-flow sampling, dye-tracer tests, and diel dissolved oxygen studies have been performed to help calibrate the water quality model.

Groundwater for Agriculture

A new groundwater model is being developed incorporating refined aquifer properties and stratigraphy based on over 700 boring logs and hundreds of pump tests. The model will provide a much more accurate view of the aquifers than existing Groundwater Availability Models. This will allow better characterization of project impacts, and better design of well fields to minimize impacts to the aquifers and existing wells.

PRELIMINARY RESULTS

The preliminary results of the Study Period are summarized annually in the Project Viability Assessment. The 2005 Project Viability Assessment was completed in October 2005 (http://www.lcra.org/lswp/pva.html). Additional results are presented to the Advisory Group on a regular basis, and will be available for presentation in October 2006 for WEFTEC'06.

Matagorda Bay

The approach for measuring bay health, termed the Bay Health Framework, was developed by the study team. The framework was favorably received by the Science Review Panel (SRP) and key resource agencies. Important physical, chemical, and biological data regarding the bay have been collected and organized using powerful database and display tools, and the initial analysis has begun. The model for predicting salinity in the various areas of the bay was selected, the model grid developed, and the model modified to allow modeling of shallow edge marsh areas that are critical habitat for organisms. Preliminary habitat maps have been developed for the bay and its surrounding marsh areas. Using salinity modeling results, bathymetric information and species preference data, habitat models are being developed for key species (Figure 4). Statistical analysis and modeling using the Texas Parks and Wildlife Department (TPWD) Coastal Fisheries Data is underway, including creative approaches such as use of "freshets" of fresh water defined by inflow hydrographs (as opposed to relatively arbitrary monthly inflows) as independent variables. Figure 5 summarizes the interactions among the various bay modeling efforts.

