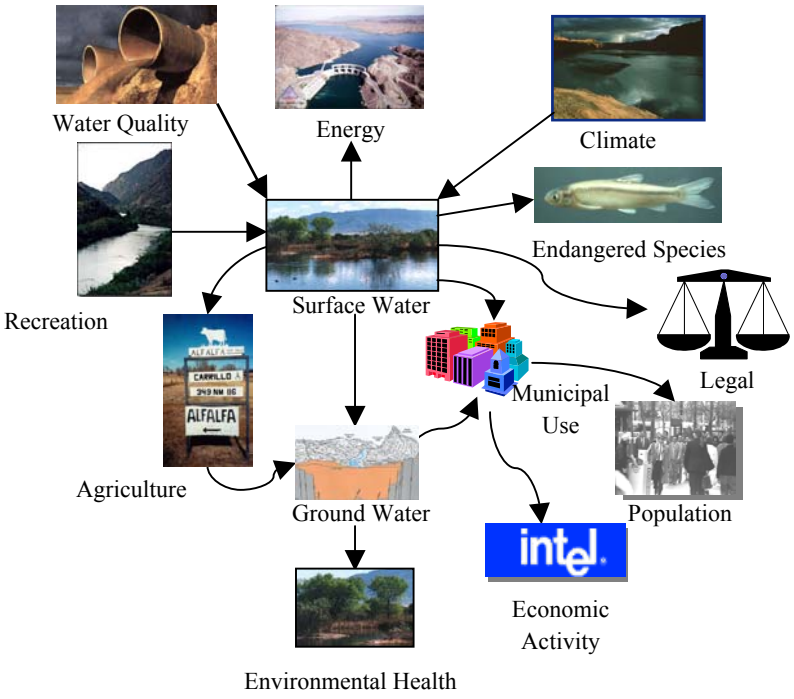
Water Use Management –Systems Modeling and Cooperative Management for *Long-Term Sustainability*

Background

Water is a precious, life-giving commodity. The availability of fresh water dictates the success of most ventures including agriculture production, municipal growth, industrial output, tourism and maintenance of fragile ecosystems. These needs compete for already over-subscribed, seasonally and annually variable surface water and groundwater resources. The challenge for water managers is to balance the competing existing needs, legal mandates and future water uses to maintain a sustainable water supply for us, our children and generations to come.



Schematic showing a few of the factors influencing water resource planning.

In order to achieve an efficiently managed, sustainable water supply we need to:

- Understand the basic processes controlling our water supply.
- Collectively consider the broad sphere of interrelationships between water, the environment, urban development, economic vitality, legal institutions, and the social/cultural fabric of the community.
- Evaluate consequences of alternative water management strategies prior to implementation.
- Develop a cooperative framework for engaging stakeholders in the management of these limited resources.

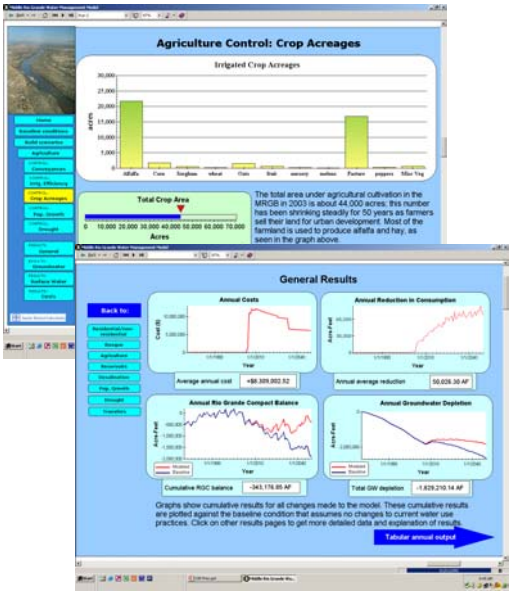
Approach

Sustainable management of watersheds and their water resources benefits from the development and application of models that offer a comprehensive and integrated view of these complex systems and the demands placed upon them. The utility of these models is greatly enhanced if they are developed in a participatory process that incorporates the views and knowledge of decision-makers, resource managers, special interest groups and the public. System dynamics provides a unique mathematical framework for integrating the physical and social processes important to watershed management, while providing an interactive interface for engaging the public in the decision process. System dynamics is based on the concept of a spatially aggregated commodity balance. These system level models focus on capturing the broad structure of the system, specifically the feedback and time delays between interacting subsystems. The spatially aggregated models are computationally efficient allowing simulations to be conducted on a PC in a matter of seconds to minutes. By employing interactive interfaces, these models can be taken directly to the public and used in real time in regional resource planning.

Current Research Projects

Sandia has research activities focused on national and international water issues using novel approaches and unique expertise in hydrologic system evaluation, numerical analysis, data management, and cooperative modeling. Current efforts include:

Community-Based Water Planning for the Middle Rio Grande
An interactive system dynamics model was developed to assist in community-based water planning for a three county region in North-Central New Mexico. Model development involved a cooperative effort between Sandia, community volunteers, local water managers, the council of governments, and the public. The model was used to quantitatively evaluate over 25 alternatives water conservation measures and to educate/engage the public in the planning process.



Interactive interfaces allowing model users to test alternative water conservation strategies

Upper Rio Grande Water Operations EIS
A collaborative effort with the US Corps of Engineers and a number of other state and federal agencies to develop a water operations plan for the upper Rio Grande (headwaters to Ft. Quitman, TX). The model will assess the impacts of water operations on a variety of environmental, cultural, and institutional features within the basin. This system dynamics model will serve as a framework for integrating project results and communicating with the public.

Lower Rio Grande Water Planning
Managing the flows of the Rio Grande has become a contentious issue between the United States and Mexico. To better understand these transboundary water issues a system dynamics model is being developed through the cooperation of Sandia, the University of Arizona, the Institute de Mexico Technologia de Agua, and Universidad Autonoma de Ciudad Juarez. The model supports a full accounting of the factors influencing water supply and demand on both sides of the border between Ft. Quitman, Texas and the Gulf of Mexico.

System Dynamics Toolbox
The objective of this project is to develop a resource-planning toolbox to support integrated watershed management and foster communication between water professionals, decision-makers, and the public. Within this toolbox will reside the overall framework by which an analyst can build a basin-specific model. Comprising the toolbox are a suite of subsystem modules and constitutive relations that the analyst can "swap" in and out to capture the physical and social systems important to their specific problem. This generic toolbox with all of its modules will be developed within the common computational platform of system dynamics linked to a GIS.

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Rio Grande watershed

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000, SAND2002-2271P