Figure 4 – Example of Habitat Suitability Modeling Results

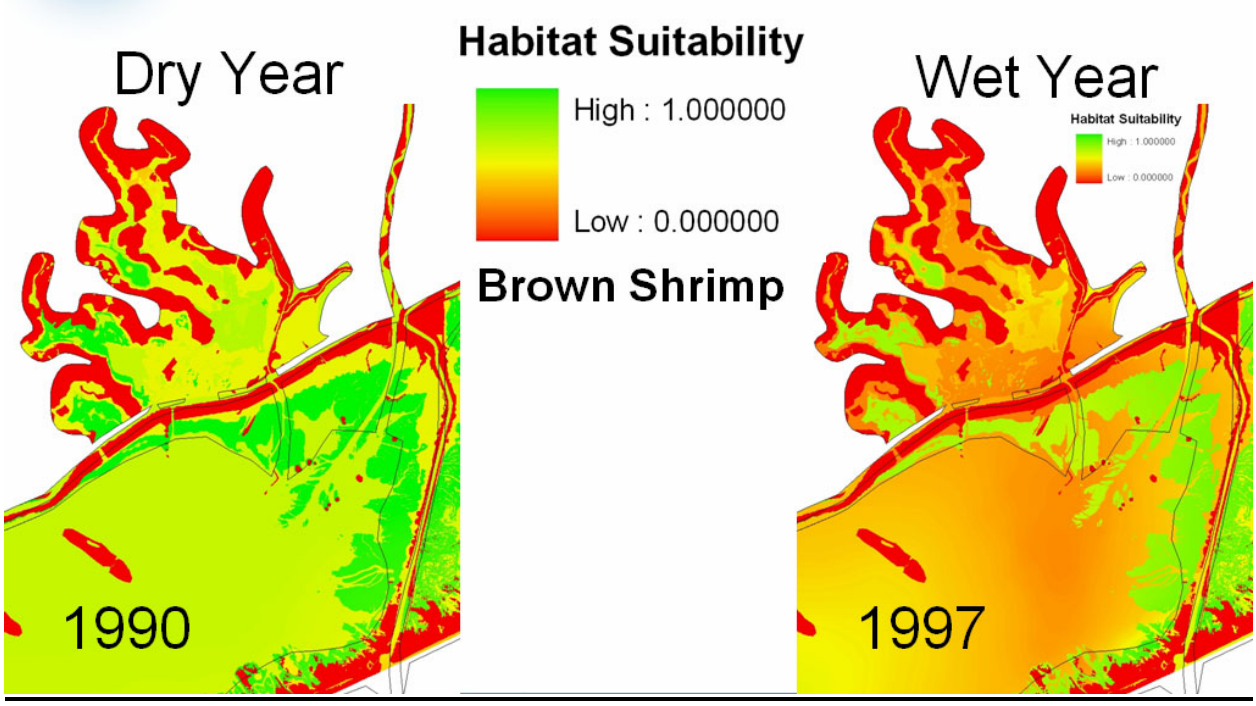
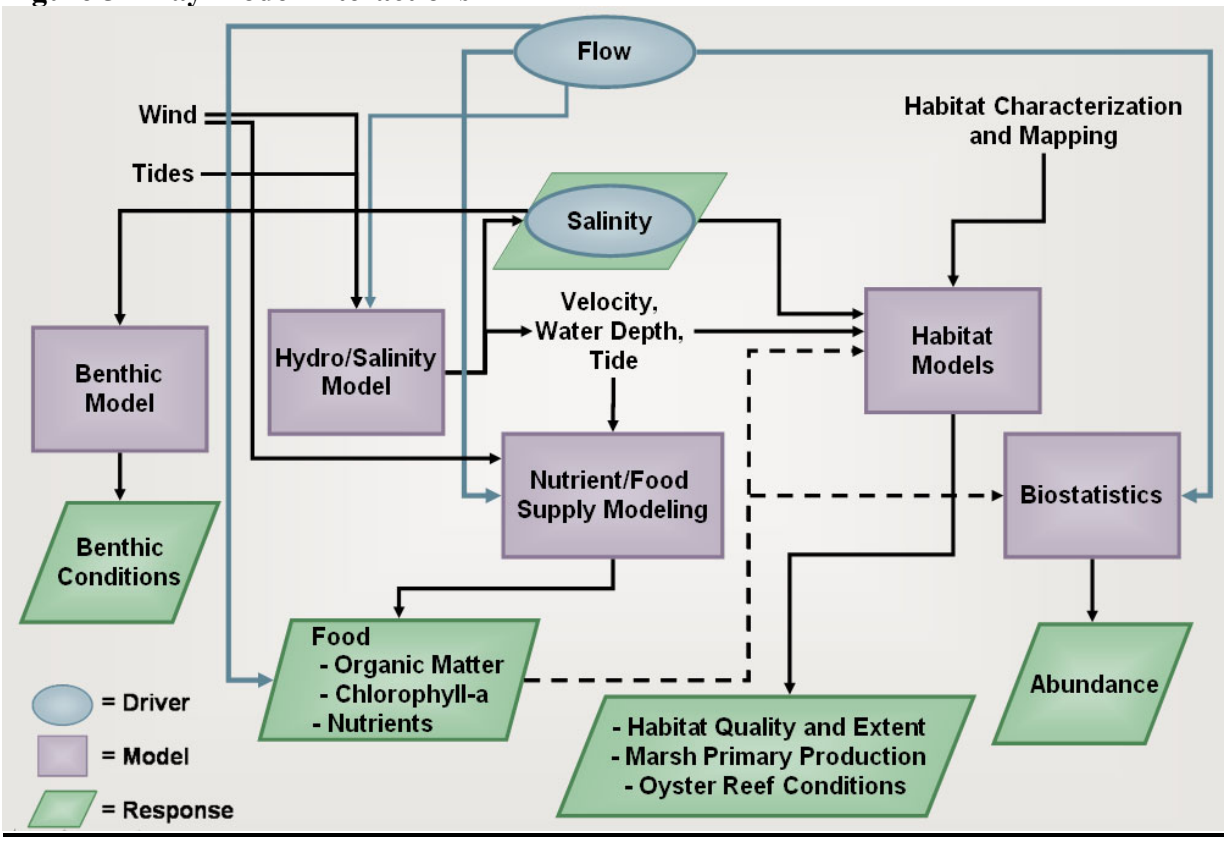


Figure 5 – Bay Model Interactions



Water Availability and Yield

Studies continue to refine how the various sources of water available to LCRA can be effectively used as a system to meet future water needs both inside and outside the lower Colorado River basin. The results to date increase confidence in the availability of river water to support the LSWP and the transfer of up to 150,000 acre-feet per year to SAWS. Agricultural conservation estimates continue to affirm that conservation savings in the irrigation districts should exceed the 118,000 acre-feet per year projected. Assumed critical instream flow criteria (for drought protection of aquatic life, for use pending the results of the river studies) in the lower Colorado River are expected to be satisfied almost all the time with or without the LSWP in operation. Assumed criteria for freshwater inflow to Matagorda Bay (for use pending the results of the bay study) are expected to be satisfied slightly more often with the LSWP in operation. Storage in the Highland Lakes and the associated lake levels are projected to be higher with the LSWP than without the LSWP, as required by the enacting legislation for the Project.

River Habitat and Water Quality

The study team has surveyed ten representative sites of the various reaches and habitats in the river, documented river shape and structure (geomorphology), evaluated habitat, and sampled aquatic species present. The study team has developed and is calibrating detailed hydraulic models to relate river flow to quantity and quality of aquatic habitat at the ten intensive sites (See Figure 6 for example). The 30 blue suckers (state-listed threatened species in the Colorado River basin) that were tagged with radio transmitters in 2004 have been tracked (See Figure 7). Upstream movement of over 170 river miles was observed during spring 2005. With respect to the QUAL-TX water quality model, no water quality concerns have yet been identified in the river below Smithville. Because the section of the river between Austin and Smithville has the highest volumes of wastewater discharges, it is the reach most likely to experience potential changes in water quality if the river flow regime changes.

Figure 6 – Example of Hydraulic Model Velocity Output

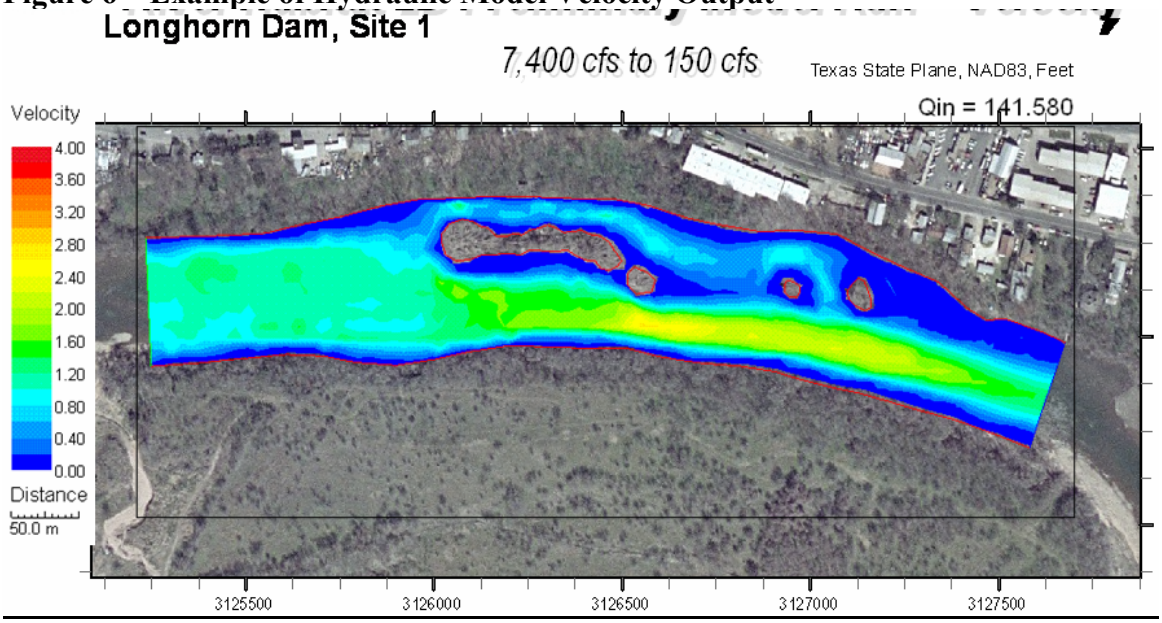


Figure 7 – Blue Sucker

Groundwater for Agriculture

A river gain-loss study has been completed. Also recharge rates have been estimated based on the data collected. Model parameters and aquifer properties have been defined in much greater detail than existing regional models. The conceptual model is complete, and the detailed model development is in progress. Analyses using existing models indicate that the projected groundwater yield is available to meet agriculture's needs.

SUMMARY AND CONCLUSIONS

A majority of the technical work and studies will be completed in 2006, with virtually all of the remaining study work completed in 2007 and permitting activities continuing through 2010. The preliminary results to date reinforce the viability of the project. A number of key evaluations will be completed in 2006 that will help define environmental requirements for instream flows and freshwater inflows. These results will in turn help refine the water availability estimates and optimization of system operations. In addition, agricultural conservation studies will aid in defining irrigation demand estimates, and detailed groundwater modeling will provide needed information on the availability and constraints of the groundwater resource to meet agricultural needs.

A number of key issues remain to be addressed in the remaining Study Period. These include:

- Translation of the detailed and complex bay environmental work into recommended freshwater inflow criteria.

- Translation of detailed river environmental work into recommended instream flow criteria.
- Incorporation of environmental recommendations into surface water availability analysis and optimization of the complex system of LCRA reservoirs, irrigation districts and water rights.
- Development and operation of a groundwater system that supports irrigation and minimizes affects on existing groundwater users.
- Successfully siting and designing efficient facilities.